

QGIS Training Manual

QGIS Project

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Cuprins

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CAPITOLUL 1

Curs Introductiv

1.1 Cuvânt înainte

Welcome to our course! We will be showing you how to use QGIS easily and efficiently. If you are new to GIS, we will tell you what you need to get started. If you are an experienced user, you will see how QGIS fulfills all the functions you expect from a GIS program, and more!

1.1.1 Why QGIS?

As information becomes increasingly spatially aware, there is no shortage of tools able to fulfill some or all commonly used GIS functions. Why should anyone be using QGIS over some other GIS software package?

Here are only some of the reasons:

- *It's free, as in lunch.* Installing and using the QGIS program costs you a grand total of zero money. No initial fee, no recurring fee, nothing.
- *It's free, as in liberty.* If you need extra functionality in QGIS, you can do more than just hope it will be included in the next release. You can sponsor the development of a feature, or add it yourself if you are familiar with programming.
- *It's constantly developing.* Because anyone can add new features and improve on existing ones, QGIS never stagnates. The development of a new tool can happen as quickly as you need it to.
- *Extensive help and documentation is available.* If you're stuck with anything, you can turn to the extensive documentation, your fellow QGIS users, or even the developers.
- Cross-platform. QGIS can be installed on macOS, Windows and Linux.

Now that you know why you want to use QGIS, these exercises will make you know how.

1.1.2 Fundal

In 2008 we launched the Gentle Introduction to GIS, a completely free, open content resource for people who want to learn about GIS without being overloaded with jargon and new terminology. It was sponsored by the South African government and has been a phenomenal success, with people all over the world writing to us to tell us how they are using the materials to run University Training Courses, teach themselves GIS and so on. The Gentle Introduction is not a software tutorial, but rather aims to be a generic text (although we used QGIS in all examples) for someone learning about GIS. There is also the QGIS manual which provides a detailed functional overview of the QGIS application. However, it is not structured as a tutorial, but rather as a reference guide. At Linfiniti Consulting CC. we frequently run training courses and have realised that a third resource is needed - one that leads the reader sequentially through learning the key aspects of QGIS in a trainer-trainee format - which prompted us to produce this work.

Acest manual de instruire pune la dispoziție toate materialele necesare desfășurării unui curs de 5 zile despre QGIS, PostgreSQL și PostGIS. Cursul are un conținut structurat, fiind deopotrivă adecvat începătorilor, utilizatorilor intermediari sau avansați, și având multe exerciții cu răspunsuri complete adnotate.

1.1.3 Licență



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- If you publish this work under a self publishing site such as https://www.lulu.com we request that you donate the profits to the QGIS project.
- You may not commercialise this work, except with the expressed permission of the authors. To be clear, by commercialisation we mean that you may not sell for profit, create commercial derivative works (e.g. selling content for use as articles in a magazine). The exception to this is if all the profits are given to the QGIS project. You may (and we encourage you to do so) use this work as a text book when conducting training courses, even if the course itself is commercial in nature. In other words, you are welcome to make money by running a

training course that uses this work as a text book, but you may not profit off the sales of the book itself - all such profits should be contributed back to QGIS.

1.1.4 Capitole Sponsorizate

This work is by no means a complete treatise on all the things you can do with QGIS and we encourage others to add new materials to fill any gaps. Linfiniti Consulting CC. can also create additional materials for you as a commercial service, with the understanding that all such works produced should become part of the core content and be published under the same license.

1.1.5 Autori

- Rüdiger Thiede Rudi has written the QGIS instructional materials and parts of the PostGIS materials.
- Tim Sutton (tim@kartoza.com) Tim has overseen and guided the project and co-authored the PostgreSQL and PostGIS parts.
- Horst Düster (horst.duester@kappasys.ch) Horst este co-autor al părților de PostgreSQL și PostGIS
- Marcelle Sutton Marcelle provided proof-reading and editorial advice during the creation of this work.

1.1.6 Contribuții Individuale

Introduceți numele dvs. aici!

1.1.7 Sponsori

• Cape Peninsula University of Technology

1.1.8 Fișiere sursă și rapoarte despre probleme

Sursa acestui document se poate găsi în Depozitul Documentației QGIS de pe GitHub. Consultați GitHub.com pentru instrucțiunile de folosire a sistemului de versionare git.

În ciuda eforturilor depuse, ați putea găsi unele erori sau ați putea omite unele informații pe durata acestei instruiri. Vă rugăm să le raportați la https://github.com/qgis/QGIS-Documentation/issues.

1.1.9 Ultima versiune

You can always obtain the latest version of this document by visiting the online version which is part of the QGIS documentation website (https://www.qgis.org/resources/hub/#documentation).

Notă: The documentation website contains links to both online and PDF versions of the Training manual and other parts of the QGIS documentation.

1.2 About the exercises

Now that you know why you want to use QGIS, we can show you how.

Atenționare: This course includes instructions on adding, deleting and altering GIS datasets. We have provided training datasets for this purpose. Before using the techniques described here on your own data, always ensure you have proper backups!

1.2.1 How to use this tutorial

Any text that *looks like this* refers to something that you can see in the QGIS user interface.

Text that looks
ightarrow like
ightarrow this directs you through menus.

This kind of text refers to something you can type, such as a command.

This/kind/of.text refers to a path or filename.

This+That refers to a keyboard shortcut comprised of two buttons.

1.2.2 Tiered course objectives

This course caters to different user experience levels. Depending on which category you consider yourself to be in, you can expect a different set of course outcomes. Each category contains information that is essential for the next one, so it's important to do all exercises that are at or below your level of experience.

??? (Basic level) Basic

In this category, the course assumes that you have little or no prior experience with theoretical GIS knowledge or the operation of GIS software.

Limited theoretical background will be provided to explain the purpose of an action you will be performing in the program, but the emphasis is on learning by doing.

When you complete the course, you will have a better concept of the possibilities of GIS, and how to harness their power via QGIS.

??? (Moderate level) Intermediate

In this category, it is assumed that you have working knowledge and experience of the everyday uses of GIS software.

Building on the instructions for the beginner level will provide you with familiar ground, as well as to make you aware of the cases where QGIS does things slightly differently from other software you may be used to. You will also learn how to use analysis functions in QGIS.

When you complete the course, you should be comfortable with using QGIS for all of the functions you usually need for everyday use.

??? (Advanced level) Advanced

In this category, the assumption is that you are experienced with GIS software, have knowledge of and experience with spatial databases, using data on a remote server, perhaps writing scripts for analysis purposes, etc.

Building on the instructions for the other two levels will familiarize you with the approach that the QGIS interface follows, and will ensure that you know how to access the basic functions that you need. You will also be shown how to make use of the QGIS plugin system, database access, and so on.

When you complete the course, you should be well-acquainted with the everyday operation of QGIS, as well as its more advanced functions.

1.2.3 Data

The sample data that accompanies this resource is freely available and comes from the following sources:

- Streets and Places datasets from OpenStreetMap
- Property boundaries (urban and rural), water bodies from NGI
- SRTM DEM from the CGIAR CSI

Download the prepared dataset from the Training data repository and unzip the file. All the necessary data are provided in the exercise_data folder.

If you are an instructor, and would like to use more relevant data, you will find instructions for creating local data in the *Pregătirea Datelor pentru Exerciții* appendix.

CAPITOLUL 2

Modulul;: Crearea și Explorarea unei Hărți de Bază

În acest modul, veți crea o hartă de bază care va fi folosită mai târziu pentru demonstrații ulterioare ale funcționalităților QGIS.

2.1 Lesson: An Overview of the Interface

Vom explora interfața cu utilizatorul QGIS, pentru a vă familiariza cu meniurile, barele de instrumente, canevasul hărții și lista de straturi care formează structura de bază a interfeței.

Scopul acestei lecții: De a înțelege noțiunile de bază ale interfeței QGIS.

2.1.1 ???? Try Yourself: The Basics



Elementele identificate în figura de mai sus sunt:

- 1. Lista Straturilor/Panoul Navigatorului
- 2. Bare de instrumente
- 3. Canevasul hărții
- 4. Bara de Stare
- 5. Bara Laterală de Instrumente
- 6. Bara locatorului

??? The Layers List

În lista Straturi, puteți vedea o listă, în orice moment, a tuturor straturilor disponibile pentru dvs.

Extinderea obiectelor restrânse (făcând clic pe săgeata sau pe simbolul plus de lângă ei) vă va oferi mai multe informații despre aspectul stratului actual.

Hovering over the layer will give you some basic information: layer name, type of geometry, coordinate reference system and the complete path of the location on your device.

Un clic-dreapta pe un strat vă va oferi un meniu cu o mulțime de opțiuni suplimentare. Veți folosi unele dintre ele mult timp de acum înainte, așa că haideți să aruncăm o privire asupra lor!

Notă: Un strat vectorial este un set de date, de obicei, al unui anumit tip de obiect, cum ar fi drumuri, copaci, etc. Un strat vectorial poate consta fie în puncte, în linii sau poligoane.

??? The Browser Panel

The QGIS Browser is a panel in QGIS that lets you easily navigate in your database. You can have access to common vector files (e.g. ESRI Shapefile or MapInfo files), databases (e.g. PostGIS, Oracle, SpatiaLite, GeoPackage or MS SQL Server) and WMS/WFS connections. You can also view your GRASS data.

If you have saved a project, the Browser Panel will also give you quick access to all the layers stored in the same path of the project file under in the *Project Home* item.

Moreover, you can set one or more folder as Favorites: search under your path and once you have found the folder,

right click on it and click on Add as a Favorite. You should then be able to see your folder in the *Favorites* item.

Sfat: It can happen that the folders added to Favorite item have a really long name: don't worry right-click on the path and choose Rename Favorite... to set another name.

??? Toolbars

Your most often used sets of tools can be turned into toolbars for basic access. For example, the *Project* toolbar allows you to save, load, print, and start a new project. You can easily customize the interface to see only the tools you use most often, adding or removing toolbars as necessary via the *View* \succ *Toolbars* menu.

Even if they are not visible in a toolbar, all of your tools will remain accessible via the menus. For example, if you remove the *Project* toolbar (which contains the *Save* button), you can still save your map by clicking on the *Project* menu and then clicking on *Save*.

??? The Map Canvas

This is where the map itself is displayed and where layers are loaded. In the map canvas you can interact with the visible layers: zoom in/out, move the map, select features and many other operations that we will deeply see in the next sections.

??? The Status Bar

Shows you information about the current map. Also allows you to adjust the map scale, the map rotation and see the mouse cursor's coordinates on the map.

??? The Side Toolbar

By default the Side toolbar contains the buttons to load the layer and all the buttons to create a new layer. But remember that you can move all the toolbars wherever it is more comfortable for you.

??? The Locator Bar

Within this bar you can access to almost all the objects of QGIS: layers, layer features, algorithms, spatial bookmarks, etc. Check all the different options in the locator_options section of the QGIS User Manual.

Sfat: With the shortcut Ctrl+K you can easily access the bar.

2.1.2 ???? Try Yourself: 1

Încercați să identificați cele patru elemente enumerate pe ecranul dvs., fără a face referire la diagrama de mai sus. Vedeți dacă puteți identifica numele și funcțiile lor. Vă veți familiariza cu aceste elemente, pe măsură ce le veți folosi în următoarele zile.

Răspuns

Refer back to the image showing the interface layout and check that you remember the names and functions of the screen elements.

2.1.3 ???? Try Yourself: 2

Încercați să identificați fiecare dintre aceste instrumente pe ecran. Care este scopul lor?



Notă: Dacă nici unul dintre aceste instrumente nu este vizibil pe ecran, încercați să activați unele bare de instrumente care sunt în prezent ascunse. De asemenea, rețineți că, dacă nu există suficient spațiu pe ecran, o bară de instrumente poate fi redusă prin ascunderea unora dintre instrumentele sale. Puteți vedea instrumentele ascunse, făcând clic pe butonul cu două săgeți îndreptate în dreapta, de pe oricare bară de instrumente restrânsă. Puteți vedea un balon cu numele oricărui instrument, prin trecerea un pic a mouse-ului pe deasupra unui instrument.

Răspuns

- 1. Save as
- 2. Zoom to layer(s)
- 3. Invert selection
- 4. Rendering on/off
- 5. Measure line

2.1.4 Ce urmează?

Now that you are familiar with the basics of the QGIS interface, in the next lesson we will see how to load some common data types.

2.2 Lesson: Adding your first layers

Vom porni aplicația, și vom crea o hartă de bază, pentru utilizarea în exemple și exerciții.

Scopul acestei lecții: De a începe cu un exemplu de hartă.

Notă: Before starting this exercise, QGIS must be installed on your computer. Also, you should have downloaded the *sample data* to use.

Lansați QGIS cu ajutorul scurtăturii de pe ecran, din meniul de strat, etc., în funcție de modul în care ați efectuat instalarea.

Notă: The screenshots for this course were taken in QGIS 3.4 running on Linux. Depending on your setup, the screens you encounter may well appear somewhat different. However, all the same buttons will still be available, and the instructions will work on any OS. You will need QGIS 3.4 (the latest version at time of writing) to use this course.

Să începem imediat!

2.2.1 ???? Follow Along: Prepare a map

1. Deschideți QGIS. Veți avea o hartă nouă, albă.

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2. The *Data Source Manager* dialog allows you to choose the data to load depending on the data type. We'll use it to load our dataset: click the ^{Open Data Source Manager} button.

If you can't find the icon, check that the Data Source Manager toolbar is enabled in the View > Toolbars menu.

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- 3. Load the ${\tt protected_areas.shp}$ vector dataset:
 - 1. Click on the Vector tab.
 - 2. Enable the *File* source type.
 - 3. Press the ... button next to *Vector Dataset(s)*.
 - 4. Select the exercise_data/shapefile/protected_areas.shp file in your training directory.
 - 5. Click Open. You will see the original dialog, with the file path filled in.

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6. Click *Add* here as well. The data you specified will now load: you can see a protected_areas item in the *Layers* panel (bottom left) with its features shown in the main map canvas.



Felicitări! Aveți o hartă de bază. Acum ar fi un moment bun pentru a vă salva munca.

- 1. Clic pe butonul *Save As*:
- 2. Save the map under a solution folder next to exercise_data and call it basic_map.qgz.

2.2.2 ???? Try Yourself:

Repeat the steps above to add the places.shp and rivers.shp layers from the same folder (exercise_data/shapefile) to the map.

Răspuns

In the main area of the dialog you should see many shapes with different colors. Each shape belongs to a layer you can identify by its color in the left panel (your colors may be different from the ones in Fig. 2.1 below):



Fig. 2.1: A basic map

2.2.3 ???? Follow Along: Loading vector data from a GeoPackage Database

Databases allow you to store a large volume of associated data in one file. You may already be familiar with a database management system (DBMS) such as Libreoffice Base or MS Access. GIS applications can also make use of databases. GIS-specific DBMSes (such as PostGIS) have extra functions, because they need to handle spatial data.

The GeoPackage open format is a container that allows you to store GIS data (layers) in a single file. Unlike the ESRI Shapefile format (e.g. the protected_areas.shp dataset you loaded earlier), a single GeoPackage file can contain various data (both vector and raster data) in different coordinate reference systems, as well as tables without spatial information; all these features allow you to share data easily and avoid file duplication.

In order to load a layer from a GeoPackage, you will first need to create the connection to it:

- 1. Click on the Goven Data Source Manager button.
- 2. On the left click on the \bigcirc *GeoPackage* tab.
- 3. Click on the *New* button and browse to the training_data.gpkg file in the exercise_data folder you downloaded before.

4. Select the file and press *Open*. The file path is now added to the Geopackage connections list, and appears in the drop-down menu.

You are now ready to add any layer from this GeoPackage to QGIS.

- 1. Click on the *Connect* button. In the central part of the window you should now see the list of all the layers contained in the GeoPackage file.
- 2. Select the *roads* layer and click on the *Add* button.

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A roads layer is added to the Layers panel with features displayed on the map canvas.

3. Click on *Close*.

Congratulations! You have loaded the first layer from a GeoPackage.

2.2.4 ???? Follow Along: Loading vector data from a SpatiaLite Database with the Browser

QGIS provides access to many other database formats. Like GeoPackage, the SpatiaLite database format is an extension of the SQLite library. And adding a layer from a SpatiaLite provider follows the same rules as described above: Create the connection \rightarrow Enable it \rightarrow Add the layer(s).

While this is one way to add SpatiaLite data to your map, let's explore another powerful way to add data: the Browser.

- 1. Click the ⁴/₄ icon to open the *Data Source Manager* window.
- 2. Click on the *Browser* tab.
- 3. In this tab you can see all the storage disks connected to your computer as well as entries for most of the tabs in the left. These allow quick access to connected databases or folders.

For example, click on the drop-down icon next to the \bigvee *GeoPackage* entry. You'll see the training-data.gpkg file we previously connected to (and its layers, if expanded).

- 4. Right-click the SpatiaLite entry and select New Connection....
- 5. Navigate to the exercise_data folder, select the landuse.sqlite file and click *Open*.

Notice that a *landuse.sqlite* entry has been added under the *SpatiaLite* one.

- 6. Expand the *landuse.sqlite* entry.
- 7. Double-click the *landuse* layer or select and drag-and-drop it onto the map canvas. A new layer is added to the *Layers* panel and its features are displayed on the map canvas.



Sfat: Enable the *Browser* panel in *View* \triangleright *Panels* \triangleright and use it to add your data. It's a handy shortcut for the *Data Source Manager* \triangleright *Browser* tab, with the same functionality.

Notă: Remember to save your project frequently! The project file doesn't contain any of the data itself, but it remembers which layers you loaded into your map.

2.2.5 ???? Try Yourself: Load More Vector Data

Load the following datasets from the exercise_data folder into your map using any of the methods explained above:

- buildings
- water

Răspuns

Your map should have seven layers:

- protected_areas
- places
- rivers
- roads
- landuse
- buildings (taken from training_data.gpkg) and
- water (taken from exercise_data/shapefile).

2.2.6 Follow Along: Reordering the Layers

Straturile din lista de straturi sunt desenate pe hartă într-o anumită ordine. Stratul cel mai jos în listă este desenat primul, iar stratul de la vârful listei este desenat ultimul. Schimbând ordinea în care sunt prezentate în listă puteți schimba ordinea în care sunt desenate.

Notă: You can alter this behavior using the *Control rendering order* checkbox beneath the *Layer Order* panel. We will however not discuss this feature yet.

Ordinea în care straturile au fost încărcate în hartă probabil că nu este logică în acest moment. Este posibil ca stratul de străzi să fie complet ascuns deoarece alte straturi sunt deasupra lui.

De exemplu, această ordine a straturilor...



... would result in roads and places being hidden as they run underneath the polygons of the landuse layer.

Pentru a rezolva această problemă:

- 1. Clic apoi glisați pe un strat din Lista straturilor.
- 2. Reordonați-le, pentru a arăta în felul următor:



Veți vedea că harta are mai mult sens, cu străzile și clădirile desenate deasupra regiunilor.

2.2.7 În concluzie

Now you've added all the layers you need from several different sources and created a basic map!

2.2.8 Ce urmează?

Now you're familiar with the basic function of the *Open Data Source Manager* button, but what about all the others? How does this interface work? Before we go on, let's take a look at some basic interaction with the QGIS interface. This is the topic of the next lesson.

2.3 Lesson: Navigating the Map Canvas

Această secțiune se va concentra asupra instrumentelor de navigație principale, folosite la navigarea pe Canevasul Hărților din QGIS. Aceste instrumente vă vor permite explorarea vizuală a straturilor, la diverse scări.

Scopul acestei lecții: Înțelegerea noțiunilor despre scara hărții și utilizarea instrumentelor Deplasare și Zoom din QGIS.

2.3.1 ???? Follow Along: Basic Navigation Tools

Before learning how to navigate within the Map Canvas, let's add some layers that we can explore during this tutorial.

1. Open a new blank project and using the steps learnt in *Create a Map*, load the previously seen protected_areas, roads and buildings layers to the project. The result view should look similar to the snippet in Fig. 2.2 below (colors do not matter):



Fig. 2.2: Protected areas, roads and buildings added

Let's first learn how to use the Pan Tool.

- 1. In the *Map Navigation Toolbar*, make sure the Pan button is activated.
- 2. Move the mouse to the center of the Map Canvas area.
- 3. Left-click and hold, and drag the mouse in any direction to pan the map.

Next, let's zoom in and take a closer look at the layers we imported.

- 1. In the *Map Navigation Toolbar*, click on the $\overset{\bigcirc}{\overset{\longrightarrow}}$ Zoom In button.
- 2. Move your mouse to approximately the top left area of where there is the highest density of buildings and roads.
- 3. Left click and hold.
- 4. Then drag the mouse, which will create a rectangle, and cover the dense area of buildings and roads (Fig. 2.3).



Fig. 2.3: Zoom in

5. Release the left click. This will zoom in to include the area that you selected with your rectangle.
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6. To zoom out, select the $p_{\text{Zoom Out}}$ button and perform the same action as you did for zooming in.

As you pan, zoom in, or zoom out, QGIS saves these views in a history. This allows you to backtrack to a previous view.

- 1. In the *Map Navigation Toolbar*, click on Rast button to go to your previous view.
- 2. Click on $\sqrt{2}$ Zoom Next button to proceed to move forward in your history.

Sometimes after exploring the data, we need to reset our view to the extent of all the layers. Instead of trying to use the Zoom Out tool multiple times, QGIS provides us with a button to do that action for us.

1. Click on the Zoom Full Extent button.

As you zoomed in and out, notice that the *Scale* value in the Status Bar changes. The *Scale* value represents the Map Scale. In general, the number to the right of : represents how many times smaller the object you are seeing in the Map Canvas is to the actual object in the real world.

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You can also use this field to set the Map Scale manually.

- 1. In the Status Bar, click on the Scale text field.
- 2. Type in 50000 and press Enter. This will redraw the features in the Map Canvas to reflect the scale you typed in.
- 3. Alternatively, click on the options arrow of the Scale field to see the preset map scales.



4. Select 1:5000. This will also update the map scale in the Map Canvas.

Now you know the basics of navigating the Map Canvas. Check out the User Manual on Zooming and Panning to learn about alternative ways of navigating the Map Canvas.

2.3.2 În concluzie

Knowing how to navigate the Map Canvas is important, as it allows one to explore and visually inspect the layers. This could be done for initial data exploration, or to validate output of a spatial analysis.

2.4 Lesson: Symbology

Simbolistica unui strat reprezintă aspectul său vizual pe hartă. Abilitățile de bază ale GIS, comparativ cu alte moduri de reprezentare a datelor cu aspecte spațiale, constă în faptul că, în GIS, aveți o reprezentare vizuală dinamică a datelor cu care lucrați.

Prin urmare, aspectul vizual al hărții (care depinde de simbolistica straturilor individuale) este foarte important. Utilizatorul final a hărților pe care le produceți, va trebui să fie capabil de a înțelege cu ușurință ceea ce reprezintă harta. La fel de important, dvs. trebuie să fiți în măsură să explorați datele cu care lucrați, iar o bună simbolistică ajută foarte mult.

Cu alte cuvinte, a avea propria simbologie nu reprezintă un lux sau doar o noțiune frumoasă. De fapt, este esențial să utilizați un GIS în mod corespunzător, pentru a produce hărți și informații pe care oamenii să le poată folosi.

Scopul acestei lecții: De a putea crea simbolistica dorită pentru orice strat vectorial.

2.4.1 ???? Follow Along: Changing Colors

To change a layer's symbology, open its Layer Properties. Let's begin by changing the color of the landuse layer.

- 1. Right-click on the landuse layer in the layers list.
- 2. Select the menu item *Properties*... in the menu that appears.

Notă: De asemenea, în mod implicit, puteți accesa proprietățile unui strat făcând un dublu clic pe acesta, în lista Straturilor.

Sfat: The V button at the top of the *Layers* panel will open the *Layer Styling* panel. You can use this panel to change some properties of the layer: by default, changes will be applied immediately!

3. In the *Layer Properties* window, select the *Symbology* tab:

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- 4. Click the color select button next to the Color label. A standard color dialog will appear.
- 5. Alegeți o culoare gri, apoi faceți clic pe OK.
- 6. Clic iarăși pe OK din fereastra Layer Properties, apoi veți vedea schimbarea de culoare asupra stratului.

2.4.2 ???? Try Yourself:

Change the color of the water layer to light blue. Try to use the *Layer Styling* panel instead of the *Layer Properties* menu.

Soluție

- Verify that the colors are changing as you expect them to change.
- It is enough to select the water layer in the legend and then click on the ^{Open the Layer Styling panel} button. Change the color to one that fits the water layer.



If you want to work on only one layer at a time and don't want the other layers to distract you, you can hide a layer by clicking in the checkbox next to its name in the layers list. If the box is blank, then the layer is hidden.

2.4.3 ???? Follow Along: Changing Symbol Structure

This is good stuff so far, but there's more to a layer's symbology than just its color. Next we want to eliminate the lines between the different land use areas so as to make the map less visually cluttered.

1. Open the Layer Properties window for the landuse layer.

Under the Symbology tab, you will see the same kind of dialog as before. This time, however, you're doing more than just quickly changing the color.

- 2. In the symbol layers tree, expand the Fill dropdown and select the Simple fill option.
- 3. Click on the Stroke style dropdown. At the moment, it should be showing a short line and the words Solid Line.
- 4. Change this to No Line.

| Q | Layer Properties - landuse — Sy | mbology | ~ ^ × |
|-------------------|---------------------------------|----------------------------------|-------------------|
| ٩ | Single Symbol | | - |
| information | ▼ Fill Simple Fill | | |
| Source | | | |
| ≼ Symbology | | | |
| (abc Labels | | | |
| abc Masks | Symbol layer type Simple Fill | | - |
| 幹 3D View | Fill color | | |
| 📬 Diagrams | Fill style | Solid | |
| Fields | Stroke color | | |
| 🔡 Attributes Form | Stroke width | 0,260000 🚳 🗘 Millimeters | - C, |
| • Joins | Stroke style | No Line | - 6. |
| auxiliary Storage | Join style | Bevel | ▼ €, |
| Actions | Offset | 0,000000 Willimeters | • 🖶 |
| 👻 🤛 Display | У | 0,000000 | |
| Kendering | ✓ Enable symbol layer | s 🥡 | |
| U Temporal | Layer Rendering | | |
| 🗧 Variables | Style * | ✓ <u>O</u> k ✓ <u>A</u> ppliquer | ⊗ <u>A</u> nnuler |

5. Clic pe OK

Now the landuse layer won't have any lines between areas.

2.4.4 ???? Try Yourself:

- Change the water layer's symbology again so that it has a darker blue outline.
- Change the rivers layer's symbology to a sensible representation of waterways.

Remember: you can use the *open the Layer Styling panel* button and see all the changes instantly. That panel also allows you to undo individual changes while symbolizing a layer.

Răspuns

Your map should now look like this:



If you are a Beginner-level user, you may stop here.

- Use the method above to change the colors and styles for all the remaining layers.
- Try using natural colors for the objects. For example, a road should not be red or blue, but can be gray or black.
- Also feel free to experiment with different Fill style and Stroke style settings for the polygons.



2.4.5 ???? Follow Along: Scale-Based Visibility

Sometimes you will find that a layer is not suitable for a given scale. For example, a dataset of all the continents may have low detail, and not be very accurate at street level. When that happens, you want to be able to hide the dataset at inappropriate scales.

In our case, we may decide to hide the buildings from view at small scales. This map, for example...



... nu este foarte utilă. Clădirile sunt greu de distins la acea scară.

Pentru a activa randarea în funcție de scară:

- 1. Open the Layer Properties dialog for the buildings layer.
- 2. Activate the \checkmark *Rendering* tab.
- 3. Enable scale-based rendering by clicking on the checkbox labeled *Scale dependent visibility*:
- 4. Change the *Minimum* value to 1:10000.

| <u>@</u> | Layer Properties - landuse — Rendering V 🔨 🗡 | | | | | | | |
|--------------|--|--|--|--|--|--|--|--|
| Q | ▼ ✓ Scale Dependen <u>t</u> Visibility | | | | | | | |
| 🧿 Informatio | Minimum (exclusive) Maximum (inclusive) | | | | | | | |
| k Source | | | | | | | | |
| 褖 Symbolog | y Simplify <u>G</u> eometry | | | | | | | |
| (abc Labels | Note: Feature simplification may speed up rendering but can result in rendering inconsistencies | | | | | | | |
| abc Masks | Simplification algorithm | | | | | | | |
| 🔶 3D View | Simplify on provider side if possible (Not supported) | | | | | | | |
| 🐪 Diagrams | Maximum scale at which the layer should be simplified (1:1 always simplifies) | | | | | | | |
| Fields | Fixed Reference Scale | | | | | | | |
| 🔡 Attributes | Form Selections | | | | | | | |
| • Joins | Force layer to render as a raster (may result in smaller export file sizes) Refresh layer at interval | | | | | | | |
| avxiliary S | Storage Configuration Reload Data | | | | | | | |
| 🔅 Actions | The layer will be completely refreshed. | | | | | | | |
| 🧭 Display | Any cached data will be discarded and refetched from the provider. This mode may result in slower map refreshes. | | | | | | | |
| Kendering | Interval (seconds) | | | | | | | |
| 🕓 Temporal | | | | | | | | |
| 8 Variables | Kerresn layer on notification Only if message is | | | | | | | |
| Elevation | Ţ \$\$ <u>A</u> ide Style ↓ Style ↓ Style ↓ | | | | | | | |

5. Clic pe OK

P P

Test the effects of this by zooming in and out in your map, noting when the buildings layer disappears and reappears.

Notă: You can use your mouse wheel to zoom in increments. Alternatively, use the zoom tools to zoom to a window:

2.4.6 ???? Follow Along: Adding Symbol Layers

Now that you know how to change simple symbology for layers, the next step is to create more complex symbology. QGIS allows you to do this using symbol layers.

1. Go back to the landuse layer's symbol properties panel (by clicking Simple fill in the symbol layers tree).

In this example, the current symbol has no outline (i.e., it uses the No Line border style).

| Q | Layer Properties - landuse — Sy | rmbology | ~ ^ X |
|-------------------|---------------------------------|----------------------------------|-------------------|
| ۹ | Single Symbol | | • |
| 🧃 Information | ▼ Fill Simple Fill | | |
| 🗞 Source | | | |
| | | | |
| (abc Labels | | | |
| abc Masks | Symbol layer type Simple Fill | | - |
| 🔶 3D View | Fill color | | |
| 🐪 Diagrams | Fill style | Solid | - €, |
| Fields | Stroke color | | ■• €, |
| 🔡 Attributes Form | Stroke width | 0,260000 🚳 🗘 Millimeters | - 6, |
| • Joins | Stroke style | No Line | - C. |
| Auxiliary Storage | Join style | Bevel | - C |
| Actions | x Offset | 0,000000 Dillimeters | - 6. |
| 💭 Display | У | 0,000000 | |
| Kendering | ✓ Enable symbol layer | s 🦻 | |
| 🕓 Temporal | Layer Rendering | | |
| 🗧 Variables 🚽 🚽 | Style * | ✓ <u>O</u> k ✓ <u>A</u> ppliquer | ⊗ <u>A</u> nnuler |

2. Select the *Fill* level in the tree and click the Add symbol layer button. The dialog will change to look something like this, with a new symbol layer added:

| | Layer Properties - landuse Symbology | 8 |
|---------------------|--|----------------------|
| ۹ | 🚍 Single symbol | • |
| 🥡 Information | ▲ Fill Simple fill | |
| 🗞 Source | Simple fill | |
| 😻 Symbology | | |
| (abc Labels | | |
| abo Masks | Symbol layer type Simple fill | • |
| 🛉 Diagrams | Fill color | |
| 脊 3D View | Fill style Solid | • 4 |
| Fields | Stroke color | |
| Attributes Form | Stroke width 0,260000 | Millimeters - |
| | Stroke style Solid Line | • E |
| Joins | Join style 🖣 Bevel | |
| 📄 Auxiliary Storage | x 0,000000 | |
| Actions | Offset y 0,000000 | ↑ Millimeters → |
| 🧭 Display | ✓ Enable symbol layer 🚭 🗌 Draw effects 🗼 | |
| 🞸 Rendering | Laver Rendering | |
| 🗧 Variables | ▼ ②Help Style ▼ | ✓Apply ★ Cancel ✓ OK |

It may appear somewhat different in color, for example, but you're going to change that anyway.

Now there's a second symbol layer. Being a solid color, it will of course completely hide the previous kind of symbol. Plus, it has a *Solid Line* border style, which we don't want. Clearly this symbol has to be changed.

Notă: It's important not to get confused between a map layer and a symbol layer. A map layer is a vector (or raster) that has been loaded into the map. A symbol layer is part of the symbol used to represent a map layer. This course will usually refer to a map layer as just a layer, but a symbol layer will always be called a symbol layer, to prevent confusion.

With the new Simple Fill symbol layer selected:

- 1. Set the border style to No Line, as before.
- 2. Change the fill style to something other than Solid or No brush. For example:

| Q | Layer Properties - landuse — Sy | mbology | ~ ^ × |
|-------------------|--|-------------------------------------|-------------------|
| Q | 🚪 Single Symbol | | • |
| information | ▼ III Fill | | |
| 🗞 Source | Simple Fill | | |
| | | | |
| (abc Labels | | | |
| abo Masks | Symbol layer type Simple Fill | | * |
| 幹 3D View | Fill color | | |
| 🐪 Diagrams | Fill style | tttt Cross | |
| Fields | Stroke color | | |
| 🗄 Attributes Form | Stroke width | 0,260000 🚳 🗘 Millimeters | |
| • Joins | Stroke style | No Line | |
| Auxiliary Storage | Join style | Revel | - C, |
| Actions | Offset v | 0,000000 0,000000 Millimeters | - 6. |
| 🧭 Display | 🗸 Enable symbol laver 🖉 🔹 Draw offerti | | |
| 🞸 Rendering | | | |
| Temporal | ► Layer Rendering | <u>✓ O</u> k <u>✓ A</u> ppliquer | ⊘ <u>A</u> nnuler |

3. Clic pe OK

Now you can see your results and tweak them as needed. You can even add multiple extra symbol layers and create a kind of texture for your layer that way.

| 🔻 🔯 Fill | 4 | |
|---|---|--|
| Simple fill Simple fill Simple fill | | |
| | | |

It's fun! But it probably has too many colors to use in a real map...

2.4.7 ???? Try Yourself:

Remembering to zoom in if necessary, create a simple, but not distracting texture for the buildings layer using the methods above.

Răspuns

Customize your buildings layer as you like, but remember that it has to be easy to tell different layers apart on the map.

Iată un exemplu:



2.4.8 ???? Follow Along: Ordering Symbol Levels

When symbol layers are rendered, they are also rendered in a sequence, similar to the way the different map layers are rendered. This means that in some cases, having many symbol layers in one symbol can cause unexpected results.

- 1. Give the roads layer an extra symbol layer (using the method for adding symbol layers demonstrated above).
- 2. Give the base line a *Stroke width* of 1.5 and a black color.
- 3. Give the new, uppermost layer a thickness of 0.8 and a white color.

Veți observa că se întâmplă acest lucru:



Well, roads have now a *street* like symbology, but you see that lines are overlapping each others at each cross. That's not what we want at all!

To prevent this from happening, you can sort the symbol levels and thereby control the order in which the different symbol layers are rendered.

To change the order of the symbol layers:

- 1. Select the topmost *Line* layer in the symbol layers tree.
- 2. Click *Advanced* ► *Symbol levels*... in the bottom right-hand corner of the window.

| <u>@</u> | Layer Prope | erties - training_ | data — roads — Sym | bology | ~ ^ X |
|-------------------|-----------------|--------------------|--------------------|--------------|------------------------|
| ۹ | 불 Single Symbol | | | | Ŧ |
| 🥡 Information | <u> </u> | → | 1.12 | | ÷ |
| 🇞 Source | | Simp | le Line le Line | | |
| | | | | | |
| (abc Labels | | | | | |
| abo Masks | Color | | | | |
| 🔗 3D View | Opacity 🛑 | | | | □ 100,0 % 🗘 € |
| Magrams | Width 1,50000 | | Milli | meters | • |
| Fields | Q Favorites | | | | |
| Attributes Form | Default | | | | |
| Joins | | | | | |
| auxiliary Storage | | | | | |
| Sctions | dash black | dash blue | dash green | dash red | effect emboss |
| 🧭 Display | | | | | Save Symbol Advanced * |
| 🞸 Rendering | Layer Rendering | | | | Symbol Levels |
| 🕓 Temporal | Aide Style | • | | √ <u>O</u> k | Animation Settings |

This will open a dialog like this:

| | | Symbol Lev | els | 8 |
|--------------|-----------------|---------------|--|------------|
| Enable s | symbol levels | | | |
| in the cells | define in which | rendering pas | ers are rendered. The num is the layer will be drawn. | bers |
| | Layer 0 | — 1 | Layer 1 | |
| | | | | |
| | | | | |
| Help | | | ¥ <u>C</u> ancel | <u>o</u> ĸ |

3. Check Section 2015 Check Check Section 2015 Check Check Section 2015 Check Section 201

In our case, we just want to activate the option, like this:

| | | Symbol Lev | els | 8 |
|--|---|---------------------------------|--|----|
| ✓ Enable s Define the in the cells | ymbol levels order in which I define in which | the symbol lay rendering pas | ers are rendered. The numbe is the layer will be drawn. | rs |
| | Layer 0 | | Layer 1 | |
| = | - 0 | 1 | | |
| | | | | |
| | | | | |
| | | | | |
| Help | | | ≭ <u>C</u> ancel | : |

This will render the white line above the thick black line borders:

4. Faceți clic pe Ok pentru a reveni la hartă.

Harta va arăta acum în modul următor:



When you're done, remember to save the symbol itself so as not to lose your work if you change the symbol again in the future. You can save your current symbol style by clicking the *Save Style*... button at the bottom of the *Layer Properties* dialog. We will be using the *QGIS QML Style File* format.

Save your style in the solution/styles/better_roads.qml folder. You can load a previously saved style at any time by clicking the *Load Style*... button. Before you change a style, keep in mind that any unsaved style you are replacing will be lost.

2.4.9 ???? Try Yourself:

Change the appearance of the roads layer again.

Make the roads narrow and yellow, with a thin, pale gray outline and a thin black line in the middle. Remember that you may need to change the layer rendering order via the *Advanced* \succ *Symbol levels*... dialog.



Răspuns

To make the required symbol, you need three symbol layers:

| | | Layer Properties - roads (triple_levels) Symbology 🛛 🔗 |
|----------|----------------------|--|
| Q | | 📮 Single symbol 👻 |
| i | Information | Line Simple line |
| ે્ | Source | Simple line |
| ~ | Symbology | |
| abc | Labels | |
| ۹. | Diagrams | |
| Ŷ | 3D View | Opacity 100.0 % |
| | Source Fields | Color |
| 8 | Attributes Form | Width 2.10000 |
| •◀ | Joins | |
| 5 | Auxiliary Storage | Q Favorites |
| ٩ | Actions | |
| , | Display | |
| Ý | Rendering | dash black dash blue dash green dash red effect emboss effect neon |
| 3 | Variables | Save Symbol Advanced - |
| 2 | Metadata | ▶ Laver Rendering |
| 4 | Dependencies | ②Help Style → ✓Apply X Cancel |

The lowest symbol layer is a broad, solid gray line. On top of it there is a slightly thinner solid yellow line and finally another thinner solid black line.

If your symbol layers resemble the above but you're not getting the result you want:

1. Check that your symbol levels look something like this:

| Symbol Levels 🛛 🛞 | | | | | | |
|--|--------------|----------------|-------|--|--|--|
| ✓ Enable symbol levels Define the order in which the symbol layers are rendered. The numbers in the cells define in which rendering pass the layer will be drawn. | | | | | | |
| | Layer 0 | Layer 1 | Layer | | | |
| _ | 0 | - 1 | — 2 | | | |
| ۹ Help | <u>√_0</u> K | | | | | |

2. Now your map should look like this:



2.4.10 ???? Try Yourself:

Symbol levels also work for classified layers (i.e., layers having multiple symbols). Since we haven't covered classification yet, you will work with some rudimentary pre-classified data.

- 1. Create a new project and add only the roads dataset.
- 2. Apply the style file advanced_levels_demo.qml provided in exercise_data/styles to the layer. This can be done through the *Style* ► *Load Style*... combobox at the bottom of the *Layer Properties* dialog.
- 3. Focalizați în aria Swellendam.
- 4. Using symbol layers, ensure that the outlines of layers flow into one another as per the image below:



Răspuns

1. Adjust your symbol levels to these values:

| | Symbol Level | s 😣 | | | |
|--|--------------|----------------------------|--|--|--|
| ✓ Enable symbol levels Define the order in which the symbol layers are rendered. The numbers in the cells define in which rendering pass the layer will be drawn. | | | | | |
| | Layer 0 | Layer 1 | | | |
| Trunk | 1 | 3 | | | |
| — Tertiary | — 1 | - 2 | | | |
| = Unclassified | — 0 | 1 | | | |
| | | | | | |
| Help | * <u>c</u> | <u>C</u> ancel <u>√</u> OK | | | |

- 1. Experiment with different values to get different results.
- 2. Open your original map again before continuing with the next exercise.

2.4.11 ???? Follow Along: Symbol layer types

In addition to setting fill colors and using predefined patterns, you can use different symbol layer types entirely. The only type we've been using up to now was the *Simple Fill* type. The more advanced symbol layer types allow you to customize your symbols even further.

Each type of vector (point, line and polygon) has its own set of symbol layer types. First we will look at the types available for points.

Tipurile de Straturi pentru Simbolurile de tip Punct

- 1. Uncheck all the layers except for places.
- 2. Change the symbol properties for the places layer:

| | Layer Properties - places Symbology 🛛 😣 | | | | | | | |
|----------|---|-------------------|---------------|------------------|-----------|-------------|----------------------------|--|
| Q | | 불 Single symb | ol | | | | • | |
| i | Information | | 🔻 🔍 Mar | ker | | | + | |
| ્રે | Source | | • Si | imple marker | | | | |
| ~ | Symbology | | | | | | | |
| abc | Labels | | | | | | | |
| abo | Masks | Unit Millime | ters | | | | • | |
| ۹. | Diagrams | Opacity Color | | | | | ─ 100,0 % ♀ | |
| \ | 3D View | Size 2,000 | 000 | | | | | |
| 1 | Fields | Rotation 0,00 | 2 | | | | ÷ . | |
| - | Attributes Form | Q Favorites | | | | | ≪ ▼ 🕌 | |
| •◀ | Joins | | | | | | | |
| 2Ì | Auxiliary Storage | • | 0 | | ٠ | ٠ | * | |
| ٩ | Actions | dot black | dot white | dot blue | dot green | dot red | effect drop | |
| 9 | Display | | | | | | shadow | |
| Ý | Rendering | ð | Ð | \odot | | | | |
| 3 | Variables | | | | | | | |
| 2 | Metadata | shield disability | topo hospital | topo pop capital | | | | |
| 4 | Dependencies | | | | | Save Sym | bol Advanced - | |
| ÷ | Legend | ▶ Layer Rende | ering | | | | | |
| | QGIS Server | () Help | Style 🝷 | | | 🖌 Apply 🛛 🗱 | <u>C</u> ancel <u>√</u> OK | |

3. You can access the various symbol layer types by selecting the *Simple marker* layer in the symbol layers tree, then click the *Symbol layer type* dropdown:

| | Layer Properties - places Symbology | | | | | | | |
|------------|---------------------------------------|------------------|-----------------------------|---------------------------|-------------------|--|--|--|
| Q | | 📑 Single symbo | bl | | • | | | |
| i | Information | <u> </u> | Ellipse marker | | | | | |
| 3. | Source | | Filled marker | | | | | |
| <u></u> | 300100 | •• | Font marker | | 2 | | | |
| ~ | Symbology | | Geometry generator | | | | | |
| abc | Labels | | MdSK Raster image marker | | | | | |
| abc | Masks | Symbol layer typ | e Simple marker | | | | | |
| | D ¹ | | SVG marker | | | | | |
| | Diagrams | Size | Vector field marker | | | | | |
| Ŷ | 3D View | Fill color | | | | | | |
| | Fields | Stroke color | | | | | | |
| 8 | Attributes Form | Stroke style | Solid Line | • | | | | |
| • | Joins | Stroke width | Hairline | Millimeters • (| | | | |
| | Auviliary Storago | Join style | Revel | • | | | | |
| | Auxiliary Storage | Rotation | 0,00 ° | ¢ (| | | | |
| ` | Actions | | x 0,000000 | | | | | |
| 9 | Display | Offset | v 0,000000 | Millimeters 🔹 🌾 | | | | |
| * | Rendering | | VCenter | • | | | | |
| 3 | Variables | Anchor point | HCenter | - | | | | |
| 2 | Metadata | | | $F \times I > \mathbb{N}$ | | | | |
| 4 | Dependencies | $\Box 0 0$ | | | | | | |
| i = | Legend | Layer Rende | ring | | | | | |
| | QGIS Server | • OHelp | tyle 👻 | ✓Apply X Cancel | <mark>∥</mark> ок | | | |

- 4. Investigate the various options available to you, and choose a symbol with styling you think is appropriate.
- 5. If in doubt, use a round *Simple marker* with a white border and pale green fill, with a *Size* of 3.00 and a *Stroke width* of 0.5.

Tipurile de Straturi pentru Simbolurile de tip Linie

Pentru a vedea diferitele opțiuni disponibile pentru datele de tip linie:

1. Change the Symbol layer type for the roads layer's topmost symbol layer to Marker line:

| | | | Layer Properties - roa | ads Symbology | | | | | × |
|------------|-------------------|-----------------|------------------------|-----------------|---------------------|--------------------|---|-------------|---|
| Q | | 불 Single symb | ol | | | | | | • |
| i | Information | A | ▼ — Line | | | | | Ð 🖌 | |
| ગ્ર્ | Source | | — Simple lin | e | | | | | 2 |
| | Symbology | | Geometry generate | or | | | | | μ |
| \sim | Symbology | | Hashed line | | | | | | |
| abc | Labels | | Marker line 🛛 🔓 | | | | | | ╞ |
| abc | Masks | Symbol layer ty | oe Simple line | | | | | | |
| ۹. | Diagrams | Color | | | | | | €. | |
| Ŷ | 3D View | Stroke width | 0,260000 | | € | Millimeters | • | €. | |
| i | Fields | Offset | 0,000000 | | - | Millimeters | • | €, | |
| 8 | Attributes Form | Stroke style | Solid Line | | | | • | €, | |
| | Joins | Join style | Revel | | | | • | ¢, | |
| | A | Cap style | Square | | | | • | e, | |
| | Auxiliary Storage | Use custom | dash pattern | | | | | | |
| . | Actions | | | | | Millimeters | • | | |
| 9 | Display | | | | | | | | |
| * | Rendering | | | | | | | | |
| 3 | Variables | | | | | | | | |
| 2 | Metadata | | | | | | | | |
| 4 | Dependencies | ✓ Enable symb | ollayer 🖶 🗌 🛙 | Draw effects 🔺 | | | | | |
| i = | Legend | ▶ Layer Rende | ring | | | | | | |
| | | Ulter Help | ityle 👻 | | Appl | y X <u>C</u> ancel | | <u>/о</u> к | |

2. Select the *Simple marker* layer in the symbol layers tree. Change the symbol properties to match this dialog:

| | | L | ayer Properties - roads Symbology. | | 8 |
|--------------|-------------------|---------------------|---|------------------------------|----------|
| Q | | 불 Single symbo | l | | - |
| 🧿 Ir | nformation | | ▼ · · · Line | | |
| રે 🗞 s | ource | | Marker line Marker | | |
| 😻 s | Symbology | | Simple marker | | |
| (abc L | abels. | | | | |
| abo M | Masks | Symbol layer typ | e Simple marker | | • |
| 9 1 D | Diagrams | Size | 0,500000 | Millimeters + | €. |
| ? 3 | D View | Fill color | | | €. |
| 📔 F | ields | Stroke color | | • | €. |
| 🗄 A | Attributes Form | Stroke style | Solid Line | · · | €. |
| ر 🍋 | loins | Stroke width | Hairline | Millimeters • | €. |
| | Auxiliary Storage | Join style | 🖣 Bevel | • | |
| | stions | Rotation | 0,00 ° | * | |
| ~ ^ | | Offset | x 0,000000 | Millimeters V | |
| – D | Display | onsee | y 0,000000 | • | |
| ≼ R | Rendering | | VCenter | • | |
| ε ν | /ariables | Anchor point | HCenter | • | €. |
|) N | Metadata | | | $\flat \times \flat > \flat$ | |
| 🔁 D | Dependencies | $\square 0 \square$ | | | e |
| Е L | .egend | Layer Rende | ring | | |
| 💌 c | OGIS Server | 🛛 🕜 Help 🛛 S | tyle 👻 | ✓Apply ¥ Cancel | <u> </u> |

3. Select the *Marker line* layer and change the interval to 1.00:

| | | Layer F | Properties - roads Symbology | | | | 8 |
|----------|-------------------|---|-----------------------------------|---------|------------------|-----------|----|
| Q | | 🚍 Single symbol | | | | | • |
| i | Information | | ··· Line | | | • | |
| ૺૢૢૢ | Source | >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> | ▼ • Marker | | | | |
| ~ | Symbology | | Simple marker | | | | |
| abc | Labels | | | | |] | |
| abc | Masks | Symbol layer type Mar | ker line | | | | • |
| ۹. | Diagrams | Marker placement 🖷 | • | | | | |
| Ŷ | 3D View | • with interval 1,0 | 00000 | 1 Mi | llimeters | - | ⊒. |
| 1 | Fields | \bigcirc on every vertex | | | | | |
| | Attributes Form | on last vertex only | 1 | | | | |
| | Accordent | O on first vertex only | у | | | | |
| | Joins | ○ on central point | | | | | |
| | Auxiliary Storage | on central point of | fsegments | | | | |
| ٢ | Actions | on every curve poi | int | | | | |
| | Display | Offset along line | 0,000000 | ‡ Mi | llimeters | • | - |
| | | Rotate marker to fo | llow line direction | | | | |
| Š | Rendering | Average angle over | 4,000000 | ‡ Mi | llimeters | • | ⊒. |
| 3 | Variables | Line offset | 0,000000 | 1 Mi | llimeters | • | = |
| 2 | Metadata | | | | | | |
| | Dependencies | ✓ Enable symbol layer | Draw effects | | | | |
| - | Legend | Layer Rendering | | | | | |
| | QGIS Server | Help Style | • | ✓ Apply | ¥ <u>C</u> ancel | <u>√o</u> | к |

4. Ensure that the symbol levels are correct (via the *Advanced* ► *Symbol levels* dialog we used earlier) before applying the style.

Once you have applied the style, take a look at its results on the map. As you can see, these symbols change direction along with the road but don't always bend along with it. This is useful for some purposes, but not for others. If you prefer, you can change the symbol layer in question back to the way it was before.

Tipurile de Straturi pentru Simbolurile de tip Poligon

Pentru a vedea diferitele opțiuni disponibile pentru datele poligonale:

- 1. Change the *Symbol layer type* for the water layer, as before for the other layers.
- 2. Investigați ce pot face diferitele opțiuni din listă.
- 3. Alegeți una dintre ele, pe care o găsiți potrivită.
- 4. Dacă aveți îndoieli, utilizați Umplere cu model din puncte, având următoarele opțiuni:

| | | L | ayer Properties - water Symbology | | | | | 8 |
|------------|-----------------------|------------------|--|-------|---------------------|---|-------------|---|
| Q | | 불 Single symbo | l | | | | | • |
| ? ર | Information Source | | Fill Point pattern fill Marker | | | | | |
| ~ | Symbology | 0 | Simple marker | | | | | |
| abc | Labels | | | | | | | |
| abc | Masks | Symbol layer typ | e Simple marker | | | | • | - |
| ۹. | Diagrams | Size | 2,00000 | • | Millimeters | • | €, | |
| \ | 3D View | Fill color | | | | ŀ | | |
| | Fields | Stroke color | | | | · | €, | |
| | Attributes Form | Stroke style | Solid Line | | | • | €, | |
| • | Joins | Stroke width | Hairline | - | Millimeters | • | €, | |
| đ | Auxiliary Storage | Join style | 🖣 Bevel | | | • | €, | |
| | Actions | Rotation | 0,00 ° | | | - | e, | |
| , , | Display | Offset | x 0,00000 | | Millimeters | • | €, | |
| * | Rendering | د ا | VCenter | | | • | e. | |
| 3 | Variables | Anchor point | HCenter | | | • | 4 | F |
| 2 | Metadata | | | • × | $ \rangle \rangle$ | | | |
| | Dependencies | | | | | | e. | Ŧ |
| i = | Legend | Layer Render | ing | | | | | |
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| | | | Layer Properties - water Symbology | | | 8 |
|----------------------------------|------------------------------------|--------------|---|----------|--------------------|------------|
| Q | | 불 Single sy | nbol | | | • |
| (য়) ২১১ ১৯০ ১৯০ ১৯০ | Information Source Symbology | | Fill Point pattern fill Marker Simple marker | | | |
| abc | Masks | Symbol layer | type Point pattern fill | | | |
| 4 | Diagrams | Distance | | | | |
| \ | 3D View | Horizontal | 4,000000 | Ţ | Millimeters | |
| | Fields | Vertical | 4,000000 | - | Millimeters | <u> </u> |
| 8 | Attributes Form | Horizontal | 0,000000 | * | Millimeters | • |
| •◀ | Joins | Vertical | 0,000000 | \$ | Millimeters | • 🖶 |
| đ | Auxiliary Storage | Offset | | | | |
| õ | Actions | Horizontal | 0,000000 | \$ | Millimeters | <u> </u> |
| ••• ••• | Display | Vertical | 0,000000 | ÷ | Millimeters | • E |
| * | Rendering | | | | | |
| 3 | Variables | | | | | |
| 2 | Metadata | | | | | |
| 4 | Dependencies | ✓ Enable sy | nbol layer 🗲 🗌 Draw effects 🗼 | | | |
| - | Legend | ▶ Layer Re | ndering | | | |
| | OGIS Server | Help | Style 👻 | Appl | y X <u>C</u> ancel | <u> </u> |

- 5. Adăugați un nou strat simbol, cu o Umplere simplă, normală.
- 6. Faceți-l în același albastru deschis, cu un chenar albastru mai închis.
- 7. Mutați-l sub stratul simbol cu modelul din puncte, cu ajutorul butonului Move down:

| | | | Layer Properties - water Symbology | | | | 8 |
|--|-----------------------|-----------------|--|-----------|-------------------------|---|--------------|
| Q | | 불 Single symt | ool | | | | • |
| ं २े | Information Source | | Fill Simple fill > > > > | | | | |
| من المن المن المن المن المن المن المن ال | Symbology Labels | _ | | | | | |
| abc | Masks | Symbol layer ty | vpe Simple fill | | | | - |
| ۹. | Diagrams | Fill color | | | | • | |
| Ŷ | 3D View | Fill style | Solid | | | • | €, |
| i | Fields | Stroke color | | | | | €. |
| :8 | Attributes Form | Stroke width | 0,260000 | | Millimeters | • | |
| • | Joins | Stroke style | Solid Line | | | • | €, |
| đ | Auxiliary Storage | Join style | Revel | | | - | €, |
| ٢ | Actions | Offset | x 0,000000 | ¢ | Millimeters | • | |
| , | Display | | y 0,000000 | • | | | |
| * | Rendering | | | | | | |
| 3 | Variables | | | | | | |
| 2 | Metadata | | | | | | |
| | Dependencies | ✓ Enable symt | ool layer 🕞 🗌 Draw effects 🗼 | | | | |
| ÷ | Legend | Layer Rend | ering | | | | |
| | QGIS Server | - OHelp | Style 🝷 | 🖌 🗸 Apply | y <mark>≭</mark> Cancel | | / <u>о</u> к |

As a result, you have a textured symbol for the water layer, with the added benefit that you can change the size, shape and distance of the individual dots that make up the texture.

2.4.12 ???? Try Yourself:

Apply a green transparent fill color to the protected_areas layer, and change the outline to look like this:



Răspuns

Here are examples of the symbol structure:



| | Layer Properties - protected_areas Symbology 🔗 | | | | | | |
|----------|--|-----------------|---------------|------------------|-------------|--|--|
| Q | | 불 Single symb | ol | | • | | |
| <i>i</i> | Information | Fill | ***** | | | | |
| 1 | Source | | Simple marker | | | | |
| ~ | Symbology | Simple | e fill | 4++++ | | | |
| abc | Labels | | | | | | |
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| | Source Fields | Size | 2.200000 | - Mittinieter • | | | |
| | Attributes | Fill color | | 1 | | | |
| | Form | Stroke color | | | | | |
| | | Stroke style | Solid Line | - | | | |
| | Auxiliary Storage | Stroke width | 0.200000 | 🖾 🜲 Millimeter 👻 | | | |
| ్లం | Actions | Join style | 🖣 Bevel | • | | | |
| 9 | Display | Rotation | 0.00 ° | 4 | | | |
| * | Rendering | Offset | x 0.000000 | Millimeter - | | | |
| 3 | Variables | | y 0.000000 | | | | |
| 2 | Metadata | Laver Bonde | VCenter | • | | | |
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2.4.13 ???? Follow Along: Geometry generator symbology

You can use the Geometry generator symbology with all layer types (points, lines and polygons). The resulting symbol depends directly on the layer type.

Very briefly, the Geometry generator symbology allows you to run some spatial operations within the symbology itself. For example you can run a real centroid spatial operation on a polygon layer without creating a point layer.

Moreover, you have all the styling options to change the appearance of the resulting symbol.

Let's give it a try!

- 1. Select the water layer.
- 2. Click on Simple fill and change the Symbol layer type to Geometry generator.

| | | L | a Centroid fill | |) |
|----------|-------------------|------------------|-----------------------------|--------------------|---|
| Q | | Single symbo | Geometry generator | | |
| | | | Gradient fill | | Б |
| | Information | | Line pattern fill | | H |
| 3 | Source | | Point pattern fill | | Н |
| | Symbology | | Random marker fill | | μ |
| ~ | Symbology | | Raster image fill | | |
| abc | Labels | | SVG fill | | L |
| abc | Masks | Symbol laver typ | Shapeburst fill | | |
| | | - , | Simple fill | | |
| % | Diagrams | Fill color | Outline: Arrow | | |
| 9 | 3D View | Fill style | Outline: Hashed line | | |
| | Fields | Stroke color | Outline: Marker line | | |
| | Fields | | Outline: Simple line | | |
| -8 | Attributes Form | Stroke width | 0,260000 | Millimeters V | |
| • | Joins | Stroke style | | · | |
| | | Join style | Bevel | • 🖶 | |
| 5 | Auxiliary Storage | x | 0.000000 | | |
| ٢ | Actions | Offset | | Millimeters 👻 | |
| — | Display | У | 0,000000 | | |
| ~ | Renderina | | | | |
| | | | | | |
| 5 | Variables | | | | |
| 2 | Metadata | | | | |
| 1 | Dependencies | ✓ Enable symbol | ol layer 😩 🗌 Draw effects 🗼 | | |
| ÷ | Legend | ▶ Layer Rende | ring | | |
| | OGIS Server | , 🕜 Help S | tyle 👻 | Apply X Cancel VCK | |

- 3. Before to start writing the spatial query we have to choose the Geometry Type in output. In this example we are going to create centroids for each feature, so change the Geometry Type to *Point / Multipoint*.
- 4. Now let's write the query in the query panel:



| Layer Properties - water Symbology 🛛 😣 | | | | | | |
|--|-------------------|--|-------------|--|--|--|
| Q | | 🔄 Single symbol | • | | | |
| i | Information | Fill Geometry generator | | | | |
| ×. | Source | Marker Simple marker | | | | |
| ~ | Symbology | | | | | |
| abc | Labels | | | | | |
| abc | Masks | Symbol layer type Geometry generator | • | | | |
| ۹. | Diagrams | Geometry type * Point / MultiPoint | • | | | |
| Ŷ | 3D View | <pre>centroid(\$geometry)</pre> | 3 | | | |
| | Fields | | | | | |
| -8 | Attributes Form | | | | | |
| • | Joins | | | | | |
| s) | Auxiliary Storage | | | | | |
| ٩ | Actions | | | | | |
| 9 | Display | | | | | |
| * | Rendering | | | | | |
| 3 | Variables | | | | | |
| 2 | Metadata | | Þ | | | |
| 4 | Dependencies | ✓ Enable symbol layer < ☐ Draw effects | | | | |
| ÷ | Legend | Layer Rendering | | | | |
| | QGIS Server | Ţ ❷Help Style ▼ | <u>√о</u> к | | | |

5. When you click on *OK* you will see that the water layer is rendered as a point layer! We have just run a spatial operation within the layer symbology itself, isn't that amazing?



With the Geometry generator symbology you can really go over the edge of normal symbology.

??? Try Yourself:

Geometry generator are just another symbol level. Try to add another Simple fill underneath the Geometry generator one.

Change also the appearance of the Simple marker of the Geometry generator symbology.

The final result should look like this:





Răspuns

- 2. Move the new symbol at the bottom of the list clicking the \bigtriangledown button.
- 3. Choose a good color to fill the water polygons.
- 4. Click on Marker of the Geometry generator symbology and change the circle with another shape as your wish.
- 5. Try experimenting other options to get more useful results.

2.4.14 ???? Follow Along: Creating a Custom SVG Fill

Notă: To do this exercise, you will need to have the free vector editing software Inkscape installed.

1. Start the Inkscape program. You will see the following interface:



Ar trebui să vi se pară familiar dacă ați folosit alte programe de editare a imaginilor vectoriale, cum ar fi Corel. În primul rând, vom schimba canevasul la o dimensiune adecvată pentru o mică textură.

- 2. Click on the menu item *File* ► *Document Properties*. This will give you the *Document Properties* dialog.
- 3. Schimbați Unitățile în px.
- 4. Change the *Width* and *Height* to 100.
- 5. Închideți dialogul, după încheiere.
- 6. Faceți clic pe elementul de meniu View ► Zoom ► Page pentru a vedea pagina la care lucrați.
- 7. Selectați instrumentul Circle:

| 00 | New document 1 – Inkscape | |
|------------------|---|---------------------------------------|
| <u>F</u> ile | lit View Layer Object Path Text Filters Extensions Help | |
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| Fill: Stroke: | NA 0: 🔤 🕸 👌 💶 NA Shift: click to toggle select; drag for rubberband selection; Alt: click to select under; drag to move selected or select by touch | X: -28.31 Y: 74.13 Z: 943% 🗘 |

- 8. Mențineți apăsat butonul mouse-ului și trasați pe pagină o elipsă. Pentru a transforma o elipsă într-un cerc, mențineți apăsat și butonul Ctrl pe durata desenării.
- 9. Right-click on the circle you just created and open its *Fill and Stroke* options. You can modify its rendering, such as:
 - 1. Stabiliți pentru culoarea de Umplere o culoare albastru spre gri pal,
 - 2. Assign to the border a darker color in Stroke paint tab,
 - 3. And reduce the border thickness under Stroke style tab.



- 10. Draw a line using the *Pencil* tool:
 - 1. Click once to start the line. Hold Ctrl to make it snap to increments of 15 degrees.
 - 2. Deplasați indicatorul pe orizontală și puneți un punct cu un simplu click.
 - 3. Click and snap to the vertex of the line and trace a vertical line, ended by a simple click.
 - 4. Now join the two end vertices.
 - 5. Change the color and width of the triangle symbol to match the circle's stroke and move it around as necessary, so that you end up with a symbol like this one:



11. If the symbol you get satisfies you, then save it as landuse_symbol under the directory that the course is in, under exercise_data/symbols, as SVG file.

În QGIS:

- 1. Open the Layer Properties for the landuse layer.
- 2. In the Symbology tab, change the symbol structure by changing the Symbol Layer Type to SVG Fill shown below.
- 3. Click the ... button and then Select File... to select your SVG image.

It's added to the symbol tree and you can now customize its different characteristics (colors, angle, effects, units...).
| Layer Properties - landuse Symbology | | | | | | |
|--|---|--|--|---|---------------|-----|
| Q | | 불 Single symbo | ol | | | • |
| (j) २३३ ४४ | Information Source Symbology | | ▼ | <mark>G fill Line</mark> — Simple line | | |
| abc | Labels | | | | | |
| abc | Masks | Symbol layer typ | e SVG fill | | | • |
| ۹. | Diagrams | Texture width | 10,00000 | | Millimeters + | e, |
| Ŷ | 3D View | Fill color | | | | E. |
| i | Fields | Stroke color | | | | €, |
| 8 | Attributes Form | Stroke width | 0,260000 | | Millimeters - | €, |
| • | Joins | Rotation | 0,00 ° | ave such the | | e, |
| | Auxiliary Storage Actions Actions Display Rendering Variables Variables Metadata Dependencies Legend QGIS Server Digitizing | ✓ App Sym accor amen arrow backg comp cross emer enter food gpsic healt landm ents/GIS/QGIS/ ✓ Enable symbol | nbols nmodation iity vs grounds ionents es gency tainment ons h nark TrainingManua | Image: A matrix of the second seco | | |
| | | Layer Rende | ring tyle - | | | √ок |

Once you validate the dialog, features in landuse layer should now be covered by a set of symbols, showing a texture like the one on the following map. If textures are not visible, you may need to zoom in the map canvas or set in the layer properties a bigger *Texture width*.



2.4.15 ???? Follow Along: Masking

Masking feature allows you to mask some symbol layer using another symbol layer or label.

In the following exercise, we want to configure rendering so that polygon labels will mask the black part of lines layer.

- 1. Load the selective_masking.qgs from dataset in directory exercise_data/masking.
- 2. Open the Layer Properties window for the polys layer.

Under the (abc Labels tab, you will see that (abc Single Labels have already been defined.

- 3. From the Labels tab, select the Mask (and not Masks in general category list)
- 4. Enable label mask by checking the *Enable mask* option

A message tells you that the now defined label mask shape can be later selected as a mask source to mask other symbol layers. Let's do that.

- 5. Clic pe OK
- 6. Open the Layer Properties window for the lines layer.
- 7. Go to the Masks tab
- 8. Click on the black line part of lines checkbox from masked symbol layers

A message warns you that you have to select both masking and masked symbol layers to be able to save masking configuration. Again, let's do that.

9. Click on polys Label mask checkbox

The message disappears, you can now safely save your configuration.

| Q | Layer Properties - lines — Masks | ~ ^ | × |
|-------------------|----------------------------------|----------------|-----|
| Q | Masked symbol layers | | |
| 🥡 Information | | | |
| 🗞 Source | | | |
| ኛ Symbology | | | |
| (abc) Labels | | | |
| (abc) Masks | | | |
| 😚 3D View | Mask sources | | |
| 🌳 Diagrams | ✓ polys ✓ Label mask | | |
| Fields | | | |
| 🕄 Attributes Form | | | |
| • Joins | | | |
| Auxiliary Storage | | | |
| Actions | ▼ DK ✓ Apply | ⊘ <u>C</u> ano | cel |

10. Clic pe OK

You can see now that labels are masking the black part of lines, leaving only the yellow part.



2.4.16 ???? Follow Along: Masking using points symbols

We want now to mask the black part of lines using only black planes that represent the points layer (i.e. B52 and Jet points categories). For the sake of visibility, you can switch off polys layer visibility.

1. Open the Layer Properties window for the points layer.

Under the *Symbology* tab, you will see that a *Categorized* renderer has been defined with 3 different symbols depending on the Class field value.

2. Double click on B52 plane icon, within the Symbol column

| ର | | Symbol Sele | ector | | ~ ^ X |
|-----------------|------------------------|-------------|-------------|--------------|------------------|
| | ✓ ★ Marker ★ SVG Ma | rker | | | |
| Color | | | | | - |
| Opacity | | | | 100.0 % | €, |
| Size 11.00000 | | ¢ [| Aillimeters | | - - |
| Rotation 0.00 ° | | | | | \$ €, |
| Q Favorites | | | | | 🛛 💌 👫 |
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| dot black | dot white | dot blue | dot green | dot red | |
| | | ۰ | <u>^</u> | Save Symbol | dvanced ∽ |
| 聞 <u>H</u> elp | | | | <u>~ о</u> к | ⊗ <u>C</u> ancel |

3. Click the Add symbol layer button and select the Mask Symbol layer type

A new hierarchy Mask (*symbol layer*) > Marker (*symbol*) > Simple Marker (*symbol layer*) appear below the root symbol Marker.

| 1 | 👻 📥 Marker | æ 🔺 |
|---|---|-----|
| | ▼ Mask | |
| + | Marker Simple Marker SVG Marker | |

Now, let's define a mask that is identical to our plane marker but a little bit bigger.

- 4. Select the newly created Simple Marker symbol layer and change its Symbol layer type to SVG marker
- 5. Set the SVG file path to be the same as the already existing SVG marker, and the size to be bigger (24 millimeters is a pretty good choice for this use case).

Mask color doesn't matter here, only the shape is used in masking. Symbol layer order is also irrelevant in that situation.

You should get something like that:

| ର | | Symbol Selector | ~ ^ × |
|----------------------------|-------------------------|---|------------------|
| - | | Marker SVG Marker Mask Marker SVG Marker | |
| Symbol layer ty | pe SVG | Marker | * |
| Size | Width Height Unit | 18.00000 18.00000 Millimeters | e. e. |
| Fill color Stroke color | | • • | €. |
| Stroke width | No stro | oke | €. |
| Rotation | 0.00 ° | | |
| Offset | x 0.000 y 0.000 | 0000 The second | €, |
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- 6. Repeat the same operations on Jet symbol.
- 7. Clic pe OK

- 8. Open the Layer Properties window for the lines layer.
- 9. Go to the Masks tab.

The black line part of lines checkbox from masked symbol layers is already checked from our previous configuration.

- 10. Uncheck the Label mask polys checkbox and check both B52 and Jet Mask symbol layer
- 11. Clic pe OK

You now see that black planes are masking the black part of lines, with only the yellow part visible.



2.4.17 În concluzie

Changing the symbology for the different layers has transformed a collection of vector files into a legible map. Not only can you see what's happening, it's even nice to look at!

2.4.18 Further Reading

Exemple de Hărți Aspectuoase

2.4.19 Ce urmează?

Changing symbols for whole layers is useful, but the information contained within each layer is not yet available to someone reading these maps. What are the streets called? Which administrative regions do certain areas belong to? What are the relative surface areas of the farms? All of this information is still hidden. The next lesson will explain how to represent this data on your map.

Notă: V-ați amintit recent să efectuați o salvare a hărții?

CAPITOLUL 3

Module: Classifying Vector Data

Clasificarea datelor vectoriale vă permite să atribuiți diferite simboluri entităților (diverse obiecte din același strat), în funcție de atributele lor. Acest lucru permite celui care folosește harta, să vadă cu ușurință atributele feluritelor entități.

3.1 Lesson: Vector Attribute Data

Datele vectoriale sunt, fără îndoială, cel mai comun tip de date utilizate zilnic în GIS. Modelul vectorial reprezintă locația și forma entităților geografice cu ajutorul punctelor, liniilor și poligoanelor (iar pentru datele 3D, de asemenea, cu ajutorul suprafețelor și volumelor), în timp ce celelalte proprietăți ale acestora sunt incluse ca atribute (deseori prezentate sub formă de tabel în QGIS).

Până în prezent, nici una dintre schimbările pe care le-am adus hărții nu au fost influențate de obiectele afișate. Cu alte cuvinte, toate zonele de utilizare a terenurilor și toate drumurile arată la fel. Atunci când văd o hartă, privitorii nu știu nimic despre drumurile pe care le observă; doar faptul că există un drum de o anumită formă, într-o anumită zonă.

Adevărata putere a GIS-ului constă în faptul că toate obiectele care sunt vizibile pe harta au, la rândul lor, atribute. Hărțile dintr-un GIS nu sunt doar imagini. Ele reprezintă nu numai obiectele din locații, dar, ci și informații despre aceste obiecte.

The goal for this lesson: To learn about the structure of vector data and explore the attribute data of an object

3.1.1 ???? Follow Along: Viewing Layer Attributes

De asemenea, este important de știut că datele cu care lucrați nu reprezintă doar locul "unde" se află obiectele în spațiu, dar vă spun și **ce** sunt acele obiecte.

From the previous exercise, you should have the protected_areas layer loaded in your map. If it is not loaded, then you can find the protected_areas.shp *ESRI Shapefile* format dataset in directory exercise_data/ shapefile.

The polygons representing the protected areas constitute the **spatial data**, but we can learn more about the protected areas by exploring the **attribute table**.

1. In the Layers panel, click on the protected_areas layer to select it.

2. In the *Layer* menu, click the ^{Open Attribute Table} button (also accessible from top toolbars buttons). This will open a new window showing the attribute table of the protected_areas layer.

| | 🞗 protected_areas :: Features Total: 2, Filtered: 2, Selected: 0 | | | | | | | | - 🗆 | × |
|---|--|----------------|-----------|-------------|-------------|--------------|-------------|----------|----------|-------|
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| 1 | r2855697 | 2855697 | relation | protected_a | Western Ca | nature_reser | Bontebok N | boundary | Q892884 | en:Bo |
| 2 | w187055916 | 187055916 | way | protected_a | Western Ca | nature_reser | Marloth Nat | NULL | NULL | NULL |
| | | | | | | | | | | |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| | | | | | | | | | | Þ |
| | T Show All Feat | ures 🖕 | | | | | | | | 3 🔳 |

A row is called a **record** and is associated with a **feature** in the Canvas Map, such as a polygon. A column is called a **field** (or an **attribute**), and has a name that helps describe it, such as name or id. Values in the cells are known as **attribute values**. These definitions are commonly used in GIS, so it is good to become familiar with them.

In the protected_areas layer, there are two **features**, which are represented by the two polygons we see on the Map Canvas.

Notă: In order to understand what the **fields** and **attribute values** represent, one may need to find documentation (or metadata) describing the meaning of the attribute values. This is usually available from the creator of the data set.

Next, let's see how a record in the attribute table is linked to a polygon feature that we see on the Map Canvas.

- 1. Reveniți la fereastra QGIS principală.
- 2. In the *Edit* \blacktriangleright *Select* menu, click on the Select *Feature(s)* button.
- 3. Asigurați-vă că stratul protected_areas este încă selectat în panoul *Straturilor*.
- 4. Move your mouse to the Map Canvas and left click on the smaller of the two polygons. The polygon will turn yellow indicating it is selected.



5. Go back to the *Attribute Table* window, and you should see a record (row) highlighted. These are the attribute values of the selected polygon.

| 6 | protected_a | areas :: Features | Total: 2, Filtere | d: 2, Selected: 1 | 1 | | | | — | \times |
|-----|----------------|-------------------|-------------------|-------------------|-------------|--------------|-------------|----------|----------|----------|
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| 1 | 2855697 | 2855697 | relation | protected_a | Western Ca | nature_reser | Bontebok N | boundary | Q892884 | en:B |
| 2 ۱ | w187055916 | 187055916 | way | protected_a | Western Ca | nature_reser | Marloth Nat | NULL | NULL | NUL |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 4 | | | | | | | | | | Þ |
| | Show All Featu | ures " | | | | | | | | 8 |

De asemenea, puteți selecta o entitate folosind Tabela de Atribute.

1. In the *Attribute Table* window, on the far left, click on the row number of the record that is currently not selected.

| | 0 | protected_a | areas :: Features | Total: 2, Filtere | d: 2, Selected: 1 | 1 | | | - | - 🗆 | × |
|---|------|----------------|-------------------|-------------------|-------------------|------------|--------------|-------------|----------|----------|------|
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| | 1 r2 | 2855697 | 2855697 | relation | protected_a | Western Ca | nature_reser | Bontebok N | boundary | Q892884 | en:B |
| | 2 | 187055916 | 187055916 | way | protected_a | Western Ca | nature_reser | Marloth Nat | NULL | NULL | NUL |
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| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | • | Show All Featu | Ires | | | | | | | | 3 💼 |
| | 4 | Show All Leave | 11C5 - | | | | | | | | |

- 2. Go back to the main QGIS window and look at the Map Canvas. You should see the larger of the two polygons colored yellow.
- 3. To deselect the feature, go to the *Attribute Table* window and click on Deselect all features from the layer button.

Sometimes there are many features shown on the Map Canvas and it might be difficult to see which feature is selected from the Attribute Table. Another way to identify the location of a feature is to use the *Flash Feature* tool.

- 1. In the *Attribute Table*, right-click on any cell in the row that has the attribute value r2855697 for the field full_id.
- 2. In the context menu, click on Flash Feature and watch the Map Canvas.



You should see the polygon flash red a few times. If you missed it, try it again.

Another useful tool is the Zoom to Feature tool, that tells QGIS to zoom to the feature of interest.

- 1. In the *Attribute Table*, right-click on any cell in the row that has the attribute value r2855697 for the field full_id.
- 2. In the context menu, click on Zoom to Feature



Look at the Map Canvas. The polygon should now occupy the extent of the Map Canvas area.

Acum, puteți închide tabelul de atribute.

3.1.2 ???? Try Yourself: Exploring Vector Data Attributes

- 1. How many fields are available in the rivers layer?
- 2. Tell us a bit about the town places in your dataset.
- 3. Open the attribute table for the *places* layer. Which field would be the most useful to represent in label form, and why?

Răspuns

- There should be 9 fields in the *rivers* layer:
 - 1. Select the layer in the Layers panel.
 - 2. Right-click and choose *Open Attribute Table*, or press the ^{IIII} button on the *Attributes Toolbar* (it can be enabled from *View* ► *Toolbars* menu).
 - 3. Totalizează numărul de coloane.

A quicker approach could be to double-click the *rivers* layer, open the *Layer properties* \succ *Fields* tab, where you will find a numbered list of the table's fields.

- Information about towns is available in the *places* layer. Open its attribute table as you did with the *rivers* layer: there are two features whose *place* attribute is set to town: *Swellendam* and *Buffeljagsrivier*. You can add comment on other fields from these two records, if you like.
- The name field is the most useful to show as labels. This is because all its values are unique for every object and are very unlikely to contain *NULL* values. If your data contains some *NULL* values, do not worry as long as most of your places have names.

3.1.3 În concluzie

Acum știți cum să folosiți tabelul de atribute pentru a vedea ceea ce se află, de fapt, în datele pe care îl utilizați. Orice set de date va fi util pentru dvs. numai dacă are atributele care vă interesează. Dacă știți de care atribute aveți nevoie, puteți decide rapid dacă puteți utiliza un anumit set de date, sau dacă trebuie să căutați un altul care are datele cerute.

3.1.4 Ce urmează?

Diferite atribute sunt utile pentru diferite scopuri. Unele dintre ele pot fi reprezentate direct sub formă de text, pentru ca utilizatorul sa le poată vedea. Veți afla cum să faceți acest lucru în lecția următoare.

3.2 Lesson: Labels

Etichetele pot fi adăugate pe o hartă, pentru a afișa informații despre un obiect. Orice strat vectorial poate avea etichete asociate cu el. Conținutul acestor etichete se bazează pe datele atributului unui strat.

Scopul acestei lecții: De a aplica etichete folositoare și plăcute unui strat.

3.2.1 ???? Follow Along: Using Labels

First, ensure that the **(abc** button is visible in the GUI:

- 1. Go to the menu item View ► Toolbars
- 2. Ensure that the *Label Toolbar* item has a check mark next to it. If it doesn't, click on the *Label Toolbar* item to activate it.
- 3. Click on the places layer in the Layers panel so that it is highlighted
- 4. Click on the *label* toolbar button to open the *Labels* tab of the *Layer Styling* panel
- 5. Switch from No Labels to and Single Labels

You'll need to choose which field in the attributes will be used for the labels. In the previous lesson, you decided that the name field was the most suitable one for this purpose.

6. Select name from the Value list:

| Laye | r Styling | | | | | | ð 🗙 | | | |
|----------|----------------|---------------------------|----------|-------|----------|------------|------|--|--|--|
| ° ° | places | | | | | | • | | | |
| * | 📾 Sing | Single Labels | | | | | | | | |
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| <u>a</u> | Text | | | | | | | | | |
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| | | | | | | | | | | |
| | | | | | | Save Sett | ings | | | |
| | • | • | | ✓ Liv | e update | App | oly | | | |

7. Clic pe Aplicare.

Etichetele hărții ar trebui să arate astfel:



3.2.2 ???? Follow Along: Changing Label Options

Depending on the styles you chose for your map in earlier lessons, you might find that the labels are not appropriately formatted and either overlap or are too far away from their point markers.

Notă: Above, you used the **abc** button in the *Label Toolbar* to open the *Layer Styling* panel. As with *Symbology*, the same label options are available via both the *Layer Styling* panel and the *Layer Properties* dialog. Here, you'll use the *Layer Properties* dialog.

- 1. Open the Layer Properties dialog by double-clicking on the places layer
- 2. Select the Labels tab
- 3. Make sure *Text* is selected in the left-hand options list, then update the text formatting options to match those shown here:

| 🔇 Layer Prop | erties - place | es Labels | | | | | | | × |
|--------------|----------------|--------------------------------------|---------|----------------|----|---------|---------|-------------------|----------|
| Q | | 📾 Single Labels | | | | | | | - 🕎 |
| 🥡 Informat | ion | Value abc name | | | | | | | 3 |
| 🗞 Source | | ▼ Text Sample | | | | | | | |
| Symbolo | gy | Lorem Ipsum | | | | | | | |
| (abc Labels | | Lorem Ipsum | | | | 1:59610 | - 10 - | | * * |
| abo Masks | | abc Text | Text | | | | | | |
| Diagram: | s | <pre>+ab < c Formatting</pre> | Font | Arial | | | | • | €, |
| Fields | | abc Buffer | Style | Regular | | | | - | €, |
| Attribute | s Form | Background | | <u>U</u> 🖶 S 🖶 | | | В | . <i>I</i> | €, |
| Joins | | Shadow Callouts | Size | 13.0000 | | | | \$ | €, |
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| Actions | 2 | J Rendering | Color | | | | | • | €, |
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| | | | Q Fa | avorites | | | | • | * |
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| C Variables | | | | | | | | | |
| 📝 Metadata | а | | | | | | | | |
| 참 Depende | ncies | | | | | | | | |
| E Legend | | | | | | | | | |
| 🔛 QGIS Ser | ver | | | | | | | | |
| 📝 Digitizing | 9 | | | | | | | Save Sett | tings |
| | | Style * | | | ОК | Cancel | Apply | He | lp |

4. Clic pe Aplicare.

That font may be larger and more familiar to users, but its readability is still dependent on what layers are rendered beneath it. To solve this, let's take a look at the *Buffer* option.

- 5. Select Buffer from the left-hand options list
- 6. Select the checkbox next to Draw text buffer, then choose options to match those shown here:

| Q Layer Properties - p | aces Labels | | | | | | | × |
|------------------------|--------------------------------------|------------------|-----------------------|----|-----------|---------|------|--------|
| ۹ | Gingle Labels | | | | | | • | 0 |
| 🥡 Information | Value abc name | | | | | | • | ε |
| Source | ▼ Text Sample | | | | | | | • |
| | Lorem Ipsum | 1 | | | | | | |
| (abc Labels | Lorem Ipsum | | | Ĩ | 5 1:59610 | - | | * * |
| abc Masks | abc Text | Buffer | | | | | | |
| M Diagrams | <pre>+ab < c Formatting</pre> | ✓ Draw text buff | ier 🚛 | | | | | |
| Fields | abc Buffer | Size | 1.0000 | | | | • | Ļ |
| | Background | | Millimeters | | | | - | Ļ |
| Attributes Form | Shadow | Color | | | | | | Ļ |
| • Joins | Callouts | | ✔ Color buffer's fill | | | | | |
| Auxiliary Storage | A Rendering | Opacity | | | | 100.0 % | ÷ (= | Ļ |
| octions | | Pen join style | Revel | | | | - | Ļ |
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| 🞸 Rendering | | Draw effe | its | | | | | r. |
| 8 Variables | | | | | | | | |
| 📝 Metadata | | | | | | | | |
| 🔁 Dependencies | | | | | | | | |
| Legend | | | | | | | | |
| QGIS Server | | | | | | | | |
| 📝 Digitizing | | | | OK | Canad | (Annha | Usla | |
| | - Style | | | UK | Cancer | Apply | пер | |

7. Clic pe Aplicare.

You'll see that this adds a colored buffer or border to the place labels, making them easier to pick out on the map:



Now we can address the positioning of the labels in relation to their point markers.

- 8. Select *Placement* from the left-hand options list
- 9. Select Around point and change the value of Distance to 2.0 Millimeters:

| Q Layer Properties - places Labels | × |
|--|---|
| Q Single Labels | - 🔹 |
| <i>i</i> Information | 3 - |
| Source | |
| Symbology Lorem Ipsum | |
| (abc Labels Lorem Ipsum | ◆ 1:42259 ▼ K ▼ |
| abc Masks | Placement |
| Diagrams the Formatting | ▲ |
| Fields | ○ Cartographic ● Around point ○ Offset from point |
| Attributes Form | |
| Joins Callouts | Distance 2.0000 |
| Auxiliary Storage | |
| Actions | Quadrant (=, |
| 🤛 Display | |
| 🞸 Rendering | |
| 8 Variables | Geometry generator |
| 📝 Metadata | |
| The period of the second secon | 4 |
| E Legend | Point / MultiPoint |
| QGIS Server | ▼ Data defined |
| Digitizing | Coordinate X (Y) |
| Style * | OK Cancel Apply Help |

10. Clic pe Aplicare.

You'll see that the labels are no longer overlapping their point markers.

3.2.3 ???? Follow Along: Using Labels Instead of Layer Symbology

In many cases, the location of a point doesn't need to be very specific. For example, most of the points in the places layer refer to entire towns or suburbs, and the specific point associated with such features is not that specific on a large scale. In fact, giving a point that is too specific is often confusing for someone reading a map.

To name an example: on a map of the world, the point given for the European Union may be somewhere in Poland, for instance. To someone reading the map, seeing a point labeled *European Union* in Poland, it may seem that the capital of the European Union is therefore in Poland.

So, to prevent this kind of misunderstanding, it's often useful to deactivate the point symbols and replace them completely with labels.

In QGIS, you can do this by changing the position of the labels to be rendered directly over the points they refer to.

- 1. Open the (abc Labels tab of the Layer Properties dialog for the places layer
- 2. Select the *Placement* option from the options list
- 3. Click on the Offset from point button

| Q Layer Properties - places Labels | | | × |
|--------------------------------------|--|-------------------|----------|
| Q Generation Single Labels | | • |) 🍖 |
| <i>i</i> Information | | • | 3 |
| Source | | | |
| Symbology Lorem Ipsum | 1 | | |
| Labels | | ♦ 1:42259 ▼ 🔩 ▼ | * * |
| abo Masks abo Text | Placement | | • |
| Diagrams < e Formatung | Cartographic Around point Offset from po | oint | |
| Attributes Form | | un v | |
| Joins Callouts | Quadrant (abc) (abc) (abc) | | |
| Auxiliary Storage | (abc) (abc) (abc) | | |
| Cions Display | Offset X,Y 0.0000 | 0.0000 | - - |
| 🞸 Rendering | Millimeters | • (= | • |
| 8 Variables | Rotation 0.00° | | ₽ |
| 📝 Metadata | Geometry generator | | |
| The pendencies | | | |
| Legend | 4 | • | |
| QGIS Server | ° Point / MultiPoint | • | |
| Digitizing | ▼ Data defined | Cancel Apply Helr | - |
| | | | |

This will reveal the *Quadrant* options which you can use to set the position of the label in relation to the point marker. In this case, we want the label to be centered on the point, so choose the center quadrant:

4. Hide the point symbols by editing the layer *Symbology* as usual, and setting the size of the *Marker* size to 0.0:

| Q | Layer Properties - pla | Symbology > | < | | | | | | |
|-----|------------------------|--|---|--|--|--|--|--|--|
| Q | | Single symbol | - | | | | | | |
| i | Information | ▼ Marker E | | | | | | | |
| ેં | Source | | | | | | | | |
| ~ | Symbology | | | | | | | | |
| abc | Labels | | | | | | | | |
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| ٩ | Actions | | | | | | | | |
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| | QGIS Server | Save Symbol Advanced 👻 | J | | | | | | |
| M | Digitizing | Layer Rendering | | | | | | | |
| | 201/5-00 | Style * OK Cancel Apply Help | | | | | | | |

5. Click *Apply* and you'll see this result:



If you were to zoom out on the map, you would see that some of the labels disappear at larger scales to avoid overlapping. Sometimes this is what you want when dealing with datasets that have many points, but at other times you will lose useful information this way. There is another possibility for handling cases like this, which we'll cover

in a later exercise in this lesson. For now, zoom out and click on the button in the toolbar and see what happens.

3.2.4 ????? Try Yourself: Customize the Labels

• Reset the label and symbol settings to have a point marker and a label offset of 2.0 Millimeters.

Răspuns

Your map should now show the marker points and the labels should be offset by 2mm. The style of the markers and labels should allow both to be clearly visible on the map:



• Set the map to the scale 1:100000. You can do this by typing it into the *Scale* box in the *Status Bar*. Modify your labels to be suitable for viewing at this scale.

Răspuns

One possible solution has this final product:



To arrive at this result:

- Use a font size of 10
- Use an around point placement distance of 1.5 mm
- Use a marker size of 3.0 mm
- In addition, this example uses the Wrap on character option:

| Layer S | Styling | | | | | | ð× | | |
|----------|------------------|----------------|---------|------------|----------|--------|-----|--|--|
| ° pla | aces | | | | | | • | | |
| * | Single Labels | | | | | | | | |
| abc | Value abc name | Value abc name | | | | | | | |
| 600 🔶 | abc +ab | 8 | abc | abc | | | | | |
| <u>a</u> | Formatting | | | | | | | | |
| 4 | Type case | No ch | ange | | | - | €, | | |
| | Spacing | letter | 0.00 | 00 | | \$ | €, | | |
| | | word | 0.000 | 0 | | \$ | €, | | |
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| | Text orientation | | • | €. | | | | | |
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| | Multiple lines | | | | | | | | |
| | Wrap on cha | racter | | | | | €, | | |
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| | | | Maxi | mum line l | • | | | | |
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| | Formatted nu | umbers | € | - | | | | | |
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| | Show plu | ıs sign | | | | | €, | | |
| | | | | | | | | | |
| | • | | | ✓ Live u | ipdate | Ap | ply | | |

• Enter a space in this field and click *Apply* to achieve the same effect. In our case, some of the place names are very long, resulting in names with multiple lines which is not very user friendly. You might find this setting to be more appropriate for your map.

3.2.5 ???? Follow Along: Labeling Lines

Acum, după ce știm cum funcționează etichetarea, remarcăm o problemă suplimentară. Punctele și poligoanele sunt ușor de etichetat, dar ce spuneți despre linii? Dacă le etichetăm în același mod ca și pe puncte, rezultatele ar arăta astfel:



We will now reformat the roads layer labels so that they are easy to understand.

- 1. Hide the places layer so that it doesn't distract you
- 2. Activate (abc Single Labels for the roads layer as you did above for places
- 3. Set the font *Size* to 10 so that you can see more labels
- 4. Zoom in on the Swellendam town area
- 5. In the Labels tab's Placement tab, choose the following settings:

| Q Layer Properties - roads L | .abels | | | | | | | > | < |
|--------------------------------|-----------------|-------------------|------------------------|----------------|---------------|-------|---|----------|---|
| ٩ | 🚥 Single Labels | | | | | | | • | |
| 🧃 Information 📩 Va | lue abc name | | | | | | | - [8 | |
| Source | 7 Text Sample | | | | | | | | |
| 💸 Symbology | Lorem Ipsum | | | | | | | _ | |
| (abc Labels | orem Ipsum | | | | 1:8860 | • | | | * |
| abc Masks | abo Text | Placement | | | | | | | |
| 🙀 Diagrams 💈 | e Formatting | | | | | | | | * |
| 1 mars | Buffer | | | | | | | | |
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| 🔡 Attributes Form | Shadow | | | | | | | | |
| • Joins | Callouts | | About the only on the | n Dalam ka | _ | | | | |
| Auvilians Storage | Placement | Allowed positions | | | 2 | | | <u>ا</u> | |
| | / Rendering | | Line orientation deper | ndent position | | | | | |
| Actions | | Distance 0.000 | 0 | | | | Ţ | ÷ | |
| 🧭 Display | | Millime | ters | | | | - | €, | |
| 🞸 Rendering | | Repeat No repe | at | | | | ٢ | €, | |
| 🗧 Variables | | Points | | | | | - | €, | |
| Metadata | | Overrun feature | No overrun | | | | - | €, | |
| Dependencies | | | Millimeters | | | | • | | |
| E Legend | | ▼ Geome | try generator | | | | | | |
| QGIS Server | | | | | | | | | |
| Digitizing | | | | | | | | | - |
| 🔶 | Style - | | | OK | Cancel | Apply | H | lelp | |

You'll probably find that the text styling has used default values and the labels are consequently very hard to read. Update the *Text* to use a dark-grey or black *Color* and the *Buffer* to use a light-yellow *Color*.

Harta va arăta aproximativ în modul următor, în funcție de scară:



You'll see that some of the road names appear more than once and that's not always necessary. To prevent this from happening:

6. In the *Labels* tab of the *Layer Properties* dialog, choose the *Rendering* option and select *Merge connected lines to avoid duplicate labels* as shown:

| Q Layer Properties - roads Labels | | × |
|---|---|------|
| Q Single Labels | | - (|
| <i>i</i> Information | | 3 - |
| Source | | |
| Symbology | | |
| (abc Labels Lorem Ipsum | († 1:8860 v 1:8860 v | • |
| abc Masks abc Text Diagrams 2 abc | Rendering | |
| Fields | Pixel size-based visibility (labels in map units) Minimum 3 px \$ | |
| Attributes Form | Maximum 10000 px | |
| Joins Callouts | Label z-index 0.00 | €, |
| Actions | Data defined Show label 《曰, Always show 《曰, | |
| Display Kendering | Show upside-down labels onever owhen rotation defined always | |
| 8 Variables | ▼ Feature options | |
| 📝 Metadata | Label every part of multi-part features | €, |
| Tependencies | Limit number of features to be labeled to | |
| E Legend | 2000 | * |
| QGIS Server | 5.00 mm | |
| Digitizing | OK Cancel Apply | Help |

7. Clic pe OK

Another useful function is to prevent labels being drawn for features too short to be of notice.

8. In the same *Rendering* panel, set the value of *Suppress labeling of features smaller than* ... to 5.00 mm and note the results when you click *Apply*

Try out different *Placement* settings as well. As we've seen before, the *Horizontal* option is not a good idea in this case, so let's try the *Curved* option instead.

9. Select the Curved option in the Placement panel of the Labels tab

Iată rezultatul:



După cum se vede, unele etichete care erau vizibile anterior sunt ascunse, datorită dificultății de le face să urmeze liniile întortocheate ale străzilor și să rămână totuși lizibile. În același timp, alte etichete devin mult mai utile, întrucât urmăresc drumurile, în loc să plutească în spațiul dintre ele. Puteți decide pe care dintre aceste opțiuni să o utilizați, în funcție de ceea ce credeți că e mai util sau că arată mai bine.

3.2.6 ???? Follow Along: Data Defined Settings

- 1. Deactivate labeling for the roads layer
- 2. Reactivate labeling for the places layer
- 3. Open the attribute table for places via the 🛄 button

It has one *field* which is of interest to us now: place which defines the type of urban area for each *record*. We can use this data to influence the label styles.

- 4. Navigate to the Text panel in the places Labels panel
- 5. Click the 🗐 button next to the Italic text button beneath *Style* and select *Edit...* to open the *Expression String Builder*:

| Q Expression String Builder | | × |
|---|---|-------------|
| Expression Function Editor | | |
| | Q Search Show Help | |
| = + - / * ^ () '\n' Expected format: bool [1=True]0=False] Feature <national &="" *<="" park="" reception="" shop="" td=""><td>symbol_color value Aggregates Arrays Color Conditionals Conversions Date and Time Fields and Values Files and Paths Fuzzy Matching General Geometry Map Layers Maps Math Operators Rasters Record and Attributes String User expressions Variables Recent (generic)</td><td></td></national> | symbol_color value Aggregates Arrays Color Conditionals Conversions Date and Time Fields and Values Files and Paths Fuzzy Matching General Geometry Map Layers Maps Math Operators Rasters Record and Attributes String User expressions Variables Recent (generic) | |
| | OK | Cancel Help |

6. Under *Fields and Values*, double click on place and then click *All Unique*. This will list all unique values of the place field of this layer. Add a = in the text editor and then double click on town.

Alternatively, you can type: "place" = 'town' directly in the text editor.

7. Click OK twice:

| Q Expression String Builder | | × |
|--|---|---|
| Expression Function Editor | | |
| | Q. Search Show Values | group field |
| "place" = 'town' = + - / * ^ () '\n' Expected format: bool [1=True]0=False] Feature (National Park Reception & Shop ♥) Preview: 0 | symbol_color * value * > Aggregates * > Arrays * > Color * > Conditionals * > Conversions * > Date and Time * * Fields and Values * abc full_id * abc osm_id * abc osm_id * abc osm_id * abc name * abc name * abc name * abc wikidata * abc wikipedia * > Files and Paths * > General * General * Gaps * Maps * Math * | Double-click to add field name to expression string. Right-Click on field name to open context menu sample value loading options. Notes Loading field values from WFS layers isn't supported, before the layer is actually inserted, ie. when building queries. Values Search All Unique 10 Samples hamlet locality suburb town |
| | | OK Cancel Help |

Notice that the labels for all places whose place field matches town are displayed in italics.



3.2.7 ???? Try Yourself: Using Data Defined Settings

Notă: We're jumping ahead a bit here to demonstrate some advanced labeling settings. At the advanced level, it's assumed that you'll know what the following means. If you don't, feel free to leave out this section and come back later when you've covered the requisite materials.

- 1. Open the Attribute Table for places
- 2. Enter edit mode by clicking the \swarrow button
- 3. Add a new column with the to button
- 4. Configurați-l astfel:

| 🔇 Add Fiel | d | × |
|---------------|-----------------------|----|
| N <u>a</u> me | FONT_SIZE | |
| Comment | | |
| Туре | Decimal number (real) | - |
| Provider type | e double | |
| Length | 8 | \$ |
| Precision | 1 | \$ |
| | OK Cancel | |

5. Use this to set custom font sizes for each different type of place (each key in the place field)

Răspuns

- 1. Still in edit mode, set the FONT_SIZE values to whatever you prefer. The example uses 16 for towns, 14 for suburbs, 12 for localities, and 10 for hamlets.
- 2. Remember to save changes and exit edit mode
- 3. Return to the *Text* formatting options for the places layer and select FONT_SIZE in the *Attribute field* of the font size 🗐 data defined override dropdown:

| 🔇 *basic_map - QGIS 3e6a | ae65df1 | | | | | | | - 🗆 🗙 | • R |
|---------------------------|-----------------------|-----------|----------------------------|---------------------|----------------|-------------|----------------------------|------------------|---------------|
| Q Layer Properties - pla | aces Labels | | | | | | × | | • R |
| Q | 📟 Single Labels | | | | | - | 💊 🚍 🕶 🖓 💷 🔹 | | fie |
| 🥡 Information | Value abc name | | | | | - | 3 | | 0 |
| Source | ▼ Text Sample | | | | | | | | |
| | Lorem Insun | . | | | | | F C | | • |
| 🥎 Symbology | Loronnipoun | | | | | | | $\sum J/\sum$ | - |
| (abc Labels | Lorem Ipsum | | | • 1:3 | 5423 💌 🕼 💌 | | | | |
| abo Masks | abc Text | Text | | | | | | | 6 |
| 🙀 Diagrams | +ab < e Formatting | Font | Arial | | | • | | | |
| Fields | abc Buffer | Style | Regular | | | - | | | |
| | Background | | | | BE | 7 4 | E | v | |
| Attributes Form | Shadow | Circ | | | | - 1 [] | | | |
| • Joins | Callouts | Size | 13.0000 | | | | Data defined override | _ [™] | |
| auxiliary Storage | Rendering | | Points | | | | Description | agsrivier | |
| . Actions | | Color | | | - (| | Store Data in the Project | | |
| Dicalar | | Opacity | | | 100.0 % | Ŷ | Attribute Field | full id (ctring) | |
| | | QF | avorites | | ≪ | - | Expression | osm_id (string) | I) |
| 🞸 Rendering | | | | | | 1 | Variable | ▶ osm_type (stri | ng) |
| 🗧 🗧 Variables | | | | | | | Edit | is_in (string) | |
| 📝 Metadata | | | | | | - | Paste | | |
| Dependencies | | | | | | L., | rissistuilt | sagns_id (strin | ig) |
| - | | | | | | | | wikidata (strin | g) |
| Legend | | | | | | | | wikipedia (stri | ng) ouble) |
| QGIS Server | | | | | | | | 10141_3122 (dd | 7001C) 7 |
| 📝 Digitizing | | | | | Save | Setting | JS | | 8 |
| | ▼ Style ▼ | | | OK Car | icel Apply | Help | | | |
| | | | | | | | | | G |
| | | | | A . | | | <u> </u> | | |
| く、Type to locate (Ctrl+K) | Toggles the e | diting st | Coordinate 20.4195,-34.029 | 3 8 Scale 1:35423 * | Magnifier 100% | ‡ Ro | otation 0.0 ° 🗘 🗸 Render 💮 | EPSG:4326 🕎 | |

Your results, if using the above values, should be this:



3.2.8 ???? Further Possibilities With Labeling

We can't cover every option in this course, but be aware that the *Label* tab has many other useful functions. You can set scale-based rendering, alter the rendering priority for labels in a layer, and set every label option using layer attributes. You can even set the rotation, XY position, and other properties of a label (if you have attribute fields allocated for the purpose), then edit these properties using the tools adjacent to the main *Layer Labeling Options* button:



(Aceste instrumente vor fi active dacă există câmpurile de atribute obligatorii și vă aflați în modul de editare.)

Simțiți-vă liberi să explorați mai multe posibilități ale sistemului de etichetare.

3.2.9 În concluzie

Ați învățat cum să folosiți atributele stratului, pentru a crea în mod dinamic etichetele. Acest lucru poate face harta mult mai informativă și mai elegantă!

3.2.10 Ce urmează?

Now that you know how attributes can make a visual difference for your map, how about using them to change the symbology of objects themselves? That's the topic for the next lesson!

3.3 Lesson: Classification

Labels are a good way to communicate information such as the names of individual places, but they can't be used for everything. For example, let us say that someone wants to know what each landuse area is used for. Using labels, you would get this:



Acest lucru face etichetarea hărții dificil de înțeles, și chiar copleșitoare atunci când există suprafețe de teren cu numeroase utilizări.

Scopul acestei lecții: De a afla cum se pot clasifica în mod eficient datele vectoriale.

3.3.1 ???? Follow Along: Classifying Nominal Data

- 1. Open the Layer Properties dialog for the landuse layer
- 2. Go to the Symbology tab
- 3. Faceți clic, în meniul cu derulare verticală, pe Simbol Unic și schimbați-l în Categorisit:
| | | | Layer Properties - | landuse Symbology | | 8 |
|----------------------|-----|------------------------------|--------------------|---------------------|---------|------------------------------|
| Q | | 불 Categori | ized | | | • |
| 🥡 Informat | ion | Value | | | | 3 |
| Source | | Symbol | | | | |
| 💐 Symbolo | ogy | Color ramp | | Random colo | ors | F |
| (abc Labels | | Symbol 🔺 | Value Legend | | | |
| ն Masks | | | | | | |
| 📬 Diagram | s | | | | | |
| 🔶 3D View | | | | | | |
| 📋 Fields | | | | | | |
| E Attribute Form | es | | | | | |
| • Joins | | | | | | |
| Auxiliary Storage | | Classify | | | | |
| Sctions | | Layer Re | endering | | | Advanced |
| 🧭 Display | - | Help | Style - | | 🖌 Apply | ¥ <u>C</u> ancel <u>√</u> OK |

- 4. In the new panel, change the Value to landuse and the Color ramp to Random colors
- 5. Click the button labeled *Classify*

| Layer Properties - landuse Symbology 🛛 😣 | | | | | | | |
|--|---|--|---|-------------|-------|-------------------------|------------|
| ۹ | 불 Categor | ized | | | | | • |
| 🥡 Information 🥤 | Value | abe landuse | | | | | 3 - |
| Source | Symbol | | | | | | |
| 😻 Symbology | Color ramp | | | Random colo | rs | | - |
| Labels Masks Diagrams 3D View Fields Attributes | Symbol ▲ ▼ ▼ ▼ ▼ ▼ ▼ ▼ ▼ ▼ ▼ ▼ ▼ ▼ | Value cemetery conservation farmland forest grass industrial orchard reservoir residential village_green vineyard | Legend cemetery conservation farmland forest grass industrial orchard reservoir residential village_green vineyard | | | | |
| Joins | ✓ | all other values | | | | | |
| Storage | Classify | 문 🗖 Del | ete All | | | | Advanced - |
| Actions | ▶ Layer Re | endering | | | | | |
| 🧭 Display | Help | Style 🝷 | | | Apply | ≭ <u>C</u> ancel | <u> </u> |

6. Clic pe OK

Veți vedea ceva de genul următor:



7. Click the arrow (or plus sign) next to landuse in the Layers panel, you'll see the categories explained:



Now our landuse polygons are colored and are classified so that areas with the same land use are the same color.

8. If you wish to, you can change the symbol of each landuse area by double-clicking the relevant color block in the *Layers* panel or in the *Layer Properties* dialog:



Observați că există o categorie necompletată:

| | Layer Prop | erties - landuse | Symbology | | | 8 |
|---|--|---|---------------|-------|------------------|---------------|
| ۹ 📮 Cate | gorized | | | | | • |
| 🥡 Information 🔷 Value | abc landuse | | | | | 3 - |
| Source Symbol | | | | | | |
| Symbology Color rar | np | | Random colors | | | - |
| Image: Symbol Image: Symbol <t< th=""><th> Value cemetery conservation farmland forest grass industrial orchard reservoir residential village_green vineyard </th><th>Legend cemetery conservation farmland forest grass industrial orchard reservoir residential village_green vineyard</th><th></th><th></th><th></th><th></th></t<> | Value cemetery conservation farmland forest grass industrial orchard reservoir residential village_green vineyard | Legend cemetery conservation farmland forest grass industrial orchard reservoir residential village_green vineyard | | | | |
| Joins | all other values | 5 | | | | |
| Storage Classif | y 🕀 💻 Del | ete All | | | | Advanced - |
| 🦵 Display 🚽 🕐 Hel | Style - | | | Apply | ¥ <u>C</u> ancel | ∫_ <u>√</u> К |

This empty category is used to color any objects which do not have a landuse value defined or which have a *NULL* value. It can be useful to keep this empty category so that areas with a *NULL* value are still represented on the map. You may like to change the color to more obviously represent a blank or *NULL* value.

Amintiți-vă să salvați harta dvs. acum, astfel încât să nu pierdeți toate modificările greu efectuate!

3.3.2 ???? Try Yourself: More Classification

Use the knowledge you gained above to classify the buildings layer. Set the categorisation against the building field and use the *Spectral* color ramp.

Notă: Amintiți-vă să focusați într-o zonă urbană, pentru a vedea rezultatele.

3.3.3 ???? Follow Along: Ratio Classification

Există patru tipuri de clasificare: nominal, ordinal, interval și raport.

In **nominal** classification, the categories that objects are classified into are name-based; they have no order. For example: town names, district codes, etc. Symbols that are used for nominal data should not imply any order or magnitude.

- For points, we can use symbols of different shape.
- For polygons, we can use different types of hatching or different colours (avoid mixing light and dark colours).
- For lines, we can use different dash patterns, different colours (avoid mixing light and dark colours) and different symbols along the lines.

In **ordinal** classification, the categories are arranged in a certain order. For example, world cities are given a rank depending on their importance for world trade, travel, culture, etc. Symbols that are used for ordinal data should imply order, but not magnitude.

- For points, we can use symbols with light to dark colours.
- For polygons, we can use graduated colours (light to dark).
- For lines, we can use graduated colours (light to dark).

In **interval** classification, the numbers are on a scale with positive, negative and zero values. For example: height above/below sea level, temperature in degrees Celsius. Symbols that are used for interval data should imply order and magnitude.

- For points, we can use symbols with varying size (small to big).
- For polygons, we can use graduated colours (light to dark) or add diagrams of varying size.
- For lines, we can use thickness (thin to thick).

In **ratio** classification, the numbers are on a scale with only positive and zero values. For example: temperature above absolute zero (0 degrees Kelvin), distance from a point, the average amount of traffic on a given street per month, etc. Symbols that are used for ratio data should imply order and magnitude.

- For points, we can use symbols with varying size (small to big).
- For polygons, we can use graduated colours (light to dark) or add diagrams of varying size.
- For lines, we can use thickness (thin to thick).

In the example above, we used nominal classification to color each record in the landuse layer based on its landuse attribute. Now we will use ratio classification to classify the records by area.

We are going to reclassify the layer, so existing classes will be lost if not saved. To store the current classification:

- 1. Open the layer's properties dialog
- 2. Click the *Save Style* ... button in the *Style* drop-down menu.
- 3. Select *Rename Current...*, enter land usage and press OK.

The categories and their symbols are now saved in the layer's properties.

- 4. Click now on the *Add...* entry of the *Style* drop-down menu and create a new style named ratio. This will store the new classification.
- 5. Close the Layer Properties dialog

We want to classify the landuse areas by size, but there is a problem: they don't have a size field, so we'll have to make one.

- 1. Open the Attributes Table for the landuse layer.
- 2. Enter edit mode by clicking the $\sqrt{Toggle editing}$ button
- 3. Add a new column of decimal type, called AREA, using the known field button:

| | Add Field | 8 |
|---------------------|-------------------------|---|
| N <u>a</u> me | AREA | |
| Comment | | |
| Туре | Decimal number (double) | • |
| Provider type FLOAT | | |
| | 🗱 Cancel 🛛 🖌 OK | |

4. Clic pe OK

The new field will be added (at the far right of the table; you may need to scroll horizontally to see it). However, at the moment it is not populated, it just has a lot of *NULL* values.

To solve this problem, we will need to calculate the areas.

1. Open the field calculator with the $\stackrel{\textcircled{}}{\Longrightarrow}$ button.

You will get this dialog:

| Q landuse — Field Calculator | × |
|---|----------------|
| Only update 0 selected features | |
| ✓ Create a new field Update exist | ting field |
| Create virtual field Output field name | |
| Output field type Binary object (BLOB) | · · · |
| Output field length 0 🗘 Precision 3 🗘 | |
| Expression Function Editor | |
| C E C to L C Show Help | |
| row_number | |
| Agrays Arrays Color Conditionals Conversions Date and Time Fields and Values Files and Paths Fuzzy Matching General Geometry Map Layers Maps Math Operators Rasters Record and Attribu String User expressions Variables | OK Cancel Help |

- 2. Check the \mathbf{V} Update existing fields
- 3. Select AREA in the fields drop-down menu

| Fie | ld Calculator 🛛 😣 |
|--|-------------------------|
| Only update 0 selected features | |
| Create a new field | ✓ Update existing field |
| Create virtual field | |
| Output field name | 124054 |
| Output field type Binary object (BLOB) | And AREA |
| Output field length 0 🗘 Precision 3 🗘 | |

- 4. Under the Expression tab, expand the Geometry functions group in the list and find \$area
- 5. Double-click on it so that it appears in the *Expression* field

| | landuse — Field Calculator 🛛 😵 |
|--|--|
| Only update 0 selected Features | |
| Create a new field | ✓ Update existing field |
| Create virtual field Output field name Output field type Binary object (BLOB) Output field length O Precision 3 Expression Function Editor | ■ 1.2 AREA ▼ |
| \$area \$area = + - / * ^ () '\n' Feature 1 Preview: 1312821.1395745648 | Q search Show Help Custom A search Custom A search Date and Time Fields and Values Files and Paths Fuzzy Matching Fuzzy Matching Geometry angle_at_vertex Sarea area azimuth bounds bound |
| Help | ≭ <u>C</u> ancel |

- 6. Clic pe OK
- 7. Scroll to the AREA field in the attribute table and you will notice that it is populated with values (you may need to click the column header to refresh the data).

Notă: These areas respect the project's area unit settings, so they may be in square meters or square degrees.

- 5. Press \square to save the edits and exit the edit mode with // Toggle editing
- 6. Close the attribute table

Now that we have the data, let's use them to render the landuse layer.

- 1. Open the Layer properties dialog's Symbology tab for the landuse layer
- 2. Change the classification style from Categorized to Graduated
- 3. Change the Value to AREA
- 4. Under Color ramp, choose the option Create New Color Ramp...:

| Q I | ayer Properties - Iar | nduse Symbolog | у | | | | × |
|------------|-----------------------|--|--|----|--------|-------------|------------|
| Q | | 😑 Graduated | I | | | | |
| i | Information | Value | 1.2 AREA | | | | • |
| રે | Source | Symbol | | | | | |
| \sim | Symbology | Legend format | %1 - %2 | | | Precision 4 | Trim |
| ~ | symbology | Color ramp | | | | | - |
| abc | Labels | Classes | Invert Color Ramp | | | | |
| abc | Masks | Symbol • | Random Color Ramp | | | | |
| <u>~</u> | Diamana | -, | Blues | | | | |
| * | Diagrams | | Greens | | | | |
| | Fields | | Greys | | | | |
| 8 | Attributes Form | | RdGv | | | | |
| | | | Reds | | | | |
| • | Joins | | Spectral | | | | |
| Ē | Auxiliary Storage | | Viridis | | | | |
| õ | Actions | | All Color Ramps > | | | | |
| <u>~</u> | Actions | | Create New Color Ramp | | | | |
| — | Display | | Edit Color Ramp | | | | |
| * | Rendering | Mode 🕕 Equ | Save Color Ramp ai Count (Quantile) | | | Classes | 5 \$ |
| 0 | Temporal | Classify | 🕀 🥅 Delete All | | | | Advanced * |
| 0 | Variables | ✓ Link class be | pundaries | | | | |
| | Vullables | Layer Rei | ndering | | | | |
| 2 | Metadata | The Style The St | | ОК | Cancel | Apply | Help |

5. Choose Gradient (if it's not selected already) and click OK. You will see this:

| 🔇 Select Color Ramp | | × |
|---------------------|-----------------------|---------|
| Color 1 Color 2 | Type Continuous | - |
| | | |
| | | |
| Curdiant Step | | |
| | | |
| | | |
| | Он | 240° \$ |
| Standard colors | () s | 100% 🗘 |
| | • v | 100% 🗘 |
| _ | () R | 0 |
| | () G | 0 |
| | Ов | 255 🌲 |
| | Opacity | 100% 🗘 |
| 송 <mark>-</mark> | HTML notation #0000ff | |
| | | |
| Current | | |
| | | |
| ▼ Plot | | |
| | | |
| Toformation | | |
| Tutotuanou | OK Cancel | нер |

Veți folosi acest lucru pentru a desemna Color 1 pentru suprafețele mici și Color 2 pentru suprafețele mari.

6. Choose appropriate colors

În acest exemplu, rezultatul arată în felul următor:

| Q Select Color Ramp | | × |
|----------------------------|-----------------------|--------|
| Color 1 Color 2 | Type Continuous | • |
| | | |
| | | |
| ■ Gradient Stop | | |
| Relative position 0.0 % | | |
| I O I / | Он | 91° 🗘 |
| Standard colors | ⊖ s | 38% |
| | • v | 87% |
| | O R | 178 |
| | () G | 223 |
| | Ов | 138 |
| | Opacity | 100% 🌲 |
| | HTML notation #b2df8a | |
| Current | | |
| → | | |
| | | |
| ▼ Plot | | |
| | | • |
| Information | OK Cancel | Help |

- 7. Clic pe OK
- 8. You can save the colour ramp by selecting *Save Color Ramp*... under the *Color ramp* tab. Choose an appropriate name for the colour ramp and click *Save*. You will now be able to select the same colour ramp easily under *All Color Ramps*.
- 9. Under *Mode* choose Equal Count (Quantile).
- 10. Click Classify

Now you will have something like this:

| QI | Layer Properties - Iar | anduse Symbology | × |
|----------|------------------------|---|----------------------|
| Q | | 🚘 Graduated | - |
| i | Information | Value 1.2 AREA | 3 |
| ્રે | Source | Symbol | |
| ~ | Symbology | Legend format %1 - %2 | Precision 0 🗘 🗸 Trim |
| \sim | , ,, | Color ramp | ▼ |
| abc | Labels | Classes Histogram | |
| abc | Masks | Symbol Values Legend | |
| 9 | Diagrams | I31.30 - 10512.65 131 - 10513 I0512.65 - 35728.06 10513 - 35728 | |
| 1 | Fields | 35728.06 - 132271.73 35728 - 132272 132271.73 - 362220.57 132272 - 362221 | |
| :8 | Attributes Form | 362220.57 - 112894046.06 362221 - 112894046 | |
| •◀ | Joins | Mode 🔢 Equal Count (Quantile) 🔻 | Classes 5 |
| s' | Auxiliary Storage | Classify (문) 😑 Delete All | Advanced 👻 |
| ٢ | Actions | ✓ Link dass boundaries | |
| — | Display | Layer Rendering Style OK Cancel | Apply Help |

Lăsați totul așa cum este.

11. Click OK:



3.3.4 ???? Try Yourself: Refine the Classification

• Modificați valorile pentru Mod și Clase până când veți obține o clasificare care are sens.

Răspuns

The settings you used might not be the same, but with the values *Classes* = 6 and *Mode* = *Natural Breaks (Jenks)* (and using the same colors, of course), the map will look like this:



3.3.5 ???? Follow Along: Rule-based Classification

Adesea este utilă combinarea mai multor criterii pentru o clasificare, dar, din păcate, clasificarea normală ia în considerare doar un singur atribut. Acesta este cazul în care este utilă clasificarea bazată pe reguli.

In this lesson, we will represent the landuse layer in a way to easily identify Swellendam city from the other residential area, and from the other types of landuse (based on their area).

- 1. Open the Layer Properties dialog for the landuse layer
- 2. Switch to the Symbology tab
- 3. Switch the classification style to Rule-based

QGIS will automatically show the rules that represent the current classification implemented for this layer. For example, after completing the exercise above, you may see something like this:

| QL | ayer Properties - Iano | luse Symbology | | × |
|-----|------------------------|--|--|-----------------|
| Q | | 🔚 Rule-based | | • |
| i | Information | Label | Rule | Min. scale Max. |
| ેં | Source | ✓ 131 - 101924 ✓ 101924 - 309418 ✓ 309418 - 839955 | "AREA" >= 131.299349 AND "AREA" <= 101924.499748 "AREA" > 101924.499748 AND "AREA" <= 309417.846808 "AREA" > 309417.846808 AND "AREA" <= 839954.777508 | |
| ~ | Symbology | ✓ ✓ Ø39955 - 1578789 ✓ Ø39955 - 1578789 ✓ ✓ Ø4452227 | "AREA" > 839954.777508 AND "AREA" <= 1578788.863263 "AREA" > 1578788.863263 AND "AREA" <= 34452226.958486 | |
| abc | Labels | 34452227 - 112894046 | "AREA" > 34452226.958486 AND "AREA" <= 112894046.060455 | |
| abc | Masks | | | |
| ۹. | Diagrams | • | | Þ |
| | Fields | ₽ = <u>)</u> Σ | | Symbol Levels |
| 8 | Attributes Form | Refine Selected Rules * Layer Rendering | | |
| • | Joins | Style * | OK Cancel A | pply Help |

- 4. Click and drag to select all the rules
- 5. Use the Remove selected rules button to remove all of the existing rules

Let's now add our custom rules.

- 1. Click the rule button
- 2. The *Edit rule* dialog then appears
- 3. Enter Swellendam city as Label
- 4. Click the ϵ button next to the *Filter* text area to open the *Expression String Builder*
- 5. Enter the criterion "name" = 'Swellendam' and validate

| | Expression String Builde | r | 8 | | | |
|--|--|--|------------------------------|--|--|--|
| Expression Function Editor | | | | | | |
| name" = 'Swellendam' | Q. Search Show Values ▶ Conditionals ▲ ▶ Conversions ▶ ▶ Custom ▶ ▶ Date and Time ▼ ▼ Fields and Values NULL 123 ogc_fid abc full_id | group field Double-click to add field name to expression string. Right-Click on field name to open context menu sample value loading options. Notes Values Values Search | | | | |
| = + - / * ^ () '\n' Feature 1 • • • • • • | abc osm_id abc osm_type abc landuse abc name abc type abc type abc wikipedia abc boundary abc is_in abc leisure abc name:de | All Unique Fynbos Heights Gaikou Lodge Koloniesbos Koornland Marloth Nature Reserve Railton Swellendam Wamakersbos | 10 Samples | | | |
| Help | | | ¥ <u>C</u> ancel <u>√</u> OK | | | |

6. Back to the *Edit rule* dialog, assign it a darker grey-blue color in order to indicate the town's importance in the region and remove the border

| | Edit Rule | 8 |
|------------------------------|--|----------|
| Label | Swellendam city | |
| • Filter | "name" = 'Swellendam' E Test | |
| ○ Else | Catch-all for other features | |
| Description | | |
| Scale rar | ige | _ |
| Minimum (Distance) 1:100 | (exclusive) Maximum (inclusive) | _ |
| Jymbot | | |
| | ✓ Fill ✓ Simple fill ✓ | - |
| Unit M | illimeters 🔹 | |
| Opacity | □ 100.0 % 🗘 | |
| Help | ¥ <u>C</u> ancel | • |

- 7. Apăsați pe OK
- 8. Repeat the steps above to add the following rules:
 - 1. Other residential label with the criterion "landuse" = 'residential' AND "name" <> 'Swellendam'. Choose a pale blue-grey *Fill color*
 - 2. Big non residential areas label with the criterion "landuse" <> 'residential' AND "AREA" >= 605000. Choose a mid-green color.

| | | Layer Properties — landuse (basic) — Symbology | | | | 8 |
|-------------------------|--|--|------------|------------|---------|------------------------------|
| ۹ | 🛢 Rule-based | | | | | • |
| 🧃 Information 🔒 | Label | Rule | Min. Scale | Max. Scale | Count | Duplicate Count |
| 🗞 Source 🎸 Symbology | ✓ Swellendam city ✓ Other residenttial ✓ Big non residential areas | name = Sweitendam "landuse" = 'residential' AND "name" <> 'Swellendam' "landuse" <> 'residential' AND "AREA" >= 605000 | | | | |
| (abc Labels | | | | | | |
| abo Masks | | | | | | |
| 💝 3D View | | | | | | |
| 🐪 Diagrams | | | | | | |
| 🥫 Fields | Pefipe Selected Pules | | | | | Symbol Levels |
| 🔡 Attributes Form | Layer Rendering | | | | | |
| • 📢 Joins | | | | | Apply 3 | ≰ <u>C</u> ancel <u>√</u> OK |

These filters are exclusive, in that they exclude areas on the map (non-residential areas which are smaller than 605000 (square meters) are not included in any of the rules).

3. We will catch the remaining features using a new rule labeled **Small non residential areas**. Instead of a filter expression, Check the *Else*. Give this category a suitable pale green color.

| Label Small non residential areas ○ Filter ELSE E Test ● Else Catch-all for other features Description Scale range Minimum (exclusive) Maximum (inclusive) 1:10000 | 8 |
|--|---|
| Filter ELSE E Test Else Catch-all for other features Description Scale range Minimum (exclusive) Maximum (inclusive) ☐ 1:10000 ✓ 🔊 🖉 1:1000 ✓ 🔊 ✓ | - |
| Else Catch-all for other features Description Scale range Minimum (exclusive) Maximum (inclusive) 1:10000 1:1000 1: | |
| Description Scale range Minimum (exclusive) Maximum (inclusive) 1:100000 Symbol | |
| Scale range Minimum (exclusive) → 1:100000 ✓ Symbol ✓ Fill | |
| Minimum (exclusive) Maximum (inclusive) | |
| Fill Simple fill | |
| | |
| Unit Millimeters - | |
| Opacity 100.0 % | |
| Color | |
| | - |

Your rules should now look like this:

| | | Layer Properties — landuse (basic) — Symbology 🛛 🛛 🛛 🛛 🛛 | | | | | | | |
|---|--|--|------------|------------|-------------|-----------------|--|--|--|
| Q | 🗮 Rule-based | | | | | • | | | |
| information Source Symbology Labels Masks 3D View Discource | Label ✓ Swellendam city ✓ Other residenttial ✓ Big non residential areas ✓ Small non residential areas | Rule "name" = 'Swellendam' "landuse" = 'residential' AND "name" <> 'Swellendam' "landuse" <> 'residential' AND "AREA" >= 605000 ELSE | Min. Scale | Max. Scale | Count | Duplicate Count | | | |
| Diagrams Fields Attributes Form Joins | Image: Provide the selected Rules Layer Rendering Image: Other Provide the selected Rules | | | | 🖉 Apply 🛛 🗱 | Symbol Levels | | | |

9. Apply this symbology

Harta dvs. va arăta în felul următor:



Acum aveți o hartă cu cele mai notabile zone rezidențiale din Swellendam și cu alte zone, non-rezidențiale, colorate în funcție de dimensiunea lor.

3.3.6 În concluzie

Simbologia ne permite să reprezentăm atributele unui strat într-un mod ușor de citit. Ne facilitează atât nouă, cât și utilizatorului hărții, înțelegerea semnificației entităților, utilizând atributele relevante alese. În funcție de problemele cu care ne confruntăm, vom aplica diferite tehnici de clasificare pentru a le rezolva.

3.3.7 Ce urmează?

Acum avem o hartă cu un aspect plăcut, dar oare cum o vom exporta din QGIS, într-un format tipăribil, ca imagine sau ca PDF? Asta e tema următoarei lecții!

CAPITOLUL 4

Module: Laying out the Maps

În acest modul, veți învăța cum să gestionați compozițiile imprimabile QGIS, dotate cu toate elementele necesare pentru a produce hărți de calitate.

4.1 Lesson: Using Print Layout

Now that you've got a map, you need to be able to print it or to export it to a document. The reason is, a GIS map file is not an image. Rather, it saves the state of the GIS program, with references to all the layers, their labels, colors, etc. So for someone who doesn't have the data or the same GIS program (such as QGIS), the map file will be useless. Luckily, QGIS can export its map file to a format that anyone's computer can read, as well as printing out the map if you have a printer connected. Both exporting and printing is handled via the *Print Layout*.

The goal for this lesson: To use the QGIS Print Layout to create a basic map with all the required settings.

4.1.1 ???? Follow Along: The Layout Manager

QGIS allows you to create multiple maps using the same map file. For this reason, it has a tool called the *Layout Manager*.

1. Click on the *Project* ► *Layout Manager*... menu entry to open this tool. You'll see a blank *Layout manager* dialog appear.

| Layout Manager 🛛 🔿 🔿 🛇 |
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| Show Duplicate Remove Rename |
| |
| Empty layout |
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| Open template directory User Default |
| ②Help ¥ Close |

- 2. Under New from Template, select Empty layout and press the Create... button.
- 3. Give the new layout the name of Swellendam and click OK.
- 4. You will now see the Print Layout window:

| Swellendam | ~ ^ X |
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You could also create this new layout via the *Project* ► *New Print Layout...* menu.

Whichever route you take, the new print layout is now accessible from the *Project* \triangleright *Layouts* \triangleright menu, as in the image below.

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4.1.2 ???? Follow Along: Basic Map Composition

În acest exemplu, compoziția arată deja în modul dorit. Asigurați-vă că și a dvs. arată așa cum ați intenționat.

- 1. Right-click on the sheet in the central part of the layout window and choose *Page properties*... in the context menu.
- 2. Check that the values in the *Item Properties* tab are set to the following:
 - *Size*: A4
 - Orientation: Landscape

Acum aveți aspectul paginii pe care l-ați dorit, dar această pagină este în continuare neagră. Îi lipsește în mod clar o hartă. Haideți să reparăm asta!

3. Click on the Add Map button.

With this tool activated, you will be able to place a map on the page.

4. Faceți clic și trasați un dreptunghi pe pagina albă:



Harta va apărea pe pagină.

5. Deplasați harta făcând clic și mișcând-o după dorință:



6. Resize it by clicking and dragging the boxes on the edges:



Notă: Harta poate să prezinte un lot diferit, desigur! Acest lucru depinde de modul în care este configurat propriul proiect. Dar nu vă faceți griji! Aceste instrucțiuni sunt generale, astfel încât ele vor lucra la fel, indiferent de ceea ce se afișează pe hartă.

- 7. Asigurați-vă că lăsați marginile în jurul conturului, și un spațiu în partea de sus pentru titlu.
- 8. Măriți și micșorați pagina (dar nu și harta!) folosind aceste butoane:

🔁 🕀 💭

9. Zoom and pan the map in the main QGIS window. You can also pan the map using the Rove item content tool.

The map view updates as you zoom in or zoom out.

10. If, for any reason, the map view does not refresh correctly, you can force the map to refresh by clicking the Refresh view button.

Remember that the size and position you've given the map doesn't need to be final. You can always come back and change it later if you're not satisfied. For now, you need to ensure that you've saved your work on this map. Because a *Print Layout* in QGIS is part of the main map file, you must save your project.

11. Go to the *Layout* \blacktriangleright **a** *Save Project*. This is a convenient shortcut to the one in the main dialog.

4.1.3 ???? Follow Along: Adding a Title

Now your map is looking good on the page, but your readers/users are not being told what's going on yet. They need some context, which is what you'll provide for them by adding map elements. First, let us add a title.

- 1. Click on the Add Label button
- 2. Click on the page, above the map, accept the suggested values in the *New Item Properties* dialog, and a label will appear at the top of the map.
- 3. Redimensionați-o și puneți-o în partea centrală, de sus, a paginii. Aceasta poate fi redimensionată și mutată în același mod în care se redimensionează și se mută harta.

Pe măsură ce mutați titlul, veți observa că liniile directoare apar pentru a vă ajuta să-l poziționați în centrul paginii.

However, there is also a tool in the Actions Toolbar to help position the title relative to the map (not the page):

- 4. Click the map to select it
- 5. Hold in Shift on your keyboard and click on the label so that both the map and the label are selected.
- 6. Look for the Align selected items left button and click on the dropdown arrow next to it to reveal the positioning options and click Align center:



Now the label frame is centered on the map, but not the contents. To center the contents of the label:

- 1. Selectați eticheta făcând clic pe ea.
- 2. Click on the Item Properties tab in the side panel of the layout window.
- 3. Modificați textul etichetei în "Swellendam":

| Layout | Item Prop | erties | Guides | | | | | | |
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- 4. Use this interface to set the font and alignment options under the Appearance section:
 - 1. Choose a large but sensible font (the example will use the default font with a size of 36)
 - 2. Set the Horizontal Alignment to Center.

De asemenea, puteți schimba culoarea fontului, dar probabil că cel mai bine este să-l păstrați negru, așa cum este în mod implicit.

- 5. Setarea implicită nu adăugă un cadru casetei de text a titlului. Cu toate acestea, dacă doriți să adăugați un cadru, puteți proceda astfel:
 - 1. În fila Proprietăților elementului, derulați caseta verticală până veți vedea opțiunea Frame.
 - 2. Clic pe caseta Frame pentru a activa cadrul. Puteți schimba culoarea cadrului și lățimea.

În acest exemplu, nu vom activa rama, așa că aceasta este pagina noastră de până acum:

| | *Swellendam | • • | 8 |
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To make sure that you don't accidentally move these elements around now that you've aligned them, you can lock items into place:

- 1. Select both the label and the map items
- 2. Click the Lock Selected Items button in the Actions Toolbar.

Notă: Click the ^[1] ^{Unlock All Items} button in the *Actions* Toolbar to be able to edit the items again.

4.1.4 ???? Follow Along: Adding a Legend

The map reader also needs to be able to see what various things on the map actually mean. In some cases, like the place names, this is quite obvious. In other cases, it's more difficult to guess, like the colors of the forests. Let's add a new legend.

- 1. Click on the Add Legend button
- 2. Click on the page to place the legend, accept the suggested values in the New Item Properties dialog,
- 3. A legend is added to the layout page, showing layers symbology as set in the main dialog.
- 4. As usual, you can click and move the item to where you want it:



4.1.5 ???? Follow Along: Customizing Legend Items

Nu este chiar totul necesar în legendă, deci, să eliminăm unele elemente nedorite.

- 1. In the *Item Properties* tab, you'll find the *Legend items* group.
- 2. Uncheck the Auto update box, allowing you to directly modify the legend items
- 3. Select the entry with buildings
- 4. Delete it from the legend by clicking the \square button

Puteți redenumi, de asemenea, elementele.

- 1. Selectați un strat din aceeași listă.
- 2. Click the *Edit* selected item properties button.
- 3. Rename the layers to Places, Roads and Streets, Surface Water, and Rivers.

You can also reorder the items:



Pe măsură ce legenda va fi probabil extinsă cu noile nume de straturi, ați putea dori să mutați și să redimensionați legenda și/sau harta. Acesta este rezultatul:



4.1.6 ???? Follow Along: Exporting Your Map

Notă: Ți-ai amintit să vă salvați munca adesea?

Finally the map is ready for export! You'll see the export buttons near the top left corner of the layout window:

• Print Layout: interfaces with a printer. Since the printer options will differ depending on the model of printer that you're working with, it's probably better to consult the printer manual or a general guide to printing for more information on this topic.

The other buttons allow you to export the map page to a file.

- Export as Image: gives you a selection of various common image formats to choose from. This is probably the simplest option, but the image it creates is "dead" and difficult to edit.
- Export as SVG: If you're sending the map to a cartographer (who may want to edit the map for publication), it's best to export as an SVG. SVG stands for "Scalable Vector Graphic", and can be imported to programs like Inkscape or other vector image editing software.
- Export as PDF: If you need to send the map to a client, it's most common to use a PDF, because it's easier to set up printing options for a PDF. Some cartographers may prefer PDF as well, if they have a program that allows them to import and edit this format.

Pentru scopurile noastre, vom folosi PDF.

- 1. Click the Export as PDF button
- 2. Choose a save location and a file name as usual. The following dialog will show up.

| PDF Export Options | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|
| Export Options | | | | | | | | | |
| Always export as vectors | | | | | | | | | |
| Append georeference information | | | | | | | | | |
| Export RDF metadata (title, author, etc.) | | | | | | | | | |
| Text export Always Export Text as Paths (Recommended) | | | | | | | | | |
| ▼ □ Create Geospatial PDF (GeoPDF) | | | | | | | | | |
| GeoPDF creation requires GDAL version 3.0 or later. | | | | | | | | | |
| Advanced Options | | | | | | | | | |
| Disable tiled raster layer exports Simplify geometries to reduce output file size | | | | | | | | | |
| <pre>②Help</pre> ✗Cancel | | | | | | | | | |

3. You can safely use the default values now and click Save.

QGIS will proceed to the map export and push a message on top of the print layout dialog as soon as it finishes.

- 4. Click the hyperlink in the message to open the folder in which the PDF has been saved in your system's file manager
- 5. Open it and see how your layout looks.

Everything is OK? Congratulations on your first completed QGIS map project!

- 6. Anything unsatisfying? Go back to the QGIS window, do the appropriate modifications and export again.
- 7. Remember to save your project file.

4.1.7 În concluzie

Now you know how to create a basic static map layout. We can go a step further and create a map layout that adapts dynamically, with more layout items.

4.2 Lesson: Creating a Dynamic Print Layout

Now that you have learned to create a basic map layout we go a step further and create a map layout that adapts dynamically to our map extent and to the page properties, e.g. when you change the size of the page. Also, the date of creation will adapt dynamically.

4.2.1 ???? Follow Along: Creating the dynamic map canvas

- 1. Load the ESRI Shapefile format datasets protected_areas.shp, places.shp, rivers.shp and water.shp into the map canvas and adapt its properties to suit your own convenience.
- 2. After everything is rendered and symbolized to your liking, click the ^I ^{New Print Layout} icon in the *Project* toolbar or choose *Project* ► ^I *New Print Layout*. You will be prompted to choose a title for the new print layout.
- 3. We want to create a map layout consisting of a header and a map of the region near Swellendam, South Africa. The layout should have a margin of 7.5 mm and the header should be 36mm high.
- 4. Create a map item called main map on the canvas and go to the *Layout* panel. Scroll down to the *Variables* section and find the *Layout* part. Here we set some variables you can use all over the dynamic print layout. Go to the *Layout* panel and scroll down to the *Variables* section. The first variable will define the margin. Press the

the button and type in the name sw_layout_margin. Set the value to 7.5. Press the the button again and type in the name sw_layout_height_header. Set the value to 36.

- 5. Now you are ready to create the position and the size of the map canvas automatically by means of the variables. Make sure that your map item is selected, go to the *Item Properties* panel, scroll down to and open the *Position and Size* section. Click the Data defined override for X and from the *Variables* entry, choose @sw_layout_margin.
- 6. Click the Data defined override for *Y*, choose *Edit*... and type in the formula:

to_real(@sw_layout_margin) + to_real(@sw_layout_height_header)

7. You can create the size of the map item by using the variables for *Width* and *Height*. Click the ¹ Data defined override for *Width* and choose *Edit* ... again. Fill in the formula:

@layout_pagewidth - @sw_layout_margin * 2

Click the Data defined override for *Height* and choose *Edit* Here fill in the formula:

@layout_pageheight - @sw_layout_height_header - @sw_layout_margin * 2

8. We will also create a grid containing the coordinates of the main canvas map extent. Go to *Item Properties* again and choose the *Grids* section. Insert a grid by clicking the 🗗 button. Click on *Modify grid* ... and set the *Interval* for *X*, *Y* and *Offset* according to the map scale you chose in the QGIS main canvas. The *Grid type Cross* is very well suited for our purposes.

4.2.2 ???? Follow Along: Creating the dynamic header

- 1. Insert a rectangle which will contain the header with the Add Shape button. In the *Items* panel enter the name header.
- 2. Again, go to the *Item Properties* and open the *Position and Size* section. Using ^(E) Data defined override</sup>, choose the sw_layout_margin variable for X as well as for Y. *Width* shall be defined by the expression:

@layout_pagewidth - @sw_layout_margin * 2

and *Height* by the sw_layout_height_header variable.

- 3. We will insert a horizontal line and two vertical lines to divide the header into different sections using the Add Node Item. Create a horizontal line and two vertical lines and name them Horizontal line, Vertical line 1 Vertical line 2.
 - 1. For the horizontal line:
 - 1. Set X to the variable sw_layout_margin
 - 2. Set the expression for *Y* to:

@sw_layout_margin + 8

3. Set the expression for Width to:

@layout_pagewidth - @sw_layout_margin * 3 - 53.5

- 2. For the first vertical line:
 - 1. Set the expression for *X* to:

@layout_pagewidth - @sw_layout_margin * 2 - 53.5

- 2. Set *Y* to the variable sw_layout_margin
- 3. The height must be the same as the header we created, so set *Height* to the variable sw_layout_height_header.
- 3. The second vertical line is placed to the left of the first one.
 - 1. Set the expression for *X* to:

@layout_pagewidth - @sw_layout_margin * 2 - 83.5

- 2. Set *Y* to the variable sw_layout_margin
- 3. The height shall be the same as the other vertical line, so set *Height* to the variable sw_layout_height_header.

The figure below shows the structure of our dynamic layout. We will fill the areas created by the lines with some elements.

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| 1 item sele | cted | | | | | | | X: | 124.577 mi | m y: 92.8866 mm p | bage: 1 | 96.8% | | - |

4.2.3 ???? Follow Along: Creating labels for the dynamic header

1. The title of your QGIS project can be included automatically. The title is set in the *Project Properties*. Insert a label with the Add Label button and enter the name project title (variable). In the *Main Properties* of the *Items Properties* Panel enter the expression:

```
[%@project_title%]
```

Set the position of the label.

1. For *X*, use the expression:

@sw_layout_margin + 3

2. For *Y*, use the expression:

@sw_layout_margin + 0.25

3. For *Width*, use the expression:

@layout_pagewidth - @sw_layout_margin *2 - 90

4. Enter 11.25 for Height

Under Appearance set the Font size to 16 pt.

2. The second label will include a description of the map you created. Again, insert a label and name it map description. In the *Main Properties* enter the text map description. In the *Main Properties* we will also include:

printed on: [%format_date(now(),'dd.MM.yyyy')%]

Here we used two Date and Time functions (now and format_date).

Set the position of the label.

1. For *X*, use the expression:

@sw_layout_margin + 3

2. For *Y*, use the expression:

@sw_layout_margin + 11.5

3. The third label will include information about your organisation. First we will create some variables in the

Variables menu of the *Item Properties*. Go to the *Layout* menu, click the P button each time and enter the names o_department, o_name, o_adress and o_postcode. In the second row enter the information about your organisation. We will use these variables in the *Main Properties* section.

In Main Properties enter:

```
[% @o_name %]
[% @o_department %]
[% @o_adress %]
[% @o_postcode %]
```

Set the position of the label.

1. For *X*, use the expression:

@layout_pagewidth - @sw_layout_margin - 49.5

2. For *Y*, use the expression:

@sw_layout_margin + 15.5

- 3. For *Width*, use 49.00
- 4. For *Height*, use the expression:

@sw_layout_height_header - 15.5

| Layout | Item Properties | Guides | Atlas | | |
|-------------------------|--|--------|-------|--|-----|
| Item Prop | erties | | | | 0 🗙 |
| Label | | | | | |
| ▼ Main | Properties | | | | |
| [% @c [% @c [% @c | o_name%] o_department%] o_adress%] o_postcode%] | | | | |
| Ren | der as HTML | | | | |
| Insert an Expression | | | | | |

4.2.4 ???? Follow Along: Adding pictures to the dynamic header

- 1. Use the Add Picture button to place a picture above your label organisation information. After entering the name organisation logo define the position and size of the logo:
 - 1. For *X*, use the expression:

@layout_pagewidth - @sw_layout_margin - 49.5

2. For *Y*, use the expression:

@sw_layout_margin + 3.5

- 3. For *Width*, use 39.292
- 4. For Height, use 9.583

To include a logo of your organisation you have to save your logo under your home directory and enter the path under *Main Properties* \blacktriangleright *Image Source*.

- 2. Our layout still needs a north arrow. This will also be inserted by using Add North Arrow. We will use the default north arrow. Define the position:
 - 1. For *X*, use the expression:

@layout_pagewidth - @sw_layout_margin * 2 - 78

2. For *Y*, use the expression:

@sw_layout_margin + 9

- 3. For *Width*, use 21.027
- 4. For *Height*, use 21.157

4.2.5 ???? Follow Along: Creating the scalebar of the dynamic header

- 1. To insert a scalebar in the header click on ^{Add Scale Bar} and place it in the rectangle above the north arrow. In *Map* under the *Main Properties* choose your main map (Map 1). This means that the scale changes automatically according to the extent you choose in the QGIS main canvas. Choose the *Style Numeric*. This means that we insert a simple scale without a scalebar. The scale still needs a position and size.
 - 1. For *X*, use the expression:

```
@layout_pagewidth - @sw_layout_margin * 2 - 78
```

2. For *Y*, use the expression:

@sw_layout_margin + 1

- 3. For Width, use 25
- 4. For Height, use 8
- 5. Place the Reference point in the center.

Congratulations! You have created your first dynamic map layout. Take a look at the layout and check if everything looks the way you want it! The dynamic map layout reacts automatically when you change the *page properties*. For

example, if you change the page size from DIN A4 to DIN A3, click the ^{Refresh view} button and the page design is adapted.


4.2.6 Ce urmează?

On the next page, you will be given an assignment to complete. This will allow you to practice the techniques you have learned so far.

4.3 Exercițiul 1

Deschideți proiectul existent al hărții și revizuiți-l bine. Dacă ați observat mici erori sau lucruri pe care v-ar fi plăcut să le remediați mai devreme, faceți acest lucru acum.

În timp ce personalizați harta, puneți-vă întrebări. Este ușor de citit și de înțeles aceată hartă pentru cineva care nu este familiarizat cu datele respective? Dacă ați vedea această hartă pe Internet, pe un poster sau într-o revistă, v-ar capta atenția? V-ar interesa această hartă în cazul în care nu v-ar aparține?

If you're doing this course at a $\star \star \star$ Basic or $\star \star \star$ Intermediate level, read up on techniques from the more advanced sections. If you see something you'd like to do in your map, why not try to implement it?

Dacă acest curs vă este prezentat, lectorul cursul vă poate cere să prezentați o versiune finală a hărții dvs., exportate în format PDF, pentru evaluare. Dacă urmați acest curs în mod individual, este recomandabil să vă evaluați propria hartă utilizând aceleași criterii. Harta dvs. va fi evaluată pentru aspectul general și simbolistica proprie, precum și pentru aspectul și așezarea în pagină a hărții și a elementelor. Amintiți-vă că, la evaluarea hărților, accentul se va pune întotdeauna pe *ușurința în utilizare*. Cu cât este mai frumoasă harta, cu atât este mai ușor să o înțelegeți dintr-o privire.

Personalizare plăcută!

4.3.1 În concluzie

Primele patru module v-au învățat cum să creați și să stilizați o hartă vectorială. În următoarele patru module, veți învăța cum să folosiți QGIS pentru o analiză completă GIS. Aceasta va include crearea și editarea datelor vectoriale; analiza lor; utilizarea și analiza datelor raster; și utilizarea GIS pentru a rezolva o problemă de la început până la sfârșit, utilizând atât surse de date raster cât și vectoriale.

CAPITOLUL 5

Module: Creating Vector Data

Crearea hărților folosind datele existente este doar începutul. În acest modul, veți afla cum să modificați datele vectoriale existente, și cum să creați noi seturi de date.

5.1 Lesson: Creating a New Vector Dataset

Datele pe care le utlizați trebuie să vină de undeva. Pentru aplicațiile uzuale, datele există deja; dar cu cât proiectul este mai aparte și mai specializat, cu atât scad șansele ca datele să fie disponibile. În asemenea cazuri va fi nevoie să va creați propriile date.

Scopul acestei lecții: De a crea un nou set de date vectoriale.

5.1.1 ???? Follow Along: The Layer Creation Dialog

Înainte de a adăuga date vectoriale noi veți avea nevoie de un set de date la care să le adăugați. În cazul nostru veți începe prin a creea date complet noi, mai degrabă decât să editați un set de date existent. În concluzie, va trebui să începeți prin a crea propriul set de date.

- 1. Open QGIS and create a new blank project.
- 2. Navigate to and click on the menu entry *Layer* ► *Create Layer* ► *New Shapefile Layer*. You'll be presented with the *New Shapefile Layer* dialog, which will allow you to define a new layer.

| Q New S | Shapefile I | Layer | | | × |
|-------------|-------------|-----------|-----------|--------|--------------------|
| File name | | | | | |
| File encodi | ing | UTF-8 | | | • |
| Geometry | type | ° Point | | | • |
| Additional | dimensions | s 🖲 None | \odot | Z (+ M | values) 🔿 M values |
| | | EPSG:4326 | - WGS 84 | | • |
| New Field | d | | | | |
| Name | | | | | |
| Type | abc Text d | lata | | | |
| Length | 80 | | Precision | | |
| Lenger | 00 | ' | | | - Fields Link |
| | | | | Add t | o Fields List |
| Fields Lis | t | | | | |
| Name | Т | vpe | Length | Pr | recision |
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| | | | | | |
| | | | | | |
| | | | | | Remove Field |
| | | | | ОК | Cancel Help |

- 3. Click ... for the *File name* field. A save dialog will appear.
- 4. Navigate to the exercise_data directory.
- 5. Save your new layer as school_property.shp.

Este important să decideți ce fel de set de date doriți. Fiecare tip de strat vectorial este "construit diferit" în fundal, deci odată ce ați creat un strat, nu îi puteți schimba tipul.

For the next exercise, we're going to create new features which describe areas. For such features, you'll need to create a polygon dataset.

6. For Geometry Type, select Polygon from the drop down menu:

| Geometry type | 🖙 Polygon 👻 | |
|---------------|-------------|--|
|---------------|-------------|--|

Aceasta nu are nici un impact asupra restului dialogului, dar va determina folosirea tipului corect de geometrie

care să fie utilizat la crearea setului de date vectorial.

The next field allows you to specify the Coordinate Reference System, or CRS. CRS is a method of associating numerical coordinates with a position on the surface of the Earth. See the User Manual on Working with Projections to learn more.

For this example we will use the default CRS associated with this project, which is WGS84.

| EPSG:4326 - WGS 84 | - | - |
|--------------------|---|---|
| | | |

Next there is a collection of fields grouped under *New Field*. By default, a new layer has only one attribute, the id field (which you should see in the *Fields list*) below. However, in order for the data you create to be useful, you actually need to say something about the features you'll be creating in this new layer. For our current purposes, it will be enough to add one field called name that will hold Text data and will be limited to text length of 80 characters.

7. Replicate the setup below, then click the Add to Fields List button:

| New Fiel | d | | |
|----------|---------------|-----------|----------------------|
| Name | name | | |
| Туре | abc Text data | | • |
| Length | 80 | Precision | |
| | | | 1 Add to Fields List |

8. Verificați dacă dialogul dvs. arată acum astfel:

| 🔇 New S | Shapefile | Layer | | | × | | |
|-------------|------------|---------------|--|--------|---------------------------|--|--|
| File name | | aining-Data-: | 2.0\exerci | se_dat | a\school_property.shp 🚳 🛄 | | |
| File encodi | ing | UTF-8 | UTF-8 | | | | |
| Geometry | type | 🗭 Polygon | Polygon 🔹 | | | | |
| Additional | dimension | s 🖲 None | None O Z (+ M values) O M values | | | | |
| | | EPSG:4326 | EPSG:4326 - WGS 84 🔹 👻 | | | | |
| New Field | d | | | | | | |
| Name | | | | | | | |
| Type | abc Text (| lata | | | | | |
| Type | | | Duration | | | | |
| Length | 80 | | Precision | | | | |
| | | | | Ad all | d to Fields List | | |
| Fields Lis | t | | | | | | |
| Namo | т | ino | Longth | | Provision | | |
| id | | ype nteaer | 10 | | Precision | | |
| name | S | String | 80 | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | Remove Field | | |
| | | | | OK | Cancel Help | | |

9. Clic pe OK

The new layer should appear in your *Layers* panel.

5.1.2 ???? Follow Along: Data Sources

Când creați date noi, este evident necesar să se refere la obiecte care există întradevăr pe teren. De aceea, va fi nevoie să obțineți informația de undeva.

Există multe moduri de a obține date despre obiecte. De exemplu, ați putea folosi un GPS pentru a caputra puncte din lumea reală, după care să importați datele in QGIS. Sau ați putea să identificați punctele folosind un teodolit, după care să introduceți manual coordonatele pentru a crea noi entități.

Pentru exemplul nostru, veți folosi digitizarea. Eșantioanele seturilor de date raster vă sunt puse la dispoziție, așa că va trebui să le importați după nevoie.

1. Click on ^QData Source Manager</sup> button.

- 2. Select **Raster** on the left side.
- 3. In the *Source* panel, click on the ... button:
- 4. Navigate to exercise_data/raster/.
- 5. Select the file 3420C_2010_327_RGB_LATLNG.tif.
- 6. Click *Open* to close the dialogue window.

| Q Data Source Manager Rast | er × | < |
|------------------------------|--|---|
| 📂 Browser | Source type | |
| V- Vector | File Protocol: HTTP(S) cloud, etc. | |
| Raster | | |
| Mesh | Source | |
| 7 , Delimited Text | Raster Dataset(s) ercise_data\raster\3420C_2010_327_RGB_LATLNG.tif <a>[] | |
| 🤗 GeoPackage | | |
| 🍂 SpatiaLite | | |
| PostgreSQL | | |
| MSSQL | | |
| 📮 Oracle | | |
| DB2 DB2 | | |
| 🙀 Virtual Layer | | |
| 🚱 wms/wmts | | |
| 🕀 wcs | | |
| 💬 WFS | | |
| RicGIS Map Server | | |
| RrcGIS Feature Server | | |
| 🔰 GeoNode | | |
| | | |
| | | |
| | Close <u>A</u> dd Help | |

7. Click Add and Close. An image will load into your map.



8. If you don't see an aerial image appear, select the new layer, right click, and choose Zoom to Layer in the context menu.

| Q *Untitled Pro | iject - QGIS |
|-------------------------------|--|
| Project <u>E</u> dit <u>V</u> | <u>/</u> iew <u>L</u> ayer <u>S</u> ettings <u>P</u> lugins Vect <u>o</u> r <u>R</u> aster <u>D</u> atab |
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| | Show in Overview |
| | Copy Layer |
| | Re <u>n</u> ame Layer |
| | Dom to Native Resolution (100%) |
| | Stretch Using Current Extent |
| | 🖬 Duplicate Layer |
| | 🕞 Remove Layer |
| | Change Data Source |
| | Set Layer Scale Visibility |
| | Set CRS |
| | Export + |
| | Styles + |
| | Properties |
| | |

9. Click on the $\mathcal{F}^{\text{Zoom In}}$ button, and zoom to the area highlighted in blue below:



Now you are ready to digitize these three fields:



Before starting to digitize, let's move the school_property layer above the aerial image.

1. Select school_property layer in the *Layers* pane and drag it to the top.



Pentru a începe digitizarea trebuie să intrați în modul editare. Aplicațiile GIS cer asta în mod curent pentru a preveni

modificarea sau ștergerea accidentală a datelor importante. Modul editare este activat sau dezactivat independent pentru fiecare strat.

To enter edit mode for the school_property layer:

- 1. Click on the school_property layer in the Layers panel to select it.
- 2. Click on the *Toggle Editing* button.

Dacă nu puteți găsi acest buton, verificați dacă bara de instrumente *Digitizing* este activată. Ar trebui să existe un semn de selectare lângă elementul de meniu *View* \succ *Toolbars* \succ *Digitizing*.

As soon as you are in edit mode, you'll see that some digitizing tools have become active:

Capture Polygon
 Markov
 Instrumentul Vertex

Other relevant buttons are still inactive, but will become active when we start interacting with our new data.

Notice that the layer school_property in the *Layers* panel now has the pencil icon, indicating that it is in edit mode.

3. Click on the Capture Polygon button to begin digitizing our school fields.

You'll notice that your mouse cursor has become a crosshair. This allows you to more accurately place the points you'll be digitizing. Remember that even when you're using the digitizing tool, you can zoom in and out on your map by rolling the mouse wheel, and you can pan around by holding down the mouse wheel and dragging around in the map.

Prima entitate pe care o veți digitaliza este athletics field:



- 4. Începeți digitizarea făcând clic pe un punct, de-a lungul marginii câmpului.
- 5. Plasați mai multe puncte, făcând clic în continuare de-a lungul marginii, până când forma desenată acoperă complet câmpul.



- 6. After placing your last point, right click to finish drawing the polygon. This will finalize the feature and show you the *Attributes* dialog.
- 7. Completați valorile, așa cum se arată mai jos:

| school_ | property - Feature Attributes | | |
|---------|-------------------------------|--------|--|
| id | 1 | | |
| name | Athletics Field | ⊠ | |
| | | | |
| | OK | Cancel | |

8. Click OK, and you have created a new feature!

| 🔇 *Untitled Project - QGIS | _ | | \times |
|---|-------|-----------|----------|
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| | | | |
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- 9. In the *Layers* panel select the school_property layer.
- 10. Right click and choose Open Attribute Table in the context menu.

| 🔇 *Untitled Project - | QGIS | | | |
|-----------------------------------|--------------------------------|-----------------|-----------------|------------------|
| Project <u>E</u> dit <u>V</u> iew | <u>L</u> ayer <u>S</u> ettings | <u>P</u> lugins | Vect <u>o</u> r | <u>R</u> as |
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| | Compare Editing | | | |
| | Current Edits | | | |
| | Filter | | | 5 |
| | Change Data Sc | ource | | - 2 |
| | Set Layer Scale | Visibility | • | |
| | Set CRS | | | <u>`</u> |
| | Export | | | <u>۲</u> |
| | Styles | | | • 🃗 |
| | Properties | | | 2 |
| | | L. | 100 | 2 |

In the table you will see the feature you just added. While in edit mode you can update the attributes data by double click on the cell you want to update.

| 🔇 so | hool_pro | perty :: Features | Total: 1, Fil | tered: 1, | Select | _ | | \times |
|--------|--------------|-------------------|---------------|-----------|--------|------------|-------|------------|
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| 123 id | ▼ = 8 | ε | | | - Upd | ate All | Updat | e Selected |
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| | | | | | | | | |
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| | | | | | | | | |
| T Sho | ow All Featu | ures _ | | | | | | B |

- 11. Închideți tabelul de atribute.
- 12. To save the new feature we just created, click on \bigcirc Save Edits button.

Amintiți-vă că dacă ați făcut o greșeală în timp ce digitizați o entitate, o puteți edita oricând după ce ați definitivat crearea ei. Dacă ați făcut o greșeală, continuați digitizarea până ați terminat crearea entității de mai sus. Apoi:

- 1. Clic pe butonul Is Instrumentului Vertex.
- 2. Hover the mouse over a vertex you want to move and left click on the vertex.
- 3. Move the mouse to the correct location of the vertex, and left click. This will move the vertex to the new location.





The same procedure can be used to move a line segment, but you will need to hover over the midpoint of the line segment.

If you want to undo a change, you can press the \bigcirc Undo button or Ctrl+Z.

- 4. Remember to save your changes by clicking the \bigcirc Save Edits button.
- 5. When done editing, click the // Toggle Editing button to get out of edit mode.

5.1.3 ???? Try Yourself: Digitizing Polygons

Digitizarea școlii propriu-zise și a câmpului de sus. Utilizați această imagine pentru a vă ajuta:



Remember that each new feature needs to have a unique id value!

Notă: După ce ați terminat de adăugat entitățile într-un strat, nu uitați să salvați modificările și să ieșiți din modul de editare.

Notă: You can style the fill, outline and label placement and formatting of the school_property using techniques learnt in earlier lessons.

5.1.4 ???? Follow Along: Using Vertex Editor Table

Another way to edit a feature is to manually enter the actual coordinate values for each vertex using the *Vertex Editor* table.

- 1. Make sure you are in edit mode on layer school_property.
- 2. If not already activated, click on $\sqrt{8}$ Vertex Tool button.
- 3. Move the mouse over one of the polygon features you created in the school_property layer and right click on it. This will select the feature and a *Vertex Editor* pane will appear.

| | X | Y | r |
|---|---------|----------|---|
| 0 | 20.4456 | -34.0226 | |
| 1 | 20.4469 | -34.0238 | |
| 2 | 20.4457 | -34.0251 | |
| 3 | 20.4453 | -34.0247 | |
| 4 | 20.4450 | -34.0250 | |
| 5 | 20.4441 | -34.0241 | |
| 6 | 20.4456 | -34.0226 | |

Notă: This table contains the coordinates for the vertices of the feature. Notice there are seven vertices for this feature, but only six are visually identified in the map area. Upon closer inspection, one will notice that row 0 and 6 have identical coordinates. These are the start and end vertices of the feature geometry, and are required in order to create a closed polygon feature.

4. Click and drag a box over a vertex, or multiple vertices, of the selected feature.



The selected vertices will change to a color blue and the *Vertex Editor* table will have the corresponding rows highlighted, which contain the coordinates of the vertices.

| 🔇 *basic_map - QGIS | | | | | | _ | | \times |
|---|---|--|-----------------------------------|--------------|----------|---------|------|----------|
| Project <u>E</u> dit <u>V</u> iew <u>L</u> ayer <u>S</u> et | tings <u>P</u> lugins Vect <u>o</u> r | <u>R</u> aster <u>D</u> atabase | <u>W</u> eb <u>M</u> esh <u>H</u> | <u>H</u> elp | | | | |
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| Vertex Editor | 0 × | | | | | 100 | | |
| x y | r | | | | / | 100 | 186. | |
| 0 20.4456 -34.0226 | 200 | C. Barrison | | Ø | 100 | | 100 | |
| 1 20.4469 -34.0238 | - | States and | | | S. 1 | 100 | | |
| 2 20.4457 -34.0251 | Contract Sector | Street Cold | 12.13 | X | 200 | 100 | | 100 |
| 3 20.4453 -34.0247 | | Station of the local division in which the local division in which the local division in | | | 1 | 200 | | 1.1 |
| 4 20.4450 -34.0250 | | States of States | | | | | | |
| 5 20.4441 -34.0241 | 100 | 10000 | 1 . | Sec. | | / | | |
| 6 20.4456 -34.0226 | 1000 | 4 | | 1.0 | | | 200 | _ / |
| | and the second se | | | | | | | |

5. To update a coordinate, double left click on the cell in the table that you want to edit and enter the updated value. In this example, the x coordinate of row 4 is updated from 20.4450 to 20.4444.

| Vertex Editor | | | ð 🗙 |
|------------------|-------------|-------------|---------|
| x | y | r | |
| 0 20.4456 | -34.0226 | | |
| 1 20.4469 | -34.0238 | | |
| 2 20.4457 | -34.0251 | | |
| 3 20.4453 | -34.0247 | | |
| 4 20.4444 | -34.0250 | | |
| 5 20.4441 | -34.0241 | | |
| 6 20.4456 | -34.0226 | | |
| | | | |
| Q Type to loca | te (Ctrl+K) | Valid; rdii | 20.4441 |

- 6. After entering the updated value, hit the enter key to apply the change. You will see the vertex move to the new location in the map window.
- 7. When done editing, click the *V*^{Toggle Editing} button to get out of edit mode, and save your edits.

5.1.5 ???? Try Yourself: Digitizing Lines

We are going to digitize two routes which are not already marked on the roads layer; one is a path, the other is a track. Our path runs along the southern edge of the suburb of Railton, starting and ending at marked roads:



Piste este situată un pic mai departe de sud:



- 1. If the *roads* layer is not yet in your map, then add the roads layer from the GeoPackage file training-data.gpkg included in the exercise_data folder of the training data you downloaded. You can read 222 Follow Along: Loading vector data from a GeoPackage Database for a how-to.
- 2. Create a new ESRI Shapefile line dataset called routes.shp in the exercise_data directory, with attributes id and type (use the approach above to guide you.)
- 3. Activate edit mode on the *routes* layer.
- 4. Since you are working with a line feature, click on the ^V Add Line button to initiate line digitizing mode.
- 5. One at a time, digitize the path and the track on the routes layer. Try to follow the routes as accurately as possible, adding additional points along corners or turns.
- 6. Set the type attribute value to path or track.
- 7. Use the *Layer Properties* dialog to add styling to your routes. Feel free to use different styles for paths and tracks.
- 8. Save your edits and toggle off editing mode by pressing the \swarrow Toggle Editing button.

Răspuns

The symbology doesn't matter, but the results should look more or less like this:



5.1.6 În concluzie

Acum știți cum să creați entități! Acest curs nu acoperă adăugarea entităților de tip punct, deoarece nu este neapărat necesară după ce ați lucrat cu entități mai complexe (lini și poligoane). Funționează exact la fel, cu excepția faptului că dați clic doar o singură dată unde doriți să plasați punctul, îi completați atributele ca de obicei, după care entitatea este creată.

Cunoașterea digitizării este importantă deoarece reprezintă o activitate frecventă în aplicațiile GIS.

5.1.7 Ce urmează?

Features in a GIS layer aren't just pictures, but objects in space. For example, adjacent polygons know where they are in relation to one another. This is called **topology**. In the next lesson you'll see an example of why this can be useful.

5.2 Lesson: Feature Topology

Topologia reprezintă un aspect util de straturi de date vectoriale, deoarece minimizează erorile, cum ar fi suprapunerile sau lacunele.

De exemplu: dacă două entități au o frontieră comună, și editați granița cu ajutorul topologiei, atunci nu va trebui să editați mai întâi un element, apoi pe celălalt, și ulterior să aliniați cu atenție frontierele, astfel încât acestea să se potrivească. În schimb, puteți edita bordurile lor comune, ambele entități schimbându-se în același timp.

Scopul acestei lecții: De a înțelege topologia, cu ajutorul exemplelor.

5.2.1 ???? Follow Along: Snapping

Snapping makes topological editing easier. This will allow your mouse cursor to snap to other objects while you digitize. To set snapping options:

- 1. Navigate to the menu entry Project ► Snapping Options....
- 2. Set up your *Snapping options*: enable snapping using the \checkmark Enable Snapping button, choose the *Advanced Configuration*, activate the landuse layer with *Type vertex* and tolerance 12 pixels:

| | ettings | 8 | | | |
|---|--|---|---|----------------------|--|
| 🔌 🕅 Advanced Configur | ation, Y 1 | Topological Editi | ng 🔀 Snap | ping on Intersection | |
| Layer | Туре | Tolerance | Units | Avoid overlap | |
| places buildings roads water rivers landuse protected_areas | vertex vertex vertex vertex vertex vertex vertex | 12 12 12 12 12 12 12 12 | pixels pixels pixels pixels pixels pixels pixels | ✓ | |
| | | | | Q Filter layers | |

- 3. Make sure that the box in the Avoid overlap column is checked.
- 4. Leave the dialog.
- 5. Select the *landuse* layer and enter edit mode (\checkmark)
- 6. Check (under *View* > *Toolbars*) that the *Advanced Digitizing* toolbar is enabled.
- 7. Focalizați această arie (activând straturile și etichetele, dacă este necesar):



8. Digitize this new (fictional) area shown in red:



9. When prompted, give it an OGC_FID of 999, but feel free to leave the other values unchanged.

If you are careful while digitizing, and allow the cursor to snap to the vertices of adjoining areas, you'll notice that there won't be any gaps between your new area and the existing adjacent areas.

10. Note the \bigcirc undo and \bigcirc redo tools in the Advanced Digitizing toolbar.

5.2.2 ???? Follow Along: Correct Topological Features

Topology features can sometimes need to be updated. In our study area, an area has been turned into forest, so the landuse layer need an update. We will therefore expand and join some forest features in this area:



Instead of creating new polygons to join the forest areas, we are going to use the *Vertex Tool* to edit and join existing polygons.

- 1. Enter edit mode (if it is not active already)
- 2. Selectați KInstrumentul Vertex.
- 3. Choose an area of forest, select a vertex, and move it to an adjoining vertex so that the two forest features meet:



4. Click on the other vertices and snap them into place.

Limitele topologic corecte vor arăta astfel:



Continuați și alăturați mai multe zone zone folosind Instrumentul Vertex.

You can also use the ^{Add Polygon Feature} tool to fill the gap between the two forest polygons. If you have enabled *Avoid overlap*, you don't have to add every single vertex - they will be added automatically if your new polygon overlaps the existing ones.

If you are using our example data, you should have a forest area looking something like this:



Nu vă faceți griji dacă ați îmbinat mai multe, mai puține sau zone diferite de pădure.

5.2.3 ???? Follow Along: Tool: Simplify Feature

Continuing on the same layer, we will test the Simplify Feature tool:

- 1. Faceți clic pe el pentru a-l activa.
- 2. Click on one of the areas which you joined using either the *Vertex Tool* or *Add Feature* tool. You will see this dialog:



3. Modify the *Tolerance* and watch what happens:



This allows you to reduce the number of vertices.

4. Clic pe OK

The advantage of this tool is that it provides you with a simple and intuitive interface for generalization. But notice that the tool ruins topology. The simplified polygon no longer shares boundaries with its adjacent polygons, as it should. So this tool is better suited for stand-alone features.

Înainte de a merge mai departe, setați poligonul înapoi la starea inițială, prin anularea ultimei modificări.

5.2.4 ???? Try Yourself: Tool: Add Ring

The Add Ring tool allows you to add an interior ring to a polygon feature (cut a hole in the polygon), as long as the hole is completely contained within the polygon (touching the boundary is OK). For example, if you have digitized the outer boundaries of South Africa and you need to add a hole for Lesotho, you would use this tool.

If you experiment with the tool, you may notice that the snapping options can prevent you from creating a ring inside a polygon. So you are advised to turn off snapping before cutting a hole.

- 1. Disable snapping for the landuse layer using the ³ Enable Snapping</sup> button (or use the shortcut s).
- 2. Use the 2 Add Ring tool to create a hole in the middle of a polygon geometry.
- 3. Draw a polygon over the target feature, as if you were using the $rac{1}{100}$ Add polygon tool.
- 4. When you right-click, the hole will be visible.
- 5. Remove the hole you just created using the Selete Ring tool. Click inside the hole to delete it.

Răspuns

The exact shape doesn't matter, but you should be getting a hole in the middle of your feature, like this one:



• Undo your edit before continuing with the exercise for the next tool.

5.2.5 ???? Try Yourself: Tool: Add Part

The $\sum^{Add Part}$ tool allows you to add a new part to a feature, that is not directly connected to the main feature. For example, if you have digitized the boundaries of mainland South Africa, but you haven't yet added the Prince Edward Islands, you would use this tool to create them.

- 1. Select the polygon to which you wish to add the part by using the Select Features by area or single click tool.
- 2. Use the Add Part tool to add an outlying area.
- 3. Delete the part you just created using the $\sum_{\text{Delete Part}} \text{Delete Part}$ tool.

Notă: Click inside the part to delete it.

Răspuns

1. First select the Bontebok National Park:



2. Now add your new part:



3. Undo your edit before continuing with the exercise for the next tool.

5.2.6 ???? Follow Along: Tool: Reshape Features

The Peatures tool is used to extend a polygon feature or cut away a part of it (along the boundary). Extindere:

1. Select the polygon using the Select Features by area or single click tool.

- 2. Left-click inside the polygon to start drawing.
- 3. Draw a shape outside the polygon. The last vertex should be back inside the polygon.
- 4. Right-click to finish the shape:



Acest lucru va genera un rezultat similar cu:



Cut away a part:

- 1. Select the polygon using the Select Features by area or single click tool.
- 2. Faceți clic în afara poligonului.
- 3. Draw a shape inside the polygon. The last vertex must be back outside the polygon.
4. Right-click outside the polygon:



Iată rezultatul:



5.2.7 ???? Try Yourself: Tool: Split Features

The Split Features tool is similar to the Reshape Features tool, except that it does not delete either of the two parts. Instead, it keeps them both.

We will use the tool to split a corner from a polygon.

- 1. First, select the landuse layer and re-enable snapping for it.
- 2. Select the Split Features tool and click on a vertex to begin drawing a line.
- 3. Draw the bounding line.
- 4. Click a vertex on the "opposite" side of the polygon you wish to split and right-click to complete the line:



5. At this point, it may seem as if nothing has happened. But remember that the landuse layer is rendered without border lines, so the new division line will not be shown.

6. Use the Select Features by area or single click tool to select the part you just split out; the new feature will now be highlighted:



5.2.8 ???? Try Yourself: Tool: Merge Features

Now we will re-join the feature you just split out to the remaining part of the polygon:

- 1. Experiment with the Merge Selected Features and Merge Attributes of Selected Features tools.
- 2. Notați diferențele.

Răspuns

- Use the Merge Selected Features tool, making sure to first select both of the polygons you wish to merge.
- Use the feature with the *OGC_FID* of 1 as the source of your attributes (click on its entry in the dialog, then click the *Take attributes from selected feature* button):

If you're using a different dataset, it is highly likely that your original polygon's *OGC_FID* will not be 1. Just choose the feature which has an *OGC_FID*.

| 00 | 0 | | | | | Merge feature attributes | | | | | | |
|-----|-----|----------------------|------------------|-----------|------------|--------------------------|-------------|-------------|-------------|-------------|-------------|-------|
| | | OGC_FID | GEOMETRY | osm_id | osm_way_id | name | type | aeroway | amenity | admin_leve | barrier | |
| ld | | Skip attribute 🛟 | Feature 1 | Feature 1 | Feature 1 | Feature 1 | Feature 1 🛟 | Fei |
| 1 | | 1 🖾 | NULL | 2855697 🛛 | NULL | Bontebok National Park | boundary 🛛 | NULL | NULL | NULL | NULL | atior |
| -14 | | | NULL | 2855697 🛛 | NULL | Bontebok National Park | boundary 🛛 | NULL | NULL | NULL | NULL | atior |
| Me | rge | Skipped | | 2855697 | | Bontebok National Park | boundary | | | | | natic |
| | | Take attributes from | selected feature | | | | | | | | | |
| | | | | | | | | | | | Cancel | ж |

Using the Merge Attributes of Selected Features tool will keep the geometries distinct, but give them the same attributes.

5.2.9 În concluzie

Editarea topologică este un instrument puternic, care vă permite să creați și să modificați obiectele rapid și ușor, asigurându-vă în același timp că ele rămân corecte din punct de vedere topologic.

5.2.10 Ce urmează?

Now you know how to digitize the shape of the objects easily, but adding attributes is still a bit of a headache! Next we will show you how to use forms, making attribute editing simpler and more effective.

5.3 Lesson: Forms

Atunci când adăugați prin digitizare noi date, vi se prezintă o fereastră de dialog care vă permite să completați atributele entităților. Totuși, acest dialog nu este, în mod implicit, prea aspectuos. Acest lucru poate cauza o problemă de uzabilitate, mai ales dacă aveți de creat seturi de date de mari dimensiuni, sau dacă doriți ca alte persoane să vă ajute la digitizare, aceștia descoperind repede că formularele implicite sunt confuze.

Din fericire, QGIS vă permite să creați propriile dialoguri personalizate pentru un strat. Această lecție vă arată cum.

Scopul acestei lecții: De a crea un formular pentru un strat.

5.3.1 ???? Follow Along: Using QGIS» Form Design Functionality

- 1. Select the roads layer in the Layers panel
- 2. Enter Edit Mode as before
- 3. Open the roads layer's attribute table
- 4. Right-click on any cell in the table. A short menu will appear, that includes the Open form entry.
- 5. Click on it to see the form that QGIS generates for this layer

Evident, ar fi frumos să fiți în măsură să faceți acest lucru, mai degrabă, în timp ce vă uitați la hartă, decât să fie nevoie să căutați tot timpul o stradă specifică în *Tabela de Atribute*.

- 1. Select the roads layer in the Layers panel
- 2. Using the ^{CA} ^{Identify Features} tool, click on any street in the map.
- 3. The *Identify Results* panel opens and shows a tree view of the fields values and other general information about the clicked feature.
- 4. At the top of the panel, check the Auto open form for single feature results checkbox in the $\sqrt[3]{Identify Settings}$ menu.
- 5. Now, click again on any street in the map. Along the previous *Identify Results* dialog, you'll see the now-familiar form:

| 000 | Attributes - roads | |
|------------|--------------------|-----|
| osm_id | 47587910 | ן נ |
| name | NULL |] |
| highway | unclassified |] |
| waterway | NULL |] |
| aerialway | NULL |] |
| barrier | NULL | |
| man_made | NULL |] |
| other_tags | "lanes"=>"2" | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | Cancel OK | |

6. Each time you click on a single feature with the *Identify* tool, its form pops up as long as the *Auto open form* is checked.

5.3.2 ???? Try Yourself: Using the Form to Edit Values

Dacă sunteți în modul de editare, puteți utiliza acest formular pentru a edita atributele unei entități.

- 1. Activați modul de editare (dacă nu este deja activat).
- 2. Using the ^{Identify Features} tool, click on the main street running through Swellendam:



- 3. Edit its highway value to be secondary
- 4. Exit edit mode and save your edits
- 5. Open the *Attribute Table* and note that the value has been updated in the attributes table and therefore in the source data

5.3.3 ???? Follow Along: Setting Form Field Types

E frumos să editați lucruri folosind un formular, dar tot trebuie să introduceți manual totul. Din fericire, formele au așa-numitele *widgets*, care vă permit să editați datele în diverse moduri.

- 1. Open the roads layer's Properties...
- 2. Mergeți la fila Câmpuri. Veți vedea următoarele:

| | | | | | Laye | r Propertie | s - roads Fie | elds | | | | (| 8 |
|----------|--------------------|----|-------------------|------------|-------|-------------|-----------------|--------|-----------|---------|----------------|---------------------|---|
| Q | | | 6 | / | | | | | | | | | |
| G | Information | | Id 🔹 | Name | Alias | Туре | Type name | Length | Precision | Comment | WMS | WFS | |
| 3~ | | | 123 0 | fid | | qlonglong | Integer64 | 0 | 0 | | ✓ | ✓ | |
| 1 | Source | | abc 1 | full_id | | QString | String | 255 | 0 | | v | V | |
| ~ | Symbology | | abc 2 | osm_id | | QString | String | 255 | 0 | | v | v | Η |
| abc | Labels | | abc 3 | osm_type | | QString | String | 255 | 0 | | v | ✓ | |
| abc | Masks | | abc 4 | highway | | QString | String | 255 | 0 | | ✓ | V | |
| % | Diagrams | | abc 5 | lanes | | QString | String | 255 | 0 | | v | ✓ | |
| | | 1 | abc 6 | maxspeed | | QString | String | 255 | 0 | | v | ✓ | |
| | 3D VIEW | | abc 7 | oneway | | QString | String | 255 | 0 | | v | ✓ | |
| | Fields | | abc 8 | ref | | QString | String | 255 | 0 | | v | V | |
| | Attributes Form | | abc 9 | surface | | QString | String | 255 | 0 | | v | ✓ | |
| • | Joins | | ^{abc} 10 | name | | QString | String | 255 | 0 | | v | ✓ | |
| đ | Auxiliary | | abc 11 | embankment | | QString | String | 255 | 0 | | v | • | |
| | Storage | | ^{abc} 12 | maxweight | | QString | String | 255 | 0 | | v | v | Ŧ |
| ~ | Actions | •[| Hel | p Style - | · | | | | | Apply 🗶 | <u>C</u> ancel | √ <u>о</u> к | |

3. Switch to the *Attributes Form* tab. You'll see this:

| | Layer | r Properties - roads Attribute | s Form | 8 |
|----------------------|--|----------------------------------|--------|--|
| Q | Autogenerate | | - 🏓 | Show form on add feature (global settings) 👻 |
| 🧿 Information 🔒 | Available Widgets | | | |
| Source | fid full_id | | | |
| | osm_id osm_type | | | |
| (abc Labels | highway lanes | | | |
| abo Masks | maxspeed oneway | | | |
| 🐪 Diagrams | ref surface | | | |
| প 3D View | embankment | | | |
| Fields | maxweight destination:back destination:forward | | | |
| 🔡 Attributes Form | destination:ref:ba | | | |
| • 📢 Joins | cutting access | | | |
| Auxiliary Storage | hgv foot | | | |
| Actions | Image: Weight of the second se | | | ✓ Apply X Cancel ✓ OK |

4. Click on the oneway row and choose *Checkbox* as *Widget Type* in the list of options:

| | | La | ayer Properties - roads Attributes Form | \otimes |
|----------------------------|--|----|--|-----------|
| Q | Autogenerate | | 👻 🌏 Show form on add feature (global settings) | • |
| 🧿 📫 | Available Widgets | • | General | |
| 3 2 2 2 2 2 | fid full_id | | Alias | |
| * • | osm_type | [| V Editable 🗌 Label on top | |
| | lanes maxspeed | | | |
| | oneway ref | | Checkbox | |
| | surface name | | Classification | |
| | embankment maxweight destination:backw | | Color Date/Time | |
| | destination:forward destination:ref:ba | | Enumeration Attachment | |
| • | destination:symbo cutting | | Hidden | |
| et / | access hgv foot | | Key/Value List | |
| ، 🝳 | sac_scale name:af | | Range Reference | |
| 두 ι | lanes:backward lanes:forward | | Text Edit | |
| 💉 F | reg_rer bicycle | | Unique Values | |
| 8 1 | sidewalk | | Value Map | |
| 24 | bridge layer | | Value Relation | - |
| ₹ ₹ | Image: Style | | ✓ Apply X Cancel ✓ OK | |

- 5. Clic pe OK
- 6. Enter edit mode (if the roads layer is not already in edit mode)
- 7. Click on the ^{Identify Features} tool
- 8. Click on the same main road you chose earlier

 $You will now see that the {\it oneway} attribute has a checkbox next to it denoting {\tt True} (checked) or {\tt False} (unchecked).$

5.3.4 ???? Try Yourself:

Setați un widget mai adecvat pentru câmpul highway.

Răspuns

For the *TYPE*, there is obviously a limited amount of types that a road can be, and if you check the attribute table for this layer, you'll see that they are predefined.

- 1. Set the widget to Value Map and click Load Data from Layer.
- 2. Select roads in the Label dropdown and highway for both the Value and Description options:

| | 2 highwa | y QString | String | 254 | 0 | | Unique values ed | itable | | |
|---|-----------------------------|-----------|-----------------------------------|----------------------------|-----------------------|---------------------|----------------------|-------------|--------|----------|
| C | | | Attrib | | og "highway" | C | Line edit | | | |
| F | | | Attrib | ute cuit Dia | iog nignway | | | | | |
| | Line edit Classification | | Editable | | | 000 | Load values from | n layer | | |
| | Range | | Laber on top | | | Select data from | attributes in select | ted layer. | | |
| | File name | | Combo box with shown in the co | h predefined i mbo box. | tems. Value is stored | in the attribute, o | Layer | roads | | ŧ |
| | Enumeration | (| Load Data fr | om layer | Load Data from C | SV file | Value | highway | ; | |
| | Hidden Checkbox | | Value | Desc | ription | | Description | highway | \$ | VIEW AII |
| | Text edit Calendar | | 1 | | | | Value | Description | | |
| | UUID generator | | | | | | 1 footway | footway | | |
| | Webview | | | | | | 2 path | path | | |
| | | | | | | | 3 primary | primary | | |
| | | | | | | | 4 residential | residential | | |
| | | | | | | | 5 service | service | | |
| | | | | | | | 6 tertiary | tertiary | | |
| | | | Remove Se | elected | | | Late e | | Cancel | ОК |
| | | | | | | | | | | |
| | | | | | | | | _ | | |
| | | | | | | Ca | OK | | | |

- 3. Click OK three times.
- 4. If you use the *Identify* tool on a street now while edit mode is active, the dialog you get should look like this:

| 000 | Attributes - roads | |
|------------|--------------------|-----------|
| osm_id | 238808188 | ⊠ |
| name | Voortrek Street | |
| highway | secondary | \$ |
| waterway | NULL | |
| aerialway | NULL | |
| barrier | NULL | |
| man_made | | |
| other_tags | "lanes"=>"2" | \otimes |
| | | |
| | | |
| | Cancel | ОК |

5.3.5 ???? Try Yourself: Creating Test Data

Aveți posibilitatea să proiectați, de asemenea, formularul propriu complet de la zero.

- 1. Create a simple point layer named test-data with two attributes:
 - name (text)
 - age (integer)

| | N | ew GeoPackage Layer 🛛 🛛 😣 | | | | | | | | |
|-----------------------|-----------|--|--|--|--|--|--|--|--|--|
| | | | | | | | | | | |
| Database | trair | ning_data.gpkg 🛛 🔛 | | | | | | | | |
| Table name | test | -data | | | | | | | | |
| Geometry type 🔅 Point | | | | | | | | | | |
| | | clude Z dimension 🗌 Include M values | | | | | | | | |
| | EPS | G:4326 - WGS 84 🔹 🍖 | | | | | | | | |
| New Field | New Field | | | | | | | | | |
| Name | ſ | | | | | | | | | |
| Tune | ſ | 122 Whole Number (integer) | | | | | | | | |
| туре | | ************************************** | | | | | | | | |
| Maximum length | | | | | | | | | | |
| | | Add to Fields List | | | | | | | | |
| Fields List | | | | | | | | | | |
| Name | Typ | ne Length | | | | | | | | |
| name | tex | at 80 | | | | | | | | |
| age | int | eger | | | | | | | | |
| | | Remove Field | | | | | | | | |
| Advanced O | ptio | ns | | | | | | | | |
| Layer identifie | er | test-data | | | | | | | | |
| Layer descript | ion | | | | | | | | | |
| Feature id col | umn | fid | | | | | | | | |
| Geometry col | umn | geometry | | | | | | | | |
| | | ✓ Create a spatial index | | | | | | | | |
| Help | | 8 <u>C</u> ancel | | | | | | | | |

2. Capturați câteva puncte de pe noul strat folosind instrumentele de digitizare, așa că veți avea un pic de date cu care să operați. Ar trebui să vedeți în continuare formularul implicit, generat de QGIS, de fiecare dată când capturați un nou punct.

Notă: Este posibil să trebuiască să dezactivați Acroșarea, dacă este activată în urma acțiunilor anterioare.

| | test-data - Feature Attributes | | | × |
|------|--------------------------------|------|--------------------|---|
| fid | Autogenerate | | | |
| name | richard | | ⊗ |] |
| age | | 23 | | |
| | 8 <u>C</u> ar | ncel | ⊘ 0 | < |

5.3.6 ???? Follow Along: Creating a New Form

Now we want to create our own custom form for the attribute data capture phase. To do this, you need to have QT *Designer* installed (only needed for the person who creates the forms).

- 1. Start QT Designer.
- 2. În caseta de dialog care apare, creați un nou dialog:

| 000 | New Form |
|--|-----------------------------|
| templates/forms Dialog with Buttons Bottom Dialog with Buttons Right Dialog without Buttons Main Window Widget Widgets | Embedded Design |
| | Device: None |
| | Screen Size: Default size ÷ |
| Show this Dialog on Startup | |
| Open Recent v | Close Create |

- 3. Căutați Widget Box în partea stângă a ecranului (implicit). Aceasta conține un element denumit Line Edit.
- 4. Faceți clic și trageți acest articol în formular. Aceasta va crea o nouă Linie de Editare în formular.
- 5. Având selectat noul element de linie de editare, îi veți vedea *proprietățile* de-a lungul părții laterale a ecranului (din partea dreaptă, în mod implicit):

| 000 | Property Editor | | | | | | | |
|----------------------|---------------------------|--|--|--|--|--|--|--|
| Filter | 🕂 💻 🦯 | | | | | | | |
| lineEdit : QLineEdit | | | | | | | | |
| Property | Value | | | | | | | |
| QObject | | | | | | | | |
| objectName | lineEdit + | | | | | | | |
| QWidget | | | | | | | | |
| enabled | | | | | | | | |
| geometry | [(80, 40), 113 x 21] | | | | | | | |
| sizePolicy | [Expanding, Fixed, 0, 0] | | | | | | | |
| minimumSize | 0 x 0 | | | | | | | |
| maximumSize | 16777215 x 16777215 | | | | | | | |
| sizeIncrement | 0 x 0 | | | | | | | |
| baseSize | 0 x 0 | | | | | | | |
| palette | Inherited | | | | | | | |
| ▶ font | A [.Lucida Grande UI, 13] | | | | | | | |
| cursor | 1 IBeam | | | | | | | |
| mouseTracking | ✓ | | | | | | | |
| focusPolicy | StrongFocus | | | | | | | |
| contextMenuPolicy | DefaultContextMenu | | | | | | | |
| acceptDrops | | | | | | | | |
| ▶ toolTip | | | | | | | | |
| ▶ statusTip | | | | | | | | |
| whatsThis | | | | | | | | |
| accessibleName | | | | | | | | |
| accessibleDescrip | | | | | | | | |
| layoutDirection | LeftToRight | | | | | | | |
| autoFillBackground | | | | | | | | |
| styleSheet | | | | | | | | |
| locale | English, SouthAfrica | | | | | | | |
| inputMethodHints | ImhNone | | | | | | | |
| QLineEdit | | | | | | | | |
| inputMask | | | | | | | | |
| ▶ text | | | | | | | | |
| maxLength | 32767 | | | | | | | |
| frame | | | | | | | | |
| echoMode | Normal | | | | | | | |
| cursorPosition | 0 | | | | | | | |
| alignment | AlignLeft, AlignVCenter | | | | | | | |
| dragEnabled | | | | | | | | |
| readOnly | | | | | | | | |
| placeholderText | | | | | | | | |
| ouroorMouo Chulo | LogicalMovoStyle | | | | | | | |

- 6. Set its name to name.
- 7. Using the same approach, create a new Spin Box and set its name to age.
- 8. Add a *Label* with the text Add a New Person in a bold font (look in the object *properties* to find out how to set this). Alternatively, you may want to set the title of the dialog itself (rather than adding a label).
- 9. Add a Label for your Line Edit and your Spin Box.
- 10. Arrange the elements to your own desire.
- 11. Faceți clic oriunde, în fereastra de dialog.
- 12. Find the *Lay Out in a Form Layout* button (in a toolbar along the top edge of the screen, by default). This lays out your dialog automatically.
- 13. Set the dialog's maximum size (in its properties) to 200 (width) by 150 (height).
- 14. Your form should now look similar to this:

| 9 % - | a | dd | _р | eo | pl | e. | ui | * | • |)(| × |
|--------------|----------|----|-----|----|-----|----|----|----------|---|----|----|
| Add | a | Ne | w P | er | sol | 2 | | | | | |
| Nan | ne | | | | | | | | | |]: |
| Age | | 0 | | | | | | | | 4 | |
| | | | | | | | | | | | |
| 8 | <u>)</u> | an | cel |]: | | | 9 | <u>0</u> | Κ | |]: |

- 15. Save your new form as exercise_data/forms/add_people.ui
- 16. When it's done saving, you can close Qt Designer

5.3.7 ???? Follow Along: Associating the Form with Your Layer

- 1. Go back to QGIS
- 2. Dublu clic pe stratul test-data din legendă, pentru a-i accesa proprietățile.
- 3. Click on the Attributes Form tab in the Layer Properties dialog
- 4. În caseta cu lista derulantă Attribute editor layout, selectați Provide ui-file.
- 5. Click the ellipsis button and choose the add_people.ui file you just created:

| | Layer Pro | operties - test-d | ata Attributes Fo | rm | | 8 |
|-------------------|--|-----------------------|---------------------|-----------------------|-----------------------|-------------|
| Q | Provide ui-file | | • | ntern of Show form or | add feature (global s | ettings) 👻 |
| 🥡 Inform | ation Edit UI /home/qgis-user/forms/ad | dd_people.ui | | | | |
| 🗞 Source | Available Widgets Fields | ▼ General | | | | |
| | logy fid name | Alias | | | | |
| (abc Labels | age Relations | Comment ✓ Editable | Label on top | | | |
| BC Masks | QML Widget HTML Widget | ▼ Widget Type | e | | | |
| Ϋ Diagra | ms | Text Edit | | | | |
| 🔶 3D Vie | w | Multiline | | | | |
| Fields | | | | | | |
| E Attrib | utes Form | | | | | |
| • Joins | | ▼ Constraints | | | | |
| Auxilia Storag | ry e | Not null | | e not null constrain | it | |
| Sction | s | Unique | | e unique constraint | | |
| 🗭 Displa | y | Expression | | | | 3 - |
| 💉 Rende | ring | Expression de | scription | | | |
| 8 Variab | les | Enforce exp | pression constraint | | | |
| - Motod | ata | Defaults | | | | |
| | ala | Default value | | | | 3 |
| 🐴 Deper | dencies | Preview | | | | |
| E Legen | d | Apply defau | ult value on update | | | |
| 💽 QGIS S | erver | | | | Apply XCancel | <u>√о</u> к |

- 6. Click OK on the Layer Properties dialog
- 7. Enter edit mode and capture a new point
- 8. Când faceți acest lucru, vă va fi prezentat dialogul personalizat (în loc de cel generic, pe care îl creează de obicei QGIS).

- 9. If you click on one of your points using the ^{Identify Features} tool, you can now bring up the form by right clicking in the identify results window and choosing *View Feature Form* from the context menu.
- 10. If you are in edit mode for this layer, that context menu will show *Edit Feature Form* instead, and you can then adjust the attributes in the new form even after initial capture.

5.3.8 În concluzie

Folosind formularele, vă puteți face viața mai ușoară, atunci când editați sau când creați date. Prin editarea tipurilor de widget sau pin crearea unui formular cu totul nou, de la zero, puteți controla experiența cuiva care digitalizează date noi, minimizând, astfel, neînțelegerile și erorile inutile.

5.3.9 Further Reading

If you completed the advanced section above and have knowledge of Python, you may want to check out this blog entry about creating custom feature forms with Python logic, which allows advanced functions including data validation, autocompletion, etc.

5.3.10 Ce urmează?

Deschiderea unui formular o dată cu identificarea unei entități este una dintre acțiunile standard, pe care o poate efectua QGIS. Cu toate acestea, puteți efectua direct acțiunile personalizate pe care le definiți. Acesta este subiectul lecției următoare.

5.4 Lesson: Actions

Now that you have seen a default action in the previous lesson, it is time to define your own actions.

An action is something that happens when you click on a feature. It can add a lot of extra functionality to your map, allowing you to retrieve additional information about an object, for example. Assigning actions can add a whole new dimension to your map!

Scopul acestei lecții: De a afla cum să adăugați acțiuni particularizate.

In this lesson you will use the *school_property* layer you created previously. The sample data include photos of each of the three properties you digitized. What we are going to do is to associate each property with its image. Then we will create an action that will open the image for a property when clicking on the property.

5.4.1 ???? Follow Along: Add a Field for Images

The school_property layer has no way to associate an image with a property yet. First we will create a field for this purpose.

- 1. Deschideți dialogul Layer Properties.
- 2. Dați clic pe fila Fields.
- 3. Comutați în modul de editare:

| | | | | L | ayer Prop | oerties - school | l_property Fi | elds | | (| 3 |
|----------|-----------------|-----|-----|------|-------------|------------------------|-----------------|--------|--------------------|-----------------|---|
| Q | | 16 | | | ** | | | | | | |
| ગ્ર્ | Source | | d 🔻 | То | ggle editin | ig mode _{ype} | Type name | Length | Precision | Comment | |
| | Cumbology | 123 | 0 | id | | qlonglong | Integer64 | 10 | 0 | | ~ |
| | Symbology | abc | 1 | name | | QString | String | 80 | 0 | E | ~ |
| abc | Labels | | | | | | | | | | |
| abc | Masks | | | | | | | | | | |
| ۹. | Diagrams | _ | | | | | | | | | |
| \ | 3D View | | | | | | | | | | |
| | Fields | | | | | | | | | | |
| 8 | Attributes Form | | | | | | | | | | |
| •◀ | Joins | • | | | | | | | | | Þ |
| 2 | Auxiliary | - | Hel | P | Style 🝷 | | | 🚽 Ar | oply X <u>C</u> an | cel <u>√O</u> K | |

4. Adăugați o nouă coloană:

| | | | Laye | г Ргорег | ties - schoo | l_property Fi | elds | | | 8 |
|-----|-----------------|--------------|----------|----------|--------------|-----------------|--------|-----------|---------|---|
| Q | | | 1 | | | | | | | |
| i | Information | New | field me | Alias | Туре | Type name | Length | Precision | Comment | |
| 3. | Source | 123 O | id | | qlonglong | Integer64 | 10 | 0 | | 1 |
| | 300100 | abc 1 | name | | QString | String | 80 | 0 | | ✓ |
| ~ | Symbology | | | | | | | | | |
| abc | Labels | | | | | | | | | |
| abc | Masks | | | | | | | | | |
| ۹. | Diagrams | | | | | | | | | |
| Ŷ | 3D View | | | | | | | | | |
| | Fields | | | | | | | | | |
| | Attributes Form | | | | | | | | | |
| . 1 | loins | 4 | | | | | | | | Þ |

5. Introduceți valorile de mai jos:

| | Add Field 😵 |
|---------------|---------------------------------------|
| N <u>a</u> me | image |
| Comment | |
| Туре | Text (string) |
| Provider type | string |
| Length | 255 \$ |
| | ≭ <u>C</u> ancel √ <u>O</u> K |

- 6. After the field has been created, move to the *Attributes Form* tab and select the image field.
- 7. Set *Widget Type* to *Attachment*:

| | Layer Pro | perties - school_property Attributes Form 🛛 😵 |
|-------------------------------|--------------------|--|
| Q | Autogenerate | 👻 🍖 Show form on add feature (global settings) 👻 |
| 🥡 Information | Available Widgets | ▼ General |
| 🔇 Source | id name | Alias |
| ኛ Symbology | image Relations | Comment |
| (abc Labels | ▼ Other Widgets | ✓ Editable Label on top |
| fin Macks | HTML Widget | ▼ Widget Type |
| | | Attachment |
| M Diagrams | | Path |
| প 3D View | | |
| Fields | | Default path //home/tveite/Downloads/QGIS/QGIS-Trainin |
| Attributes For | | Relative paths |
| | | Relative to project path |
| | | O Relative to default path |
| Storage | | Storage Mode |
| Sections | | |
| 🧭 Display | | Price pacins Directory paths |
| | | |
| | | ✓ Display Resource Path |
| Variables | | ✓ Display button to open file dialog |
| 📝 Metadata | | Filter |
| Pependencies | - | Use a hyperlink for document path (read-only) |
| E Legend | | |
| QGIS Server | , 🕜 Help Style 🔹 | ✓Apply X Cancel ✓QK |

- 8. Click OK in the Layer Properties dialog.
- 9. Folosiți instrumentul *Identify* pentru a faceți clic pe una dintre cele trei entități din stratul *school_property*. Since you are still in edit mode, the dialog should be active and look like this:

| | school_property - Feature Attributes | 8 |
|-----------------|--------------------------------------|-------------|
| <u>A</u> ctions | | |
| id | 2 | |
| name | school_campus | |
| image | | |
| | ≭ <u>C</u> ancel | <u>√о</u> к |

- 10. Clic pe butonul de răsfoire (... de lângă câmpul imagine).
- 11. Select the path for your image. The images are in <code>exercise_data/school_property_photos/</code> and are named the same as the features they should be associated with.
- 12. Clic pe OK
- 13. Asociați toate imaginile cu entitățile corecte folosind această metodă.
- 14. Salvați modificările și ieșiți din modul de editare.

5.4.2 ???? Follow Along: Creating an Action

1. Open the *Actions* tab for the *school_property* layer, and click on the Add a new action button.

| | | | Layer Proper | ties - school_p | roperty / | Actions | | | | 8 |
|-----|-------------------|-------------|-----------------|-----------------|-------------|-----------|---------------|-----------------|-------------------------|------------|
| Q | | Action List | | | | | | | | |
| i | Information | Des | cription | Short Title | Action | Capture | Action Scopes | On Notification | Only when | editable |
| 3¢ | Source | | | | | | | | | |
| * | Symbology | | | | | | | | | |
| abc | Labels | | | | | | | | | |
| abc | Masks | | | | | | | | | |
| ۹. | Diagrams | | | | | | | | | |
| Ŷ | 3D View | | | | | | | | | |
| | Fields | | | | | | | | | |
| :8 | Attributes Form | | | | | | | | | |
| •◀ | Joins | • | | | | | | | | • |
| Ē | Auxiliary Storage | | | | | | | Cr | eate Defau | lt Actions |
| Ö | Actions | Show in a | Attribute Table | | 4 | Add a new | action | | | |
| 9 | Display | Help | Style 🝷 | | | | | Apply | ≭ <u>C</u> ancel | <u> </u> |

2. In the Add New Action dialog, enter the words Show Image into the Description field:

| | Add New Action | 8 |
|--|--|---|
| Туре | Generic Capture output | |
| Description | Mandatory description |] |
| Short Name | Leave empty to use only icon |] |
| Icon | | |
| Action Scop | les | |
| Field Se | соре | |
| Layer S | cope | |
| ✓ Canvas | | |
| ✓ Feature | e Scope | |
| Action Text | | |
| The action The conter For the typ For other t | text defines what happens if the action is triggered. It depends on the type. De <i>Python</i> the content should be python code ypes it should be a file or application with optional parameters | |
| 1 | | |
| | | |
| Everyte if | • C Insert | |
| Execute IF | only when editable | |
| Help | ≭ <u>C</u> ancel √ <u>O</u> K | j |

Ceea ce veți face în continuare diferă în funcție de sistemul de operare, asa că alegeți un curs adecvat:

• Windows

Dați clic pe meniul vertical Type și alegeți Open.

• Ubuntu Linux

Under *Action*, write eog for the *Gnome Image Viewer*, or write display to use *ImageMagick*. Remember to put a space after the command!

- macOS
 - 1. Clic pe caseta Type, apoi alegeți Mac.
 - 2. Under Action, write open. Remember to put a space after the command!

Now you can continue writing the command.

Vreți să deschideți imaginea, si QGIS știe unde se află. Tot ce rămâne de făcut este să îi spuneți Action unde se află imaginea.

3. Selectați *image* din listă:

| | Add New Action | 8 |
|--|---|--|
| Туре | Generic 👻 | Capture output |
| Description | Mandatory description | |
| Short Name | Leave empty to use only icon | |
| Icon | | |
| Action Scop | bes | |
| Field So | cope | |
| Layer S | cope | |
| ✓ Canvas | i | |
| ✓ Feature | e Scope | |
| Action Text | : | |
| The action The conter For the typ For other t | text defines what happens if the action is t at depends on the type. Se <i>Python</i> the content should be python cod types it should be a file or application with o | riggered. le optional parameters |
| | | |
| | | |
| abc image | | • E Insert |
| abc name | | |
| abc image | e 🔓 | |
| Help | X | ¢ <u>C</u> ancel √ <u>O</u> K |

- 4. Click the Insert field button. QGIS will add the phrase [% "image" %] in the Action Text field.
- 5. Click the OK button to close the Add New Action dialog

6. Click OK to close the Layer Properties dialog

Now it is time to test the new action:

- 1. Click on the school_property layer in the Layers panel so that it is highlighted.
- 2. Find the ^{QR Run feature action} button (in the *Attributes Toolbar*).
- 3. Click on the down arrow to the right of this button. There is only one action defined for this layer so far, which is the one you just created.

| 🍭 • 🛃 • 📑 • I | |
|------------------|------|
| Show image 😽 | ox L |

- 4. Apăsați butonul pentru a activa instrumentul.
- 5. Folosind acest instrument, faceți clic pe oricare din cele trei proprietăți școlare.

The image for that property should open.

5.4.3 ???? Follow Along: Searching the Internet

Let's say we are looking at the map and want to know more about the area that a farm is in. Suppose you know nothing of the area in question and want to find general information about it. Your first impulse, considering that you're using a computer right now, would probably be to Google the name of the area. So let's tell QGIS to do that automatically for us!

1. Deschideți tabela de atribute a stratului landuse.

We will be using the name field for each of our landuse areas to search Google.

- 2. Închideți tabelul de atribute.
- 3. Mergeți înapoi la Acțiuni în Proprietățile Stratului.
- 4. Click on the Create Default Actions button to add a number of pre-defined actions.
- 5. Remove all the actions but the *Open URL* action with the short name *Search Web* using the Remove the selected action button below.
- 6. Double-click on the remaining action to edit it
- 7. Change the Description to Google Search, and remove the content of the Short Name field.
- 8. Make sure that *Canvas* is among the checked *Action scopes*.

Ceea ce veți face în continuare diferă în funcție de sistemul de operare, asa că alegeți un curs adecvat:

• Windows

Sub *Tip*, alegeți *Deschidere*. Acest lucru va spune Windows-ului să deschidă o adresă de Internet din browser-ul implicit, cum ar fi Internet Explorer.

• Ubuntu Linux

Under Action, write xdg-open. This will tell Ubuntu to open an Internet address in your default browser, such as Chrome or Firefox.

• macOS

Under Action, write open. This will tell macOS to open an Internet address in your default browser, such as Safari.

Now you can continue writing the command

Orice comandă ați folosit mai sus, trebuie să îi spuneți ce adresă să deschidă în continuare. Vreți să accesați Google și să căutați automat o expresie.

Usually when you use Google, you enter your search phrase into the Google Search bar. But in this case, you want your computer to do this for you. The way you tell Google to search for something (if you don't want to use its search bar directly) is by giving your Internet browser the address https://www.google.com/search?q=SEARCH_PHRASE, where SEARCH_PHRASE` is what you want to search for. Since we don't know what phrase to search for yet, we will just enter the first part (without the search phrase).

9. In the *Action* field, write https://www.google.com/search?q=. Remember to add a space after your initial command before writing this in!

Now you want QGIS to tell the browser to tell Google to search for the value of name for any feature that you could click on.

- 10. Selectați câmpul name.
- 11. Click Insert button:

| | Edit Action | 8 |
|--|--|-------------------|
| Туре | Generic Capture | e output |
| Description | Google Search | |
| Short Name | Leave empty to use only icon | |
| Icon | | |
| Action Scope | bes | |
| Field S | Scope | |
| Layer S | Scope | |
| Canvas | IS | |
| Featur | re Scope | |
| Action Text | : | |
| The action The conter For the typ For other t | n text defines what happens if the action is triggered. ent depends on the type. pe <i>Python</i> the content should be python code types it should be a file or application with optional para | ameters |
| 1 xd | dg-open·http://www.google.com/search?q=[%name%] | |
| 4 | | |
| | I 3 - | nsert |
| Execute if | f notification matches | |
| Enable | only when editable | |
| Help | X Cancel | √<u>о</u>к |

What this means is that QGIS is going to open the browser and send it to the address https://www.google.com/search?q=[% "name" %]. [% "name" %] tells QGIS to use the contents of the name field as the phrase to search for.

So if, for example, the landuse area you click on is named Marloth Nature Reserve, QGIS is going to send the browser to https://www.google.com/search?q=Marloth%20Nature%20Reserve, which will cause your browser to visit Google, which will in turn search for "Marloth Nature Reserve".

- 12. If you have not done so already, set everything up as explained above.
- 13. Click the OK button to close the Add New Action dialog
- 14. Click OK to close the Layer Properties dialog

Acum vom testa noua versiune.

- 1. With the *landuse* layer active in the *Layers* panel, click on the down arrow to the right of the Run feature action button, and select the only action (Google Search) defined for this layer.
- 2. Click on any landuse area you can see on the map. Your browser will now open, and will start a Google search for the place that is recorded as that area's name value.

Notă: În cazul în care acțiunea nu funcționează, verificați dacă totul a fost introdus corect; erorile de introducere sunt comune pentru această activitate!

5.4.4 ???? Follow Along: Open a Webpage Directly in QGIS

Above, you've seen how to open a webpage in an external browser. There are some shortcomings with this approach in that it adds an unknowable dependency – will the end-user have the software required to execute the action on their system? As you've seen, they don't necessarily even have the same kind of base command for the same kind of action, if you don't know which OS they will be using. With some OS versions, the above commands to open the browser might not work at all. This could be an insurmountable problem.

However, QGIS sits on top of the incredibly powerful and versatile Qt library. Also, QGIS actions can be arbitrary, tokenized (i.e. using variable information based on the contents of a field attribute) Python commands!

Now you will see how to use a python action to show a web page. It is the same general idea as opening a site in an external browser, but it requires no browser on the user's system since it uses the Qt QWebView class (which is a webkit based html widget) to display the content in a pop-up window.

Let us use Wikipedia this time. So the URL you request will look like this:

https://wikipedia.org/wiki/SEARCH_PHRASE

Pentru a crea acțiunea stratului:

- 1. Deschideți dialogul Proprietăților Stratului și mergeți la fila Actions.
- 2. Setați o nouă acțiune, folosind următoarele proprietăți pentru acțiune:
 - Tip: Python
 - Descriere: Wikipedia
 - Scope: Feature, Canvas
 - Action Text:

```
from qgis.PyQt.QtCore import QUrl
from qgis.PyQt.QtWebKitWidgets import QWebView
myWV = QWebView(None)
myWV.load(QUrl('https://wikipedia.org/wiki/[%name%]'))
myWV.show()
```

| | Edit Action | × |
|---|---|--|
| Гуре | Python | Capture output |
| Description | Wikipedia | |
| Short Name | Leave empty to use only icon | |
| con | | |
| Action Scope | 25 | |
| Layer | | |
| ✓ Feature | e | |
| ✓ Canvas | i i i i i i i i i i i i i i i i i i i | |
| Field | | |
| Form | | |
| | | |
| For the typ widget em the form v For other t | e <i>Python</i> the content should be Python code, if the action is trigge bedded in a drag and drop designer form, the form instance is exp rariable. Types it should be a file or application with optional parameters | red from a button osed to Python as |
| 1 fr | om qgis.PyQt.QtCore import QUrl | |
| 2 fro | om qgis.PyQt.QtWebKitWidgets import QWebView | |
| 4 my | WV = QWebView(None) | |
| 5 myl | <pre>WV.load(QUrl('https://wikipedia.org/wiki/[%name%]')) WV.char()</pre> | |
| 7 | wv.snow() | |
| 4 | | • |
| 123 | | ▼ E Insert |
| Execute if | notification matches | |
| | | |
| 🕐 Help | |] <u>C</u> ancel ⊘ <u>O</u> K |

Aici se întâmplă mai multe lucruri:

- [%name%] will be replaced by the actual attribute value when the action is invoked (as before).
- The code simply creates a new QWebView instance, sets its URL, and then calls show() on it to make it visible as a window on the user's desktop.

You could also use this approach to display an image without requiring that the users have a particular image viewer on their system.

3. Try to use the methods described above to load a Wikipedia page using the Wikipedia action you just created.

5.4.5 În concluzie

Actions allow you to give your map extra functionality, useful to the end-user who views the same map in QGIS. Due to the fact that processes called can be shell commands for any operating system, as well as Python, the sky is the limit in terms of the functions you could incorporate!

5.4.6 Ce urmează?

Now that you've done all kinds of vector data creation, you will learn how to analyze the data to solve problems. That is the topic of the next module.

CAPITOLUL 6

Module: Vector Analysis

Acum, după ce ați editat câteva entități, trebuie să știți ce altceva se poate face cu ele. Având entități cu atribute este frumos, dar, în final, aceasta nu reprezintă chiar ceva care să se detașeze net față de o hartă non-GIS.

Avantajul cheie al unui GIS este: un GIS poate răspunde întrebărilor.

Pentru următoarele trei module, ne vom strădui să răspundem la o *întrebare de cercetare* folosind funcții GIS. De exemplu, dacă sunteți un agent imobiliar și vă aflați în căutarea unei proprietăți rezidențiale în Swellendam, care trebuie să respecte următoarele criterii:

- 1. Să fie situată în Swellendam.
- 2. Trebuie să fie la distanță de conducere rezonabilă, față de o școală (de exemplu, 1 km).
- 3. Trebuie să aibă mai mult de 100m pătrați în dimensiune.
- 4. Să fie situată sub 50m față de un drum principal.
- 5. Să fie situată la maximumb500m față de un restaurant.

În următoarele câteva module, vom valorifica puterea instrumentelor de analiză GIS, pentru a localiza proprietățile agricole potrivite pentru această nouă dezvoltare rezidențială.

6.1 Lesson: Reprojecting and Transforming Data

Let us talk about Coordinate Reference Systems (CRSs) again. We have touched on this briefly before, but haven't discussed what it means practically.

Scopul acestei lecții: De a reproiecta și transforma seturile de date vectoriale.

6.1.1 ???? Follow Along: Projections

The CRS that all the data, as well as the map itself are in right now is called *WGS84*. This is a very common Geographic Coordinate System (GCS) for representing data. But there's a problem, as we will see.

- 1. Save your current map
- 2. Then open the map of the world which you will find under exercise_data/world/world.qgs
- 3. Zoom in to South Africa by using the Zoom In tool
- 4. Try setting a scale in the *Scale* field, which is in the *Statusbar* along the bottom of the screen. While over South Africa, set this value to 1:5 000 000 (one to five million).
- 5. Pan around the map while keeping an eye on the Scale field

Notice the scale changing? That's because you are moving away from the one point that you zoomed into at 1:50000, which was at the center of your screen. All around that point, the scale is different.

Pentru a înțelege de ce, gândiți-vă la un glob al Pământului. Acesta are linii care pornesc de la Nord înspre Sud. Aceste linii longitudinale sunt situate departe una de alta la ecuator, dar se întâlnesc la poli.

In a GCS, you are working on this sphere, but your screen is flat. When you try to represent the sphere on a flat surface, distortion occurs, similar to what would happen if you cut open a tennis ball and tried to flatten it out. What this means on a map is that the longitude lines stay equally far apart from each other, even at the poles (where they are supposed to meet). This means that, as you travel away from the equator on your map, the scale of the objects that you see gets larger and larger. What this means for us, practically, is that there is no constant scale on our map!

To solve this, let's use a Projected Coordinate System (PCS) instead. A PCS "projects" or converts the data in a way that makes allowance for the scale change and corrects it. Therefore, to keep the scale constant, we should reproject our data to use a PCS.

6.1.2 ???? Follow Along: "On the Fly" Reprojection

By default, QGIS reprojects data "on the fly". What this means is that even if the data itself is in another CRS, QGIS can project it as if it were in a CRS of your choice.

You can change the CRS of the project by clicking on the ^{Current projection} button in the bottom right corner of QGIS.

- 1. In the dialog that appears, type the word global into the *Filter* field. A few CRSs should appear in the *Predefined Reference Systems* field below.
- 2. Select WGS 84 / NSIDC EASE-Grid 2.0 Global | EPSG:6933 entry by clicking on it, and then click OK.

Observați modul în care forma Africii de Sud se schimbă. Toate proiecțiile lucrează prin schimbarea formelor aparente ale obiectelor de pe Terra.

- 3. Zoom to a scale of 1:5 000 000 again, as before.
- 4. Deplasați un pic harta.

Observați că scara rămâne la fel!

Reproiectarea "din zbor" este folosită, de asemenea, pentru a combina seturile de date aflate în diverse CRS-uri

- 1. Add another vector layer to your map which has the data for South Africa only. You will find it as exercise_data/world/RSA.shp.
- 2. Load it. A quick way to see its CRS is by hovering the mouse over the layer in the legend. It is EPSG: 3410. Ce observati?

The layer is visible even if it has a different CRS from the continents one.

6.1.3 ???? Follow Along: Saving a Dataset to Another CRS

Sometimes you need to export an existing dataset with another CRS. As we will see in the next lesson, if you need to make distance calculations on layer, it is always better to have the layer in a projected coordinate system.

Be aware that the «on the fly» reprojection is related to the **project** and not to single layers. This means that a layer can have a different CRS from the project even if you see it in the *correct* position.

You can easily export the layer with another CRS.

- 1. Add the buildings dataset from training_data.gpkg
- 2. Right-click on the buildings layer in the Layers panel
- 3. Select *Export* ► *Save Features As...* in the menu that appears. You will be shown the *Save Vector Layer as...* dialog.
- 4. Click on the Browse button next to the File name field
- 5. Navigate to exercise_data/ and specify the name of the new layer as buildings_reprojected. shp.
- 6. Change the value of the *CRS*. Only the recent CRSs used will be shown in the drop-down menu. Click on the Select projection button next to the drop-down menu.
- 7. The Coordinate Reference System Selector dialog will appear. In its Filter field, search for 34S.
- 8. Select WGS 84 / UTM zone 34S | EPSG:32734 from the list

| Coordinate Reference System Selector | | | | | | |
|--|---|------------|--|--|--|--|
| Select the coordinate reference system for the vector file coordinate reference system. | e. The data points will be transformed from the l | ayer | | | | |
| Filter Q 34S | | | | | | |
| Recently used coordinate reference systems | 5 | | | | | |
| Coordinate Reference System | Authority ID | | | | | |
| WGS 84 / UTM zone 34S | EPSG:32734 | | | | | |
| Coordinate reference systems of the world | Hide deprecate | ed CRSs | | | | |
| ordinate Reference System | Authority ID | | | | | |
| RGRDC 2005 / UTM zone 34S | EPSG:4062 | | | | | |
| WGS 72 / UTM zone 34S | EPSG:32334 | | | | | |
| WGS 72BE / UTM zone 34S | EPSG:32534 | | | | | |
| WGS 84 / UTM zone 34S | EPSG:32734 | | | | | |
| | | - | | | | |
| | | • | | | | |
| Selected CRS WGS 84 / UTM zone 34S | | | | | | |
| Extent: 18.00, -80.00, 24.00, 0.00 Proj4: +proj=utm +zone=34 +south +datum=WGS84 +units=m +no_defs | | Ren a | | | | |
| 🔀 Help | Cancel | <u>о</u> к | | | | |

9. Leave the other options unchanged. The Save Vector Layer as... dialog now looks like this:

| | 5 | Save Vector | r Layer as | |
|------------|--|-------------|-------------------------------------|---------------------|
| Format | ESBI Shanefile | | | |
| Formac | Estri snapenie | | | |
| File name | ome/matteo/exercise | _data/exerc | cise_data/buildings_reprojected.shp | |
| Layer name | | | | |
| CRS | EPSG:32734 - WGS 84 / UTM zone 34S 🔹 🌚 | | | |
| Encoding | | UTF-8 | | • |
| Save only | selected features | | | |
| Add save | d file to man | | | |
| V Add save | o nie to map | | | |
| Select f | ields to export and | their expo | ort options | |
| ▼ Geomet | ry | | | |
| Geometry | type | | Automatic | • |
| Force m | nulti-type | | | |
| 🗌 Include | z-dimension | | | |
| ▶ Exte | nt (current: layer) | | | |
| Layer O | ptions | | | |
| Custom | Options | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| 🔀 Help | | | <u>Cancel</u> | <i>₽</i> <u>о</u> к |

10. Clic pe OK

You can now compare the old and new projections of the layer and see that they are in two different CRS but they are still overlapping.

6.1.4 ???? Follow Along: Creating Your Own Projection

Există mai multe proiecții decât cele incluse în QGIS în mod implicit. De asemenea, puteți crea propriile proiecții.

- 1. Start a new map
- 2. Load the world/oceans.shp dataset
- 3. Go to *Settings* ► *Custom Projections...* and you will see this dialog.

| | Custom Coordinate Reference System Definition | 8 |
|--------------|--|--------------------------------|
| Define | | |
| You can def | ne your own custom Coordinate Reference System (CRS) here. The definition must conform to a WKT or Proj string format f | or specifying a CRS. |
| Name | Parameters | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Name | | |
| Format | WKT (Decommended) | |
| Tormac | | Nalidate |
| | | |
| | | |
| Parameters | | |
| | | |
| | | |
| | | |
| Test | | |
| Use the text | boxes below to test the CRS definition you are creating. Enter a coordinate where both the lat/long and the transformed re map). Then press the calculate button to see if the CRS definition you are creating is accurate. | sult are known (for example by |
| Geog | raphic / WGS84 | Destination CRS |
| North | | |
| East | | |
| | Calculate | |
| | | |
| Burste. | | |

- 4. Click on the P Add new CRS button to create a new projection
- 5. O proiecție interesant de utilizat se numește Van der Grinten I. Introduceți această denumire în câmpul *Nume*.

Această proiecție reprezintă Pământul pe un teren circular, în locul uneia dreptunghiulară, la fel ca majoritatea celorlalte proiecții.

- 6. In Format, select WKT (Recommended)
- 7. Add the following string in the Parameters field:

```
PROJCRS["unknown",
BASEGEOGCRS["unknown",
DATUM["unknown",
ELLIPSOID["unknown",6371000,0,
LENGTHUNIT["metre",1,
ID["EPSG",9001]]]],
PRIMEM["Greenwich",0,
ANGLEUNIT["degree",0.0174532925199433],
ID["EPSG",8901]]],
CONVERSION["unknown",
METHOD["Van Der Grinten"],
PARAMETER["Longitude of natural origin",0,
```

(continues on next page)

(continuare din pagina precedentă)

```
ANGLEUNIT["degree",0.0174532925199433],
        ID["EPSG",8802]],
    PARAMETER["False easting",0,
        LENGTHUNIT["metre",1],
        ID["EPSG",8806]],
    PARAMETER["False northing",0,
        LENGTHUNIT["metre",1],
        ID["EPSG",8807]]],
CS[Cartesian,2],
    AXIS["(E)",east,
        ORDER[1],
        LENGTHUNIT["metre",1,
            ID["EPSG",9001]]],
    AXIS["(N)", north,
        ORDER[2],
        LENGTHUNIT["metre",1,
            ID["EPSG",9001]]]
```

| | Custom Coordinate Reference System Definition | | × |
|--------------|---|-----|---|
| ▼ Define | | | - |
| You can defi | ne your own custom Coordinate Reference System (CRS) here. The definition must conform to a WKT or Proj string format for specifying a CRS. | | |
| Name | | ÷ | |
| Van der (| Jrinten I PROJERS["Unknown",BASEGEOGERS["Unknown",DATUM["Unknown",ELLIPSOID["Unknown",63/1000,0,LENGTHUNTI["metre",1,ID[| | |
| | | | |
| | | | |
| | | | |
| | | | |
| Name | Van der Grinten I | | |
| Format | | _ | |
| Format | We (recommended) | - | |
| | PROJCRS["unknown", | ate | |
| | BASELEOGCHSI UIKIIOWII, DATUMI'uikinown" | | |
| | ELLIPSOID["unknown",6371000,0, | | |
| | LENGTHÜNIT["metre",1, | | |
| Parameters | ID["EPSG",9001]]]], | | |
| | ANGE FUNTET (Jorgen 0.0174532925199433) | | |
| | ID["EPSG",8901]]], | | |
| | CONVERSION["unknown", | | |
| | METHOD "Van Der Grinten"), | | |
| ▶ Test | | | |
| Help | | | < |
| - netb | | | • |

- 8. Clic pe OK
- 9. Click on the ^{Current CRS} button at the right of the status bar to change the project CRS
- 10. Choose your newly defined projection (search for its name in the Filter field)
- 11. După aplicarea acestei proiecții, harta va fi reproiectată astfel:



6.1.5 În concluzie

Diferite proiecții sunt utile pentru scopuri diferite. Prin alegerea proiecția corectă, vă puteți asigura că entitățile de pe hartă sunt reprezentate cu precizie.

6.1.6 Further Reading

Materials for the Advanced section of this lesson were taken from this article.

Read further information on Coordinate Reference Systems.

6.1.7 Ce urmează?

In the next lesson you will learn how to analyze vector data using QGIS» various vector analysis tools.

6.2 Lesson: Vector Analysis

Vector data can also be analyzed to reveal how different features interact with each other in space. There are many different analysis-related functions, so we won't go through them all. Rather, we will pose a question and try to solve it using the tools that QGIS provides.

Scopul acestei lecții: De a pune o întrebare și de a o rezolva folosind instrumentele de analiză.

6.2.1 ???? The GIS Process

Before we start, it would be useful to give a brief overview of a process that can be used to solve a problem. The way to go about it is:

- 1. Definirea Problemei
- 2. Obținerea Datelor
- 3. Analiza Problemei
- 4. Prezentarea Rezultatelor

6.2.2 ???? The Problem

Let's start off the process by deciding on a problem to solve. For example, you are an estate agent and you are looking for a residential property in Swellendam for clients who have the following criteria:

- 1. It needs to be in Swellendam
- 2. It must be within reasonable driving distance of a school (say 1km)
- 3. It must be more than 100m squared in size
- 4. Closer than 50m to a main road
- 5. Closer than 500m to a restaurant

6.2.3 ???? The Data

To answer these questions, we are going to need the following data:

- 1. The residential properties (buildings) in the area
- 2. The roads in and around the town
- 3. The location of schools and restaurants
- 4. The size of buildings

These data are available through OSM, and you should find that the dataset you have been using throughout this manual also can be used for this lesson.

If you want to download data from another area, jump to the Introduction Chapter to read how to do it.

Notă: Although OSM downloads have consistent data fields, the coverage and detail does vary. If you find that your chosen region does not contain information on restaurants, for example, you may need to chose a different region.

6.2.4 ???? Follow Along: Start a Project and get the Data

We first need to load the data to work with.

- 1. Start a new QGIS project
- 2. If you want, you can add a background map. Open the *Browser* and load the *OSM* background map from the *XYZ Tiles* menu.



- 3. In the training_data.gpkg Geopackage database, you will find most the datasets we will use in this chapter:
 - 1. buildings
 - 2. roads
 - 3. restaurants
 - 4. schools

Load them, and also landuse.sqlite.

4. Zoom to the layer extent to see Swellendam, South Africa

Before proceeding we will filter the roads layer, in order to have only some specific road types to work with.

Some roads in OSM datasets are listed as unclassified, tracks, path and footway. We want to exclude these from our dataset and focus on the other road types, more suitable for this exercise.

Moreover, OSM data might not be updated everywhere, and we will also exclude NULL values.

- 5. Right click on the roads layer and choose Filter....
- 6. In the dialog that pops up we filter these features with the following expression:

```
"highway" NOT IN ('footway', 'path', 'unclassified', 'track') AND "highway" IS_
→NOT NULL
```

The concatenation of the two operators NOT and IN excludes all the features that have these attribute values in the highway field.

IS NOT NULL combined with the AND operator excludes roads with no value in the highway field.

Note the \mathbb{V} icon next to the *roads* layer. It helps you remember that this layer has a filter activated, so some features may not be available in the project.


The map with all the data should look like the following one:

6.2.5 ???? Try Yourself: Convert Layers» CRS

Because we are going to be measuring distances within our layers, we need to change the layers» CRS. To do this, we need to select each layer in turn, save the layer to a new one with our new projection, then import that new layer into our map.

You have many different options, e.g. you can export each layer as an ESRI Shapefile format dataset, you can append the layers to an existing GeoPackage file, or you can create another GeoPackage file and fill it with the new reprojected layers. We will show the last option, so the training_data.gpkg will remain clean. Feel free to choose the best workflow for yourself.

Notă: In this example, we are using the WGS 84 / UTM zone 34S CRS, but you should use a UTM CRS which is more appropriate for your region.

- 1. Right click the roads layer in the Layers panel
- 2. Click Export -> Save Features As...
- 3. In the Save Vector Layer As dialog choose GeoPackage as Format
- 4. Click on ... for the File name, and name the new GeoPackage vector_analysis
- 5. Change the Layer name to roads_34S
- 6. Change the CRS to WGS 84 / UTM zone 34S
- 7. Click on OK:

| Save Vector Layer as 🛞 | | | | | | |
|--|---|---------|------------------|------------------|-------------------|--|
| Format File name Layer name CRS Encoding Save only Select fi | t GeoPackage ing roads_34S EPSG:32734 - WGS 84 / UTM zone 34S ing UTF-8 e only selected features lect fields to export and their export options | | | | | |
| Select fields to export and their export options Geometry Geometry type Force multi-type Include z-dimension Extent (current: layer) Layer Options Custom Options | | | | | | |
| Help | | ✓ Add s | aved file to map | * <u>C</u> ancel | √<u>о</u>к | |

This will create the new GeoPackage database and add the roads_34S layer.

8. Repeat this process for each layer, creating a new layer in the vector_analysis.gpkg GeoPackage file with _34S appended to the original name.

On macOS, press the *Replace* button in the dialog that pops up to allow QGIS to overwrite the existing GeoPackage.

Notă: When you choose to save a layer to an existing GeoPackage, QGIS will **add** that layer next to the existing layers in the GeoPackage, if no layer of the same name already exists.

- 9. Remove each of the old layers from the project
- 10. Once you have completed the process for all the layers, right click on any layer and click *Zoom to layer extent* to focus the map to the area of interest.

Now that we have converted OSM data to a UTM projection, we can begin our calculations.

6.2.6 ???? Follow Along: Analyzing the Problem: Distances From Schools and Roads

QGIS allows you to calculate distances between any vector object.

- 1. Make sure that only the roads_34S and buildings_34S layers are visible (to simplify the map while you're working)
- 2. Click on the *Processing* ► *Toolbox* to open the analytical *core* of QGIS. Basically, **all** algorithms (for vector **and** raster analysis) are available in this toolbox.
- 3. We start by calculating the area around the roads_34S by using the *Buffer* algorithm. You can find it in the *Vector Geometry* group.

Processing Toolbox ΘX 🎭 🦺 🕓 🖹 i Þ i 🔧 Q Search... * Recently used Q Cartography Q Database File tools Graphics Q Interpolation • Q Layer tools Network analysis Raster analysis Raster terrain analysis Raster tools Q Vector analysis • Q Vector creation Q Vector general Q Vector geometry Add geometry attributes 🔆 Aggregate 🔆 Boundary 🔆 Bounding boxes Buffer Centroids Check validity 💏 Collect geometries 🧠 Concave hull (alpha shapes) Concave hull (k-nearest neighbor) 🔆 Convert geometry type Convex hull 🔅 Create layer from extent 🔆 Create wedge buffers Delaunay triangulation 🔆 Delete holes 🔆 Densify by count 🔆 Densify by interval Dissolve Drape (set z-value from raster) 🜞 Drop M/Z values Eliminate selected polygons 🔆 Explode lines 🔆 Extend lines Extract specific vertices *** Extract vertices 🔆 Filter vertices by m value 🔆 Filter vertices by z value 🜞 Fix geometries 🔆 Geometry by expression 🔆 Interpolate point on line 澔 Koon N higgost parts You can add more algorithms to the toolbox, enable additional providers [close

Or you can type buffer in the search menu in the upper part of the toolbox: Strumenti di Processing ΘX 🎭 🬏 🕓 🖹 i 🛡 Q buffer × . Q Geometria vettore Buffer 🔆 Buffer multi-anello (distanza costante) 🔆 Buffer su singolo lato 🔆 Create wedge buffers Tapered buffers 隊 Variable width buffer (by m-value) GDAL Geoprocessing di Vettori 🚋 Buffer su singolo lato 🚡 Vettori buffer GRASS Raster (r.*) 🛞 r.buffer 🛞 r.buffer.lowmem Vettore (v.*) v.buffer 🔆 SAGA Raster tools 🔇 Raster buffer 🔆 Raster proximity buffer 🚭 Threshold raster buffer Voctor gonoral

4. Double click on it to open the algorithm dialog

5. Select roads_34S as *Input layer*, set *Distance* to 50 and use the default values for the rest of the parameters.

| Buffer | | | | |
|--|---|--|--|--|
| Parameters Log | • | Buffer | | |
| Input layer √° roads_34S [EPSG:32734] ▼ ② | | This algorithm computes a buffer area for all the features in an input layer, using a fixed or dynamic distance. | | |
| Distance 50,000000 meters | | The segments parameter controls the number of line segments to use to approximate a quarter circle when creating rounded offsets. | | |
| Segments | | The end cap style parameter controls how line endings are handled in the buffer. | | |
| End cap style | | The join style parameter specifies whether round, miter or beveled joins should be used when offsetting corners in a line. | | |
| Join style Round | | The miter limit parameter is only applicable for miter join styles, and controls the maximum distance from the offset curve to use when creating | | |
| Miter limit 2,000000 | | a mitered join. | | |
| Dissolve result Buffered | | | | |
| [Create temporary layer] ✓ Open output file after running algorithm | | | | |
| | | | | |
| 0% | 5 | Cancel | | |
| @ Help Run as Batch Process | | ≭ <u>C</u> lose | | |

6. The default *Distance* is in meters because our input dataset is in a Projected Coordinate System that uses meter as its basic measurement unit. You can use the combo box to choose other projected units like kilometers, yards, etc.

Notă: If you are trying to make a buffer on a layer with a Geographical Coordinate System, Processing will warn you and suggest to reproject the layer to a metric Coordinate System.

- 7. By default, *Processing* creates temporary layers and adds them to the *Layers* panel. You can also append the result to the GeoPackage database by:
 - 1. Clicking on the ... button and choose Save to GeoPackage...
 - 2. Naming the new layer roads_buffer_50m
 - 3. Saving it in the vector_analysis.gpkg file

| Buffer | | | | |
|--|---|--|--|--|
| Parameters Log | • | Buffer | | |
| Input layer √° roads_34S [EPSG:32734] ▼ ② | | This algorithm computes a buffer area for all the features in an input layer, using a fixed or dynamic distance. | | |
| Distance | | The segments parameter controls the number of line segments to use to approximate a quarter circle when creating rounded offsets. | | |
| Segments | | The end cap style parameter controls how line endings are handled in the buffer. | | |
| End cap style | | The join style parameter specifies whether round, miter or beveled joins should be used when offsetting corners in a line. | | |
| Join style Round | | The miter limit parameter is only applicable for miter join styles, and controls the maximum distance from the offset curve to use when creating | | |
| Miter limit 2,000000 | | a mitered join. | | |
| Dissolve result Buffered | | | | |
| okg' table="roads_buffer_50m" (geom) V Open output file after running algorithm | | | | |
| |] | | | |
| 0% Cancel | | | | |
| Help Run as Batch Process | | ≭ <u>C</u> lose √ Run | | |

8. Click on *Run*, and then close the *Buffer* dialog Acum, harta dvs. va arăta în felul următor:



If your new layer is at the top of the *Layers* list, it will probably obscure much of your map, but this gives you all the areas in your region which are within 50m of a road.

Notice that there are distinct areas within your buffer, which correspond to each individual road. To get rid of this problem:

1. Uncheck the *roads_buffer_50m* layer and re-create the buffer with *Dissolve results* enabled.

| Buffer | | | | |
|--|---|---|--|--|
| Parameters Log | • | Buffer | | |
| Input layer √° roads_34S [EPSG:32734] 		 ② | | This algorithm computes a buffer area for all the features in an input layer, using a fixed or dynamic distance. | | |
| Distance 50,000000 meters | | The segments parameter controls the number of line segments to use to approximate a quarter circle when creating rounded offsets. | | |
| Segments | | The end cap style parameter controls how line endings are handled in the buffer. | | |
| End cap style | | The join style parameter specifies whether round, miter or beveled joins should be used when offsetting corners in a line. | | |
| Join style Round | | The miter limit parameter is only applicable for miter join styles, and controls the maximum distance from the offset curve to use when creatin | | |
| Miter limit 2,000000 | | a mitered join. | | |
| A Dissolve result Bu Dissolve result bk Python identifier: ' <i>DISSOLVE</i> ' geom) ✓ Open output file after running algorithm | | | | |
| | | | | |
| 0% Weip Run as Batch Process | | Cancel ≭ <u>C</u> lose | | |

- 2. Save the output as *roads_buffer_50m_dissolved*
- 3. Click Run and close the Buffer dialog

Once you have added the layer to the Layers panel, it will look like this:



Acum, nu mai există subdiviziuni inutile.

Notă: The *Short Help* on the right side of the dialog explains how the algorithm works. If you need more information, just click on the *Help* button in the bottom part to open a more detailed guide of the algorithm.

6.2.7 ???? Try Yourself: Distance from schools

Utilizați aceeași abordare de mai sus, și creați un tampon pentru școlile dumneavoastră.

It shall be 1 km in radius. Save the new layer in the vector_analysis.gpkg file as schools_buffer_1km_dissolved.

Răspuns

• Your buffer dialog should look like this:

| Buffer | |
|---|---|
| Parameters Log | Buffer |
| Input layer Input layer schools_34S [EPSG:32734] | This algorithm computes a buffer area for all the features in an input layer, using a fixed or dynamic distance. |
| □ Selected features only Distance 1.000000 | The segments parameter controls the number of line segments to use to approximate a quarter circle when creating rounded offsets |
| Segments | The end cap style parameter controls how line endings are handled in the buffer. |
| End cap style Round | The join style parameter specifies whether round, miter or beveled joins should be used when offsetting corners |
| Round Miter limit | in a line. The miter limit parameter is only applicable for miter join styles, and |
| 2.000000 ♀ ✓ Dissolve result | controls the maximum distance from the offset curve to use when creating a mitered join. |
| Buffered ogr:dbname='/home/matteo/vector_analysis.gpkg' table="schools_buffer_1km_d] | |
| ✓ Open output file after running algorithm | |
| 0% | Cancel |
| Help Run as Batch Process | X <u>C</u> lose |

The *Buffer distance* is *1* kilometer.

• The *Segments to approximate* value is set to 20. This is optional, but it's recommended, because it makes the output buffers look smoother. Compare this:



To this:



The first image shows the buffer with the *Segments to approximate* value set to 5 and the second shows the value set to 20. In our example, the difference is subtle, but you can see that the buffer's edges are smoother with the higher value.

6.2.8 ???? Follow Along: Overlapping Areas

Now we have identified areas where the road is less than 50 meters away and areas where there is a school within 1 km (direct line, not by road). But obviously, we only want the areas where both of these criteria are satisfied. To do that, we will need to use the *Intersect* tool. You can find it in *Vector Overlay* group in the *Processing Toolbox*.

1. Use the two buffer layers as *Input layer* and *Overlay layer*, choose vector_analysis.gpkg GeoPackage in *Intersection* with *Layer name* road_school_buffers_intersect. Leave the rest as suggested (default).

| Intersection | 8 |
|--|--|
| Parameters Log Input layer schools_buffer_1km [EPSG:32734] ? Selected features only Overlay layer roads_buffer_50m [EPSG:32734] ? Selected features only Input fields to keep (leave empty to keep all fields) [optional] options selected Overlay fields to keep (leave empty to keep all fields) [optional] options selected Verlay fields to keep (leave empty to keep all fields) [optional] Overlay fields prefix [optional] Intersection Intersection Iysis.gpkg' table="road_school_buffers_intersect" (geom) | Intersection This algorithm extracts the overlapping portions of features in the Input and Overlay layers. Features in the output Intersection layer are assigned the attributes of the overlapping features from both the Input and Overlay layers. |
| ✓ Open output file after running algorithm | |
| | |
| 0% | Cancel |
| Help Run as Batch Process | ≭ <u>C</u> lose |

2. Clic pe Run

In the image below, the blue areas are where both of the distance criteria are satisfied.



3. You may remove the two buffer layers and only keep the one that shows where they overlap, since that's what we really wanted to know in the first place:



6.2.9 ???? Follow Along: Extract the Buildings

Now you've got the area that the buildings must overlap. Next, you want to extract the buildings in that area.

- 1. Look for the menu entry *Vector Selection* ► *Extract by location* within the *Processing Toolbox*
- 2. Select buildings_34S in *Extract features from*. Check *intersect* in *Where the features (geometric predicate)*, select the buffer intersection layer in *By comparing to the features from*. Save to the vector_analysis.gpkg, and name the layer well_located_houses.

| Parameters Log | • | |
|---|---|---|
| Extract features from → buildings_34S [EPSG:32734] → Where the features (geometric predicate) ↓ intersect touch contain overlap disjoint are within equal cross By comparing to the features from → road_school_buffers_interser → → Selected features only Extracted (location) g' table="well_located_houses" (geom) ↓ Open output file after running algorithm | | Extract by location This algorithm creates a new vector layer that only contains matching features from an input layer. The criteria for adding features to the resulting layer is defined based on the spatial relationship between each feature and the features in an additional layer. |
| 0% 0% Whelp Run as Batch Process | | Cancel X <u>C</u> lose X Run |

- 3. Click Run and close the dialog
- 4. You will probably find that not much seems to have changed. If so, move the *well_located_houses* layer to the top of the layers list, then zoom in.



The red buildings are those which match our criteria, while the buildings in green are those which do not.

5. Now you have two separated layers and can remove buildings_34S from the layer list.

6.2.10 ???? Try Yourself: Further Filter our Buildings

We now have a layer which shows us all the buildings within 1km of a school and within 50m of a road. We now need to reduce that selection to only show buildings which are within 500m of a restaurant.

Using the processes described above, create a new layer called *houses_restaurants_500m* which further filters your *well_located_houses* layer to show only those which are within 500m of a restaurant.

Răspuns

To create the new *houses_restaurants_500m* layer, we go through a two step process:

1. First, create a buffer of 500m around the restaurants and add the layer to the map:

| Buffer | |
|--|--|
| Parameters Log | Buffer |
| Input layer Imput layer Impu layer Impu layer Impu layer Impu layer Impu layer <th>This algorithm computes a buffer area for all the features in an input layer, using a fixed or dynamic distance.</th> | This algorithm computes a buffer area for all the features in an input layer, using a fixed or dynamic distance. |
| □ Selected features only Distance 500.000000 | The segments parameter controls the number of line segments to use to approximate a quarter circle when creating rounded offsets. |
| Segments 5 | The end cap style parameter controls how line endings are handled in the buffer. |
| End cap style Round | The join style parameter specifies whether round, miter or beveled joins should be used when offsetting corners |
| Join style Round Miter limit | in a line. The miter limit parameter is only applicable for miter join styles, and |
| 2.00000 ♀ ✓ Dissolve result | controls the maximum distance from the offset curve to use when creating a mitered join. |
| Buffered ne/matteo/vector analysis.gpkg' table="houses restaurants 500m" (geom) sgl= | |
| ✓ Open output file after running algorithm | |
| 0% | Cancel |
| BHelp Run as Batch Process | X <u>C</u> lose Run |
| | |



2. Next, extract buildings within that buffer area:

| Extract by Location | |
|--|--|
| Extract by Location Parameters Log Extract features from Where the features (geometric predicate) V intersect touch contain overlap disjoint are within equal cross By comparing to the features from restaurants_buffer_500m [EPSG:32734] | Extract by location This algorithm creates a new vector layer that only contains matching features from an input layer. The criteria for adding features to the resulting layer is defined based on the spatial relationship between each feature and the features in an additional layer. |
| Selected features only Extracted (location) hatteo/vector_analysis.gpkg' table="restaurants_buffer_500m" (geom) sql= ✓ Open output file after running algorithm | |
| 0% | Cancel |
| BHelp Run as Batch Process | X <u>C</u> lose |

Your map should now show only those buildings which are within 50m of a road, 1km of a school and 500m of a restaurant:



6.2.11 ???? Follow Along: Select Buildings of the Right Size

To see which buildings are of the correct size (more than 100 square meters), we need to calculate their size.

- 1. Select the *houses_restaurants_500m* layer and open the *Field Calculator* by clicking on the Calculator button in the main toolbar or in the attribute table window
- 2. Select *Create a new field*, set the *Output field name* to AREA, choose *Decimal number (real)* as *Output field type*, and choose *\$area* from the *Geometry* group.

| | Field Calculator 🛛 🛛 😣 |
|--|---|
| Only update 0 selected features | |
| ✓ Create a new field | Update existing field |
| Create virtual field | |
| Output field name AREA | |
| Output field type Decimal number (real | |
| Output field length O Precision | 3 |
| Expression Function Editor | |
| =+-/*^ ()\n 🗅 🗐 💼 | Q Searc Show Help function \$area |
| \$area | Custom Date and Time Fields and Values Files and Paths Fuzzy Matching General Geometry angle_at_vertex Sarea |
| Output preview: 1501.0355253089597 | area and if no ellipsoid is set then the * |
| You are editing information on OK, edit mode will automaticall | this layer but the layer is currently not in edit mode. If you click y be turned on. |
| Help | ≭ <u>C</u> ancel |
| | |

The new field AREA will contain the area of each building in square meters.

- 3. Click *OK*. The AREA field has been added at the end of the attribute table.
- 4. Click the \bigvee Toggle Editing button to finish editing, and save your edits when prompted.
- 5. In the *Source* tab of the layer properties, set the *Provider Feature Filter* to "AREA >= 100.

| | | C | Query Builde | r | | 8 |
|---|----------------|--------------|--------------|-----------------------------------|---------|--------|
| Set provider fi | lter on house | es_restauran | ts_500m | | | |
| Fields | | | Value | s | | |
| old_name addr:erf internet_acc level sport man_made layer height AREA | cess | | | Search Sample se unfiltered | layer | All |
| = | < | > | LIKE | % | IN | NOT IN |
| <= | >= | != | ILIKE | AND | OR | NOT |
| Provider spec | ific filter ex | pression | | | | |
| <pre>"AREA" >= 4</pre> | = 100 | | Test | <u>C</u> lear | X Cance | ! |

6. Clic pe OK

Your map should now only show you those buildings which match our starting criteria and which are more than 100 square meters in size.

6.2.12 ???? Try Yourself:

Save your solution as a new layer, using the approach you learned above for doing so. The file should be saved within the same GeoPackage database, with the name solution.

6.2.13 În concluzie

Using the GIS problem solving approach together with QGIS vector analysis tools, you were able to solve a problem with multiple criteria quickly and easily.

6.2.14 Ce urmează?

In the next lesson, we will look at how to calculate the shortest distance along roads from one point to another.

6.3 Lesson: Network Analysis

Calculating the shortest distance between two points is a common GIS task. Tools for this can be found in the *Processing Toolbox*.

The goal for this lesson: learn to use Network analysis algorithms.

6.3.1 ???? Follow Along: The Tools and the Data

You can find all the network analysis algorithms in the *Processing* \blacktriangleright *Network Analysis* menu. You can see that there are many tools available:



Open the project exercise_data/network_analysis/network.qgz. It contains two layers:

- network_points
- network_lines

The *network_lines* layer has already a style that helps to understand the road network.



The shortest path tools provide ways to calculate either the shortest or the fastest path between two points of a network, given:

- start and end points selected on the map
- start point selected on the map and end points taken from a point layer
- start points taken from a point layer and end point selected on the map

Let's start.

6.3.2 ???? Calculate the shortest path (point to point)

The *Network analysis* \blacktriangleright *Shortest path (point to point)* allows you to calculate the shortest distance between two manually selected points on the map.

In this example we will calculate the shortest (not fastest) path between two points.

- 1. Open the Shortest path (point to point) algorithm
- 2. Select network_lines for Vector layer representing network
- 3. Use Shortest for Path type to calculate

Use these two points as starting and ending points for the analysis:



- 4. Click on the ... button next to *Start point* (*x*, *y*) and choose the location tagged with *Starting Point* in the picture. Enable the snapping options for an accurate selection. The coordinates of the clicked point are added.
- 5. Do the same thing, but choosing the location tagged with Ending point for *End point* (*x*, *y*)
- 6. Click on the *Run* button:

| Shortest Path (Po | pint to Poin | t) ~ ^ 😣 |
|---|--------------|---|
| Parameters Log | 4 | Shortest path (point to |
| Vector layer representing network | | point) |
| V° network_lines [EPSG:32734] | ╲ | This algorithm computes optimal |
| Selected features only | | (shortest or fastest) route between given start and end points. |
| Path type to calculate | | 2L. |
| Shortest | - | |
| Start point | | |
| -337683.461296,14891793.324881 [EPSG:32734] | | |
| End point | | |
| -338394.378190,14891385.941820 [EPSG:32734] | | |
| Advanced Parameters | | |
| Shortest path | | |
| | * | |
| ☑ Open output file after running algorithm | | |
| | | |
| 0% | | Cancel |
| Advanced * Run as Batch Process |] | ✓ Run Sermer |

7. A new line layer is created representing the shortest path between the chosen points. Uncheck the network_lines layer to see the result better:



8. Open the attribute table of the output layer. It contains three fields, representing the coordinates of the start and end points and the **cost**.

We chose Shortest as *Path type to calculate*, so the **cost** represent the **distance**, in layer units, between the two locations.

In our case, the *shortest* distance between the chosen points is around 1000 meters:

| Shortest path – | – Features Total: 1, Filtered: 1, Sele | ected: 0 🛛 🗸 🔨 😣 |
|---------------------------------|--|--------------------|
| | i 🗏 💊 🔩 🍸 🖀 🌾 🔎 🛙 | i ii 💋 🔛 i 🚍 i 🍳 🗐 |
| start 🔻 | end | cost |
| 1 -337683.461296, 14891793.3249 | -338394.37819, 14891385.9418 | 906,4072543701861 |
| | | |
| | | |
| | | |
| 🛅 Show All Features 🖕 | | |

Now that you know how to use the tool, feel free to test other locations.

6.3.3 ???? Try Yourself: Fastest path

With the same data of the previous exercise, try to calculate the fastest path between the two points.

How much time do you need to go from the start to the end point?

Răspuns

1. Open *Network Analysis* ► *Shortest Path (Point to Point)* and fill the dialog as:

| R | Shortest Path (| Point to Poir | oint) | ~ ^ 😣 |
|--|-----------------|---------------|---|----------------|
| Parameters Log | | | Shortest path (point t | to |
| Vector layer representing network V* network_lines [EPSG:32734] Selected features only Path type to calculate Fastest Start point | - CJ | ₹ , | point) This algorithm computes optima (shortest or fastest) route betwe given start and end points. | ıl en |
| -337683.461296,14891793.324881 [EPSG End point | i:32734] | | | |
| -338394.378190,14891385.941820 [EPSG Advanced Parameters Shortest path | :32734] | | | |
| Create temporary layer] | hm | | | |
| | 0% | | | ancel |
| Advanced Run as E | 3atch Process | | V Run | <u>F</u> ermer |

- 2. Make sure that the Path type to calculate is Fastest.
- 3. Click on *Run* and close the dialog.
- 4. Open now the attribute table of the output layer. The *cost* field contains the travel time between the two points (as fraction of hours):

| 🔇 Shortest path — | Features Total: 1, Filtered: 1, Selec | ted: 0 🗸 🗸 😣 |
|---------------------------------|---------------------------------------|----------------------|
| | 😑 💫 🍡 🍸 🖀 🍫 🗭 i 🎼 | 🖺 🞽 🗮 🖷 🍭 🗐 |
| start | end | cost |
| 1 -337683.461296, 14891793.3249 | -338394.37819, 14891385.9418 | 0,018128145087403721 |
| | | |
| | | |
| | | |
| Show All Features | | |

6.3.4 ???? Follow Along: Advanced options

Let us explore some more options of the Network Analysis tools. In the *previous exercise* we calculated the **fastest** route between two points. As you can imagine, the time depends on the travel **speed**.

We will use the same layers and starting and ending points of the previous exercises.

- 1. Open the Shortest path (point to point) algorithm
- 2. Fill the Input layer, Start point (x, y) and End point (x, y) as we did before
- 3. Choose Fastest as the Path type to calculate

- 4. Open the Advanced parameter menu
- 5. Change the *Default speed (km/h)* from the default 50 value to 4

| Shortest Path (Point | nt to Point) \checkmark \land (|
|--|---|
| Parameters Log /ector layer representing network √° network_lines [EPSG:32734] ✓ CD ✓ Selected features only Path type to calculate Fastest Start point 337683.461296,14891793.324881 [EPSG:32734] Selected point | Shortest path (point to point) This algorithm computes optimal (shortest or fastest) route between given start and end points. |
| -338394.378190,14891385.941820 [EPSG:32734] | |
| Advanced Parameters Direction field [optional] Value for forward direction [optional] | • |
| Value for backward direction [optional] Value for both directions [optional] | |
| Default direction Both directions | • |
| Speed field [optional] Default speed (km/h) | • |
| 4,000000 Topology tolerance 0,000000 meters | |
| Shortest path | |
| Open output file after running algorithm | |
| 0% | Cancel |
| Advanced Run as Batch Process | √ Run <mark>⊗ F</mark> ermer |

- 6. Click on Run
- 7. Once the algorithm is finished, close the dialog and open the attribute table of the output layer.

The *cost* field contains the value according to the speed parameter you have chosen. We can convert the *cost* field from hours with fractions to the more readable *minutes* values.

- 8. Open the field calculator by clicking on the \mathbf{E} icon
- 9. Add a new field to store the path cost in *minutes*.

| <u> </u> | Shortest path — Field Calculator | \sim \sim \otimes |
|---|--|-------------------------|
| Only update 0 selected features | | |
| ✓ Create a new field | Update existing field | |
| Create virtual field | | |
| Output field name minutes | | |
| Output field type 1.2 Decimal Number (rea | b) | |
| Output field length 10 🗘 Precision | 3 | |
| Expression Function Editor | | |
| | Q Searc Show Values group field | * |
| "cost" * 60 | Date and Time Double-click to add field name to express String | sion |
| | feature geometry id | |
| | NULL All Unique 10 Sam | ples |
| | abc start | |
| Feature 51296, 14891793.3249 💌 🔳 🕨 | 1.2 cost | |
| Preview: 13,596108815552794 | Files and Paths | |
| ₿ <u>A</u> ide | ✓ <u>o</u> k | ∑ <u>A</u> nnuler |

That's it! Now you know how many minutes it will take to get from one point to the other one if the whole network speed is at 4 km/h.

6.3.5 ???? Shortest path with speed limit

The Network analysis toolbox has other interesting options. Looking at the following map:



we would like to know the **fastest** route considering the **speed limits** of each road (the labels represent the speed limits in km/h). The shortest path without considering speed limits would of course be the purple path. But in that road the speed limit is 20 km/h, while in the green road you can go at 100 km/h!

As we did in the first exercise, we will use the *Network analysis* \blacktriangleright *Shortest path (point to point)* and we will manually choose the start and end points.

- 1. Open the Network analysis Shortest path (point to point) algorithm
- 2. Select network_lines for the Vector layer representing network parameter
- 3. Choose Fastest as the Path type to calculate
- 4. Select the *Start point* (x, y) and *End point* (x, y) as we did before
- 5. Open the Advanced parameters menu
- 6. Choose the *speed* field as the *Speed Field* parameter. With this option the algorithm will take into account the speed limits for each road.

| Shortest Path (Poi | int to Point | i) v ^ 😣 |
|---|--------------|--|
| Parameters Log Vector layer representing network √° network_lines [EPSG:32734] Selected features only | • | Shortest path (point to point) This algorithm computes optimal (shortest or fastest) route between given start and end points. |
| Path type to calculate Fastest Start point | - | |
| -337683.461296,14891793.324881 [EPSG:32734] End point | | |
| -338394.378190,14891385.941820 [EPSG:32734] Advanced Parameters | | |
| Direction field [optional] Value for forward direction [optional] | • | |
| Value for backward direction [optional] | | |
| Value for both directions [optional] | | |
| Default direction | | |
| Both directions | - | |
| Speed field [optional] | | |
| 1.2 speed | - | |
| Default speed (km/h) | | |
| 50,000000 | \$ | |
| Topology tolerance | | |
| 0,000000 🗘 meters | - | |
| Shortest path | | |
| [Create temporary layer] | | |
| ✓ Open output file after running algorithm | | |
| | | |
| 0% | | Cancel |
| 🛱 <u>A</u> ide Advanced * Run as Batch Process | | ✓ Run 😣 <u>F</u> ermer |

- 7. Click on the Run button
- $8. \ Turn \ off \ the \ {\tt network_lines} \ layer \ to \ better \ see \ the \ result$



As you can see the fastest route does not correspond to the shortest one.

6.3.6 ???? Service area (from layer)

The *Network Analysis* \blacktriangleright *Service area (from layer)* algorithm can answer the question: given a point layer, what are all the reachable areas given a distance or a time value?

Notă: The *Network Analysis* \succ *Service area (from point)* is the same algorithm, but it allows you to manually choose the point on the map.

Given a distance of 250 meters we want to know how far we can go on the network from each point of the *network_points* layer.

- 1. Uncheck all the layers except network_points
- 2. Open the Network Analysis ► Service area (from layer) algorithm
- 3. Choose network_lines for Vector layer representing network
- 4. Choose network_points for Vector layer with start points
- 5. Choose Shortest in Path type to calculate
- 6. Enter 250 for the Travel cost parameter
- 7. Click on Run and close the dialog

| ର | Service Area (From Laye | er) | ~ ^ 😣 |
|--|-------------------------|---|--|
| Parameters Log Vector layer representing network √° network_lines [EPSG:32734] Selected features only | , • 🗘 🛷 | Service area (from lay This algorithm creates a new vec the edges or parts of edges of a layer that can be reached within or a time, starting from features | /er) tor with all network line a distance of a point |
| Path type to calculate Shortest Vector layer with start points [* network_points [EPSG:32734] Selected features only Travel cost (distance for 'Shortest', time for ' | • 🗘 🍾 | layer. The distance and the time (referred to as "travel cost") must respectively in the network layer hours. | (both be specified units or in |
| 250,000000 Advanced Parameters Service area (lines) [optional] | | | |
| [Create temporary layer] ✓ Open output file after running algorithm Service area (boundary nodes) [optional] | | | |
| [Skip output] | | | |
| | 0% | | Cancel |
| Advanced 👻 Run as Bat | ch Process | ✓ Run | 8 <u>F</u> ermer |

The output layer represents the maximum path you can reach from the point features given a distance of 250 meters:



Cool isn't it?

6.3.7 În concluzie

Now you know how to use *Network analysis* algorithm to solve shortest and fastest path problems. We are now ready to perform some spatial statistic on vector layer data. Let's go!

6.3.8 Ce urmează?

Mai departe, veți vedea cum să rulați algoritmii statisticilor spațiale asupra seturilor de date vectoriale.

6.4 Lesson: Spatial Statistics

Notă: Lecția a fost dezvoltată de Linfiniti și S Motala (Cape Peninsula University of Technology

Spatial statistics allows you to analyze and understand what is going on in a given vector dataset. QGIS includes many useful tools for statistical analysis.

The goal for this lesson: To know how to use QGIS» spatial statistics tools within the Processing Toolbox.

6.4.1 ???? Follow Along: Create a Test Dataset

We will create a random set of points, to get a dataset to work with.

To do so, you will need a polygon dataset to define the area you want to create the points in.

We will use the area covered by streets.

- 1. Start a new project
- Add your roads dataset, as well as srtm_41_19 (elevation data) found in exercise_data/raster/ SRTM/.

Notă: You might find that the SRTM DEM layer has a different CRS to that of the roads layer. QGIS is reprojecting both layers in a single CRS. For the following exercises this difference does not matter, but feel free to reproject (as shown earlier in this module).

- 3. Open *Processing* toolbox
- 4. Use the *Vector Geometry* ► *Minimum bounding geometry* tool to generate an area enclosing all the roads by selecting Convex Hull as the *Geometry Type*:

| Minimum Bounding Geometry 🛛 😵 | | | | | |
|---|-----------|---|--|--|--|
| Parameters Log Input layer | • | Minimum bounding geometry | | | |
| ✓ roads [EPSG:4326] ✓ □ Selected features only | 2 | This algorithm creates geometries which enclose the features from an input layer. | | | |
| Field (optional, set if features should be grouped by class) [optio | nal] • | Numerous enclosing geometry types are supported, including bounding boxes (envelopes), oriented rectangles, circles | | | |
| Geometry type | | and convex hulls. | | | |
| Convex Hull Bounding geometry | | a field. If set, this causes the output layer to contain one feature per grouped value | | | |
| [Create temporary layer] | | with a minimal geometry covering just the features with matching values. | | | |
| Open output file after running algorithm | | | | | |
| 0% | | Cancel | | | |
| WHelp Run as Batch Process | | ¥ <u>C</u> lose √Run | | | |

As you know, if you don't specify the output, *Processing* creates temporary layers. It is up to you to save the layers immediately or at a later stage.

Crearea de puncte aleatorii

• Create 100 random points in this area using the tool at *Vector Creation* \succ *Random points in layer bounds*, with a minimum distance of 0.0:

| Random Points in Layer Bounds | | | | | |
|--|--|--|--|--|--|
| Parameters Log Input layer ➢ Bounding geometry [EPSG:4326] ▼ | Random points in layer bounds | | | | |
| Selected features only Number of points 100 Minimum distance between points 0,000000 ↓ degrees Random points [Create temporary layer] ✔ Open output file after running algorithm | This algorithm creates a new point layer with a given number of random points, all of them within the extent of a given layer. A distance factor can be specified, to avoid points being too close to each other. | | | | |
| 0% | Cancel | | | | |
| Welp Run as Batch Process | ¥ <u>C</u> lose √Run | | | | |

Notă: The yellow warning sign tells you that that parameter concerns distances. The *Bounding geometry* layer is in a Geographical Coordinate System and the algorithm is just reminding you this. For this example we won't use this parameter so you can ignore it.

If needed, move the generated random point to the top of the legend to see them better:

| *Untitled Project - QGIS | | | | | | | |
|---|---|--|-----------------------------------|-------------------------------|-----------------------------|-----------------|------------|
| Proje | t <u>E</u> dit <u>V</u> iew <u>L</u> ayer <u>S</u> ettings | <u>P</u> lugins Vect <u>o</u> r <u>R</u> a | ster <u>D</u> atabase <u>W</u> eb | <u>M</u> esh Pro <u>c</u> ess | ing <u>H</u> elp | | |
| | 눧 🔒 🔂 🕄 👫 👘 🏺 | 🔍 👯 🔍 🕀 | P 🕫 🔏 🗐 | 🗉 😂 | 💊 👯 🕂 | 1,00000 \$ | » |
| ₩. | / 🔒 📸 族 - 🖬 🖮 | 8 8 6 6 | abc 🔩 🔤 abc | ab i abc abc | » / • • • | | |
| i, | 🍭 - 🛃 - 🖥 - 😼 🛅 🔛 | 🔆 Σ 🔤 - 🖓 | , | 6 6 7 7 | 222 | | 🦿 » 🕵 |
| ✓ ✓ | Layers Image: Second secon | 88 | 0 % * | • • • • • | | | |
| е с * Q Ту | CeoPackage SpatiaLite pe to locate (Ctrl+K) | rdii 20.083,-34.0 | 46 👋 e 1:324314 💌 | n 100% | 3 0,0 ° | 🗘 🗸 Render 💮 Ef | PSG:4326 🗨 |

Eşantionarea datelor

To create a sample dataset from the raster, you'll need to use the *Raster Analysis* \blacktriangleright *Sample raster values* algorithm. This tool samples the raster at the locations of the points and adds the raster values in new field(s) depending on the number of bands in the raster.

- 1. Open the Sample raster values algorithm dialog
- 2. Select Random_points as the layer containing sampling points, and the SRTM raster as the band to get values from. The default name of the new field is rvalue_N, where N is the number of the raster band. You can change the name of the prefix if you want.

| Sample Raster Values | l | 8 |
|--|---|--|
| Parameters Log Input Point Layer Random points [EPSG:4326] Selected features only Raster Layer to sample srtm_41_19 [EPSG:32733] Advanced parameters Output column prefix | | Sample raster values This algorithm creates a new vector layer with the same attributes of the input layer and the raster values corresponding on the point location. If the raster layer has more than one band, all the band values are |
| Sampled Points [Create temporary layer] ✓ Open output file after running algorithm 0% | | sampled. Cancel |
| WHelp Run as Batch Process | (| ≭ <u>C</u> lose |

3. Press Run

Now you can check the sampled data from the raster file in the attribute table of the Sampled Points layer. They will be in a new field with the name you have chosen.

Un posibil strat eșantion este prezentat aici:


The sample points are classified using the rvalue_1 field such that red points are at a higher altitude. You will be using this sample layer for the rest of the statistical exercises.

6.4.2 ???? Follow Along: Basic Statistics

Obține statisticile de bază pentru acest strat.

- 1. Click on the \sum Show statistical summary icon in the *Attributes Toolbar*. A new panel will pop up.
- 2. In the dialog that appears, specify the Sampled Points layer as the source.
- 3. Select the *rvalue_1* field in the field combo box. This is the field you will calculate statistics for.
- 4. The Statistics Panel will be automatically updated with the calculated statistics:

| | Statistics | | ØX | | | | | | |
|----------------|---------------------------|---------|----|--|--|--|--|--|--|
| | ° Sampled Points | | - | | | | | | |
| 3,00 | ^{1.2} rvalue_1 | | 3 | | | | | | |
| V _O | Statistic | Value | | | | | | | |
| • | Count | 100 | | | | | | | |
| | Sum | 14148 | | | | | | | |
| ?₀ | Mean | 141.48 | | | | | | | |
| Po | Median | 122.5 | | | | | | | |
| V. | St dev (pop) | 89.4792 | | | | | | | |
| @ | St dev (sample) | 89.93 | | | | | | | |
| - | Minimum | 18 | | | | | | | |
| | Maximum | 737 | | | | | | | |
| | Range | 719 | | | | | | | |
| v~- | Minority | 18 | | | | | | | |
| | Majority | 120 | | | | | | | |
| 1 | Variety | 78 | | | | | | | |
| | Q1 | 97 | | | | | | | |
| | Q3 | 163.5 | | | | | | | |
| | IQR | 66.5 | | | | | | | |
| | Missing (null) values | 0 | | | | | | | |
| | Selected features | only 🖹 | 2 | | | | | | |
| | ег | | | | | | | | |
| ۹ тур | ् Type to locate (Ctrl+K) | | | | | | | | |

Notă: You can copy the values by clicking on the Copy Statistics To Clipboard button and paste the results into a spreadsheet.

5. Close the Statistics Panel when done

Many different statistics are available:

Număr

The number of samples/values.

Sum

The values added together.

Media

The mean (average) value is simply the sum of the values divided by the number of values.

Mediana

If you arrange all the values from smallest to greatest, the middle value (or the average of the two middle values, if N is an even number) is the median of the values.

St Dev (pop)

Abaterea standard. Oferă o indicație despre cât de strâns sunt grupate valorile în jurul mediei. Cu cât este mai mică deviația standard, cu atât mai apropiată tinde să fie media.

Minimum

Valoarea minimă.

Maximum

Valoarea maximă.

Intervalul

Diferența dintre valorile minime și maxime.

Q1

First quartile of the data.

Q3

Third quartile of the data.

Missing (null) values

The number of missing values.

6.4.3 ???? Follow Along: Compute statistics on distances between points

- 1. Create a new temporary point layer.
- 2. Enter edit mode, and digitize three points somewhere among the other points.

Alternatively, use the same random point generation method as before, but specify only **three** points.

3. Save your new layer as *distance_points* in the format you prefer.

To generate statistics on the distances between points in the two layers:

- 1. Open the *Vector Analysis* ► *Distance matrix* tool.
- 2. Select the distance_points layer as the input layer, and the Sampled Points layer as the target layer.
- 3. Set their id field as unique field references
- 4. Change the Output matrix type option into Summary distance matrix.
- 5. set value of *Use only the nearest* (*k*) *target points* to 2.

6. If you want you can save the output layer as a file or just run the algorithm and save the temporary output layer later.

| Distance Matrix | | | | |
|--|----------------------|--|------------------------------|--------------------------|
| Parameters Log Input point layer | Di | stance | e matrix | (|
| Selected features only | cont dist poir | algorithn aining a c ances bet its layer. | listance mat ween all the | rix, with points in a |
| Input unique ID field | | | | |
| Target point layer | | | | |
| Selected features only | | | | |
| 123 id | | | | |
| Output matrix type Summary distance matrix (mean, std. dev., min, max) | | | | |
| Use only the nearest (k) target points | | | | |
| Distance matrix [Create temporary layer] | | | | |
| ✓ Open output file after running algorithm | | | | |
| 0% | | | | Cancel |
| B Help Run as Batch Process | | | ≍ <u>C</u> lose | Run |

- 7. Click Run to generate the distance matrix layer.
- 8. Open the attribute table of the generated layer: values refer to the distances between the *distance_points* features and their two nearest points in the *Sampled Points* layer:

| | I | Distance matr | ix :: Features | Total: 3, Filte | ered: 3, Selec | ted: 0 - 1 | х х |
|---|----------------|---------------|----------------|-----------------|----------------|------------|-----|
| / | 1 🗟 🖓 | iii ~ 0 | 🖻 i 🗞 🗮 💟 | 💊 🍸 🖺 🐥 | P 🗈 🖪 | | |
| | InputID | MEAN | STDDEV | MIN | MAX | | |
| 1 | 1 | 401.87013 | 235.74757 | 166.12256 | 637.61770 | | |
| 2 | 2 | 653.19728 | 229.72430 | 423.47299 | 882.92158 | | |
| з | 0 | 1005.87036 | 296.03133 | 709.83903 | 1301.90169 | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| 7 | Show All Featu | ures 🖕 | | | | | |

With these parameters, the *Distance Matrix* tool calculates distance statistics for each point of the input layer with respect to their two nearest points in the target layer. The fields of the output layer contain the mean, standard deviation, minimum and maximum for the calculated distances.

For further testing, you may want to modify the Output matrix type option or the number of target points.

6.4.4 ???? Follow Along: Nearest Neighbor Analysis (within layer)

To do a nearest neighbor analysis of a point layer:

- 1. Choose Vector analysis ► Nearest neighbor analysis.
- 2. In the dialog that appears, select the Random points layer and click Run.
- 3. The results will appear in the Processing Result Viewer Panel.

| Processing Toolbox | ð× |
|---|--|
| 🎭 🧟 🍯 📄 🔧 | |
| Q Search | |
| Recently used | |
| Q Cartography | |
| Q Database | |
| File tools | • |
| Results Viewer | Ø× |
| Nearest neighbour [04:51:51] | |
| | |
| Algorithm: Nearest neighbour File path: /tmp/processing MXcuY 6aa2320aecdf41d4adbe6e45440f2 | <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> <u></u> |
| be/OUTPUT HTML FILE.html | - |

4. Click on the blue link to open the html page with the results:



6.4.5 ???? Follow Along: Mean Coordinates

Pentru a obține coordonatele medii ale unui set de date:

- 1. Start Vector analysis ► Mean coordinate(s)
- 2. In the dialog that appears, specify Random points as Input layer, and leave the optional choices unchanged.
- 3. Clic pe Run

Let us compare this to the central coordinate of the polygon that was used to create the random sample.

- 1. Start Vector geometry ► Centroids
- 2. In the dialog that appears, select Bounding geometry as the input layer.

As you can see, the mean coordinates (pink point) and the center of the study area (in green) don't necessarily coincide.

The centroid is the barycenter of the layer (the barycenter of a square is the center of the square) while the mean coordinates represent the average of all node coordinates.



6.4.6 ???? Follow Along: Image Histograms

The histogram of a dataset shows the distribution of its values. The simplest way to demonstrate this in QGIS is via the image histogram, available in the *Layer Properties* dialog of any image layer (raster dataset).

- 1. In your *Layers* panel, right-click on the srtm_41_19 layer
- 2. Select Properties
- 3. Choose the *Histogram* tab. You may need to click on the *Compute Histogram* button to generate the graphic. You will see a graph that shows the frequency distribution for the raster values.



- 4. The graph can be exported as an image with the $\boxed{\blacksquare}^{\text{Save plot}}$ button
- 5. You can see more detailed information about the layer in the *Information* tab (the mean and max values are estimated, and may not be exact).

The mean value is 332.8 (estimated to 324.3), and the maximum value is 1699 (estimated to 1548)! You can zoom in the histogram. Since there are a lot of pixels with value 0, the histogram looks compressed vertically. By zooming in to cover everything but the peak at 0, you will see more details:



Notă: If the mean and maximum values are not the same as above, it can be due to the min/max value calculation. Open the *Symbology* tab and expand the *Min / Max Value Settings* menu. Choose Min / max and click on *Apply*.

Keep in mind that a histogram shows you the distribution of values, and not all values are necessarily visible on the graph.

6.4.7 ???? Follow Along: Spatial Interpolation

Let's say you have a collection of sample points from which you would like to extrapolate data. For example, you might have access to the *Sampled points* dataset we created earlier, and would like to have some idea of what the terrain looks like.

- 1. To start, launch the GDAL ► Raster analysis ► Grid (IDW with nearest neighbor searching) tool in the Processing Toolbox.
- 2. For Point layer select Sampled points
- 3. Set Weighting power to 5.0
- 4. In Advanced parameters, set Z value from field to rvalue_1
- 5. Finally click on Run and wait until the processing ends
- 6. Close the dialog

Here is a comparison of the original dataset (left) to the one constructed from our sample points (right). Yours may look different due to the random nature of the location of the sample points.



As you can see, 100 sample points aren't really enough to get a detailed impression of the terrain. It gives a very general idea, but it can be misleading as well.

6.4.8 ???? Try Yourself: Different interpolation methods

1. Use the processes shown above to create a set of 10 000 random points

Notă: If the number of points is really big, the processing time can take a long time.

- 2. Use these points to sample the original DEM
- 3. Use the Grid (IDW with nearest neighbor searching) tool on this dataset.
- 4. Set *Power* and *Smoothing* to 5.0 and 2.0, respectively.

Rezultatele (în funcție de poziționarea punctelor aleatorii) va arata mai mult, sau mai puțin, ca aceasta:



This is a better representation of the terrain, due to the greater density of sample points. Remember, larger samples give better results.

6.4.9 În concluzie

QGIS has a number of tools for analyzing the spatial statistical properties of datasets.

6.4.10 Ce urmează?

Now that we have covered vector analysis, why not see what can be done with rasters? That is what we will do in the next module!

CAPITOLUL 7

Modulul: Rastere

Am folosit rastere pentru digitizarea anterioară, dar datele raster pot fi folosite, de asemenea, și în mod direct. În acest modul, veți vedea cum se face acest lucru în QGIS.

7.1 Lesson: Working with Raster Data

Raster data is quite different from vector data. Vector data has discrete features with geometries constructed out of vertices, and perhaps connected with lines and/or areas. Raster data, however, is like any image. Although it may portray various properties of objects in the real world, these objects don't exist as separate objects. Rather, they are represented using pixels with different values.

During this module you are going to use raster data to supplement your existing GIS analysis.

The goal for this lesson: To learn how to work with raster data in QGIS.

7.1.1 ???? Follow Along: Loading Raster Data

Raster data can be loaded with the same methods we used for vector data. However we suggest to use the *Browser* Panel.

- 1. Open the Browser Panel and expand the exercise_data/raster folder.
- 2. Load all the data in this folder:
 - 3320C_2010_314_RGB_LATLNG.tif
 - 3320D_2010_315_RGB_LATLNG.tif
 - 3420B_2010_328_RGB_LATLNG.tif
 - 3420C_2010_327_RGB_LATLNG.tif

You should see the following map:

| | | | | | | | *(| Jntitled | Project - | QGIS | | | | | (| • • • |
|---------------------------------|----------------|---|--|--|-----------------|-----------------|----------------|-----------------|---------------|--------------|-------------------|-----------------|--------------|----------------|-----------|-------|
| Projec | t <u>E</u> dit | <u>V</u> iew | <u>L</u> ayer | <u>S</u> ettings | <u>P</u> lugins | Vect <u>o</u> r | <u>R</u> aster | <u>D</u> atabas | e <u>W</u> eb | <u>M</u> esh | Pro <u>c</u> essi | ng <u>H</u> elp | | | | |
| | <u> </u> | | 🛐 👫 | 1 | 🕨 🗩 🏅 | ∋ 🎵 | \mathbb{Q} | P 🔎 | A |] 📕 (| • 2 | ∛ 🌜 | 1,000 | 00 \$ | | » |
| 1. | / 8 | •°° / | × - 2 | 2 🖬 > | 6 P [| • | | | abc (abc | ab at | abc | » [| - Q Q. | | | |
| | Q 🛯 | . - 8 | | | 🔆 Σ | | T . | • | °:- • | 6 | 7 7 | | 2 P 0 | | , % , | » 🙊 |
| ⊗ √₀ ₽₀ ₽₀ ₽₀ ₽₀ | Layers | 33200 33200 34208 34200 | E ₁ ≠ 2010 0_2010 3_2010 2010 2010 2010 | 314_RGB 315_RGE 328_RGB 327_RGB | © 1 | | | | | | | | | | | |
| ۹ ту | pe to loc | ate (Ctr | l+K) | | ť | 20.3412,-3 | 4.0054 | ð a 1:982 | 81 - | | 100% | ‡ a 0, | 0° 🗘 | 🗸 Render 🛛 🛞 🛛 | EPSG:4326 | Q |

There we have it - four aerial images covering our study area.

7.1.2 ???? Follow Along: Create a Virtual Raster

Now as you can see from this, your solution layer lies across all four images. What this means is that you are going to have to work with four rasters all the time. That's not ideal. It would be better to have one file to work with.

Luckily, QGIS allows you to do exactly this, and without needing to actually create a new raster file. You can create a **Virtual Raster**. This is also often called a *Catalog*, which explains its function. It's not really a new raster. Rather, it is a way to organize your existing rasters into one catalog: one file for easy access.

To make a catalog we will use the *Processing* \blacktriangleright *Toolbox*.

- 1. Open the *Build virtual raster* algorithm from the *GDAL* > *Raster miscellaneous*;
- 2. In the dialog that appears, click on the ... button next to the *Input layers* parameter and check all the layers or use the *Select All* button;
- 3. Uncheck *Place each input file into a separate band*. Notice the code that is generated at the bottom of the dialog under *GDAL/OGR console call*. This is the command that will be executed when you click *Run*. The text updates as you change different options in the dialog.

Notă: Keep in mind that you can copy and paste the text in the OSGeo Shell (Windows user) or Terminal (Linux and OSX users) to run the command. You can also create a script for each GDAL command. This is very handy when the procedure is taking a long time or when you want to schedule specific tasks. Use the *Help* button to get more help on the syntax of the command.

4. Finally click on Run.

Notă: As you know from the previous modules, *Processing* creates temporary layers by default. To save the file, click on the ... button under *Virtual*.

| Build Virtual Raster 😣 |
|--|
| Parameters Log |
| Input layers |
| 4 elements selected |
| Resolution |
| Average |
| ✓ Place each input file into a separate band |
| Allow projection difference |
| Advanced parameters |
| Add alpha mask band to VRT when source raster has none |
| Override projection for the output file [optional] |
| ▼ 🌏 |
| Resampling algorithm |
| Nearest Neighbour 👻 |
| Nodata value(s) for input bands (space separated) [optional] |
| |
| Additional command-line parameters [optional] |
| |
| Virtual |
| [Save to temporary file] |
| ✓ Open output file after running algorithm |
| GDAL/OGR console call |
| gdalbuildvrt -resolution average -separate -r nearest -input_file_list /tmp/ processing_waXvap/9e7966068f424564a9ca71decadc15f9/buildvrtInputFiles.txt / tmp/processing_waXvap/219f32d6606644108251f5ad770a7945/OUTPUT.vrt |
| |
| 0% Cancel |
| ②Help Run as Batch Process ¥ Close |

You can now remove the original four rasters from the Layers Panel and leave only the output virtual catalog raster.

7.1.3 ???? Transforming Raster Data

The above methods allow you to virtually merge datasets using a catalog, and to reproject them "on the fly". However, if you are setting up data that you'll be using for quite a while, it may be more efficient to create new rasters that are already merged and reprojected. This improves performance while using the rasters in a map, but it may take some time to set up initially.

Reproiectare rasterelor

Open *Warp* (*reproject*) from *GDAL* ► *Raster projections*.

You can also reproject virtual rasters (catalogs), enable multithreaded processing, and more.

| Warp (Reproject) | 8 |
|--|-----|
| Parameters Log | |
| Input layer |] |
| ▼ Virtual [EPSG:4326] | |
| Source CRS [optional] | |
| Image: Contract of the second s | |
| Target CRS [optional] | |
| Project CRS: EPSG:4326 - WGS 84 🔹 🍕 | |
| Resampling method to use | |
| Nearest Neighbour 🔹 |] |
| Nodata value for output bands [optional] | |
| Not set |) . |
| Output file resolution in target georeferenced units [optional] | |
| Not set |] |
| Advanced parameters Reprojected | |
| [Save to temporary file] | |
| ✓ Open output file after running algorithm | |
| GDAL/OGR console call | |
| gdalwarp -t_srs EPSG:4326 -r near -of GTiff /tmp/ processing_E3t0r2/4d43521175294d8a8f7935de8c0d5ca3/OUTPUT.vrt /tmp/ processing_E3t0r2/cf35f6625870499798aa2930475ab4b1/OUTPUT.tif | |
| | |
| 0% Cancel | |
| ②Help Run as Batch Process ★Close | |

Îmbinarea rastererelor

If you need to create a new raster layer and save it to disk you can use the merge algorithm.

Notă: Depending on how many raster files you are merging and their resolution, the new raster file created can be really big. Consider instead to create a raster catalog as described in the *Create a Virtual Raster* section.

- 1. Click on the *Merge* algorithm from the *GDAL* \blacktriangleright *Raster miscellaneous* menu.
- 2. As we did for the Create a Virtual raster, use the ... button to choose which layers you want to merge.

You can also specify a Virtual raster as input, and then all of the rasters that it consists of will be processed.

3. If you know the GDAL library, you can also add your own options by opening the Advanced parameters menu.

| Merge 😣 |
|---|
| Parameters Log |
| Input lavers |
| 4 elements selected |
| Grab pseudocolor table from first laver |
| Place each input file into a separate band |
| Output data type |
| Float32 |
| Advanced parameters |
| Merged |
| [Save to temporary file] |
| ✓ Open output file after running algorithm |
| GDAL/OGR console call |
| gdal_merge.py -ot Float32 -of GTiff -o /tmp/ processing_E3t0r2/517f150854b344bc9f4588a6e9884e32/OUTPUT.tifoptfile /tmp/processing_E3t0r2/44e87c4b7bdf4453aa9552e0d6695f3b/ mergeInputFiles.txt |
| |
| 0% Cancel |
| ②Help Run as Batch Process X Close ✓Run |

7.1.4 În concluzie

QGIS face mai ușoară includerea datelor raster în proiectele existente.

7.1.5 Ce urmează?

Next, we'll use raster data that isn't aerial imagery, and see how symbolization is useful in the case of rasters as well.

7.2 Lesson: Changing Raster Symbology

Not all raster data are aerial photos. There are many other forms of raster data, and in many of those cases, it is essential to symbolize the them so that they becomes properly visible and useful.

Scopul acestei lecții: De a schimba simbolistica pentru un strat raster.

7.2.1 ???? Try Yourself:

- 1. Use the Browser Panel to load srtm_41_19.tif, found under exercise_data/raster/SRTM/
- 2. Zoom to the extent of this layer by right-clicking on it in the Layers panel and selecting Zoom to Layer.

This dataset is a *Digital Elevation Model (DEM)*. It is a map of the elevation (altitude) of the terrain, allowing us to see where the mountains and valleys are, for example.

While each pixel of the dataset of the previous section contained color information, in a *DEM*, each pixel contains elevation values.

Once the DEM is loaded, you will notice that it is a grayscale representation:



QGIS has automatically applied a stretch to the pixel values of the image for visualization purposes, and we will learn more about how this works as we continue.

7.2.2 ???? Follow Along: Changing Raster Layer Symbology

You have two different options to change the raster symbology:

- 1. Within the *Layer Properties* dialog, by right-clicking on the layer in the Layer tree and selecting the *Properties* option. Then switch to the *Symbology* tab
- 2. By clicking on the *Open the Layer Styling panel* button right above the *Layers* panel (shortcut F7). This will open

the *Layer Styling* panel, where you can switch to the V^{Symbology} tab.

Choose the method you prefer to work with.

7.2.3 ???? Follow Along: Singleband gray

When you load a raster file, if it is not a photo image like the ones of the previous section, the default style is set to a grayscale gradient.

Let's explore some of the features of this renderer.

| | Lay | yer Properties - srtm_41_19 | Symbology 🔗 |
|---------------|--|-----------------------------|---------------------------------------|
| Q | 🔻 Band Renderi | ing | |
| 🥡 Information | Render type Si | ingleband gray 👻 | |
| Source | Gray band | Band 1 (Gray) | • |
| 😻 Symbology | Color gradient | Black to white | • |
| ITransparency | | Min 0 | Max 1548 |
| 📐 Histogram | Contrast enhancement | Stretch to MinMax | • |
| 🞸 Rendering | 🔻 Min / Max \ | /alue Settings | |
| 🗥 Pyramids | ○ Use <u>r</u> defin | ed | |
| 🚽 Metadata | Cumulative count cut | e 2,0 🗘 - 98,0 🌲 % | |
| E Legend | • <u>M</u> in / max | | |
| GIS Server | O Mean +/- | leviation x 2,00 \$ | |
| _ | Statistics exte | ent | Whole raster |
| | Accuracy | | Estimate (faster) |
| | | | |
| | ▼ Color Render | ing | |
| | Blending mode | Normal | • Reset |
| | Brightness | 0 | Contrast 0 |
| | Saturation | | Grayscale Off |
| | Hue | Colorize | Strength 100% _ |
| | Resampling | | |
| | Zoomed: in Ne | arest neighbour 👻 out Ne | arest neighbour 👻 Oversampling 2,00 🌩 |
| | Th | umbnail Legend | Palette |
| | | | |
| | Help Sty | le 🔻 | ✓ Apply X Cancel ✓ OK |

The default *Color gradient* is set to Black to white, meaning that low pixel values are black and while high values are white. Try to invert this setting to White to black and see the results.

Very important is the *Contrast enhancement* parameter: by default it is set to Stretch to MinMax meaning that the pixel values are stretched to the minimum and maximum values.

Look at the difference with the enhancement (left) and without (right):



But what are the minimum and maximum values that should be used for the stretch? The ones that are currently under *Min / Max Value Settings*. There are many ways to calculate the minimum and maximum values and use them for the stretch:

- 1. User Defined: you enter the Min and Max values manually
- 2. **Cumulative count cut**: this is useful when you have some extreme low or high values. It *cuts* the 2% (or the value you choose) of these values
- 3. Min / max: the Real or Estimated minimum and maximum values of the raster
- 4. Mean +/- standard deviation: the values will be calculated according to the mean value and the standard deviation

7.2.4 ???? Follow Along: Singleband pseudocolor

Grayscales are not always great styles for raster layers. Let's try to make the DEM more colorful.

- Change the *Render type* to *Singleband pseudocolor*. If you don't like the default colors loaded, select another *Color ramp*
- Click the *Classify* button to generate a new color classification
- If it is not generated automatically click on the OK button to apply this classification to the DEM

| | La | ayer Pro | operties | - srtm_41_1 | 9 Symbolog | у | | (| |
|------------------|----------------------|----------|----------|-------------|--------------|-------|------------------|--------------|--|
| Q | 💌 Band Render | ing | | | | | | | |
| 🥡 Information | Render type | ingleba | nd pseu | docolor 👻 | | | | | |
| Nource | Band | | Band 1 | (Gray) | | | | • | |
| Symbology | Min | | 0 | | Max | | 1548 | | |
| Iransparency | Min / Max | Value S | ettings | | | | | | |
| Histogram | Interpolation | | | Linear | | | | • | |
| 💉 Rendering | Color ramp | | | | | | | | |
| Pyramids | Label unit suffix | | | | | | | | |
| | Value | Color | Label | | | | | | |
| | 0 | | 0 | | | | | | |
| E Legend | 387 | | 387 | | | | | | |
| CGIS Server QGIS | 774 | | 774 | | | | | | |
| | 1161 | | 1161 | | | | | | |
| | 1101 | | 1101 | | | | | | |
| | 1548 | | 1548 | | | | | | |
| | | | | | | | | | |
| | Mode Contin | uous | • | | | | Classes 5 | 5 | |
| | Classify 🖶 😑 🐟 📄 🔜 | | | | | | | | |
| | Clip out of | range va | alues | | | | | | |
| | ▼ Color Render | ing | | | | | | | |
| | Help Sty | ∕le - | | | | Apply | × <u>C</u> ancel | <u> √о</u> к | |

Veți vedea un raster care arată în felul următor:



This is an interesting way of looking at the DEM. You will now see that the values of the raster are again properly displayed, going from blue for the lower areas to red for the higher ones.

7.2.5 Follow Along: Changing the transparency

Sometimes changing the transparency of the whole raster layer can help you to see other layers covered by the raster itself and better understand the study area.

To change the transparency of the whole raster switch to the *Transparency* tab and use the slider of the *Global Opacity* to lower the opacity:

| | Layer Properties - | srtm_41_19 Transparency | | |
|-------------------------------|--|---------------------------|---------------------|------------|
| Q | ▼ Global Opacity | | | |
| 🥡 Information | | 0 | 55.6 % | 6 🖾 🗘 |
| Source | ▼ No Data Value | | | |
| 🐳 Symbology | No data value not defined | | | |
| Transparency | Additional no data value | | | |
| 📐 Histogram | Custom Transparency Option | ns | | |
| N Pondoring | Transparency band None | | | - |
| Kendening | Transparent pixel list | | | |
| A Pyramids | From | То | Percent Transparent | |
| 📝 Metadata | | | | |
| E Legend | | | | |
| QGIS Server | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | 🔀 Help 🛛 Style 👻 | | ✓ Apply ● Cancel | <u>Ф</u> к |

More interesting is changing the transparency for some pixel values. For example in the raster we used you can see a homogeneous color at the corners. To set these pixels as transparent, go to *Custom Transparency Options* in the *Transparency* tab.

- By clicking on the Add values manually button, you can add a range of values and set their transparency percentage
- For single values the ^{Add} values from display</sup> button is more useful
- Click on the Add values from display button. The dialog disappears, and you can interact with the map.
- Click on the homogeneous color in a corner of the DEM
- You will see that the transparency table will be filled with the clicked values:

| | Layer Properties - s | rtm_41_19 Tran | sparency | 8 |
|---------------|--------------------------|------------------|-------------------------|-------------|
| ۹ | ▼ Global Opacity | | | |
| 🥡 Information | | | □ 100,0 % | Ť |
| 🇞 Source | ▼ No Data Value | | | |
| 😻 Symbology | 🗌 No data value 🛛 not de | fined | | |
| Transparency | Additional no data value | | | |
| 📐 Histogram | Custom Transparency | Options | | |
| ≼ Rendering | Transparency band Non | e | • | |
| Revramids | Transparent pixel list | | | |
| | From | То | Percent Transparent | ÷ |
| 📝 Metadata | 1 0 | 0 | 100 | |
| 듣 Legend | | | | |
| 🔯 QGIS Server | | | | |
| | | | | |
| | | | | |
| | ②Help Style ▼ | | ✓Apply ¥ <u>C</u> ancel | <u>/о</u> к |

• Click on *OK* to close the dialog and see the changes.



See? The corners are now 100% transparent.

7.2.6 În concluzie

These are some the basic functions to get you started with raster symbology. QGIS also gives you many other options, such as symbolizing a layer using paletted/unique values, representing different bands with different colors in a multispectral image, or making an automatic hillshade effect (useful only with DEM raster files).

7.2.7 Referință

The SRTM dataset was obtained from CGIAR CSI website.

7.2.8 Ce urmează?

Acum, că putem vedea datele noastre afișate corect, să investigăm modul în care putem analiza mai departe.

7.3 Lesson: Terrain Analysis

Anumite tipuri de rastere vă permit să câștigați o perspectivă mai largă asupra terenului pe care îl reprezintă. Modelele Digitale ale Elevației (DEMS) sunt deosebit de utile în această privință. În această lecție veți folosi anumite instrumente pentru analiza terenului, pentru a afla mai multe despre zona de studiu, în scopul dezvoltării rezidențiale propuse de mai devreme.

Scopul acestei lecții: De a utiliza instrumentele de analiză a terenului pentru a extrage mai multe informații despre teren.

7.3.1 ???? Follow Along: Calculating a Hillshade

We are going to use the same DEM layer as in the previous lesson. If you are starting this chapter from scratch, use the *Browser* panel and load the raster/SRTM/srtm_41_19.tif.

The DEM layer shows you the elevation of the terrain, but it can sometimes seem a little abstract. It contains all the 3D information about the terrain that you need, but it doesn't look like a 3D object. To get a better impression of the terrain, it is possible to calculate a *hillshade*, which is a raster that maps the terrain using light and shadow to create a 3D-looking image.

We are going to use algorithms in the *Raster* ► *Raster terrain analysis* menu.

- 1. Click on the Hillshade menu
- 2. The algorithm allows you to specify the position of the light source: *Azimuth* has values from 0 (North) through 90 (East), 180 (South) and 270 (West), while the *Vertical angle* sets how high the light source is (0 to 90 degrees).
- 3. We will use the following values:
 - *Z factor* at 1.0
 - Azimuth (horizontal angle) at 300.0°
 - Vertical angle at 40.0°



- $\mbox{4. Save the file in a new folder {\tt exercise_data/raster_analysis/with the name hillshade.tif } \\$
- 5. Finally click on Run

Aveți acum un nou strat denumit hillshade, care arată astfel:



That looks nice and 3D, but can we improve on this? On its own, the hillshade looks like a plaster cast. Can't we use it together with our other, more colorful rasters somehow? Of course we can, by using the hillshade as an overlay.

7.3.2 ???? Follow Along: Using a Hillshade as an Overlay

Umbra versanților poate furniza informații foarte utile despre lumina solară, la un moment dat al zilei. Ea poate fi, de asemenea, utilizată în scopuri estetice, pentru a face harta să arate mai bine. Cheia pentru acest lucru este setarea reliefului de a fi în cea mai mare parte transparent.

- 1. Change the symbology of the original *srtm_41_19* layer to use the *Pseudocolor* scheme as in the previous exercise
- 2. Hide all the layers except the *srtm_41_19* and *hillshade* layers
- 3. Click and drag the *srtm_41_19* to be beneath the *hillshade* layer in the *Layers* panel
- 4. Set the *hillshade* layer to be transparent by clicking on the *Transparency* tab in the layer properties
- 5. Set the *Global opacity* to 50%.

You'll get a result like this:



6. Switch the *hillshade* layer off and back on in the *Layers* panel to see the difference it makes.

Using a hillshade in this way, it's possible to enhance the topography of the landscape. If the effect doesn't seem strong enough to you, you can change the transparency of the *hillshade* layer; but of course, the brighter the hillshade becomes, the dimmer the colors behind it will be. You will need to find a balance that works for you.

Remember to save the project when you are done.

7.3.3 Follow Along: Finding the best areas

Think back to the estate agent problem, which we last addressed in the *Vector Analysis* lesson. Let us imagine that the buyers now wish to purchase a building and build a smaller cottage on the property. In the Southern Hemisphere, we know that an ideal plot for development needs to have areas on it that:

- are north-facing
- with a slope of less than 5 degrees
- But if the slope is less than 2 degrees, then the aspect doesn't matter.

Let's find the best areas for them.

7.3.4 ???? Follow Along: Calculating the Slope

Slope informs about how steep the terrain is. If, for example, you want to build houses on the land there, then you need land that is relatively flat.

To calculate the slope, you need to use the *Slope* algorithm of the *Processing* > *Raster terrain analysis*.

- 1. Open the algorithm
- 2. Choose *srtm_41_19* as the *Elevation layer*
- 3. Keep the *Z* factor at 1.0
- 4. Save the output as a file with the name slope.tif in the same folder as the hillshade.tif
- 5. Click on Run

Now you'll see the slope of the terrain, each pixel holding the corresponding slope value. Black pixels show flat terrain and white pixels, steep terrain:



7.3.5 ???? Try Yourself: Calculating the aspect

Aspect is the compass direction that the slope of the terrain faces. An aspect of 0 means that the slope is North-facing, 90 East-facing, 180 South-facing, and 270 West-facing.

Since this study is taking place in the Southern Hemisphere, properties should ideally be built on a north-facing slope so that they can remain in the sunlight.

Use the *Aspect* algorithm of the *Processing* \blacktriangleright *Raster terrain analysis* to get the aspect.tif layer saved along with the slope.tif.

Răspuns

Set your Aspect dialog up like this:

| Q Aspect | | | × | | |
|--|---|--|-------------|--|--|
| Parameters Log Elevation layer Image: srtm_41_19 [EPSG:32733] Image: srtm_41_19 [EPSG:32733] Z factor 1.000000 Image: srtm_41_40 [EPSG:32733] Aspect QGIS-Training-Data/exercise_data/raster_analysis/aspect.tif Image: srtm_41_10 [EPSG:32733] Image: srtm_41_10 [EPSG:32733] Image: srtm_41_10 [EPSG:32733] Image: srtm_41_10 [EPSG:32733] <th>•</th> <th colspan="4">Aspect This algorithm calculates the aspect of the Digital Terrain Model in input. The final aspect raster layer contains values from 0 to 360 that express the slope direction: starting from North (0°) and continuing clockwise.</th> | • | Aspect This algorithm calculates the aspect of the Digital Terrain Model in input. The final aspect raster layer contains values from 0 to 360 that express the slope direction: starting from North (0°) and continuing clockwise. | | | |
| 0% Run as Batch Process | | Run Close | Cancel Help | | |

Your result:



7.3.6 ???? Follow Along: Finding the north-facing aspect

Now, you have rasters showing you the slope as well as the aspect, but you have no way of knowing where ideal conditions are satisfied at once. How could this analysis be done?

Răspunsul se află cu ajutorul: Calculatorului raster.

QGIS has different raster calculators available:

- Raster ► Raster Calculator
- In processing:
 - Raster Analysis ► Raster calculator
 - GDAL ► Raster miscellaneous ► Raster calculator
 - SAGA \blacktriangleright Raster calculus \blacktriangleright Raster calculator

Each tool is leading to the same results, but the syntax may be slightly different and the availability of operators may vary.

We will use Raster Analysis - Raster calculator in the Processing Toolbox

- 1. Open the tool by double clicking on it.
 - The upper left part of the dialog lists all the loaded raster layers as name@N, where name is the name of the layer and N is the band.
 - In the upper right part you will see a lot of different operators. Stop for a moment to think that a raster is an image. You should see it as a 2D matrix filled with numbers.
- 2. North is at 0 (zero) degrees, so for the terrain to face north, its aspect needs to be greater than 270 degrees or less than 90 degrees. Therefore the formula is:

 $aspect@1 \le 90 \text{ OR } aspect@1 \ge 270$

- 3. Now you have to set up the raster details, like the cell size, extent and CRS. This can be done manually or it can be automatically set by choosing a Reference layer. Choose this last option by clicking on the ... button next to the *Reference layer(s)* parameter.
- 4. In the dialog, choose the aspect layer, because we want to obtain a layer with the same resolution.
- 5. Save the layer as aspect_north.tif.

The dialog should look like:

| Log | | | | | | | Raster calculator |
|--|--|---------------------|----------------|------|--------|----------|---|
| pression | Oncenteurs | | | | | | This algorithm allows performing algebraic operations using raster layers. |
| Layers | Operators | | | | | | The resulting layer will have its values computed according |
| aspect@1 hillshade@1 | + | * | COS | sin | log 10 | AND | an expression. The expression can contain numerical value operators and references to any of the layers in the curre |
| slope@1 | - | 1 | acos | asin | In | OR | project. The following functions are also supported: |
| srtm_41_19@1 | ^ | sqrt | tan | atan | (|) | - sin(), cos(), tan(), atan2(), ln(), log10() |
| | < | > | = | != | <= | >= | The extent, cell size, and output CRS can be defined by th |
| | abs | min | max | | | | covers selected reference layer(s) will be used. If the cell is not specified, the minimum cell size of selected reference |
| | | | | | | | layer(s) will be used. If the output CRS is not specified, th |
| xpression | | | | | | | CRS of the first reference layer will be used. |
| aspect@1 <= 90 OR | aspect@1 >= 270 | | | | | | The cell size is assumed to be the same in both X and Y ax |
| | | | | | | | Layers are referred by their name as displayed in the layer and the number of the band to use (based on 1), using the |
| | | | | | | | pattern 'layer_name@band number'. For instance, the fir band from a layer named DEM will be referred as DEM@1. |
| Expression is valid | | | | | | | When using the calculator in the batch interface or from t |
| wodofinad overvassi | | | | | | | console, the files to use have to be specified. The |
| reaennea expresso | ons | | | | | | file (without the full path). For instance, if using a layer at |
| NDVI | | | | • | Add | Save | referred as rasterfile, tif@1. |
| | | | | | | | |
| erence layer(s) (used t | or automated extent, ce | lisize, and CRS) [o | ptionalj | | | | |
| nputs selected | | | | | | | |
| size (use 0 or empty ti | o set it automatically) (op | luonalj | | | | | |
| 00000 | | | | | | ₩ | |
| nut extent [optional] | | | | | | | |
| put extent [optional] | | | | | | | |
| put extent [optional] t set | | | | | | | |
| put extent [optional] t set put CRS [optional] | | | | | | _ | |
| tput extent [optional] t set tput CRS [optional] | | | | | | • | |
| put extent [optional] t set put CRS [optional] put (dev/oithub/OGIS-Train | ino-Data/exercise data/ | raster analysis/as | pect north tif | | | • | |
| put extent [optional] t set put CRS [optional] put dev/github/QGIS-Train Open output file after | ing-Data/exercise_data/ | raster_analysis/as | pect_north.tif | | | • 🛞 | |
| put extent [optional] t set put CRS [optional] put dev/github/QGIS-Train Open output file after | ing-Data/exercise_data/ running algorithm | raster_analysis/as | pect_north.tif | | | • | |

6. Finally click on Run.

Rezultatul va fi acesta:



The output values are 0 or 1. What does it mean? For each pixel in the raster, the formula we wrote returns whether it matches the conditions or not. Therefore the final result will be **False** (0) and **True** (1).

7.3.7 ???? Try Yourself: More criteria

Now that you have done the aspect, create two new layers from the DEM.

- The first shall identify areas where the slope is less than or equal to 2 degrees
- The second is similar, but the slope should be less than or equal to 5 degrees.
- Save them under exercise_data/raster_analysis as slope_lte2.tif and slope_lte5. tif.

Răspuns

- Set your Raster calculator dialog up with:
- the following expression: slope@1 <= 2
- the slope layer as the *Reference layer(s)*

| arameters Log | | | | | | | Raster calculator |
|----------------------------|---------------------------|---------------------|--------------|------|--------|------|--|
| pression | | | | | | | This algorithm allows performing algebraic operations us |
| ayers | Operators | | | | | | The and the large will have the values are used a second |
| aspect@1 aspect_portb@1 | + | * | cos | sin | log 10 | AND | an expression. The expression can contain numerical v operators and references to any of the layers in the cu |
| hillshade@1 | - | 1 | acos | asin | In | OR | project. The following functions are also supported: |
| srtm_41_19@1 | ^ | sqrt | tan | atan | (|) | - sin(), cos(), tan(), atan2(), ln(), log10() |
| | < | > | = | != | <= | >= | The extent, cell size, and output CRS can be defined by user. If the extent is not specified, the minimum extent |
| | abs | min | max | | | | covers selected reference layer(s) will be used. If the of is not specified, the minimum cell size of selected refere |
| reversion | | | | | | | layer(s) will be used. If the output CRS is not specified, CRS of the first reference layer will be used. |
| xpression | | | | | | | The cell size is assumed to be the same in both X and Y |
| "slope@1" <= 2 | | | | | | | Layers are referred by their name as displayed in the la |
| | | | | | | | and the number of the band to use (based on 1), using pattern "aver name@band number". For instance, the |
| | | | | | | | band from a layer named DEM will be referred as DEM@ |
| Expression is valid | | | | | | | When using the calculator in the batch interface or from console, the files to use have to be specified. The |
| redefined expressio | ns | | | | | | corresponding layers are referred using the base name file (without the full path). For instance, if using a layer |
| NDVI | | | | - | Add | Save | path/to/my/rasterifie.tif, the first band of that layer wi |
| | | | | |) [] | | |
| erence layer(s) (used fi | or automated extent, ce | llsize, and CRS) [d | ptional] | | | | |
| nputs selected | | | | | | | |
| size (use 0 or empty to | set it automatically) [op | itional] | | | | | |
| 00000 | | | | | | | |
| put extent [optional] | | | | | | | |
| t set | | | | | | | |
| put CRS [optional] | | | | | | | |
| | | | | | | • | |
| put | | | | | | | |
| dev/github/QGIS-Traini | ng-Data/exercise_data/ | raster_analysis/sl | ope_lte2.tif | | | | |
| | unning algorithm | | | | | | |
| Open output file after i | | | | | | | |
| Open output file after r | | | | | | | |

• For the 5 degree version, replace the 2 in the expression and file name with 5.

Your results:

• 2 degrees:


• 5 degrees:



7.3.8 ???? Follow Along: Combining Raster Analysis Results

Now you have generated three raster layers from the DEM:

- *aspect_north*: terrain facing north
- *slope_lte2*: slope equal to or below 2 degrees
- *slope_lte5*: slope equal to or below 5 degrees

Where the condition is met, the pixel value is 1. Elsewhere, it is 0. Therefore, if you multiply these rasters, the pixels that have a value of 1 for all of them will get a value of 1 (the rest will get 0).

The conditions to be met are:

- at or below 5 degrees of slope, the terrain must face north
- at or below 2 degrees of slope, the direction that the terrain faces does not matter.

Therefore, you need to find areas where the slope is at or below five degrees AND the terrain is facing north, OR the slope is at or below 2 degrees. Such terrain would be suitable for development.

Pentru a calcula zonele care îndeplinesc aceste criterii:

- 1. Open the Raster calculator again
- 2. Use this expression in *Expression*:

(<code>aspect_north@1 = 1 AND slope_lte5@1 = 1</code>) OR <code>slope_lte2@1 = 1</code>

- 3. Set the *Reference layer(s)* parameter to aspect_north (it does not matter if you choose another they have all been calculated from srtm_41_19)
- 4. Save the output under exercise_data/raster_analysis/ as all_conditions.tif
- 5. Click Run

Rezultatul:



Sugestie: The previous steps could have been simplified using the following command:

| ((aspect@1 <= 90 OR | aspect@1 >= 270) | AND slope@1 <= 5) | OR slope@1 <= 2 |
|---------------------|------------------|-------------------|-----------------|
|---------------------|------------------|-------------------|-----------------|

7.3.9 ???? Follow Along: Simplifying the Raster

As you can see from the image above, the combined analysis has left us with many, very small areas where the conditions are met (in white). But these aren't really useful for our analysis, since they are too small to build anything on. Let us get rid of all these tiny unusable areas.

- 1. Open the *Sieve* tool (*GDAL* ► *Raster Analysis* in the *Processing Toolbox*)
- 2. Set the *Input file* to all_conditions, and the *Sieved* to all_conditions_sieve.tif (under exercise_data/raster_analysis/).
- 3. Set the *Threshold* to 8 (minimum eight contiguous pixels), and check *Use 8-connectedness*.

| Sieve |
|---|
| Parameters Log |
| Input layer |
| all_condition [EPSG:32733] |
| Threshold |
| 8 |
| ✓ Use 8-connectedness |
| Do not use the default validity mask for the input band |
| Validity mask [optional] |
| · · · · · · · · · · · · · · · · · · · |
| Sieved |
| /home/matteo/exercise_data/exercise_data/raster_analysis/all_conditions_sieve.tif |
| ✓ Open output file after running algorithm |
| GDAL/OGR console call |
| |
| 0% Cancel |
| Belp Run as Batch Process X Close ✓Run |

Once processing is done, the new layer will be loaded.



What is going on? The answer lies in the new raster file's metadata.

- Layer Properties all_conditions_sieve | Information Q . Information from provider Information all_conditions_sieve Name /home/matteo/exercise data/exercise data/raster analysis/ 🗞 Source Path all conditions sieve.tit CRS EPSG:32733 - WGS 84 / UTM zone 33S - Projected Symbology 969491.2754000000422820.6196099.3408000003546476 : Extent 1038119.7730999999912456.6250296.9956000000238419 Transparency Unit meters Width 837 Histogram Height 661 Data type Float32 - Thirty two bit floating point GDAL Driver Description GTiff GDAL Driver Metadata GeoTIFF Dataset Description /home/matteo/exercise_data/exercise_data/raster_analysis/ Pyramids all_conditions_sieve.tif Compression Metadata Band 1 STATISTICS_APPROXIMATE=YES STATISTICS_MAXIMUM=1 Legend STATISTICS_MEAN=-266696862.2513 STATISTICS_MINIMUM=-2147483648 🛃 QGIS Server STATISTICS_STDDEV=708237202.43956 More information AREA_OR_POINT=Area Dimensions X: 837 Y: 661 Bands: 1 Origin 969491,6.2503e+6 Pixel Size 81.9934,-81.9934 Identification 🕫 Help ✓ Apply ∉ОК Style Ŧ
- 4. View the metadata under the *Information* tab of the *Layer Properties* dialog. Look the STATISTICS_MINIMUM value:

This raster, like the one it is derived from, should only feature the values 1 and 0, but it has also a very large negative number. Investigation of the data shows that this number acts as a null value. Since we are only after areas that weren't filtered out, let us set these null values to zero.

5. Open the Raster Calculator, and build this expression:

```
(all_conditions_sieve@1 <= 0) = 0
```

This will maintain all non-negative values, and set the negative numbers to zero, leaving all the areas with value 1 intact.

 Save the output under exercise_data/raster_analysis/ as all_conditions_simple. tif.

Rezultatul dvs. arată în felul următor:



This is what was expected: a simplified version of the earlier results. Remember that if the results you get from a tool aren't what you expected, viewing the metadata (and vector attributes, if applicable) can prove essential to solving the problem.

7.3.10 ???? Follow Along: Reclassifying the Raster

We have used the *Raster calculator* to do calculations on raster layers. There is another powerful tool that we can use to extract information from existing layers.

Back to the aspect layer. We know now that it has numerical values within a range from 0 through 360. What we want to do is to *reclassify* this layer to other discrete values (from 1 to 4), depending on the aspect:

- 1 = North (from 0 to 45 and from 315 to 360);
- 2 = East (from 45 to 135)
- 3 = South (from 135 to 225)
- 4 = West (from 225 to 315)

This operation can be achieved with the raster calculator, but the formula would become very very large.

The alternative tool is the *Reclassify by table* tool in *Raster analysis* in the *Processing Toolbox*.

- 1. Open the tool
- 2. Choose aspect as the Input raster layer
- 3. Click on the ... of *Reclassification table*. A table-like dialog will pop up, where you can choose the minimum, maximum and new values for each class.
- 4. Click on the Add row button and add 5 rows. Fill in each row as the following picture and click OK:

| Fixed table | | | | |
|-------------|---------|---------|-------|------------------|
| | Minimum | Maximum | Value | <u>√о</u> к |
| 1 | 0 | 45 | 1 | ¥ <u>C</u> ancel |
| 2 | 315 | 360 | 1 | Add Row |
| 3 | 45 | 135 | 2 | Remove Row(s) |
| 4 | 135 | 225 | 3 | Remove All |
| 5 | 225 | 315 | 4 | |

The method used by the algorithm to treat the threshold values of each class is defined by the *Range boundaries*. 5. Save the layer as reclassified.tif in the exercise_data/raster_analysis/ folder

| Reclassify by Table | 8 |
|--|--|
| Parameters Log Raster layer | Reclassify |
| Aspect [EPSG:32733] Band number Band 1 (Gray) Reclassification table Fixed table (5x3) Advanced parameters Output no data value -9999,00000 | This algorithm reclassifies a raster band by assigning new class values based on the ranges specified in a fixed table. |
| Range boundaries min < value <= max | |
| Reclassified raster rcise_data/raster_analysis/reclassified.sdat ✓ Open output file after running algorithm | |
| 0% O% Process | Cancel |

6. Click on Run

If you compare the native *aspect* layer with the *reclassified* one, there are not big differences. But by looking at the legend, you can see that the values go from 1 to 4.

Let us give this layer a better style.

- 1. Open the Layer Styling panel
- 2. Choose Paletted/Unique values, instead of Singleband gray

3. Click on the *Classify* button to automatically fetch the values and assign them random colors:

| Layer S | Styling | | | | C | PX |
|----------|------------|--------------|------------|---------------|-------|----|
| 👔 rec | lassified | | | | | • |
| * | E Paletted | /Unique valu | les | | • | - |
| | Band | Band 1 (Gra | ay) | | * | |
| <u>#</u> | Color ramp | | Randor | n colors | • | |
| * | Value | Color | Label | | | |
| | 1 | | 1 | | | |
| | 2 | | 2 | | | |
| | 3 | | 3 | | | |
| | 4 | | 4 | | | |
| | | | | | | |
| | Clas | sify | ₽ - | Delete All | | |
| | Layer Kent | iening | | | | |
| | Blending n | node | Normal | | • | Ŧ |
| | • | | | ✓ Live update | Apply | / |
| Layer | Styling Pr | ocessing Too | olbox | | | |

The output should look like this (you can have different colors given that they have been randomly generated):



With this reclassification and the paletted style applied to the layer, you can immediately differentiate the aspect areas.

7.3.11 ???? Follow Along: Querying the raster

Unlike vector layers, raster layers don't have an attribute table. Each pixel contains one or more numerical values (singleband or multiband rasters).

All the raster layers we used in this exercise consist of just one band. Depending on the layer, pixel values may represent elevation, aspect or slope values.

How can we query the raster layer to get the value of a pixel? We can use the Kather Identify Features button!

- 1. Select the tool from the Attributes toolbar.
- 2. Click on a random location of the *srtm_41_19* layer. *Identify Results* will appear with the value of the band at the clicked location:

| Identify Results | 0 🗙 |
|-------------------------------|---------------|
| 🖂 🕵 🟦 🕵 🧏 | i 🗈 👄 i 👯 🕶 🔧 |
| Feature | Value |
| ▼ 0 | srtm_41_19 |
| srtm_41_19 | |
| Band 1 | 592 |
| (Derived) | |
| | |
| Mode Current laye | er 🔹 |
| View Tree - | Help |

3. You can change the output of the *Identify Results* panel from the current tree mode to a table one by selecting *Table* in the *View* menu at the bottom of the panel:

| Identify Result | S | | | ð 🗙 |
|-----------------|-----|-----------|-------|------|
| Layer | FID | Attribute | Value | |
| 1 srtm_41_19 | 1 | Band 1 | 592 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| View Table | • | | | Help |

Clicking each pixel to get the value of the raster could become annoying after a while. We can use the *Value Tool* plugin to solve this problem.

- 1. Go to Plugins ► Manage/Install Plugins...
- 2. In the *All* tab, type value t in the search box
- 3. Select the Value Tool plugin, press Install Plugin and then Close the dialog.



The new Value Tool panel will appear.

Sfat: If you close the panel you can reopen it by enabling it in the *View* \triangleright *Panels* \triangleright *Value Tool* or by clicking on the icon in the toolbar.

- 4. To use the plugin just check the *Enable* checkbox and be sure that the srtm_41_19 layer is active (checked) in the *Layers* panel.
- 5. Move the cursor over the map to see the value of the pixels.



6. But there is more. The Value Tool plugin allows you to query **all** the active raster layers in the *Layers* panel. Set the *aspect* and *slope* layers active again and hover the mouse on the map:



7.3.12 În concluzie

You've seen how to derive all kinds of analysis products from a DEM. These include hillshade, slope and aspect calculations. You've also seen how to use the raster calculator to further analyze and combine these results. Finally you learned how to reclassify a layer and how to query the results.

7.3.13 Ce urmează?

Now you have two analyses: the vector analysis which shows you the potentially suitable plots, and the raster analysis that shows you the potentially suitable terrain. How can these be combined to arrive at a final result for this problem? That's the topic for the next lesson, starting in the next module.

CAPITOLUL 8

Module: Completing the Analysis

Aveți acum două jumătăți ale unei analize: o parte vector și o parte raster. În acest modul, veți afla cum să le combinați. Veți încheia analiza și veți prezenta rezultatele finale.

8.1 Lesson: Raster to Vector Conversion

Conversia între formatele raster și cele vectoriale, vă permite să faceți uz atât de datele raster cât și de cele vectoriale, atunci când rezolvați o problemă GIS, precum și utilizarea diferitelor metode unice de analiză, pentru aceste două forme de date geografice. Acest lucru crește flexibilitatea atunci când luați în calcul sursele de date și metodele de procesare pentru rezolvarea unei probleme GIS.

Pentru a combina analiza raster cu cea vectorială, trebuie să convertiți un tip de date în altul. Haideți să convertim rasterul rezultat din lecția anterioară într-un vector.

Scopul acestei lecții: De a obține rezultatul raster într-un vector, care să poată fi utilizat pentru a completa analiza.

8.1.1 ???? Follow Along: The Raster to Vector Tool

Începeți cu harta de la ultimul modul, raster_analysis.qgs. Ar trebui să aveți all_conditions_simple.tif calculat în timpul exercițiilor anterioare.

- Clic pe Raster ► Conversion ► Polygonize (Raster to Vector). Va apărea fereastra de dialog a instrumentului.
- Setați-l astfel:

| Polygonize (Raster to Vector) |
|--|
| Parameters Log |
| Input layer |
| all_conditions_simple [EPSG:32733] |
| Band number |
| Band 1 (Gray) |
| Name of the field to create |
| suitable |
| Use 8-connectedness |
| Advanced parameters |
| Additional command-line parameters [optional] |
| |
| Vectorized |
| ease_3.10/exercise_data/residential_development/all_terrain.shp |
| ✓ Open output file after running algorithm |
| GDAL/OGR console call |
| gdal_polygonize.py /home/hari/Desktop/QGIS-Training-Data- release_3.10/exercise_data/raster_analysis/all_conditions_simple.tif /home/hari/Desktop/QGIS-Training-Data-release_3.10/ exercise_data/residential_development/all_terrain.shp -b 1 -f "ESRI Shapefile" all_terrain suitable |
| |
| 0% Cancel |
| Belp Run as Batch Process X Close ✓ Run |

- Change the field name (describing the values of the raster) to *suitable*.
- Save the layer under exercise_data/residential_development as all_terrain.shp.

Now you have a vector file which contains all the values of the raster, but the only areas you're interested in are those that are suitable; i.e., those polygons where the value of *suitable* is 1. You can change the style of this layer if you want to have a clearer visualization of it.

8.1.2 ??? Try Yourself:

Consultați înapoi la modulul de analiză vectorială.

- Create a new vector file that contains only the polygons where *suitable* has the value of 1.
- Save the new file under exercise_data/residential_development/ as suitable_terrain.shp.

Răspuns

- Open the *Query Builder* by right-clicking on the *all_terrain* layer in the *Layers* panel, and selecting the *Properties* ► *Source* tab.
- 2. Then build the query "suitable" = 1.
- 3. Click *OK* to filter out all the polygons where this condition isn't met. When viewed over the original raster, the areas should overlap perfectly:

| Polygonize (Raster to Vector) |
|--|
| Parameters Log |
| Input layer |
| all_conditions_simple [EPSG:32733] |
| Band number |
| Band 1 (Gray) |
| Name of the field to create |
| suitable |
| Use 8-connectedness |
| Advanced parameters |
| Additional command-line parameters [optional] |
| |
| Vectorized |
| ease_3.10/exercise_data/residential_development/all_terrain.shp |
| ✓ Open output file after running algorithm |
| GDAL/OGR console call |
| gdal_polygonize.py /home/hari/Desktop/QGIS-Training-Data- release_3.10/exercise_data/raster_analysis/all_conditions_simple.tif /home/hari/Desktop/QGIS-Training-Data-release_3.10/ exercise_data/residential_development/all_terrain.shp -b 1 -f "ESRI Shapefile" all_terrain suitable |
| |
| 0% Cancel |
| ● Help Run as Batch Process ★ Close |

4. You can save this layer by right-clicking on the *all_terrain* layer in the *Layers* panel and choosing *Save As...*, then continue as per the instructions.

8.1.3 ???? Follow Along: The Vector to Raster Tool

Although unnecessary for our current problem, it's useful to know about the opposite conversion from the one performed above. Convert to raster the suitable_terrain.shp vector file you just created in previous step.

Clic pe Raster ► Conversion ► Rasterize (Vector to Raster) pentru a lansa acest instrument, apoi setați-l ca în imaginea de mai jos:

| Rasterize (Vector to Raster) 🛛 🛛 |
|---|
| Parameters Log |
| Input layer |
| [□ all_terrain [EPSG:32733] |
| Selected features only |
| Field to use for a burn-in value [optional] |
| 123 SUITABLE 👻 |
| A fixed value to burn [optional] |
| 0.000000 🚳 🗘 |
| Output raster size units |
| Pixels • |
| Width/Horizontal resolution |
| 837.000000 🚳 🗘 |
| Height/Vertical resolution |
| 616.000000 🗠 🗘 |
| Output extent (xmin, xmax, ymin, ymax) |
| 54,1037709.8059691756,6196099.3408,6250051.015321028 [EPSG:32733] |
| Assign a specified nodata value to output bands [optional] |
| 0.000000 🚳 🗘 |
| ▼ Advanced parameters |
| Additional creation options [optional] |
| Profile Default |
| Namo Valuo |
| |
| |
| 0% Cancel |
| BHelp Run as Batch Process X <u>C</u> lose |

- *Input layer* is *all_terrain*.
- Field name is *suitable*.
- Output raster size units is Pixels.
- *Width* and *Height* are 837 and 661, respectively.
- Get the *Output extent* from the *all_terrain* layer.
- Set output file *Rasterized* to exercise_data/residential_development/ raster_conversion.tif.

Notă: Dimensiunea imaginii de ieșire este specificată aici pentru a fi similară cu cea a rasterului original, care a fost vectorizat. Pentru a vizualiza dimensiunile unei imagini, deschideți-i metadatele (fila *Metadata* din *Proprietățile Stratului*).

- Clic pe OK, în fereastra de dialog, pentru a începe procesul de conversie.
- Atunci când ați încheiat, evaluați succesul prin compararea noului raster cu cel original. Cele două ar trebui să se potrivească exact, pixel cu pixel.

8.1.4 În concluzie

Conversia între formatele raster și cele vectoriale vă permite să extindeți aplicabilitatea datelor, și nu trebuie să ducă la degradarea datelor.

8.1.5 Ce urmează?

Acum, că avem rezultatele analizei de teren disponibile în format vectorial, ele pot fi folosite pentru a rezolva problema clădirii pe care ar trebui să o propunem în scopul dezvoltării rezidențiale.

8.2 Lesson: Combining the Analyses

Folosind rezultatele vectorizate ale analizei raster, veți putea selecta numai acele clădiri de pe terenul potrivit.

Scopul acestei lecții: De a utiliza terenul vectorizat rezultat la selectarea terenurilor adecvate.

8.2.1 ???? Try Yourself:

- 1. Save your current map (raster_analysis.qgs).
- 2. Open the map which you created during the vector analysis earlier (you should have saved the file as analysis.qgs).
- 3. In the *Layers* panel, enable these layers:
 - relieful,
 - *soluția* (or *buildings_over_100*)
- 4. In addition to these layers, which should already be loaded in the map from when you worked on it before, also add the suitable_terrain.shp dataset.
- 5. If you are missing some layers, you should find them in exercise_data/ residential_development/
- 6. Use the *Intersection* tool (*Vector* ► *Geoprocessing Tools*) to create a new vector layer called new_solution. shp which contains only those buildings which intersect the *suitable_terrain* layer.

Ar trebui să aveți de acum un strat care prezintă anumite clădiri din soluția dvs., cum ar fi:



8.2.2 ???? Try Yourself: Inspecting the Results

Uitați-vă la fiecare dintre clădirile dumneavoastră din stratul *new_solution*. Comparați-le cu stratul *suitable_terrain*, prin schimbarea simbologiei stratului *new_solution*, astfel încât acesta să aibă numai are contur. Ce părere aveți despre observa unele dintre clădiri? Sunt toate acestea potrivite doar pentru că se intersectează cu stratul *suitable_terrain*? De ce sau de ce nu? Pe care dintre ele le-ați considera ca fiind necorespunzătoare?

Răspuns

You may notice that some of the buildings in your new_solution layer have been "sliced" by the *Intersection* tool. This shows that only part of the building - and therefore only part of the property - lies on suitable terrain. We can therefore sensibly eliminate those buildings from our dataset.

8.2.3 ???? Try Yourself: Refining the Analysis

Puteți vedea din rezultate, că unele clădirile care au fost incluse nu au fost cu adevărat adecvate, astfel încât să putem rafina acum analiza.

We want to ensure that our analysis returns only those buildings which fall entirely within the *suitable_terrain* layer. How would you achieve this? Use one or more Vector Analysis tools and remember that our buildings are all over 100m squared in size.

Răspuns

At the moment, your analysis should look something like this:



Consider a circular area, continuous for 100 meters in all directions.



If it is greater than 100 meters in radius, then subtracting 100 meters from its size (from all directions) will result in a part of it being left in the middle.



Therefore, you can run an *interior buffer* of 100 meters on your existing *suitable_terrain* vector layer. In the output of the buffer function, whatever remains of the original layer will represent areas where there is suitable terrain for 100 meters beyond.

To demonstrate:

- 1. Go to *Vector* \blacktriangleright *Geoprocessing Tools* \blacktriangleright *Buffer(s)* to open the Buffer(s) dialog.
- 2. Setați-l astfel:

| O O O Buff | er(s) |
|--------------------------------|-------------------|
| Input vector layer | |
| suitable_terrain_34S | \$ |
| Use only selected featur | res |
| Segments to approximate | 10 |
| Buffer distance | -100 |
| O Buffer distance field | |
| suitable | ▼ |
| Dissolve buffer results | |
| Output shapefile | |
| suitable_terrain_continuou | s_100m.shp Browse |
| Add result to canvas | |
| | Close OK |

- 3. Use the *suitable_terrain* layer with 10 segments and a buffer distance of -100. (The distance is automatically in meters because your map is using a projected CRS.)
- 4. Save the output in exercise_data/residential_development/ as suitable_terrain_continuous100m.shp.
- 5. If necessary, move the new layer above your original *suitable_terrain* layer.

Your results will look like something like this:



- 6. Now use the Select by Location tool (Vector \blacktriangleright Research Tools \blacktriangleright Select by location).
- 7. Set up like this:

| 000 | Select by location |
|---------------|-------------------------|
| Select featur | es in: |
| new solutio | on \$ |
| that intersec | t features in: |
| suitable_te | rrain_continuous_100m 🛟 |
| Use select | ed features only |
| Modify curre | nt selection by: |
| creating new | w selection 💲 |
| 🗹 Add result | to canvas |
| | Close OK |

 Select features in *new_solution* that intersect features in *suitable_terrain_continuous100m.shp*. This is the result:



The yellow buildings are selected. Although some of the buildings fall partly outside the new *suitable_terrain_continuous100m* layer, they lie well within the original *suitable_terrain* layer and therefore meet all of our requirements.

 Save the selection under exercise_data/residential_development/ as final_answer. shp.

8.2.4 În concluzie

Ați răspuns acum la întrebarea de cercetare originală, și v-ați conturat deja o opțiune (argumentată și susținută de o analiză) care poate sta la baza unei recomandări cu privire la proprietatea de dezvoltat.

8.2.5 Ce urmează?

Mai departe, vom prezenta aceste rezultate ca parte a celei de-a doua dvs. misiuni.

8.3 Exercițiu

Folosind compozitorul de hărți, creați o nouă hartă care reprezintă rezultatele analizei dumneavoastră. Includeți următoarele straturi:

- locuri (cu etichete),
- relieful,
- soluție (sau noua_soluție),
- *drumuri* și
- fie *aerial_photos*, fie *DEM*.

Scrieți un scurt text explicativ, însoțitor. Includeți în acest text criteriile care au fost luate în considerare pentru achizițiea și dezvoltarea ulterioară a casei, precum și recomandările dvs. de utilizare a clădirilor.

8.4 Lesson: Supplementary Exercise

În această lecție, veți efectua o analiză GIS completă în QGIS.

Notă: Lesson developed by Linfiniti Consulting (South Africa) and Siddique Motala (Cape Peninsula University of Technology)

8.4.1 Definirea Problemei

You are tasked with finding areas in and around the Cape Peninsula that are suitable habitats for a rare fynbos plant species. The extent of your area of investigation covers Cape Town and the Cape Peninsula between Melkbosstrand in the north and Strand in the south. Botanists have provided you with the following preferences exhibited by the species in question:

- It grows on east facing slopes
- It grows on slopes with a gradient between 15% and 60%
- It grows in areas that have a total annual rainfall of > 1000 mm
- It will only be found at least 250 m away from any human settlement
- The area of vegetation in which it occurs should be at least 6000 m^2 in area

As a student at the University, you have agreed to search for the plant in four different suitable areas of land. You want those four suitable areas to be the ones that are closest to the University of Cape Town where you live. Use your GIS skills to determine where you should go to look.

8.4.2 Conturarea unei Soluții

The data for this exercise can be found in the exercise_data/more_analysis folder.

You are going to find the four suitable areas that are closest to the University of Cape Town.

The solution will involve:

- 1. Analyzing a DEM raster layer to find the east facing slopes and the slopes with the correct gradients
- 2. Analyzing a rainfall raster layer to find the areas with the correct amount of rainfall
- 3. Analyzing a zoning vector layer to find areas that are away from human settlement and are of the correct size

8.4.3 Follow Along: Setting up the Map

- 1. Click on the ^{Current CRS} button in the lower right corner of the screen. Under the *CRS* tab of the dialog that appears, use the "Filter" tool to search for "33S". Select the entry *WGS 84 / UTM zone 33S* (with EPSG code 32733).
- 2. Clic pe OK

| Q Project Properties — C | RS | × |
|--------------------------|--|---------------------------------------|
| Q | Project Coordinate Reference System (CRS) | |
| 🔀 General | No CRS (or unknown/non-Earth projection) | |
| Metadata | Filter Q 33s | |
| | Recently Used Coordinate Reference Systems | |
| 🔯 View Settings | Coordinate Reference System | Authority ID |
| | WGS 84 / UTM zone 33S | EPSG:32733 |
| CRS | | |
| Transformations | | |
| ኛ Styles | 4 | |
| Data Sources | Predefined Coordinate Reference Systems | Hide deprecated CRSs |
| E Relations | Coordinate Reference System | Authority ID |
| | Schwarzeck / UTM zone 33S | EPSG:29333 |
| S Variables | WGS 72 / UTM zone 33S | EPSG:32333 |
| | WGS 72BE / UTM zone 33S | EPSG:32533 |
| Diacros | WGS 84 / UTM zone 33S | EPSG:32733 |
| | • | |
| 📲 QGIS Server | WGS 84 / UTM zone 335 | · · · · · · · · · · · · · · · · · · · |
| Temporal | Properties Units: meters Dynamic (relies on a datum which is not plate- fixed) | |
| | | OK Cancel Apply Help |

Fig. 8.1: Setting up the CRS

3. Save the project file by clicking on the $\boxed{\blacksquare}$ Save Project toolbar button, or use the *Project* \blacktriangleright Save As... menu item.

Save it in a new directory called Rasterprac, that you should create somewhere on your computer. You will save whatever layers you create in this directory as well. Save the project as your_name_fynbos.qgs.

8.4.4 Încărcarea Datelor în Hartă

In order to process the data, you will need to load the necessary layers (street names, zones, rainfall, DEM, districts) into the map canvas.

Pentru vectori...

- 1. Click on the ^V_□ ^{Open Data Source Manager} button in the *Data Source Manager Toolbar*, and enable the ^V_□ *Vector* tab in the dialog that appears, or use the *Layer* ► *Add Layer* ► ^V_□ *Add Vector Layer*... menu item
- 2. Ensure that *File* is selected
- 3. Click on the ... button to browse for vector dataset(s)
- 4. In the dialog that appears, open the exercise_data/more_analysis/Streets directory
- 5. Selectați fișierul Street_Names_UTM33S.shp
- 6. Clic pe Deschidere.

The dialog closes and shows the original dialog, with the file path specified in the text field next to *Vector dataset(s)*. This allows you to ensure that the correct file is selected. It is also possible to enter the file path in this field manually, should you wish to do so.

- 7. Click *Add*. The vector layer will be loaded into your map. Its color is automatically assigned. You will change it later.
- 8. Rename the layer to Streets
 - 1. Right-click on it in the Layers panel (by default, the pane along the left-hand side of the screen)
 - 2. Click Rename in the dialog that appears and rename it, pressing the Enter key when done
- 9. Repeat the vector adding process, but this time select the Generalised_Zoning_Dissolve_UTM33S. shp file in the Zoning directory.
- 10. Rename it to Zoning.
- 11. Load also the vector layer admin_boundaries/Western_Cape_UTM33S.shp into your map.
- 12. Rename it to Districts.

For rasters...

- 1. Click on the Goven Data Source Manager button and enable the Raster tab in the dialog that appears, or use the Layer ► Add Layer ► Add Raster Layer... menu item
- 2. Ensure that *File* is selected
- 3. Navigate to the appropriate file, select it, and click Open
- 4. Do this for each of the following two raster files, DEM/SRTM.tif and rainfall/reprojected/ rainfall.tif
- 5. Rename the SRTM raster to DEM and the rainfall raster to Rainfall (with an initial capital)

8.4.5 Modificarea ordinii straturilor

Click and drag layers up and down in the *Layers* panel to change the order they appear in on the map so that you can see as many of the layers as possible.

Now that all the data is loaded and properly visible, the analysis can begin. It is best if the clipping operation is done first. This is so that no processing power is wasted on computing values in areas that are not going to be used anyway.

8.4.6 Găsires Districtelor Corecte

Due to the aforementioned area of investigation, we need to limit our districts to the following ones:

- Bellville
- Cape
- Goodwood
- Kuils River
- Mitchells Plain
- Simon Town
- Wynberg
- 1. Right-click on the Districts layer in the Layers panel.
- 2. In the menu that appears, select the Filter... menu item. The Query Builder dialog appears.
- 3. You will now build a query to select only the candidate districts:

- 1. In the *Fields* list, double-click on the NAME_2 field to make it appear in the *SQL* where clause text field below
- 2. Click the IN button to append it to the SQL query
- 3. Open the brackets
- 4. Click the All button below the (currently empty) Values list.

After a short delay, this will populate the Values list with the values of the selected field (NAME_2).

- 5. Double-click the value Bellville in the Values list to append it to the SQL query.
- 6. Add a comma and double-click to add Cape district
- 7. Repeat the previous step for the remaining districts
- 8. Close the brackets



Fig. 8.2: Query builder The final query should be (the order of the districts in the brackets does not matter):

```
"NAME_2" in ('Bellville', 'Cape', 'Goodwood', 'Kuils River',
'Mitchells Plain', 'Simon Town', 'Wynberg')
```

Notă: You can also use the OR operator; the query would look like this:

```
"NAME_2" = 'Bellville' OR "NAME_2" = 'Cape' OR
"NAME_2" = 'Goodwood' OR "NAME_2" = 'Kuils River' OR
"NAME_2" = 'Mitchells Plain' OR "NAME_2" = 'Simon Town' OR
"NAME_2" = 'Wynberg'
```

1. Click OK twice.

The districts shown in your map are now limited to those in the list above.

8.4.7 Decuparea Rasterelor

Acum, că aveți o zonă de interes, puteți decupa rasterele după ea.

- 1. Open the clipping dialog by selecting the menu item *Raster* ► *Extraction* ► *Clip Raster by Mask Layer...*
- 2. In the Input layer dropdown list, select the DEM layer
- 3. In the Mask layer dropdown list, select the Districts layer
- 4. Scroll down and specify an output location in the *Clipped (mask)* text field by clicking the ... button and choosing *Save to File...*
 - 1. Navigate to the Rasterprac directory
 - 2. Enter a file name DEM_clipped.tif
 - 3. Save
- 5. Make sure that *Open output file after running algorithm* is checked
- 6. Click Run

After the clipping operation has completed, leave the *Clip Raster by Mask Layer* dialog open, to be able to reuse the clipping area

7. Select the Rainfall raster layer in the *Input layer* dropdown list and save your output as Rainfall_clipped.tif

- 8. Do not change any other options. Leave everything the same and click Run.
- 9. After the second clipping operation has completed, you may close the Clip Raster by Mask Layer dialog
- 10. Save the map



Fig. 8.3: Map view with filtered vector, clipped raster and reordered layers

Align the rasters

For our analysis we need the rasters to have the same CRS and they have to be aligned.

First we change the resolution of our rainfall data to 30 meters (pixel size):

- 1. In the *Layers* panel, ensure that Rainfall_clipped is the active layer (i.e., it is highlighted by having been clicked on)
- 2. Click on the Raster > Projections > Warp (Reproject)... menu item to open the Warp (Reproject) dialog
- 3. Under Resampling method to use, select Bilinear (2x2 kernel) from the drop down menu
- 4. Set Output file resolution in target georeferenced units to 30
- 5. Scroll down to *Reprojected* and save the output in your rainfall/reprojected directory as Rainfall30.tif.
- 6. Make sure that *Open output file after running algorithm* is checked

Fig. 8.4: Warp (Reproject) Rainfall_clipped

Then we align the DEM:

- 1. In the *Layers* panel, ensure that DEM_clipped is the active layer (i.e., it is highlighted by having been clicked on)
- 2. Click on the Raster Projections Warp (Reproject)... menu item to open the Warp (Reproject) dialog
- 3. Under Target CRS, select Project CRS: EPSG:32733 WGS 84 / UTM zone 33S from the drop down menu
- 4. Under Resampling method to use, select Bilinear (2x2 kernel) from the drop down menu
- 5. Set Output file resolution in target georeferenced units to 30
- 6. Scroll down to *Georeferenced extents of output file to be created*. Use the button to the right of the text box to select *Calculate from Layer* ► *Rainfall30*.
- 7. Scroll down to Reprojected and save the output in your DEM/reprojected directory as DEM30.tif.
- 8. Make sure that *Open output file after running algorithm* is checked

Pentru a vedea în mod corespunzător ce se întâmplă, simbolistica pentru straturi trebuie să fie schimbată.

8.4.8 Schimbarea simbologiei straturilor vectoriale

- 1. In the Layers panel, right-click on the Streets layer
- 2. Select Properties from the menu that appears
- 3. Switch to the Symbology tab in the dialog that appears
- 4. Click on the Line entry in the top widget
- 5. Select a symbol in the list below or set a new one (color, transparency, ...)
- 6. Click OK to close the Layer Properties dialog. This will change the rendering of the Streets layer.
- 7. Follow a similar process for the Zoning layer and choose an appropriate color for it

8.4.9 Schimbarea simbologiei straturilor raster

Simbologia straturilor raster este oarecum diferită.

- 1. Open the Properties dialog for the Rainfall30 raster layer
- 2. Switch to the *Symbology* tab. You'll notice that this dialog is very different from the version used for vector layers.
- 3. Expand Min/Max Value Settings
- 4. Ensure that the button Mean +/- standard deviation is selected
- 5. Make sure that the value in the associated box is 2.00
- 6. For Contrast enhancement, make sure it says Stretch to MinMax
- 7. For Color gradient, change it to White to Black
- 8. Clic pe OK

Fig. 8.5: Raster symbology

The Rainfall30 raster, if visible, should change colors, allowing you to see different brightness values for each pixel

9. Repeat this process for the DEM30 layer, but set the standard deviations used for stretching to 4.00

8.4.10 Curățarea hărții

- 1. Remove the original Rainfall and DEM layers, as well as Rainfall_clipped and DEM_clipped from the *Layers* panel:
 - Clic-dreapta pe aceste straturi apoi selectați Remove.

Nota: Acest lucru nu va elimina datele de pe dispozitivul de stocare, doar le va scoate din harta dvs.

- 2. Save the map
- 3. You can now hide the vector layers by unchecking the box next to them in the *Layers* panel. This will make the map render faster and will save you some time.

8.4.11 Crearea reliefului

In order to create the hillshade, you will need to use an algorithm that was written for this purpose.

- 1. In the Layers panel, ensure that DEM30 is the active layer (i.e., it is highlighted by having been clicked on)
- 2. Click on the Raster > Analysis > Hillshade... menu item to open the Hillshade dialog
- 3. Scroll down to Hillshade and save the output in your Rasterprac directory as hillshade.tif
- 4. Make sure that *Open output file after running algorithm* is checked
- 5. Click Run
- 6. Așteptați să se termine prelucrarea.

| and the second s | |
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| | |
| 100 | |
| 712 | |
| 600 | |
| Sec. 1 | |

Fig. 8.6: Raster analysis Hillshade

The new hillshade layer has appeared in the Layers panel.

- 1. Right-click on the hillshade layer in the Layers panel and bring up the Properties dialog
- 2. Click on the Transparency tab and set the Global Opacity slider to 20%
- 3. Clic pe OK
- 4. Note the effect when the transparent hillshade is superimposed over the clipped DEM. You may have to change the order of your layers, or click off the Rainfall30 layer in order to see the effect.

8.4.12 Panta

- 1. Click on the Raster ► Analysis ► Slope... menu item to open the Slope algorithm dialog
- 2. Select DEM30 as Input layer
- 3. Check Slope expressed as percent instead of degrees. Slope can be expressed in different units (percent or degrees). Our criteria suggest that the plant of interest grows on slopes with a gradient between 15% and 60%. So we need to make sure our slope data is expressed as a percent.
- 4. Specify an appropriate file name and location for your output.
- 5. Make sure that M Open output file after running algorithm is checked

6. Click Run

Fig. 8.7: Raster analysis Slope

The slope image has been calculated and added to the map. As usual, it is rendered in grayscale. Change the symbology to a more colorful one:

- 1. Open the layer *Properties* dialog (as usual, via the right-click menu of the layer)
- 2. Click on the Symbology tab
- 3. Where it says Singleband gray (in the Render type dropdown menu), change it to Singleband pseudocolor
- 4. Choose Mean +/- standard deviation x for Min / Max Value Settings with a value of 2.0
- 5. Select a suitable Color ramp
- 6. Click Run

8.4.13 Try Yourself: Aspect

Use the same approach as for calculating the slope, choosing Aspect... in the Raster ► Analysis menu.

Remember to save the project periodically.

8.4.14 Reclasificarea rasterelor

- 1. Choose Raster \blacktriangleright Raster calculator...
- 2. Specify your Rasterprac directory as the location for the *Output layer* (click on the ... button), and save it as slope15_60.tif
- 3. Ensure that the Open output file after running algorithm box is selected.

In the *Raster bands* list on the left, you will see all the raster layers in your *Layers* panel. If your Slope layer is called *slope*, it will be listed as *slope@1*. Indicating band 1 of the slope raster.

4. The slope needs to be between 15 and 60 degrees.

Using the list items and buttons in the interface, build the following expression:

(slope@1 > 15) AND (slope@1 < 60)

- 5. Alegeți o locație pentru câmpul Output layer și numele de fișier corespunzător.
- 6. Clic pe Run



Fig. 8.8: Raster calculator Slope

Now find the correct aspect (east-facing: between 45 and 135 degrees) using the same approach.

1. Build the following expression:

(aspect@1 > 45) AND (aspect@1 < 135)

You will know it worked when all of the east-facing slopes are white in the resulting raster (it's almost as if they are being lit by the morning sunlight).

Find the correct rainfall (greater than 1000 mm) the same way. Use the following expression:

Rainfall30@1 > 1000

Now that you have all three criteria each in separate rasters, you need to combine them to see which areas satisfy all the criteria. To do so, the rasters will be multiplied with each other. When this happens, all overlapping pixels with a value of 1 will retain the value of 1 (i.e. the location meets the criteria), but if a pixel in any of the three rasters has the value of 0 (i.e. the location does not meet the criteria), then it will be 0 in the result. In this way, the result will contain only the overlapping areas that meet all of the appropriate criteria.

8.4.15 Combinarea rasterelor

- 1. Open the *Raster Calculator* (*Raster* ► *Raster Calculator*...)
- 2. Build the following expression (with the appropriate names for your layers):

[aspect45_135] * [slope15_60] * [rainfall_1000]

- 3. Set the output location to the Rasterprac directory
- 4. Name the output raster aspect_slope_rainfall.tif
- 5. Ensure that *Open output file after running algorithm* is checked
- 6. Click Run

The new raster now properly displays the areas where all three criteria are satisfied.

Save the project.

```
1
```

Fig. 8.9: Map view where all three criteria are satisfied

The next criterion that needs to be satisfied is that the area must be 250 m away from urban areas. We will satisfy this requirement by ensuring that the areas we compute are inside rural areas, and are 250 m or more from the edge of the area. Hence, we need to find all rural areas first.

8.4.16 Găsirea zonele rurale

- 1. Hide all layers in the Layers panel
- 2. Unhide the Zoning vector layer
- 3. Right-click on it and bring up the *Attribute Table* dialog. Note the many different ways that the land is zoned here. We want to isolate the rural areas. Close the Attribute table.
- 4. Right-click on the Zoning layer and select Filter... to bring up the Query Builder dialog
- 5. Build the following query:

"Gen_Zoning" = 'Rural'

See the earlier instructions if you get stuck.

6. Click OK to close the Query Builder dialog. The query should return one feature.

Query builder Zoning

You should see the rural polygons from the Zoning layer. You will need to save these.

- 1. In the right-click menu for Zoning, select Export ► Save Features As....
- 2. Save your layer under the Rasterprac directory
- 3. Name the output file rural.shp
- 4. Clic pe OK
- 5. Save the project

Now you need to exclude the areas that are within 250m from the edge of the rural areas. Do this by creating a negative buffer, as explained below.

8.4.17 Crearea unui tampon negativ

- 1. Click the menu item Vector ► Geoprocessing Tools ► Buffer...
- 2. In the dialog that appears, select the rural layer as your input vector layer (*Selected features only* should not be checked)
- 3. Set *Distance* to -250. The negative value means that the buffer will be an internal buffer. Make sure that the units are meters in the dropdown menu.
- 4. Check M Dissolve result
- 5. In Buffered, place the output file in the Rasterprac directory, and name it rural_buffer.shp
- 6. Click Save
- 7. Click Run and wait for the processing to complete
- 8. Închideți dialogul Buffer.

Make sure that your buffer worked correctly by noting how the rural_buffer layer is different from the rural layer. You may need to change the drawing order in order to observe the difference.

- 9. Remove the rural layer
- 10. Save the project



Fig. 8.10: Map view with rural buffer

Now you need to combine your rural_buffer vector layer with the aspect_slope_rainfall raster. To combine them, we will need to change the data format of one of the layers. In this case, you will vectorize the raster, since vector layers are more convenient when we want to calculate areas.

8.4.18 Vectorizarea rasterului

- 1. Click on the menu item Raster ► Conversion ► Polygonize (Raster to Vector)...
- 2. Select the aspect_slope_rainfall raster as Input layer
- 3. Set Name of the field to create to suitable (the default field name is DN Digital number data)
- 4. Save the output. Under *Vectorized*, select *Save file as*. Set the location to Rasterprac and name the file aspect_slope_rainfall_all.shp.
- 5. Ensure that *Open output file after running algorithm* is checked
- 6. Click Run
- 7. Close the dialog when processing is complete
| 🔇 Polygonize (Raster to Vector) | × |
|--|-------------------|
| Parameters Log | |
| Input layer | |
| spect_slope_rainfall [EPSG:32733] | • |
| Band number | |
| Band 1 (Gray) | - |
| Name of the field to create | |
| suitable | |
| Use 8-connectedness | |
| ▼ Advanced Parameters | |
| Additional command-line parameters [optional] | |
| | |
| Vectorized | |
| D:/KARTOZA/Rasterprac/aspect_slope_rainfall_all.shp | |
| ✓ Open output file after running algorithm | |
| GDAL/OGR console call | |
| gdal_polygonize.bat D:\KARTOZA\Rasterprac\aspect_slope_rainfall.tiff -b 1 -f "ESRI Shapefile" D:/KAR aspect_slope_rainfall_all.shp aspect_slope_rainfall_all suitable | :TOZA/Rasterprac/ |
| | |
| | |
| 0% | Cancel |
| Advanced * Run as Batch Process Run Close | Help |

Fig. 8.11: Raster to Vector

All areas of the raster have been vectorized, so you need to select only the areas that have a value of 1 in the suitable field. (Digital Number.

- 1. Open the Query Builder dialog (right-click Filter...) for the new vector layer
- 2. Build this query:

| "suitable" = 1 | |
|----------------|--|
|----------------|--|

- 3. Clic pe OK
- 4. After you are sure the query is complete (and only the areas that meet all three criteria, i.e. with a value of 1 are visible), create a new vector file from the results, using the *Export* ► *Save Features As...* in the layer's right-click menu
- 5. Save the file in the Rasterprac directory
- 6. Name the file aspect_slope_rainfall_1.shp
- 7. Remove the $\verb"aspect_slope_rainfall_all" layer from your map$
- 8. Save your project

When we use an algorithm to vectorize a raster, sometimes the algorithm yields what is called "Invalid geometries", i.e. there are empty polygons, or polygons with mistakes in them, that will be difficult to analyze in the future. So, we need to use the "Fix Geometry" tool.

8.4.19 Fixing geometry

- 1. In the Processing Toolbox, search for "Fix geometries", and Execute... it
- 2. For the Input layer, select aspect_slope_rainfall_1
- 3. Under *Fixed geometries*, select *Save file as*, and save the output to Rasterprac and name the file fixed_aspect_slope_rainfall.shp.
- 4. Ensure that M Open output file after running algorithm is checked
- 5. Click Run
- 6. Close the dialog when processing is complete

Now that you have vectorized the raster, and fixed the resulting geometry, you can combine the aspect, slope, and rainfall criteria with the distance from human settlement criteria by finding the intersection of the fixed_aspect_slope_rainfall layer and the rural_buffer layer.

8.4.20 Determining the Intersection of vectors

- 1. Click the menu item Vector ► Geoprocessing Tools ► Intersection...
- 2. In the dialog that appears, select the rural_buffer layer as Input layer
- 3. For the Overlay layer, select the fixed_aspect_slope_rainfall layer
- 4. In Intersection, place the output file in the Rasterprac directory
- 5. Name the output file rural_aspect_slope_rainfall.shp
- 6. Click Save
- 7. Click Run and wait for the processing to complete
- 8. Close the Intersection dialog.

Make sure that your intersection worked correctly by noting that only the overlapping areas remain.

9. Save the project

The next criteria on the list is that the area must be greater than 6000 m^2 . You will now calculate the polygon areas in order to identify the areas that are the appropriate size for this project.

8.4.21 Calculați aria pentru fiecare poligon

- 1. Open the new vector layer's right-click menu
- 2. Select Open attribute table
- 3. Click the *V* Toggle editing button in the top left corner of the table, or press Ctrl+e
- 4. Click the Open field calculator button in the toolbar along the top of the table, or press Ctrl+i
- 5. In the dialog that appears, make sure that *Create new field* is checked, and set the *Output field name* to area The output field type should be a decimal number (real). Set *Precision* to 1 (one decimal).
- 6. In the *Expression* area, type:

\$area

This means that the field calculator will calculate the area of each polygon in the vector layer and will then populate a new integer column (called area) with the computed value.

| Q rural_aspect_slope_rainfall — Field Calculator | r | × |
|---|---|--|
| Only update 0 selected features Create a new field | Update existing field | |
| Create virtual field Output field name area Output field type 1.2 Decimal number (real) Output field length 10 Precision | ▼ | ~ |
| Expression Function Editor | | |
| Image: Second | Q. se Show Help feature function \$area geometry area calculated by this function resp id row_number Aggregates ellipsoid has been set for the project ellipsoid and area unit settings. For example, ellipsoid is set then the calculated area will be ellipsoid an o ellipsoid is set then the calculated will be planimetric. Conditionals Syntax Files and Values Files and Paths Fuezy Matching Geometry affine_transf apply_dash Sarea *area → 42 | Jre. The ects etting if an it then il, and if d area |
| | OK Cancel | Help |

Fig. 8.12: Calculatorul de Câmpuri

- 7. Clic pe OK
- 8. Do the same thing for another new field called id. In Field calculator expression, type:

\$id

Acest lucru ne asigură că fiecare poligon are un ID unic, în scop de identificare.

9. Click *Toggle editing* again, and save your edits if prompted to do so

| Q rural_aspect_slope_rainfall — Features Total: 77, Filtered: 7 − □ × | | | | | |
|---|-------------------|-----------------|----------|---------|----------|
| / | | a ti ≺ ⊘ | 8 🗧 🗧 🛯 | 💊 🍸 🔳 🐥 | 9 |
| | Gen_Zoning | suitable | area | id | |
| 1 | Rural | 1 | 25755.3 | 0 | |
| 2 | Rural | 1 | 12405.3 | 1 | |
| 3 | Rural | 1 | 4492.5 | 2 | |
| 4 | Rural | 1 | 10782.0 | 3 | |
| 5 | Rural | 1 | 1797.1 | 4 | |
| 6 | Rural | 1 | 898.5 | 5 | |
| 7 | Rural | 1 | 50971.4 | 6 | |
| 8 | Rural | 1 | 898.6 | 7 | |
| 9 | Rural | 1 | 5391.3 | 8 | |
| 10 | Rural | 1 | 67387.2 | 9 | |
| 11 | Rural | 1 | 10782.1 | 10 | |
| 12 | Rural | 1 | 3594.0 | 11 | |
| 13 | Rural | 1 | 105537.8 | 12 | |
| 14 | Rural | 1 | 2723.2 | 13 | |
| 15 | Rural | 1 | 898.5 | 14 | |
| | Show All Features | | | | 3 |

Fig. 8.13: Attribute table with area and id columns

8.4.22 Selectarea zonelor cu o dimensiune dată

Acum, că ariile sunt cunoscute:

1. Build a query (as usual) to select only the polygons that are larger than 6000 m^2 . The query is:

"area" > 6000

2. Save the selection in the Rasterprac directory as a new vector layer called suitable_areas.shp.

You now have the suitable areas that meet all of the habitat criteria for the rare fynbos plant, from which you will pick the four areas that are nearest to the University of Cape Town.

8.4.23 Digitize the University of Cape Town

- 1. Create a new vector layer in the Rasterprac directory as before, but this time, use *Point* as *Geometry type* and name it university.shp
- 2. Ensure that it is in the correct CRS (Project CRS: EPSG: 32733 WGS 84 / UTM zone 33S)
- 3. Finish creating the new layer (click OK)
- 4. Hide all layers except the new university layer and the Streets layer.
- 5. Add a background map (OSM):
 - 1. Go to the *Browser* panel and navigate to *XYZ Tiles* ► *OpenStreetMap*
 - 2. Drag and drop the OpenStreetMap entry to the bottom of the Layers panel

Using your internet browser, look up the location of the University of Cape Town. Given Cape Town's unique topography, the university is in a very recognizable location. Before you return to QGIS, take note of where the university is located, and what is nearby.

- 6. Ensure that the Streets layer clicked on, and that the university layer is highlighted in the Layers panel
- 7. Navigate to the *View* ► *Toolbars* menu item and ensure that *Digitizing* is selected. You should then see a toolbar icon with a pencil on it (^{Toggle editing}). This is the *Toggle Editing* button.
- 8. Click the Toggle editing button to enter edit mode. This allows you to edit a vector layer
- 9. Click the [•] [•] ^{Add Point Feature} button, which should be nearby the ^{//} ^{Toggle editing} button
- 10. With the *Add feature* tool activated, left-click on your best estimate of the location of the University of Cape Town
- 11. Supply an arbitrary integer when asked for the id
- 12. Clic pe OK
- 13. Click the 🔯 Save Layer Edits button
- 14. Click the Toggle editing button to stop your editing session
- 15. Save the project

8.4.24 Find the locations that are closest to the University of Cape Town

- 1. Go to the *Processing Toolbox*, locate the *Join Attributes by Nearest* algorithm (*Vector general* ► *Join Attributes by Nearest*) and execute it
- 2. Input layer should be university, and Input layer 2 suitable_areas
- 3. Set an appropriate output location and name (Joined layer)
- 4. Set the Maximum nearest neighbors to 4
- 5. Ensure that M Open output file after running algorithm is checked
- 6. Leave the rest of the parameters with their default values
- 7. Click Run

The resulting point layer will contain four features - they will all have the location of the university and its attributes, and in addition, the attributes of the nearby suitable areas (including the id), and the distance to that location.

- 1. Open the attribute table of the result of the join
- 2. Note the id of the four nearest suitable areas, and then close the attribute table
- 3. Open the attribute table of the suitable_areas layer
- 4. Build a query to select the four suitable areas closest to the university (selecting them using the id field)

Acesta este răspunsul final la întrebarea.

For your submission, create a fully labeled layout that includes the semi-transparent hillshade layer over an appealing raster of your choice (such as the DEM or the slope raster, for example). Also include the university and the suitable_areas layer, with the four suitable areas that are closest to the university highlighted. Follow all the best practices for cartography in creating your output map.

CAPITOLUL 9

Module: Plugins

Plugin-uri vă permit extinderea funcționalitatății QGIS. În acest modul, vi se arată cum să activați și să utilizați plugin-uri.

9.1 Lesson: Installing and Managing Plugins

Pentru a începe să utilizați plugin-uri, trebuie să știți cum să le descărcați, să le instalați și să le activați. Pentru a face acest lucru, veți învăța cum să utilizați *Instalatorul de Plugin-uri* și *Managerul de Plugin-uri*.

Scopul acestei lecții: Pentru a înțelege și pentru a utiliza sistemul de plugin-uri QGIS.

9.1.1 ???? Follow Along: Managing Plugins

- 1. Pentru a deschide Plugin Manager, faceți clic pe elementul de meniu Plugins ► Manage and Install Plugins.
- 2. În fereastra de dialog care apare, identificați plugin-ul Processing:

| Q Plugins All (1081) | | | X |
|------------------------|---------------------------------|---------------------|--------------------------------------|
| 🚵 All | Q processing | | ☑ |
| | 🔹 maps2WinBUGS 🔷 | This is a core plug | in, so you can't uninstall it |
| p Installed | 📤 Mascaret | _ | ماد |
| | 🐀 Maxent Model | Processi | na 🕷 |
| Not installed | Merge Selected Features (Pro | | |
| | 🚖 MOJXML Loader | Contial data no | according from a work for OCIC |
| S New | s MOPST | Spauai uata pi | ocessing manework for Q015 |
| — | 🖕 MOS-Adeupa-CE | Spatial data proces | sing framework for OGIS |
| Install from ZIP | 🚖 Networks | | and handhold for Quie |
| | NTv2 Datum Transformations | | |
| 🧱 Settings | 🗸 🐽 OrfeoToolbox provider | Category | Analysis |
| | ORS Tools | More info | homepage bug tracker code repository |
| | PAT - Precision Agriculture Tc | Author | Victor Olaya |
| | PCRaster Tools | Installed version | 2 12 00 |
| | 🖕 Pelias Geocoding | Instance version | 2.12.55 |
| | PostGIS geoprocessing tools | | |
| | Potential Slope Failure for pro | | |
| | ✓ | | |
| | Processing R Provider | | |
| | Processing Saga NextGen Pro | Upgrade All | Uninstall Plugin Reinstall Plugin |
| | | | Close Help |

- 3. Click in the box next to this plugin and uncheck it to deactivate it.
- 4. Clic Close.
- Looking at the menu, you will notice that the *Processing* menu is is now gone. This means that many of the processing functions you have been using before have disappeared! For example look at the *Vector* ► and *Raster* ► menus. This is because they are part of the *Processing* plugin, which needs to be activated to use them.
- 6. Open the Plugin Manager again and reactivate the Processing plugin by clicking in the checkbox next to it.
- 7. Close the dialog. The Processing menu and functions should be available again.

9.1.2 ???? Follow Along: Installing New Plugins

The list of plugins that you can activate and deactivate draws from the plugins that you currently have installed. To install new plugins:

1. Select the *Not Installed* option in the *Plugin Manager* dialog. The plugins available for you to install will be listed here. This list will vary depending on your existing system setup.

| Q Plugins Not installed | I (1069) | | × |
|--|--|--|----------|
| 溢 All | Q processing | | |
| Not installed Not installed Install from ZIP Settings | AGT - Archaeological Geophy Append Features to Layer ArrNorm Batch Hillshader BecaGIS BoundaryDelineation Buffer Without Overlaps Cartography Tools | Not installed plugins Here you see the list of all plugins available in the repositories but which are not yet installed . Click on the name to see details. You can change the sorting via the context menu (right click) A plugin can be downloaded and installed by clicking on it's name, and then click the 'Install plugin' button. | ;,). |
| | Contour plugin Coregistration Customize ToolBars Danish Address Tools Degree to DMS table converto Disconnected Islands Dissolve Adjacent Polygons DMS to degree table converto dzetsaka : Classification tool Easy Processing Tool | | |
| | 🖕 Equi Processing 🚽 | Upgrade All Uninstall Plugin Reinstall Plugin Close Help | |

2. Find information about the plugin by selecting it in the list

| Q Plugins Not installed | d (1069) | | × |
|---------------------------|---|----------------------------|--|
| iii 💒 | Q, Search | | |
| Installed | CZML Billboard Maker D3 Data Visualization DAI | Data Plotly | K |
| Not installed | Danish Address Tools | D3 Plots for QGIS | |
| (1) Install from ZIP | Data Plotly Data-Driven Input Mask | Draw D3 plots in QGIS | |
| 🔆 Settings | DataExplorer: Data Analysis a Datafordeler Datafordeler | ★★★★★ 95 rating vote | (s), 189842 downloads |
| | DataForsyningen DataGrandEst DataSud | Tags | vector, python, d3, plots, graphs, datavis, dataplotly, dataviz |
| | Date/Time Tools Datos Espaciales de Referenci | More info | homepage bug tracker code repository |
| | DaumAPI DP Style Manager | Author | Matteo Ghetta (Faunalia) |
| | DB Style Manager DBGI DDG Street Images | Available version (stable) | 4.0.3 updated at uto jun 27 09:25:41 2023 |
| | Deactivate Active Labels | | |
| | s debugvs | • | Þ |
| | 🔹 Deepness: Deep Neural Remo | Upgrade All | Install Plugin |
| | | | Close Help |

3. Install the one(s) you are interested in by clicking the *Install Plugin* button below the plugin information panel.

Notă: if the plugin has some error it will be listed in the *Invalid* tab. You can then contact the plugin owner to fix the problem.

9.1.3 ???? Follow Along: Configuring Additional Plugin Repositories

Plugin-urile care sunt disponibile pentru instalare depind de depozitele configurate pentru utilizare.

QGIS plugins are stored online in repositories. By default, only the official repository is active, meaning that you can only access plugins that are published there. Given the diversity of available tools, this repository should meet most of your needs.

Este posibil, totuși, să încercați mai multe plugin-uri decât cele implicite. În primul rând, ați vrea să configurați depozite suplimentare. Pentru a face acest lucru:

1. Open the Settings tab in the Plugin Manager dialog

| Q Plugins Settings | | | | × |
|----------------------|--|--|--|---|
| 📥 All | Check for Upd | ates on Startup | | |
| Installed | If this function repositories will be | is enabled, QGIS will inform you v e performed during opening of the Plug | henever a plugin update is available. Otherwise, fetching in Manager window. | |
| 🗯 Not installed | 🔻 🗸 Show also | Experimental Plugins | | |
| Install from ZIP | Experimental p development, and plugins unless you | lugins are generally unsuitable for d should be considered 'incomplete' or ' u intend to use them for testing purpos | or production use. These plugins are in early stages of oroof of concept' tools. QGIS does not recommend installing these es. | |
| Settings | ▼ Show also | Deprecated Plugins | | |
| | Deprecated plu considered 'obsoli alternatives avail | igins are generally unsuitable for ete' tools. QGIS does not recommend in able. | production use. These plugins are unmaintained, and should be nstalling these plugins unless you still need it and there are no other | |
| | Flugin Repositori | | | |
| | Status | Name | URL | |
| | Connected | QGIS službeni repozitorij dodataka | https://plugins.qgis.org/plugins/plugins.xml?qgis=3.32 | |
| | - Kelodu Kepo | | | |
| | | | Close | |

- 2. Clic pe butonul Adăugare, pentru a găsi și a adăuga un nou depozit.
- 3. Furnizați un Nume și Adresa URL pentru noul depozit pe care doriți să-l configurați și asigurați-vă că este selectată caseta *Enabled*.

| Repository details | | | | |
|--------------------|--|--|--|--|
| Name | Faunalia | | | |
| URL | https://www.faunalia.eu/qgis/plugins.xml | | | |
| Parameters | ?qgis=3.2 | | | |
| Authentication | Clear Edit | | | |
| Enabled | \checkmark | | | |
| | | | | |
| | | | | |
| | | | | |
| | ● <u>C</u> ancel | | | |

4. Veți vedea acum noul depozit de plugin-uri, enumerat în lista Depozitelor configurate pentru Plugin-uri

| | Plugins | Settings | |
|--|--|--|--|
| 🌦 All | Check for updates on startup | | - |
| installed | every time QGIS starts | | * |
| 🍅 Not installed | Note: If this function is enabled, QGIS will i fetching repositories will be performed duri | nform you whenever a new plugin or plug ng opening of the Plugin Manager window | |
| Invalid | ▼ ✓ Show also experimental plugins | | |
| Install from ZIP Settings | Note: Experimental plugins are generally and should be considered 'incomplete' or ' you intend to use them for testing purpose | unsuitable for production use. These plug proof of concept' tools. QGIS does not rec is. | ins are in early stages of development, commend installing these plugins unless |
| | ▼ | | |
| Note: Deprecated plugins are generally unsuitable for production use. These plugins are unmaintained, and should be considered 'obsolete' tools. QGIS does not recommend installing these plugins unless you still need it and there are no other alternatives available. | | | |
| | Plugin repositories | | |
| | Status Name | URL | |
| | Connected Valuation Connected QGIS Official Plugin Reposition | https://plugins.qgis.org/plugins/plugi | ins.xml?qgis=3.2 |
| | Reload all repositories | [| Add Edit Delete |
| | (B) Help | | ≭ <u>⊆</u> lose |

- 5. Puteți selecta, de asemenea, opțiunea de a afișa Plugin-urile Experimentale, prin alegerea Show also experimental plugins
- 6. If you now switch back to the Not Installed tab, you will see that additional plugins are available for installation.
- 7. To install a plugin, click on it in the list and then on the Install plugin button.

9.1.4 În concluzie

Installing plugins in QGIS should be straightforward and effective!

9.1.5 Ce urmează?

Mai departe, vă vom prezenta câteva plugin-uri utile ca exemple.

9.2 Lesson: Useful QGIS Plugins

Acum, că puteți instala, activa și dezactiva plugin-uri, să vedem cum vă poate ajuta în practică acest lucru, privind la câteva exemple de plugin-uri utile.

Scopul acestei lecții: De a vă familiariza cu interfața plugin-urilor și de a face cunoștință cu unele plugin-uri utile.

9.2.1 ???? Follow Along: The QuickMapServices Plugin

The QuickMapServices plugin is a simple and easy to use plugin that adds base maps to your QGIS project. It has many different options and settings. Let's start to explore some of its features.

- 1. Start a new map and add the roads layer from the training_data Geopackage.
- 2. Install the QuickMapServices plugin.
- 3. Click on Web ► QuickMapServices. The first menu lists different map providers (OSM, NASA) with available maps.
- 4. Click on an entry and you would load the base map into your project.



Nice! But one of the main strengths of QMS is to provide access to many data providers. Let's add them.

- 1. Click on Web \blacktriangleright QuickMapServices \blacktriangleright Settings
- 2. Go to the More services tab.
- 3. Read carefully the message of this tab and if you agree click on the Get Contributed pack button.
- 4. Click Save.

- <u>Web M</u>esh Pro<u>c</u>essing <u>H</u>elp MetaSearch QuickMapServices 🕑 2gis 🕐 AutoNavi Bing 📸 ESRI 🍥 GeoQ G Google 🥶 NASA CartoDB 👓 BasemapAT 🔌 Stamen 🖂 USGS Waze 9 Yandex 🔎 OSM ④ Search QMS 4 Add to Search 🕘 Settings About QMS
- 5. Reopen the Web \blacktriangleright QuickMapServices menu you will see that more providers are available.

6. Choose the one that best fits your needs, and load the data in the project!

It is also possible to search trough the now available data providers

- 1. Open the plugin's search tab by clicking on *Web* ► *QuickMapServices* ► *Search QMS*. This option of the plugin allows you to filter the available base maps by the current extent of the map canvas or using a search word.
- 2. Click on the *Filter by extent* and you should see one service available. If no service is found, zoom out and pan around the world (or your location) or search with a keyword.
- 3. Click on the Add button next to a returned dataset to load it.
- 4. The base map will be loaded and you will have a background for the map.



9.2.2 ???? Follow Along: The QuickOSM Plugin

With an incredible simple interface, the QuickOSM plugin allows you to download OpenStreetMap data.

???? Follow Along: Using the Quick Query

- 1. Start a new empty project and add the *roads* layer from the training_data GeoPackage.
- 2. Install the QuickOSM plugin. The plugin adds two new buttons in the QGIS Toolbar and is accessible in the *Vector* ► *QuickOSM* menu.
- 3. Open the QuickOSM dialog. The plugin has many different tabs: we will use the Quick Query one.
- 4. You can download specific features by selecting a generic *Key* or be more specific and choose a specific *Key* and *Value* pair.

Sfat: if you are not familiar with the *Key* and *Value* system, click on the *Help with key/value* button. It will open a web page with a complete description of this concept of OpenStreetMap.

- 5. Look for *railway* in the *Key* menu and let the *Value* be empty: so we are downloading all the *railway* features without specifying any values.
- 6. Select Layer Extent in the next drop-down menu and choose roads.
- 7. Click on the *Run query* button.

| | _ | | | | | |) |
|-------------|---|--|---|-------|----------------------------|-------------|-----|
| Map preset | Hop wit | h key/value | | | | Reset | |
| Quick query | Preset | Not mandatory. Ex: bakery | | | | | ٠ |
| | | Key | | Value | | Add Dal | ete |
| Query | 1 | ralway | Query on all values | 105 | * | * - | |
| CISH Pile | | | | | | | |
| Parameters | | | | | | | |
| About | | | | | | | |
| | | | | | | | |
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| | | | | | | | |
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| | | | | | | | |
| | 20 Layer D | xtent ▼ V ^r raedt | | | • Only set | ected featu | res |
| | Stayer t | there is a set of the large function of the set of the large ${\bf r}$ is the set of the large ${\bf r}$ | xternit are going to be downloaded. | | | ected featu | 16 |
| | Si Layar D Al CSM obje | bitent ▼] [√" made ds with the key "solvery" in the convex or layer e aver gamy in a new preset. [♥] | start are going to be downloaded. Show query | | Only set Ran query | ected featu | 105 |
| | Al CSM obje | blent ▼ | dent are going to be downloaded. Show query | | Only set Ran query | ected featu | res |
| | Starger to Al CEM objects S Coury h Advance | onient ▼] [√ reads chi with the key Yablasy' in the centres or leger e ave query in a new preset. [♥] other sl | dent are going to be downloaded. Show query | | ■ Only set ■ Ran query | ected featu | 765 |
| | Al cost obje | odent ▼] √ reads clowff the key Valleay ¹ in the censes or layer e are garer in a new preset]♥] colory st | dent are going to be downloaded. Show query | | ■ Only set ■ Ran query | ected featu | res |

After some seconds the plugin will download all the features tagged in OpenStreetMap as railway and load them directly into the map.

Nothing more! All the layers are loaded in the legend and are shown in the map canvas.



Atenționare: QuickOSM creates temporary layer when downloading the data. If you want to save them permanently, click on the icon next to the layer and choose the options you prefer. Alternatively you can open the *Advanced* menu in QuickOSM and choose where to save the data in the *Directory* menu.

???? Follow Along: The QuickOSM Query engine

The quickest way to download data from QuickOSM plugin is using the *Quick query* tab and set some small parameters. But if you need some more specific data?

If you are an OpenStreetMap query master you can use QuickOSM plugin also with your personal queries.

QuickOSM has an incredible data parser that, together with the amazing query engine of Overpass, lets you download data with your specific needs.

For example: we want to download the mountain peaks that belongs into a specific mountain area known as Dolomites.

You cannot achieve this task with the *Quick query* tab, you have to be more specific and write your own query. Let's try to do this.

- 1. Start a new project.
- 2. Open the QuickOSM plugin and click on the Query tab.
- 3. Copy and paste the following code into the query canvas:

```
<!--
This shows all mountains (peaks) in the Dolomites.
You may want to use the "zoom onto data" button. =>
-->
<osm-script output="json">
<!-- search the area of the Dolomites -->
<query type="area">
 <has-kv k="place" v="region"/>
  <has-kv k="region:type" v="mountain_area"/>
  <has-kv k="name:en" v="Dolomites"/>
</query>
<print mode="body" order="quadtile"/>
<!-- get all peaks in the area -->
<query type="node">
  <area-query/>
  <has-kv k="natural" v="peak"/>
</auerv>
<print mode="body" order="quadtile"/>
<!-- additionally, show the outline of the area -->
<query type="relation">
  <has-kv k="place" v="region"/>
  <has-kv k="region:type" v="mountain_area"/>
  <has-kv k="name:en" v="Dolomites"/>
</query>
<print mode="body" order="quadtile"/>
<recurse type="down"/>
<print mode="skeleton" order="quadtile"/>
</osm-script>
```

Notă: This query is written in a xml like language. If you are more used to the Overpass QL you can write the query in this language.

4. And click on Run Query:

| Q QuickOSM | | × | |
|--|--|-----------------|--|
| Map preset Quick query Query OSM File Parameters About | <pre><!-- </pre--> </pre> </th <th></th> <th></th> | | |
| | Generate query | Run query | |
| | Advanced | | |
| | Overpass Turbo | Documentation * | |
| | 4 | | |
| | 09 | ۷۵ | |

The mountain peaks layer will be downloaded and shown in QGIS:



You can write complex queries using the Overpass Query language. Take a look at some example and try to explore the query language.

9.2.3 ???? Follow Along: The DataPlotly Plugin

The **DataPlotly** plugin allows you to create D3 plots of vector attributes data thanks to the plotly library.

- 1. Start a new project
- 2. Load the *sample_points* layer from the exercise_data/plugins folder
- 3. Install the plugin following the guidelines described in [2][2] Follow Along: Installing New Plugins searching Data Plotly
- 4. Open the plugin by clicking on the new icon in the toolbar or in the Plugins ► Data Plotly menu

In the following example we are creating a simple Scatter Plot of two fields of the *sample_points* layer. In the DataPlotly Panel:

| DataPle | otly | | | | | | | | | | | | | x |
|----------------|------------------|------------|----------|-------------------|------|-------|------------|------------|---|-------|-------------|-----------|--------------------|------------|
| * | Plot type 📝 Sca | atter Plot | | | | | | | | | | | | • |
| Q ₀ | ▼ Plot Parame | ters | | | | | | | | | | | | |
| | Layer | ° sam | ple_poin | its cted featu | ures | Use (| only visib | le feature | s | | | | | • |
| | Feature subset | ¢, | | | | | | | | | | | | |
| | X field | 1.2 d | | | | | | | | | | | * | 3 |
| | Y field | 1.2 mg | | | | | | | | | | | • | 3 |
| | Properties | | | | | | | | | | | | | |
| | Legend title | | d - mg | | | | | | | | | | | €. |
| | Marker color | | | | | | | | | | Marker size | 10.00 | \$ | €. |
| | Stroke color | | | | | | | | | | Stroke widt | 1.00 | | €. |
| | Marker type | | Points | | | | | | | | | | | - |
| | Point type | | • | | | | | | | | | | | - |
| | Opacity | | | | | | | | | | | - 10 | 0.0 % | ÷ |
| | Hover tooltip | | All Valu | es | | | | | | | | | | - |
| | Hover label a | as text | | | | | | | | | | | | |
| | Type of plot | | | Single Plo | ot | | | | | | | | | • |
| | 🤞 Clean Plot Can | ivas | | | | | | | | Updat | te Plot | Create Pl | ot Confi | guration 👻 |

1. Choose *sample_points* in the Layer filter, *cl* for the *X Field* and *mg* for the *Y Field*:

2. If you want you can change the colors, the marker type, the transparency and many other settings: try to change some parameters to create the plot below.



3. Once you have set all the parameters, click on the Create Plot button to create the plot.

The plot is interactive: this means you can use all the upper buttons to resize, move, or zoom in/out the plot canvas. Moreover, each element of the plot is interactive: by clicking or selecting one or more point on the plot, the corresponding point(s) will be selected in the plot canvas.

You can save the plot as a png static image or as an html file by clicking on the end or on the to button in the lower right corner of the plot.

There is more. Sometimes it can be useful to have two (or more) plots showing different plot types with different variables on the same page. Let's do this!

- 1. Go back to the main plot settings tab by clicking on the 💞 button in the upper left corner of the plugin panel
- 2. Change the *Plot Type* to *Box Plot*
- 3. Choose group as Grouping Field and ph as Y Field
- 4. In the lower part of the panel, change the *Type of Plot* from *SinglePlot* to *SubPlots* and let the default option *Plot in Rows* selected.

| 1 | Plot Parame | ters |
|---|------------------------------|--|
| L | Layer | Sample_points Use only selected features Use only visible features |
| | Feature subset | <≡, |
| | Grouping field (optional) | 123 group E |
| | Y field | 1.2 ph |
| | Legend title Box color | ph E, |
| | Stroke color | ▼ (=, Stroke width 1.00 () (=, |
| | Opacity | 100.0 % |
| | Box orientation | Vertical 🔹 |
| | Show statistics | None |
| | Outliers | No Outliers 🔹 |
| | | |

5. Once done click on the Create Plot button to draw the plot



Now both scatter plot and box plot are shown in the same plot page. You still have the chance to click on each plot item and select the corresponding features in the map canvas.

Sfat: Each plot has its own manual page available in the **1** tab. Try to explore all the plot types and see all the other settings available.

9.2.4 În concluzie

Sunt disponibile multe plugin-uri utile pentru QGIS. Folosind instrumentele încorporate, pentru instalarea și gestionarea acestor plugin-uri, puteți găsi noi plugin-uri și să efectuați o utilizare optimă a acestora.

9.2.5 Ce urmează?

Apoi, vom analiza modul de utilizare al straturilor care sunt găzduite pe servere aflate la distanță, în timp real.

CAPITOLUL 10

Module: Online Resources

Atunci când se analizează sursele de date pentru o hartă, nu este necesar să vă limitați la datele pe care le-ați salvat pe computerul la care lucrați. Există surse de date online, pe care le puteți încărca atât timp cât sunteți conectat la Internet.

În acest modul, vom acoperi cele două tipuri de servicii GIS bazate pe web: Servicii Web Mapping (WMS) și Servicii Web Feature (WFS).

10.1 Lesson: Web Mapping Services

Un Serviciu de Cartografiere Web (WMS) este un serviciu găzduit pe un server aflat la distanță. Similar unui site web, îl puteți accesa, atât timp cât aveți o conexiune la server. Cu ajutorul QGIS, puteți încărca un WMS direct în harta existentă.

Din lecția despre plugin-uri, ne amintim că este posibilă încărcarea unei noi imagini raster, spre exemplu, de la Google. Totuși, aceasta este o tranzacție once-off: o dată ce ați descărcat imaginea, aceasta nu se mai schimbă. Un WMS este diferit prin faptul că este un serviciu live, care se va actualiza automat, la deplasarea sau mărirea hărții.

Scopul acestei lecții: De a folosi un WMS și de a-i înțelege limitările.

10.1.1 ???? Follow Along: Loading a WMS Layer

For this exercise, you can either use the basic map you made at the start of the course, or just start a new map and load some existing layers into it. For this example, we used a new map and loaded the original *places*, *landuse* and *protected_areas* layers and adjusted the symbology:



- 1. Încărcați aceste straturi într-o nouă hartă, sau folosiți harta originală doar cu aceste straturi vizibile.
- 2. Before starting to add the WMS layer, deactivate "on the fly" projection (*Project* ► *Properties...* ► *CRS* tab, check *No CRS (or unknown/non-Earth projection).* This may cause the layers to no longer overlap properly, but don't worry: we'll fix that later.
- 3. To add WMS layers, click on the ⁴ button to open the *Data Source Manager* dialog and enable the ⁴ *WMS/WMTS* tab.

| Q Data Source Manager WMS/WMTS | | | – 🗆 X |
|---|----------------|--------------------|---------|
| Vector | | | |
| Raster | | | ~ |
| Mesh Connect New | Edit Remove | Load | i Save |
| Point Cloud | Title Abstract | | |
| | ne poster | | |
| GeoPackage | | | |
| | | | |
| | | | |
| | | | |
| PostgresQL | | | |
| MS SQL Server | | | |
| Orade | | | |
| Virtual Layer | | | |
| SAP HANA | | | |
| Tile size | | | |
| Request step size | | | |
| WFS / OGC API - Features Maximum number of GetFeatureInt | io results | 10 | |
| wcs Coordinate Reference System | | EPSG:4326 - WGS 84 | - |
| Use contextual WMS Legend | | | |
| Vector Tile | | | |
| Load as separate layers | | |) |
| Select layer(s) | | | |
| 🔍 Metadata Search 🥃 | | Close | dd Help |

Remember how you connected to a SpatiaLite or GeoPackage database at the beginning of the course. The *landuse*, *buildings*, and *roads* layers are stored in a database. To use those layers, you first needed to connect to the database. Using a WMS is similar, with the exception that the layers are on a remote server.

4. Pentru a crea o nouă conexiune la un WMS, faceți clic pe butonul New.

You'll need a WMS address to continue. There are several free WMS servers available on the Internet. One of these is terrestris, which makes use of the OpenStreetMap dataset.

5. Pentru a face uz de acest WMS, setați-l în dialogul curent, astfel:

| lame | terrestris | | | |
|---|---|--|---|--------------|
| IRL | https://ows.terr | estris.de/osm | /service | |
| uther | tication | | | |
| Con | figurations Ba | asic | | |
| Choo | ose or create an a | uthentication | configuration | |
| No | Authentication | - // | | |
| | | | | |
| TTP H | leaders er | | | |
| TTP H Refer | leaders er dvanced WMTS Options | | | |
| Refer | leaders er dvanced WMTS Options | | al | • |
| Refer | leaders er dvanced WMTS Options DPI-Mode S server-side tile p | pixel ratio | all Undefined (not scaled) | • |
| TTP H Refer MS/V WMS WMT | leaders er dvanced WMTS Options DPI- <u>M</u> ode S server-side tile p gnore GetMap/Get | pixel ratio tTile/GetLeger | all Undefined (not scaled) ndGraphic URI reported in capabilitie | * * ES |
| Refer | leaders er dvanced WHTS Options DPI-Mode S server-side tile p gnore GetMap/Get gnore GetFeature | oixel ratio tTile/GetLeger Info URI repo | all Undefined (not scaled) ndGraphic URI reported in capabilitie rted in capabilities | * * |
| TTP F Refer MMS/V WMS WMT | leaders er dvanced WHTS Options DPI-Mode S server-side tile p gnore GetMap/Get gnore GetPeaturel gnore reported lay | pixel ratio tTile/GetLeger Info URI repo yer extents | all Undefined (not scaled) ndGraphic URI reported in capabilitie rted in capabilities | * * |
| TTP H Refer MMS/V WMS WMT | leaders er dvanced WHTS Options DPI-Mode S server-side tile p gnore GetMap/Get gnore GetFeature gnore reported lay gnore axis orienta | oixel ratio tTile/GetLeger Info URI repo yer extents tion (WMS 1.3 | all Undefined (not scaled) ndGraphic URI reported in capabilitie rted in capabilities 3/WMTS) | * 25 |
| TTP H Refer MS/V WMS WMT I I I I I I I I I I I I I | leaders er dvanced WHTS Options DPI-Mode S server-side tile p gnore GetFeaturei gnore GetFeaturei gnore reported lay gnore axis orienta ivert axis oriental | bixel ratio Trile/GetLeger Info URI repo yer extents tion (WMS 1.: tion | all Undefined (not scaled) ndGraphic URI reported in capabilitie rted in capabilities 3/WMTS) | * * 25 |

- The value of the *Name* field should be terrestris.
- The value of the URL field should be https://ows.terrestris.de/osm/service.
- 6. Faceți clic pe Ok. Ar trebui să vedeți listat noul server WMS:

| Q Data Source Manager WMS/WMTS | | | _ | |
|-----------------------------------|----------------|--------------------|--------|------|
| Vector Layers Layer Order Tileset | 5 | | | |
| Raster | | | | Ŧ |
| Mesh Connect New | Edit Remove | | Load | Save |
| Point Cloud | Title Abstract | | | |
| 2. Delimited Text | nuc postace | | | |
| GeoPackage | | | | |
| U GPS | | | | |
| SpatiaLite | | | | |
| PostgreSQL | | | | |
| MS SQL Server | | | | |
| Oracle Image Encoding | | | | |
| Virtual Layer | | | | |
| Options | | | | |
| Tile size | | | | |
| WES / OGC APT - | | | | |
| Maximum number of GetFeature | Info results | 10 | | |
| wcs Coordinate Reference System | | EPSG:4326 - WGS 84 | | - |
| XYZ | | | | |
| Vector Tile | | | | |
| ArcGIS REST Server | | | | |
| Select layer(\$) Metadata Search | | Clos | se Add | Help |

7. Faceți clic pe Conectare. În lista de mai jos, ar trebui să vedeți încărcate acum, aceste noi intrări:

| Q Data Source Manage | er WMS/WMTS | - 🗆 × |
|----------------------|--|----------------|
| Erowser | Layers Layer Order Tilesets | |
| Vector | terrestris | • |
| Raster | Connect New Edit Remove | Load Save |
| Mesh | | Abstract |
| Point Cloud | ♥ 0 OpenStreetMap WMS OpenStre | |
| GPS 🍂 SpatiaLite | SRTM30-Colored Hillshade SRTM30 Colored Hillshade by terrestris SRTM30-Contour SRTM30 Contour Lines - by terrestris SRTM30 Contour Lines - by terrestris If Dark Dark | |
| PostgreSQL | | |
| MS SQL Server | | |
| 📮 Orade | Image Encoding | |
| Virtual Layer | O PNG O JPEG | |
| SAP HANA | Options | |
| WMS/WMTS | Tile size | |
| WFS / OGC API - | Request step size | |
| Features | Maximum number of GetFeatureInfo results 10 | 1326 - WIGS 84 |
| wcs | Use contextual WMS Legend | 50 H050T |
| Vector Tile | Laver name | |
| ArcGIS REST Server | Load as separate layers | |
| | Select layer(s) | |
| Metadata Search | | Close Add Help |

Acestea sunt toate straturile găzduite de acest server WMS.

8. Click once on the *OSM-WMS* layer. This will display the default *Coordinate Reference System* in use and the number of CRSes supported by the dataset:

| 🔇 Data Source Manag | er WMS/WMTS | - 🗆 X |
|-----------------------------|---|---|
| Frowser Browser | Layers Layer Order Tilesets | |
| Vector | terrestris | • |
| Raster | Connect New Edit Remove | Load Save |
| Mesh | ID A Name Title | Abstract |
| Point Cloud | | MS MS - by terrestris -ls - by terrestris |
| Delimited Text | 4 OSM-Overlay-WMS OSM Overlay WMS 6 TOPO-WMS Topographic WMS 8 TOPO-OSM-WMS Topographic OSM V | - by terrestris - by terrestris VMS - by terrestris |
| GPS | SRTM30-Colored SRTM30 Colored + I SRTM30-Colored Hillshade SRTM30 Colored Hill SRTM30-Colored Hillshade SRTM30 Colored Hill SRTM30-Contour SRTM30 Contour Li | llshade - by terrestris nes - by terrestris |
| 🌽 SpatiaLite | ▶ 16 Dark Dark | |
| PostgreSQL | | |
| MS SQL Server | | |
| Orade | Image Encoding | |
| Virtual Layer | O PNG O JPEG | |
| SAP HANA | Options | |
| WMS/WMTS | Tile size | |
| WFS / OGC API - Features | Maximum number of GetFeatureInfo results | 10 |
| ter wcs | Coordinate Reference System (25 available) | EPSG:4326 - WGS 84 |
| хүz | Use contextual WMS Legend | |
| Vector Tile | Layer name OpenStreetMap WMS - by terrestris | |
| ArcGIS REST Server | Load as separate layers | |
| Q Metadata Search | 1 Layer selected | Close Add Help |

Since we're not using EPSG: 4326 - WGS 84 for our map, let's find one that meets our needs.

- 1. Click the ^{Select CRS} button. You will see a standard *Coordinate Reference System Selector* dialog showing all the CRS the data is published with.
- 2. We want a *projected* CRS, so let's choose *WGS* 84 / *Pseudo-Mercator* with EPSG: 3857. You can use the top *Filter* widget.

| 🔇 Select CRS | × |
|--|----------------------|
| Predefined CRS | • |
| Filter Q | |
| Recently Used Coordinate Reference Systems | |
| Coordinate Deference System | Authority ID |
| Coordinate Reference System | Addional ID |
| W65 64 | EP36:4320 |
| Predefined Coordinate Reference Systems | Hide deprecated CRSs |
| Coordinate Reference System | Authority ID |
| WGS 84 | EPSG:4326 |
| Projected Coordinate Systems | |
| ▼ Cassini | |
| DHDN / Soldner Berlin | EPSG:3068 |
| Lambert Azimuthal Equal Area | |
| ETRS89-extended / LAEA Europe | EPSG:3035 |
| Lambert Conformal Conic | |
| ETRS89 / LCC Germany (E-N) | EPSG:5243 |
| ETRS89 / LCC Germany (N-E) | EPSG:4839 |
| ETRS89-extended / LCC Europe | EPSG:3034 |
| ▼ Mercator | |
| Google Maps Global Mercator | EPSG:900913 |
| WGS 84 / Pseudo-Mercator | EPSG:3857 |
| ▼ Swiss Ohl Mercator | * |
| | • |
| WGS 84 / Pseudo-Mercator Properties • Units: meters • Dynamic (relies on a datum which is not plate-fixed) • Celestial body: Earth • Based on <i>World Geodetic System</i> <i>1984 ensemble</i> (EPSG:6326), which has a limited accuracy of at best 2 | |
| | OK Cancel Help |

- 1. Click OK. The Coordinate Reference System associated with the entry has changed.
- 9. Click Add to load the layer in your project using Layer name` (default is OpenStreetMap WMS by terrestris).
- 10. Close the Data Source Manager dialog if not done automatically
- 11. In the *Layers* panel, click and drag it to the bottom of the list.
- 12. Zoom out in order to get a global view of the layers. You will notice that your layers aren't located correctly (near west of Africa). This is because "on the fly" projection is disabled.



- 13. Let's enable the reprojection again, but using the same projection as the *OpenStreetMap WMS* layer, which is WGS 84 / Pseudo Mercator.
 - 1. Open the *Project* \blacktriangleright *Properties*... \blacktriangleright *CRS* tab
 - 2. Uncheck No CRS (or unknown/non-Earth projection)
 - 3. Alegeți WGS 84 / Pseudo Mercator din listă.

| Q Project Properties — C | RS | × |
|--------------------------|---|------|
| Q | Project Coordinate Reference System (CRS) | |
| General | No CRS (or unknown/non-Earth projection) | |
| □ | Filter Q 3857 | |
| | Recently Used Coordinate Reference Systems | |
| View Settings | Coordinate Reference System Authority ID | |
| CRS CRS | | |
| Transformations | | |
| 🐳 Styles | Predefined Coordinate Reference Systems Hide deprecated | CRSs |
| = | Coordinate Reference System Authority ID | |
| Data Sources | Projected Coordinate Systems | _ |
| | Lambert Conformal Conic NAD, 1992, HADN, Add, MI, Marguetta, Ma, ESDI, 199257 | |
| | Marcator | |
| 8 Variables | WGS 84 / Pseudo-Mercator EPSG: 3857 | |
| S Macros | | |
| 🖃 🗒 QGIS Server | | - |
| Temporal | WGS 84 / Pseudo-Mercator Properties Units: meters Dynamic (relies on a datum which | |
| Sensors | OK Cancel Apply H | elp |

- 4. Clic pe OK
- 14. Now right-click on one of your own layers in the *Layers* panel and click *Zoom to layer(s)*. You should see the Swellendam area:



Notă cum se suprapun străzile stratului WMS cu propriile noastre străzi. Ăsta e un semn bun!

Natura și limitele WMS

By now you may have noticed that this WMS layer actually has many features in it. It has streets, rivers, nature reserves, and so on. What's more, even though it looks like it's made up of vectors, it seems to be a raster, but you can't change its symbology. Why is that?

This is how a WMS works: it's a map, similar to a normal map on paper, that you receive as an image. What usually happens is that you have vector layers, which QGIS renders as a map. But using a WMS, those vector layers are on the WMS server, which renders it as a map and sends that map to you as an image. QGIS can display this image, but can't change its symbology, because all that is handled on the server.

This has several advantages, because you don't need to worry about the symbology. It's already worked out, and should be nice to look at on any competently designed WMS.

On the other hand, you can't change the symbology if you don't like it, and if things change on the WMS server, then they'll change on your map as well. This is why you sometimes want to use a Web Feature Service (WFS) instead, which gives you vector layers separately, and not as part of a WMS-style map.

This will be covered in the next lesson, however. First, let's add another WMS layer.

10.1.2 ???? Try Yourself:

- 1. Add the eAtlas WMS server at this URL: https://maps.eatlas.org.au/maps/wms
- 2. Load a World: Hillshading layer into the map.
- 3. You might want to set its *Encoding* to JPEG and its *Tile size* option to 200 by 200, so that it loads faster.
- 4. Your map should look like this (you may need to re-order the layers, and apply some transparency):



Răspuns

- 1. Go to the Data Source Manager, WMS / WMTS tab and create a new connection entry
- 2. Use the \Box text box to filter the list of layers and select the corresponding layer
- 3. Remember to check/turn its CRS into EPSG:3857 WGS 84 / Pseudo Mercator as the rest of the map.

| | | | Data Source Manager WMS/ | WMTS | | ~ ^ 😣 |
|--------------|--------------------------|--|--------------------------------|--|----------------------------------|---|
| | Browser | Layers Layer Order Tilesets | | | | |
| V, | Vector | eAtlas | | | | - |
| Ο, | Raster | C <u>o</u> nnect <u>N</u> ew Ed | lit Remove | | | Load Save |
| × | Mesh | Q world: hillshading | | | | |
| 0: | Point Cloud | ID Vame | | Title | | Abstract |
| 2 | Delimited Text | Imagery Base Maps Earth World: Bright Earth Basem | Cover ap (e-Atlas) | Imagery Base Maps B World: Bright Earth B | Earth Cover Jasemap (e-Atlas) | |
| | GeoPackage | ea-be:World_e-Atlas-UCSD Bright-Earth Hillshading | _SRTM30-plus_v8_Hillshading | World: Hillshading - S Transparent Hillshad | RTM30-plus v8.0 (e-Atlas e | This layer shows hillshadi |
| ę. | GPS | Bright-Earth_Raster ea-be:World_e-Atlas-UCSD | _SRTM30-plus_v8_Hillshading-lr | Raster World: Hillshading Lo | - w Res - SRTM30-plus v8 | A sample style for rasters, This layer shows hillshadi |
| / . | SpatiaLite | Bright-Earth_Hillshading Bright-Earth_Raster | | Transparent Hillshad Raster | e | A sample style for rasters, |
| ¶. | PostgreSQL | Image Encoding | | | | |
| J D_+ | MS SQL Server | ○ PNG ○ PNG8 ● JPEG ○ | GIF 🔿 TIFF 🔿 SVG | | | |
| V | Virtual Layer | Options | | | | |
| (C | WMS/WMTS | Tile size | 200 | | 200 | |
| | WFS / OGC API - Features | Request step size | | | | |
| 0 | wcs | Maximum number of GetFeature | Info results | | 10 | |
| Ш. | XYZ | Coordinate Reference System (67 | 79 available) | | EPSG:3857 - WGS 84 / Pse | eudo-Mercator 🔹 🌏 |
| Щ, | Vector Tile | Use contextual WMS Legend | | | | |
| | ArcGIS REST Server | | | | | |
| 놂 | GeoNode | Layer name World: Hillshading - SRT | M30-plus V8.0 (e-Atlas, UCSD) | | | |
| Q | Metadata Search | 1 Layer selected | | | | |
| | | ₩ <u>A</u> ide | | | | ✓ <u>A</u> dd Sermer |

4. After the layer is loaded, you can modify its *Opacity* value (under the *Transparency* properties tab)

10.1.3 **???** Try Yourself:

O parte din dificultatea de a folosi WMS, este de a găsi un server bun (și gratuit).

• Find a new WMS at directory.spatineo.com (or elsewhere online). It must not have associated fees or restrictions, and must have coverage over the Swellendam study area.

Amintiți-vă că pentru un WMS aveți nevoie doar de URL-ul său (și, de preferință, un fel de descriere).

Răspuns

Spatineo is one of many places you can search for a OGC data. Type in the text area a name, keyword, location of your interest to see if you get some working results. For this lesson, you might want to filter the results to include WMS only.

You may notice that many WMS servers are not always available. Sometimes this is temporary, sometimes it is permanent. An example of a WMS server that worked at the time of writing is the *MapServer Demonstration Server* WMS at https://demo.mapserver.org/cgi-bin/wms?SERVICE=WMS&VERSION=1.3.0& REQUEST=GetCapabilities. It does not require fees or have access constraints, and it is global. Therefore, it does satisfy the requirements. Keep in mind, however, that this is merely an example. There are many other WMS servers to choose from.

10.1.4 ???? Try Yourself:

• Add the *bluemarble* layer from the *MapServer Demonstration Server*. Is that a suitable dataset for our study area?

Răspuns

- 1. Hide all other WMS layers to prevent them from rendering unnecessarily in the background.
- 2. Use the same approach as before to add the new server and the appropriate layer as hosted on that server:

| Q | | Data Source Manager WMS/WMTS | ~ ^ × |
|----|--------------------------|---|---|
| | Browser | Layers Layer Order Tilesets | |
| V, | Vector | MapServer | • |
| Ŷ, | Raster | Connect New Edit Remove | Load Save |
| × | Mesh | ٩ | |
| | Point Cloud | ID Vame Title Abstr 0 WMS server WMS Demo Server for ManServer This is | act |
| ۶. | Delimited Text | 1 bluemarble Blue Marble World Elevation and Bathymetry 2 continents World continents | |
| | GeoPackage | 4 country_bounds World country boundaries 6 cities World cities | |
| ٠ | GPS | · o caes · vona caes | |
| 1 | SpatiaLite | | |
| ф. | PostgreSQL | Image Encoding | |
| JD | MS SQL Server | PNG PNG PNG PNG TIFF SVG | |
| V | Virtual Layer | Ontions | |
| (P | WMS/WMTS | | |
| | WFS / OGC API - Features | Request step size | |
| ŧ | wcs | Maximum number of GetFeatureInfo results | 10 |
| | XYZ | Coordinate Reference System (4 available) | EPSG:3857 - WGS 84 / Pseudo-Mercator 🔹 🊳 |
| | Vector Tile | Use contextual WMS Legend | |
| | ArcGIS REST Server | | |
| * | GeoNode | Layer name Blue Marble World Elevation and Bathymetry Raster | |
| | Metadata Search | Load as separate layers 1 Layer selected | |
| | | 蹲 <u>A</u> ide | <u>✓ A</u> dd <mark>⊗</mark> <u>F</u> ermer |

3. If you zoom into the Swellendam area, you'll notice that this dataset has a low resolution:



Therefore, it's better not to use this data for the current map. The Blue Marble data is more suitable at global or national scales

10.1.5 În concluzie

Folosind un WMS, puteți adăuga hărți inactive ca fundaluri pentru datele hărților existente.

10.1.6 Further Reading

- Spatineo Directory
- OpenStreetMap.org list of WMS servers

10.1.7 Ce urmează?

Now that you've added an inactive map as a backdrop, you'll be glad to know that it's also possible to add features (such as the other vector layers you added before). Adding features from remote servers is possible by using a Web Feature Service (WFS). That's the topic of the next lesson.

10.2 Lesson: Web Feature Services

Un Serviciu Web Feature (WFS) pune la dispoziție utilizatorilor date GIS în formate care pot fi încărcate direct în QGIS. Spre deosebire de un WMS, care oferă doar o hartă pe care nu o puteți edita, un WFS oferă acces direct la entități.

Scopul acestei lecții: De a folosi un WFS și de a-i înțelege cum diferă de un WMS.

10.2.1 ???? Follow Along: Loading a WFS Layer

- 1. Începeți o nouă hartă. Aceasta are scop demonstrativ și nu va fi salvată.
- 2. Click the ^Q Open Data Source Manager</sup> button.
- 3. Enable the WFS / OGC API Features tab.
- 4. Clic pe butonul New.
- 5. În caseta de dialog care apare, introduceți nsidc.org la *Nume* și https://nsidc.org/cgi-bin/ atlas_south?version=1.1.0 la *URL*.

| nectio | on Details | |
|--|--|--|
| ama | nside ora | |
| anne | maldelorg | |
| RL | https://nsid | lc.org/cgi-bin/atlas_south?version=1.1.0 |
| uther | itication | |
| Con | figurations | Basic |
| Choo | ose or create | an authentication configuration |
| | | |
| Conf auth | Authenticatio igurations sto entication da >tions | n • |
| Conf auth F S O J | Authenticatio igurations str entication da stions | n · · · · · · · · · · · · · · · · · · · |
| Conf auth FS OJ Versio Max. | Authenticatio igurations str entication da ptions on number of fe | Image: Constraint of the provided credentials in the QGIS tabase. Maximum Maximum Detect eatures |
| Conf auth FS OI Versio Max. | Authenticatio igurations str entication da >tions number of fe nable feature | Image: Second state Image: Second state ore encrypted credentials in the QGIS tabase. Maximum Maximum Detect eadures |
| Conf auth FS OI Versio Max. | Authentication igurations stu entication da ptions on number of fe nable feature | Image: Contract of the second seco |
| Conf auth FS OI Versic Max. ✓ E Page | Authentication igurations str entication da ptions number of fe nable feature size | Maximum Detect Maximum Detect Paging Detect |
| Conf auth FS OI Max. ✓ E Page | Authenticatio igurations sta entication da ptions on number of fe nable feature size gnore axis ori | Maximum Detect Maximum Maximu |
| Conf auth FS OI Versid Max. ✓ E Page II Ir | Authentication igurations sta entication da ptions on number of fe nable feature size gnore axis ori | Maximum Detect Maximum Maximu |

- 6. Clic OK, apoi noua conexiune va apărea în Conexiunile serverului.
- 7. Clic pe Connect. Va apărea o listă a straturilor disponibile:

| Q Data Source Manager WFS / OGC API - Features - 🗆 X | | | | | |
|--|-----------------------|---|--------------------------------------|--|---------|
| Browser Server Connections | | | | | |
| V. | Vector | nsidc.org | | | |
| Ο, | Raster | Connect New Edit | Remove | Load | Save |
| × | Mesh | Q | | | |
| | | Title | Name | Abstract | Sql |
| | Point Cloud | Antarctic coastline (includes ice shelves) | antarctic ice shelves outline | Bohlander, J. and T. Scambos. 2007. Ant | |
| | i onte choda | Antarctic continent | antarctic continent | Bohlander, J. and T. Scambos. 2007. Ant | |
| | | Antarctic grounding line (excludes ice shel | antarctic coastline | Bohlander, J. and T. Scambos. 2007. Ant | |
| - Z - | Delimited Text | Antarctic ice core locations | antarctic ice cores | Maurer, J. compiler. 2009. Deep ice core I | |
| | | Antarctic ice shelves | antarctic ice shelves fill | Bohlander, J. and T. Scambos. 2007. Ant | |
| 1 | GeoPackage | Antarctic island coastlines | antarctic islands coastlines | Bohlander, J. and T. Scambos, 2007, Ant | |
| | | Antarctic island coastlines | antarctica islands coastlines | Bohlander, J. and T. Scambos, 2007, Ant. | |
| 100 | | Antarctic islands | antarctic islands | Bohlander, J. and T. Scambos, 2007, Ant. | |
| 6 | GPS | Antarctic menadunes | antarctic megadunes | Bohlander, 1, and T. Scambos, 2005, Out | |
| - | | Antarctic permanent research stations | antarctic research stations | Wikipedia contributors, 24 January 2007 | |
| 1 | SpatiaLite | Antarctic Polar Front | antarctic polar front | Orsi, A. and Rvan, U. 2001, Locations of | |
| · • | | Antarctic suface elevation contours | antarctica elevation contours | Liu, H., K. Jezek, B. Li, and Z. Zhao, 200 | |
| 62 | Dectoro COI | Antarctica border | antarctica country border | Bohlander, 1, and T. Scambos, 2007, Ant | |
| | FUSIGIESQL | coastlines (excluding Antarctica) | coastlines excluding antarctica | Center for International Earth Science Inf | |
| MAD | | countries (excluding Antarctica) | country borders excluding antarctica | Center for International Earth Science Inf | |
| <u> </u> | MS SQL Server | dacier outlines | placier outlines | Armstrong, R., B. Raup, S. J.S. Khalsa, R. | |
| | | daciers | daciers | National Imagery and Mapping Agency (N | |
| | Oracle | International Date Line | international date line | National Geographic Society, 1992, Natio | |
| | | land (excluding Antarctica) | land excluding antarctica | Center for International Earth Science Inf | |
| R 74 | | South Pole of Cold | south pole of cold | Wikipedia contributors, 23 January 2007. | |
| 8 | Virtual Layer | South Pole of Inaccessibility | south_pole_inaccessibility | Wikipedia contributors, 20 January 2007. | |
| | | South Pole Geographic | south_pole_reagraphic | Labels the location of the South Pole (90 | |
| | SAP HANA | South Pole, Geomagnetic | south pole geomagnetic | McClean, S. 24 January 2007, Geomagne | |
| | | South Pole, Magnetic | south pole magnetic | McClean, S. 24 January 2007, Geomagne | |
| | MINE MARTE | South Poles | south poles wfs | Labels the location of various types of So | |
| | WFS / OGC API - | | | | |
| | WCS | 4 | | | • |
| | | | | | |
| | XYZ | Use title for layer name | extent | | |
| | | | | | |
| ₩. | Vector Tile | Coordinate Reference System | | | |
| | ArcGIS REST Server | EPSG:3031 | | | Change |
| Q | Metadata Search | • | Bui | ld query Close <u>A</u> dd | Help |

- 8. Uncheck the *Only request features overlapping the view extent* option below the layers list, since your current map canvas may not cover our area of interest: Antarctica.
- 9. Find the layer *antarctica_country_border*. You can use the *Filter* box at the top.
- 10. Faceți clic pe strat pentru a-l selecta.
- 11. Find and select also the layer *south_poles_wfs*. You might need to hold Ctrl.
| Q | Data Source Manag | ger WFS / OGC API - Features | | | | _ | | × |
|--------------|-----------------------------|--------------------------------------|--------------------------------------|------------------------|---------------------|-----------------|---------|---|
| | Browser | Server Connections | | | | | | |
| ∇ | Vector | nsidc.org | | | | | | • |
| ۰, | Raster | Connect New | Edit Remove | | | Load | Save | |
| | Mesh | Q | | | | | | |
| | | Title | Name | Abstract | | 5 | Sql | |
| | Point Cloud | Antarctic coastline (includes ice sh | elves) antarctic_ice_shelves_outline | Bohlander | , J. and T. Scamb | os. 2007. Ant | | |
| 0+ | | Antarctic continent | antarctic_continent | Bohlander | , J. and T. Scamb | os. 2007. Ant | | |
| | | Antarctic grounding line (excludes | ice shel antarctic_coastline | Bohlander | , J. and T. Scamb | os. 2007. Ant | | |
| - / + | Delimited Text | Antarctic ice core locations | antarctic ice cores | Maurer, J. | . compiler. 2009. I | Deep ice core I | | |
| | | Antarctic ice shelves | antarctic ice shelves fill | Bohlander | , J. and T. Scamb | os. 2007. Ant | | |
| 150 | GeoPackage | Antarctic island coastlines | antarctic islands coastlines | Bohlander | J. and T. Scamb | os, 2007, Ant | | |
| 1 + | | Antarctic island coastlines | antarctica islands coastlines | Bohlander | . 1. and T. Scamb | os. 2007. Ant | | |
| a fam | | Antarctic islands | antarctic islands | Bohlander | 1 and T. Scamb | os 2007 Ant | | |
| 0 | GPS | Antarctic magadupas | antarctic_islands | Boblander | 1 and T. Scamb | os. 2005. Out | | |
| | | Antar cuc megaduries | tions antarctic research stations | Wikipedia | contributors 24.1 | lanuary 2007 | | |
| | Spatial ite | Antarctic permanent research stat | tions antarctic_research_stations | wikipeula Orai A ar | Contributors, 241 | | | |
| r + | opulative | Antarctic Polar Front | antarctic_polar_front | Ursi, A. a | nd Ryan, U. 2001 | . Locations of | | |
| 630 | | Antarctic suface elevation contour | rs antarctica_elevation_contours | LIU, H., K. | Jezek, B. Li, and | Z. Znao, 200 | | _ |
| · · · · | PostgreSQL | Antarctica border | antarctica_country_border | Bonlander | , J. and T. Scamb | os. 2007. Ant | | |
| | | coastlines (excluding Antarctica) | coastlines_excluding_antarctica | Center for | r International Ea | rth Science Inf | | |
| 1D | MS SOL Server | countries (excluding Antarctica) | country_borders_excluding_ant | tarctica Center for | r International Ea | rth Science Inf | | |
| + | no oqe och ver | glacier outlines | glacier_outlines | Armstrong | g, R., B. Raup, S. | J.S. Khalsa, R | | |
| | | glaciers | glaciers | National I | magery and Mapp | ing Agency (N | | |
| | Oracle | International Date Line | international_date_line | National G | Geographic Society | 1992, Natio | | |
| | | land (excluding Antarctica) | land_excluding_antarctica | Center for | r International Ea | rth Science Inf | | |
| K/Υ | Virtual Lawor | South Pole of Cold | south pole of cold | Wikipedia | contributors, 23 J | lanuary 2007 | | |
| 8 | vii tuai Layei | South Pole of Inaccessibility | south pole inaccessibility | Wikipedia | contributors, 20 J | lanuary 2007 | | |
| | | South Pole, Geographic | south pole geographic | Labels the | location of the S | outh Pole (90 | | |
| | SAP HANA | South Pole, Geomagnetic | south pole geomagnetic | McClean, | S. 24 January 200 | 07. Geomagne | | |
| | | South Pole, Magnetic | south pole magnetic | McClean, | S. 24 January 200 |)7. Geomagne | | |
| 1 | MMSAMMTS | South Poles | south poles wfs | Labels the | location of variou | is types of So | | |
| V | WFS / OGC API - Features | | | | | | | |
| ŧ | WCS | | | | | | | Þ |
| | | Use the for layer name | | | | | | |
| | XYZ | Only request features overlapping | the view extent | | | | | |
| ₩, | Vector Tile | Coordinate Reference System | | | | | | |
| 6 | ArcGIS REST Server | EPSG:3031 | | | | | Change. | |
| Q | Metadata Search | v | | Build query | Close | Add | Help | p |

12. Clic pe Add.

It may take a while to load the layers. When they are loaded, they will appear in the map, showing the outlines of Antarctica and a few points over.



How is this different from having a WMS layer?

- 13. Select any of the layers and you'll notice that feature selection and attribute table tools are enabled. These are vector layers.
- 14. Select the *south_poles_wfs* layer and open its attribute table. You should see this:



De vreme ce punctele au atribute, putem să le punem etichete și să le schimbăm simbolistica. Iată un exemplu:



Diferențe între straturile WMS

Un Serviciu Web Feature întoarce stratul însuși, nu doar o hartă redată pentru acesta. Asta vă dă acces direct la date, însemnând că puteți să schimbați simbologia și puteți rula funcții analitice. Cu toate acestea, costul este transmiterea unui volum mai mare de date. Asta va fi evident dacă straturile pe care le încărcați au forme complexe, multe atribute sau multe entități; sau chiar dacă doar încărcați multe straturi. Din această cauză straturile WFS au nevoie de regulă de mult timp pentru a se încărca.

10.2.2 ???? Follow Along: Querying a WFS Layer

Deși este posibil să interogați un strat WFS după încărcare, este de regulă mai eficient să îl interogați înainte de a-l încărca. În felul acesta cereți doar entitățile pe care le doriți, ceea ce înseamnă că utilizați o bandă mai mică.

De exemplu, pe serverul WFS pe care îl utilizăm în acest moment, există un strat numit *countries (excluding Antarctica)*. Să spunem că dorim să știm unde se află Africa de Sud față de stratul *south_poles_wfs* (și poate și față de *antarctica_country_border* layer) care a fost deja încărcat.

Există două metode. Puteți încărca tot stratul *countries* ..., după care să construiți o interogare ca în mod normal după ce acesta s-a încărcat. Dar, transmițând datele pentru toate țările lumii și utilizând pe urmă doar datele pentru Africa de Sud pare a fi o irosire a lățimii de bandă. În funcție de conexiune, acest set de date poate necesita mai multe minute pentru a se încărca.

Alternativa este de a construi o interogare ca pe un filtru, chiar înainte de încărcarea stratului de pe server.

- 1. Enable the WFS / OGC API Features tab in the Data Source Manager dialog
- 2. Connect to the server we used before and you should see the list of available layers.
- 3. Find and double-click the *countries (excluding Antarctica)* layer. The layer name is country_borders_excluding_antarctica. You can also select the layer and press *Build query* button at the bottom of the dialog:

| 🔇 Data So | ource Manage | er — WFS / OGC API - Features | | > | < |
|------------------|---------------------|--|----------------------------------|---|-----|
| F Brows | ser | Server Connections | | | |
| Vector | r | nsidc.org | | • |] [|
| Raster | er | Connect New Edi | t | Load Save | |
| Mesh | | Q | | | |
| | | Title | Name | Abstract Sql | |
| Point (| Cloud | Antarctic coastline (includes ice shelves) | antarctic_ice_shelves_outline | Bohlander, J. and T. Scambos. 2007. Antarctic | |
| • | | Antarctic continent | antarctic_continent | Bohlander, J. and T. Scambos. 2007. Antarctic | |
| | | Antarctic grounding line (excludes ice shel. | antarctic coastline | Bohlander, J. and T. Scambos. 2007. Antarctic | |
| 🔰 🚽 Delimit | ited Text | Antarctic ice core locations | antarctic ice cores | Maurer, J. compiler. 2009. Deep ice core locatio | |
| | | Antarctic ice shelves | antarctic ice shelves fill | Bohlander, J. and T. Scambos, 2007, Antarctic | |
| GeoPa | ackage | Antarctic island coastlines | antarctic islands coastlines | Bohlander, J. and T. Scambos, 2007, Antarctic | |
| | | Antarctic island coastlines | antarctica islands coastlines | Bohlander, J. and T. Scambos, 2007, Antarctic | |
| 1 | | Antarctic islands | antarctic islands | Bohlander, J. and T. Scambos, 2007, Antarctic | |
| GPS | | Antarctic menadunes | antarctic megadunes | Bohlander, J. and T. Scambos, 2005, Outlines o | |
| 14 | | Antarctic permanent research stations | antarctic research stations | Wikipedia contributors, 24 January 2007, List of | |
| 🖉 🖉 Spatia | aLite | Antarctic Polar Front | antarctic polar front | Orsi, A. and Rvan, U. 2001, Locations of the va | |
| | | Antarctic surface elevation contours | antarctica elevation contours | Liu, H., K. Jezek, B. Li, and Z. Zhao, 2001, Rad | |
| Desta | | Antarctica border | antarctica_country_border | Boblander, 1, and T. Scambos, 2007. Antarctic | |
| + Postgr | i esqu | coastlines (excluding Antarctica) | coastlines excluding antarctica | Center for International Earth Science Informati | |
| NR. | | countries (excluding Antarctica) | country borders excluding antarc | Center for International Earth Science Informati | |
| MS SQ | QL Server | placier outlines | glacier outlines | Armstrong, R., B. Raup, S.J.S. Khalsa, R. Barry | |
| | | glaciers | gladiers | National Imagery and Mapping Agency (NIMA). | |
| Oracle | e | International Date Line | international date line | National Geographic Society, 1992, National Ge | |
| + | | land (excluding Antarctica) | land excluding antarctica | Center for International Earth Science Informati | |
| K 7 | | South Pole of Cold | south pole of cold | Wikipedia contributors, 23 January 2007, Pole o | |
| Virtual | al Layer | South Pole of Inaccessibility | south pole inaccessibility | Wikipedia contributors, 20 January 2007, South | |
| | | South Pole, Geographic | south pole geographic | Labels the location of the South Pole (90 deg S | |
| SAP H | IANA | South Pole, Geomagnetic | south pole geomagnetic | McClean, S. 24 January 2007, Geomagnetism Er | |
| - | | South Pole, Magnetic | south pole magnetic | McClean, S. 24 January 2007, Geomagnetism Er | |
| AND IN THE A | ANATE | South Poles | south poles wfs | Labels the location of various types of South Pol | |
| WFS Feature | / OGC API - ures | | | | |
| e wcs | | | | | Þ |
| | | Use title for layer name | | | |
| XYZ | | Only request features overlapping the view | evtent | | |
| | | Only request reatures overlapping the view | extent | | |
| Vector | r Tile | Coordinate Reference System | | | |
| ArcGIS Server | IS REST er | EPSG:3031 | | Change | |
| Q Metad | data Search | , | | Build query Close Add Help | |

4. In the dialog that appears, type the following SELECT * FROM country_borders_excluding_antarctica WHERE "Countryeng" = 'South Africa' query in the SQL Statement box.

| 🔇 SQL C | Query Composer | × |
|-----------|--|-----------------------------|
| SQL State | ment SELECT * FROM country_borders_excluding_antax | rctica WHERE "Countryeng" = |
| Columns | * | Data |
| | | Columns |
| Table(s) | country_borders_excluding_antarctica | |
| Where | Countryeng = 'South Africa' | Functions 💌 |
| | | Spatial predicates 💌 |
| Order by | | Operators 💌 |
| Rese | it | OK Cancel Help |

5. Press OK.

6. The expression used will appear as the Sql value of the target layer:

| Q Data Source Manager — W | VFS / OGC API - Features | | | | | | _ | |
|-----------------------------|--|-------------------------|-----------------|-----------------------|---------------------|---------------|------------------|------------------|
| F Browser | Server Connections | | | | | | | |
| Vector | nsidc.org | | | | | | | • |
| Raster | Connect New E | dit Remove | | | | | Load | Save |
| Mesh | Q | | | | | | | |
| | Title A | Name | Abstract | Sql | | | | |
| Point Cloud | Antarctic coastline (includes ice shelves) | antarctic ice shelves | Bohlander, | | | | | |
| | Antarctic continent | antarctic continent | Bohlander, | | | | | |
| | Antarctic grounding line (excludes ice | antarctic coastline | Bohlander, | | | | | |
| Delimited Text | Antarctic ice core locations | antarctic ice cores | Maurer, J | | | | | |
| | Antarctic ice shelves | antarctic ice shelves | Bohlander, | | | | | |
| GeoPackage | Antarctic island coastlines | antarctic islands coa | Bohlander, | | | | | |
| | Antarctic island coastlines | antarctica islands co | Bohlander, | | | | | |
| 1 | Antarctic islands | antarctic islands | Bohlander, | | | | | |
| C+ GPS | Antarctic megadunes | antarctic megadunes | Bohlander, | | | | | |
| 4 | Antarctic permanent research stations | antarctic research s | Wikipedia c | | | | | |
| 🖉 SpatiaLite | Antarctic Polar Front | antarctic polar front | Orsi, A. an | | | | | |
| · • | Antarctic surface elevation contours | antarctica elevation | Liu, H., K. J., | | | | | |
| PostareSOI | Antarctica border | antarctica country b | Bohlander, | | | | | |
| + Postgresqe | coastlines (excluding Antarctica) | coastlines excluding | Center for | | | | | |
| MD. | countries (excluding Antarctica) | country borders exc | Center for | SELECT * FROM country | borders excluding | antarctica WH | ERE "Countryeng" | = 'South Africa' |
| MS SQL Server | glacier outlines | alacier outlines | Armstrong, | , | | | | |
| | glaciers | daciers | National Im | | | | | |
| Oracle | International Date Line | international date line | National Ge | | | | | |
| + | and (excluding Antarctica) | land excluding antar | Center for | | | | | |
| | South Pole of Cold | south pole of cold | Wikipedia c | | | | | |
| | South Pole of Inaccessibility | south pole inaccessi | Wikipedia c | | | | | |
| - | South Pole, Geographic | south pole geographic | Labels the I | | | | | |
| SAP HANA | South Pole, Geomagnetic | south pole geomagn | McClean, S | | | | | |
| | South Pole, Magnetic | south pole magnetic | McClean, S | | | | | |
| WMS AVIMTS | South Poles | south poles wfs | Labels the I | | | | | |
| WFS / OGC API - Features | | | | | | | | |
| 🖶 wcs | | | | | | | | |
| 10/7 | Use the for layer name | | | | | | | |
| + XYZ | Only request features overlapping the vie | w extent | | | | | | |
| Vector Tile | Coordinate Reference System | | | | | | | |
| ArcGIS REST Server | EPSG:3031 | | | | | | | Change |
| 🔍 Metadata Search 📿 | | | | | <u>B</u> uild query | Close | Add | Help |

7. Click *Add* with the layer selected as above. Only the country with the Countryeng value of South Africa will load from that layer:



Did you notice the Ψ icon next to the country_borders_excluding_antarctica layer? It indicates that the loaded layer is filtered and does not display in the project all of its features.

8. Dacă ați încercat ambele metode, veți observa că această variantă este mult mai rapidă decât încărcarea tuturor țărilor înaintea filtrării!

Note cu privire la disponibilitatea WFS

Este o raritate să găsiți un WFS care să pună la dispoziție caracteristicile dorite dacă acestea sunt foarte specifice. Motivul pentru care cele mai multe servicii Web Feature sunt relativ rare este pentru că necesită transmiterea unui volum mare de date pentru a descrie complet o entitate. În concluzie nu este foarte rentabilă găzduirea unui WFS în comparație cu un WMS, care trimite doar imagini.

Cel mai comun tip de WFS pe care îl veți întâlni va fi deci probabil într-o rețea local sau chiar pe propriul calculator, mai degrabă decât in Internet.

10.2.3 În concluzie

Straturile WFS sunt de preferat față de straturile WMS dacă aveți nevoie de acces direct la atributele si geometriile acestora. Cu toate acestea, ținând cont de volumul de date care trebuie descărcat (ceea ce duce la probleme de viteză și de asemenea la lipsa de servere WFS disponibile publicului larg) nu este întotdeauna posibil să folosiți un WFS în loc de un WMS.

10.2.4 Ce urmează?

În continuare, vom vedea cum se utilizează QGIS Server pentru a furniza servicii OGC.

CAPITOLUL 11

Module: QGIS Server

Acest modul a fost publicat de Tudor Bărăscu.

În acest capitol vom examina modul de instalare și utilizare a serverului QGIS.

Pentru a afla mai multe despre QGIS Server, citiți QGIS-Server-manual.

11.1 Lesson: Install QGIS Server

The goal for this lesson: To learn how to install QGIS Server on Debian Stretch. With negligible variations you can also follow it for any Debian based distribution like Ubuntu and its derivatives.

Notă: In Ubuntu you can use your regular user, prepending sudo to commands requiring admin permissions. In Debian you can work as admin (root), without using sudo.

11.1.1 ???? Follow Along: Install from packages

In this lesson we're going to do only the install from packages as shown here .

Instalați Serverul QGIS cu:

```
apt install qgis-server --no-install-recommends --no-install-suggests
```

```
# if you want to install server plugins, also:
apt install python3-qgis
```

QGIS Server should be used in production without QGIS Desktop (with the accompanying X Server) installed on the same machine.

11.1.2 ???? Follow Along: QGIS Server Executable

The QGIS Server executable is qgis_mapserv.fcgi. You can check where it has been installed by running find / -name 'qgis_mapserv.fcgi' which should output something like /usr/lib/cgi-bin/ qgis_mapserv.fcgi.

Optionally, if you want to do a command line test at this time you can run the /usr/lib/cgi-bin/ qgis_mapserv.fcgi --version command which should output something like:

```
QGIS 3.21.0-Master 'Master' (1c70953f1e)
QGIS code revision 1c70953f1e
Qt version 5.15.2
Python version 3.9.5
GDAL/OGR version 3.2.2
PROJ version 7.2.1
EPSG Registry database version v10.008 (2020-12-16)
GEOS version 3.9.0-CAPI-1.16.2
SQLite version 3.34.1
OS Ubuntu 21.04
```

We'll see later on how to make WMS requests.

11.1.3 ??? HTTP Server Configuration

In order to access on the installed QGIS server from an Internet Browser we need to use an HTTP server. The Apache HTTP Server installation process is detailed in httpserver section.

Notă: If you installed QGIS Server without running an X Server (included in Linux Desktop) and if you also want to use the GetPrint command then you should install a fake X Server and tell QGIS Server to use it. You can do that by following the Xvfb installation process.

11.1.4 ???? Follow Along: Create another virtual host

Let's create another Apache virtual host pointing to QGIS Server. You can choose whatever name you like (coco. bango, super.duper.training, example.com, etc.) but for simplicity sake we're going to use myhost.

- Let's set up the myhost name to point to the localhost IP by adding 127.0.0.1 x to the /etc/hosts with the following command: sh -c "echo '127.0.0.1 myhost' >> /etc/hosts" or by manually editing the file with gedit /etc/hosts.
- We can check that myhost points to the localhost by running in the terminal the ping myhost command which should output:

```
qgis@qgis:~$ ping myhost
PING myhost (127.0.0.1) 56(84) bytes of data.
64 bytes from localhost (127.0.0.1): icmp_seq=1 ttl=64 time=0.024 ms
64 bytes from localhost (127.0.0.1): icmp_seq=2 ttl=64 time=0.029 ms
```

• Let's try if we can access QGIS Server from the myhost site by doing: curl http://myhost/ cgi-bin/qgis_mapserv.fcgi or by accessing the url from your Debian box browser. You will probably get:

```
<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">
<html><head>
<title>404 Not Found</title>
</head><body>
<htl>Not Found</htl>
The requested URL /cgi-bin/qgis_mapserv.fcgi was not found on this server.
(continues on next page)
```

(continuare din pagina precedentă)

```
<hr>
<address>Apache/2.4.25 (Debian) Server at myhost Port 80</address></body></html>
```

- Apache doesn't know that he's supposed to answer requests pointing to the server named myhost. In order to setup the virtual host the simplest way would be to make a myhost.conf file in the /etc/ apache2/sites-available directory that has the same content as qgis.demo.conf except for the ServerName line that should be ServerName myhost. You could also change where the logs go as otherwise the logs for the two virtual hosts would be shared but this is optional.
- Let's now enable the virtual host with a2ensite myhost.conf and then reload the Apache service with service apache2 reload.
- If you try again to access the http://myhost/cgi-bin/qgis_mapserv.fcgi url you'll notice everything is working now!

11.1.5 În concluzie

You learned how to install different QGIS Server versions from packages, how to configure Apache with QGIS Server, on Debian based Linux distros.

11.1.6 Ce urmează?

Now that you've installed QGIS Server and it's accessible through the HTTP protocol, we need to learn how to access some of the services it can offer. The topic of the next lesson is to learn how to access QGIS Server WMS services.

11.2 Lesson: Serving WMS

The data used for this exercise are available in the qgis-server-tutorial-data subdirectory of the *training data* you downloaded. For convenience and to avoid possible permissions problems, we will assume that these files are stored in /home/qgis/projects directory. Hence, adapt the following instructions to your path.

Datele demo conțin un proiect QGIS denumit world.qgs, care este pregătit deja pentru a fi expus de către serverul QGIS. Dacă doriți să utilizați propriul proiect sau să aflați cum se poate pregăti un proiect, consultați secțiunea Creatingwmsfromproject.

Notă: Acest modul prezintă adresele URL, astfel încât audiența să poată distinge cu ușurință parametri și valorile acestora. În timp ce formatul normal este:

...&field1=value1&field2=value2&field3=value3

acest tutorial folosește:

```
&field1=value1
&field2=value2
&field3=value3
```

Pasting them into Mozilla Firefox works properly but other web browsers like Chrome may add unwanted spaces between the field:parameter pairs. So, if you encounter this issue you can either use Firefox or modify the URLs so that they're in one line format.

Let's make a WMS GetCapabilities request in the web browser or with curl:

```
http://qgisplatform.demo/cgi-bin/qgis_mapserv.fcgi
?SERVICE=WMS
&VERSION=1.3.0
&REQUEST=GetCapabilities
&map=/home/qgis/projects/world.qgs
```

In the Apache config from the previous lesson the QGIS_PROJECT_FILE variable sets the default project to / home/qgis/projects/world.qgs. However, in the above request we made use of the **map** parameter to be explicit and to show it can be used to point at any project. If you delete the **map** parameter from the above request QGIS Server will output the same response.

By pointing any WMS client to the GetCapabilities URL, the client gets in response an XML document with metadata of the Web Map Server's information, e.g. what layers does it serve, the geographical coverage, in what format, what version of WMS etc.

As QGIS is also a ogc-wms you can create a new WMS server connection with the help of the above GetCapabilities url. See the *Lesson: Web Mapping Services* or the ogc-wms-servers section on how to do it.

By adding the countries WMS layer to your QGIS project you should get an image like the one below:



Fig. 11.1: QGIS Desktop consuming the QGIS Server countries layer WMS service

Notă: QGIS Server serves layers that are defined in the world.qgs project. By opening the project with QGIS you can see there are multiple styles for the countries layer. QGIS Server is also aware of this and you can choose the style you want in your request. The classified_by_population style was chosen in the above image.

11.2.1 Jurnalizarea

When you're setting up a server, the logs are always important as they show you what's going on. We have setup in the *.conf file the following logs:

- QGIS Server log at /logs/qgisserver.log
- qgisplatform.demo Apache access log at qgisplatform.demo.access.log
- qgisplatform.demo Apache error log at qgisplatform.demo.error.log

The log files are simply text files so you can use a text editor to check them out. You can also use the tail command in a terminal: sudo tail -f /logs/qgisserver.log.

This will continuously output in the terminal what's written in that log file. You can also have three terminals opened for each of the log files like so:

qgis@qgis: ~ File Edit View Search Terminal Help qgis@qgis:~\$ sudo tail -f /var/log/apache2/qgisplatform.demo.error.log ^C qgis@qgis:~\$ sudo tail -f /var/log/apache2/qgisplatform.demo.error.log qgis@qgis: ~ File Edit View Search Terminal Help 200 11378 "-" "curl/7.52.1" 127.0.0.1 - - [17/Mar/2017:04:09:41 -0400] "GET /cgi-bin/ggis mapserv.fcgi?SERVICE=W MS&VERSION=1.3.0&REQUEST=GetCapabilities&map=/home/qgis/projects/world.qgs HTTP/1.1" 200 11378 "-" "curl/7.52.1" 127.0.0.1 - - [17/Mar/2017:04:09:42 -0400] "GET /cgi-bin/qgis mapserv.fcgi?SERVICE=W MS&VERSION=1.3.0&REQUEST=GetCapabilities&map=/home/qgis/projects/world.qgs HTTP/1.1" 200 11378 "-" "curl/7.52.1" qgis@qgis: ~ × File Edit View Search Terminal Help [1732][04:09:42] Sent 1 blocks of 11205 bytes [1732][04:09:42] Request finished in 3 ms ^C qgis@qgis:~\$ sudo tail -f /logs/qgisserver.log [1732][04:09:42] MAP:/home/qgis/projects/world.qgs [1732][04:09:42] REQUEST:GetCapabilities [1732][04:09:42] SERVICE:WMS [1732][04:09:42] VERSION:1.3.0 [1732][04:09:42] Found capabilities document in cache [1732][04:09:42] Checking byte array is ok to set... [1732][04:09:42] Byte array looks good, setting response... [1732][04:09:42] Sending HTTP response [1732][04:09:42] Sent 1 blocks of 11205 bytes

Fig. 11.2: Using the tail command to visualise QGIS Server logs output

When you use QGIS Desktop to consume the QGIS Server WMS services you will see all the requests QGIS sends to the Server in the access log, the errors of QGIS Server in the QGIS Server log etc.

Notă:

[1732][04:09:42] Request finished in 3 ms

- If you look at the logs in the following sections you should get a better understanding on what's happening.
- By restarting Apache while looking in the QGIS Server log you can find some extra pointers on how things work.

11.2.2 GetMap requests

In order to display the countries layer, QGIS Desktop, like any other WMS client, is using GetMap requests.

A simple request looks like:

```
http://qgisplatform.demo/cgi-bin/qgis_mapserv.fcgi
?MAP=/home/qgis/projects/world.qgs
&SERVICE=WMS
&VERSION=1.3.0
&REQUEST=GetMap
&BBOX=-432786,4372992,3358959,7513746
&SRS=EPSG:3857
&WIDTH=665
&HEIGHT=551
&LAYERS=countries
&FORMAT=image/jpeg
```

The above request should output the following image:

Figure: simple GetMap request to QGIS Server



Fig. 11.3: Qgis Server response after a simple GetMap request

11.2.3 ???? Try Yourself: Change the Image and Layers parameters

Based on the request above, let's replace the countries layer with another.

In order to see what other layers are available you could open up the world.ggs project in QGIS and look at its contents. Keep in mind though that the WMS clients don't have access to the QGIS project, they just look at the capabilities document contents.

Also, there's a configuration option so that some of the layers existing in the QGIS project are ignored by QGIS when serving the WMS service.

So, you could look at the layer list when you point QGIS Desktop to the GetCapabilities URL or you could try yourself finding other layer names in the GetCapabilities XML response.

One of the layer names that you could find and works is countries_shapeburst. You may find others but keep in mind some may not be visible at such a small scale so you could get a blank image as response.

You can also play around with others parameters from above, like changing the returned image type to image/png.

11.2.4 ???? Follow Along: Use Filter, Opacities and Styles parameters

Let's do another request that adds another layer, some basic parameters, **FILTER** and **OPACITIES**, but also uses the standard STYLES parameter.

```
http://qgisplatform.demo/cgi-bin/qgis_mapserv.fcgi
?MAP=/home/qgis/projects/world.qgs
&SERVICE=WMS
&VERSION=1.3.0
&REQUEST=GetMap
&BBOX=-432786,4372992,3358959,7513746
&SRS=EPSG:3857
&WIDTH=665
&HEIGHT=551
&FORMAT=image/jpeg
&LAYERS=countries,countries_shapeburst
&STYLES=classified_by_name,blue
&OPACITIES=255,30
&FILTER=countries:"name" IN ( 'Germany', 'Italy')
```

The above request should output the following image:



Fig. 11.4: Response to a GetMap request with FILTER and OPACITIES parameters

As you can see from the above image, among other things, we told QGIS Server to render only **Germany** and **Italy** from the countries layer.

11.2.5 ???? Follow Along: Use Redlining

Let's do another GetMap request that makes use of the redlining feature and of the **SELECTION** parameter detailed in the Basics section:

```
http://qgisplatform.demo/cgi-bin/qgis_mapserv.fcgi
?MAP=/home/qgis/projects/world.qgs
&SERVICE=WMS
&VERSION=1.3.0
&REQUEST=GetMap
&BBOX=-432786,4372992,3358959,7513746
&SRS=EPSG:3857
&WIDTH=665
&HEIGHT=551
&LAYERS=countries,countries_shapeburst
&FORMAT=image/jpeg
&HIGHLIGHT_GEOM=POLYGON((590000 6900000, 590000 7363000, 2500000 7363000, 2500000_
G900000, 590000 6900000))
&HIGHLIGHT_SYMBOL=<StyledLayerDescriptor><UserStyle><Name>Highlight</Name>
-<FeatureTypeStyle><Rule><Name>Symbol</Name><LineSymbolizer><Stroke><SvgParameter_</pre>
```

```
(continuare din pagina precedentă)
```

Pasting the above request in your web browser should output the following image:



Fig. 11.5: Response to a request with the REDLINING feature and SELECTION parameter

You can see from the above image that the countries with the 171 and 65 ids were highlighted in yellow (Romania and France) by using the **SELECTION** parameter and we used the **REDLINING** feature to overlay a rectangle with the **QGIS Tutorial** label.

11.2.6 GetPrint requests

One very nice feature of QGIS Server is that it makes use of the QGIS Desktop print layouts. You can learn about it in the wms_getprint section.

If you open the world.qgs project with QGIS Desktop you will find a print layout named Population distribution. A simplified GetPrint request that exemplifies this amazing feature is:

```
http://qgisplatform.demo/cgi-bin/qgis_mapserv.fcgi
?map=/home/qgis/projects/world.qgs
&SERVICE=WMS
&VERSION=1.3.0&
REQUEST=GetPrint
&FORMAT=pdf
&TRANSPARENT=true
&SRS=EPSG:3857
&DPI=300
&TEMPLATE=Population distribution
&map0:extent=-432786,4372992,3358959,7513746
&LAYERS=countries
```



Fig. 11.6: Shows the pdf resulted from the above GetPrint request

Naturally, it's hard to write your GetMap, GetPrint etc. requests.

QGIS Web Client or QWC is a Web client project that can work alongside QGIS Server so that you can publish your projects on the Web or help you create QGIS Server requests for a better understanding about the possibilities.

O puteți instala în felul următor:

- As user qgis go to the home directory with cd /home/qgis.
- Download the QWC project from here and unzip it.
- Make a symbolic link to the /var/www/html directory as it's the DocumentRoot that we've setup in the virtual host configuration. If you unzipped the archive under /home/qgis/Downloads/ QGIS-Web-Client-master we can do that with sudo ln -s /home/qgis/Downloads/ QGIS-Web-Client-master /var/www/html/.
- Access http://qgisplatform.demo/QGIS-Web-Client-master/site/qgiswebclient.html?map=/home/qgis/ projects/world.qgs from your Web browser.

Now you should be able to see the Map as in the following figure:



Fig. 11.7: QGIS Web Client consuming the world.qgs project

If you click the Print button in QWC you can interactively create GetPrint requests. You can also click the ? icon in the QWC to access the available help so that you can better discover the QWC possibilities.

11.2.7 În concluzie

You learned how use QGIS Server to provide WMS Services.

11.2.8 Ce urmează?

În continuare, vom vedea cum se utilizează QGIS ca interfață pentru faimosul GIS GRASS.

CAPITOLUL 12

Module: GRASS

GRASS (Sistem de Suport pentru Analiza Resurselor Geografice) este un GIS bine-cunoscut, cu sursă deschisă, și cu o gamă largă de funcții utile. Acesta a fost lansat în 1984, și a cunoscut multe îmbunătățiri și funcționalități suplimentare de atunci. QGIS vă permite să faceți uz direct de puternicele instrumente GIS din Grass.

12.1 Lesson: GRASS Setup

Using GRASS in QGIS requires you to think of the interface in a slightly different way. Remember that you're not working in QGIS directly, but working in GRASS *via* QGIS. Hence, make sure you have installed QGIS Desktop with Grass support.

To open a QGIS session with GRASS available on Windows you have to click on the QGIS Desktop with GRASS icon.

Scopul acestei lecții: Pentru a începe un proiect GRASS în QGIS.

12.1.1 ???? Follow Along: Start a New GRASS Session

To launch GRASS from within QGIS, you need to activate it as with any other plugin:

- 1. First, open a new QGIS project.
- 2. In the *Plugin Manager*, enable *A GRASS 8* in the list:

| <u>R</u> | | Plugins Installed (9) | ~ ^ | × |
|--------------------|-------------------------------|--|-----------------------------|----|
| iii All | Q Search | | | |
| Installed | 🔽 🗐 DB Manager | This is a core plugin, so you can't uninstall it | | |
| | 🔲 🧊 Geometry Checker | CDVCC 8 | 0 | 30 |
| >> Not installed | 🗸 🎢 GRASS 8 | GRASS 0 | | na |
| 🏇 Install from ZIP | 🗸 🞡 GRASS GIS provider | GRASS 8 (Geographic Resources Analysis Support System) | | |
| | 🔽 🧟 MetaSearch Catalog Client | | | |
| i Settings | OfflineEditing | Category Plugins | | |
| | 🗌 🚳 OrfeoToolbox provider | Installed version Version 2.0 | | |
| | 🗸 🜞 Processing | | | |
| | 🔲 🎉 Topology Checker | | | |
| | | Upgrade All Uninstall Plugin Reinstall | Plugin | |
| | A Aide | | <mark>⊗ <u>F</u>erme</mark> | er |

The GRASS toolbar and the GRASS panel will appear:

| Modulos | Class ma |
|--|----------|
| Region | Close ma |
| Filter | |
| ▼ GRASS MODULES | |
| Create new GRASS location and transfer data into | it |
| File management | |
| Region settings | |
| Projection management | |
| Raster | |
| Vector | |
| Imagery | |
| Temporal | |
| Database | |
| Convert coordinates | |
| ▶ Help | |
| | |
| | |
| | |
| | |

Fig. 12.1: GRASS Toolbar and Panel

The GRASS panel is not active because, before you can use GRASS, you need to create a Mapset. GRASS always works in a database environment, which means that you need to import all the data you want to use into a GRASS database.

The GRASS database has a straightforward structure, even if at a first look it seems very complicated. The most important thing you should know is that the upper level of the database is the Location. Each Location can contain different Mapset: in every Mapset you will find the PERMANENT Mapset because it is created by default by GRASS. Each Mapset contains the data (raster, vector, etc) in a particular structure, but don't worry, GRASS will take care of this for you.

Just remember: Location contains Mapset that contains the data. For more information visit the GRASS website.



Fig. 12.2: GRASS database structure (from GRASS docs)

12.1.2 ???? Follow Along: Start a New GRASS Project

1. Click on the *Plugins* \blacktriangleright *GRASS* \blacktriangleright *New Mapset* menu:

| | | *Untitled Project - QGIS [tm] | | × |
|----------------------------------|--|---------------------------------|---|-------------------|
| Project Edit View Layer Settings | Plugins Vector Raster Database Web Proce | essing <u>H</u> elp | | |
| 🗋 🖿 🗟 🛃 🖸 🔇 🧖 🐥 | Manage and Install Plugins | - 🖽 - 🖸 - 🎭 💷 🗰 🌞 Σ 🚍 | • 📮 🗉 • | |
| | 👩 🍓 Python Console 🛛 Ctrl+Alt+ | P 👌 🧿 🗸 🛯 🛐 🔠 🙊 🛐 | | |
| Lavers | GRASS | 🕨 🎼 Open Mapset | SS Tools | ଅ ସ |
| 📕 🥑 🏨 🐵 👎 🗞 - 🖬 🖬 🗔 | <u>P</u> lugin Reloader | 🔸 🎼 New Mapset | manset is open. You can open a GRASS mapset from the br | owser using the |
| | | Close Mapset | pset item's context menu action Open mapset. | suber ability are |
| Va | | M Open GRASS Tools | odules Region | OClose mapset |
| Pa | | Display Current Grass Region | Filter | |
| Layers Browser | eady Coordinate -0. | 405,1.194 🛞 Scale 1:1692146 🔻 🚇 | GRASS MOULES Shell Shell Create new GRASS location and transfer data into it File management Region settings Projection management Raster Vector Imagery Temporal Database Convert coordinates Help Magnifier 100% Rotation 0.0 V Render Vender Vend | EPSG:4326 |

You'll be asked to choose the location of the GRASS database.

2. Setați-l ca director care va fi utilizat de către GRASS pentru instalarea bazei de date:



3. Clic pe Next.

GRASS needs to create a Location, which describes the maximum extent of the geographic area you'll be working in, also known as Grass Region.

Notă: the Region is extremely important for GRASS because it describes the area in which all layers will be taken into account for GRASS. Everything that is outside will not be considered. Don't worry, you can always change the extent of the GRASS Region after the Location has been created

1. Call the new location SouthAfrica:

| ର | New Mapset | \sim | ^ | × |
|-------------------------|---|--------|------|---|
| GRASS Location | | | | |
| O Select location | | | Ŧ | |
| Create new location | SouthAfrica | | | |
| The GRASS location is a | collection of maps for a particular territory or project. | | | |
| | | | | |
| | | | | |
| | < <u>P</u> récédent <u>S</u> uivant > | Annu | ller | |

- 2. Clic pe Next.
- 3. We'll be working with WGS 84, so search for and select this CRS:

| | New Map | set | | ~ | ^ | |
|--|----------------------|--|-------------|-----------|------|---|
| Projection | | | | | | |
| O Not defined | | | | | | |
| Projection | | | | | | |
| Filter | | | | | | 1 |
| Recently Used Coordinate Reference | e Systen | 15 | | | | ľ |
| Coordinate Reference System | .е с у 5 сен. | uthority ID | | | | |
| EPSG-4226 - WGS 84 | 5 | PSG-1226 | | | × | ł |
| IALL 2015;200005200 - 52 Europa (20 | 15) - I/ | 2015-20000520 | 0 | | 0 | Ĩ |
| Predefined Coordinate Reference S | ystems | | Hide depr | ecated (| RSs | |
| Predefined Coordinate Reference Sy | ystems | Authority ID |] Hide depr | ecated (| RSs | |
| Predefined Coordinate Reference S Coordinate Reference System WGS 72BE | ystems | Authority ID EPSG:4324 | Hide depr | ecated (| CRSs | |
| Predefined Coordinate Reference S Coordinate Reference System WGS 72BE WGS 84 | ystems | Authority ID EPSG:4324 EPSG:4326 |] Hide depr | ecated (| CRSs | |
| Predefined Coordinate Reference System Coordinate Reference System WGS 72BE WGS 84 WGS 84 (CRS84) | ystems | Authority ID EPSG:4324 EPSG:4326 OGC:CRS84 |] Hide depr | ecated (| CRSs | |
| Predefined Coordinate Reference System WGS 72BE WGS 84 WGS 84 (CRS84) WGS 84 (G1150) | ystems | Authority ID EPSG:4324 EPSG:4326 OGC:CRS84 EPSG:9055 |] Hide depr | ecated (| CRSs | |
| Predefined Coordinate Reference S Coordinate Reference System WGS 72BE WGS 84 WGS 84 (CRS84) WGS 84 (CRS84) WGS 84 (G1150) WGS 84 | ystems | Authority ID EPSG:4324 EPSG:4326 OGC:CR584 EPSG:9055 | Hide depr | ecated (| RSs | |
| Predefined Coordinate Reference System WGS 72BE WGS 84 WGS 84 (CRS84) WGS 84 (G1150) 4 WGS 84 | ystems | Authority ID EPSG:4324 EPSG:4326 OGC:CRS84 EPSG:9055 | Hide depr | ecated (| CRSs | |
| Predefined Coordinate Reference System WGS 72BE WGS 84 WGS 84 (CRS84) WGS 84 (G1150) 4 WGS 84 Properties • Geographic (uses latitude and | ystems | Authority ID EPSG:4324 EPSG:4326 OGC:CRS84 EPSG:9055 | Hide depr | ecated (| CRSs | |
| Predefined Coordinate Reference System WGS 72BE WGS 84 WGS 84 (CRS84) WGS 84 (G1150) 4 WGS 84 Properties • Geographic (uses latitude and longitude for coordinates) | ystems | Authority ID EPSG:4324 EPSG:4326 OGC:CRS84 FPSG:9055 | Hide depr | ecated of | CRSs | |
| Predefined Coordinate Reference System WGS 72BE WGS 84 WGS 84 (CRS84) WGS 84 (G1150) WGS 84 Properties Geographic (uses latitude and longitude for coordinates) Dynamic (relies on a datum | ystems | Authority ID EPSG:4324 EPSG:4326 OGC:CRS84 EPSG:9055 | Hide depr | ecated of | RSs | |
| Predefined Coordinate Reference System WGS 72BE WGS 84 WGS 84 (CRS84) WGS 84 (G1150) VGS 84 Properties Geographic (uses latitude and longitude for coordinates) Dynamic (relies on a datum | ystems | Authority ID EPSG:4324 EPSG:4326 OGC:CRS84 EPSG:9055 | Hide depr | ecated of | CRSs | |

- 4. Clic pe Next.
- 5. Acum selectați regiunea Africii de Sud din caseta cu derulare verticală și faceți clic pe Set:

| 2 | New Mapset V 🔨 | × |
|---|---|---|
| Default GRAS | SS Region | |
| | North -21.27000000 | |
| West 13.680000 | 000 East 33.98000000 | |
| | South -35.90000000 | |
| Cal | culate from Layer * Layout Map * Bookmark * | |
| | Map Canvas Extent Draw on Canvas | |
| Preset regions | South Africa 👻 Set | |
| The GRASS region for one location. change the defau | h defines a workspace for raster modules. The default region is valid It is possible to set a different region in each mapset. It is possible to alt location region later. | |
| | < <u>P</u> récédent <u>S</u> uivant > Annuler | |

- 6. Clic pe Next.
- 7. Creați un set de hărți, care este fișierul hărții cu care veți lucra.

| ଭ | New Mapset | ~ ^ × |
|--|--|---|
| Mapset | | |
| New mapset | | |
| grass_mapset | | |
| The GRASS mapset is a collection all mapsets in the location but | on of maps used by one user. A user he can open for writing only his ma | r can read maps from pset (owned by user). |
| | < <u>P</u> récédent | Suivant > Annuler |

Once you're done, you'll see a dialog asking with a summary of all the information entered.

| Q | New Mapset | ~ ^ X |
|-------------------------------------|--------------------------------------|-----------|
| Create New Mapset | | |
| Database : /home/delazj/exercise_da | ita | |
| Location : SouthAfrica | | |
| Mapset : grass_mapset | | |
| ✓ Open new mapset | | |
| | | |
| | < <u>P</u> récédent <u>T</u> erminer | r Annuler |

- 8. Clic Finish.
- 9. Clic pe OK, în dialogul de încheiere cu succes.

You will see that the GRASS Panel will become active and you can start to use all GRASS tools.

12.1.3 ???? Follow Along: Loading Vector Data into GRASS

You have now a blank map and before you can start to use all the GRASS tools you have to load data into the GRASS database, specifically into the Mapset. You cannot use GRASS tools with layer that are not loaded into a GRASS Mapset.

There are many different ways to load data in the GRASS database. Let's start with the first one.

???? Follow Along: Load data using the QGIS Browser

In section [2][2] The Browser Panel we saw that the easiest and quickest way to load the data in QGIS is the Browser Panel.

GRASS data are recognized from the QGIS Browser as real GRASS data and you can notice it because you will see

the GRASS icon next to the GRASS Mapset. Moreover you will see the 💯 icon next to the Mapset that is opened.



Notă: You will see a replication of the GRASS Location as normal folder: GRASS Mapset data are those within the $\widehat{\mathbb{W}}$ folder

You can easily drag and drop layers from a folder to the GRASS Mapset.

Let's try to import the roads layer into the grass_mapset Mapset of the SouthAfrica Location.

Go to the Browser, and simply drag the roads layer from the training_data.gpkg GeoPackage file into the grass_mapset Mapset.



That's it! If you expand the Mapset you will see the imported roads layer. You can now load in QGIS the imported layer like all the other layers.

Sfat: You can also load layers from the Layer Legend Panel to Mapset in the Browser Panel. This will speed up

incredibly your workflow!

???? Follow Along: Load data using the GRASS Panel

We will use now the *long* method to load the rivers.shp layer into the same Mapset.

- 1. Load data into QGIS as usual. Use the rivers.shp dataset (found in the exercise_data/ shapefile/folder)
- 2. As soon as it is loaded, click on the *Filter* box of the GRASS Panel and find the vector import tool by entering the term v.in.ogr.qgis (available under *File management* ► *Import into GRASS* ► *Import vector into GRASS*):

Atenționare: There are 2 similar tools: v.in.ogr.qgis and v.in.ogr.qgis.loc. We are looking for the first one.

| GRASS Tools: SouthAfrica/grass_mapset | 0 |
|--|------------------------|
| Modules Region | Oclose mapset |
| Filter v.in. | × |
| GRASS MODULES Create new GRASS location and transfer data into Create new GRASS location from vector data v.in.ogr.qgis.loc | it |
| File management | d create a fitted loc |
| Import into GRASS Import vector into GRASS | |
| v.in.ogr.qgis Import loaded vector | r |
| → W v.in.ogr Import OGR vector | |
| V.In.ogr.loc | nd create a fitted lo |
| Import OGR vectors i | in a given data sour 👻 |
| Reload tree Run | debug Close debug |

The v stands for *vector*, in means a function to import data into the GRASS database, ogr is the software library used to read vector data, and qgis means that the tool will look for a vector from among the vectors already loaded into QGIS.

3. Once you've found this tool, click on it to bring up the tool itself. Choose the *rivers* layer in the *Loaded Layer* box and type and name it g_rivers to prevent confusion:

| GRASS Tools: SouthAfrica/grass_mapset | 0 🗙 |
|--|---------------|
| Modules Region 🗸 🕈 🍥 | Oclose mapset |
| Module: v.in.ogr.qgis | |
| Options Output Manual | |
| Loaded layer | |
| rivers | - |
| Password | |
| | |
| | |
| Nom de la couche vectorielle en sortie | |
| g_rivers | |
| | |
| Show advanced options >> | |
| | |
| | |
| Run View output | ut Close |
| | |

Notă: $\star \star \star$ Note the extra import options provided under *Advanced Options*. These include the ability to add a WHERE clause for the SQL query used for importing the data.

- 4. Faceți clic pe Run pentru a începe importul.
- 5. După finalizare, dați clic pe butonul View output pentru a vedea noul strat GRASS importat în hartă.
- 6. Închideți primul instrument de import (dați clic pe butonul *Close* imediat în dreapta de *View output*), după care închideți fereastra *GRASS Tools*.
- 7. Remove the original rivers layer.

Acum ați rămas doar cu stratul GRASS importat, așa cum este afișat în harta dvs. din QGIS.

12.1.4 ???? Follow Along: Loading Raster Data into GRASS

You can import a raster layer in the same ways we imported vector layers.

We are going to import in the GRASS Mapset the layer srtm_41_19_4326.tif.

Notă: the raster layer is already in the correct CRS, WGS 84. If you have layers in different CRS you must reproject them in the same CRS of the GRASS Mapset

- 1. Load the srtm_41_19_4326.tif layer in QGIS
- 2. Deschideți iarăși dialogul Instrumentelor GRASS.
- 3. Click on the Modules tab.
- 4. Search for r.in.gdal.qgis (available under *File management* ► *Import into GRASS* ► *Import raster into GRASS* ► *Import raster into GRASS* From QGIS view) and double click the tool to open the tool's dialog.
- 5. Set it up so that the input layer is srtm_41_19_4326.tif and the output is g_dem.

| GRASS Tools: SouthAfrica/grass_mapset | t Ø 🛚 |
|---------------------------------------|-----------------------|
| Modules Region 💝 🔶 📡 | OClose mapset |
| Module: r.in.gdal.qgis | |
| Options Output Manual | |
| Loaded layer | |
| srtm_41_19_4326 | • |
| Password | |
| | |
| Nom de la couche matricielle e | n sortio |
| | |
| g_dem | |
| | |
| Show advanced options >> | |
| | |
| | |
| | Run View output Close |

- 6. Clic pe Run
- 7. Când procesul s-a încheiat, faceți clic pe Vizualizare rezultat.
- 8. Închideți fila curentă, apoi Închideți întregul dialog.



9. You may now remove the original srtm_41_19_4326.tif layer.

12.1.5 ???? Try Yourself: Add Layers to Mapset

Try to import in the GRASS Mapset the vector layers water.shp and places.shp from the exercise_data/shapefile/ folder. As we did for rivers rename the imported layer as g_water and g_places to avoid confusion

Răspuns

You can add layers (both vector and raster) into a GRASS Mapset by drag and drop them in the Browser (see 222 Follow Along: Load data using the QGIS Browser) or by using the v.in.gdal.qgis for vector and r.in.gdal.qgis for raster layers.

12.1.6 ???? Open an existing GRASS Mapset

If you have an existing GRASS Mapset you can easily reopen it in another session of QGIS.

You have several method to open a GRASS Mapset, let's explore some of them.

Let's close the Mapset by clicking on the Close Mapset button of the GRASS Tools window.

???? Follow Along: Using the GRASS plugin

- 1. Click on the *Plugins* \blacktriangleright *GRASS* \blacktriangleright *Open Mapset* menu.
- 2. Browse to the GRASS database folder: be careful! You must choose the parent folder, not the GRASS Mapset one. Indeed GRASS will read all the Locations of the database and all the Mapsets of each Location:

| Q | Select GRASS Mapset | ~ ^ × |
|----------|----------------------------|-------------------|
| Gisdbase | /home/delazj/exercise_data | Browse |
| Location | SouthAfrica | • |
| Mapset | grass_mapset | • |
| | <u>0</u> k | ⊗ <u>A</u> nnuler |

3. Choose the Location SouthAfrica and the Mapset grass_mapset that we have created before.

That's it! The GRASS Panel will become active meaning that the Mapset has been correctly opened.

???? Follow Along: Using the QGIS Browser

Even faster and easier is opening a Mapset using the QGIS Browser:

- 1. Close the Mapset (if it is open) by clicking on the Close Mapset button of the GRASS Tools window.
- 2. In the QGIS Browser, browse to the folder of the GRASS database.
- 3. Right click on the Mapset (remember, the Mapset has the W GRASS icon next to it). You will see some options.
- 4. Click on *Open mapset*:



The Mapset is now open and ready to use!

Sfat: Right click on a GRASS Mapset offers you a lot of different settings. Try to explore them and see all the useful options.

12.1.7 În concluzie

Fluxul de lucru GRASS pentru asimilarea datelor este ușor diferit de metoda QGIS pentru că GRASS încarcă datele într-o structură de bază de date spațială. Cu toate acestea, utilizănd QGIS ca interfață, puteți ușura setarea unui mapset GRASS prin utilizarea straturilor existente QGIS ca surse de date pentru GRASS.

12.1.8 Ce urmează?

Acum, o dată ce datele sunt importate în GRASS, ne putem uita la operațiunile avansate de analiză pe care le oferă GRASS.

12.2 Lesson: GRASS Tools

În această lecție vom prezenta o selecție de instrumente pentru a vă oferi o idee despre capabilitățile GRASS.

12.2.1 ???? Follow Along: Create an aspect map

- 1. Open the GRASS Tools tab
- 2. Load the g_dem raster layer from the grass_mapset Mapset
- 3. Look for the *r.aspect* module by searching for it in the *Filter* field of the *Modules List* tab
- 4. Open the tool and set it up like this and click on the *Run* button:

| GRASS Tools: SouthAfrica/grass_mapset | Ø 🕱 |
|---------------------------------------|---------------|
| Modules Region 🖲 🔚 | OClose mapset |
| Module: r.aspect | |
| Options Output Manual | |
| Name of input elevation raster map | |
| g_dem | - 1 |
| Name for output aspect raster map | |
| g_aspect | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| Rup View eutou | t Close |
| Nun View outpu | Close |

5. When the process is finished click on *View Output* to load the resulting layer in the canvas:


The g_aspect layer is stored within the *grass_mapset* Mapset so you can remove the layer from the canvas and reload it whenever you want.

12.2.2 ???? Follow Along: Get basic statistic of raster layer

We want to know some basic statistics of the g_dem raster layer.

- 1. Open the GRASS Tools tab
- 2. Load the g_dem raster layer from the grass_mapset Mapset
- 3. Look for the *r.info* module by searching for it in the *Filter* field of the *Modules List* tab
- 4. Set up the tool like this and click on *Run*:

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| RASS Tools: SouthAfrica/grass_mapset | 0 1 | | | | |
|--|---------------|--|--|--|--|
| Modules Region 🄀 🕖 | Oclose mapset | | | | |
| Module: r.info | | | | | |
| Options Output Manual | | | | | |
| Name of raster map | | | | | |
| s Tools: SouthAfrica/grass_mapset | | | | | |
| ASS Tools: SouthAfrica/grass_mapset | | | | | |
| S Tools: SouthAfrica/grass_mapset dules Region Close mapset dule: r.info ptions Output Manual Name of raster map g.dem Print raster history instead of info Print extended metadata information in shell script style | | | | | |
| Print extended metadata information in shell script style | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| s Toois: SouthAmrca/grass_mapset odules Region S odule: r.info Dptions Output Manual Image: Close mapset Image: Close mapset | | | | | |
| Module: r.info Options Output Mame of raster map g_dem Print raster history instead of info Print extended metadata information in shell script style | | | | | |
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| | | | | | |
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| | | | | | |
| | | | | | |
| | | | | | |
| Run | Close | | | | |

5. Within the Output tab you will see some raster information printed, like the path of the file, the number of rows and columns and other useful information:

| Iodules | Region | 5. 0 | | OClose maps |
|---|--|---|---|--|
| | | | | |
| Module: r | info | | | |
| Options | Output | Manual | | |
| r.info m | ap=g_dem@g | grass_mapset | | ·····+ |
| Map: Mapse Locat DataB Title Times | g_der t: grass ion: South ase: /home : g_der tamp: none | m@grass_mapset s_mapset hAfrica e/matteo/exer n e | et Date: Mon Aug 6 Login of Creator rcise_data/grass/grassdata | 5 10:48:55 2018 : matteo |
| Typ Dat Row Col Tot Ran | e of Map: a Type: s: umns: al Cells: Project: N: 3 E: 2 ge of data | raster FCELL 619 568861 ion: Latitude 33:45:02.7900 20:50:22.0302 a: min = 6 | Number of Categories e-Longitude 0255 S: 34:16:12.038772S R 235E W: 20:04:06.845095E R 0 max = 1699 | tes: 0:00:03.01978 tes: 0:00:03.01978 |
| Dat ge | a Descript nerated by | tion: / r.in.gdal | | |
| Com r. a/ m" | ments: in.gdal in training_n memory=30 | nput="/home/m nanual_data/r 00 offset=0 r | natteo/lavori/miei/grant_tm/QGI raster/SRTM/srtm_41_19_4326.tif num_digits=0 | S-Training-Dat\ "output="g_de\ |
| + | ully finis | shed | | + |
| | | | 100% | |
| | | | | Run Close |

12.2.3 ???? Follow Along: The Reclass Tool

Reclassifying a raster layer is a very useful task. We just created the g_aspect layer from the g_dem one. The value range gets from 0 (North) passing through 90 (East), 180 (South), 270 (West) and finally to 360 (North again). We can reclassify the g_aspect layer to have just 4 **categories** following specific *rules* (North = 1, East = 2, South = 3 and West = 4).

Grass reclassify tool accepts a txt file with the defined rules. Writing the rules is very simple and the GRASS Manual contains very good description.

Sfat: Each GRASS tool has its own Manual tab. Take the time to read the description of the tool you are using to don't miss some useful parameters

1. Load the g_aspect layer or, if you don't have create it, go back to the [2][2] Follow Along: Create an aspect map section.

- 2. Look for the *r.reclass* module by searching for it in the *Filter* field of the *Modules List* tab
- 3. Open the tool and set it up like the following picture. The file containing the rules is in the exercise_data/ grass/ folder, named reclass_aspect.txt.
- 4. Click on *Run* and wait until the process is finished:

| | | a/grass_maps | | | | | | _ | | |
|---------|-------------|---------------|----------------|----------|---------|--|---------|------|--|--|
| Modules | Region | 1 | | | | | Close m | apse | | |
| Module: | r.reclass | | | | | | | | | |
| Options | Output | Manual | | | | | | | | |
| Name | of raster | man to be re | classifi | ad | | | | | | |
| Name | orraster | map to be re | Classifi | eu | | | | | | |
| g_as | spect | | | | | | • H | | | |
| File c | ontaining i | reclass rules | | | | | | . | | |
| /hon | ne/matteo/e | xercise_data/ | grass/re | lass_asp | ect.txt | | | | | |
| Name | for output | t raster man | | | | | | - 1 | | |
| | i or output | t raster map | | | | | | | | |
| g_re | classified | | g_reclassified | | | | | | | |
| | | | | | | | | | | |
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5. Click on View Output to load the reclassified raster in the canvas

The new layer is made up by just 4 values (1, 2, 3, and 4) and it is easier to manage and to process.



Sfat: Open the reclass_aspect.txt with a text editor to see the rules and to start becoming used to them. Moreover, take a deep look at the GRASS manual: a lot of different examples are pointed out.

12.2.4 ???? Try Yourself: Reclassify with your rules

Try to reclassify the g_dem layer into 3 new categories:

- from 0 to 1000, new value = 1
- from 1000 to 1400, new value = 2
- from 1400 to the maximum raster value, new value = 3

Răspuns

To discover the maximum value of the raster run the r.info tool: in the console you will see that the maximum value is 1699. You are now ready to write the rules.

1. Open a text editor and add the following rules:

```
0 thru 1000 = 1
1000 thru 1400 = 2
1400 thru 1699 = 3
```

- 2. Save the file as my_rules.txt file and close the text editor.
- 3. Run the r.reclass tool: choose the g_dem layer and load the file containing the rules you just have saved.
- 4. Click on *Run* and then on *View Output*. You can change the colors and the final result should look like the following picture:



12.2.5 ??? Follow Along: The Mapcalc Tool

The Mapcalc tools is similar to the Raster Calculator of QGIS. You can perform mathematical operation on one or more raster layers and the final result will be a new layer with the calculated values.

The aim of the next exercise is to extract the values greater than 1000 from the g_dem raster layer.

- 1. Look for the *r.mapcalc* module by searching for it in the *Filter* field of the *Modules List* tab.
- 2. Startați instrumentul.

The *Mapcalc* dialog allows you to construct a sequence of analyses to be performed on a raster, or collection of rasters. You will use these tools to do so:



În ordine, acestea sunt:

- Add map: Add a raster file from your current GRASS mapset.
- Add constant value: Add a constant value to be used in functions, 1000 in this case
- Add operator or function: Add an operator or function to be connected to inputs and outputs, we will use the operator greater equals than
- *Add connection*: Connect elements. Using this tool, click and drag from the red dot on one item to the red dot on another item. Dots that are correctly connected to a connector line will turn gray. If the line or dot is red, it is not properly connected!
- Select item: Select an item and move selected items.
- *Delete selected item*: Removes the selected item from the current mapcalc sheet, but not from the mapset (if it is an existing raster)
- Open: Open an existing file with the operation defined

- Save: Save all the operation in a file
- *Save as*: Save all the operations as a new file on the disk.
- 3. Using these tools, construct the following algorithm:

| GRASS Tools: SouthAfrica/grass_mapset @ 🗷 |
|--|
| Modules Region 🔛 |
| Module: r.mapcalc Options Output Image: |
| g_dem >= Output |
| Output g_dem_1000 |
| Run View output Close |

4. Click on Run and then on View output to see the output displayed in your map:

| | | | | | *Untitled Project - C | 685 [tm] | | | | |
|--|---|---------------------------------------|---------------------------|-----------------------------------|-----------------------|----------------------------|-------------------------|-------------------|-------------------|-------------------|
| Project St | R yiew Layer 5 | ettings Bugins Vector Baster | Database Web Programing 1 | prip. | | | | | | |
| 0 - 8 | I II G R (0 | · · · · · · · · · · · · · · · · · · · | A 14 15 15 10 1 4, 4, - 1 | 5-10- 5 11 10 0 1 = | + 🔛 🕅 + | | | | | |
| 1.18 | GN R B 1 | 0.0 + 0 - 4 5 - | | 0 - II - A II | | | | | | |
| Cayers | ×, ∀ 5, - 3 0 : 000 : 100 1 7 € | 08 \$ 14 | | | | •• | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Layer | s Browser | | | | | | | | | |
| LL Type to | Tecatar (CD/=K) | 1 legend entries removed. | | | | Coordinate 20.5214-03.7858 | Scale 1 15/15/4 * 🗃 Mag | piller 300% 2 Rol | ation 0.01 D V Re | ner @ 8756.4326 @ |

This shows all the areas where the terrain is higher than 1000 meters.

Sfat: You can also save the formula you have created and load it in another QGIS project by clicking on the last button on the GRASS Mapcalc toolbar.

12.2.6 În concluzie

În această lecție, am acoperit doar câteva dintre numeroasele instrumente GRASS. Pentru a explora capacitățile GRASS, deschideți dialogul *Instrumentelor GRASS*, apoi derulați până la *Lista Modulelor*. Sau, pentru o abordare mai structurată, căutați în fila *Modules Tree*, care prezintă instrumentele organizate după tip.

CAPITOLUL 13

Module: Assessment

Folosiți datele dvs pentru această secțiune. Veți avea nevoie de:

- un set de date vectoriale al punctelor de interes, cu numele punctelor și multiple categorii
- un set vectorial cu datele drumurilor
- un set vectorial cu date poligonale despre utilizarea terenurilor (folosind limitele de proprietate)
- o imagine a spectrului vizibil (cum ar fi o fotografie aeriană)
- a DEM (downloadable from the CGIAR-CSI if you don't have your own)

13.1 Crearea unei hărți de bază

Înainte de a orice, aveți nevoie de o hartă de bază, care va asigura un context pentru rezultatele analizei dvs.

13.1.1 Adăugarea unui strat de tip punct

 Adăugați stratul de tip punct. În funcție de nivelul la care urmați cursul, efectuați doar ceea ce este listat în secțiunea corespunzătoare de mai jos:

???

- Etichetați punctele în conformitate cu un atribut unic, cum ar fi numele locurilor. Utilizați un font mic pentru a nu scoate în evidență etichetele. Informațiile trebuie să fie disponibile, dar nu ar trebui să fie principalele entități de pe hartă.
- Clasificați punctele în culori diferite, pe baza unei categorii. De exemplu, categoriile ar putea include "destinație turistică", "secție de poliție" și "centrul orașului".

???

- Do the same as the $\bigstar \Leftrightarrow \Leftrightarrow$ section.
- Clasificați dimensiunea punctului după importanță: cu cât mai semnificativă e o entitate, cu atât mai mare este punctul. Cu toate acestea, nu depășiți o dimensiune a punctului de 2.00.
- Entităților care nu sunt localizate într-un singur punct (cum ar fi un nume de provincie/regiune, sau un nume de oraș, la o scară mai mare), nu le atribuiți nici un punct.

???

- Nu folosiți deloc simboluri punctiforme pentru a simboliza stratul. În schimb, folosiți etichetele centrate pe puncte; simbolurile punctiforme nu ar trebui să aibă o dimensiune.
- Folosiți Setări definite cu ajutorul datelor pentru a stiliza etichetele în categorii semnificative.
- Adăugați coloanele corespunzătoare pentru datele atributelor, dacă este necesar. Când faceți acest lucru, nu creați date fictive mai degrabă, utilizați *Calculatorul de Câmpuri* pentru a popula noile coloane, pe baza valorilor existente în setul de date.

13.1.2 Adăugarea stratului de tip linie

• Adăugați stratul rutier și apoi schimbați-i simbolistica. Nu etichetați drumurile.

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• Alegeți pentru simbolistica drumului o linie lată, de culoare deschisă. De asemenea, adăugați-i o oarecare transparență.

???

- Creați un simbol cu straturi multiple pentru simboluri. Simbolul rezultat ar trebui să arate ca un drum adevărat. Aveți posibilitatea să utilizați un simbol simplu pentru aceasta; de exemplu, o linie neagră, cu o linie solidă, albă și subțire în centru. Simbolul ar putea arăta chiar și mai elaborat, totuși, harta rezultată nu ar trebui să arate prea încărcată.
- Dacă setul dvs. de date are o densitate mare de drumuri la scara la care doriți să prezentați harta, atunci, ar trebui să aveți două straturi rutiere: unul cu un simbol mai complex, și altul cu un simbol mai simplu, pentru scări mai mici. (Utilizați vizibilitatea în funcție de scară, pentru a se face trecerea la scara adecvată.)
- Toate mqrcajele ar trebui să aibă straturi multiple cu simboluri. Utilizați simbolurile pentru a le afișa corect.

???

- Do the same as in the $\star \star \ddagger$ section above.
- În plus, drumurile ar trebui să fie clasificate. Atunci când se utilizează simboluri de teren realiste, fiecare tip de drum ar trebui să aibă un simbol adecvat; de exemplu, o autostradă ar trebui să apară cu două benzi pentru fiecare sens.

13.1.3 Adăugarea stratului de tip poligon

• Adăugați stratul de folosință a terenurilor și schimbați-i simbolistica.

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• Clasificați stratul conform utilizării terenului. Folosiți culori solide.

???

• Clasificați stratul conform utilizării terenurilor. Dacă este cazul, includeți straturi simbol, diferite tipuri de simboluri, etc. Aveți grijă ca rezultatele să aibă intensitate redusă și să arate uniform, cu toate acestea. Țineți minte că acesta va fi parte a unui fundal!

???

• Utilizați clasificarea bazata pe reguli pentru a clasifica utilizarea terenurilor în categorii generale, cum ar fi "urban", "rural", "rezervație naturală", etc.

13.1.4 Crearea fundalului raster

• Creați o reliefare din DEM, și utilizați-o ca o suprapunere pentru o versiune clasificată a DEM-ului în sine. Ați putea folosi, de asemenea, plugin-ul *Relief* (după cum se arată în lecția despre plugin-uri).

13.1.5 Finalizarea hărții de bază

• Utilizând resursele de mai sus, creați o hartă de bază folosind unele straturi sau pe toate. Această hartă ar trebui să includă toate informațiile de bază necesare pentru a orienta utilizatorul, și să fie vizual unificată / "simplă".

13.2 Analiza datelor

- Căutați o proprietate care îndeplinește anumite criterii.
- Puteți decide cu privire la propriile criterii, pe care le trebuie să le documentați.
- Iată unele indicații pentru aceste criterii:
 - proprietatea țintă ar trebui să aibă (un) anumit tip(uri) de utilizare a terenului
 - ar trebui să fie la o anumită distanță de drumuri, sau să fie traversată de un drum
 - ar trebui să fie la o anumită distanță de unele categorii de puncte, cum ar fi un spital, de exemplu

13.2.1 ??? / ???

• Includeți analiza raster în rezultatele dvs. Luați în considerare cel puțin o proprietate derivată din raster, cum ar fi aspectul sau panta acestuia.

13.3 Harta Finală

- Utilizați Compoziții Imprimabile pentru a crea o hartă finală, care încorporează rezultatele analizei dvs.
- Includeți această hartă într-un document, împreună cu criteriile documentate. Dacă harta a devenit prea ocupată vizual, datorită strat(ului) adăugat, deselectați straturile care vă sunt cel mai puțin necesare.
- Harta dvs. trebuie să includă un titlu și o legendă.

CAPITOLUL 14

Module: Forestry Application

În modulele 1 până la 13, ați învățat deja destul de multe despre lucrul în QGIS. Dacă vă interesează să aflați despre unele utilizări forestiere ale GIS, urmând acest modul veți avea posibilitatea de a aplica ceea ce ați învățat, și, în plus, vi se vor prezenta câteva noi instrumente utile.



Dezvoltarea acestui modul a fost sponsorizată de Uniunea Europeană.

14.1 Lesson: Forestry Module Presentation

Utilizarea acestui modul pentru silvicultură necesită cunoștințele acumulate în modulele de la 1 la 11 din acest manual de formare. Exercițiile din următoarele lecții presupun că aveți abilitatea de a face multe dintre operațiunile de bază din QGIS, iar instrumentele care nu au mai fost utilizate înainte sunt prezentate acum în detaliu.

În plus, modulul urmează un nivel de bază de-a lungul lecțiilor, astfel încât, dacă aveți experiență anterioară cu QGIS, puteți urma instrucțiunile fără probleme.

Rețineți că trebuie să descărcați un pachet de date suplimentare pentru acest modul.

14.1.1 Datele Eşantion pentru Silvicultură

Notă: The sample data used in this module is part of the training manual data set and is available in the exercise_data\forestry\ folder.

The forestry related sample data (forestry map, forest data), has been provided by the EVO-HAMK forestry school. The datasets have been modified to adapt to the lessons needs.

The general sample data (aerial images, LiDAR data, basic maps) has been obtained from the National Land Survey of Finland open data service, and adapted for the purposes of the exercises. The open data file download service can be accessed in English here.

Atenționare: În ceea ce privește restul manualului de instruire, acest modul include instrucțiuni privind adăugarea, ștergerea și modificarea seturilor de date GIS. V-am furnizat seturile de date de instruire în acest scop. Înainte de a utiliza tehnicile descrise aici asupra datelor dvs., asigurați-vă întotdeauna că aveți copiile de rezervă corespunzătoare!

14.2 Lesson: Georeferencing a Map

O activitate silvică obișnuită constă în actualizarea informațiilor pentru zonele forestiere. Este posibil ca informațiile anterioare pentru acea zonă să aibă o vechime de mai mulți ani, să fi fost colectate în mod analogic (adică, pe hârtie) sau poate că au fost digitizate, dar tot ce aveți reprezintă versiunea pe hârtie a datelor inventarului respectiv.

Cel mai probabil, v-ați dori să utilizați aceste informații în GIS, de exemplu, pentru a le compara mai târziu cu inventarele ulterioare. Acest lucru presupune că va trebui să digitizați manual informațiile, cu ajutorul softului GIS. Dar, înainte de a începe digitizarea, trebuie făcuți pași importanți, cum ar fi scanarea și georeferențierea hărții de hârtie.

Scopul acestei lecții: De a afla cum să utilizați instrumentul de Georeferențiere din QGIS.

14.2.1 ???? Scan the map

Prima activitate constă în scanarea hărții. Dacă harta dvs. este prea mare, atunci o puteți scana pe porțiuni, dar rețineți că pentru fiecare parte va trebui să reluați acțiunile de preprocesare și georeferențiere. Din acest motiv, este recomandabil să împărțiți harta în cel mai mic număr de porțiuni posibile.

If you are going to use a different map that the one provided with this manual, use your own scanner to scan the map as an image file, a resolution of 300 DPI will do. If your map has colors, scan the image in color so that you can later use those colors to separate information from your map into different layers (for ex., forest stands, contour lines, roads...).

For this exercise you will use a previously scanned map, you can find it as rautjarvi_map.tif in the data folder exercise_data/forestry

14.2.2 ???? Follow Along: Georeferencing the scanned map

1. Open QGIS and set the project's CRS to EPSG: 3067 - ETRS89 / TM35FIN(E, N) in Project ► Properties ► CRS, which is the currently used CRS in Finland.

| | Project Properties — CRS | 8 |
|-------------------|--|----------------------|
| ۹ | Project Coordinate Reference System (CRS) | |
| 🔀 General | No CRS (or unknown/non-Earth projection) | |
| 📝 Metadata | Filter Q | |
| | Recently Used Coordinate Reference Systems | |
| View Settings | Coordinate Reference System | Authority ID |
| CRS CRS | ETRS89 / TM35FIN(E,N) | EPSG:3067 |
| | KKJ / Finland zone 2 | EPSG:2392 |
| 🎲 Transformations | NAD27 / Alaska Albers | EPSG:2964 |
| Default Styles | | |
| 🛅 Data Sources | 4 | |
| ■ Relations | Predefined Coordinate Reference Systems | Hide deprecated CRSs |
| C | Coordinate Reference System | Authority ID |
| | ETRS89 / TM26 | EPSG:3038 |
| | ETRS89 / TM27 | EPSG:3039 |
| | ETRS89 / TM35FIN(E,N) | EPSG:3067 |
| 📲 QGIS Server | ETRS89 / TM35FIN(N,E) | EPSG:3902 |
| A | | |
| V Temporal | ETRS89 / TM35FIN(E,N) Properties Units: meters Static (relies on a datum which is plate-fixed) Method: Universal Transverse Mercator | |
| | Help | ⊘Apply ⊗Cancel ⊘OK |

2. Save the QGIS project as map_digitizing.qgs.

You will use the georeferencing tool from QGIS named Georeferencer. To georeference the map:

1. Open the georeference tool, Layer \blacktriangleright Georeferencer....



- 2. Add the map image file, rautjarvi_map.tif, as the image to georeference, *File* > *Open raster*.
- 3. Clic pe OK

Ulterior ar trebui să definiți setările de transformare pentru georeferențierea hărții:

- 1. Deschideți Settings ► Transformation settings.
- 2. Set the *Transformation type* to Linear and the *Resampling method* to Nearest neighbour.
- 3. Press the Select CRS button next to the *Target SRS* option and select the EPSG:2392 KKJ / Finland zone 2 CRS; it is the CRS that was used in Finland back in 1994 when this map was created.
- 4. Click the icon next to the *Output raster* box, go to the folder and create the folder exercise_data\ forestry\digitizing and name the file as rautjarvi_georef.tif.
- 5. Check M Load in QGIS when done
- 6. Leave the rest of parameters as default.

| | Transformation Settings | | | | |
|---|--------------------------------------|--|--|--|--|
| Transformation Parame | eters | | | | |
| Transformation type | Linear | | | | |
| Resampling method | Nearest neighbour 🔹 | | | | |
| Target SRS | EPSG:2392 - KKJ / Finland zone 2 🔹 🔹 | | | | |
| Output Settings | | | | | |
| Output raster a/forestry/digitizing/rautjarvi_georef.tif <a>[| | | | | |
| Compression | None 👻 | | | | |
| Save GCP points | | | | | |
| Create world file o | only (linear transforms) | | | | |
| Use 0 for transpare | ency when needed | | | | |
| Set target resoluti | on | | | | |
| Horizontal | 0.00000 | | | | |
| Vertical | -1.00000 | | | | |
| Reports | | | | | |
| Generate PDF map | | | | | |
| Generate PDF report | | | | | |
| ✓ Load in QGIS when d | Jone | | | | |
| Help | <mark>⊗</mark> Cancel ⊘ <u>O</u> K | | | | |

7. Clic pe OK

The map contains several cross-hairs marking the coordinates in the map, we will use those to georeference this image. You can use the zooming and panning tools as you usually do in QGIS to inspect the image in the Georeferencer's window.

- 1. Zoom in to the left lower corner of the map and note that there is a cross-hair with a coordinate pair, X and Y, that as mentioned before are in KKJ / Finland zone 2 CRS. You will use this point as the first ground control point for the georeferencing your map.
- 2. Selectați instrumentul *Adăugare punct*, apoi faceți clic pe intersecția firelor reticulare (deplasați și măriți după nevoie).
- 3. In the *Enter map coordinates* dialogue write the coordinates that appear in the map (X: 2557000 and Y: 6786000) and their CRS (EPSG: 2392 KKJ / Finland zone 2)

| Enter Map | Coordinates 8 |
|---|---|
| Enter X and Y coordinates (DMS (<i>dd mm ss.ss</i>), DD which correspond with the selected point on the i pencil and then click a corresponding point on ma | (<i>dd.dd</i>) or projected coordinates (<i>mmmm.mm</i>)) mage. Alternatively, click the button with icon of a p canvas of QGIS to fill in coordinates of that point. |
| X / East 2557000 | |
| Y/North 6786000 | |
| EPSG:2392 - KKJ / Finland zone 2 | - |
| ✓ Automatically hide georeferencer window | |
| | ✓ From Map Canvas ⊗Cancel ⊘OK |

4. Clic pe OK

Prima coordonată de georeferențiat deja este gata.

- 5. Look for other black cross-hairs in the image, they are separated 1000 meters from each other both in North and East direction. You should be able to calculate the coordinates of those points in relation to the first one.
- 6. Zoom out in the image and move to the right or the top until you find other cross-hair, and estimate how many kilometres you have moved. Try to get ground control points as far from each other as possible.
- 7. Digitize at least three more ground control points in the same way you did the first one. You should end up with something similar to this:



With already three digitized ground control points you will be able to see the georeferencing error as a red line coming out of the points. The error in pixels can be seen also in the *GCP table* in the dX[pixels] and dY[pixels] columns. The error in pixels should not be higher than 10 pixels. If it is, you should review the points you have digitized and the coordinates you have entered to find what the problem is. You can use the image above as a guide.

Once you are happy with your control points, you can save them for later use:

- 1. Go to *File* ► *Save GCP points as...*
- 2. In the folder exercise_data\forestry\digitizing, name the file rautjarvi_map.tif. points.

Finally, georeference your map:

- 1. Go to *File* \blacktriangleright *Start georeferencing*.
- 2. Note that you named the file already as rautjarvi_georef.tif when you edited the Georeferencer settings.

Now you can see the map in QGIS project as a georeferenced raster. Note that the raster seems to be slightly rotated, but that is simply because the data is in KKJ / Finland zone 2 and your project is in ETRS89 / TM35FIN(E,N).

- 3. To check that your data is properly georeferenced, you can
 - 1. Open the aerial image in the exercise_data\forestry folder, named rautjarvi_aerial. tif.
 - 2. Your map and this image should match quite well: set the map transparency to 50% and compare it to the aerial image.



4. Salvați modificările proiectului QGIS, apoi veți continua din acest punct cu lecția următoare.

14.2.3 În concluzie

You have now georeferenced a paper map, making it possible to use it as a map layer in QGIS.

14.2.4 Ce urmează?

In the next lesson, you will digitize the forest stands in your map as polygons and add the inventory data to them.

14.3 Lesson: Digitizing Forest Stands

Unless you are going to use your georeferenced map as a simple background image, the next natural step is to digitize elements from it. You have already done so in the exercises about creating vector data in *Lesson: Creating a New Vector Dataset*, when you digitized the school fields. In this lesson, you are going to digitize the forest stands» borders that appear in the map as green lines but instead of doing it using an aerial image, you will use your georeferenced map.

Scopul acestei lecții: Învățarea unei tehnici pentru a ajuta activitatea de digitizare a arboretului forestier și, în cele din urmă, adunarea din acesta a datelor de inventar.

14.3.1 ???? Follow Along: Extracting the Forest Stands Borders

Open your map_digitizing.qgs project in QGIS, that you saved from the previous lesson.

O dată ce ați scanat și georeferențiat harta, ați putea începe digitizarea, folosind imaginea drept ghid. Acesta ar fi, probabil, cel mai potrivit mod de lucru, atunci când imaginea pe care trebuie să o digitizați reprezintă, de fapt, o fotografie aeriană.

If what you are using to digitize is a good map, as it is in our case, it is likely that the information is clearly displayed as lines with different colors for each type of element. Those colors can be relatively easy extracted as individual images using an image processing software like GIMP. Such separate images can be used to assist the digitizing, as you will see below.

Primul pas va fi de a utiliza GIMP la obținerea unei imagini care conține doar pâlcuri de pădure, reprezentate de toate acele linii verzui pe care le puteți vedea în harta originală, scanată:

- 1. Deschideți GIMP (dacă nu l-ați instalat încă, descărcați-l de pe internet sau cereți-l profesorului dvs.).
- 2. Open the original map image, *File* ► *Open*, rautjarvi_map.tif in the exercise_data/forestry folder. Note that the forest stands are represented as green lines (with the number of the stand also in green inside each polygon).



- 3. Acum puteți selecta pixelii din imagine, care reprezintă limitele parcelelor forestiere (pixelii verzui):
 - 1. Deschideți instrumentul Select ► By color.
 - 2. With the tool active, zoom into the image (Ctrl + mouse wheel) so that a forest stand line is close enough to differentiate the pixels forming the line. See the left image below.
 - 3. Faceți clic și glisați cursorul mouse-ului în partea din mijloc a liniei, astfel încât instrumentul va colecta valorile câtorva dintre culorile pixelilor.
 - 4. Eliberați butonul mouse-ului și așteptați câteva secunde. Din întreaga imagine vor fi selectați pixelii care se potrivesc culorilor colectate de către instrument.
 - 5. Micșorați, pentru a vedea cum au fost selectați pixelii verzui din întreaga imagine.
 - 6. Dacă rezultatul nu vă mulțumește, repetați operațiunea de clic și glisare.
 - 7. Pixelii selectați de către dumneavoastră ar trebui să arate în genul imaginii din dreapta-jos.



- 4. O dată ce ați terminat selecția, trebuie să o copiați sub forma unui nou strat, care se va salva ulterior ca fișier de tip imagine:
 - 1. Copy (Ctrl+C or *Edit* ► *Copy*) the selected pixels.
 - 2. And paste the pixels directly as a new layer (*Edit* ► *Paste as* ► *New Layer*). GIMP will display the pasted pixels as a new layer (Pasted Layer) in the *Layers* panel.
 - 3. Faceți clic pe pictograma "ochiului" de lângă stratul de imagine original pentru a-l dezactiva, astfel încât numai *Stratul Lipit* va fi vizibil:



5. Finally, select *File* ► *Export As...*, set *Select File Type (By Extension)* as a *TIFF image*, select the digitizing folder and name it rautjarvi_map_green.tif. Select no compression when asked.

Ați putea face același proces cu alte elemente din imagine, de exemplu, extrăgând liniile negre care reprezintă drumurile, sau cele maro care reprezintă liniile de contur ale terenului. Dar pentru noi, arboretul forestier este suficient.

14.3.2 ???? Try Yourself: Georeference the Green Pixels Image

Ca și în lecția anterioară, trebuie să georeferențiați această nouă imagine pentru a o putea folosi cu restul de date.

Note that you don't need to digitize the ground control points anymore because this image is basically the same image as the original map image, as far as the Georeferencer tool is concerned. Here are some things you should remember:

- This image is also, of course, in KKJ / Finland zone 2 CRS.
- Ar trebui să utilizați punctele de control din teren salvate, *Fișier* ► Încărcare puncte GCP.
- Amintiți-vă să revizuiți Setările de Transformare.
- Name the output raster as rautjarvi_green_georef.tif in the digitizing folder.

Verificați dacă noul raster se potrivește cu harta originală.

14.3.3 ???? Follow Along: Creating Supporting Points for Digitizing

Având în vedere instrumentele de digitizare din QGIS, v-ați putea gândi că ar fi de ajutor acroșarea la pixelii verzi, pe durata digitizării. Exact acest lucru îl veți face în continuare: veți crea puncte din acei pixeli, pentru a le folosi mai târziu ca ghidaje în digitizarea arboretelor forestiere, când se vor utiliza instrumentele de acroșare disponibile în QGIS.

- 1. Folosiți instrumentul *Raster* ► *Conversie* ► *Poligonizare (Din Raster în Vector)* pentru a vectoriza liniile verzi în poligoane. Dacă nu vă mai amintiți cum se efectuează acest lucru, puteți să reexaminați *Lesson: Raster to Vector Conversion.*
- 2. Save as rautjarvi_green_polygon.shp inside the digitizing folder.
- 3. Măriți și analizați forma poligoanelor. Veți obține ceva de genul:



- 4. Next option to get points out of those polygons is to get their centroids:
 - 1. Open Vector ► Geometry Tools ► Centroids....
 - 2. Set *Input Layer* to *rautjarvi_green_polygon* (the polygon layer you have just created)
 - 3. Set Centroids output to green_centroids.shp file within the folder digitizing
 - 4. Check Solution Open output file after running algorithm
 - 5. Press Run. This will calculate the centroids for the polygons as a new layer and add it to the project.



- 5. Now you can remove the pautjarvi_green_polygon layer from the TOC.
- 6. Change the symbology of the centroids layer as follows:
 - 1. Open the Layer Properties for green_centroids.
 - 2. Mergeți la fila Simbologiei.
 - 3. Set Size to 1.00 and choose Map Units

It is not necessary to differentiate points from each other, you just need them to be there for the snapping tools to use them. You can use those points now to follow the original lines much easily than without them.

14.3.4 ???? Follow Along: Digitize the Forest Stands

Now you are ready to start with the actual digitizing work. You would start by creating a vector file of *polygon type*, but for this exercise, there is a shapefile with part of the area of interest already digitized. You will just finish digitizing the half of the forest stands that are left between the main roads (wide pink lines) and the lake:



^{1.} Go to the digitizing folder using your file manager browser.

- 2. Drag and drop the forest_stands.shp vector file to your map.
- 3. Change the new layer's symbology so that it will be easier to see the polygons that have already been digitized.
 - 1. Set *Fill color* to green and change the *Opacity* to 50%.
 - 2. Select Simple Fill and set Stroke width to 1.00 mm.

Acum, așa cum vă amintiți de la modulele din trecut, trebuie să configurați și activați opțiunile de acroșare:

- 1. Go to *Project* ► *Snapping options*...
- 2. Press ⁽²⁾ Enable Snapping</sup> and select Advanced Configuration
- 3. Check the green_centroids and forest_stands layers
- 4. Set Type for each layer to Vertex
- 5. Set Tolerance for each layer to 10
- 6. Set Units for each layer to pixels
- 7. Check Mark Avoid Overlap for the forest_stands layer
- 8. Press *Topological editing*
- 9. Choose W Follow Advanced Configuration
- 10. Close the pop-up

| ର | | | | Project Snapping Sett | ings | ~ × |
|-------------------------------------|--------------|-----------|--------|-----------------------|----------------------|---|
| 🔌 🕅 Advanced Configur | ation 🕽 🔯 Di | sabled 0 | - 0 | - 🖓 Topological I | Editing SAllow Overl | ap 🕽 🖂 Snapping on Intersection 🛛 😒 Self-snapping |
| Layer | Туре | Tolerance | Units | Avoid Overlap | Min Scale | Max Scale |
| green_centroids | Vertex | 10 | pixels | | not set | not set |
| forest_stands | Vertex | 10 | pixels | \checkmark | not set | not set |
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With these snapping settings, whenever you are digitizing and get close enough to one of the points in the centroids layer or any vertex of your digitized polygons, a pink square will appear on the point that will be snapped to.

11. Finally, turn off the visibility of all the layers except *forest_stands* and *rautjarvi_georef*. Make sure that the map image has not transparency any more.

A few important things to note before you start digitizing:

- Nu încercați să fiți prea exacți în digitizarea frontierelor.
- If a border is a straight line, digitize it with just two nodes. In general, digitize using as few nodes as possible.
- Zoom in to close ranges only if you feel that you need to be accurate, for example, at some corners or when you want a polygon to connect with another polygon at a certain node.
- Folosiți butonul din mijloc al mouse-ului pentru a mări/micșora și deplasa, pe durata digitizării.
- Digitizați doar un singur poligon la un moment dat.
- După digitizarea unui poligon, scrieți id-ul pâlcului de pădure pe care îl puteți vedea în hartă.

Acum puteți începe digitizarea:

- 1. Locate the forest stand number 357 in the map window.
- 2. Select the forest_stands layer.

- 3. Click the \bigvee Toggle Editing button to enable editing
- 4. Select Add Polygon Feature tool.
- 5. Start digitizing the stand 357 by connecting some of the dots. Note the pink crosses indicating the snapping.



When you are done:

- 1. Right click to end digitizing that polygon.
- 2. Enter the forest stand *ID* within the form (in this case 357).
- 3. Clic pe OK

If a form did not appear when you finished digitizing the polygon, go to *Settings* \blacktriangleright *Options* \blacktriangleright *Digitizing* and make sure that the *Suppress attribute form pop-up after feature creation* is not checked.

Poligonul dvs. digitizat va arăta astfel:



Now for the second polygon, pick up the stand number 358. Make sure that Avoid Overlap is checked for the *forest_stands* layer (as shown above). This option ensures polygons do not overlap. So, if you digitize over an existing polygon, the new polygon will be trimmed to meet the border of the existing polygons. You can use this option to automatically obtain a common border.

- 1. Începeți digitizarea standului 358 la unul dintre colțurile comune cu pâlcul 357.
- 2. Continue normally until you get to the other common corner for both stands.
- 3. Finally, digitize a few points inside polygon 357 making sure that the common border is not intersected. See left image below.
- 4. Clic-dreapta pentru a termina editarea pâlcului de pădure 358.
- 5. Enter the ID as 358.
- 6. Click *OK*. Your new polygon should have a common border with the stand 357 as you can see in the image below.



The part of the polygon that was overlapping the existing polygon has been automatically trimmed and you are left with a common border - as you intended it to be.

14.3.5 ???? Try Yourself: Finish Digitizing the Forest Stands

Now you have two forest stands ready. And a good idea on how to proceed. Continue digitizing on your own until you have digitized all the forest stands that are limited by the main road and the lake.

It might look like a lot of work, but you will soon get used to digitizing the forest stands. It should take you about 15 minutes.

During the digitizing you might need to edit or delete nodes, split or merge polygons. You learned about the necessary tools in *Lesson: Feature Topology*, now is probably a good moment to go read about them again.

Remember that having *Enable topological editing* activated, allows you to move nodes common to two polygons so that the common border is edited at the same time for both polygons.

Rezultatul dvs. va arăta în felul următor:



14.3.6 ???? Follow Along: Joining the Forest Stand Data

It is possible that the forest inventory data you have for you map is also written in paper. In that case, you would have to first write that data to a text file or a spreadsheet. For this exercise, the information from the inventory for 1994 (the same inventory as the map) is ready as a comma separated text (csv) file.

- 1. Open the rautjarvi_1994.csv file from the exercise_data\forestry directory in a text editor and note that the inventory data file has an attribute called *ID* that has the numbers of the forest stands. Those numbers are the same as the forest stands ids you have entered for your polygons and can be used to link the data from the text file to your vector file. You can see the metadata for this inventory data in the file rautjarvi_1994_legend.txt in the same folder.
- 2. Now add this file into the project:

- 1. Use the Add Delimited Text Layer tool. This is accessed via Layer ► Add Layer ► Add Delimited Text Layer....
- 2. Set details in the dialog as follows:

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| ¥ | Mesh | ۲ | CSV (comma separate | ed values) | | | | | | | |
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| сф. | PostgreSQL | ✓ | First record has field r | names | | | Trim fields | | | | |
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| | | | | | | | | | | | |
| | | | Aide | | | | | | | ✓ Add Serme | er |
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- 3. Press Add to load the formatted csv file in the project.
- 3. To link the data from the . CSV file with the digitized polygons, create a join between the two layers:
 - 1. Open the Layer Properties for the forest_stands layer.
 - 2. Mergeți la fila Îmbinări.
 - 3. Click Click Add new join on the bottom of the dialog box.
 - 4. Select rautjarvi_1994.csv as the Join layer
 - 5. Set the Join field to ID
 - 6. Set the Target field to ID
 - 7. Faceți clic pe Ok de două ori.

The data from the text file should be now linked to your vector file. To see what has happened, select the forest_stands layer and use ^{Open Attribute Table}. You can see that all the attributes from the inventory data file are now linked to your digitized vector layer.

You will see that the field names are prefixed with rautjarvi_1994_. To change this:

- 1. Open the Layer Properties for the forest_stands layer.
- 2. Mergeți la fila Îmbinări.
- 3. Select Join Layer rautjarvi_1994
- 4. Click the *L* Edit selected join button to enable editing
- 5. Under *Custom field name prefix* remove the prefix name

| ି ବ | Add Vector Joi | n | \sim \sim \otimes |
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| Join field | 123 IC |) | • |
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| ✔ Cache join layer in memory | | | |
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| Edi <u>t</u> able join layer | | | |
| Joined fields | | | |
| ▼ ✓ Custom field <u>n</u> ame prefix | 1 | | |
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The data from the .csv file is just linked to your vector file. To make this link permanent, so that the data is actually recorded to the vector file you need to save the forest_stands layer as a new vector file. To do this:

- 1. Right click on forest_stands layer
- 2. Choose *Export* ► *Save Features As...*
- 3. Set Format to ESRI Shapefile
- 4. Set file name to forest_stands_1994.shp under the forestry folder
- 5. To include the new file as a layer in the project, check *Add saved file to map*

| 2 | | Save Vector | Layer as | | ~ ^ |
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| Format | ESRI Shapefile | | | | |
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| File name | 5IS-Training-Data/e | xercise_data | /forestry/forest_star | nds_1994.shp @ | · |
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14.3.7 ???? Try Yourself: Adding Area and Perimeter

To finish gathering the information related to these forest stands, you might calculate the area and the perimeter of the stands. You calculated areas for polygons in *Lesson: Supplementary Exercise*. Go back to that lesson if you need to and calculate the areas for the forest stands. Name the new attribute Area and make sure that the values calculated are in hectares. You could also do the same for the perimeter.

Now your forest_stands_1994 layer is ready and packed with all the available information.

Save your project to keep the current map layers in case you need to come back later to it.

14.3.8 În concluzie

It has taken a few clicks of the mouse but you now have your old inventory data in digital format and ready for use in QGIS.

14.3.9 Ce urmează?

You could start doing different analysis with your brand new dataset, but you might be more interested in performing analysis in a dataset more up to date. The topic of the next lesson will be the creation of forest stands using current aerial photos and the addition of some relevant information to your dataset.

14.4 Lesson: Updating Forest Stands

Now that you have digitized the information from the old inventory maps and added the corresponding information to the forest stands, the next step is to create the inventory of the current state of the forest.

You will digitize new forest stands using an aerial photo. As with the previous lesson, you will use an aerial Color Infrared (CIR) photograph. This type of imagery, where the infrared light is recorded instead of the blue light, is widely used to study vegetated areas.

După digitizarea pâlcurilor de pădure, veți adăuga informații, cum ar fi noile constrângeri rezultate din reglementările de conservare.

The goal for this lesson: To digitize a new set of forest stands from CIR aerial photographs and add information from other datasets.

14.4.1 ???? Comparing the Old Forest Stands to Current Aerial Photographs

The National Land Survey of Finland has an open data policy that allows you downloading a variety of geographical data like aerial imagery, traditional topographic maps, DEM, LiDAR data, etc. The service can be accessed in English here. The aerial image used in this exercise has been created from two orthorectified CIR images downloaded from that service (M4134F_21062012 and M4143E_21062012).

- 1. Open QGIS and set the project's CRS to ETRS89 / ETRS-TM35FIN in Project ► Properties... ► CRS
- 2. Add the CIR image rautjarvi_aerial.tif to the project:
 - 1. Go to the exercise_data\forestry\ folder using your file manager browser
 - 2. Drag and drop the file rautjarvi_aerial.tif onto your project
- 3. Save the QGIS project as digitizing_2012.qgs

Imaginile CIR sunt din 2012. Puteți compara pâlcurile care au fost create în 1994 cu aproape 20 de ani mai târziu.

- 1. Add the forest_stands_1994.shp layer created in the previous lesson:
 - 1. Go to the exercise_data\forestry\ folder using your file manager browser
 - 2. Drag and drop the file forest_stands_1994.shp onto your project
- 2. Set the symbology for the layer so that you can see through your polygons:
 - 1. Right click *forest_stands_1994*
 - 2. Select Properties
 - 3. Go to the *Symbology* tab
 - 4. Set Fill color to transparent fill
- 5. Set Stroke color to purple
- 6. Set *Stroke width* to 0.50 mm
- 3. Examinați modul în care vechiul pâlc forestier poate fi interpretat vizual (sau nu) ca o pădure omogenă.
- 4. Focalizați și deplasați-vă în jurul zonei. Veți observa, probabil, că unele dintre pâlcurile vechi de pădure ar putea corespunde încă cu imaginea, pe când altele nu.

This is a normal situation, as some 20 years have passed and different forest operations have been carried out (harvesting, thinning...). It is also possible that the forest stands looked homogeneous back in 1992 to the person who digitized them but as time has passed some forest has developed in different ways. It is also possible that that forest inventory priorities back then were different from those of today.

Apoi, veți crea noi pâlcuri de pădure pentru această imagine, fără a le utiliza pe cele vechi. Mai târziu, le puteți compara pentru a vedea diferențele.

14.4.2 ???? Interpreting the CIR Image

Let's digitize the same area that was covered by the old inventory, limited by the roads and the lake. You don't have to digitize the whole area, as in the previous exercise you can start with a vector file that already contains most of the forest stands.

- 1. Remove the layer *forest_stands_1994*
- 2. Add the file exercise_data\forestry\forest_stands_2012.shp to the project
- 3. Set the styling of this layer so that the polygons have no fill and the borders are visible
 - 1. Open Properties dialog of the forest_stands_2012 layer
 - 2. Go to the 🎺 *Symbology* tab
 - 3. Set *Fill color* to transparent fill
 - 4. Set Stroke color to green
 - 5. Set Stroke width to 0.50 mm



You can see that the northern section of the inventory area is still missing. Your task is to digitize the missing forest stands.

Before you start, spend some time reviewing the forest stands already digitized and the corresponding forest in the image. Try to get an idea about how the stands borders are decided, it helps if you have some forestry knowledge.

Some points to consider:

• Which forests have deciduous species (in Finland these are mostly birch forests) and which ones have conifers (in this area these are pine or spruce)? In CIR images, deciduous species usually show up as a bright red color whereas conifers show as a dark green color.

- How old is the forest? The size of the tree crowns can be identified in the imagery.
- How dense are the different forest stands? A forest stand where a thinning operation has recently been done would show spaces between the tree crowns and should be easy to differentiate from other forest stands around it.
- Zonele albăstrui indică terenuri virane, drumuri și zone urbane, culturi care nu au ajuns să crească, etc.
- Don't use zooms too close to the image when trying to identify forest stands. A scale between 1:3 000 and 1:5 000 should be enough for this imagery. See the image below (1:4000 scale):



14.4.3 ???? Try Yourself: Digitizing Forest Stands from CIR Imagery

When digitizing the forest stands, you should try to get forest areas that are as homogeneous as possible in terms of tree species, forest age, stand density... Don't be too detailed though, or you will end up making hundreds of small forest stands - and that would not be useful at all. You should try to get stands that are meaningful in the context of forestry, not too small (at least 0.5 ha) but not too big either (no more than 3 ha).

With these points in mind, you can now digitize the missing forest stands.

- 1. Set up the snapping and topology options:
 - 1. Go to Project ► Snapping options...
 - 2. Press State Snapping and select Advanced Configuration
 - 3. Check the *forest_stands_2012* layer
 - 1. Set Type to Vertex

- 2. Set *Tolerance* to 10
- 3. Set Units to pixels
- 4. Check the box under Avoid Overlap
- 5. Press *Topological editing*
- 6. Choose Se Follow Advanced Configuration
- 7. Close the pop-up

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- 2. Select the *forest_stands_2012* layer on the Layers list
- 3. Click the // Toggle Editing button to enable editing
- 4. Start digitizing using the same techniques as in the previous lesson. The only difference is that you don't have any point layer that you are snapping to. For this area you should get around 14 new forest stands. While digitizing, fill in the StandID field with numbers starting at 901.
- 5. Când veți definitiva, stratul dvs. ar trebui să arate în felul următor:



Now you have a new set of polygons showing the different forest stands in 2012 - as interpreted from the CIR images. However, you are missing the forest inventory data. For that you will need to visit the forest and get some sample data that you will use to estimate the forest attributes for each of the forest stands. You will see how to do that in the next lesson.

You can add some extra information about conservation regulations that need to be taken into account for this area.

14.4.4 ????? Follow Along: Updating Forest Stands with Conservation Information

For the area you are working in, there are some conservation regulations that must be taken into account when doing the forest planning:

- Two locations of a protected species of Siberian flying squirrel (Pteromys volans) have been identified. According to the regulation, an area of 15 meters around the spots must be left untouched.
- A riparian forest of special interest that is growing along a stream in the area must be protected. In a visit to the field, it was found that 20 meters to both sides of the stream must be protected.

You have a vector file containing the information about the squirrel locations and another containing the digitized stream running from the North area towards the lake.

1. From the exercise_data\forestry\ folder, add the squirrel.shp and stream.shp files to the project.

2. Use the Open Attribute Table tool to view the squirrel layer

You can see that there are two locations that are defined as Siberian flying squirrel, and that the area to be protected is indicated by a distance of 15 meters from the locations.

Let's more accurately delimitate that area to protect. We will create a buffer around the point locations, using the protection distance.

- 1. Deschideți Vector ► Geoprocessing Tools ► Buffer.
- 2. Set Input layer to squirrel
- 3. Set *Distance* to 15 meters
- 4. Set Buffered to exercise_data\forestry\squirrel_15m.shp
- 5. Check M Open output file afer running algorithm
- 6. Click Run
- 7. Once the process is completed, click Close

| R Buffer | | ~ ^ 😣 |
|---|----|---|
| Parameters Log |) | Buffer |
| Input layer Squirrel [EPSG:25835] Selected features only Distance | | This algorithm computes a buffer area for all the features in an input layer, using a fixed or dynamic distance. |
| 15,000000 Image: The second | | The segments parameter controls the number of line segments to use to approximate a quarter circle when creating rounded offsets. |
| End cap style Round | • | The end cap style parameter controls how line endings are handled in the buffer. |
| Join style Round Miter limit | • | The join style parameter specifies whether round, miter or beveled joins should be used when |
| 2,000000 | * | offsetting corners in a line. The miter limit parameter is only |
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| ning-Data/exercise_data/forestry/squirrel_15m.shp Image: Open output file after running algorithm |], | distance from the offset curve to use when creating a mitered join. |
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If you zoom in to the location in the northern part of the area, you will notice that the buffer area extends over two neighbouring stands. This means that whenever a forest operation takes place in that stand, the protected location should also be taken into account.



For the protection of the squirrels locations, you are going to add a new attribute (column) to your new forest stands that will contain information about locations that have to be protected. This information will then be available whenever a forest operation is planned, and the field team will be able to mark the area that has to be left untouched before the work starts.

To join the information about the squirrels to your forest stands, you can use the Join attributes by location algorithm:

- 1. Deschideți Vector ► Managementul Datelor ► Îmbină atributele după locație.
- 2. Set Join to features in to prest_stands_2012
- 3. In Geometric predicate, check 🗹 intersect
- 4. Set By comparing to to pairel_15m
- 5. Set Join type as Take attributes of the first matching feature only (one-to-one)
- 6. Leave unchecked Discard records which could not be joined
- 7. Set Joined layer to exercise_data\forestry\stands_squirrel.shp
- 8. Check Solution Open output file afer running algorithm
- 9. Click Run
- 10. Once the process is completed, you can Close the dialog.

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| ☑ intersect | additional attributes in its |
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| equal cross | their values are taken from a |
| □ touch | second vector layer. A spatial criteria is applied to select the |
| By comparing to | values from the second layer that |
| 🖙 squirrel_15m [EPSG:25835] 🔹 🖓 🔧 | are added to each feature from the first layer in the resulting |
| □ Selected features only | one. |
| Fields to add (leave empty to use all fields) [optional] | |
| 0 fields selected | |
| Join type | |
| Take attributes of the first matching feature only (one-to-one) | |
| Discard records which could not be joined | |
| Joined field prefix [optional] | |
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| Joined layer [optional] | |
| b/QGIS-Training-Data/exercise_data/forestry/stands_squirrel.shp 🛽 | |
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Now you have a new forest stands layer, stands_squirrel.shp showing the protection information for the Siberian flying squirrel.

- 1. Open the attribute table of the stands_squirrel layer
- 2. Sort the table by clicking on *point_pr* field in the table header.

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| 3 | 13 | 914 | 1 | liito orava | 15 | |
| 4 | 15 | 916 | 1 | liito orava | 15 | |
| 5 | 0 | 901 | NULL | NULL | NULL | |
| 6 | 1 | 902 | NULL | NULL | NULL | |
| 7 | 2 | 903 | NULL | NULL | NULL | |
| 8 | 3 | 904 | NULL | NULL | NULL | |
| 9 | 4 | 905 | NULL | NULL | NULL | * |
| | Show All Feat | ures 🖕 | | | | 2 |

You can see that there are some forest stands that have the information about the protection locations. The information in the forest stands data will indicate to the forest manager that there are protection considerations to be taken into account. Then he or she can get the location from the *squirrel* dataset, and visit the area to mark the corresponding buffer around the location so that the operators in the field can avoid disturbing the squirrels environment.

14.4.5 ???? Try Yourself: Updating Forest Stands with Distance to the Stream

Following the same approach as for the protected squirrel locations you can now update your forest stands with protection information related to the stream. A few points:

- Remember the buffer is 20 meters around the stream
- You want to have all the protection information in the same vector file, so use stands_squirrel.shp as the base layer
- Name your output as forest_stands_2012_protect.shp

Once the process is completed, open the attribute table of the output layer and confirm that you have all the protection information for the riparian forest stands associated with the stream.

When you are happy with the results, save your QGIS project.

14.4.6 În concluzie

You have seen how to interpret CIR images to digitize forest stands. Of course it would take some practice to make more accurate stands and usually using other information like soil maps would give better results, but you know now the basis for this type of task. And adding information from other datasets resulted to be quite a trivial task.

14.4.7 Ce urmează?

The forest stands you digitized will be used for planning forestry operations in the future, but you still need to get more information about the forest. In the next lesson, you will see how to plan a set of sampling plots to inventory the forest area you just digitized, and get the overall estimate of forest parameters.

14.5 Lesson: Systematic Sampling Design

Ați digitizat deja un set de poligoane care reprezintă arboretul, totuși, încă nu aveți informații despre pădure. Pentru aceasta, puteți programa o achiziție de date pentru a inventaria întreaga pădure și pentru a-i estima parametrii. În această lecție veți crea un set sistematic de suprafețe de probă.

Atunci când începeți planificarea inventarului forestier, este important să vă definiți în mod clar obiectivele, tipurile de suprafețe de probă care vor fi utilizate, precum și datele care vor fi colectate în vederea atingerii obiectivelor. Pentru fiecare caz în parte, acestea vor depinde de tipul pădurii și de scopul managementului; ar trebui să fie planificate cu atenție de către cineva cu cunoștințe forestiere. În această lecție, veți crea un inventar teoretic, bazat pe un design sistematic al suprafețelor de probă.

Scopul acestei lecții: Crearea planului sistematic al suprafețelor de probă, pentru o vedere de ansamblu a zonei de pădure.

14.5.1 Inventarierea Pădurii

There are several methods to inventory forests, each of them suiting different purposes and conditions. For example, one very accurate way to inventory a forest (if you consider only tree species) would be to visit the forest and make a list of every tree and their characteristics. As you can imagine this is not commonly applicable except for some small areas or some special situations.

The most common way to find out about a forest is by sampling it, that is, taking measurements in different locations at the forest and generalizing that information to the whole forest. These measurements are often made in *sample plots* that are smaller forest areas that can be easily measured. The sample plots can be of any size (for ex. 50 m2, 0.5 ha) and form (for ex. circular, rectangular, variable size), and can be located in the forest in different ways (for ex. randomly, systematically, along lines). The size, form and location of the sample plots are usually decided following statistical, economical and practical considerations. If you have no forestry knowledge, you might be interested in reading this Wikipedia article.

14.5.2 ???? Follow Along: Implementing a Systematic Sampling Plot Design

For the forest you are working with, the manager has decided that a systematic sampling design is the most appropriate for this forest and has decided that a fixed distance of 80 meters between the sample plots and sampling lines will yield reliable results (for this case, +- 5% average error at a probability of 68%). Variable size plots has been decided to be the most effective method for this inventory, for growing and mature stands, but a 4 meters fixed radius plots will be used for seedling stands.

În practică, trebuie pur și simplu să reprezentăm suprafețele de probă sub formă de puncte, care vor fi folosite ulterior de către echipele din teren:

- 1. Open your digitizing_2012.qgs project from the previous lesson.
- 2. Remove all the layers except for *forest_stands_2012*.
- 3. Salvați proiectul în forest_inventory.qgs

Acum trebuie să creați o rețea dreptunghiulară de puncte separate, aflate la 80 de metri unul de altul:

1. Open Vector ► Research Tools Regular points.

- 2. Press the drop-down button next to the *Input extent* field and from the *Calculate from Layer* menu, select *forest_stands_2012*.
- 3. In the Point spacing/count settings, enter 80 meters.
- 4. Check the Use point spacing box to indicate that the value represents the distance between the points.
- 5. Under *Regular points*, save the output as systematic_plots.shp in the forestry\sampling\ folder.
- 6. Check Open output file after running algorithm.
- 7. Press Run.

Notă: The suggested *Regular points* creates the systematic points starting in the upper-left corner of the extent of the selected polygon layer. If you want to add some randomness to this regular points, you could use a randomly calculated number between 0 and 80 (80 is the distance between our points), and then write it as the *Initial inset from corner (LH side)* parameter in the tool's dialog.

Observați că instrumentul a folosit întreaga extindere a stratului de arboret, pentru a genera o grilă dreptunghiulară de puncte. Însă, vă interesează doar acele puncte care se află în interiorul suprafeței de pădure (a se vedea imaginile de mai jos):



- 1. From the Processing toolbox, open $GDAL \succ$ Vector geoprocessing \blacktriangleright Clip vector by mask layer.
- 2. Select *systematic_plots* as the *Input layer*.
- 3. Set *forest_stands_2012* as the *Mask layer*.
- 4. Save the *Clipped (mask)* result as systematic_plots_clip.shp in the forestry\sampling\ folder.
- 5. Check Open output file after running algorithm.

6. Press Run.

You have now the points that the field teams will use to navigate to the designed sample plots locations. You can still prepare these points so that they are more useful for the field work. At the least you will have to add meaningful names for the points and export them to a format that can be used in their GPS devices.

Let's start with the naming of the sample plots. If you check the *Attribute table* for the plots inside the forest area, you can see that you have the default *id* field automatically generated by the *Regular points* tool. Label the points to see them in the map and consider if you could use those numbers as part of your sample plot naming:

- 1. Open the Layer Properties ► 🔤 Labels for the systematic_plots_clip layer.
- 2. Turn the top menu into **be** *Single Labels*.
- 3. For the Value entry, select the field id.
- 4. Go to the abc Buffer tab, check the Draw text buffer and set the buffer Size to 1.
- 5. Clic pe OK

Acum, priviți etichetele de pe hartă. Puteți vedea că punctele au fost create și numerotate mai întâi de la vest înspre est și apoi de la nord înspre sud. Dacă priviți iarăși la tabela de atribute, veți observa că ordinea din tabel urmează, de asemenea, acest model. Numai dacă aveți un alt motiv pentru a denumi suprafețele de probă într-un mod diferit, modul de denumire Vest-Est/Nord-Sud urmează o ordine logică și reprezintă o opțiune bună.

Nevertheless, the number values in the id field are not so good. It would be better if the naming would be something like p_1, p_2.... You can create a new column for the systematic_plots_clip layer:

- 1. Go to the Attribute table for systematic_plots_clip.
- 2. Enable the \swarrow edit mode.
- 3. Open the Field calculator:
 - 1. Check Create a new field
 - 2. Enter Plot_id as *Output field name*
 - 3. Set the Output field type to Text (string).
 - 4. In the *Expression* field, write, copy or construct this formula concat ('P_', @row_number). Remember that you can also double click on the elements inside the *Function list*. The concat function can be found under *String* and @row_number is under the *Variables* group.
- 4. Clic pe OK
- 5. Dezactivați modul de editare și salvați modificările.

Now you have a new column with plot names that are meaningful to you. For the systematic_plots_clip layer, change the field used for labeling to your new Plot_id field.



14.5.3 ???? Follow Along: Exporting Sample Plots as GPX format

The field teams will be probably using a GPS device to locate the sample plots you planned. The next step is to export the points you created to a format that your GPS can read. QGIS allows you to save your point and line vector data in GPS eXchange Format (GPX), which is an standard GPS data format that can be read by most of the specialized software. You need to be careful with selecting the CRS when you save your data:

1. Right-click systematic_plots_clip layer and select Export
Save features as....

| Save Vector Layer as 😣 | | | | | |
|--|---|--|--|--|--|
| Format File name Layer name | GPS eXchange Format [GPX] a/exercise_data/forestry/sampling/plots_wgs84.gpx | | | | |
| CRS | Default CRS: EPSG:4326 - WGS 84 🔹 🍥 | | | | |
| Encoding Save only Select fi Persist lay Geometr Exten Datasou Layer Op Custom | UTF-8 selected features elds to export and their export options yer metadata ty tt (current: none) tree Options obtions Options | | | | |
| Help | ✓ Add saved file to map ⊗ <u>C</u> ancel ⊘ <u>O</u> K | | | | |

- 2. În Format selectați GPS eXchange Format [GPX].
- 3. Save the output *File name* as plots_wgs84.gpx in the forestry\sampling\ folder.
- 4. În CRS alegeți CRS-ul Selectat.
- 5. Browse for EPSG:4326 WGS 84.

Notă: The GPX format accepts only this CRS, if you select a different one, QGIS will give no error but you will get an empty file.

- 6. Clic pe OK
- 7. In the dialog that opens, select only the waypoints layer (the rest of the layers are empty).

The inventory sample plots are now in a standard format that can be managed by most of the GPS software. The field teams can now upload the locations of the sample plots to their devices. That would be done by using the specific devices own software and the plots_wgs84.gpx file you just saved. Other option would be to use the *GPS Tools* plugin but it would most likely involve setting the tool to work with your specific GPS device. If you are working with your own data and want to see how the tool works you can find out information about it in the section working_gps in the **QGIS User Manual**.

Salvați acum proiectul dvs. QGIS.

14.5.4 În concluzie

You just saw how easily you can create a systematic sampling design to be used in a forest inventory. Creating other types of sampling designs will involve the use of different tools within QGIS, spreadsheets or scripting to calculate the coordinates of the sample plots, but the general idea remains the same.

14.5.5 Ce urmează?

In the next lesson you will see how to use the Atlas capabilities in QGIS to automatically generate detailed maps that the field teams will be using to navigate to the sample plots assigned to them.

14.6 Lesson: Creating Detailed Maps with the Atlas Tool

Proiectarea sistematică de eșantionare este gata, iar echipele de teren și-au încărcat coordonatele GPS în dispozitivele de navigare. Există, de asemenea, un formular pentru date, în care se vor colecta informațiile măsurate pentru fiecare schiță. Pentru a găsi mai ușor drumul spre fiecare parcelă, s-au solicitat o serie de hărți detaliate, în cazul în care unele informații din teren pot fi văzute în mod clar, împreună cu un subset mic de schițe și câteva informații despre zonă. Puteți utiliza instrumentul Atlas pentru a genera automat o serie de hărți, având un format comun.

Scopul acestei lecții: Aflați cum să utilizați instrumentul Atlas în QGIS, pentru a genera hărți tipăribile detaliate, în scopul sprijinirii activității de inventariere în teren.

14.6.1 ???? Follow Along: Preparing the Print Layout

Înainte de a putea automatiza hărțile detaliate ale zonei forestiere și schițele noastre de eșantionare, trebuie să creăm un șablon cu toate elementele pe care le considerăm utile în munca de teren. Desigur, cea mai importantă va fi o stilizare corectă, dar, după cum ați văzut mai înainte, va trebui să adăugați și o mulțime de alte elemente care completează harta tipărită.

- 1. Deschideți proiectul QGIS din lecția anterioară forest_inventory.qgs. Ar trebui să aveți cel puțin următoarele straturi:
 - *forest_stands_2012* (cu o transparență de 50%, umplere verde și linii de margine de culoare verde mai închis)
 - systematic_plots_clip
 - rautjarvi_aerial
- 2. Salvați proiectul sub un nume nou, map_creation.qgs.

To create a printable map, remember that you use the Layout Manager:

- 1. Open Project

 A dayout Manager....
- 2. In the Layout manager dialog:
 - 1. Under New from template, press the Create... button next to the Empty layout entry
 - 2. Name your print layout forest_map.
 - 3. Press OK. A new print layout is created and opened, showing a blank paper.
- 3. In the print Layout window, ensure properties are set for an A4 paper:
 - 1. Right-click over the paper and select *Page properties*. The *Page properties* panel is open on the right side of the layout.
 - 2. Asigurați-vă că Dimensiunea este A4.

- 3. Asigurați-vă că Orientarea este Peisaj.
- 4. Enable the Layout tab next to the Page properties panel and set Export resolution to 300 dpi.

Composing a map is easier if you make use of the canvas grid to position the different elements. Review the settings for the layout grid:

- 1. In the Layout tab expand the Guides and Grid region.
- 2. Check that Grid spacing is set to 10 mm and that Snap tolerance is set to 5 px.

Trebuie să activați folosirea grilei:

- 1. Deschideți meniul :menuselection: Vizualizare
- 2. Bifați Afișarea grilei.
- 3. Bifați Acroșare la grilă.
- 4. Notice that options for using *Guides* are checked by default, which allows you to see guiding lines when you are moving elements in the layout.
- 5. Now you can start to add elements to your layout. Add first a map element so you can review how the map canvas looks as you will be making changes in the layers symbology:
 - 1. Click on the Add Map button.
 - 2. Țineți apăsat butonul stâng al mouse-ului și trasați un dreptunghi în care să încadrați cea mai mare parte a hărții.



Observați modul în care cursorul mouse-ului se acroșează la grila canevasului. Utilizați această funcție atunci când adăugați alte elemente. Dacă doriți să aveți mai multă acuratețe, schimbați setările de *Spațiere* ale grilei. Dacă dintr-un motiv oarecare nu mai doriți acroșarea la grilă la un moment dat, puteți întotdeauna bifa sau debifa meniul *Vizualizare*.

14.6.2 ??? Follow Along: Adding Background Map

Leave the layout open but go back to the map. Let's add some background data and create some styling so that the map content is as clear as possible.

- 1. Add the background raster <code>basic_map.tif</code> that you can find in the <code>exercise_data\forestry\</code> folder.
- 2. If prompted select the ETRS89 / ETRS-TM35FIN CRS for the raster.

După cum puteți vedea, harta de fundal este deja stilizată. Acest tip de raster cartografic gata de utilizare este foarte frecvent. El este creat din date vectoriale, stilizate într-un format standard și stocate ca un raster, așa că nu trebuie să vă îngrijoreze obținerea unui rezultat bun.

3. Acum măriți schițele dvs., astfel încât să puteți vedea doar aproximativ patru sau cinci linii de parcele.

The current styling of the sample plots is not the best:



While during the last exercises, the white buffer was OK on top of the aerial image, now that the background image is mostly white you barely can see the labels. But how does it look in the print layout? Let's check it:

- 1. Go to the print layout window.
- 2. Use the Select/Move item button to select the map element in the layout.
- 3. Mergeți la fila Proprietățile itemului tab.
- 4. Click on 🖭 Set map extent to match main canvas extent.
- 5. If you need to refresh the element, click on \bigcirc *Update map preview*.

Obviously this is not good enough; you want to make the plot numbers as clearly visible as possible for the field teams.

14.6.3 ???? Try Yourself: Changing the Symbology of the Layers

Ați exersat simbologia cu *Modulul;: Crearea și Explorarea unei Hărți de Bază*, și etichetarea cu *Module: Classifying Vector Data.* Reveniți la aceste module dacă trebuie să vă reamintiți unele dintre opțiunile și instrumentele disponibile. Scopul dvs. este de a afișa locațiile loturilor și numele lor cât mai clar, dar întotdeauna să fie posibilă vizualizarea elementelor din fundalul hărții. Vă puteți orienta după această imagine:



You will use later the the green styling of the forest_stands_2012 layer. In order to keep it, and have a visualization of it that shows only the stand borders:

- 1. Right click on *forest_stands_2012* and select *Duplicate*
- 2. Obțineți un nou strat numit forest_stands_2012 copy pe care îl puteți utiliza pentru a defini un stil diferit, de ex.: fără umplere și cu margini roșii.

Acum aveți două vizualizări diferite ale parcelelor împădurite și puteți decide pe care să o afișați pentru harta dvs. detaliată.

3. Go back to the print layout window often to see what the map would look like. For the purposes of creating detailed maps, you are looking for a symbology that looks good not at the scale of the whole forest area (left

image below) but at a closer scale (right image below). Remember to use \bigcirc Update map preview and \textcircled Set map extent to match main canvas extent whenever you change the zoom in your map or the layout.



14.6.4 ???? Try Yourself: Create a Basic Map Template

- 1. Once you have a symbology you are happy with, you are ready to add some more information to your printed map. Add at least the following elements:
 - Titlu.
 - O scară grafică.
 - Cadrul grilei pentru harta dvs.
 - Coordonate situate pe părțile laterale ale grilei.
- 2. You have created a similar layout already in *Module: Laying out the Maps*. Go back to that module as you need. You can look at this example image for reference:



- 3. Exportați harta dvs. ca o imagine și priviți-o.
 - 1. Layout ► Export as Image....
 - 2. Use for example the *JPG format*.

Iată cum va arăta atunci la tipărire.

14.6.5 ??? Follow Along: Adding More Elements to the Print Layout

Așa cum probabil ați observat în imaginea hărții șablon propusă, există o mulțime de loc în partea dreaptă a canevasului. Haideți să vedem ce altceva ar putea merge acolo. Pentru scopul hărții noastre, o legendă nu este cu adevărat necesară, dar o imagine de ansamblu a hărții și niște casete de text ar putea adăuga valoare hărții.

Harta de ansamblu va ajuta echipele de teren să plaseze harta detaliată în interiorul suprafeței generală a pădurii:

- 1. Adăugați un alt element de hartă pe canevas, chiar sub textul din titlu.
- 2. În fila Proprietăților elementului, deschideți caseta cu derulare verticală Overview.

- 3. Puneți *Overview frame* pe *Map 0*. Acest lucru creează un dreptunghi umbrit deasupra hărții mici, care reprezintă extinderea vizibilă în harta mai mare.
- 4. Check also the *Frame* option with a black color and a *Thickness* of 0.30.



Notice that your overview map is not really giving an overview of the forest area which is what you want. You want this map to represent the whole forest area and you want it to show only the background map and the forest_stands_2012 layer, and not display the sample plots. And also you want to lock its view so it does not change anymore whenever you change the visibility or order of the layers.

- 1. Go back to the map, but don't close the Print Layout.
- 2. Right click the *forest_stands_2012* layer and click on Zoom to Layer Extent.
- 3. Dezactivați toate straturile, cu excepția basic_map și forest_stands_2012.
- 4. Expand the ^{Manage map themes} tool on the *Layers* panel and select *Add theme*.
- 5. Name it basic_overview.
- 6. Go back to the print layout.
- 7. With the small map selected, click the *Set map extent to match main canvas extent* to set its extents to what you can see in the map window.
- 8. Lock the view for the overview map by checking *Follow map theme* and selecting basic_overview under *Main properties*.

Now your overview map is more what you expected and its view will not change anymore. But, of course, now your detail map is not showing anymore the stand borders nor the sample plots. Let's fix that:

- 1. Mergeți din nou la fereastra hărții și selectați straturile pe care le doriți să fie vizibile (systematic_plots_clip, forest_stands_2012 copy și Basic_map).
- 2. Transfocați iarăși, pentru a avea vizibile doar câteva linii ale parcelelor.
- 3. Go back to the Print Layout window.

- 4. Select the bigger map in your layout.
- 5. In Item properties click on Update preview and Set map extent to match main canvas extent.

Observați că numai harta mai mare afișează vizualizarea curentă a hărții, iar harta mai mică de ansamblu păstrează aceeași vedere pe care ați blocat-o.

Rețineți, de asemenea, că o vedere de ansamblu afișează un cadru umbrit pentru extinderea prezentată în harta detaliată.



Șablonul hărții dvs. este aproape gata. Adăugați în hartă cele două casete de text de mai jos, una conținând textul «Zona detaliată a hărții:», iar cealaltă «Observații:». Plasați-le așa cum se vede în imaginea de mai sus.

Puteți adăuga, de asemenea, o săgeată a Nordului la harta generală:

- 1. Select the Add North Arrow tool.
- 2. Click and drag a rectangle at the upper right corner of the overview map.
- 3. In Item properties Check SVG image
- 4. Browse SVG Browser ► SVG Groups for an arrow image.
- 5. Under Image rotation, check the Sync with map and select Map 1 (the overview map).
- 6. Redimensionați imaginea săgeții la o dimensiune care arată bine pe hărțile mici.

The basic map layout is ready, now you want to make use of the Atlas tool to generate as many detail maps in this format as you consider necessary.

14.6.6 ???? Follow Along: Creating an Atlas Coverage

Acoperirea Atlasului reprezintă doar un strat vectorial care va fi folosit pentru a genera hărțile detaliate, o hartă pentru fiecare entitate din aria de acoperire. Pentru a vă face o idee despre aceasta, iată un set complet de hărți detaliate pentru zona de pădure:



Acoperirea poate fi orice strat existent, dar, de obicei, are mai mult sens crearea unuia în acest scop specific. Haideți să creăm o rețea de poligoane care acoperă zona de pădure:

- 1. In the QGIS map view, open Vector ► Research Tools ► Create grid.
- 2. Setați instrumentul așa cum se arată în această imagine:

| 🕺 Vector grid 💦 💽 💽 |
|--|
| Grid extent |
| forest_stands_2012 |
| Align extents and resolution to selected raster layer |
| Update extents from layer Update extents from canvas |
| X Min 397024.141 Y Min 6785465.69525 |
| X Max 398082.827472 Y Max 6787173.746 |
| Parameters X 600.00000000 Y 300.000000000 Output grid as polygons Output grid as lines |
| Output shapefile |
| cise_data/forestry/sampling/atlas_coverage.shp Browse |
| Add result to canvas |
| 0% OK Close |

- 3. Salvați rezultatul ca atlas_coverage.shp.
- 4. Style the new atlas_coverage layer so that the polygons have no filling.

Noile poligoane acoperă întreaga zonă de pădure și vă conferă o idee despre ceea ce va conține fiecare hartă (creată din fiecare poligon).



14.6.7 ???? Follow Along: Setting Up the Atlas Tool

Ultimul pas este de a crea instrumentul Atlas:

- 1. Go back to the print layout.
- 2. În panoul din dreapta, mergeți la fila Atlas generation.
- 3. Setați opțiunile după cum urmează:

| | | | n l |
|---------------|----------------------|------------------------|-----------------|
| Composition | Item properties | Atlas generation | |
| | 000000 Atlas genera | ition propositionality | nonnon X |
| X Generate a | an atlas | | |
| Configurat | tion | | |
| Coverage la | yer atlas_covera | age 🔹 | • |
| 🗶 Hidden o | overage layer | | |
| Filter wit | h | | 3 |
| V Output | | | |
| Output filena | ame expression | | |
| 'fieldmap_' | \$feature | | 3 |
| Single file | e export when possib | ble | |
| Sort by | ID | | |
| | | | |

That tells the Atlas tool to use the features (polygons) inside atlas_coverage as the focus for every detail map. It will output one map for every feature in the layer. The *Hidden coverage layer* tells the Atlas to not show the polygons in the output maps.

Mai trebuie să fie făcut un lucru. Trebuie să indicați Atlasului care element va fi actualizat pentru fiecare hartă de ieșire. Până acum, probabil că ați ghicit că harta care urmează a fi schimbată pentru fiecare entitate, este cea pe care ați pregătit-o să conțină vederile detaliate ale parcelelor eșantion, ea reprezentând elementul cel mai mare de pe canevas:

- 1. Select the bigger map element (Map 0).
- 2. Mergeți la fila Proprietățile itemului tab.
- 3. În listă, bifați Controlat de atlas.
- 4. And set the *Marging around feature* to 10%. The view extent will be 10% bigger than the polygons, which means that your detail maps will have a 10% overlap.



Acum puteți utiliza instrumentul de vizualizare pentru Atlas, pentru a revizui ceea ce vor arăta hărțile:

- 1. Activați previzualizarea Atlasului folosind butonul [™] sau, în cazul în care bara de instrumente nu este vizibilă, via *Atlas* ► *Previzualizare Atlas*.
- 2. Puteți folosi săgețile din bara de instrumente a Atlasului, sau din meniul *Atlas*, pentru a vă deplasa printre hărțile care vor fi create.

Note that some of them cover areas that are not interesting. Let's do something about it and save some trees by not printing those useless maps.

14.6.8 ??? Follow Along: Editing the Coverage Layer

Pe lângă eliminarea poligoanelor pentru acele zone care nu sunt interesante, puteți personaliza, de asemenea, etichetele din harta dvs., prin generarea conținutului acestora din *Tabela de atribute* a stratului de acoperire.

- 1. Mergeți înapoi la vizualizarea hărții.
- 2. Enable editing for the *atlas_coverage* layer.
- 3. Selectați poligoanele care sunt evidențiate (în galben) în imaginea de mai jos.
- 4. Eliminați poligoanele selectate.
- 5. Dezactivați editarea și salvați modificările.



You can go back to the print layout and check that the previews of the Atlas use only the polygons you left in the layer.

Stratul de acoperire pe care îl utilizați, încă nu conține informații utile, pe care să le puteți folosi la personalizarea conținutului etichetelor din hartă. Primul pas este de a le crea; în acest scop puteți adăuga, de exemplu, un cod de zonă pentru zonele poligonale, și un câmp cu câteva observații pe care să le aibă în vedere echipele din teren:

- 1. Open the *Attribute table* for the *atlas_coverage* layer.
- 2. Activează editarea.
- 3. Folosiți calculatorul pentru a crea și popula următoarele două câmpuri.
- 4. Create a field named Zone of type Whole number (integer).
- 5. In the Expression box write/copy/construct @row_number.
- 6. Create another field named Remarks, of type Text (string) and a width of 255.
- 7. In the *Expression* box write 'No remarks.'. This will set all the default value for all the polygons.

The forest manager will have some information about the area that might be useful when visiting the area. For example, the existence of a bridge, a swamp or the location of a protected species. The *atlas_coverage* layer is

probably in edit mode still, add the following text in the *Remarks* field to the corresponding polygons (double click the cell to edit it):

- For the Zone 2: Bridge to the North of plot 19. Siberian squirrel between p_13 and p_14.
- For the Zone 6: Difficult to transit in swamp to the North of the lake.`
- For the Zone 7: Siberian squirrel to the South East of p_94.
- Dezactivează editarea și salvează modificările.

Almost ready, now you have to tell the Atlas tool that you want some of the text labels to use the information from the *atlas_coverage* layer's attribute table.

- 1. Go back to the Print Layout.
- 2. Select the text label containing Detailed map....
- 3. Setați dimensiunea Fontului la 12.
- 4. Duceți cursorul la sfârșitul textului din etichetă.
- 5. In the Item properties tab, inside the Main properties click on Insert or Edit an Expression
- 6. In the Function list double-click on the field Zone under Field and Values.
- 7. Clic pe OK
- 8. The text inside the box in the *Item properties* should show Detail map inventory zone: [% "Zone" %]. Note that the [% "Zone" %] will be substituted by the value of the field *Zone* for the corresponding feature from the layer *atlas_coverage*.
- 9. Testați conținutul etichetei, prin vizualizarea unor diferite hărți din Atlas.
- 10. Do the same for the labels with the text *Remarks:* using the field with the zone information. You can leave a break line before you enter the expression. You can see the result for the preview of zone 2 in the image below:



11. Utilizați previzualizarea din Atlas pentru a naviga prin toate hărțile care vor fi create în curând!

14.6.9 ???? Follow Along: Printing the Maps

Nu în ultimul rând, imprimați sau exportați hărțile în fișiere imagine sau PDF. Aveți posibilitatea să utilizați *Atlas* ► *Export Atlas as Images...* sau *Atlas* ► *Export Atlas as PDF....* În prezent, formatul de export SVG nu funcționează în mod corespunzător și va da un rezultat slab.

Haideți să exportăm hărțile într-un singur PDF pe care îl puteți trimite la biroul teritorial pentru imprimare:

- 1. Mergeți la fila Atlas generation, în panoul din dreapta.
- 2. Sub *Output* bifați *Single file export when possible*. Acest lucru va pune toate hărțile împreună într-un fișier PDF; în cazul în care această opțiune nu este bifată, veți obtine câte un fișier pentru fiecare hartă.
- 3. Open Layout ► Export as PDF....
- 4. Save the PDF file as inventory_2012_maps.pdf in your exercise_data\forestry\ samplig\map_creation\ folder.
- 5. Deschideți fișierul PDF pentru a verifica dacă totul a mers cum era de așteptat.
- 6. Puteți crea la fel de ușor imagini separate pentru fiecare hartă (amintiți-vă să debifați crearea unui singur fișier), unde puteți vedea miniaturile imaginilor care vor fi create:



7. In the *Print Layout*, press save in order to save your print layout changes in the project. This also saves the project file. You can reopen the project at any time and run or edit the atlas.

It is also possible to save your map as a layout template as forestry_atlas.qpt in your exercise_data\forestry\map_creation\ folder. Use *Layout* > *Save as Template*. You will be able to use this template again and again in other projects.

8. Close the Print Layout and the project.

14.6.10 În concluzie

Ați reușit să creați o hartă șablon, care poate fi folosită pentru a genera automat hărți detaliate, în scopul ușurării utilizării în teren. După cum ați observat, acest lucru nu a fost o sarcină ușoară, dar beneficiul va veni atunci când va trebui să creați hărți similare pentru alte regiuni, unde puteți utiliza șablonul pe care tocmai l-ați salvat.

14.6.11 Ce urmează?

In the next lesson, you will see how you can use LiDAR data to create a DEM and then use it to enhance your data and maps visibility.

14.7 Lesson: Calculating the Forest Parameters

Estimarea parametrilor unei păduri reprezintă scopul inventarului forestier. Continuând exemplul din lecția precedentă, vom utiliza informațiile de inventar adunate din teren pentru a calcula parametrii, mai întâi pentru întreaga pădure, iar ulterior pentru pâlcurile digitizate anterior.

Scopul acestei lecții: De a calcula parametrii forestieri la nivel general și la nivel de pâlc.

14.7.1 ???? Follow Along: Adding the Inventory Results

Echipele din teren au vizitat pădurea și, cu ajutorul informațiilor pe care le-ați furnizate dvs., au adunate informații despre fiecare parcelă de pădure.

Most often the information will be collected into paper forms in the field, then typed to a spreadsheet. The sample plots information has been condensed into a .csv file that can be easily open in QGIS.

Continue with the QGIS project from the lesson about designing the inventory, you probably named it forest_inventory.qgs.

În primul rând, adăugați măsurătorile din suprafețele de probă în proiectul dvs. QGIS:

- 1. Go to Layer ► Add Layer ► Add Delimited Text Layer....
- Browse to the file systematic_inventory_results.csv located in exercise_data/ forestry/results/.
- 3. Asigurați-vă că este selectată opțiunea Point coordinates.
- 4. Set the fields for the coordinates to the *X* and *Y* fields.
- 5. Clic pe OK
- 6. When prompted, select ETRS89 / ETRS-TM35FIN as the CRS.
- 7. Deschideți noul Tabel de Atribute și aruncați o privire datelor.

You can read the type of data that is contained in the sample plots measurements in the text file legend_2012_inventorydata.txt located in the exercise_data/forestry/results/ folder.

The systematic_inventory_results layer you just added is actually just a virtual representation of the text information in the .csv file. Before you continue, convert the inventory results to a real spatial dataset:

- 1. Right click on the systematic_inventory_results layer.
- 2. Browse to exercise_data/forestry/results/ folder.
- 3. Name the file sample_plots_results.shp.
- 4. Bifați caseta Add saved file to map.
- 5. Remove the systematic_inventory_results layer from your project.

14.7.2 ???? Follow Along: Whole Forest Parameters Estimation

You can calculate the averages for this whole forest area from the inventory results for the some interesting parameters, like the volume and the number of stems per hectare. Since the systematic sample plots represent equal areas, you can directly calculate the averages of the volumes and number of stems per hectare from the sample_plots_results layer.

Puteți calcula media unui câmp dintr-un strat vectorial, folosind instrumentul Basic statistics:

- 1. Open Vector ► Analysis Tools ► Basic statistics for Fields.
- 2. Select sample_plots_results as the Input Vector Layer.
- 3. Select Vol as Target field.
- 4. Clic pe OK

The average volume in the forest is 135.2 m3/ha.

You can calculate the average for the number of stems in the same way, 2745 stems/ha.

| Input Vector Layer sample_plots_results | | Input Vector Lag sample_plots_r | yer results | |
|---|---------------|-------------------------------------|-------------------------------|---------------|
| Use only selected features Target field | | Use only sel Target field | ected features | |
| Vol | | ▼ Stems | | |
| Statistics output | | Statistics output | t | |
| Parameter | Value | | Parameter | Value |
| Mean | 135.153153153 | Mean | | 2744.65765766 |
| StdDev | 69.966941769 | StdDev | | 2775.63980935 |
| Sum | 15002.0 | Sum | | 304657.0 |
| Min | 15.0 | Min | | 167.0 |
| Max | 333.0 | ▲ ▼ Max | | 11400.0 |
| Press Ctrl+C to copy results to the clipboard | | Press Ctrl+C to | copy results to the clipboard | |
| 0% | OK Close | | 0% | K Close |

14.7.3 ???? Follow Along: Estimating Stand Parameters

Puteți folosi același eșantion de date pentru a calcula estimări pentru diferitele pâlcuri de pădure digitizate anterior. Despre unele pâlcuri nu există date și, de aceea, pentru ele nu se vor obține informații. S-ar fi putut prevedea o culegere de date suplimentară, la momentul planificării inventarului sistematic, în cadrul căreia echipele din teren să fi efectuat măsurători. Sau, ar putut fi trimisă ulterior o echipă în teren pentru a estima pâlcurile omise, în scopul completării inventarul. Chiar și așa, veți obține informații pentru un număr bun de pâlcuri folosind doar parcelele planificate.

Trebuie să obțineți media parcelelor care se încadrează în fiecare pâlc forestier. Atunci când doriți să combinați informațiile, în funcție de locațiile relative ale acestora, veți efectua o îmbinare spațială:

- 1. Deschideți instrumentul Vector ► Data Management ► Join attributes by location.
- 2. Set forest_stands_2012 as the *Target vector layer*. The layer you want the results for.
- 3. Set sample_plots_results as the *Join vector layer*. The layer you want to calculate estimates from.
- 4. Bifați Take summary of intersecting features.
- 5. Bifați pentru a calcula doar Media.

- 6. Name the result as forest_stands_2012_results.shp and save it in the exercise_data/ forestry/results/ folder.
- 7. La final, selectați Keep all records..., astfel încât să puteți verifica mai târziu care locație nu a primit informații.
- 8. Clic pe OK
- 9. Acceptați adăugarea noului strat la proiectul dvs. când vi se solicită.
- 10. Închideți instrumentul de Îmbinare a atributelor după locație.

Open the *Attribute table* for *forest_stands_2012_results* and review the results you got. Note that a number of forest stands have NULL as the value for the calculations, those are the ones having no sample plots. Select them all and view them in the map, they are some of the smaller stands:



Let's calculate now the same averages for the whole forest as you did before, only this time you will use the averages you got for the stands as the bases for the calculation. Remember that in the previous situation, each sample plot represented a theoretical stand of 80×80 m. Now you have to consider the area of each of the stands individually instead. That way, again, the average values of the parameters that are in, for example, m3/ha for the volumes are converted to total volumes for the stands.

Trebuie să calculați mai întâi ariile pentru locații, iar apoi volumele totale și numărul de tulpini pentru fiecare dintre acestea:

- 1. Activați editarea în Tabela de Atribute.
- 2. Deschideți Calculatorul de câmpuri.

- 3. Create a new field called area.
- 4. Set the Output field type to Decimal number (real).
- 5. Set the Precision to 2.
- 6. In the *Expression* box, write <code>\$area / 10000</code>. This will calculate the area of the forest stands in ha.
- 7. Clic pe OK

Acum calculați un câmp cu volumele totale și numărul estimat de tulpini, pentru fiecare element:

- 1. Name the fields s_vol and s_stem.
- 2. Valorile numerice din câmpurile pot fi de tip întreg sau chiar și de tip real.
- 3. Use the expressions "area" * "MEANVol" and "area" * "MEANStems" for total volumes and total stems respectively.
- 4. Închideți editările, după ce ați încheiat.
- 5. Dezactivați editarea.

În situația anterioară, zonele reprezentate de fiecare parcelă eșantion au fost aceleași, astfel încât a fost suficientă calcularea mediei parcelelor eșantion. Acum, pentru a calcula estimările, trebuie să împărțim suma volumelor pâlcurilor, sau numărul de tulpini, la suma suprafețelor acelor pâlcuri care conțin informații.

- 1. In the *Attribute table* for the forest_stands_2012_results layer, select all the stands containing information.
- 2. Open Vector ► Analysis Tools ► Basic statistics for fields.
- 3. Select the forest_stands_2012_results as the Input layer.
- 4. Select area as Field to calculate statistics on.
- 5. Check the Selected features only
- 6. Clic pe OK

| 🙋 Basics statistics | ? 🔀 |
|---|----------------|
| Input Vector Layer | |
| forest_stands_2012_results | - |
| X Use only selected features | |
| Target field | |
| area | • |
| Statistics output | |
| Parameter | Value 🔺 |
| Mean | 0.971161764706 |
| StdDev | 0.688308297253 |
| Sum | 66.039 |
| Min | 0.181 |
| Max | 3.726 |
| Press Ctrl+C to copy results to the clipboard | |
| 0% | OK Close |

As you can see, the total sum of the stands» areas is 66.04 ha. Note that the area of the missing forest stands is only about 7 ha.

In the same way, you can calculate that the total volume for these stands is $8908 \text{ m}^3/\text{ha}$ and the total number of stems is 179594 stems.

Folosind informațiile din pâlcurile forestiere, în locul folosirii directe a celor din parcelele eșantion, rezultă următoarele estimări medii:

- 184.9 m3/ha and
- 2719 stems/ha.

Salvați proiectul în forest_inventory.qgs.

14.7.4 În concluzie

Ați reușit să efectuați estimări pentru întreaga pădure, folosind informațiile din parcelele de probă, fără a ține seama de caracteristicile forestiere, precum și utilizând interpretarea imaginilor aeriene ale pâlcurilor forestiere. De asemenea, ați primit informații valoroase despre anumite pâlcuri, care pot fi utilizate pentru gestionarea pădurilor în anii următori.

14.7.5 Ce urmează?

În lecția următoare, veți crea mai întâi un fundal reliefat, dintr-un set de date LiDAR, care va fi folosit pentru a pregăti prezentarea pe hartă a rezultatelor forestiere, pe care tocmai le-ați calculat.

14.8 Lesson: DEM from LiDAR Data

Puteți îmbunătăți aspectul hărți folosind diverse imagini de fundal. Ați putea folosi harta de bază sau imaginile aeriene pe care le-ați utilizat înainte, dar un raster cu relieful terenului va arata mai frumos în anumite situații.

Veți folosi LAStools pentru a extrage un DEM dintr-un set de date LIDAR, și apoi să creați un raster al reliefului pe care să-l folosiți mai târziu în prezentarea hărții dvs.

Scopul acestei lecții: Instalarea LAStools și calcularea unui DEM din datele LiDAR și dintr-un raster cu relieful.

14.8.1 ???? Follow Along: Installing Lastools

Managing LiDAR data within QGIS is possible using the Processing framework and the algorithms provided by LAStools.

Puteți obține un model de elevație digital (DEM), dintr-un nor de puncte LiDAR, iar ulterior se poate crea un raster al umbririi reliefului, care este vizual mai intuitiv în scopuri de prezentare. În primul rând, va trebui să configurați setările cadrului de lucru *Processing* pentru a lucra în mod corespunzător cu LAStools:

- Închideți QGIS, dacă ați început deja.
- Un plugin LiDAR vechi ar putea fi deja instalat în sistemul dvs., în dosarul C:/Program Files/QGIS Valmiera/apps/qgis/python/plugins/processing/.
- Dacă aveți un folder denumit lidar, ștergeți-l. Acest lucru este valabil pentru anumite instalări de QGIS 2.2 și 2.4.
| 🗸 🗸 🗸 🗸 🗸 🗸 🗸 | • python • plugins • processing | • | 🕶 🐓 Search pr | юс 🖌 |
|--------------------------|----------------------------------|-------------|---------------|------|
| Organize 🔻 🛛 🏹 Open 🛛 In | nclude in library 👻 Share with 👻 | Burn » | !≡ ▼ 🗖 | 2 |
| Name | Date modified | Туре | Size | |
| 퉬 admintools | 6/5/2014 3:20 PM | File folder | | |
| 퉬 algs | 6/5/2014 3:20 PM | File folder | | |
| 퉬 commander | 6/5/2014 3:20 PM | File folder | | |
| 퉬 core | 6/5/2014 3:20 PM | File folder | | |
| 퉬 exampleprovider | 6/5/2014 3:20 PM | File folder | | |
| 퉬 gdal | 6/5/2014 3:20 PM | File folder | | |
| 퉬 grass | 6/5/2014 3:20 PM | File folder | | |
| 퉬 gui | 6/5/2014 3:20 PM | File folder | | |
| 퉬 images | 6/5/2014 3:20 PM | File folder | | |
| 퉬 lidar | 6/5/2014 3:20 PM | File folder | | |
| 퉬 modeler | 6/5/2014 3:20 PM | File folder | | |
| 퉬 otb | 6/5/2014 3:20 PM | File folder | | |
| 퉬 outputs | 6/5/2014 3:20 PM | File folder | | |
| 퉬 parameters | 6/5/2014 3:20 PM | File folder | | |
| 퉲 r | 6/5/2014 3:20 PM | File folder | | |
| ····· | 6 /E /2014 2.20 DM | Tile Kellen | | |

- Go to the <code>exercise_data\forestry\lidar\</code> folder, there you can find the file <code>QGIS_2_2_toolbox.zip</code>. Open it and extract the <code>lidar</code> folder to replace the one you just deleted.
- If you are using a different QGIS version, you can see more installation instructions in this tutorial.

Now you need to install the LAStools to your computer. Get the newest *lastools* version here and extract the content of the lastools.zip file into a folder in your system, for example, C:\lastools\. The path to the lastools folder cannot have spaces or special characters.

Notă: Citiți fișierul LICENSE.txt din interiorul folderului lastools. Unele dintre aceste instrumente LAS sunt gratuite, pe când altele nu, acestea necesitând licențiere pentru utilizare comercială și guvernamentală. În scopuri educaționale sau de evaluare, puteți utiliza și testa LAStools oricât de mult doriți.

Plugin-ul și algoritmii curenți sunt de acum instalați în computerul dvs., aproape gata de utilizare, fiind nevoie doar să configurați cadrul de lucru Processing pentru a începe utilizarea lor:

- Deschideți un nou proiect în QGIS.
- + Setați ETRS
89 / ETRS-TM35FIN ca \mbox{CRS} al proiectului.
- Salvați proiectul ca forest_lidar.qgs.

Pentru a seta LAStools în QGIS:

- Mergeți la *Processing* ► *Options and configuration*.
- În dialogul Opțiunilor de procesare, mergeți la Furnizori și apoi la Instrumente pentru datele LiDAR.
- Bifați Activare.
- Pentru Folderul LAStools setați c:\lastools\ (sau folderul în care ați extras LAStools).

| Processing options | -? |
|------------------------------------|-------------|
| Search | |
| Setting | Value |
| 🕂 🏶 General | |
| 🗄 🕰 Models | |
| Providers | |
| 🕀 🖓 GDAL/OGR | |
| 🕀 🕸 GRASS commands | |
| 🕀 📰 📴 GeoServer/PostGIS tools | |
| 🕀 🥰 Modeler-only tools | |
| 🕀 🚺 Orfeo Toolbox (Image analysis) | s) |
| 🕀 🕺 QGIS geoalgorithms | |
| 🕀 🔞 R scripts | |
| 🗄 😵 SAGA | |
| 🗄 🚺 TauDEM (hydrologic analysis) |) |
| 🖮 📉 Tools for LiDAR data | |
| 🗠 🔀 Activate | × |
| - 🔀 Fusion folder | |
| 🔍 🔀 LAStools folder | C:\lastools |
| 🗄 🖻 Scripts | |
| | OK Cancel |

14.8.2 ???? Follow Along: Calculating a DEM with LAStools

Ați folosit deja bara de instrumente *Processing* din *Lesson: Spatial Statistics* pentru a rula câțiva algoritmi SAGA. Acum o veți utiliza pentru a rula programele LAStools:

- Deschideți Processing ► Toolbox.
- În meniul derulant din partea inferioară, selectați Interfață avansată.
- Ar trebui să vedeți categoria Instrumentelor pentru datele LiDAR.



- Extindeți-o pentru a vedea instrumentele disponibile, apoi extindeți, de asemenea, categoria *LAStools* (numărul de algoritmi poate varia).
- Derulați în jos până când găsiți algoritmul *lasview*, apoi faceți dublu-clic pentru a-l deschide.
- At *Input LAS/LAZ file*, browse to exercise_data\forestry\lidar\ and select the rautjarvi_lidar.laz file.

| 🔏 lasview 💽 | lasclip lascolor |
|---|--|
| Parameters Log Help verbose No input LAS/LAZ file | |
| C:\qgis_forestry\exercise_data\forestry\lidar\rautjarvi_lidar.laz | Iasoverlap Iasprecision Iasquery Iassort Iassplit Iasthin Iastile Iasvalidate |
| 0% Run Close Cancel | lasview laszip shp2las txt2las |

• Clic pe *Run*

Acum puteți vedea datele LiDAR în fereastra dialogului Doar un mic vizualizator LAS și LAZ:



Există multe alte lucruri pe care le puteți efectua în cadrul acestui vizualizator, dar pentru moment trebuie doar să faceți un clic și să glisați norul de puncte LiDAR, pentru a vedea cum arată.

Notă: If you want to know further details on how the LAStools work, you can read the README text files about each of the tools, in the C:\lastools\bin\ folder. Tutorials and other materials are available at the Rapidlasso webpage.

• Închideți vizualizatorul atunci când sunteți gata.

Crearea unui DEM cu LAStools se poate face în două etape, mai întâi pentru a clasifica norul de puncte în ground și no ground, iar apoi pentru a calcula DEM-ul folosind numai punctele ground.

- Mergeți înapoi la Bara Instrumentelor de Procesare.
- Notați Search... box, write lasground.
- Dublu clic pentru a deschide instrumentul *lasground*, apoi setați-l așa cum se arată în această imagine:

| Parameters | Log | Help | | | | | | | | | | |
|--------------|-------------|---------|--------|--------|----------|----------|------------|--|--|--|---|---|
| verbose | | | | | | | | | | | | Í |
| No | | | | | | | | | | | - | |
| input LAS/L | AZ file | | | | | | | | | | | |
| C:\qgis_fo | orestry\exe | rcise_d | ata\fo | restry | lidar\ra | autjarvi | _lidar.laz | | | | | |
| horizontal f | eet | | | | | | | | | | | |
| No | | | | | | | | | | | - | |
| vertical fee | t | | | | | | | | | | | |
| No | | | | | | | | | | | - | |
| airborne Lil | DAR | | | | | | | | | | | |
| Yes | | | | | | | | | | | - | |
| terrain type | 2 | | | | | | | | | | | |
| wilderness | ; | | | | | | | | | | - | |
| preprocess | ing | | | | | | | | | | | |
| default | | | | | | | | | | | • | |
| | | | | | | | | | | | | • |
| | | | | | | | | | | | | |
| | | | | | | | 0% | | | | | |

• The output file is saved to the same folder where the rautjarvi_lidar.laz is located and it is named rautjarvi_lidar_1.las.

Puteți să-l deschideți cu lasview,



The brown points are the points classified as ground and the gray ones are the rest, you can click the letter g to visualize only the ground points or the letter u to see only the unclassified points. Click the letter a to see all the points again. Check the lasview_README.txt file for more commands. If you are interested, also this tutorial about editing LiDAR points manually will show you different operations within the viewer.

- Închideți iarăși vizualizatorul.
- În Processing Toolbox, căutați las2dem.
- Deschideți instrumentul *las2dem*, apoi setați-l așa cum se arată în această imagine:

| 🕺 las2dem 💽 |
|---|
| Parameters Log Help |
| verbose |
| |
| |
| C:\qgis_forestry\exercise_data\forestry\lidar\rautjarvi_lidar_1.las |
| filter (by return, classification, flags) |
| |
| step size / pixel size |
| 1.000000 |
| |
| Attribute |
| elevation |
| Product |
| actual values |
| Output raster file |
| C:/qgis_forestry/exercise_data/forestry/results/rautjarvi_dem.tif |
| X Open output file after running algorithm |
| |
| 0% |
| Run Close Cancel |

DEM-ul rezultat este adăugat la hartă cu numele generic Output raster file.

Notă: Instrumentele *lasground* și *las2dem* necesită licențiere. Le puteți utiliza chiar și în lipsa licenței, așa cum este indicat în fișierul licenței, dar veți obține diagonale în imaginile rezultate.

14.8.3 ??? Follow Along: Creating a Terrain Hillshade

For visualization purposes, a hillshade generated from a DEM gives a better

visualization of the terrain:

- Deschideți Raster ► Terrain analysis ► Hillshade.
- As the *Output layer*, browse to exercise_data\forestry\lidar\ and name the file hillshade. tif.
- Lasă restul parametrilor la setările implicite.

| 🌠 Hillshade | ? 🔀 |
|-------------------------|-------------------------------------|
| Elevation layer | rautjarvi_dem 💌 |
| Output layer | estry/lidar/rautjarvi_hillshade.tif |
| Output format | GeoTIFF |
| Z factor | 1 |
| X Add result to project | |
| Illumination | |
| Azimuth (horizontal ang | le) 300.00 🔷 |
| Vertical angle | 40.00 |
| | OK Cancel |

• Selectați ETRS89 / ETRS-TM35FIN ca și CRS, atunci când vi se solicită.

În ciuda liniilor diagonale rămase în relieful rasterului rezultat, puteți vedea în mod clar un relief exact al zonei. Puteți vedea chiar și diferite albii săpate de curgerea apelor prin pădure.



14.8.4 În concluzie

Using LiDAR data to get a DEM, specially in forested areas, gives good results with not much effort. You could also use ready LiDAR derived DEMs or other sources like the SRTM 9m resolution DEMs. Either way, you can use them to create a hillshade raster to use in your map presentations.

14.8.5 Ce urmează?

În următorul, și ultimul pas din acest modul, veți folosi un raster rezultat și rezultatele inventarului forestier pentru a crea o prezentare pentru harta rezultatelor.

14.9 Lesson: Map Presentation

În lecțiile anterioare ați importat, sub formă de proiect GIS, un vechi inventar de pădure, l-ați actualizat, ați proiectat un inventar, ați creat hărți pentru munca de teren și ați calculat parametrii pădurii folosind măsurătorile din teren.

Adesea, pentru a prezenta rezultatele, este importantă crearea de hărți, în cadrul unui proiect GIS. O hartă care prezintă inventarul forestier va facilita înțelegerea acestuia dintr-o simplă privire, fără analiza detaliată a cifrelor.

Scopul acestei lecții: De a crea o hartă care să prezinte rezultatele inventarerii, folosind ca fundal un raster al reliefului umbrit.

14.9.1 ??? Follow Along: Preparing the Map Data

Deschideți proiectul QGIS din lecția de calculare a parametrilor, forest_inventory.qgs. Păstrați cel puțin următoarele straturi:

- forest_stands_2012_results.
- basic_map.
- rautjarvi_aerial.
- kbd:lakes (dacă nu îl aveți, adăugați-l din exercise_data\forestry\ folder).

You are going to present the average volumes of your forest stands in a map. If you open the *Attribute table* for the forest_stands_2012_results layer, you can see the NULL values for the stands without information. To be able to get also those stands into your symbology you should change the NULL values to, for example, -999, knowing that those negative numbers mean there is no data for those polygons.

Pentru stratul forest_stands_2012_results:

- Deschideți Tabela sa de Atribute și activați editarea.
- Selectati poligoanele cu valoarea NULL.
- Utilizați calculatorul pentru a actualiza valorile din câmpul MEANVol la -999, doar pentru entitățile selectate.
- Dezactivați editarea și salvați modificările.

Acum puteți un stil implicit pentru acest strat:

- Mergeți la fila Simbologiei.
- Click on Style \blacktriangleright Load Style....
- Selectați folderul forest_stands_2012_results.qml from the exercise_data\forestry\ results\.
- Clic pe OK

| 🦸 Layer Properties - forest_star | nds_2012_results Style | | | ? 💌 |
|----------------------------------|---|----------------------------------|-----------------------|-------------------------------|
| General | Layer rendering | <i></i> | | |
| 😻 Style | Layer transparency Layer blending mode | Hard light | Feature blending mode | Normal V |
| abc Labels | 🗧 Graduated 🛛 👻 | | | |
| Fields Col | olumn MEANp_vol | ٠ ٤. | | |
| Syr | mbol | Change | | Classes 7 |
| Col | olor ramp [source] | ▼ Inver | t | Mode Natural Breaks (Jenks) 🔻 |
| Joins | iymbol Value -999.0000 - 0.0000 | .abel No data | | |
| Diagrams | 0.0000 - 15.0000 0 |) - 15 15 - 25 | | |
| 🧑 Metadata | 50.0000 - 100.0000 100.0000 - 150.00 | 29 - 50 50 - 100 100 - 150 | | |
| | 150.0000 - 300.00 : | 150 - 300 | | |
| | | | | |
| | | | | |
| | Classify Add class | Delete all | | Advanced 💌 |
| | Load Style | Save As Default | Restore Default Style | Save Style 🔻 |
| | | | OK Cance | Apply Help |

Harta dvs. va arăta în felul următor:

| 🕺 QGIS 2.2.0 | -Valmiera - lid | ar | | | | | | | | | |
|---|--|-------------------|-------------------|--------------------------------|---|-----------------------------------|---|--------------------------|----------|--------|-----|
| P <u>r</u> oject <u>E</u> dit | t <u>V</u> iew <u>L</u> aye | r <u>S</u> etting | s <u>P</u> lugins | Vect <u>o</u> r <u>R</u> aster | r <u>D</u> atabase | MMQGIS | Processing | <u>H</u> elp | | | |
| | | 2 | \$ 🔬 | 🕛 🏶 . | ، 🔍 🕏 | 19 🏂 | Ç Q | | » | 🔍 » | ? » |
| | forest No dat 0 - 15 15 - 25 25 - 50 50 - 10 100 - 1 150 - 3 akes billsha | yers | 2012 resul | | 234 35 35 35 35 39 39 | | 5 3 7 27 26 8 42 25 ²⁶ 43 23 43 | 20 43 45 47 | 11 | 2 | |
| ♥ ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ● | | | | 67 | 61 59 61 60 63 65 82 81 83 81 87 8 | 57 55 67 69 66 7 66 7 | 3 51 51 50 53 52 77 63 71 0 72 73 74 79 79 78 89 | 2 48 3 49 75 77 | 1 | ¢ | |
| <pre> Compare A compa</pre> | n update availat | <u>de 🛞 li</u> | | 3971 | 102 103 101 38,6787216 | 106 96 95 97 98 100 | 105 ⁹⁰ 91 94 98 99 99 1 | 92 | | Render | .0 |

14.9.2 ???? Try Yourself: Try Different Blending Modes

Stilul pe care l-ați încărcat:

| 🌠 Layer Properties - forest | _stands_2012 | _results Style | | | | | | ? 🔀 |
|-----------------------------|--------------|--|------------------------------|-----------------|--------|-----------------------|---------|--------------------------|
| 🔀 General | ▼ Layer re | ndering | 0 | | | | | |
| 😻 Style | Layer tran | sparency ding mode | Hard ligh | ıt | ▼ F | eature blending mode | Normal | |
| (abc) Labels | Gradua | ted 💌 | | | | | | |
| Fields | Column | MEANp_vol | | | E | | | |
| Kendering | Symbol | | | Chan | ge | | Classes | 7 |
| | Color ramp | [source] | | • | Invert | | Mode | Natural Breaks (Jenks) 💌 |
| Joins | Symbol | Value -999.0000 - 0.0000 | Label No data | | | | | |
| Diagrams | | 0.0000 - 15.0000 15.0000 - 25.0000 25.0000 - 50.0000 | 0 - 15 15 - 25 25 - 50 | | | | | |
| 🥡 Metadata | | 50.0000 - 100.0000 100.0000 - 150.00 | 50 - 100 100 - 150 | | | | | |
| | | 150.0000 - 300.00 | 150 - 300 | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | Classify | Add class | Delete | Delete all | | | | Advanced 💌 |
| | | Load Style | | Save As Default | | Restore Default Style | | Save Style 🔹 |
| | | | | | | OK Car | cel | Apply Help |

is using the Hard light mode for the *Layer blending mode*. Note that the different modes apply different filters combining the underlying and overlying layers, in this case the hillshade raster and your forest stands are used. You can read about these modes in the User Guide.

Încercați în diverse moduri și observați diferențele în hartă. Apoi, stabiliți unul care vă place cel mai mult pentru harta finală.

14.9.3 ???? Try Yourself: Using a Layout Template to Create the Map result

Use a template prepared in advanced to present the results. The template forest_map.qpt is located in the exercise_data\forestry\results\ folder. Load it using the *Project* ► *Layout Manager...* dialog.

| 37 37 37 37 37 38 37 Composer title | 1 |
|---|--------|
| Composer man Create unique print composer title (title generated if left empty) | |
| results | |
| OK Cancel | |
| | |
| | |
| New from template | None N |
| Specific Add | のない |
| ercise_data/forestry/results/forest_map.qpt | A PA |
| Open template directory user default | 111 |
| Show Duplicate Remove Rename Close | |
| | |

Open the print layout and edit the final map to get a result you are happy with.

Șablonul hărții pe care îl utilizați vă va oferi o hartă similară cu aceasta:



Salvați proiectul dumneavoastră QGIS ca referință pentru viitor.

14.9.4 În concluzie

Prin intermediul acestui modul ați văzut cum poate fi planificat și prezentat un inventar forestier de bază în QGIS. Mult mai multe analize forestiere sunt posibile în varietatea de instrumente pe care le puteți accesa, dar sperăm că acest manual va oferit un bun punct de plecare pentru a explora noi modalități de obținere a rezultatelor dorite.

CAPITOLUL 15

Module: Database Concepts with PostgreSQL

Baze de date relaționale sunt o parte importantă a oricărui sistem GIS. În acest modul, veți învăța despre Sistemele de Gestiune a Bazelor de date Relaționale (RDBMS), utilizând PostgreSQL pentru a crea o nouă bază de date în scopul stocării datelor, și veți afla despre alte funcții tipice RDBMS.

15.1 Lesson: Introduction to Databases

Înainte de a utiliza PostgreSQL, să ne asigurăm de terenul nostru prin acoperirea teoriei generale a bazelor de date. Nu va fi nevoie să introduceți codul exemplificat; acesta este prezent doar în scopuri ilustrative.

Scopul acestei lecții: De a înțelege conceptele fundamentale ale bazelor de date.

15.1.1 Ce este o bază de date?

O bază de date constă într-o colecție organizată de date, pentru una sau mai multe utilizări, de obicei în formă digitală. - Wikipedia

Un sistem de management al bazelor de date (DBMS) este format din software care operează bazele de date, oferind depozitare, acces, securitate, backup și alte facilități. - *Wikipedia*

15.1.2 Tabele

În bazele de date tradiționale și în bazele de date tip fișier, o tabelă este un set de elemente de date (valori) care este organizat utilând un model de coloane verticale (care sunt identificate prin numele lor) și de rânduri orizontale. O tableă are un număr specificat de coloane, dar poate avea oricâte rânduri. Fiecare rând este identificat prin valorile unui anumit subset de coloane care a fost identificat ca o potențială cheie. - *Wikipedia*

În bazele de date SQL, o tabelă este, de asemenea, cunoscută ca relație.

15.1.3 Coloane / Câmpuri

O coloană este un set de valori de date având un anume tip simplu, câte una pentru fiecare rând din tabel. Coloanele funizează structura pe baza căreia se compune fiecare rând. Termenul de câmp este utilizat interschimbabil cu coloană, deși mulți consideră că este mai corect să se utilizeze câmp (sau valoare a câmpului) când este vorba de elementul care există la intersecția dintre o coloană și un rând. - *Wikipedia*

O coloană:

| name | |
|-------|--|
| ++ | |
| Tim | |
| Horst | |

Un câmp:

| Horst |

15.1.4 Înregistrări

O înregistrare reprezintă informația stocată într-un rând din tabelă. Fiecare înregistrare va avea câte un câmp pentru fiecare dintre coloanele tabelei.

2 | Horst | 88 <-- one record

15.1.5 Tipuri de date

Tipurile de date restrâng tipurile de informații care pot fi stocate într-o coloană. - Tim and Horst

Există mai multe feluri de tipuri de date. Să ne concentrăm pe cele mai comune:

- String to store free-form text data
- Integer to store whole numbers
- Real to store decimal numbers
- Date to store Horst's birthday so no one forgets
- Boolean to store simple true/false values

You can tell the database to allow you to also store nothing in a field. If there is nothing in a field, then the field content is referred to as a **«null» value**:

```
insert into person (age) values (40);
select * from person;
```

Rezultat:

There are many more datatypes you can use - check the PostgreSQL manual!

15.1.6 Modelarea unei Baze de Date cu Adrese

Să folosim un studiu de caz simplu, pentru a vedea cum este construită o bază de date. Dorim să creăm o bază de date cu adrese.

??? Try Yourself:

Notați proprietățile care alcătuiesc o adresă simplă și pe care am dori să le stocăm în baza noastră de date.

Răspuns

For our theoretical address table, we might want to store the following properties:

House Number Street Name Suburb Name City Name Postcode Country

When creating the table to represent an address object, we would create columns to represent each of these properties and we would name them with SQL-compliant and possibly shortened names:

house_number street_name suburb city postcode country

Structura Adresei

Propietățile care descriu o adresă sunt coloanele. Tipul de informație stocat în fiecare coloană este tipul de date al acesteia. În secțiunea următoare vom analiza tabela noastră conceptuală de adrese pentru a vedea cum o putem înbunătăți!

15.1.7 Teoria Bazelor de Date

Procesul de creare a unei baze de date presupune crearea unui model al lumii reale; luând concepte din lumea reală și reprezentându-le, ca entități, în baza de date.

15.1.8 Normalizarea

Un concept de bază al bazelor de date este evitarea duplicării / redundanței datelor. Procesul eliminării redundanței dintr-o bază de date este numit Normalizare.

Normalizarea este o metodă sistematică de garantare că structura bazei de date este potrivită pentru interogări de uz general și nu prezintă anumite caracterisitici - anomalii de inserare, modificare sau ștergere - care ar putea duce la pierderea integrității datelor. - *Wikipedia*

Există diferite tipuri de «forme» de normalizare.

Let's take a look at a simple example:

select * from people;

| Table "public.people" | | | | | | | | |
|-----------------------------|---|---|--|--|--|--|--|--|
| Column | Туре | Modifiers | | | | | | |
| id | integer | <pre>not null default nextval('people_id_seq'::regclass) </pre> | | | | | | |
| name address phone_no | , character varying(50) character varying(200) character varying | not null | | | | | | |
| Indexes: "people_p | key" primary key, btree (| id) | | | | | | |
| | | | | | | | | |

| id | name | address | phone_no |
|--------|-------------------------------|---|------------------------------|
| 1 2 | Tim Sutton Horst Duester | 3 Buirski Plein, Swellendam 4 Avenue du Roix, Geneva | 071 123 123 072 121 122 |
| (2 | rows) | | |

Imaginați-vă că aveți mulți prieteni cu același nume de stradă sau oraș. Fiecare dintre aceste date sunt duplicate, consumă spațiu. Mai rău, dacă un nume de oraș se schimbă, trebuie să depuneți mult efort pentru a actualiza baza de date.

15.1.9 ???? Try Yourself:

Reproiectați tabela people de mai sus pentru a reduce duplicarea și pentru a normaliza structura de date.

You can read more about database normalisation here

Răspuns

The major problem with the *people* table is that there is a single address field which contains a person's entire address. Thinking about our theoretical *address* table earlier in this lesson, we know that an address is made up of many different properties. By storing all these properties in one field, we make it much harder to update and query our data. We therefore need to split the address field into the various properties. This would give us a table which has the following structure:

| id | name | house | _no | street_name | | city | | phone_no | |
|----|---------------|-------|-----|---------------|----|------------|----|-------------|--|
| | | + | +- | | +- | | +- | | |
| 1 | Tim Sutton | 3 | | Buirski Plein | | Swellendam | | 071 123 123 | |
| 2 | Horst Duester | 4 | | Avenue du Roi | < | Geneva | | 072 121 122 | |

In the next section, you will learn about Foreign Key relationships which could be used in this example to further improve our database's structure.

15.1.10 Indecși

Un index în baza de date este o structură de date care îmbunătățește viteza operațiilor de extragere de date dintr-o tabelă a bazei de date. - *Wikipedia*

Imagine you are reading a textbook and looking for the explanation of a concept - and the textbook has no index! You will have to start reading at one cover and work your way through the entire book until you find the information you need. The index at the back of a book helps you to jump quickly to the page with the relevant information:

create index person_name_idx on people (name);

Now searches on name will be faster:

| Table "public.people" | | | | | | | | | | |
|--------------------------------------|--|--|--|--|--|--|--|--|--|--|
| Column | Туре | Modifiers | | | | | | | | |
| id | integer | <pre>/ not null default / nextval('people_id_seq'::regclass) /</pre> | | | | | | | | |
| name address phone_no | character varying(50) character varying(200) character varying | not null | | | | | | | | |
| Indexes: "people_pk "person_na | ey" PRIMARY KEY, btree (me_idx" btree (name) | id) | | | | | | | | |

15.1.11 Secvențe

O secvență este un generator de numere unice. Este utilizat în mod normal pentru a creea un identificator unic pentru o coloană a unei tabele.

In this example, id is a sequence - the number is incremented each time a record is added to the table:

15.1.12 Diagrama Relațiilor dintre Entități

Într-o bază de date normalizată, există în mod uzual multe relații (tabele). Diagrama relațiilor între entități (Diagrama ER) este utilizată pentru stabilirea dependențelor logice între relații. Să examinăm tabela noastră nenormalizată *people*, utilizată anterior în cadrul lecției:

With a little work we can split it into two tables, removing the need to repeat the street name for individuals who live in the same street:

```
select * from streets;
id | name
```

(continues on next page)

(continuare din pagina precedentă)

```
1 | Plein Street
(1 row)
```

și:



Putem apoi lega cele două tabele utilizând «keys» streets.id și people.streets_id.

Dacă desenăm o Diagramă ER pentru aceste două tabele ar arăta cam așa:



Diagrama ER ne ajută să exprimăm relații «unul la mulți». În acest caz simbolul săgeată spune că pe o stradă pot locui mai mulți oameni.

??? Try Yourself:

Modelul nostru *people* are încă niște probleme de normalizare - încercați să îl normalizați în continuare și ilustrați-vă ideile printr-o Diagramă ER.

Răspuns

Our *people* table currently looks like this:

The *street_id* column represents a «one to many» relationship between the people object and the related street object, which is in the *streets* table.

One way to further normalise the table is to split the name field into *first_name* and *last_name*:

| id first_name | 1 | ast_name | | house_no | | street_id | | phone_r | 10 |
|-----------------|---|----------|--|----------|--|-----------|--|---------|-----|
| 1 Horst | | Duster | | 4 | | 1 | | 072 121 | 122 |

We can also create separate tables for the town or city name and country, linking them to our *people* table via «one to many» relationships:

| id f | irst_name | - | last_name | 1 | house_no | 1 | street_id | 1 | town_id | 1 | country_id | |
|--------|-----------|---|-----------|---|----------|---|-----------|----|---------|----|------------|--|
| 1 | Horst | | Duster | | 4 | | 1 | +- | 2 | +- | 1 | |

An ER Diagram to represent this would look like this:



15.1.13 Constrângeri, Chei Primare și Chei Externe

O constrîngere într-o bază de date este utilizată pentru a garanta că o relație se potrivește cu viziunea celui care a modelat baza de date despre cum ar trebui stocate datele. De exemplu o constrângere pentru codul poștal ar putea garanta că numărul trebuie să se afle între 1000 și 9999.

O cheie Primară este compusă din unul sau mai multe câmpuri care fac o înregistrare unică. În mod uzual cheia primară se numește id și este o secvență.

O cheie Externă este utilizată pentru a face legătura unei înregistrări cu o altă tabelă (folosind cheia primară a acelui tabel).

În Diagramele ER, legăturile dintre tabele sunt în mod normal bazate pe chei Externe legate de chei Primare.

If we look at our people example, the table definition shows that the street column is a foreign key that references the primary key on the streets table:

| Table "publi | lc.people" | | | | | | | | |
|---|--------------------------|------------------------|--|--|--|--|--|--|--|
| Column | Туре | Modi | liers | | | | | | |
| id | integer | not n nextva | <pre>ill default il('people_id_seq'::regclass)</pre> | | | | | | |
| name | character varying(50) | | | | | | | | |
| house_no | integer | not n | 11 | | | | | | |
| street_id | integer | not n | 11 | | | | | | |
| phone_no | character varying | | | | | | | | |
| Indexes: | | | | | | | | | |
| "people_pkey" PRIMARY KEY , btree (id) | | | | | | | | | |
| Foreign-key constraints: | | | | | | | | | |
| "people_stre | eet_id_fkey" FOREIGN KEY | (stree | id) REFERENCES streets(id) | | | | | | |

15.1.14 Tranzacții

La adăugarea, modificarea sau ștergerea datelor într-o bază de date, este important ca de fiecare dată baza de dată să rămână într-o stare bună în cazul în care ceva nu merge bine. Cele mai multe baze de date pun la dispoziție o facilitate numită tranzacție. Tranzacțiile permit crearea unui moment de revenire la care vă puteți întoarce dacă modificările bazei de date nu au funcționat conform planului.

Să considerăm un scenariu în care aveți un sistem contabil. Trebuie să transferați fonduri dintr-un cont și să le adăugați în altul. Secvența de pași ar fi:

- eliminați R20 din Joe
- adăugați R20 la Anne

Dacă ceva nu merge bine în cadrul procesului (ex. pană de curent), tranzacția va reveni.

15.1.15 În concluzie

Bazele de date permit administrarea datelor într-un mod structurat utilizând structuri de cod simple.

15.1.16 Ce urmează?

Acum că am văzut cum funcționează teoretic bazele de date, să creăm o bază de date nouă pentru a implementa partea teoretică prezentată.

15.2 Lesson: Implementing the Data Model

Acum, că am acoperit toată teoria, haideți să creăm o bază de date nouă. Această bază de date va fi utilizată în exercițiile noastre din lecțiile care vor urma.

Scopul acestei lecții: De a instala soft-ul necesar și de a-l utiliza la implementarea bazei de date exemplu.

15.2.1 Instalare PostgreSQL

Notă: You can find PostgreSQL packages and installation instructions for your operating system at https://www.postgresql.org/download/. Please note that the documentation will assume users are running QGIS under Ubuntu.

Pe Ubuntu:

sudo apt install postgresql-9.1

Veți obține un mesaj de genul ăsta:

```
[sudo] password for qgis:
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following extra packages will be installed:
postgresql-client-9.1 postgresql-client-common postgresql-common
Suggested packages:
oidentd ident-server postgresql-doc-9.1
The following NEW packages will be installed:
postgresql-9.1 postgresql-client-9.1 postgresql-client-common postgresql-common
0 upgraded, 4 newly installed, 0 to remove and 5 not upgraded.
```

(continues on next page)

(continuare din pagina precedentă)

```
Need to get 5,012kB of archives. After this operation, 19.0MB of additional disk space will be used. Do you want to continue [Y/n]?
```

Apăsați Y și Enter apoi așteptați ca descărcarea și instalarea să se încheie.

15.2.2 Ajutor

PostgreSQL has very good online documentation.

15.2.3 Crearea unui utilizator pentru baza de date

Pe Ubuntu:

After the installation is complete, run this command to become the postgres user and then create a new database user:

sudo su - postgres

Introduceți parola când vi se solicită (aveți nevoie de drepturi sudo).

Now, at the postgres user's bash prompt, create the database user. Make sure the user name matches your unix login name: it will make your life much easier, as postgres will automatically authenticate you when you are logged in as that user:

createuser -d -E -i -l -P -r -s qgis

Introduceți o parolă când vi se solicită. Ar trebui să utilizați o parolă diferită pentru parola contului dumneavoastră.

Ce reprezintă aceste opțiuni?

```
-d, --createdbrole can create new databases-E, --encryptedencrypt stored password-i, --inheritrole inherits privileges of roles it is a member of (default)-1, --loginrole can login (default)-P, --pwpromptassign a password to new role-r, --createrolerole can create new roles-s, --superuserrole will be superuser
```

Now you should leave the postgres user's bash shell environment by typing:

exit

15.2.4 Verificați noul cont

psql -l

Ar trebui să returneze ceva de genul următor:

Type Q to exit.

15.2.5 Crearea unei baze de date

The createdb command is used to create a new database. It should be run from the bash shell prompt:

createdb address -O qgis

You can verify the existence of your new database by using this command:

psql -l

Which should return something like this:

```
| en_ZA.utf8 | en_ZA.utf8 |
| en_ZA.utf8 | en_ZA.utf8 |
| en_ZA.utf8 | en_ZA utf8 |
Name
             Owner
                     | Encoding | Collation | Ctype
                                                                  Access privileges
                                                            address
          | qgis
                     UTF8
postgres | postgres | UTF8
template0 | postgres | UTF8
                                 | en_ZA.utf8 | en_ZA.utf8 | =c/postgres:
→postgres=CTc/postgres
template1 | postgres | UTF8
                                 | en_ZA.utf8 | en_ZA.utf8 | =c/postgres:_
→postgres=CTc/postgres
(4 rows)
```

Type Q to exit.

15.2.6 Pornirea unei sesiuni către baza de date, din linia de comandă

Vă puteți conecta ușor la baza de date, procedând astfel:

psql address

Pentru a ieși din mediul bazei de date psql, tastați:

/d

Pentru ajutor în utilizarea liniei de comandă, tastați:

\?

Pentru ajutor în utilizarea comenzii SQL, tastați:

\help

Pentru a obține ajutor pentru o anumită comandă, tastați (de exemplu):

\help create table

See also the Psql cheat sheet.

15.2.7 Crearea Tabelelor SQL

Let's start making some tables! We will use our ER Diagram as a guide. First, connect to the address db:

psql address

Apoi creați o tabelă a străzilor:

create table streets (id serial not null primary key, name varchar(50));

serial și varchar sunt **tipuri de date**. serial îi spune lui PostgreSQL să pornească o secvență (generator automat) pentru completarea automată a id pentru fiecare înregistrare nouă. varchar(50) îi spune lui PostgreSQL să creeze un câmp de caractere de lungime 50.

Veți remarca faptul că comanda se termină cu ; - toate comenzile SQL trebuie terminate în acest fel. Când apăsați Enter, psql va raporta ceva de genul:

```
NOTICE: CREATE TABLE will create implicit sequence "streets_id_seq"
    for serial column "streets.id"
NOTICE: CREATE TABLE / PRIMARY KEY will create implicit index
    "streets_pkey" for table "streets"
CREATE TABLE
```

Asta înseamnă că tabelul a fost creeat cu succes, având cheia primară streets_pkey care folosește streets. id.

Notă: Dacă apăsați enter fără a introduce ;, veți obține un prompt de tipul: address-#. Aceasta deoarece PG așteaptă să mai introduceți ceva. Introduceți ; pentru a executa comanda.

To view your table schema, you can do this:

\d streets

Which should show something like this:

| Table "p Column | ublic.streets" Type | Modifiers | | | | | | |
|--------------------|----------------------------------|---|--|--|--|--|--|--|
| id | integer | <pre>/ not null default / nextval('streets_id_seq'::regclass)</pre> | | | | | | |
| name | character varying(50) | 1 | | | | | | |
| Indexes: | | | | | | | | |
| "stree | ts_pkey" PRIMARY KEY, bt: | ree (id) | | | | | | |

To view your table contents, you can do this:

select * from streets;

Which should show something like this:

```
id | name
---+----
(0 rows)
```

După cum puteți vedea, tabela noastră este vidă, în mod curent.

Try Yourself: ???

Folosiți abordarea de mai sus pentru a crea un tabel denumit people:

Adăugați câmpuri ca număr de telefon, adresă de acasă, nume etc. (acestea nu sunt toate nume valide: schimbați-le pentru a deveni valide). Asigurați-vă că îi adăugați tabelului o coloană ID cu același tip de date ca și mai sus.

Răspuns

The SQL required to create the correct people table is:

The schema for the table (enter δ people) looks like this:

| Table "public.people" | | | | | | | | | |
|-----------------------|--------------------------|--|--|--|--|--|--|--|--|
| Column | Туре | Modifiers | | | | | | | |
| id | integer | <pre>not null default nextval('people_id_seq'::regclass)</pre> | | | | | | | |
| name | character varying(50) | | | | | | | | |
| house_no | integer | not null | | | | | | | |
| street_id | integer | not null | | | | | | | |
| phone_no | character varying | | | | | | | | |
| Indexes: | | | | | | | | | |
| "people_p | okey" PRIMARY KEY, btree | (id) | | | | | | | |

For illustration purposes, we have purposely omitted the fkey constraint.

15.2.8 Crearea Cheilor în SQL

Problema cu soluția noastră de mai sus este că baza de date nu știe că oamenii și străzile au o relație logică. Pentru a exprima această relație va trebui să definim o cheie externă care face legătura cu cheia primară a tabelului de străzi.



Sunt două moduri de a face asta:

- Adăugați cheia după crearea tabelului
- Definiți cheia la momentul creării tabelului

Our table has already been created, so let's do it the first way:

```
alter table people
add constraint people_streets_fk foreign key (street_id) references streets(id);
```

Asta spune tabelului people că valoarea câmpurilor street_id trebuie să fie o valoare validă id din tabelul streets.

The more usual way to create a constraint is to do it when you create the table:

```
create table people (id serial not null primary key,
    name varchar(50),
    house_no int not null,
    street_id int references streets(id) not null,
    phone_no varchar null);
```

\d people

After adding the constraint, our table schema looks like this now:

| Table "public.people" | | | | | | | | | |
|-----------------------|---------|--|--|--|--|--|--|--|--|
| Column | Туре | Modifiers | | | | | | | |
| id | integer | <pre>not null default nextval('people_id_seq'::regclass)</pre> | | | | | | | |

(continuare din pagina precedentă)

```
name | character varying(50) |
house_no | integer | not null
street_id | integer | not null
phone_no | character varying |
Indexes:
  "people_pkey" PRIMARY KEY, btree (id)
Foreign-key constraints:
  "people_streets_fk" FOREIGN KEY (id) REFERENCES streets(id)
```

15.2.9 Crearea de indecși în SQL

We want lightning fast searches on peoples names. To provide for this, we can create an index on the name column of our people table:

```
create index people_name_idx on people(name);
\d people
```

Which results in:

```
Table "public.people"
 Column
                    Туре
                                  Modifiers
      | integer
                                  | not null default nextval
id
                                     ('people_id_seq'::regclass)
name | character varying(50) |
house_no | integer |
                     not null
street_id | integer
                                  | not null
phone_no | character varying
Indexes:
 "people_pkey" PRIMARY KEY, btree (id)
"people_name_idx" btree (name) <-- new index added!
Foreign-key constraints:
 "people_streets_fk" FOREIGN KEY (id) REFERENCES streets(id)
```

15.2.10 Ștergerea Tabelelor în SQL

If you want to get rid of a table you can use the drop command:

drop table streets;

In our current example, the above command would not work. Why not?

Răspuns

The reason the DROP command would not work in this case is because the *people* table has a Foreign Key constraint to the *streets* table. This means that dropping (or deleting) the *streets* table would leave the *people* table with references to non-existent *streets* data.

It is possible to «force» the *streets* table to be deleted by using the CASCADE command, but this would also delete the *people* and any other table which had a relationship to the *streets* table. Use with caution!

If you used the same drop table command on the *people* table, it would be successful:

drop table people;

Notă: Dacă ați introdus acea comandă și ați șters tabelul people, ar fi un moment bun să îl refaceți, deoarece îl veți folosi în exercițiile următoare.

15.2.11 Câteva cuvinte despre pgAdmin III

Prezentăm comenzile SQL de la promptul *psql* pentru că este un mod foarte util de a învăța despre bazele de date. Cu toate acestea, există metode mai rapide și mai ușoare de a face ce am prezentat. Instalați pgAdmin III și veți putea crea, șterge, modifica etc. tabele utilizănd operații «point and click» într-un GUI.

Under Ubuntu, you can install it like this:

```
sudo apt install pgadmin3
```

pgAdmin III va fi acoperit mai detaliat în alt modul.

15.2.12 În concluzie

Ați văzut cum să creați o bază de date complet nouă, pornind de la zero.

15.2.13 Ce urmează?

În continuare veți învăța cum să folosiți DBMS-ul pentru adăguarea datelor.

15.3 Lesson: Adding Data to the Model

Modelele pe care le-am creat vor trebui să fie populate de acum cu datele pe care trebuie să le conțină.

Scopul acestei lecții: De a afla cum se pot insera noi date în baza de date a modelelor.

15.3.1 Inserarea instrucțiunilor

Cum adăugați date într-o tabelă? Instrucțiunea SQL INSERT oferă funcționalitatea necesară:

insert into streets (name) values ('High street');

Mai multe lucruri de reținut:

- După numele tabelului (streets), veți lista numele coloanelor pe care le veți popula (în acest caz, doar coloana name).
- După cuvântul cheie values, plasați lista valorilor de câmp.
- Șirurile de caractere ar trebui să fie citate cu ajutorul ghilimelelor simple.
- Rețineți că nu vom introduce o valoare pentru coloana id; acest lucru se datorează faptului că este o secvență, ea fiind generată în mod automat.
- Dacă setați manual id-ul, pot apărea probleme grave cu integritatea bazei de date.

Ar trebui să vedeți INSERT 0 1 dacă a avut succes.

Puteți vedea rezultatul acțiunii dvs. de inserare selectând toate datele din tabelă:

select * from streets;

Rezultat:

Try Yourself: ???

Folosiți comanda INSERT pentru a adăuga o nouă stradă în tabelul streets.

Răspuns

Comanda SQL pe care ar trebui să o utilizați arată astfel (puteți înlocui numele străzii cu un nume la alegere):

```
insert into streets (name) values ('Low Road');
```

15.3.2 Secvențierea Adăugării Datelor, Conform Constrângerilor

15.3.3 Try Yourself: ???

Încercați să adăugați un obiect persoană în tabela people cu următoarele detalii:

```
Name: Joe Smith
House Number: 55
Street: Main Street
Phone: 072 882 33 21
```

Notă: Reamintim că, în acest exemplu, am definit numerele de telefon ca șiruri de caractere, și nu ca numere întregi.

În acest moment, ar trebui să întâmpinați un raport de eroare, dacă încercați să faceți acest lucru fără a crea mai întâi o înregistrare pentru Main Street din tabela streets.

Ar trebui să rețneți, de asemenea, că:

- Nu puteți adăuga strada folosind-ui numele
- Nu puteți adăuga o stradă folosind un id, fără a crea mai întâi o înregistrare a străzii în tabela străzilor

Amintiți-vă că cele două tabele sunt legate printr-o pereche de chei: primară/externă. Aceasta înseamnă că nici o persoană validă nu pot fi creată fără a exista, de asemenea, o înregistrare de stradă validă, corespunzătoare.

Folosind cunoștințele de mai sus, adăugați noua persoană în baza de date.

Răspuns

Iată instrucțiunea SQL corectă:

```
insert into streets (name) values('Main Road');
insert into people (name,house_no, street_id, phone_no)
values ('Joe Smith',55,2,'072 882 33 21');
```

Dacă vă uitați din nou la tabela străzilor (folosind o instrucțiune select ca cea de dinainte), veți vedea că *id-ul* intrării Drum principal este 2.

De aceea am putea introduce pur și simplu numărul 2 mai sus. Chiar dacă nu vedem Main Road scris complet în intrarea de mai sus, baza de date va putea să-l asocieze cu valoarea *street_id* de 2.

Dacă ați adăugat deja un nou obiect stradal, s-ar putea să descoperiți că noul Drum Principal are un *id* de 3 nu de 2.

15.3.4 Selectarea datelor

V-am arătat deja sintaxa pentru selectarea înregistrărilor. Să ne uităm la câteva exemple suplimentare:

```
select name from streets;
select * from streets;
select * from streets where name='Main Road';
```

În sesiunile ulterioare vom intra în mai multe detalii cu privire la modul de selectare și de filtrare a datelor.

15.3.5 Actualizarea datelor

Ce se întâmplă dacă doriți să faceți o modificare a unor date existente? De exemplu, un nume de stradă este schimbat:

update streets set name='New Main Road' where name='Main Road';

Fiți foarte atenți la folosirea acestor declarații de actualizare - în cazul în care mai mult de o înregistrare se potrivește clauzei WHERE, toate vor fi actualizate!

O soluție mai bună este de a folosi cheia primară a tabelului, pentru a referenția înregistrarea care trebuie schimbată:

update streets set name='New Main Road' where id=2;

Ar trebui să returneze UPDATE 1.

Notă: Criteriile instrucțiunii WHERE sunt sensibile la majuscule, astfel Main Road nu este similar cu Main road

15.3.6 Ştergere Dată

Pentru a șterge un obiect dintr-o tabelă, utilizați comanda DELETE:

delete from people where name = 'Joe Smith';

Să ne uităm acum la tabela noastră de personal:

15.3.7 Try Yourself: ????

| name | | house_no | | street_id | | pl | none_ | _no | |
|--------------|---|----------|---|-----------|--|-----|-------|-----|----|
| Joe Bloggs | 1 | 3 | | 2 | | 072 | 887 | 23 | 45 |
| Jane Smith | | 55 | 1 | 3 | | 072 | 837 | 33 | 35 |
| Roger Jones | | 33 | 1 | 1 | | 072 | 832 | 31 | 38 |
| Sally Norman | | 83 | | 1 | | 072 | 932 | 31 | 32 |

Folosiți abilitățile pe care le-ați învățat pentru a adăuga câțiva prieteni noi în baza de date:

15.3.8 În concluzie

Acum știți cum să adăugați date noi modelelor existente, pe care le-ați creat anterior. Amintiți-vă că, dacă doriți să adăugați noi tipuri de date, poate doriți să modificați și/sau să creați noi modele, care să conțină aceste date.

15.3.9 Ce urmează?

Acum, că ați adăugat câteva date, veți învăța cum să folosiți interogările, pentru a accesa aceste date în diferite moduri.

15.4 Lesson: Queries

Când scrieți o comandă SELECT ... interogați baza de date pentru informații.

Scopul acestei lecții: De a afla cum să creați interogări, care vor returna informații utile.

Notă: Dacă nu ați făcut asta în lecția precedentă, adăugați următoarele obiecte persoană în tabela people. Dacă primiți erori legate de constrângerile de cheie externă, va trebui să adăugați mai întâi obiectul «Main Road» în tabela de străzi.

```
insert into people (name,house_no, street_id, phone_no)
values ('Joe Bloggs',3,2,'072 887 23 45');
insert into people (name,house_no, street_id, phone_no)
values ('Jane Smith',55,3,'072 837 33 35');
insert into people (name,house_no, street_id, phone_no)
values ('Roger Jones',33,1,'072 832 31 38');
insert into people (name,house_no, street_id, phone_no)
values ('Sally Norman',83,1,'072 932 31 32');
```

15.4.1 Ordonarea Rezultatelor

Haideți să obținem o listă de persoane ordonate după numerele caselor lor:

select name, house_no from people order by house_no;

Rezultat:

| name | 1 | house_no |
|-------------|-----|----------|
| | + - | |
| Joe Bloggs | | 3 |
| Roger Jones | | 33 |
| Jane Smith | | 55 |

(continues on next page)

(continuare din pagina precedentă)

Sally Norman | 83 (4 rows)

Puteți sorta rezultatele după valorile a mai mult de o coloană:

```
select name, house_no from people order by name, house_no;
```

Rezultat:

```
name | house_no
Jane Smith | 55
Joe Bloggs | 3
Roger Jones | 33
Sally Norman | 83
(4 rows)
```

15.4.2 Filtrare

Foarte des nu veți vedea fiecare înregistrare din baza de date - în mod special există mii de înregistrări și sunteți interesat doar de una sau două.

Iată un exemplu de filtru numeric care întoarce doar obiecte ale cărui house_no este mai mic de 50:

Puteți combina filtre (definite utilizănd clauza WHERE) cu sortare (definită folosind clauza ORDER BY):

Puteți filtra, de asemenea, pe baza datelor de text:

```
select name, house_no from people where name like '%s%';
    name | house_no
    Joe Bloggs | 3
    Roger Jones | 33
    (2 rows)
```

Am folosit clauza LIKE pentru a găsi toate numele care conțin un s. De remarcat că această interogare ține cont de capitalizare, deci înregistrarea Sally Norman nu a fost întoarsă.

Dacă doriți să căutați un șir de caractere indiferent de capitalizare, puteți executa o căutare care nu ține cont de capitalizare folosind clauza ILIKE:

Acea interogare a returnat fiecare obiect people care conține un r sau un R în nume.

15.4.3 Îmbinări

Dar dacă doriți să vedeți detaliile persoanei și numele străzii în loc de ID-ul acesteia? Pentru a face asta, trebuie să legați cele două tabele într-o singură interogare. Să vedem un exemplu:

```
select people.name, house_no, streets.name
from people,streets
where people.street_id=streets.id;
```

Notă: Cu legături, veți spune întotdeauna din ce tabele se extrage informația, în aceest caz persoane și străzi. De asemenea va trebui să precizați care chei trebuie să corespundă (cheia externă și cheia primară). Dacă nu faceți această precizare, veți obține o listă cu toate combinațiile posibile de persoane și străzi, dar nu veți putea ști de fapt cine pe ce stradă locuiește!

Așa ar trebui să arate rezultatul SQL corect:

```
name | house_no | name

Joe Bloggs | 3 | Low Street

Roger Jones | 33 | High street

Sally Norman | 83 | High street

Jane Smith | 55 | Main Road

(4 rows)
```

Vom reveni la legături când vom creea interogări mai complexe în continuare. Pentru moment rețineți că permit o metodă simplă de a combina informații din două sau mai multe tabele.

15.4.4 Sub-Selectarea

Sub-selecțiile permit selectarea obiectelor dintr-un tabel, pe baza datelor dintr-un alt tabel de care este legat printr-o relație la cheia sa externă. În cazul nostru, dorim să găsim persoanele care locuiesc pe o anumită stradă.

În primul rând, să facem un pic de reglare a datelor noastre:

```
insert into streets (name) values('QGIS Road');
insert into streets (name) values('OGR Corner');
insert into streets (name) values('Goodle Square');
update people set street_id = 2 where id=2;
update people set street_id = 3 where id=3;
```

Haideți să aruncăm o privire rapidă la datele noastre în urma modificărilor: putem refolosi interogarea din secțiunea anterioară:

```
select people.name, house_no, streets.name
from people,streets
where people.street_id=streets.id;
```

Rezultat:

```
name | house_no | name

Roger Jones | 33 | High street

Sally Norman | 83 | High street

Jane Smith | 55 | Main Road

Joe Bloggs | 3 | Low Street

(4 rows)
```

Acum, vom efectua o sub-selecție asupra acestor date. Vrem să arătăm doar persoanele care locuiesc în street_id numărul 1:

```
select people.name
from people, (
    select *
    from streets
    where id=1
    ) as streets_subset
where people.street_id = streets_subset.id;
```

Rezultat:

```
name
Roger Jones
Sally Norman
(2 rows)
```

Deși acesta este un exemplu foarte simplu și inutil pentru seturile de date restrânse, el ilustrează utilitatea și importanța sub-selecțiilor în cazul interogărilor efectuate asupra seturilor de date mari și complexe.

15.4.5 Agregarea Îmbinărilor

Una dintre cele mai puternice caracteristici ale unei baze de date o reprezintă capacitatea sa de a sintetiza datele din tabelele pe care le conține. Aceste sinteze sunt denumite interogări agregate. Iată un exemplu tipic, care ne spune cât de multe obiecte de tipul om sunt în tabela de personal:

select count(*) from people;

Rezultat:

count _____4 (1 row)

Dacă dorim un rezumat după numele străzii, putem proceda astfel:

```
select count(name), street_id
from people
group by street_id;
```

Rezultat:

```
count | street_id
------
2 | 1
1 | 3
1 | 2
(3 rows)
```
Notă: Pentru că nu am folosit clauza ORDER BY, ordinea rezultatelor dvs. ar putea să nu se potrivească ce ceea ce este prezentat aici.

Try Yourself: ???

Rezumați persoanele după numele străzii și afișați numele reale ale străzilor în loc de street_ids.

Răspuns

Iată instrucțiunea SQL corectă pe care ar trebui să o utilizați:

```
select count(people.name), streets.name
from people, streets
where people.street_id=streets.id
group by streets.name;
```

Rezultat:

Veți observa că avem nume de câmpuri prefixate cu nume de tabel (de exemplu, persoane.nume și străzi.nume). Acest lucru trebuie făcut ori de câte ori numele câmpului este ambiguu (adică nu este unic în toate tabelele din baza de date).

15.4.6 În concluzie

Ați văzut cum se utilizează interogările pentru a returna datele din baza de date într-un mod care permite extragerea de informații utile.

15.4.7 Ce urmează?

Mai departe veți vedea cum să creați vizualizări, pornind de la interogările scrise.

15.5 Lesson: Views

De fiecare dată când scrieți o interogare, cheltuiți o mulțime de timp și efort pentru a o formula. Cu ajutorul vederilor, puteți salva definiția unei interogări SQL într-o «tabelă virtuală» reutilizabilă.

Scopul acestei lecții: Salvarea unei interogări sub formă de vedere.

15.5.1 Crearea unei Vederi

Puteți trata o vedere la fel ca pe o tabelă, însă datele sale provin dintr-o interogare. Haideți să efectuăm o vedere simplă, bazată pe cele de mai înainte:

```
create view roads_count_v as
  select count(people.name), streets.name
  from people, streets where people.street_id=streets.id
  group by people.street_id, streets.name;
```

După cum se poate vedea, singura schimbare este crearea vederii roads_count_v ca parte a începutului. Acum, putem selecta datele din această vedere:

```
select * from roads_count_v;
```

Rezultat:

15.5.2 Modificarea unei Vederi

O vizualizare nu este fixă și nu conține "date reale". Aceasta înseamnă că o puteți modifica cu ușurință, fără a afecta vreo dată din baza de date:

```
CREATE OR REPLACE VIEW roads_count_v AS
SELECT count(people.name), streets.name
FROM people, streets WHERE people.street_id=streets.id
GROUP BY people.street_id, streets.name
ORDER BY streets.name;
```

(Acest exemplu demonstrează, de asemenea, că cea mai bună practică este de a folosi MAJUSCULE pentru toate cuvintele cheie SQL.)

Veți vedea că s-a adăugat o clauză ORDER BY, astfel încât rândurile vederii să fie bine sortate:

15.5.3 Eliminarea unei Vederi

Dacă nu mai aveți nevoie de vedere, o puteți șterge astfel:

drop view roads_count_v;

15.5.4 În concluzie

Vederile constau în salvarea unei interogări, urmată de accesarea rezultatelor acesteia ca și cum ar fi o tabelă.

15.5.5 Ce urmează?

Uneori, atunci când are loc o schimbare asupra datelor, veți dori ca modificările să aibă efecte în altă parte a bazei de date. Următoarea lecție vă arată cum să faceți acest lucru.

15.6 Lesson: Rules

Regulile permit "arborelui de interogare" rescrierea interogărilor primite. O utilizare comună o reprezintă implementarea vederilor, inclusiv a celor actualizabile. - *Wikipedia*

Scopul acestei lecții: De a afla cum se pot crea noi reguli pentru baza de date.

15.6.1 Crearea unei reguli de jurnalizare

Presupunem că doriți să înregistrați fiecare schimbare de număr_de_telefon în tabelul jurnalul_personalului. Astfel, veți configura un tabel nou:

create table people_log (name text, time timestamp default NOW());

În etapa următoare, creați o regulă care înregistrează fiecare schimbare de număr_de_telefon în tabelul jurnalul_personalului:

```
create rule people_log as on update to people
where NEW.phone_no <> OLD.phone_no
do insert into people_log values (OLD.name);
```

Pentru a testa funcționarea regulii, haideți să modificăm un număr de telefon:

update people set phone_no = '082 555 1234' where id = 2;

Asigurați-vă că tabela people a fost actualizată corect:

Acum, datorită regulii pe care am creat-o, tabelul people_log va arăta astfel:

Notă: Valoarea câmpului time va depinde de data și ora curente.

15.6.2 În concluzie

Regulile vă permit adăugarea sau modificarea automată a datelor din baza de date, pentru a reflecta modificările din alte părți ale bazei de date.

15.6.3 Ce urmează?

Modulul următor vă va introduce în Baza Datelor Spațiale, cu ajutorul PostGIS, care preia conceptele bazelor de date și le aplică datelor GIS.

CAPITOLUL 16

Module: Spatial Database Concepts with PostGIS

Bazele de date spațiale permit stocarea geometriilor înregistrărilor în interiorul unei baze de date și, de asemenea, furnizează funcții pentru interogarea și preluarea înregistrărilor folosind aceste Geometrii. În acest modul vom folosi PostGIS, o extensie a PostgreSQL, pentru a învăța configurarea unei baze de date spațiale, importarea datelor și folosirea funcțiilor geografice oferite de PostGIS.

While working through this section, you may want to keep a copy of the **PostGIS cheat sheet** available from Boston GIS user group. Another useful resource is the online PostGIS documentation.

There are also some more extensive tutorials on PostGIS and Spatial Databases created by Boundless that are now hosted on the PostGIS's website:

- Introduction to PostGIS
- PostGIS Database Tips and Tricks

Citiți, de asemenea, PostGIS In Action.

16.1 Lesson: PostGIS Setup

Instalând funcțiile PostGIS vom putea accesa funcțiile spațiale din interiorul PostgreSQL.

Scopul acestei lecții: De a instala funcțiile spațiale, și pentru scurte demonstrații a aplicării lor.

Notă: We will assume the use of PostGIS version 2.1 or newer in this exercise. The installation and database configuration are different for older versions, but the rest of this material in this module will still work. Consult the documentation for your platform for help with installation and database configuration.

16.1.1 Instalarea sub Ubuntu

PostGIS este ușor de instalat din apt.

```
$ sudo apt install postgresql
$ sudo apt install postgis
```

Într-adevăr, este atât de ușor ...

Notă: The exact versions that will be installed depend on which version of Ubuntu you are using and which repositories you have configured. After installing you can check the version by issuing a select PostGIS_full_version(); query with psql or another tool.

To install a specific version (eg, PostgreSQL version 13 and PostGIS 3), you can use the following commands.

16.1.2 Instalare sub Windows

Installing on Windows can be done from binary packages using a normal Windows installation dialogs.

First Visit the download page. Then follow this guide.

More information about installing on Windows can be found on the PostGIS website.

16.1.3 Instalarea pe Alte Platforme

The PostGIS website download has information about installing on other platforms including macOS and on other Linux distributions

16.1.4 Configurarea Bazei de Date pentru a utiliza PostGIS

După ce PostGIS este instalat, va trebui să configurați baza de date pentru a utiliza extensiile. Dacă ați instalat versiunea PostGIS > 2.0, aceasta este la fel de simplu ca și execuția următoarei comenzi în psql, folosind baza de date de adrese din exercițiul nostru anterior.

\$ psql -d address -c "CREATE EXTENSION postgis;"

Notă: Depending on your version, you could find more instructions on how to spatially enable a database at https://postgis.net/docs/postgis_administration.html#create_spatial_db.

16.1.5 Funcțiile PostGIS instalate

PostGIS poate fi considerat ca o colecție de funcții din baza de date, care extind capabilitățile de bază ale PostgreSQL, astfel încât să poatădatelor spațiale. Prin «a face față», înțelegem stocarea, preluarea, interogarea și manipularea. Pentru a face acest lucru, sunt instalate o serie de funcții în baza de date.

Our PostgreSQL address database is now geospatially enabled, thanks to PostGIS. We are going to delve a lot deeper into this in the coming sections, but let's give you a quick little taster. Let's say we want to create a point from text. First we use the psql command to find functions relating to point. If you are not already connected to the address database, do so now. Then run:

```
\df *point*
```

This is the command we're looking for: st_pointfromtext. To page through the list, use the down arrow, then press Q to quit back to the psql shell.

Try running this command:

select st_pointfromtext('POINT(1 1)');

Rezultat:

Trei lucruri de reținut:

- Am definit un punct la poziția 1,1 (EPSG:4326 se presupune), folosind POINT (1 1),
- Am rulat o instrucțiune SQL, dar nu pe orice tabelă, doar pe datele introduse din promptul SQL,
- Rândul rezultat nu prea are sens.

Rândul rezultat se află în formatul OGC denumit «Well Known Binary» (WKB). Vom analiza în detaliu acest format în secțiunea următoare.

To get the results back as text, we can do a quick scan through the function list for something that returns text:

```
\df *text
```

The query we're looking for now is st_astext. Let's combine it with the previous query:

```
select st_astext(st_pointfromtext('POINT(1 1)'));
```

Rezultat:

```
st_astext
POINT(1 1)
(1 row)
```

Aici, am intrat în șirul POINT(1,1), transformându-l într-un punct folosind st_pointfromtext(), și aducându-l înapoi într-o formă ușor de înțeles de către utilizator cu st_astext(), care returează șirul de caractere inițial.

One last example before we really get into the detail of using PostGIS:

select st_astext(st_buffer(st_pointfromtext('POINT(1 1)'),1.0));

Care este rezultatul acestuia? S-a creat un tampon de 1 grad în jurul punctului nostru, și s-a returnat un rezultat sub formă de text.

16.1.6 Sistemele de Referință Spațială

În plus față de funcțiile PostGIS, extensia conține o colecție cu definiții ale sistemelor de referință spațială (SRS), așa cum au fost stabilite de către European Petroleum Survey Group (EPSG). Acestea sunt utilizate pentru operațiuni de conversie a sistemelor de referință și coordonate (CRS).

Putem inspecta aceste definiții SRS din baza noastră de date, pe măsură ce acestea sunt stocate în tabelele normale ale bazei de date.

First, let's look at the schema of the table by entering the following command in the psql prompt:

```
\d spatial_ref_sys
```

The result should be this:

```
Table "public.spatial_ref_sys"
Column | Type | Modifiers
srid | integer | not null
auth_name | character varying(256) |
auth_srid | integer |
srtext | character varying(2048) |
proj4text | character varying(2048) |
Indexes:
"spatial_ref_sys_pkey" PRIMARY KEY, btree (srid)
```

Puteți utiliza interogări SQL standard (așa cum am învățat din secțiunile introductive), pentru a vizualiza și manipula acest tabel - totuși, actualizarea sau ștergerea înregistrărilor nu reprezintă o idee bună dacă nu știți ce faceți.

One SRID you may be interested in is EPSG:4326 - the geographic / lat lon reference system using the WGS 84 ellipsoid. Let's take a look at it:

```
select * from spatial_ref_sys where srid=4326;
```

Rezultat:

```
srid | 4326
auth_name | EPSG
auth_srid | 4326
srtext | GEOGCS["WGS 84",DATUM["WGS_1984",SPHEROID["WGS
84",6378137,298.257223563,AUTHORITY["EPSG","7030"]],TOWGS84[0,
0,0,0,0,0,0],AUTHORITY["EPSG","6326"]],PRIMEM["Greenwich",0,
AUTHORITY["EPSG","8901"]],UNIT["degree",0.01745329251994328,
AUTHORITY["EPSG","9122"]],AUTHORITY["EPSG","4326"]]
proj4text | +proj=longlat +ellps=WGS84 +datum=WGS84 +no_defs
```

srtext reprezintă definiția proiecției în well known text (puteți recunoaște acest lucru din fișierele .prj din colecția dvs. de fișiere shape).

16.1.7 În concluzie

Acum aveți funcțiile PostGIS instalate în copia dvs. de PostgreSQL. Astfel, veți putea să faceți uz de funcțiile spațiale extinse ale PostGIS.

16.1.8 Ce urmează?

Mai departe, veți învăța cum se reprezintă entitățile spațiale într-o bază de date.

16.2 Lesson: Simple Feature Model

Cum putem să stocăm și să reprezentăm entitățile geografice într-o bază de date? În această lecție vom detalia una dintre abordări, Simple Feature Model, așa cum este definită de către OGC.

Scopul acestei lecții: De a afla ce este Modelul SFS și cum să-l folosiți.

16.2.1 Ce este OGC

Open Geospatial Consortium (OGC), o organizație internațională de voluntariat, dedicată stabilirii unor standarde, înființată în 1994. În OGC, mai mult de 370+ organizații comerciale, guvernamentale, non-profit și de cercetare la nivel mondial, colaborează într-un proces consensual deschis, încurajând dezvoltarea și implementarea standardelor pentru conținut și servicii geospațiale, prelucrarea și schimbul de date GIS. - *Wikipedia*

16.2.2 Ce este Modelul SFS

The Simple Feature for SQL (SFS) Model is a *non-topological* way to store geospatial data in a database and defines functions for accessing, operating, and constructing these data.



Modelul definește date geospațiale din tipurile Point, Linestring, și Polygon (și agregări ale acestora în obiecte Multi). For further information, have a look at the OGC Simple Feature for SQL standard.

16.2.3 Adăugați un câmp geometric la tabelă

Let's add a point field to our people table:

```
alter table people add column geom geometry;
```

16.2.4 Adăugați o constrângere bazată pe tipul geometriei

You will notice that the geometry field type does not implicitly specify what *type* of geometry for the field - for that we need a constraint:

```
alter table people
add constraint people_geom_point_chk
    check(st_geometrytype(geom) = 'ST_Point'::text
        OR geom IS NULL);
```

Aceasta adaugă o constrângere la tabelă, astfel încât ea va accepta doar o geometrie de tip punct sau o valoare nulă.

16.2.5 ???? Try Yourself:

Create a new table called cities and give it some appropriate columns, including a geometry field for storing polygons (the city boundaries). Make sure it has a constraint enforcing geometries to be polygons.

Răspuns

16.2.6 Popularea tabelei geometry_columns

At this point you should also add an entry into the geometry_columns table:

```
insert into geometry_columns values
  ('','public','people','geom',2,4326,'POINT');
```

Why? geometry_columns is used by certain applications to be aware of which tables in the database contain geometry data.

Notă: If the above INSERT statement causes an error, run this query first:

select * from geometry_columns;

If the column f_table_name contains the value people, then this table has already been registered and you don't need to do anything more.

The value 2 refers to the number of dimensions; in this case, two: X and Y.

The value 4326 refers to the projection we are using; in this case, WGS 84, which is referred to by the number 4326 (refer to the earlier discussion about the EPSG).

??? Try Yourself:

Adăugați o intrare geometry_columns adecvată pentru noul strat al orașelor

Răspuns

```
insert into geometry_columns values
    ('','public','cities','geom',2,4326,'POLYGON');
```

16.2.7 Adăugați o înregistare geometrică la tabelă, utilizând SQL

Now that our tables are geo-enabled, we can store geometries in them:

Notă: In the new entry above, you will need to specify which projection (SRID) you want to use. This is because you entered the geometry of the new point using a plain string of text, which does not automatically add the correct projection information. Obviously, the new point needs to use the same SRID as the data-set it is being added to, so you need to specify it.

If at this point you were using a graphical interface, for example, specifying the projection for each point would be automatic. In other words, you usually won't need to worry about using the correct projection for every point you want to add if you've already specified it for that data-set, as we did earlier.

Now is probably a good time to open QGIS and try to view your people table. Also, we should try editing / adding / deleting records and then performing select queries in the database to see how the data has changed.

Pentru a încărca un strat PostGIS în QGIS, utilizați opțiunea de meniu *Layer* ► *Add PostGIS Layers* sau butonul corespunzător din bara de instrumente:



Se va deschide acest dialog:

| Connections | Add PostGIS T | able(s) | | |
|--|---------------|-----------|--------------|-------|
| Connect New | Edit Delete | | Load | Save |
| Schema v Table | Column | Data Type | Spatial Type | SRID |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | _ | | |
| Also list tables with no Search options | o geometry | | | |
| Help Add | Set Filter | | | Close |

Clic pe butonul *New* pentru a deschide acest dialog:

| | 000 | Create a New PostGIS connection | | |
|----------|---|---------------------------------|-------|--|
| | Connection | n Information | | |
| 0.00 | Name | | | |
| Connecti | Service | | 1 | |
| | Host | | \$ | |
| Conr | Port | 5432 | Save | |
| | Database | |] | |
| Schema | SSL mode | disable \$ | SRID | |
| | Username | |] | |
| | Password | |] | |
| | Save Us | assword Test Connect | | |
| | Only lool | k in the layer registries | | |
| | Don't resolve type of unrestricted columns (GEOMETRY) | | | |
| | Only look in the 'public' schema | | | |
| Also lis | Also list | tables with no geometry | | |
| Help | Use esti | mated table metadata | Close | |
| | Help | Cancel OK | | |

Apoi definiți o nouă conexiune, de exemplu.:

| nme: myPG | |
|------------------|--|
| ervice: | |
| ost: localhost | |
| ort: 5432 | |
| atabase: address | |
| ser: | |
| assword: | |

To see whether QGIS has found the address database and that your username and password are correct, click *Test Connect*. If it works, check the boxes next to *Save Username* and *Save Password*. Then click *OK* to create this connection.

Înapoi în dialogul Add PostGIS Layers, faceți clic pe Connect, apoi adăugați straturile pentru proiectul dumneavoastră, ca de obicei.

??? Try Yourself:

Formulate a query that shows a person's name, street name and position (from the geom column) as plain text.

```
Răspuns
```

```
select people.name,
    streets.name as street_name,
    st_astext(people.geom) as geometry
from streets, people
where people.street_id=streets.id;
```

Rezultat:

```
name | street_name | geometry
Roger Jones | High street |
Sally Norman | High street |
Jane Smith | Main Road |
Joe Bloggs | Low Street |
Fault Towers | Main Road | POINT(33 -33)
(5 rows)
```

As you can see, our constraint allows nulls to be added into the database.

16.2.8 În concluzie

Ați văzut cum să adăugați obiecte spațiale în baza de date, și cum să le puteți viziona în aplicația GIS.

16.2.9 Ce urmează?

Mai departe, veți vedea cum se importă și se exportă datele în/din baza de date.

16.3 Lesson: Import and Export

Desigur, o bază de date care nu dispune de o modalitate de a migra facil datele. în interiorul și în afara ei, nu ar fi de mare folos. Din fericire, există o serie de instrumente care vă permit mutarea cu ușurință a datelor în interiorul și în afara PostGIS.

16.3.1 shp2pgsql

shp2pgsql is a commandline tool to import ESRI Shapefile to the database. Under Unix, you can use the following command for importing a new PostGIS table:

```
shp2pgsql -s <SRID> -c -D -I <path to shapefile> <schema>. | \
psql -d <databasename> -h <hostname> -U <username>
```

Sub Windows, procesul de import trebuie efectuat în două etape:

```
shp2pgsql -s <SRID> -c -D -I <path to shapefile> <schema>. > import.sql
psql psql -d <databasename> -h <hostname> -U <username> -f import.sql
```

Este posibil să întâlniți această eroare:

```
ERROR: operator class "gist_geometry_ops" does not exist for access method "gist"
```

This is a known issue regarding the creation *in situ* of a spatial index for the data you're importing. To avoid the error, exclude the -I parameter. This will mean that no spatial index is being created directly, and you'll need to create it in the database after the data have been imported. (The creation of a spatial index will be covered in the next lesson.)

16.3.2 pgsql2shp

pgsql2shp is a commandline tool to export PostGIS Tables, Views or SQL select queries. To do this under Unix:

```
pgsql2shp -f <path to new shapefile> -g <geometry column name> \
    -h <hostname> -U <username> <databasename>
```

Pentru a exporta datele folosiți o interogare:

```
pgsql2shp -f <path to new shapefile> -g <geometry column name> \
    -h <hostname> -U <username> "<query>"
```

16.3.3 ogr2ogr

ogr2ogr is a very powerful tool to convert data into and from postgis to many data formats. ogr2ogr is part of the GDAL library and has to be installed separately. To export a table from PostGIS to GML, you can use this command:

```
ogr2ogr -f GML export.gml PG:'dbname=<databasename> user=<username>
    host=<hostname>' <Name of PostGIS-Table>
```

16.3.4 DB Manager

You may have noticed another option in the *Database* menu labeled *DB Manager*. This is a tool that provides a unified interface for interacting with spatial databases including PostGIS. It also allows you to import and export from databases to other formats. Since the next module is largely devoted to using this tool, we will only briefly mention it here.

16.3.5 În concluzie

Importing and exporting data to and from the database can be done in many various ways. Especially when using disparate data sources, you will probably use these functions (or others like them) on a regular basis.

16.3.6 Ce urmează?

Apoi, vom vedea cum se interoghează datele pe care le-am creat mai înainte.

16.4 Lesson: Spatial Queries

Interogările spațiale nu sunt diferite de alte interogări de baze de date. Puteți utiliza coloana de geometrie la fel ca pe orice altă coloană de baze de date. O dată cu instalarea PostGIS în baza noastră de date, avem la dispoziție funcții suplimentare pentru a interoga baza de date.

Scopul acestei lecții: De a afla cum sunt implementate funcțiile spațiale similare cu funcțiile non-spațiale "normale".

16.4.1 Operatori Spaţiali

Când doriți să știți care puncte se află la o distanță de 2 grade față de un punct (X,Y), puteți proceda astfel cu:

```
select *
from people
where st_distance(geom,'SRID=4326;POINT(33 -34)') < 2;</pre>
```

Rezultat:

Notă: geom value above was truncated for space on this page. If you want to see the point in human-readable coordinates, try something similar to what you did in the section "View a point as WKT", above.

De unde știm că interogarea de mai sus returnează toate punctele incluse în cadrul a 2 grade? De ce nu 2 metri? Sau oricare altă unitate?

Răspuns

The units being used by the example query are degrees, because the CRS that the layer is using is WGS 84. This is a Geographic CRS, which means that its units are in degrees. A Projected CRS, like the UTM projections, is in meters.

Remember that when you write a query, you need to know which units the layer's CRS is in. This will allow you to write a query that will return the results that you expect.

16.4.2 Indecși Spațiali

We also can define spatial indexes. A spatial index makes your spatial queries much faster. To create a spatial index on the geometry column use:

```
CREATE INDEX people_geo_idx
   ON people
   USING gist
   (geom);
   \d people
```

Rezultat:

```
    Table "public.people"
    Modifiers

    Column |
    Type |
```

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(continuare din pagina precedentă)

```
not null default
 id
          | integer
                                  | nextval('people_id_seq'::regclass)
      | character varying(50) |
 name
 house_no | integer
                                 | not null
                                 | not null
 street_id | integer
 phone_no | character varying
         | geometry
 qeom
Indexes:
  "people_pkey" PRIMARY KEY, btree (id)
  "people_geo_idx" gist (geom) <-- new spatial key added
  "people_name_idx" btree (name)
Check constraints:
  "people_geom_point_chk" CHECK (st_geometrytype(geom) = 'ST_Point'::text
 OR geom IS NULL)
Foreign-key constraints:
  "people_street_id_fkey" FOREIGN KEY (street_id) REFERENCES streets(id)
```

16.4.3 Try Yourself: ????

Modificați tabelul orașelor, astfel încât coloana de geometrie să fie indexată spațial.

Răspuns

```
CREATE INDEX cities_geo_idx
  ON cities
  USING gist (geom);
```

16.4.4 Demo Funcții Spațiale PostGIS

În scopul demonstrării funcțiilor spațiale PostGIS, vom crea o nouă bază de date care conține câteva date (fictive).

To start, create a new database (exit the psql shell first):

createdb postgis_demo

Remember to install the postgis extensions:

psql -d postgis_demo -c "CREATE EXTENSION postgis;"

Next, import the data provided in the exercise_data/postgis/ directory. Refer back to the previous lesson for instructions, but remember that you'll need to create a new PostGIS connection to the new database. You can import from the terminal or via DB Manager. Import the files into the following database tables:

- points.shp în building
- lines.shp în road
- polygons.shp ${\bf \hat{n}}$ region

Încărcați aceste trei straturi ale bazei de date în QGIS ca de obicei, prin intermediul *Adăugării Straturilor PostGIS*. Atunci când deschideți tabelele lor cu atribute, veți observa că ambele dețin atât un câmp id cât și unul gid, create în urma importului PostGIS.

Acum, că tabelele sunt importate, putem folosi PostGIS pentru a interoga datele. Mergeți înapoi în ferestra terminalului (linia de comandă) și introduceți promptul psql astfel:

psql postgis_demo

Vom demonstra unele dintre aceste expresii de selectare prin crearea unor vederi, pentru a le deschide apoi în QGIS și pentru a le observa rezultatele.

Selectare după locație

Get all the buildings in the KwaZulu region:

```
SELECT a.id, a.name, st_astext(a.geom) as point
FROM building a, region b
WHERE st_within(a.geom, b.geom)
AND b.name = 'KwaZulu';
```

Rezultat:

```
id | name | point

30 | York | POINT(1622345.23785063 6940490.65844485)

33 | York | POINT(1622495.65620524 6940403.87862489)

35 | York | POINT(1622403.09106394 6940212.96302097)

36 | York | POINT(162287.38463732 6940357.59605424)

40 | York | POINT(1621888.19746548 6940508.01440885)

(5 rows)
```

Or, if we create a view from it:

```
CREATE VIEW vw_select_location AS
SELECT a.gid, a.name, a.geom
FROM building a, region b
WHERE st_within(a.geom, b.geom)
AND b.name = 'KwaZulu';
```

Adăugați vederea sub formă de strat, apoi vizualizați-o în QGIS:



Selectați vecinii

Show a list of all the names of regions adjoining the Hokkaido region:

```
SELECT b.name
FROM region a, region b
WHERE st_touches(a.geom, b.geom)
AND a.name = 'Hokkaido';
```

Rezultat:

```
name
Missouri
Saskatchewan
Wales
(3 rows)
```

As a view:

```
CREATE VIEW vw_regions_adjoining_hokkaido AS
SELECT b.gid, b.name, b.geom
FROM region a, region b
WHERE st_touches(a.geom, b.geom)
AND a.name = 'Hokkaido';
```

În QGIS:



Note the missing region (Queensland). This may be due to a topology error. Artifacts such as this can alert us to potential problems in the data. To solve this enigma without getting caught up in the anomalies the data may have, we could use a buffer intersect instead:

```
CREATE VIEW vw_hokkaido_buffer AS
SELECT gid, ST_BUFFER(geom, 100) as geom
```

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```
FROM region
WHERE name = 'Hokkaido';
```

Aceasta va crea o zonă tampon de 100 de metri în jurul regiunii Hokkaido.

Zona mai închisă este tamponul:



Select using the buffer:

```
CREATE VIEW vw_hokkaido_buffer_select AS
SELECT b.gid, b.name, b.geom
(
    SELECT * FROM
    vw_hokkaido_buffer
    ) a,
    region b
WHERE ST_INTERSECTS(a.geom, b.geom)
AND b.name != 'Hokkaido';
```

In this query, the original buffer view is used as any other table would be. It is given the alias a, and its geometry field, a.geom, is used to select any polygon in the region table (alias b) that intersects it. However, Hokkaido itself is excluded from this select statement, because we don't want it; we only want the regions adjoining it.

În QGIS:



It is also possible to select all objects within a given distance, without the extra step of creating a buffer:

```
CREATE VIEW vw_hokkaido_distance_select AS
SELECT b.gid, b.name, b.geom
FROM region a, region b
WHERE ST_DISTANCE (a.geom, b.geom) < 100
AND a.name = 'Hokkaido'
AND b.name != 'Hokkaido';</pre>
```

Prin aceasta se obține același rezultat, fără a fi necesar pasul tamponului intermediar:



Selectați valorile unice

Show a list of unique town names for all buildings in the Queensland region:

```
SELECT DISTINCT a.name
FROM building a, region b
WHERE st_within(a.geom, b.geom)
AND b.name = 'Queensland';
```

Rezultat:

name Beijing Berlin Atlanta (3 **rows**)

Exemple suplimentare ...

```
CREATE VIEW vw_shortestline AS
SELECT b.gid AS gid,
ST_ASTEXT(ST_SHORTESTLINE(a.geom, b.geom)) as text,
ST_SHORTESTLINE(a.geom, b.geom) AS geom
FROM road a, building b
WHERE a.id=5 AND b.id=22;
CREATE VIEW vw_longestline AS
SELECT b.gid AS gid,
ST_ASTEXT(ST_LONGESTLINE(a.geom, b.geom)) as text,
ST_LONGESTLINE(a.geom, b.geom) AS geom
FROM road a, building b
WHERE a.id=5 AND b.id=22;
```

```
CREATE VIEW vw_road_centroid AS
SELECT a.gid as gid, ST_CENTROID(a.geom) as geom
FROM road a
WHERE a.id = 1;
CREATE VIEW vw_region_centroid AS
SELECT a.gid as gid, ST_CENTROID(a.geom) as geom
FROM region a
WHERE a.name = 'Saskatchewan';
```

```
SELECT ST_PERIMETER(a.geom)
FROM region a
WHERE a.name='Queensland';
SELECT ST_AREA(a.geom)
FROM region a
WHERE a.name='Queensland';
```

```
CREATE VIEW vw_simplify AS
SELECT gid, ST_Simplify(geom, 20) AS geom
FROM road;
CREATE VIEW vw_simplify_more AS
SELECT gid, ST_Simplify(geom, 50) AS geom
FROM road;
```

```
CREATE VIEW vw_convex_hull AS
SELECT
ROW_NUMBER() over (order by a.name) as id,
a.name as town,
ST_CONVEXHULL(ST_COLLECT(a.geom)) AS geom
FROM building a
GROUP BY a.name;
```

16.4.5 În concluzie

Ați văzut cum se pot interoga obiectele spațiale, cu ajutorul noilor funcții de bază de date din PostGIS.

16.4.6 Ce urmează?

Mai departe vom investiga structurile geometriilor complexe și cum să le creați cu ajutorul PostGIS.

16.5 Lesson: Geometry Construction

În această secțiune vom intra în detalii despre cum sunt construite geometriile în SQL. În realitate, probabil veți utiliza un GIS cum ar fi QGIS pentru creearea geometriilor complexe folosind instrumentele acestora; cu toate acestea, întelegerea modului cum sunt stocate poate fi utilă pentru scrierea de interogări și înțelegerea modului cum este alcătuită baza de date.

Scopul acestei lecții: De a înțelege mai bine cum să creați entități spațiale direct în PostgreSQL/PostGIS.

16.5.1 Crearea Şirurilor de Linii

Întorcându-ne la baza de date address, să facem tabelul de străzi să se potrivească cu celelalte; de ex., să aibă o constrângere pentru geometrie, un index și o intrare în tabelul geometry_columns.

16.5.2 Try Yourself: ???

- Modificați tabela streets, astfel încât ea să aibă o coloană de geometrie de tipul ST_LineString.
- Nu uitați să faceți actualizarea coloanelor de geometrie!
- De asemenea, adăugați o constrângere pentru a preveni adăugarea geometrii care nu sunt null sau de tip LINESTRINGS.
- Creați un index spațial în noua coloană de geometrie

Răspuns

```
alter table streets add column geom geometry;
alter table streets add constraint streets_geom_point_chk check
    (st_geometrytype(geom) = 'ST_LineString'::text OR geom IS NULL);
insert into geometry_columns values ('', 'public', 'streets', 'geom', 2, 4326,
    'LINESTRING');
create index streets_geo_idx
    on streets
    using gist
    (geom);
```

Now let's insert a linestring into our streets table. In this case we will update an existing street record:

```
update streets
set geom = 'SRID=4326;LINESTRING(20 -33, 21 -34, 24 -33)'
where streets.id=2;
```

Aruncați o privire la rezultatele din QGIS. (Poate fi necesar să faceți clic-dreapta pe stratul străzilor din panoul «Straturilor», apoi alegeți «Transfocare la extinderea stratului».)

Acum, creați mai multe intrări de străzi - unele în QGIS, iar altele din linia de comandă.

16.5.3 Crearea Poligoanelor

Creating polygons is just as easy. One thing to remember is that by definition, polygons have at least four vertices, with the last and first being co-located:

```
insert into cities (name, geom)
values ('Tokyo', 'SRID=4326;POLYGON((10 -10, 5 -32, 30 -27, 10 -10))');
```

Notă: Un poligon necesită acolade duble în jurul listei sale de coordonate; aceasta pentru a permite poligoane complexe având multiple zone neconectate. De exemplu

Dacă ați urmat acest pas, puteți verifica rezultatul prin încărcarea setului de date orașe în QGIS, deschizând tabelul de atribute al acestuia, și selectând noua intrare. Remarcați cum cele două noi poligoane se comportă ca unul singur.

16.5.4 Exercițiu: Learea Orașelor de Persoane

Pentru acest exercițiu ar trebui să faceți următoarele:

- Ștergeți toate datele din tabela de personal.
- Adăugați o coloană de cheie străină în tabela de personal, care face referire la cheia primară a tabelei orașelor.
- Utilizați QGIS pentru a captura unele orașe.
- Utilizați SQL pentru a introduce câteva înregistrări de personal, verificând că fiecare are asociate o stradă și un oraș.

Your updated people schema should look something like this:

```
\d people
Table "public.people"
  Column | Type
                              Modifiers
 id | integer
                             | not null
                              | default nextval('people_id_seq'::regclass)
 name
       | character varying(50) |
 house_no | integer
                             | not null
 street_id | integer
                             | not null
 phone_no | character varying
                             1
 geom | geometry
```

(continues on next page)

(continuare din pagina precedentă)

Răspuns

```
delete from people;
alter table people add column city_id int not null references cities(id);
```

(capture cities in QGIS)

```
insert into people (name, house_no, street_id, phone_no, city_id, geom)
  values ('Faulty Towers',
           34,
           3,
           '072 812 31 28',
           1.
           'SRID=4326;POINT(13 -15)');
insert into people (name, house_no, street_id, phone_no, city_id, geom)
   values ('IP Knightly',
           32,
           1,
           '071 812 31 28',
           1,
           'SRID=4326;POINT(18 -24)');
insert into people (name, house_no, street_id, phone_no, city_id, geom)
   values ('Rusty Bedsprings',
           39,
           1.
           '071 822 31 28',
           1,
           'SRID=4326;POINT(22 -25)');
```

If you're getting the following error message:

```
ERROR: insert or update on table "people" violates foreign key constraint
    "people_city_id_fkey"
DETAIL: Key (city_id)=(1) is not present in table "cities".
```

then it means that while experimenting with creating polygons for the cities table, you must have deleted some of them and started over. Just check the entries in your cities table and use any *id* which exists.

16.5.5 Analizați Schema Noastră

Acum, schrma noastră ar trebui să arate în felul următor:



16.5.6 Try Yourself: ????

Creați marginile orașelor prin calucularea înfășurătorii convexe pentru toate adresele din acel oraș și calcularea unei zone tampon în jurul acesteia.

Răspuns

• Add some people in «Tokyo Outer Wards» city

```
INSERT INTO people (name, house_no, street_id, phone_no, city_id, geom)
  VALUES ('Bad Aboum',
           57,
           2,
           '073 712 31 21',
           2,
           'SRID=4326; POINT (22 18) ');
INSERT INTO people (name, house_no, street_id, phone_no, city_id, geom)
  VALUES ('Pat Atra',
           59,
           2,
           '074 712 31 25',
           2,
           'SRID=4326; POINT (23 14) ');
INSERT INTO people (name, house_no, street_id, phone_no, city_id, geom)
  VALUES ('Kat Herin',
           65,
           2,
           '074 722 31 28',
           2,
           'SRID=4326;POINT(29 18)');
```

• Create myPolygonTable table

```
CREATE TABLE myPolygonTable (
   id serial NOT NULL PRIMARY KEY,
   city_id int NOT NULL REFERENCES cities(id),
   geom geometry NOT NULL
);
```

(continues on next page)

(continuare din pagina precedentă)

```
ALTER TABLE myPolygonTable
ADD CONSTRAINT myPolygonTable_geom_polygon_chk
CHECK (st_geometrytype(geom) = 'ST_Polygon'::text );
```

• Create and load the convex hulls

```
INSERT INTO myPolygonTable (city_id, geom)
SELECT * FROM
(
SELECT
ROW_NUMBER() over (order by city_id)::integer AS city_id,
ST_CONVEXHULL(ST_COLLECT(geom)) AS geom
FROM people
GROUP BY city_id
) convexHulls;
```

16.5.7 Accesul la Sub-Obiecte

Folosind funcțiile SFS-Model, aveți la dispoziție o largă gamă de opțiuni pentru accesarea sub-obiectelor geometriilor SFS. Când doriți să selectați primul punct vertex al fiecărei geometrii poligon în tabelul myPolygonTable, trebuie să o faceți în felul acesta:

• Transform the polygon boundary to a linestring:

```
select st_boundary(geom) from myPolygonTable;
```

• Select the first vertex point of the resultant linestring:

```
select st_startpoint(myGeometry)
from (
    select st_boundary(geom) as myGeometry
    from myPolygonTable) as foo;
```

16.5.8 Procesarea Datelor

PostGIS suportă toate funcțiile conforme standardelor OGC SFS/MM. Toate aceste funcții încep cu ST_.

16.5.9 Decuparea

To clip a subpart of your data you can use the ST_INTERSECT() function. To avoid empty geometries, use:

where not st_isempty(st_intersection(a.geom, b.geom))



where not st_isempty(st_intersection(st_setsrid(a.geom, 32734),

b.geom));



16.5.10 Construirea de Geometrii pornind de la Alte Geometrii

Plecând de la un tabel de puncte dat, doriți să generați un linestring. Ordinea punctelor este dată de valoarea id. O altă metodă de ordonare ar putea fi marca de timp, cum ar fi cea pe care o primiți când capturiați puncte cu un receptor GPS.



To create a linestring from a new point layer called «points», you can run the following command:

```
select ST_LineFromMultiPoint(st_collect(geom)), 1 as id
from (
   select geom
   from points
   order by id
) as foo;
```

Pentru a vedea cum funcționează fără a crea un nou strat, puteți executa această comandă în stratul «people», deși desigur nu ar avea prea mult sens în lumea reală.



16.5.11 Curățarea Geometriilor

You can get more information for this topic in this blog entry.

16.5.12 Diferențele dintre tabele

To detect the difference between two tables with the same structure, you can use the PostgreSQL keyword EXCEPT:

```
select * from table_a
except
select * from table_b;
```

Ca rezultat, veți obține toate acele înregistrări din table_a care nu se regăsesc și în table_b.

16.5.13 Spațiile tabelelor

You can define where postgres should store its data on disk by creating tablespaces:

```
CREATE TABLESPACE homespace LOCATION '/home/pg';
```

When you create a database, you can then specify which tablespace to use e.g.:

```
createdb --tablespace=homespace t4a
```

16.5.14 În concluzie

Ați învățat cum să creeați geometrii mai complexe folosing instrucțiuni PostGIS. Rețineți că aceasta folosește la îmbunătățirea cunoștințelor pentru lucrul cu o bază de date spațială printr-o interfață GIS. În mod curent nu veți avea nevoie să folosiți aceste instrucțiuni manual, dar o înțelegere generală vă va ajuta la utilizarea unui GIS, în special dacă întâlniți erori care ar putea să pară altfel criptice.

CAPITOLUL 17

Ghidul de procesare al QGIS

Acest modul a fost publicat de Victor Olaya și Paolo Cavallini.

Cuprins:

17.1 Introducere

This guide describes how to use the QGIS processing framework. It assumes no previous knowledge of the Processing framework or any of the applications that it rely on. It assumes basic knowledge of QGIS. The chapters about scripting assume you have some basic knowledge of Python and maybe the QGIS Python API.

Acest ghid este conceput pentru studiu individual sau pentru utilizarea într-o sesiune de instruire.

Examples in this guide use QGIS 3.4. They might not work or not be available in versions other than that one.

This guide is comprised of a set of small exercises of progressive complexity. If you have never used the processing framework, you should start from the very beginning. If you have some previous experience, feel free to skip lessons. They are more or less independent of each other, and each one introduces some new concept or some new element, as indicated in the chapter title and the short introduction at the beginning of each chapter. That should make it easy to locate lessons dealing with a particular topic.

For a more systematic description of all the framework components and their usage, it is recommended to check the corresponding chapter in the user manual. Use it as a support text along with this guide.

All the exercises in this guide use the same free dataset used throughout the training manual and referenced at section *Data*. The zip file to download contains several folders corresponding to each one of the lessons in this guide. In each of them you will find a QGIS project file. Just open it and you will be ready to start the lesson.

Utilizare plăcută!

17.2 Câteva lucruri importante de reținut, înainte de a începe

Just like the manual of a word processor doesn't teach you how to write a novel or a poem, or a CAD tutorial doesn't show you how to calculate the size of a beam for a building, this guide will not teach you spatial analysis. Instead, it will show you how to use the QGIS Processing framework, a powerful tool for performing spatial analysis. It is up to you to learn the required concepts that are needed to understand that type of analysis. Without them, there is no point in using the framework and its algorithms, although you might be tempted to try.

Haideți să vedem, pentru mai multă claritate, un exemplu.

Având în vedere un set de puncte și, pentru fiecare punct, o anumită valoare, cu ajutorul geoalgoritmului *Kriging* se poate calcula un strat raster. Caseta de dialog a parametrilor pentru acel modul este similară celei de mai jos.

| Ordinary Kriging | | |
|---|-----------------|----------|
| Parameters Log | | |
| Points | | |
| * points [EPSG:27700] | - | |
| Selected features only | | |
| Attribute | | |
| 123 ld | | - |
| Type of Quality Measure | | |
| | | - |
| ✓ Logarithmic Transformation | | |
| V Block Kriging | | |
| Block Size | | |
| 100.000000 | | \$ |
| Maximum Distance | | |
| -1.000000 | | \$ |
| Lag Distance Classes | | |
| 100 | | \$ |
| Skip | | |
| 1 | | . |
| Variogram Model | | |
| a + b * x | | |
| Output extent (xmin, xmax, ymin, ymax) [optional] | | |
| [Leave blank to use min covering extent] | | |
| Cellsize | | |
| 1.000000 | | \$ |
| Fit | | |
| | | • |
| Search Range | | |
| | | |
| 0% | | Cancel |
| Run as Batch Process | X <u>C</u> lose | 🖉 Run |

It looks complex, right?

By reading this manual, you will learn things such as how to use that module, how to run it in a batch process to create raster layers from hundreds of points layers in a single run, or what happens if the input layer has some points selected. However, the parameters themselves are not explained. A seasoned analyst with a good knowledge of geostatistics will have no problem understanding those parameters. If you are not one of them and *sill, range*, or *nugget* are not familiar concepts to you, then you should not use the *Kriging* module. More than that, you are far from being ready to use the *Kriging* module, since it requires learning about concepts such as spatial autocorrelation or semivariograms,

which probably you also haven't heard before, or at least haven't studied long enough. You should first study and understand them, and then come back to QGIS to actually run it and perform the analysis. Ignoring this will result in wrong results and poor (and most likely useless) analysis.

Deși nu toți algoritmii sunt la fel de complecși ca și algoritmul kriging (unii dintre ei având o complexitate chiar mai mare!), aproape toți necesită o bună înțelegere a metodelor fundamentale de analiză, pe care se bazează. Fără acea cunoaștere, folosirea lor va conduce, cel mai probabil, la rezultate slabe.

Using geoalgorithms without having a good foundation of spatial analysis is like trying to write a novel without knowing anything about grammar or syntax, and having no knowledge about storytelling. You might get a result, but it is likely to have no value at all. Please, don't fool yourself and think that after reading this guide you are already capable of performing spatial analysis and get sound results. You need to study spatial analysis as well.

În continuare, este indicat un bun punct de referință, la care vă puteți raporta pentru a afla mai multe despre analiza datelor spațiale.

Analize geospațiale (a 3-a Ediție): Un Ghid Cuprinzător de Principii, Tehnici și Instrumente Software, Michael John De Smith, Michael F. Goodchild, Paul A. Longley

It is available online here

17.3 Inițierea cadrului de procesare

Primul lucru de făcut, înainte de a utiliza cadrul de prelucrare, este să-l configurați. Nu este mult de configurat, astfel încât aceasta este o sarcină ușoară.

Ulterior, vom vedea cum se configurează aplicațiile externe, care folosesc la extinderea listei algoritmilor disponibili, însă pentru moment vom lucra cu cadrul de lucru propriu-zis.

The processing framework is a core QGIS plugin, which means that it should already be installed in your system, since it is included with QGIS. In case it is active, you should see a menu called *Processing* in your menu bar. There you can access all the framework components.

| Pro <u>c</u> essing | <u>H</u> elp | | |
|-------------------------------|--------------|------------|--|
| oolbox 👔 | | Ctrl+Alt+T | |
| 🏇 Graphical <u>M</u> odeler 🗟 | | Ctrl+Alt+M | |
| 🕓 <u>H</u> istory | | Ctrl+Alt+H | |
| 🖹 <u>R</u> esults Viewer | | Ctrl+Alt+R | |
| 字 Edit Features In-Place | | | |

Dacă nu puteți găsi acel meniu, trebuie să activați plugin-ul, din managerul de plugin-uri, și să-l activați.



Elementul principal cu care vom lucra este setul de instrumente. Faceți clic pe intrarea de meniu corespunzătoare, apoi veți vedea bara de instrumente andocată în partea dreaptă a ferestrei QGIS.


The toolbox contains a list of all the available algorithms, divided in groups called *Providers*. Providers can be (de)activated in the *Settings* \blacktriangleright *Options* \triangleright *Processing*. We will discuss that dialog later in this manual.

By default, only providers that do not rely on third-party applications (that is, those that only require QGIS elements to be run) are active. Algorithms requiring external applications might need additional configuration. Configuring providers is explained in a later chapter in this manual.

Dacă ați ajuns la acest punct, acum sunteți gata de utilizare a geoalgoritmilor. Nu este nevoie să configurați nimic altceva. Putem rula deja primul nostru algoritm, lucru pe care îl vom face în lecția următoare.

17.4 Rularea primului nostru algoritm. Setul de instrumente

Notă: În această lecție vom rula primul nostru algoritm pentru a obține un prim rezultat.

Așa cum am menționat deja, cadrul de procesare poate rula algoritmi ai altor aplicații, dar conține, de asemenea, algoritmi nativi care nu au nevoie de nici un software extern pentru a rula. Pentru a începe explorarea cadrului de procesare, vom rula unul dintre algoritmii nativi. În particular, vom calcula centroizii setului de poligoane.

În primul rând, deschideți proiectul QGIS corespunzător acestei lecții. Acesta conține doar un singur strat, cu două poligoane



Now go to the text box at the top of the toolbox. That is the search box, and if you type text in it, it will filter the list of algorithms so just those ones containing the entered text are shown. If there are algorithms that match your search but belong to a provider that is not active, an additional label will be shown in the lower part of the toolbox.

Introduceți centroids, după care ar trebui să vedeți ceva de genul următor:



Caseta de căutare este o modalitate foarte practică de a găsi algoritmul pe care îl căutați. În partea de jos a casetei de dialog, o etichetă suplimentară arată că există algoritmi care se potrivesc căutării dvs., dar aparțin unui furnizor care nu este activ. Dacă dați clic pe linkul din acea etichetă, lista de algoritmi va include și rezultatele de la acei furnizori inactivi, care vor fi afișate cu gri deschis. Este afișat și un link pentru activarea fiecărui furnizor inactiv. Vom vedea mai târziu cum să activăm alți furnizori.

| Processing Toolbox | 8 X |
|--|-----------|
| centroid | |
| GRASS GIS 7 commands [314 geoalgorithms] Vector (v.*) v.delaunay - Creates a Delaunay triangulation from an input vector map containing points or c v.what.rast.centroids - Uploads raster values at positions of vector centroids to the table. QGIS geoalgorithms [116 geoalgorithms] Vector analysis tools Generate points (pixel centroids) along line Generate points (pixel centroids) inside polygons Vector geometry tools | entroids. |
| Polygon centroids | |
| GRASS commands <u>Activate</u> Vector (v.*) v.delaunay - Creates a Delaunay triangulation from an input vector map containing points or c | entroids. |
| You can add more algorithms to the toolbox, enable additional providers. [close] | |

Pentru a executa un algoritm, trebuie doar să faceți dublu clic pe numele acestuia în caseta de instrumente. Când faceți dublu clic pe algoritmul *Polygon centroids*, veți vedea următoarea fereastră de dialog.

| 🤨 Polygon centroids | | | × |
|---|-----|-------|--------|
| Parameters Log Help | | | |
| Input layer | | | |
| polygons [EPSG:23030] | | • | |
| Output layer | | | |
| [Save to temporary file] | | | |
| Copen output file after running algorithm | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| <u></u> | | | |
| 0% | | | |
| | Run | Close | Cancel |

Toți algoritmii au o interfață similară, care conține practic parametrii de intrare pe care trebuie să îi completați, și ieșirile pentru care trebuie să specificați unde se păstrează. În acest caz, singura intrare pe care o avem este un strat vectorial cu poligoane.

Selectați stratul *Poligoanelor* ca intrare. Algoritmul are o singură ieșire, care este stratul centroizilor. Există două opțiuni pentru a defini locul de salvare a datelor de ieșire: introduceți o cale pentru fișier sau salvați-l sub numele unui fișier temporar

In case you want to set a destination and not save the result in a temporary file, the format of the output is defined by the filename extension. To select a format, just select the corresponding file extension (or add it if you are directly typing the filepath instead). If the extension of the filepath you entered does not match any of the supported ones, a default extension (usually .dbf for tables, .tif for raster layers and .shp for vector ones) will be appended to the filepath and the file format corresponding to that extension will be used to save the layer or table.

În toate exercițiile din acest ghid, vom salva rezultatele într-un fișier temporar, deoarece nu este nevoie să le salvăm pentru o utilizare ulterioară. Simțiți-vă liber să le salvați într-o locație permanentă dacă doriți.

Atenționare: O dată ce se închide QGIS, fișierele temporare vor fi șterse. În cazul unui proiect cu o ieșire generată temporar, la deschiderea ulterioară a proiectului, QGIS va semnala acest lucru, din moment ce fișierul nu mai există.

După ce ați configurat fereastra de dialog pentru algoritm, apăsați Run pentru a rula algoritmul.

Veți obține rezultatul următor.



Ieșirea are același CRS ca și intrarea. Geoalgoritmii presupun că toate straturile de intrare au același CRS și, de aceea, nu vor efectua nici o reproiectare. Cu excepția cazului unor algoritmi speciali (cum ar fi cei de reproiectare), ieșirile vor avea același CRS. Vom vedea în curând mai multe despre acest lucru.

Try yourself saving it using different file formats (use, for instance, shp and geojson as extensions). Also, if you do not want the layer to be loaded in QGIS after it is generated, you can check off the checkbox that is found below the output path box.

17.5 Mai multe tipuri de date și algoritmi

Notă: În această lecție vom rula mai mult de trei algoritmi, veți învăța cum să folosiți alte tipuri de intrări, și cum să configurați rezultatele pentru a fi salvate automat într-un anumit folder.

Pentru aceste lecții vom avea nevoie de o tabelă și de un strat poligonal. Vom crea un strat de puncte bazat pe coordonatele din tabel, și apoi vom contoriza numărul de puncte din fiecare poligon. Dacă deschideți proiectul QGIS corespunzător acestei lecții, veți găsi un tabel cu coordonatele X și Y, dar veți identifica nici un strat poligonal. Nu vă faceți griji, îl vom crea folosind un geoalgoritm de procesare.

Primul lucru pe care îl vom face este de a crea un strat de puncte din coordonatele din tabel, utilizând algoritmul *Stratului de puncte din tabelă*. O dată ce știți cum se folosește caseta de căutare, nu vă va fi greu să-l găsiți. Efectuați un dublu-clic pe ea pentru a o rula și pentru a ajunge la următorul său dialog.

Acest algoritm, la fel ca și cel din lecția precedentă, generează doar o singură ieșire, având trei intrări:

- Tabela: tabela cu coordonate. Ar trebui să selectați aici tabela corespunzătoare lecției.
- *X and Y fields*: these two parameters are linked to the first one. The corresponding selector will show the name of those fields that are available in the selected table. Select the *XCOORD* field for the *X* parameter, and the *YYCOORD* field for the *Y* parameter.
- *CRS*: Since this algorithm takes no input layers, it cannot assign a CRS to the output layer based on them. Instead, it asks you to manually select the CRS that the coordinates in the table use. Click on the button on the

left-hand side to open the QGIS CRS selector, and select EPSG:4326 as the output CRS. We are using this CRS because the coordinates in the table are in that CRS.

Dialogul dvs. ar trebui să arate astfel.

| 👔 Points layer from table 🔀 🕺 |
|--|
| Parameters Log Help |
| Territ laure |
| Input layer |
| table |
| X field |
| XCOORD |
| Y field |
| YCOORD 🗸 |
| Target CRS |
| EPSG:4326 |
| Output layer |
| [Save to temporary file] |
| 🕱 Open output file after running algorithm |
| |
| 0% |
| Run Close Cancel |

Now press the *Run* button to get the following layer (you may need to zoom full to reenter the map around the newly created points):



Următorul lucru de care avem nevoie este stratul poligona;. Vom crea o grilă obișnuită de poligoane, folosind algoritmul *Creare grilă*, care are următoarea fereastră cu parametri.

| 🦞 Create grid | | | | × |
|---|------|-------|------|----|
| Parameters Log Help | | | | |
| | | | | |
| Horizontal spacing | | | | |
| 10.0 | | | | |
| Vertical spacing | | | | |
| 10.0 | | | | |
| Width | | | | |
| 360.0 | | | | |
| Height | | | | |
| 180.0 | | | | |
| Center X | | | | |
| 0.0 | | | | |
| Center Y | | | | |
| 0.0 | | | | |
| Grid type | | | | |
| Rectangle (line) | | | - | |
| CRS | | | | |
| EPSG:4326 | | | | |
| Output | | | | |
| [Save to temporary file] | | | | |
| Copen output file after running algorithm | | | | |
| | | | | • |
| | | | | |
| 0% | | | (| |
| | Run | Close | Cano | el |

Atenționare: The options are simpler in recent versions of QGIS; you just need to enter min and max for X and Y (suggested values: -5.696226,-5.695122,40.24742,40.248171)

The inputs required to create the grid are all numbers. When you have to enter a numerical value, you have two options: typing it directly on the corresponding box or clicking the button on the right-hand side to get to a dialog like the one shown next.



The dialog contains a simple calculator, so you can type expressions such as $11 \times 34.7 + 4.6$, and the result will be computed and put in the corresponding text box in the parameters dialog. Also, it contains constants that you can use, and values from other layers available.

In this case, we want to create a grid that covers the extent of the input points layer, so we should use its coordinates to calculate the center coordinate of the grid and its width and height, since those are the parameters that the algorithm takes to create the grid. With a little bit of math, try to do that yourself using the calculator dialog and the constants from the input points layer.

Selectați Dreptunghiuri (poligoane) în câmpul Tip.

As in the case of the last algorithm, we have to enter the CRS here as well. Select EPSG:4326 as the target CRS, as we did before.

În cele din urmă, ar trebui să aveți un dialog pentru parametri de genul următor:

| Q Create grid | × |
|---|--------------|
| Parameters Log Help | |
| Horizontal spacing | |
| 0.0001 | |
| Vertical spacing | |
| 0.0001 | |
| Width | |
| 0.000904 | |
| Height | |
| 0.000551 | |
| Center X | |
| -5.695674 | |
| Center Y | |
| 40.2477955 | |
| Grid type | |
| Rectangle (polygon) | - |
| CRS | |
| EPSG:4326 | |
| Output | |
| [Save to temporary file] | |
| Copen output file after running algorithm | |
| | |
| 0% | |
| Run | Close Cancel |

(Better add one spacing on the width and height: Horizontal spacing: 0.0001, Vertical spacing: 0.0001, Width: 0.001004, Height: 0.000651, Center X: -5.695674, Center Y: 40.2477955) The case of X center is a bit tricky, see: -5.696126+((-5.695222+5.696126)/2)

Apăsați *Run* pentru a obține stratul de graticule.



The last step is to count the points in each one of the rectangles of that graticule. We will use the *Count points in polygons* algorithm.

| 🦸 Count points in polygon | | x |
|--|-----|--------------|
| Parameters Log Help | | |
| Polygons | | |
| polygons [EPSG:4326] | | 🦻 |
| Points | | |
| points [EPSG:4326] | | • 🦻 |
| Count field name | | |
| NUMPOINTS | | |
| Result | | |
| [Save to temporary file] | | |
| X Open output file after running algorithm | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| 0% | | |
| | Run | Close Cancel |

Acum avem rezultatul dorit.

Before finishing this lesson, here is a quick tip to make your life easier in case you want to persistently save your data. If you want all your output files to be saved in a given folder, you do not have to type the folder name each time. Instead, go to the processing menu and select the *Options and configuration* item. It will open the configuration dialog.

| 🦞 SEXTANTE options | | <u>? ×</u> |
|--------------------|-------|------------|
| | | |
| Setting | Value | |
| 🗄 🗸 🌿 General | | |
| The Models | | |
| H | | |
| 🗄 🗠 🖬 Scripts | | |
| | | |
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| | | |
| | | |
| | ОК | Cancel |

In the Output folder entry that you will find in the General group, type the path to your destination folder.

| Q Processing options | | | <u>?×</u> | | |
|--|----------------|--------|-----------|--|--|
| | | | | | |
| Setting Value | | | | | |
| 🛱 🗰 🔅 General | | | | | |
| 🐨 💮 Keep dialog open after running an algorithm | × | | | | |
| 💮 💮 Output folder | C:\processing_ | output | | | |
| 💮 💮 Post-execution script | | | | | |
| 💮 💮 Pre-execution script | | | | | |
| 🐨 💮 Run algorithms in a new thread | × | | | | |
| Show extra info in Log panel (threaded execution only) | × | | | | |
| 🖤 💮 Show layer CRS definition in selection boxes | × | | | | |
| Show recently executed algorithms | × | | | | |
| 🐨 😳 Show table-like parameter panels | | | | | |
| 🐨 🕮 Style for line layers | | | | | |
| 🐨 🕮 Style for point layers | | | | | |
| 🐨 🌼 Style for polygon layers | | | | | |
| 🖤 😳 Style for raster layers | | | | | |
| 🐨 🏶 Use filename as layer name | | | | | |
| 🐨 💮 Use only selected features | × | | | | |
| 👾 💮 Warn before executing if layer CRS's do not match | × | | | | |
| 🗄 🗄 🗠 🐝 Models | | | | | |
| 🗄 🗄 Providers | | | | | |
| 🗄 🗠 🔽 Scripts | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | ОК | Cancel | | |

Now when you run an algorithm, just use the filename instead of the full path. For instance, with the configuration shown above, if you enter graticule.shp as the output path for the algorithm that we have just used, the result will be saved in D:\processing_output\graticule.shp. You can still enter a full path in case you want a result to be saved in a different folder.

Încercați să rulați algoritmul *Creare grilă* folosind diferite mărimi ale grilei, și, totodată, utilizând diverse tipuri de grilă.

17.6 Reproiectarea CRS-urilor

Notă: În această lecție, vom discuta despre modul în care Processing utilizează CRS-urile. Vom vedea, de asemenea, un algoritm foarte util: reproiectarea.

CRS-urile sunt o mare sursă de confuzie pentru utilizatorii QGIS Processing, așa că aici sunt câteva reguli generale cu privire la modul în care pot fi gestionate de către geoalgoritmi, la crearea unui nou strat.

 Dacă există straturi de intrare, se va utiliza CRS-ul primului strat. Acesta este presupus a fi CRS-ul tuturor straturilor de intrare, atât timp cât este necesar ca acestea să-l aibă pe același. În cazul în care utilizați straturi cu un CRS diferit, QGIS va emite un avertisment. Observați că CRS-ul straturilor de intrare este afișat alături de numele său, în dialogul parametrilor.

| E | Elevation |
|---|---------------------|
| | raster [EPSG:23030] |

• Dacă nu există niciun strat de intrare, atunci se va folosi CRS-ul proiectului, cu excepția cazului în care algoritmul conține un câmp specific pentru CRS (cum s-a întâmplat în ultima lecție cu algoritmul graticulelor)

Deschideți proiectul corespunzător acestei lecții, și veți vedea două straturi denumite 23030 și 4326. Ambele conțin același număr de puncte, dar aflate în diferite CRS-uri (EPSG:23030 și EPSG:4326). Ele apar în același loc, deoarece QGIS este reproiectat "din zbor" în CRS-ul proiectului (EPSG:4326), ele nefind, de fapt, unul și același strat.

| 🦞 Export/Add geometry columns | | | × |
|-------------------------------|-----|-------|--------|
| Parameters Log Help | | | |
| Input layer | | | |
| 4326 [EPSG:4326] | | • … | |
| Calculate using | | | |
| Layer CRS | | | - |
| Output layer | | | |
| [Save to temporary file] | | | |
| | | | |
| | | | |
| 0% | | | |
| | Run | Close | Cancel |

Deschide algoritmul Export/Adăugare coloane de geometrie.

Acest algoritm adaugă coloane noi în tabela de atribute a unui strat vectorial. Conținutul coloanelor depinde de tipul geometriei stratului. În cazul punctelor, se vor adăuga coloane noi, conținând coordonatele X și Y ale fiecărui punct.

În lista de straturi disponibile, pe care le veți găsi în câmpul stratului de intrare, le veți vedea pe fiecare, alături de CRS-ul corespunzător. Astfel, deși apar în același loc pe canevas, ele vor fi tratate în mod diferit. Selectați stratul 4326.

Celălalt parametru al algoritmului permite setarea modului în care algoritmul folosește coordonatele, pentru a calcula noua valoare care se va adăuga la straturile rezultate. Cei mai mulți algoritmi nu au o opțiune de acest gen, și vor folosi în mod direct coordonatele. Selectați opțiunea *CRS-ul Stratului* pentru a folosi coordonatele așa cum sunt. Acesta este modul în care lucrează aproape toți geo-algoritmii.

Ar trebui să obțineți un nou strat, cu exact aceleași puncte ca și celelalte două. Dacă faceți clic dreapta pe numele stratului și îi deschideți proprietățile, veți vedea că folosește CRS-ul stratului de intrare, adică, EPSG:4326. Atunci când stratul este încărcat în QGIS, nu vi se va cere să introduceți CRS-ul stratului, atât timp cât QGIS îl cunoaște.

Dacă deschideți tabelul de atribute a noului strat, veți vedea că ea conține două noi câmpuri, cu coordonatele X și Y ale fiecărui punct.

| | D Z | PT_NUM_A | PT_ST_A | xcoord | ycoord |
|----|-----|-----------|---------|-----------|-----------|
| 0 | 1 | 1.100000 | a | -5.695426 | 40.248071 |
| 1 | 2 | 2.200000 | b | -5.695885 | 40.247622 |
| 2 | 3 | 3.300000 | c | -5.695406 | 40.247520 |
| 3 | 4 | 4.400000 | a | -5.695222 | 40.247694 |
| 4 | 5 | 5.500000 | b | -5.695642 | 40.248030 |
| 5 | 6 | 6.600000 | a | -5.695855 | 40.248067 |
| 6 | 7 | 7.700000 | b | -5.696049 | 40.248028 |
| 7 | 8 | 8.800000 | c | -5.696126 | 40.247629 |
| 8 | 9 | 9.900000 | a | -5.695961 | 40.247786 |
| 9 | 10 | 11.000000 | b | -5.695353 | 40.247929 |
| 10 | 11 | 12.100000 | a | -5.695595 | 40.247739 |
| 11 | 12 | 13.200000 | b | -5.695779 | 40.247896 |

Aceste valori de coordonate sunt date în CRS-ul stratului, întrucât am ales această opțiune. Totuși, chiar dacă s-ar fi ales o altă opțiune, CRS-ul de ieșire al stratului ar fi fost același, deoarece CRS-ul de intrare este folosit pentru a seta CRS-ul stratului de ieșire. Alegerea unei alte opțiuni va face ca valorile să fie diferite, dar fără schimbarea punctului rezultat și fără ca CRS-ul stratului de ieșire să fie diferit de CRS-ul celui de intrare.

Acum, efectuați același calcul, utilizând celălalt strat. Ar trebui să găsiți stratul rezultat, randat exact în același loc ca și celelalte, având același CRS, EPSG:23030, acesta fiind CRS-ul stratului de intrare.

Dacă mergeți la tabela sa de atribute, veți vedea valori care sunt diferite de cele din primul strat pe care l-am creat.

| | ID 🗸 | PT_NUM_A | PT_ST_A | xcoord | ycoord |
|----|------|-----------|---------|---------------|----------------|
| 0 | 1 | 1.100000 | a | 270839.655869 | 4458983.162670 |
| 1 | 2 | 2.200000 | b | 270799.116425 | 4458934.552874 |
| 2 | 3 | 3.300000 | c | 270839.468187 | 4458921.978139 |
| 3 | 4 | 4.400000 | a | 270855.745301 | 4458940.799487 |
| 4 | 5 | 5.500000 | b | 270821.164389 | 4458979.173980 |
| 5 | 6 | 6.600000 | a | 270803.157564 | 4458983.848803 |
| 6 | 7 | 7.700000 | b | 270786.542791 | 4458980.047841 |
| 7 | 8 | 8.800000 | c | 270778.601980 | 4458935.968837 |
| 8 | 9 | 9.900000 | a | 270793.142411 | 4458952.931700 |
| 9 | 10 | 11.000000 | b | 270845.414756 | 4458967.311298 |
| 10 | 11 | 12.100000 | a | 270824.166376 | 4458946.784250 |
| 11 | 12 | 13.200000 | b | 270809.035643 | 4458964.649799 |

Acest lucru se datorează faptului că datele originale sunt diferite (se folosește un alt CRS), și acele coordonate sunt preluate din ea.

Ce ar trebui să învățați din asta? Ideea principală din spatele acestor exemple este aceea că geoalgoritmii folosesc stratul așa cum se află în sursa sa de date originală, ignorând complet reproiectările pe care QGIS le-ar putea efectua înainte de randare. Cu alte cuvinte, nu aveți încredere în ceea ce vedeți pe pânză, dar aveți întotdeauna în vedere faptul că vor fi utilizate datele originale. Acest lucru nu este atât de important în acest caz, din moment ce folosim doar un singur strat la un moment dat, dar într-un algoritm care are nevoie de mai multe (cum ar fi un algoritm de decupare), straturile care par să se potrivească sau să se suprapună, ar putea fi foarte departe unul față de celălalt, atât timp cât pot avea diferite CRS-uri.

Algoritmii nu realizează nici o reproiectare (cu excepția algoritmului de reproiectare pe care îl vom vedea în continuare), de aceea, trebuie ca dvs. să vă asigurați că straturile au același CRS.

Un modul interesant, care are de-a face cu CRS-ul, este cel de reproiectare. Acesta reprezintă un caz particular, deoarece are un strat de intrare (cel de reproiectat), însă nu îi va folosi CRS-ul pentru stratul de ieșire.

Deschide algoritmul de Reproiectare a stratului.

| 🦸 Reproject layer | × |
|--|--------|
| Parameters Log Help | |
| | |
| Input layer | |
| 23030 [EPSG:23030] | |
| Target CRS | |
| EPSG:4326 . | |
| Reprojected layer | |
| [Save to temporary file] | |
| X Open output file after running algorithm | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| 0% | |
| | Cancel |
| kun Close | Cancer |

Selectați oricare dintre straturile ca intrare, și alegeți EPSG:23029 ca CRS destinație. Rulați algoritmul și veți obține un nou strat, identic cu cel de intrare, dar cu un alt CRS. Acesta va apărea în aceeași regiune a canevasului, ca și celelalte, din moment ce QGIS îl va reproiecta din zbor, dar coordonatele sale originale sunt diferite. Puteți vedea acest lucru, prin rularea algoritmului de *Exportare/Adăugare coloane de geometrie* asupra acestui nou strat de intrare, și prin verificarea diferențelor dintre coordonatele adăugate și cele din tabelele de atribute ale ambelor straturi, calculate anterior.

17.7 Selecția

Notă: În această lecție vom vedea cum gestionează selecțiile algoritmii de procesare din straturile vectoriale care sunt utilizate ca intrare, și cum se poate crea o selecție, folosindu-se un anumit tip de algoritm.

Spre deosebire de alte plugin-uri de analiză din QGIS, geoalgoritmii de procesare nu dispun de caseta de bifare pentru "Utilizare doar a entităților selectate" sau ceva similar acesteia. Comportamentul privitor la selectare este stabilit pentru întreg plugin-ul și pentru toți algoritmii, și nu pentru fiecare rulare a algoritmului. Algoritmii respectă următoarele reguli simple, atunci când se utilizează un strat vectorial.

- Dacă stratul are o selecție, vor fi utilizate numai entitățile selectate.
- Dacă nu există nici o selecție, atunci vor fi utilizate toate entitățile.

Vă rugăm să rețineți că puteți schimba acest comportament prin deselectarea meniului opțiunii relevante *Processing* ► *Options* ► *General*`.

You can test that yourself by selecting a few points in any of the layers that we used in the last chapter, and running the reprojection algorithm on them. The reprojected layer that you will obtain will contain only those points that were selected, unless there was no selection, which will cause the resulting layer to contain all points from the original layer.

To make a selection, you can use any of the available methods and tools in QGIS. However, you can also use a geoalgorithm to do so. Algorithms for creating a selection are found in the toolbox under *Vector/Selection*



Deschideți algoritmul de Selecție aleatoare.



Lăsând valorile implicite, se vor selecta 10 puncte din stratul curent.



Veți observa că acest algoritm nu produce nici o ieșire, dar modifică stratul de intrare (nu stratul în sine, ci selecția sa). Acesta este un comportament mai puțin frecvent, deoarece toți ceilalți algoritmi vor produce noi straturi și nu vor modifica straturile de intrare.

Since the selection is not part of the data itself, but something that only exist within QGIS, these selection algorithms only must be used selecting a layer that is open in QGIS, and not with the file selection option that you can find in the corresponding parameter value box.

The selection we have just made, like most of the ones created by the rest of the selection algorithms, can also be done manually from QGIS, so you might be wondering what is the point on using an algorithm for that. Although now this might not make much sense to you, we will later see how to create models and scripts. If you want to make a selection in the middle of a model (which defines a processing workflow), only a geoalgorithm can be added to a model, and other QGIS elements and operations cannot be added. That is the reason why some processing algorithms duplicate functionality that is also available in other QGIS elements.

By now, just remember that selections can be made using processing geoalgorithms, and that algorithms will only use the selected features if a selection exists, or all features otherwise.

17.8 Rularea unui algoritm extern

Notă: În această lecție vom vedea cum să folosim algoritmi care depind de o terță aplicație, în speță SAGA, care este unul dintre principalii furnizori de algoritmi.

All the algorithms that we have run so far are part of processing framework. That is, they are *native* algorithms implemented in the plugin and run by QGIS just like the plugin itself is run. However, one of the greatest features of the processing framework is that it can use algorithms from external applications and extend the possibilities of those applications. Such algorithms are wrapped and included in the toolbox, so you can easily use them from QGIS, and use QGIS data to run them.

Pentru a rula, unii dintre algoritmii pe care îi vedeți în vizualizarea simplificată necesită, în prealabil, instalarea unor aplicații terțe în sistemul dumneavoastră. Un furnizor de algoritm de interes special este SAGA (Sistem de Analize Geospațiale Automate). Pentru a apela în mod corect SAGA, QGIS trebuie să fie configurat în mod corespunzător. Acest lucru nu este dificil, dacă înțelegem principiul de funcționare. Fiecare aplicație externă are propria sa configurație, iar mai târziu, în același manual vom vorbi despre altele, însă acum vom discuta despre SAGA.

În cazul în care vă aflați pe Windows, cel mai bun mod de a lucra cu algoritmii externi este de a instala QGIS cu ajutorul programului de instalare. Acesta va avea grijă de instalarea dependențelor necesare, inclusiv SAGA, astfel

că, dacă l-ați folosit, nu mai trebuie să întreprindeți altceva. Puteți deschide dialogul setărilor, apoi să mergeți la grupul *Furnizorilor/SAGA*.

| Q Processing options | | <u>? ×</u> |
|--|-----------|------------|
| Search | | |
| Setting | Value | _ |
| 🖻 ··· 🏶 Providers | | |
| 🛨 🛺 GDAL/OGR | | |
| GRASS commands | | |
| E GeoServer/PostGIS tools | | |
| 🗄 🦉 Modeler-only tools | | |
| 🖳 🖽 😳 Orfeo Toolbox (Image analysis) | | |
| United States and Stat | | |
| How We R scripts | | |
| □ ··· 🚫 SAGA (2.1) | | |
| Activate | × | |
| Enable SAGA 2.0.8 compatibility | | |
| Log console output | × | |
| Log execution commands | × | |
| Resampling region cellsize | 1.0 | |
| Resampling region max x | 1000.0 | |
| Resampling region max y | 1000.0 | |
| Resampling region min x | 0.0 | |
| Resampling region min y | 0.0 | |
| SAGA folder | C:\saga21 | |
| Use min covering grid system for resampling | × | |
| 🗄 🖳 TauDEM (hydrologic analysis) | | |
| 🔄 🖽 🤾 Tools for LiDAR data | | |
| 🖽 🔤 Scripts | | |
| | | OK Cancel |

Calea către SAGA trebuie să fie deja configurată și să indice folderul în care este instalat SAGA.

Dacă ați instalat QGIS fără să folosiți programul autonom de instalare, atunci trebuie să introduceți calea către SAGA (care trebuie să fie deja instalată). Versiunea necesară este SAGA 2.1 [aceasta se schimbă în funcție de versiunile de SAGA].

In case you are using Linux, you do not have to set the path to your SAGA installation in the processing configuration. Instead, you must install SAGA and make sure that the SAGA folder is in PATH, so it can be called from the console (just open a console and type saga_cmd to check it). Under Linux, the target version for SAGA is also 2.1, but in some installations (such as the OSGeo Live DVD) you might have just 2.0.8 available. There are some 2.1 packages available, but they are not commonly installed and might have some issues, so if you prefer to use the more common and stable 2.0.8, you can do it by enabling 2.0.8 compatibility in the configuration dialog, under the SAGA group.

| Q Processing options | | <u>? ×</u> |
|---|-------------|------------|
| Search | | |
| Setting | Value | _ |
| Securing Providers GDAL/OGR GRASS commands GeoServer/PostGIS tools Modeler-only tools Orfeo Toolbox (Image analysis) Offeo Toolbox (Image analysis) GGIS geoalgorithms R scripts SAGA (2.1) SAGA (2.1) <td>Value Value</td> <td></td> | Value Value | |
| 🗄 🗠 🔽 Scripts | | |
| | | OK Cancel |

O dată ce SAGA este instalat, puteți lansa un algoritm SAGA printr-un dublu clic pe numele său, similar celorlalți algoritmi. Din moment ce folosim interfața simplificată, nu știm care dintre algoritmi se bazează pe SAGA sau pe o altă aplicație externă, dar dacă se întâmplă să rulați unul pentru care aplicația corespunzătoare nu este instalată, vi se va indica acest lucru.



În cazul nostru, presupunând că aplicația SAGA este instalată și configurată corect, nu ar trebui să vedeți această fereastră ci, în schimb, veți obține parametrii dialogului.

Să încercăm cu un algoritm bazat pe SAGA, cel denumit Split shapes layer randomly.

| 🦞 Split shapes layer randomly | | | × |
|--|-----|-------|--------|
| Parameters Log Help | | | |
| Shapes | | | |
| points [EPSG:4326] | | | |
| Relation B / A | | | |
| 50 | | | |
| Group A | | | |
| [Save to temporary file] | | | |
| X Open output file after running algorithm | | | |
| Group B | | | |
| [Save to temporary file] | | | |
| X Open output file after running algorithm | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 0% | | | |
| | Run | Close | Cancel |

Folosind ca intrare stratul de puncte din proiectul corespunzător acestei lecții, împreună cu valorile implicite ale parametrilor, veți obține ceva de genul următor (divizarea este aleatorie, de aceea rezultatul dvs. poate fi diferit).



The input layer has been split in two layers, each one with the same number of points. This result has been computed by SAGA, and later taken by QGIS and added to the QGIS project.

If all goes fine, you will not notice any difference between this SAGA-based algorithm and one of the others that we have previously run. However, SAGA might, for some reason, not be able to produce a result and not generate the

file that QGIS is expecting. In that case, there will be problems adding the result to the QGIS project, and an error message like this will be shown.

| ¢ | Problem loading output layers | × |
|---|---|---|
| | Oooops! The following output layers could not be open | ן |
| | • Graticule: C: \Users\Volaya\AppData\Local\Temp\processing\0e1f1f410f894225bf59bdf72d187c4 2\GRATICULE.shp | |
| | The above files could not be opened, which probably indicates that they were not correctly produced by the executed algorithm | |
| | Checking the log information might help you see why those layers were not created as expected | |
| | This algorithm requires SAGA to be run. A test to check if SAGA is correctly installed and configured in your system has been performed, with the following result: | |
| | SAGA seems to be correctly installed and configured | |
| | | |
| | | |
| | | |
| | | J |
| | Close |] |

This kind of problems might happen, even if SAGA (or any other application that we are calling from the processing framework) is correctly installed, and it is important to know how to deal with them. Let's produce one of those error messages.

Deschideți algoritmul Creare graticule, și folosiți-l cu următoarele valori.

| 🦞 Create graticule | | | × |
|--|-----|-------|---------|
| Parameters Log Help | | | |
| Extent | | | |
| [Not selected] | | • | |
| Output extent(xmin, xmax, ymin, ymax) | | | |
| 0,1,0,1 | | | |
| Division Width | | | |
| 2 | | | |
| Division Height | | | |
| 2 | | | |
| Туре | | | |
| [0] Lines | | | |
| Graticule | | | |
| [Save to temporary file] | | | |
| Open output file after running algorithm | | | |
| 0% | | | |
| ~ | Run | Close | Cancel |

We are using width and height values that is larger than the specified extent, so SAGA cannot produce any output. In other words, the parameter values are wrong, but they are not checked until SAGA gets them and tries to create the graticule. Since it cannot create it, it will not produce the expected layer, and you will see the error message shown above.

Notă: În SAGA >= 2.2.3, comanda va ajusta în mod automat datele de intrare greșite, așa că nu veți obține o eroare. Pentru a provoca o eroare, utilizați valori negative la divizare.

Understanding this kind of problems will help you solve them and find an explanation to what is happening. As you can see in the error message, a test is performed to check that the connection with SAGA is working correctly, indicating you that there might be a problem in how the algorithm was executed. This applies not only to SAGA, but also to other external applications as well.

In the next lesson we will introduce the processing log, where information about commands run by geoalgorithms is kept, and you will see how to get more detail when issues like this appear.

17.9 Jurnalul de Procesare

Notă: Această lecție descrie procesarea jurnalului.

Toate analizele efectuate de cadrul de procesare se înregistrează în sistemul de jurnalizare al aplicației QGIS. Acest lucru vă permite să aflați mai multe despre istoricul utilizării uneltelor de procesare, pentru a putea depăși problemele atunci când acestea apar și, de asemenea, vă facilitează repetarea operațiunilor anterioare, întrucât sistemul de jurnalizare dispune de o anumită interactivitate.

To open the log, click on the balloon at the bottom right, on the QGIS status bar. Some algorithms might leave here information about their execution. For instance, those algorithms that call an external application usually log the console output of that application to this entry. If you have a look at it, you will see that the output of the SAGA algorithm that we just run (and that fails to execute because input data was not correct) is stored here.

Aceste informații v-ar putea fi utile, pentru a înțelege ce se întâmplă. Utilizatorii avansați vor putea să analizeze o ieșire, pentru a afla de ce a eșuat algoritmul. Dacă nu sunteți un utilizator avansat, informațiile respective vor fi utile celor care vă vor ajuta la diagnosticarea unei probleme, pentru a determina dacă a fost cauzată de instalarea unei aplicații externe sau de datele pe care le-ați introdus.

Chiar dacă un algoritm poate fi executat, în unele cazuri aceștia ar putea emite avertismente dacă rezultatul s-ar putea să nu fie corect. Un exemplu ar fi execuția unui algoritm de interpolare pe baza unui număr foarte mic de puncte, care, deși se poate desfășura, poate genera un rezultat incorect, atât timp cât ar fi trebuit să fie folosite mai multe puncte. Este foarte bune să verificați în mod regulat acest tip de avertismente, dacă nu vă sunt clare anumite aspecte ale unui algoritm.

From the *Processing* \succ *History*... menu, you'll find *algorithms* that are executed, regardless of they are executed from the GUI or from the console (which will be explained later in this manual). The execution is stored in this dialog as a console call. That means that everytime you run an algorithm, a console command is added to the log, and you have the full history of your working session. Here is how that history looks like:

| 🦞 History and log 🔹 🔋 🗙 |
|---|
| 🗄 🔐 INFO |
| WARNING |
| |
| [Sun Aug 25 2013 13:22:20] processing.runalg("saga:splitshapeslaverrandomly", "C:\\User |
| [Sun Aug 25 2013 13:22:11] processing.runalg("saga:splitshapeslaverrandomly", "D:\\gith |
| [Sun Aug 25 2013 13:21:41] processing.runalg("saga:splitshapeslaverrandomly", "D:\\gith |
| [Sun Aug 25 2013 13:16:36] processing.runalg("saga:splitshapeslayerrandomly", "D:\\gith |
| [Sun Aug 25 2013 13:16:02] processing.runalg("saga:splitshapeslayerrandomly", "D:\\gith |
| [Sun Aug 25 2013 13:15:29] processing.runalg("saga:splitshapeslayerrandomly", "D:\\gith |
| [Sun Aug 25 2013 13:13:16] processing.runalg("saga:thiessenpolygons", "C:\\Users\\Volay |
| [Sun Aug 25 2013 13:13:16] processing.runalg("saga:splitshapeslayerrandomly", "C:\\User |
| [Sun Aug 25 2013 13:12:48] processing.runalg("saga:splitshapeslayerrandomly", "D:\\gith |
| [Sun Aug 25 2013 11:46:19] processing.runalg("ggis:reprojectlayer", "D:/github/sextante |
| [Sun Aug 25 2013 11:44:22] processing.runalg("saga:clipgridwithpolygon", "C:\\Users\\Vol |
| 🔚 🔂 [Sun Aug 25 2013 11:43:51] processing.runalg("saga:dosegaps", "C:\\Users\\Volaya\\App |
| 🔚 🔂 ISun Aug 25 2013 11:43:21] processing runala/"saga:shapestogrid" "Di/oithub/sevtante. |
| processing runale ("sagausplitsbaged averrandomly" "D: Voithub Vsevtante- |
| manual/\data/\first_saga_alg/\points.shp",50.None.None) |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| Clear Close |

Acest lucru poate fi foarte util atunci când începe lucrul cu consola, pentru a afla mai multe despre sintaxa algoritmilor. Îl vom folosi când vom discuta despre modul în care se pot rula comenzile de analiză din consolă.

17.9.1 ???? Follow Along

The history is also interactive, and you can run any previous algorithm just by double-clicking on its entry. This is an easy way of replicating the work we already did before.

For instance, try the following:

- 1. Open the data corresponding to the first chapter of this manual and run the algorithm explained there.
- 2. Now go to the History dialog and locate the last algorithm in the list, which corresponds to the algorithm you have just run.
- 3. Double-click on it and a new result should be produced, just like when you run it using the normal dialog and calling it from the toolbox.

17.9.2 ???? Follow Along

You can also modify the algorithm.

- 1. Copy the algorithm call
- 2. Open the *Plugins* \blacktriangleright *Python console*
- 3. Paste your copy to run the analysis; change the parameters at will.
- 4. To display the resulting file, you may want to replace processing.run in the pasted command with processing.runAndLoadResults.

17.10 Calculatorul raster. Valorile fără-date

Notă: În această lecție vom vedea cum se utilizează calculatorul raster pentru a efectua unele operații asupra straturilor raster. Vom explica, de asemenea, ce sunt valorile fără-date și modul în care lucrează cu ele calculatorul și alți algoritmi

Calculatorul raster reprezintă unul dintre cei mai puternici algoritmi. Este un algoritm foarte flexibil și versatil, care poate fi folosit în diverse calcule, și care va deveni în curând o parte importantă a setului dvs. cu instrumente.

În această lecție vom efectua unele calcule, majoritatea simple, cu ajutorul calculatorului raster. Acest lucru ne va permite să observăm modul de gestionare a unor situații particulare cu care ne-am putea confrunta. Înțelegerea acestor aspecte este importantă pentru obținerea ulterioară a rezultatelor așteptate și, de asemenea, pentru deprinderea tehnicilor comune care se pot aplica.

Deschideti proiectul QGIS corespunzător acestei lecții și veți vedea că ea conține mai multe straturi raster.

Acum deschideți caseta de instrumente și caseta de dialog corespunzătoare calculatorului raster.

| 🦞 Raster calculator | X |
|--|--------|
| Parameters Log Help | |
| Perturbativ | |
| Raster layers | |
| 0 elements selected | |
| Formula | |
| | |
| Result | |
| [Save to temporary file] | |
| X Open output file after running algorithm | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| <u>~</u> | |
| 0% | |
| Run Close | Cancel |
| | |

Notă: Interfața diferă pentru versiunile recente.

Dialogul conține 2 parametri.

- Straturile de utilizat pentru analiză. Aceasta este o intrare multiplă, ceea ce înseamnă că puteți selecta câte straturi doriți. Faceți clic pe butonul din partea dreaptă și apoi selectați straturile pe care doriți să le utilizați în dialogul care va apărea.
- Formula de aplicat. Formula folosește ca variabile straturile selectate în parametrul de mai sus, folosind litere din alfabet (a, b, c...) sau g1, g2, g3.... Adică, formula a + 2 * b este aceeași cu g1 + 2 * g2 și va calcula suma valorii din primul strat plus de două ori valoarea din al doilea strat. Ordinea straturilor corespunde ordinii pe care o vedeți în dialogul de selecție.

Atenționare: Calculator ține cont de majuscule/minuscule.

Pentru a începe, vom schimba unitățile DEM-ului din metri în picioare. Formula de care avem nevoie este:

h' = h * 3.28084

Selectați DEM-ul din câmpul straturilor și introduceți a * 3.28084 în câmpul formulei.

Atenționare: Pentru utilizatorii care nu sunt englezi: folosiți întotdeauna ".", nu ".".

Faceți clic pe *Run* pentru a rula algoritmul. Veți obține un strat care are același aspect cu cel al stratului de intrare, dar cu valori diferite. Stratul de intrare pe care l-am folosit are valori valide în toate celulele sale, astfel încât ultimul parametru nu are niciun efect.

Să facem acum un alt calcul, de data aceasta pe stratul *accflow*. Acest strat conține valori ale debitului acumulat, un parametru hidrologic. Conține acele valori numai în zona unui bazin hidrografic dat, cu valori fără date în afara acestuia. După cum puteți vedea, randarea nu este foarte informativă, din cauza modului în care sunt distribuite valorile. Folosind logaritmul acestei acumulări de flux va rezulta o reprezentare mult mai informativă. O putem calcula folosind calculatorul raster.

Deschideți iarăși dialogul algoritmului, selectați stratul *accflow* ca singur strat de intrare, apoi introduceți următoarea formulă: log(a).

Acesta este stratul pe care îl veți obține.



Dacă selectați instrumentul *Identificare* pentru a cunoaște valoarea unui strat într-un anumit punct, selectați stratul pe care tocmai l-am creat și faceți clic pe un punct din afara bazinului, veți vedea că acesta conține o valoare no-data.

| 🦸 Identify Res | ults | | | ? × |
|-----------------------------|-------|-----------|-----|------|
| Feature | | Value | | |
| ⊡- <u>{0</u> ⊟- log_laye | r | log_layer | | |
| ⊞… (Der | ived) | | | |
| Band | 11 | no data | | |
| | | | | |
| | | | ose | Help |

Pentru exercițiul următor vom folosi două straturi în loc de unul și vom obține un DEM cu valori de cotă valide numai în bazinul definit în cel de-al doilea strat. Deschideți dialogul calculatorului și alegeți ambele straturi ale proiectului în câmpul straturilor de intrare. Introduceți următoarea formulă în câmpul corespunzător:

a/a * b

a refers to the accumulated flow layer (since it is the first one to appear in the list) and b refers to the DEM. What we are doing in the first part of the formula here is to divide the accumulated flow layer by itself, which will result in a value of 1 inside the basin, and a no-data value outside. Then we multiply by the DEM, to get the elevation value in those cells inside the basin (DEM * 1 = DEM) and the no-data value outside (DEM * $no_{data} = no_{data}$)

Acesta este stratul rezultat.



This technique is used frequently to *mask* values in a raster layer, and is useful whenever you want to perform calculations for a region other that the arbitrary rectangular region that is used by raster layer. For instance, an elevation histogram of a raster layer doesn't have much meaning. If it is instead computed using only values

corresponding to a basin (as in he case above), the result that we obtain is a meaningful one that actually gives information about the configuration of the basin.

There are other interesting things about this algorithm that we have just run, apart from the no-data values and how they are handled. If you have a look at the extents of the layers that we have multiplied (you can do it double-clicking on their names of the layer in the table of contents and looking at their properties), you will see that they are not the same, since the extent covered by the flow accumulation layer is smaller that the extent of the full DEM.

That means that those layers do not match, and that they cannot be multiplied directly without homogenizing those sizes and extents by resampling one or both layers. However, we did not do anything. QGIS takes care of this situation and automatically resamples input layers when needed. The output extent is the minimum covering extent calculated from the input layers, and the minimum cell size of their cellsizes.

In this case (and in most cases), this produces the desired results, but you should always be aware of the additional operations that are taking place, since they might affect the result. In cases when this behaviour might not be the desired, manual resampling should be applied in advance. In later chapters, we will see more about the behaviour of algorithms when using multiple raster layers.

Să încheiem această lecție cu un alt exercițiu de mascare. Urmează să calculăm panta în toate zonele cu o altitudine între 1000 și 1500 de metri.

În acest caz, nu dispunem de un strat pentru a-l utiliza drept mască, dar îl putem crea cu ajutorul calculatorului.

Pornește calculatorul folosind DEM-ul doar ca pe un strat de intrare, și următoarea formulă

ifelse(abs(a-1250) < 250, 1, 0/0)

După cum puteți vedea, putem folosi calculatorul nu numai pentru a face operații algebrice simple, ci și pentru a efectua calcule mai complexe, care implică propoziții condiționate, precum cea de mai sus.

Rezultatul are o valoare de 1 în interiorul gamei în care dorim să lucrăm, și valori fără-date în celulele din exterior.



The no-data value comes from the 0/0 expression. Since that is an undetermined value, SAGA will add a NaN (Not a Number) value, which is actually handled as a no-data value. With this little trick you can set a no-data value without needing to know what the no-data value of the cell is.

Now you just have to multiply it by the slope layer included in the project, and you will get the desired result.

All that can be done in a single operation with the calculator. We leave that as an exercise for the reader.

17.11 Calculatorul vectorial

Notă: În această lecție vom vedea cum se vor adăuga noi atribute în stratul vectorial, pe baza unei expresii matematice, cu ajutorul calculatorului vectorial.

Cunoaștem deja cum să utilizăm calculatorul raster pentru a crea noi straturi raster cu ajutorul expresiilor matematice. Un algoritm similar este disponibil pentru straturi vectoriale, și generează un nou strat cu aceleași atribute ale stratului de intrare, plus unul suplimentar cu rezultatul expresiei introduse. Algoritmul este denumit *Calculator de câmpuri* și are următoarea fereastră de dialog cu parametri.

| 🦞 Field calculator | × |
|---|-----|
| Parameters Log Help | |
| | |
| Input layer | |
| census_boundaries [USER:100001] | |
| Result field name | |
| | |
| Field type | |
| Float 🗸 | |
| Field length | |
| 10 | |
| Field precision | |
| 5 | |
| Formula | |
| | |
| Output layer | |
| [Save to temporary file] | |
| Copen output file after running algorithm | Ā |
| | |
| | |
| 0% | |
| Run Close Can | :el |

Notă: În versiunile mai noi de Processing, interfața s-a schimbat considerabil, fiind mult mai puternică și mai ușor de utilizat.

Aici sunt câteva exemple de utilizare ale acestui algoritm.

First, let's calculate the population density of white people in each polygon, which represents a census. We have two fields in the attributes table that we can use for that, namely WHITE and SHAPE_AREA. We just have to divide them and multiply by one million (to have density per square km), so we can use the following formula in the corresponding field

("WHITE" / "SHAPE_AREA") * 1000000

Dialogul parametrilor trebuie completați așa cum se arată mai jos.

| 🦞 Field calculator | × |
|---|---|
| Parameters Log Help | |
| Input layer | |
| Result field name | |
| WHITE_DENS | |
| Field type | |
| Float | |
| Field length | |
| 10 | |
| Field precision | |
| 5 | |
| Formula | |
| WHITE / SHAPE_AREA | |
| Output layer | |
| [Save to temporary file] | |
| Copen output file after running algorithm | - |
| 0% | |
| Run Close Cancel | |

Acest lucru va genera un nou câmp denumit WHITE_DENS

Now let's calculate the ratio between the MALES and FEMALES fields to create a new one that indicates if male population is numerically predominant over female population.

Introduceți următoarea formulă

"MALES" / "FEMALES"

Fereastra parametrilor ar trebui să arate acest lucru, înainte de a apăsa pe butonul OK.

| 🗑 Field calculator | x |
|--|-----|
| Parameters Log Help | |
| Input layer | P |
| census_boundaries [USER:100001] | |
| Result field name | |
| RATIO | |
| Field type | |
| Float | |
| Field length | *** |
| 10 | |
| Field precision | |
| 5 | |
| Formula | |
| float(MALES) / FEMALES | |
| Output layer | |
| [Save to temporary file] | |
| X Open output file after running algorithm | |
| | |
| 100% | |
| Run Close Cancel | |

In earlier version, since both fields are of type integer, the result would be truncated to an integer. In this case the formula should be: 1.0 * "MALES" / "FEMALES", to indicate that we want floating point number a result.

We can use conditional functions to have a new field with male or female text strings instead of those ratio value, using the following formula:

CASE WHEN "MALES" > "FEMALES" THEN 'male' ELSE 'female' END

Fereastra parametrilor ar trebui să arate acest lucru.

| 🤨 Field calculator | × |
|---|----|
| Parameters Log Help | |
| Input layer | |
| census_boundaries [USER:100001] | |
| Result field name | |
| PREDOMIN | |
| Field type | |
| String | |
| Field length | |
| 10 | |
| Field precision | |
| 5 | |
| Formula | |
| 'male' if MALES > FEMALES else 'female' | |
| Output layer | |
| [Save to temporary file] | |
| Copen output file after running algorithm | |
| | |
| | |
| 100% | |
| Run Close Cano | el |

Un calculator de câmpuri python este disponibil în Advanced Python field calculator, care nu va fi detaliat aici

| Advanced Python field calculator | | | | |
|--|----|-----|-------|--------|
| Parameters Log Help | | | | |
| Input laver | | | | |
| consult houndaries BUSED : 10000 1] | | | | |
| census_boundaries [USER: 100001] | | | | |
| Result field name | | | | |
| NewField | | | | |
| Field type | | | | |
| Integer | | | | • |
| Field length | | | | |
| 10 | | | | - |
| Field precision | | | | |
| 0 | | | | - |
| Global expression | | | | |
| | | | | |
| Formula | | | | |
| value = | | | | |
| Output layer | | | | |
| [Save to temporary file] | | | | |
| Open output file after running algorithm | | | | |
| 00 | /0 | | | |
| 0 | | | | |
| | | Run | Close | Cancel |

17.12 Definirea eextinderilor

Notă: În această lecție vom vedea cum se definesc extinderile, acest lucru fiind necesar unor algoritmi, mai ales cele pentru rastere.

Unii algoritmi au nevoie de o extindere, pentru a defini zona care urmează să fie acoperită de analiză și, de obicei, pentru a defini extinderea stratului rezultat.

Atunci când este cerută o anumită extindere, aceasta poate fi definită manual, prin introducerea celor patru valori care o definesc (min X, min Y, max X, max Y), dar există și alte modalități, mai practice și mai interesante, care pot face la fel de bine acest lucru. Vom vedea toate acestea în cadrul lecției.

Mai întâi, haideți să deschidem un algoritm care necesită definirea unei extinderi. Deschideți algoritmul de *Rasterizare*, care creează un strat raster dintr-un strat vectorial.

| 2 Shapes to grid | × | | | |
|--|--------|--|--|--|
| Parameters Log Help | | | | |
| Shapes | | | | |
| union [EPSG:23030] | • 🦻 | | | |
| Attribute | | | | |
| D | - | | | |
| Method for Multiple Values | | | | |
| [0] first | - | | | |
| Method for Lines | | | | |
| [0] thin | | | | |
| Preferred Target Grid Type | | | | |
| [0] Integer (1 byte) | | | | |
| Output extent(xmin, xmax, ymin, ymax) | | | | |
| [Leave blank to use min covering extent] | | | | |
| Cellsize | | | | |
| 100.0 | | | | |
| Grid | | | | |
| [Save to temporary file] | | | | |
| Open output file after running algorithm | | | | |
| 0% | | | | |
| Run Close | Cancel | | | |

All the parameters, except for the last two ones, are used to define which layer is to be rasterized, and configure how the rasterization process should work. The two last parameters, on the other hand, define the characteristics of the output layer. That means that they define the area that is covered (which is not necessarily the same area covered by the input vector layer), and the resolution/cellsize (which cannot be inferred from the vector layer, since vector layers do not have a cellsize).

Primul lucru pe care îl puteți face este să tastați cele 4 valori de definire, prezentate anterior, separate prin virgulă.

| Output extent(xmin, xmax, ymin, ymax) | |
|---------------------------------------|--|
| 0,90,0,90 | |

That doesn't need any extra explanation. While this is the most flexible option, it is also the less practical in some cases, and that's why other options are implemented. To access them, you have to click on the button on the right-hand side of the extent text box.



Să vedem ce poate face fiecare.

Prima opțiune este Use layer/canvas extent, care va afișa dialogul de selecție de mai jos.



Here you can select the extent of the canvas (the extent covered by the current zoom), or the extension any of the available layers. Select it and click on *OK*, and the text box will be automatically filled with the corresponding values.

The second option is *Select extent on canvas*. In this case, the algorithm dialog disappears and you can click and drag on the QGIS canvas to define the desired extent.



După ce eliberați butonul mouse-ului, dialogul va reapărea iar caseta de text va conține deja valorile corespunzătoare în extinderea definită.

The last option is *Use min covering extent from input layers*, which is the default option. This will compute the min covering extent of all layers used to run the algorithm, and there is no need to enter any value in the text box. In the case of a single input layer, as in the algorithm we are running, the same extent can be obtained by selecting that same input layer in the *Use layer/canvas extent* that we already saw. However, when there are several input layers, the min covering extent does not correspond to any of the input layer extent, since it is computed from all of them together.

Vom folosi această ultimă metodă pentru a executa algoritmul nostru de rasterizare.

Completați dialogul parametrilor după cum se arată în continuare, apoi apăsați OK.
| 🦞 Shapes to grid | × |
|--|----------|
| Parameters Log Help | |
| Shapes | |
| watersheds [EPSG:23030] | _ ₹ 2 |
| Attribute | |
| ID | • |
| Method for Multiple Values | |
| [0] first | • |
| Method for Lines | |
| [0] thin | • |
| Preferred Target Grid Type | |
| [3] Floating Point (4 byte) | - |
| Output extent(xmin, xmax, ymin, ymax) | |
| [Leave blank to use min covering extent] | |
| Cellsize | |
| 2 | |
| Grid | |
| [Save to temporary file] | |
| Open output file after running algorithm | |
| U |] |
| 100% | |
| Run Close | Cancel |

Notă: In this case, better use an *Integer (1 byte)* instead of a *Floating point (4 byte)*, since the *NAME* is an integer with maximum value=64. This will result in a smaller file size and faster computations.

Veți primi un strat raster care acoperă exact zona acoperită de stratul vectorial inițial.



In some cases, the last option, *Use min covering extent from input layers*, might not be available. This will happen in those algorithm that do not have input layers, but just parameters of other types. In that case, you will have to enter the value manually or use any of the other options.

Notice that, when a selection exist, the extent of the layer is that of the whole set of features, and the selection is not used to compute the extent, even though the rasterization is executed on the selected items only. In that case, you might want to actually create a new layer from the selection, and then use it as input.

17.13 leşiri HTML

Notă: În această lecție învățăm cum administrează QGIS ieșirile în format HTML, care sunt utilizate pentru a produce text si grafică.

Toate rezultatele obținute până în prezent au fost sub formă de straturi (vectoriale sau raster). Cu toate acestea, unii algoritmi generează ieșiri sub formă de text și grafică. Acestea sunt încapsulate în fișiere HTML și afișate în așa–numitul *Vizualizator de rezultate*, care reprezintă un alt element al cadrului de procesare.

Să vedem unul dintre acești algoritmi pentru a înțelege cum funcționează.

Deschideți proiectul cu datele de utilizat în această lecție, apoi deschideți algoritmul *Statistici de bază pentru câmpurile numerice*.

| 🖗 Basic statistics for numeric fields 🛛 🗶 |
|---|
| Parameters Log Help |
| Input vector layer |
| census_boundaries [USER: 100001] |
| Field to calculate statistics on |
| POP2000 🔻 |
| Statistics for numeric field |
| [Save to temporary file] |
| |
| |
| |
| |
| |
| |
| |
| |
| |
| 0% |
| Run Close Cancel |

Algoritmul este destul de simplu, trebuind să selectați doar stratul de utilizat și unul din câmpurile sale (unul numeric). Ieșirea este de tip HTML, dar caseta corespunzătoare funcționează similar cu cea pentru o ieșire de tip vectorial sau raster. Puteți introduce o cale de fișier sau să o lăsați necompletată, pentru ca salvarea să aibă loc într-un fișier temporar. Totuși, în acest caz sunt acceptate doar extensiile html și htm, nefiind nici o modalitate de a modifica formatul de ieșire.

Rulați algoritmul, selectând ca intrare singurul strat din proiect și câmpul *POP2000*, după care va apărea un nou dialog, similar celui prezentat anterior, iar o dată ce algoritmul este executat dialogul parametrilor se va închide.

| 🦞 Results | | ? × |
|--------------------------------|--|-------|
| E Statistics for numeric field | Count: 485 | |
| | Unique values: 403 | |
| | Minimum value: 0.0 | |
| | Maximum value: 3198.0 | |
| | Range: 3198.0 | |
| | Sum: 554636.0 | |
| | Mean value: 1143.57938144 | |
| | Median value: 1074.0 | |
| | Standard deviation: 527.408287222 | |
| | Coefficient of Variation: 0.461190797753 | |
| | | |
| | | |
| | | |
| | | |
| | | Close |

Acesta este *Vizualizatorul de rezultate*. Aici se păstrează tot rezultatul HTML generat în timpul sesiunii curente, într-o formă ușor accesibilă, astfel încât să-l puteți verifica rapid, ori de câte ori este nevoie. Orice modificare adusă straturilor se va pierde la închiderea QGIS, dacă ați ales ieșirea într-un fișier temporar. Dacă ați efectuat salvarea într-o cale permanentă, fișierul se va păstra, dar nu va apărea în *Vizualizatorul de rezultate* la următoarea deschidere a aplicației QGIS.

Some algorithms generate text that cannot be divided into other more detailed outputs. That is the case if, for instance, the algorithm captures the text output from an external process. In other cases, the output is presented as text, but internally is divided into several smaller outputs, usually in the form of numeric values. The algorithm that we have just executed is one of them. Each one of those values is handled as a single output, and stored in a variable. This has no importance at all now, but once we move to the model designer, you will see that it will allow us to use those values as numeric inputs for other algorithms.

17.14 Un prim exemplu de analiză

Notă: În această lecție, vom efectua o analiză reală, folosind doar bara de instrumente, astfel încât să vă familiarizați cu elementele cadrului de prelucrare.

O dată ce totul este configurat, iar algoritmii externi sunt gata de utilizare, dispunem de un instrument foarte puternic pentru efectuarea analizelor spațiale. Este timpul să elaborăm un exercițiu mai amplu, folosind date din lumea reală.

We will be using the well-known dataset that John Snow used in 1854, in his groundbreaking work (https://en. wikipedia.org/wiki/John_Snow_%28physician%29), and we will get some interesting results. The analysis of this dataset is pretty obvious and there is no need for sophisticated GIS techniques to end up with good results and conclusions, but it is a good way of showing how these spatial problems can be analyzed and solved by using different processing tools.

Setul de date conține fișierul shape cu decesele cauzate de holeră și locațiile pompelor, precum și o hartă OSM randată în format TIFF. Deschideți proiectul QGIS corespunzător acestei lecții.



The first thing to do is to calculate the Voronoi diagram (a.k.a. Thiessen polygons) of the pumps layer, to get the influence zone of each pump. The *Voronoi Diagram* algorithm can be used for that.

| 🤨 Voronoi Diagram | | | × |
|---|----|-------|--------|
| Parameters Help | | | |
| Detaile | | | |
| Points Layer | | | |
| Pumps | | | 2 |
| Output Shapefile | | | |
| [Save to temporary file] | | | |
| Copen output file after running algorithm | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 0% | | | |
| | ОК | Close | Cancel |

Destul de ușor, dar ne va oferi deja informații interesante.



În mod evident, cele mai multe cazuri se încadrează într-unul dintre poligoane

To get a more quantitative result, we can count the number of deaths in each polygon. Since each point represents a building where deaths occured, and the number of deaths is stored in an attribute, we cannot just count the points. We need a weighted count, so we will use the *Count points in polygon (weighted)* tool.

| 🕻 Count points in polygon(weighted) | × |
|--|-----------------------|
| Parameters Help | |
| Polygons | |
| Output Shapefile | ▼ (⊉) |
| Points | |
| Cholera_Deaths | |
| Weight field | |
| COUNT | ▼ |
| Count field name | |
| DEATHS | |
| Result | |
| [Save to temporary file] | |
| X Open output file after running algorithm | |
| | |
| 0% | |
| | OK Close Cancel |

The new field will be called *DEATHS*, and we use the *COUNT* field as weighting field. The resulting table clearly reflects that the number of deaths in the polygon corresponding to the first pump is much larger than the other ones.



Another good way of visualizing the dependence of each point in the Cholera_deaths layer with a point in the Pumps layer is to draw a line to the closest one. This can be done with the *Distance to nearest hub* tool, and using the configuration shown next.

| 🧿 Distance to nearest hub | | | × |
|--|-----|----------|-------------|
| Parameters Log Help | | | |
| Source Points Layer | | . |]@] |
| Destination Hubs Layer | | | |
| Pumps [USER: 100000] | | | - 0 |
| Hub Layer Name Attribute | | | |
| Id | | | - |
| Output Shape Type | | | |
| Line to Hub | | | _ |
| Measurement Unit | | | |
| Meters | | | • |
| Output | | | |
| [Save to temporary file] | | | |
| Open output file after running algorithm | | | |
| 00/- | | | |
| 0% | Due | Class | Cancel |
| | Run | Close | Cancel |

Rezultatul arată în felul următor:



Although the number of lines is larger in the case of the central pump, do not forget that this does not represent the number of deaths, but the number of locations where cholera cases were found. It is a representative parameter, but it is not considering that some locations might have more cases than other.

A density layer will also give us a very clear view of what is happening. We can create it with the *Kernel density* algorithm. Using the *Cholera_deaths* layer, its *COUNT* field as weight field, with a radius of 100, the extent and cellsize of the streets raster layer, we get something like this.



Amintiți-vă că, pentru a obține întinderea rezultatului, nu trebuie să o introduceți. Faceți clic pe butonul din partea dreaptă și selectați *Use layer/canvas extent*.

| 🔃 Kernel density estimation | × |
|--|---|
| Parameters Log Help | |
| Points | |
| Cholera_Deaths [USER: 100000] | |
| Weight | |
| COUNT | - III |
| Radius | |
| 100 | |
| Kernel | |
| [0] quartic kernel | |
| Target Grid | |
| [0] user defined | |
| Output extent(xmin, xmax, ymin, ymax) | |
| [Leave blank to use min covering extent] | |
| Cellsize | Use layer/canvas extent |
| 1 | Lise min convering extent from input layers |
| Grid | |
| [[[]]] | |
| 0 | |
| 0% | |
| Run Close C | Cancel |

Selectați stratul străzilor raster iar întinderea sa va fi adăugată automat în câmpul de text. Trebuie să faceți același lucru cu dimensiunea celulei, selectând-o, de asemenea, din acel strat.

Prin combinarea cu stratul de pompe, vom vedea că există o pompă în mod clar în punctul fierbinte, în care se constată densitatea maximă a cazurilor de deces.

17.15 Decuparea și îmbinarea straturilor raster

Notă: În această lecție vom vedea un alt exemplu de pregătire a datelor spațiale, pentru a continua utilizarea geoalgoritmilor în scenarii din lumea reală.

În această lecție, vom calcula un strat de pantă pentru suprafața care înconjoară o zonă dată a orașului, dintr-un strat vectorial cu un singur poligon. DEM-ul de bază este împărțit în două straturi raster care, împreună, acoperă o suprafață mult mai mare decât cea din jurul orașului în care ne dorim să lucrăm. Dacă deschideți proiectul corespunzător acestei lecții, veți vedea ceva de genul următor.



Aceste straturi au două probleme:

- Acestea acoperă o zonă care este prea mare pentru ceea ce dorim (suntem interesați de o regiune mai mică din jurul centrului orașului)
- Ele se află în două fișiere diferite (limitele orașului se încadrează doar într-un singur strat raster, dar, așa cum s-a mai zis, dorim o anumită suprafață adițională în jurul acestuia).

Ambele sunt ușor rezolvabile cu geoalgoritmii corespunzători.

În primul rând, vom crea un dreptunghi care definește zona dorită. Pentru aceasta, vom crea un strat care conține caseta de încadrare a stratului, împreună cu limitele suprafeței orașului, apoi vom crea un tampon, astfel încât să existe un strat raster care îl acoperă un pic mai mult decât este necesar.

Pentru a calcula caseta de încadrare, putem folosi algoritmul Poligonului din extinderea stratului

| 😧 Polygon from layer extent |
|--|
| Parameters Log Help |
| Input layer |
| medford_citylimits 		 🔊 |
| Calculate extent for each feature separately |
| No |
| Output layer |
| [Save to temporary file] |
| |
| 0% |
| OK Close Cancel |

Pentru a-l tampona, vom folosi algorimul Fixed distance buffer, cu următoarele valori pentru parametri.

| 🦞 Fixed distance buffer |
|--|
| Parameters Log Help |
| Input layer |
| medford_citylimits [EPSG:4326] |
| Distance |
| .25 |
| Segments |
| 5 |
| Dissolve result |
| No |
| Buffer |
| [Save to temporary file] |
| X Open output file after running algorithm |
| |
| |
| |
| |
| |
| 0% |
| Run Close Cancel |

Atenționare: Sintaxa s-a schimbat în versiunile recente; setați atât Distanța cât și vertexul Arcului la .25

Aici se află caseta de încadrare obținută, utilizând parametrii de mai sus



Este o casetă rotundă, dar putem obține cu ușurință o casetă echivalentă, cu unghiuri drepte, prin rularea algoritmului *Poligon din extinderea stratului* asupra ei. Am putea să tamponăm mai întâi limitele orașului, iar apoi să calculăm extinderea dreptunghiului, economisind un pas.



Veți observa că rasterele au o proiecție diferită față de vector. Prin urmare, ar trebui să le reproiectăm înainte de a trece mai departe, folosind instrumentul *Warp (reproiectare)*.

| Warp (reproject) | | | x |
|--|---|--------|---|
| Parameters Log Help | | | |
| | | | |
| Input layer | | | |
| demFinal | • | | |
| Source SRS (EPSG Code) | | | |
| EPSG:4269 | | | |
| Destination SRS (EPSG Code) | | | |
| EPSG: 102003 | | | |
| Resampling method | _ | | |
| bilinear | | | |
| Output layer | | | |
| [Save to temporary file] | | | |
| X Open output file after running algorithm | | | |
| 0% | | | |
| OK Clos | e | Cancel | |

Notă: Versiunile recente au o interfață mai complexă. Asigurați-vă că cel puțin o metodă de compresie este selectată.

Cu ajutorul acestui strat, care conține caseta de încadrare a stratului raster pe care dorim să-l obținem, putem decupa ambele straturi raster, utilizând algoritmul de *Decupare grilă după un poligon*.

| 😧 Clip Grid with Polygon | × |
|--------------------------|--------|
| Parameters Log Help | |
| | |
| Input | |
| floatn43w124_1 | |
| Polygons | |
| buffered 💌 | |
| Output | |
| [Save to temporary file] | |
| | |
| 0% | |
| OK Close | Cancel |

După ce straturile au fost decupate, ele se pot uni cu ajutorul algoritmului SAGA Straturi raster mozaicate.

| 🦞 Merge raster layers | × |
|--|---------|
| Parameters Log Help | |
| Grids to Merge 2 elements selected Preferred data storage type [7] 4 byte floating point Interpolation | ···· |
| [0] Nearest Neighbor | |
| [0] mean value | |
| Cell Size | |
| 0.00027777777778 | |
| Merged Grid | |
| [Save to temporary file] | |
| Copen output file after running algorithm | |
| 0% | |
| OK Close | Cancel |

Notă: Puteți economisi timp prin efectuarea mai întâi a îmbinării, și abia mai apoi a decupării, evitându-se astfel apelarea de două ori a algoritmului de decupare. Totuși, în cazul în care mai multe straturi cu o dimensiune apreciabilă trebuie îmbinate, vă veți alege cu un strat voluminos, care poate fi dificil de prelucrat ulterior. În acest caz, s-ar putea avea să apelați algoritmul de tăiere de mai multe ori, operație consumatoare de timp, însă nu vă îngrijorați pentru că veți vedea că există unele instrumente adiționale, dedicate automatizării acestui proces. Pentru exemplul următor nu este cazul să vă faceți griji, deoarece folosim numai două straturi.

Cu asta, vom obține DEM-ul final pe care ni-l dorim.



Acum este timpul să calculăm stratul pantei.

Stratul pantei poate fi calculat cu ajutorul algoritmului *Pantă, Aspect, Curbură*, însă DEM-ul obținut în ultima etapă nu este potrivit ca intrare, deoarece valorile altitudinii sunt exprimate în metri, iar mărimea celulei nu este exprimată în metri (stratul folosește un CRS cu coordonate geografice). De aceea, este nevoie de o reproiectare. Pentru a reproiecta stratul raster, se poate utiliza iarăși algoritmul *Warp (reproiectare)*. Vom efectua reproiectarea într-un CRS având metrul ca unitate (cum ar fi 3857), astfel încât vom putea calcula corect panta, fie cu SAGA, ori cu GDAL.

Panta poate fi de acum calculată, cu ajutorul noului DEM.

| Slope, Aspect, Curvature | × |
|--|--------|
| Parameters Log Help | |
| Flouristics | |
| dem - | |
| dem 🗸 🗸 | |
| [5] Fit 2 Degree Polynom (Zevenhergen & Thorpe 1987) | |
| Sione | |
| Isaye to temporary file] | |
| | |
| | |
| [Save to temporary file] | |
| Open output file after running algorithm | |
| | |
| [Save to temporary file] | ·) |
| Open output file after rupping algorithm | |
| Plan Curvature | |
| [Save to temporary file] | |
| Copen output file after running algorithm | |
| Profile Curvature | |
| [Save to temporary file] | |
| Open output file after running algorithm | |
| | |
| | |
| 0% | |
| OK Close | Cancel |

Iar aici este stratul pantei rezultate.



Panta produsă de algoritmul *Pantă, Aspect, Curbură* este exprimată în radiani, deși gradele reprezintă o unitate mai practică și mai comună. Algoritmul de *Conversii metrice* ne va ajuta să facem conversia (dar în cazul în care nu ați fi știut că acest algoritm există, ați fi putut utiliza calculatorul raster, pe care le-am folosit deja).

| 🖗 Metric Conversions | × |
|--------------------------|---------|
| Parameters Log Help | |
| | |
| Grid | |
| slope | |
| Conversion | |
| [0] radians to degree | |
| Converted Grid | |
| [Save to temporary file] | |
| | |
| 0% | |
| OK Close | Cancel |

Reproiectând stratului pantă convertit, cu ajutorul Reproiectării stratului raster, obținem stratul final pe care l-am dorit.

Datorită proceselor de reproiectare, stratul final ar putea conține datele din afara casetei de încadrare, pe care am calculat-o într-unul dintre primii pași. Acest lucru poate fi rezolvat prin reluarea decupării, așa cum am procedat la obținerea DEM-ului de bază.

17.16 Analize hidrologice

Notă: În această lecție, vom efectua unele analize hidrologice. Această analiză va fi utilizată în unele din următoarele lecții, deoarece constituie un exemplu foarte bun de analiză a fluxului de lucru, pe care o vom folosi pentru a demonstra unele caracteristici avansate.

Objectives: Starting with a DEM, we are going to extract a channel network, delineate watersheds and calculate some statistics.

1. Primul lucru este de a încărca proiectul cu datele lecției, care conține doar un DEM.



- 2. The first module to execute is *Catchment area* (in some SAGA versions it is called *Flow accumulation (Top Down)*). You can use any of the others named *Catchment area*. They have different algorithms underneath, but the results are basically the same.
- 3. Select the DEM in the *Elevation* field, and leave the default values for the rest of the parameters.

| 👰 Catchment Area (Parallel) | د |
|-----------------------------|--|
| Parameters Help | |
| | |
| Lievation | |
| dem25 | |
| Sink Routes | |
| [Not selected] | ▼ |
| Weight | L |
| [Not selected] | ▼ … |
| Material | |
| [Not selected] | ▼ … |
| Target | |
| [Not selected] | ▼ |
| Step | |
| 1 | |
| Method | |
| [0] Deterministic 8 | _ |
| Linear Flow | le l |
| | |
| 0% | |
| | OK Close Cancel |

Some algorithms calculate many layers, but the *Catchment Area* layer is the only one we will be using. You can get rid of the other ones if you want.

Randarea stratului nu este foarte informativă.



To know why, you can have a look at the histogram and you will see that values are not evenly distributed (there are a few cells with very high value, those corresponding to the channel network). Use the *Raster calculator* algorithm to calculate the logarithm of the catchment value area and you will get a layer with much more information



- 4. The catchment area (also known as flow accumulation) can be used to set a threshold for channel initiation. This can be done using the *Channel network* algorithm.
 - Initiation grid: use the catchment area layer and not the logarithm one.
 - Initiation threshold: 10.000.000
 - Initiation type: Greater than

| 🛿 Channel Network | | | | X |
|--|----|----|----------|--------|
| Parameters Help | | | | |
| | | | | |
| Elevation | | | | |
| dem25 | | | _ | |
| Flow Direction | | | | |
| [Not selected] | | | | |
| Initiation Grid | | | | |
| Catchment Area | | | | |
| Initiation Type | | | | |
| [2] Greater than | | | | - |
| Initiation Threshold | | | | |
| 10000000 | | | | |
| Divergence | | | | |
| [Not selected] | | | _ | |
| Tracing: Max. Divergence | | | | |
| 10 | | | | × |
| Tracing: Weight | | | | |
| [Not selected] | | | | |
| Min. Segment Length | | | | |
| 10 | | | | - |
| Channel Network | | | | |
| [Save to temporary file] | | | | |
| X Open output file after running algorithm | | | | |
| Channel Direction | | | | |
| [Save to temporary file] | | | | |
| X Open output file after running algorithm | | | | |
| Channel Network | | | | |
| [Save to temporary file] | | | | |
| Copen output file after running algorithm | | | | |
| | | | | |
| | | | | |
| | 0% | | | |
| | | ОК | Close | Cancel |
| | | | | |

If you increase the *Initiation threshold* value, you will get a more sparse channel network. If you decrease it, you will get a denser one. With the proposed value, this is what you get.



The image above shows just the resulting vector layer and the DEM, but there should be also a raster layer with the same channel network. That raster will be, in fact, the layer we will be using.

5. Now, we will use the *Watersheds basins* algorithm to delineate the subbasins corresponding to that channel network, using as outlet points all the junctions in it. Here is how you have to set the corresponding parameters dialog.

| 📢 Watershed Basins | × |
|--|----------|
| Parameters Help | |
| Elevation | |
| dem25 | |
| Channel Network | |
| Channel Network - | |
| Sink Route | |
| [Not selected] | |
| Min. Size | |
| 0 | . |
| Watershed Basins | |
| [Save to temporary file] | |
| X Open output file after running algorithm | |
| | |
| | |
| | |
| | |
| <u>u</u> | |
| 0% | |
| OK Close | Cancel |

Acesta veți obține.



6. This is a raster result. You can vectorise it using the Vectorising grid classes algorithm.

| 😧 Vectorising Grid Classes 🛛 🔀 |
|--|
| Parameters Help |
| |
| Grid |
| Watershed Basins 💌 |
| Class Selection |
| [1] all dasses |
| Class Identifier |
| 0 |
| Vectorised class as |
| [0] one single (multi-)polygon object 🔹 |
| Polygons |
| [Save to temporary file] |
| X Open output file after running algorithm |
| |
| |
| |
| |
| |
| |
| 0% |
| OK Close Cancel |



Acum, să încercăm să calculăm statistici referitoare la valorile elevației dintr-unul din sub-bazine. Ideea este de a avea un strat cu altitudinile din cadrul acelui sub-bazin pe care, ulterior, să-l transmitem modulului care calculează aceste statistici.

- 1. First, let's clip the original DEM with the polygon representing a subbasin. We will use the *Clip raster with polygon* algorithm. If we select a single subbasin polygon and then call the clipping algorithm, we can clip the DEM to the area covered by that polygon, since the algorithm is aware of the selection.
 - 1. Select a polygon



2. Call the clipping algorithm with the following parameters:

| 🧕 Clip grid with polygon | | | × |
|---------------------------------------|-----|-----------|--------|
| Parameters Log Help | | | |
| Input | | | |
| dem25 [EPSG:23030] | | [| |
| Polygons | | | |
| Polygons [EPSG:23030] | | | |
| Output | | | |
| [Save to temporary file] | | | |
| | | | |
| 0% | | | |
| n n n n n n n n n n n n n n n n n n n | Run | Close | Cancel |

The element selected in the input field is, of course, the DEM we want to clip.

Veți obține ceva de genul acesta.



2. This layer is ready to be used in the *Raster layer statistics* algorithm.

| 🦸 Raster layer statistics | | | x |
|---------------------------|----|----|------|
| Parameters Log Help | | | |
| Toput laver | | | |
| dinned [EPSG-23030] | Ţ | | |
| Statistics | | | - |
| [Save to temporary file] | | | |
| | | | - |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 0% | | | |
| Run Clos | se | Ca | ncel |

Statisticile rezultate sunt următoarele.

| 🧕 Results | | ?× |
|------------|-----------------------------------|-------|
| Statistics | Valid cells: 24155 | |
| | No-data cells: 14573 | |
| | Minimum value: 771.0 | |
| | Maximum value: 2080.0 | |
| | Sum: 29923203.3423 | |
| | Mean value: 1238.79955878 | |
| | Standard deviation: 271.406236765 | |
| | | |
| | | |
| | | |
| | | Close |

Vom folosi și în alte lecții atât procedura de calcule a bazinului, cât și calcularea statisticilor, pentru a afla cum ne pot

ajuta alte elemente la automatizarea amândurora, cât și pentru a lucra mai eficient.

17.17 Starting with the model designer

Notă: In this lesson we will use the model designer, a powerful component that we can use to define a workflow and run a chain of algorithms.

O sesiune normală cu uneltele de procesare include mai mult decât rularea unui singur algoritm. De obicei, multe dintre ele sunt rulate pentru a obține o ieșire, unele dintre aceste rezultate fiind folosite ca intrare pentru alți algoritmi.

Using the model designer, that workflow can be put into a model, which will run all the necessary algorithms in a single run, thus simplifying the whole process and automating it.

To start this lesson, we are going to calculate a parameter named Topographic Wetness Index. The algorithm that computes it is called *Topographic wetness index (twi)*.

| 🛿 Topographic wetness index (twi) | | | × |
|--|-----|-------|--------|
| Parameters Log Help | | | |
| Chara. | | | |
| | | | |
| dem25 [EPSG:23030] | | • | |
| Catchment Area | | | |
| dem25 [EPSG:23030] | | - | |
| Transmissivity | | | |
| [Not selected] | | | |
| Area Conversion | | | |
| [0] no conversion (areas already given as specific catchment area) | | | - |
| Method (TWI) | | | |
| [0] Standard | | | - |
| Topographic Wetness Index | | | |
| [Save to temporary file] | | | |
| Copen output file after running algorithm | | | |
| | | | |
| 0% | | | |
| | Run | Close | Cancel |

As you can see, there are two mandatory inputs: *Slope* and *Catchment area*. There is also an optional input, but we will not be using it, so we can ignore it.

The data for this lesson contains just a DEM, so we do not have any of the required inputs. However, we know how to calculate both of them from that DEM, since we have already seen the algorithms to compute slope and catchment area. So we can first compute those layers and then use them for the TWI algorithm.

Aici sunt dialogurile pentru parametrii care ar trebui să fie utilizați în calculul a 2 straturi intermediare.

| Slope, aspect, curvature | |
|--|-----|
| rameters Log Help | |
| Elevation | |
| dem25 [EPSG:23030] | ▼ … |
| Method | |
| [5] Fit 2.Degree Polynom (Zevenbergen & Thorne 1987) | |
| Slope | |
| [Save to temporary file] | |
| X Open output file after running algorithm | |
| Aspect | |
| [Save to temporary file] | |
| X Open output file after running algorithm | |
| Curvature | |
| [Save to temporary file] | |
| X Open output file after running algorithm | |
| Plan Curvature | |
| [Save to temporary file] | |
| | |
| | |

Notă: Panta trebuie să fie calculată în radiani, nu în grade.

| 🦞 Catchment area (recursive) | × |
|------------------------------|------------------|
| Parameters Log Help | |
| Slavation | _ |
| | |
| Sink Doutes | • |
| [Not selected] | |
| Weight | |
| [Not selected] | |
| Material | |
| [Not selected] | ↓ |
| Target | |
| [Not selected] | ▼ … |
| Step | |
| 1 | × |
| Target Areas | |
| [Not selected] | ▼ |
| Method | |
| [0] Deterministic 8 | ▼ |
| Convergence | |
| 1.1 | |
| | |
| 0% | |
| | Run Close Cancel |

Acesta este modul în care va trebui să setați parametrii dialogului pentru algoritmul TWI.
| Topographic wetness index (twi) | × |
|--|---------------------------------------|
| Parameters Log Help | |
| | |
| Slope | |
| Topographic Wetness Index [EPSG:23030] | ▼ |
| Catchment Area | |
| Catchment Area [EPSG:23030] | · · · · · · · · · · · · · · · · · · · |
| Transmissivity | |
| [Not selected] | ▼ |
| Area Conversion | |
| [1] 1 / cell size (pseudo specific catchment area) | ▼ |
| Method (TWI) | |
| [0] Standard | ▼ |
| Topographic Wetness Index | |
| [Save to temporary file] | |
| Copen output file after running algorithm | |
| | |
| | |
| | |
| 0% | |
| | Run Close Cancel |

This is the result that you will obtain (the default singleband pseudocolor inverted palette has been used for rendering). You can use the twi.qml style provided.



What we will try to do now is to create an algorithm that calculates the TWI from a DEM in just one single step. That will save us work in case we later have to compute a TWI layer from another DEM, since we will need just one single step to do it instead of the three above. All the processes that we need are found in the toolbox, so what we have to do is to define the workflow to wrap them. This is where the model designer comes in.

1. Deschideți modelatorul, prin selectarea intrării sale din meniul de prelucrare.

| 🦸 Processing modeler | | | | | | | |
|----------------------|-------------|-----------------|-----|--------|-----------------|----------|-------|
| Inputs Algorithms | [Enter mode | l name here] | | [Enter | group name here |] | |
| Inputs Algorithms | [Enter mode | I name here] | | Enter | group name here |] | |
| | | | | | | | |
| | | Edit model bela | Dun | 0000 | (Couro | Cauca an | |
| | | Eait model nelp | Kun | Open | Save | save as | Close |

Two things are needed to create a model: setting the inputs that it will need, and defining the algorithm that it contains. Both of them are done by adding elements from the two tabs in the left-hand side of the modeler window: *Inputs* and *Algorithms*.

- 2. Let's start with the inputs. In this case we do not have much to add. We just need a raster layer with the DEM, and that will be our only input data.
- 3. Double click on the Raster layer input and you will see the following dialog.

| 🧕 Parameter def | inition | <u>? ×</u> |
|-----------------|---------|------------|
| Parameter name | | |
| Required | Yes | • |
| [| ок | Cancel |

4. Here we will have to define the input we want:

- 1. Since we expect this raster layer to be a DEM, we will call it DEM. That's the name that the user of the model will see when running it.
- 2. Since we need that layer to work, we will define it as a mandatory layer.

Iată cum ar trebui să fie configurat dialogul.

| 🧕 Parameter defin | ition ?× |
|-------------------|-----------|
| Parameter name D | EM |
| Required | Yes |
| | OK Cancel |

5. Click on OK and the input will appear in the modeler canvas.

| 🧕 Processing modeler | | | | _ 🗆 🗵 |
|--------------------------------------|-------------------------|----------|---------------------|-------|
| Inputs Algorithms | [Enter model name here] | [Ent | er group name here] | |
| | ් DEM | × | | |
| Table Table field Vector layer | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | Edit model help | Run Open | Save Save as | Close |

- 6. Now let's move to the *Algorithms* tab.
- 7. The first algorithm we have to run is the *Slope, aspect, curvature* algorithm. Locate it in the algorithm list, double-click on it and you will see the dialog shown below.

| 🛿 Slope, aspect, curvature | ? × |
|---|-----------|
| Parameters Help | |
| | |
| Elevation | |
| DEM | • |
| Method | |
| [0] Maximum Slope (Travis et al. 1975) | • |
| Slope < OutputRaster > | |
| [Enter name if this is a final result] | |
| Aspect <outputraster></outputraster> | |
| [Enter name if this is a final result] | |
| Curvature < OutputRaster > | |
| [Enter name if this is a final result] | |
| Plan Curvature < OutputRaster > | |
| [Enter name if this is a final result] | |
| Profile Curvature <outputraster></outputraster> | |
| [Enter name if this is a final result] | |
| | |
| Parent algorithms | |
| 0 elements selected | |
| | |
| | OK Cancel |

This dialog is very similar to the one that you can find when running the algorithm from the toolbox, but the element that you can use as parameter values are not taken from the current QGIS project, but from the model itself. That means that, in this case, we will not have all the raster layers of our project available for the *Elevation* field, but just the ones defined in our model. Since we have added just one single raster input named DEM, that will be the only raster layer that we will see in the list corresponding to the *Elevation* parameter.

Output generated by an algorithm are handled a bit differently when the algorithm is used as a part of a model. Instead of selecting the filepath where you want to save each output, you just have to specify if that output is an intermediate layer (and you do not want it to be preserved after the model has been executed), or it is a final one. In this case, all layers produced by this algorithm are intermediate. We will only use one of them (the slope layer), but we do not want to keep it, since we just need it to calculate the TWI layer, which is the final result that we want to obtain.

When layers are not a final result, you should just leave the corresponding field. Otherwise, you have to enter a name that will be used to identify the layer in the parameters dialog that will be shown when you run the model later.

8. There is not much to select in this first dialog, since we do not have but just one layer in our model (The DEM input that we created). Actually, the default configuration of the dialog is the correct one in this case, so you just have to press *OK*. This is what you will now have in the modeler canvas.

| 🦸 Proces | sing modeler | | | | | | | |
|---------------------|--|--------------|-----------------|----------|----------|-----------------|---------|-------------|
| Inputs | Algorithms | [Enter model | name here] | | [Enter | group name here |] | |
| Inputs slope | Algorithms Calgorithms Calgori | Enter model | name here] | vature 🎽 |) [Enter | group name here |] | |
| | | | | | | | | * • • |
| | | [| Edit model help | Run | Open | Save | Save as | Close |

9. The second algorithm we have to add to our model is the catchment area algorithm. We will use the algorithm named *Catchment area (Paralell)*. We will use the DEM layer again as input, and none of the ouputs it produces are final, so here is how you have to fill the corresponding dialog.

| Parameters Help | |
|----------------------------|-------|
| | |
| | |
| Elevation | |
| DEM | |
| Sink Routes | |
| [Not selected] | |
| Weight | |
| [Not selected] | |
| Material | |
| [Not selected] | |
| Target | |
| [Not selected] | |
| Step | |
| 1 | |
| Method | |
| [0] Deterministic 8 | |
| Linear Flow | |
| Yes | |
| Linear Flow Threshold | |
| 500.0 | |
| Linear Flow Threshold Grid | |
| [Not selected] | |
| Channel Direction | |
| [Not selected] | |
| Convergence | |
| 1.0 | |
| ОКС | ancel |

Acum, modelul dvs. ar trebui să arate în felul următor:

| 🦸 Processing modeler | | |
|---|-------------------------|-----------------------------|
| Inputs Algorithms | [Enter model name here] | [Enter group name here] |
| Types Figure 1 Catch Image: Catch and specific Image: Catch and specific Image: Catch and specific Image: Catch and specific Image: Catch and specific Image: Catch and specific catch an | Lever modername nerej | E ent area (parallel) |
| | Edit model help R | Run Open Save Save as Close |

10. The last step is to add the Topographic wetness index algorithm, with the following configuration.

| 😧 Topographic wetness index (twi) | × |
|--|---|
| Parameters Help | |
| | |
| Slope | |
| Slope from algorithm 0(Slope, aspect, curvature) | |
| Catchment Area | |
| Catchment Area from algorithm 1(Catchment area (parallel)) | |
| Transmissivity | |
| [Not selected] | |
| Area Conversion | |
| [1] 1 / cell size (pseudo specific catchment area) | |
| Method (TWI) | |
| [0] Standard | |
| Topographic Wetness Index <outputraster></outputraster> | |
| TWI | |
| | |
| Parent algorithms | |
| 0 elements selected | |
| | |
| | |
| | |
| OK Cancel | |

In this case, we will not be using the DEM as input, but instead, we will use the slope and catchment area layers that are calculated by the algorithms that we previously added. As you add new algorithms, the outputs they

produce become available for other algorithms, and using them you link the algorithms, creating the workflow.

11. In this case, the output TWI layer is a final layer, so we have to indicate so. In the corresponding textbox, enter the name that you want to be shown for this output.

Acum, modelul dvs. este finalizat, și ar trebui să arate în felul următor:

| 🦞 Processing modeler | | | | | | |
|--|--------------|----------------------|---|--------------------------------|----------|-------|
| Inputs Algorithms | TWI from DEM | | My Models | | | |
| Inputs Algorithms □-Parameters □ Boolean □ Extent □ File □ Number □ Raster Layer □ String □ Table □ Table field □ Vector layer | TWI from DEM | In Topogra Out | In Catcl Out Iphic wetness ind | E hment area (par E e | allel) 🎽 | |
| | Edit mo | del help Run | Open | Save | Save as | Close |

12. Enter a name and a group name in the upper part of the model window.

| TWI from DEM | My Models | |
|--------------|-----------|--|
| | | |
| 윤 DEM | | |
| | | |

- 13. Save it clicking on the *Save* button. You can save it anywhere you want and open it later, but if you save it in the models folder (which is the folder that you will see when the save file dialog appears), your model will also be available in the toolbox as well. So stay on that folder and save the model with the filename that you prefer.
- 14. Now close the modeler dialog and go to the toolbox. In the Models entry you will find your model.



15. You can run it just like any normal algorithm, double-clicking on it.

| 🤨 TWI from DEM | | | × |
|---|---|--------|---|
| Parameters Log Help | | | |
| | | | |
| DEM | | | |
| raster [EPSG:23030] | • | | |
| TWI | | | |
| [Save to temporary file] | | | |
| Copen output file after running algorithm | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 0% | | | |
| Run Clos | e | Cancel | |

După cum puteți vedea, dialogul parametrilor, conține intrarea pe care ați adăugat-o modelului, împreună cu ieșirile pe care le stabiliți ca fiind finale, atunci când adăugați algoritmii corespunzători.

16. Rulați-l folosind DEM-ul ca intrare, apoi veți obține stratul TWI, într-un singur singur pas.

17.18 Modele mai complexe

Notă: In this lesson we will work with a more complex model in the model designer.

The first model that we created in the previous chapter was a very simple one, with just one input and three algorithms. More complex models can be created, with different types of inputs and containing more steps. For this chapter we will work with a model that creates a vector layer with watersheds, based on a DEM and a threshold value. That will be very useful for calculating several vector layers corresponding to different thresholds, without having to repeat each single step each time.

This lesson does not contain instructions about how to create your model. You already know the necessary steps (we saw them in a *previous lesson*) and you have already seen the basic ideas about the modeler, so you should try it yourself. Spend a few minutes trying to create your model, and don't worry about making mistakes. Remember: first add the inputs and then add the algorithms that use them to create the workflow.

Notă: In case you could not create the full model yourself and you need some extra help, the data folder corresponding to this lesson contains an «almost» finished version of it. Open the modeler and then open the model file that you will find in the data folder. You should see something like this.



This model contains all the steps needed to complete the calculation, but it just has one input: the DEM. That means that the threshold for channel definition uses a fixed value, which makes the model not as useful as it could be. That is not a problem, since we can edit the model, and that is exactly what we will do.

- 1. First, let's add a numerical input. That will ask the user for a numerical input that we can use when such a value is needed in any of the algorithms included in our model.
- 2. Click on the Number entry in the Inputs tree, and you will see the corresponding dialog.
- 3. Fill it with the following values.
 - Numele parametrului: Pragul pentru definirea canalului
 - *Default value*: 1,000,000

| 🦸 Parameter definition | <u> ? ×</u> |
|---|-------------|
| Parameter name Threshold for channel definition | |
| Min/Max values 0 | |
| Default value 1000000 | |
| OK Cancel | |

Acum, modelul dvs. ar trebui să arate în felul următor:



The input that we have just added is not used, so the model hasn't actually changed. We have to link that input to the algorithm that uses it, in this case the *Channel network* one. To edit an algorithm that already exists in the modeler, just click on the pen icon on the corresponding box in the canvas.

4. Click on the Channel network algorithm and you will see something like this.

| Channel network | ? |
|--|-----------------------|
| arameters Help | |
| Elevation | |
| DEM | |
| Flow Direction | |
| [Not selected] | _ |
| Initiation Grid | |
| Catchment Area from algorithm 1(Catchment area (parallel)) | _ |
| Initiation Type | |
| [2] Greater than | • |
| Initiation Threshold | |
| 1000000 | - |
| Divergence | |
| [Not selected] | ▼ |
| Tracing: Max. Divergence | |
| 10 | |
| Tracing: Weight | |
| [Not selected] | ▼ |
| Min. Segment Length | |
| 10 | |
| | OK Cancel |

The dialog is filled with the current values used by the algorithm. You can see that the *Initiation threshold* parameter has a fixed value of 1,000,000 (this is also the default value of the algorithm, but any other value could be put in there). However, you might notice that the parameter is not entered in a common text box, but in a drop-down menu.

5. Unfold the threshold parameter menu and you will see something like this.

| 🖗 Channel network | | | ? × |
|--|----|-----------|-----|
| Parameters Help | | | |
| | | | |
| Elevation | | | |
| DEM | | - | |
| Flow Direction | | | |
| [Not selected] | | - | |
| Initiation Grid | | | |
| Catchment Area from algorithm 1(Catchment area (parallel)) | | • | *** |
| Initiation Type | | | |
| [2] Greater than | | • | |
| Initiation Threshold | | | |
| 1000000 | | T | |
| Threshold for channel definition | | } | |
| [Not selected] | | • | |
| Tracing: Max. Divergence | | | |
| 10 | | • | |
| Tracing: Weight | | | |
| [Not selected] | | • | |
| Min. Segment Length | | | |
| 10 | | • | |
| | ОК | Can | cel |

The input that we added is there and we can select it. Whenever an algorithm in a model requires a numerical value, you can hardcode it and directly type it, or you can use any of the available inputs and values (remember that some algorithms generate single numerical values. We will see more about this soon). In the case of a string parameter, you will also see string inputs and you will be able to select one of them or type the desired fixed value.

- 6. Select the Threshold for channel definition input in the Initiation threshold parameter.
- 7. Click on OK to apply the changes to your model. Now the design of the model should look like this.



8. The model is now complete. Run it using the DEM that we have used in previous lessons, and with different threshold values.

Below you have a sample of the result obtained for different values. You can compare with the result for the default value, which is the one we obtained in the *hydrological analysis lesson*.



Fig. 17.1: Prag = 100,000



Fig. 17.2: Prag = 1,0000,000

17.19 Calculele numerice din modelator

Atenționare: Atenție, deoarece acest capitol nu este bine testat, vă rugăm să raportați orice problemă; imaginile lipsesc

Notă: În această lecție vom vedea cum se generează ieșirile numerice din modelator

Pentru această lecție, vom modifica modelul hidrologic pe care l-am creat în ultimul capitol (deschideți-l în modelator înainte de a începe), astfel încât să putem automatiza calcularea unei valori valide de prag, nefiind nevoie să cerem utilizatorului să o introducă. Deoarece această valoare se referă la variabila din pragul stratului raster, o vom extrage din acest strat, pe baza unor analize statistice simple.

Începand cu modelul menționat mai înainte, haideți să facem următoarele modificări:

În primul rând, se calculează statisticile stratului de acumulare a fluxului, utilizând algoritmul *Statisticile stratului raster*.

| 🖗 Raster layer statistics | ? × |
|--|-------------|
| Parameters Help | |
| | |
| Input layer | |
| Catchment Area from algorithm 1(Catchment area (parallel)) | |
| Statistics <outputhtml></outputhtml> | |
| [Enter name if this is a final result] | |
| | |
| Parent algorithms | |
| 0 elements selected | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | Cancel |
| | Cancer |

Acest lucru va genera un set de valori statistice, care vor fi de acum disponibile pentru toate câmpurile numerice ai altor algoritmi.

Dacă editați algoritmul *Rețelei de canale*, așa cum am făcut în ultima lecție, veți vedea că acum aveți și alte opțiuni în afară de intrarea numerică pe care ați adăugat-o.

| 🛿 Channel network | | ? × |
|---|-----|------|
| Parameters Help | | |
| | | |
| Elevation | | |
| DEM | • | |
| Flow Direction | | |
| [Not selected] | - | |
| Initiation Grid | | |
| Catchment Area from algorithm 1(Catchment area (parallel)) | - | *** |
| Initiation Type | | |
| [2] Greater than | - | |
| Initiation Threshold | | |
| Threshold for channel definition | | |
| Threshold for channel definition Minimum value from algorithm 5(Raster layer statistics) Maximum value from algorithm 5(Raster layer statistics) Sum from algorithm 5(Raster layer statistics) Mean value from algorithm 5(Raster layer statistics) valid cells count from algorithm 5(Raster layer statistics) No-data cells count from algorithm 5(Raster layer statistics) Standard deviation from algorithm 5(Raster layer statistics) | | |
| [Not selected] | - | |
| Min. Segment Length | | |
| 10 | - | |
| ОК | Car | ncel |

Cu toate acestea, nici una dintre aceste valori nu este adecvată pentru a fi utilizată ca și prag valid, atât timp cât acestea vor produce rețele de canale nu prea realistice. Putem obține, în schimb, un nou parametru pe baza lor, pentru a obține un rezultat mai bun. De exemplu, putem folosi media, la care se va adăuga de 2 ori deviația standard.

Pentru a adăuga această operațiune aritmetică, putem folosi calculatorul, pe care îl veți găsi în grupul *Geoalgorithms/modeler/modeler-tools*. Acest grup conține algoritmi care nu sunt foarte utili în afara modelatorului, dar care oferă funcționalități utile la crearea unui model.

Dialogul parametrilor pentru algoritmul calculatorului arată astfel:

| 🤨 Calculator | | ? × |
|---|----|--------|
| You can refer to model values in you formula, using single-letter variables, as follows a->Threshold for channel definition b->Minimum value from algorithm 5(Raster layer statistics) c->Maximum value from algorithm 5(Raster layer statistics) d->Sum from algorithm 5(Raster layer statistics) e->Mean value from algorithm 5(Raster layer statistics) f->valid cells count from algorithm 5(Raster layer statistics) g->No-data cells count from algorithm 5(Raster layer statistics) h->Standard deviation from algorithm 5(Raster layer statistics) h->Standard deviation from algorithm 5(Raster layer statistics) | 3 | |
| | ОК | Cancel |

După cum puteți vedea, dialogul este diferit față de celelalte pe care le-am văzut, dar aveți acolo aceleași variabile care au fost disponibile în câmpul *Threshold* din algoritmul *Channel network*. Introduceți formula de mai sus, apoi apăsați pe *OK*, pentru a adăuga algoritmul.



Dacă extindeți intrarea rezultatului, așa cum se arată mai sus, veți vedea că modelul este conectat la două dintre valori, și anume media și abaterea standard, care sunt cele pe care le-am folosit în formulă.

Adăugarea acestui nou algoritm va aduce o nouă valoare numerică. Dacă mergeți iarăsi în algoritmul Channel network,

puteți selecta acea valoare din parametrul Threshold.

| Channel network | <u>? ×</u> |
|--|------------|
| arameters Help | |
| Elevation | |
| DEM | - |
| Flow Direction | _ |
| [Not selected] | - |
| Initiation Grid | |
| Catchment Area from algorithm 1(Catchment area (parallel)) | - 8 |
| Initiation Type | 111 |
| [2] Greater than | - |
| Initiation Threshold | |
| Threshold for channel definition | • |
| Divergence | |
| [Not selected] | • |
| Tracing: Max. Divergence | |
| 10 | • |
| Tracing: Weight | |
| [Not selected] | - |
| Min. Segment Length | |
| 10 | |
| ОК С | ancel |

Faceți clic pe OK, după care modelul dvs. ar trebui să arate în felul următor:

| 🦞 Channel network | | ? |
|--|----|--------|
| Parameters Help | | |
| Elevation | | |
| Flow Direction | | |
| [Not selected] | | - |
| Initiation Grid | | |
| Catchment Area from algorithm 1(Catchment area (parallel)) | | - |
| Initiation Type | | |
| [2] Greater than | | - |
| Initiation Threshold | | |
| Threshold for channel definition | | - |
| Threshold for channel definition Minimum value from algorithm 5(Raster layer statistics) Maximum value from algorithm 5(Raster layer statistics) Sum from algorithm 5(Raster layer statistics) Mean value from algorithm 5(Raster layer statistics) valid cells count from algorithm 5(Raster layer statistics) No-data cells count from algorithm 5(Raster layer statistics) Standard deviation from algorithm 5(Raster layer statistics) Result from algorithm 6(Calculator) | | |
| Min. Segment Length | | |
| 10 | | - |
| | ОК | Cancel |

Nu vom folosi intrarea numerică pe care am adăugat-o modelului, astfel încât ea poate fi eliminată. Faceți clic-dreapta pe ea și selectați *Remove*

```
Atenționare: todo: De adăugat imaginea
```

De acum, noul nostru model este terminat.

17.20 Un model în cadrul unui model

Atenționare: Atenție, deoarece acest capitol nu este bine testat, vă rugăm să raportați orice problemă; imaginile lipsesc

Notă: În această lecție vom vedea cum să folosim un model într-un alt model, mai mare.

Am creat deja câteva modele, iar în această lecție vom vedea cum le putem combina într-unul singur, mai mare. Un model se comportă la fel ca oricare alt algoritm, ceea ce înseamnă că puteți adăuga un model pe care îl aveți deja, ca parte a altuia, pe care urmează să-l creați.

În acest caz, vom extinde modelul nostru hidrologic, prin adăugarea valorii medii TWI în fiecare dintre bazinele pe care le generează ca rezultat. Pentru aceasta, avem nevoie de calculul LST și a unor statistici. Din moment ce am creat deja un model pentru a calcula LST dintr-un DEM, este o idee bună să refolosiți acel model, în locul adăugării algoritmilor pe care îi conține în mod individual.

Să începem cu modelul folosit ca punct de plecare pentru ultima lecție.

Atenționare: todo: De adăugat imaginea

În primul rând, vom adăuga modelul LST. Pentru ca acesta să fie la îndemână, ar fi trebuit să fie salvat în dosarul modelelor, în caz contrar el nefiind afișat în caseta de instrumente sau în lista de algoritmi din modelator. Asigurați-vă că este disponibil.

Adăugați-l la modelul actual și folosiți DEM-ul de intrare ca și ieșire. Ieșirea este una temporară, din moment ce vrem să obținem doar stratul TWI, pentru a-l folosi la calculul statisticilor. Singura ieșire a acestui model va fi, în continuare, stratul vectorial al bazinelor hidrografice.

Iată dialogul parametrilor corespunzători:

Atenționare: todo: De adăugat imaginea

Acum avem un strat TWI, pe care îl putem folosi împreună cu stratul vectorial al bazinelor hidrologice, pentru a genera unul nou, care conține valorile TWI corespunzătoare fiecărui bazin hidrografic.

Acest calcul se face cu ajutorul algoritmului *Statisticilor pentru grila acoprită de poligoane*. Utilizați straturile menționate mai sus ca intrare, pentru a crea rezultatul final.

Atenționare: todo: De adăugat imaginea

Rezultatul algoritmului de *Vectorizare a claselor grilei* a reprezentat inițial produsul nostru final, însă acum dorim doar un rezultat intermediar. Pentru a schimba acest lucru, trebuie să editați algoritmul. Efectuați dublu-clic pe acesta pentru a deschide dialogul parametrilor săi, apoi ștergeți numele ieșirii. Astfel, va rezulta o ieșire temporară, așa cum este în mod implicit.

Atenționare: todo: De adăugat imaginea

Iată cum ar trebui să arate modelul final:

Atenționare: todo: De adăugat imaginea

După cum vedeți, utilizarea unui model într-un alt model nu reprezintă nimic special, putând fi adăugat la fel ca oricare alt algoritm, atât timp cât modelul este salvat în dosarul de modele și este disponibil în caseta de instrumente.

17.21 Utilizarea pentru crearea unui model doar a instrumentelor modelatorului

Notă: Această lecție vă arată cum să utilizați niște algoritmi disponibili doar în modelator, pentru a oferi funcționalități adiționale modelelor.

Scopul acestei lecții este de a folosi modelatorul la crearea unui algoritm de interpolare, care să țină cont de selecția curentă, nu doar să folosească numai entitățile selectate, dar și să utilizeze extinderea acelei selecții pentru a crea stratul raster interpolat.

The interpolation process involves two steps, as it has been already explained in previous lessons: rasterizing the points layer and fill the no-data values that appear in the rasterized layer. In case the points layer has a selection, only selected points will be used, but if the output extent is set to be automatically adjusted, the full extent of the layer will be used. That is, the extent of the layer is always considered to be the full extent of all features, not the one computed from just the selected ones. We will try to fix that by using some additional tools into our model.

Open the modeler and start the model by adding the required inputs. In this case we need a vector layer (restricted to points) and an attribute from it, with the values that we will use for rasterizing.

| ×1 | Processing modeler | | - 🗆 🗙 | |
|------------------------|-----------------------------------|----------|--|---|
| 🖿 🗟 🛃 😫 🕅 🔽 | | | | |
| Parameters | rasterize (considering selection) | workshop | | |
| 🕂 Boolean | | | ^ | 1 |
| 🕂 Extent | | | | |
| 🕂 File | | | | |
| 🕂 Number | | K | * | |
| 🕂 Raster layer | 단 points | 2 Field | 1 and the second | |
| 🕂 String | | | | |
| 🕂 Table | | | | |
| 🕂 Table field | | | | |
| 🕂 Table multiple field | | | | |
| 🕂 Vector layer | | | | |
| 🕂 Point | | | | |
| | | | | |
| Inputs Algorithms | | | > | |
| | | | | - |

The next step is to compute the extent of the selected features. That's where we can use the model-only tool called *Vector layer bounds*. First, we will have to create a layer that has the extent of those selected features. Then, we can use this tool on that layer.

An easy way of creating a layer with the extent of the selected features is to compute a convex hull of the input points layer. It will use only the selected point, so the convex hull will have the same bounding box as the selection. Then we can add the *Vector layer bounds* algorithm, and use the convex hull layer as input. It should look this in the modeler canvas:



The result from the *Vector layer bounds* is a set of four numeric values and a extent object. We will use both the numeric outputs and the extent for this exercise.



We can now add the algorithm that rasterizes the vector layer, using the extent from the *Vector layer bounds* algorithm as input.

Completați parametrii după cum se arată în continuare:

| Į | | | Rasteriz | e | | ? | × |
|--|--------------------------|---------------|----------|---|----|----|-------|
| Parameters | Help | | | | | | |
| Description | Rasterize | | | | | | |
| Shapes | | | | | | | |
| points | | | | | | | • |
| Attribute | | | | | | | |
| field | | | | | | | ¥ |
| Method for I | Aultiple Values | | | | | | |
| [4] mean | | | | | | | • |
| Method for I | ines | | | | | | |
| [0] thin | | | | | | | • |
| Preferred Ta | rget Grid Type | | | | | | |
| [3] Floating | Point (4 byte) | | | | | | - |
| Output exte | nt(xmin, xmax, ym | in, ymax) | | | | | |
| 'Extent' fro | m algorithm 'Vector | layer bounds' | | | | | ~ |
| Cellsize | | | | | | | |
| 100.0 | | | | | | | ~ |
| Grid <outpu< td=""><td>Raster ></td><td></td><td></td><td></td><td></td><td></td><td></td></outpu<> | Raster > | | | | | | |
| [Enter nam | e if this is a final res | sult] | | | | | |
| Parent algor | ithms | | | | | | |
| 0 elements | selected | | | | | | |
| | | | | | ОК | Ca | ancel |

Canevasul ar trebui să arate astfel:

| Parameters Parameter | \$ | Processing modeler | - | | × |
|--|------------------------|-----------------------------------|-------------|---|-----|
| Parameters Boolean File Raster layer String Table Table field Point Convex hull Out Weter layer Out In Vector layer Out In Exterrize Out In | 🖿 🗟 🛃 📄 👪 🛛 🕬 | | | | |
| Boolean Extent File Number Raster layer String Table field Table multiple field Vector layer Point Convex hull Out In In Weter layer bounds Out Weter layer bounds Out Weter layer bounds Out In <li< th=""><th>Parameters</th><th>rasterize (considering selection)</th><th>workshop</th><th></th><th></th></li<> | Parameters | rasterize (considering selection) | workshop | | |
| | 🕂 Boolean | | 2 | | ^ |
| File Aster layer Table Table field Table field Vector layer Point Out In Vector layer bounds Out In E Vector layer bounds Out In | 🕂 Extent | ~ | ~~ | | |
| Aumber Raster layer String Table Table field Vector layer Point Out In Vector layer bounds Out In I | 🕂 File | 🕆 points 🏷 | 🕆 field 🏷 | | |
| Aster layer String Table Table field Vector layer Point In Vector layer bounds Out Vector layer bounds Out In | 🕂 Number | | | | |
| | 🖶 Raster layer | | / | | |
| | + String | | / | | |
| In E Convex hull Out E Vector layer bounds Out E | Table | | / | | |
| Point In E Convex hull Out E Vector layer bounds Out E Out E | Table field | | / | | |
| Point | P lable multiple field | | / | | |
| Convex hull Out In Vector layer bounds Out Out Out Out Out | Print | | / | | |
| Out In | Point | Convex hull | . / | | |
| In Vector layer bounds Out Out Out Out Out ● | | Out E | | | |
| In In Resterize | | | | | |
| In Vector layer bounds Out | | | | | |
| In ♥ Vector layer bounds Out ● Out ● | | | In 🗉 | | |
| Vector layer bounds Out E | | G In ⊞ | S Rasterize | × | |
| Out E | | Vector layer bounds | Out 🗉 | | |
| Out H | | | | | |
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| | | | | | |
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| | | | | | |
| Inouts Algorithms < | Inputs Algorithms | 4 | | | > * |



Finally, fill the no-data values of the raster layer using the Close gaps algorithm.

The algorithm is now ready to be saved and added to the toolbox. You can run it and it will generate a raster layer from interpolating the selected points in the input layer, and the layer will have the same extent as the selection.

Here's an improvement to the algorithm. We have used a harcoded value for the cellsize when rasterizing. This value is fine for our test input layer, but might not be for other cases. We could add a new parameter, so the user enters the desired value, but a much better approach would be to have that value automatically computed.

We can use the modeler-only calculator, and compute that value from the extent coordinates. For instance, to create a layer with a fixed width of 100 pixels, we can use the following formula in the calculator.

| 🔏 Calculator | | ? | × |
|--|----|----|------|
| You can refer to model values in your formula, using single-letter variables, as follows: a->'min X' from algorithm 'Vector layer bounds' c->'min Y' from algorithm 'Vector layer bounds' d->'max Y' from algorithm 'Vector layer bounds' | | | |
| (b - a)/100 | | | _ |
| | OK | Ca | ncel |

Now we have to edit the rasterize algorithm, so it uses the output of the calculator instead of the hardcoded value. The final algorithm should look like this:



17.22 Interpolarea

Notă: Acest capitol prezintă cum se pot interpola datele punctuale, și vi se arată un alt exemplu real de efectuare de analize spațiale

În această lecție, vom interpola datele punctelor pentru a obține un strat raster. Înainte de a face aceasta, va trebui să realizăm o anumită pregătire a datelor, iar după interpolare vom efectua o procesare suplimentară, pentru a modifica stratul rezultat, obținând în acest fel o rutină de analiză completă.

Deschideți datele exemplu pentru această lecție, care ar trebui să arate astfel.



The data correspond to crop yield data, as produced by a modern harvester, and we will use it to get a raster layer of crop yield. We do not plan to do any further analysis with that layer, but just to use it as a background layer for easily identifying the most productive areas and also those where productivity can be improved.

The first thing to do is to clean–up the layer, since it contains redundant points. These are caused by the movement of the harvester, in places where it has to do a turn or it changes its speed for some reason. The *Points filter* algorithm will be useful for this. We will use it twice, to remove points that can be considered outliers both in the upper and lower part of the distribution.

Pentru prima execuție, folosiți următoarele valori ale parametrilor.

| 😢 Points filter | | | | X |
|--|-----|-------|-------|---|
| Parameters Log Help | | | | |
| Points | | | | |
| sorghum [EPSG:32755] | | | • | |
| Attribute | | | | |
| Area Count | | | - | |
| Radius | | | | |
| 100 | | | - | |
| Minimum Number of Points | | | | |
| 20 | | | - | |
| Maximum Number of Points | | | | |
| 250 | | | - | |
| Quadrants | | | | |
| No | | | - | |
| Filter Criterion | | | | |
| [4] remove below percentile | | | - | |
| Tolerance | | | | |
| 0.0 | | |] | |
| Percentile | | | | |
| 15 | | | - | |
| Filtered Points | | | | |
| [Save to temporary file] | | | | |
| Open output file after running algorithm | | | | • |
| 0% | | | | |
| <u> </u> | Run | Close | Cance | 2 |

Pentru următoarea execuție, folosiți configurația prezentată mai jos.

| 😧 Points filter | | | × |
|--|-----|-------|--------|
| Parameters Log Help | | | |
| Points | | | |
| Filtered Points [EPSG:32755] | | | • 🥥 📗 |
| Attribute | | | |
| Yld Mass(D | | | • |
| Radius | | | |
| 100 | | | - |
| Minimum Number of Points | | | |
| 20 | | | - |
| Maximum Number of Points | | | |
| 250 | | | ➡ :::: |
| Quadrants | | | |
| No | | | • |
| Filter Criterion | | | |
| [5] remove above percentile | | | • |
| Tolerance | | | |
| 0.0 | | | |
| Percentile | | | |
| 90 | | | - |
| Filtered Points | | | |
| [Save to temporary file] | | | |
| Open output file after running algorithm | | | • |
| | | | |
| 0% | | | |
| | Run | Close | Cancel |

Observați că nu utilizăm stratul original ca intrare, ci rezultatul execuției anterioare în loc.

Stratul de filtrare final, cu un set redus de puncte, ar trebui să arate similar cu cel original, dar conține un număr mai mic de puncte. Puteți verifica acest lucru, prin compararea tabelelor de atribute.

Acum, haideți să rasterizăm stratul folosind algoritmul Rasterizare.

| Q Shapes to grid | x |
|--|---|
| Parameters Log Help | |
| Shapes | |
| Filtered Points [EPSG: 32755] | |
| Attribute | |
| Yld Mass(D ▼ | |
| Method for Multiple Values | |
| [4] mean | |
| Method for Lines | |
| [0] thin | |
| Preferred Target Grid Type | |
| [3] Floating Point (4 byte) | |
| Output extent(xmin, xmax, ymin, ymax) | |
| [Leave blank to use min covering extent] | |
| Cellsize | |
| 15 | |
| Grid | |
| [Save to temporary file] | |
| X Open output file after running algorithm | |
| 0% | |
| Run Close Cance | 1 |

The *Filtered points* layer refers to the resulting one of the second filter. It has the same name as the one produced by the first filter, since the name is assigned by the algorithm, but you should not use the first one. Since we will not be using it for anything else, you can safely remove it from your project to avoid confusion, and leave just the last filtered layer.

Rezultatul raster arată în felul următor.



It is already a raster layer, but it is missing data in some of its cells. It only contain valid values in those cells that contained a point from the vector layer that we have just rasterized, and a no-data value in all the other ones. To fill the missing values, we can use the *Close gaps* algorithm.

| 🤶 Close gaps | × |
|---|--------|
| Parameters Log Help | |
| Grid | |
| Grid [EPSG:32755] | |
| Mask | |
| [Not selected] | |
| Tension Threshold | |
| 0.1 | |
| Changed Grid | |
| [Save to temporary file] | |
| Copen output file after running algorithm | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| 0% | |
| Run Close | Cancel |

Stratul din care lipsesc valorile fără-date arată în felul următor.



To restrict the area covered by the data to just the region where crop yield was measured, we can clip the raster layer with the provided limits layer.

| 😧 Clip grid with polygon | × |
|----------------------------|------------------|
| Parameters Log Help | |
| Input | |
| Changed Grid [EPSG: 32755] | ▼ |
| Polygons | |
| limits [EPSG:32755] | ▼ … ② |
| Output | |
| [Save to temporary file] | |
| | |
| 0% | |
| | Run Close Cancel |

And for a smoother result (less accurate but better for rendering in the background as a support layer), we can apply a *Gaussian filter* to the layer.

| 😧 Gaussian filter | | | × |
|--|-----|-------|----------|
| Parameters Log Help | | | |
| Grid | | | |
| Clipped [EPSG: 32755] | | - | |
| Standard Deviation | | | |
| 3 | | | ÷ |
| Search Mode | | | |
| [1] Cirde | | | - |
| Search Radius | | | |
| 250 | | | - |
| Filtered Grid | | | |
| [Save to temporary file] | | | |
| X Open output file after running algorithm | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 100% | | | |
| | Run | Close | Cancel |

Cu parametrii de mai sus, veți primi următorul rezultat



17.23 Mai multe despre interpolare

Notă: Acest capitol prezintă alte cazuri practice de folosire a algoritmilor de interpolare.

Interpolarea este o tehnică obișnuită, acesta putând fi folosită pentru a demonstra mai multe tehnici care pot fi aplicate cu ajutorul cadrului de lucru Processing din QGIS. Această lecție utilizează unii algoritmi de interpolare care au fost deja prezentați, dar care utilizează o abordare diferită.

Datele pentru această lecție conțin, de asemenea, un strat de puncte, în acest caz, cu date de elevație. În general, îl vom interpola în același mod ca și în lecția anterioară, însă, de data aceasta, vom salva o parte din datele originale, pe care o vom utiliza în evaluarea calității procesului de interpolare.

First, we have to rasterize the points layer and fill the resulting no-data cells, but using just a fraction of the points in the layer. We will save 10% of the points for a later check, so we need to have 90% of the points ready for the interpolation. To do so, we could use the *Split shapes layer randomly* algorithm, which we have already used in a previous lesson, but there is a better way to do that, without having to create any new intermediate layer. Instead of that, we can just select the points we want to use for the interpolation (the 90% fraction), and then run the algorithm. As we have already seen, the rasterizing algorithm will use only those selected points and ignore the rest. The selection can be done using the *Random selection* algorithm. Run it with the following parameters.

| 🤨 Random selection | | | × |
|--|-----|-------|--------|
| Parameters Log Help | | | |
| Tanut Javan | | | |
| Input layer | | | |
| Method | | | |
| Percentage of selected features | | | |
| Number/percentage of selected features | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| (| | | |
| 0% | | | |
| | Run | Close | Cancel |

Se vor selecta 90% dintre punctele din stratul de rasterizat


Selecția este aleatoare, astfel încât selecția dvs. ar putea diferi de selecția arătată în imaginea de mai sus.

Now run the *Rasterize* algorithm to get the first raster layer, and then run the *Close gaps* algorithm to fill the no-data cells [Cell resolution: 100 m].



To check the quality of the interpolation, we can now use the points that are not selected. At this point, we know the real elevation (the value in the points layer) and the interpolated elevation (the value in the interpolated raster layer). We can compare the two by computing the differences between those values.

Din moment ce vom folosi punctele care nu sunt selectate, în primul rând, haideți să inversăm selecția.



The points contain the original values, but not the interpolated ones. To add them in a new field, we can use the *Add raster values to points* algorithm

| 🔇 Add grid values to points | | | × |
|--|-----|-------|----------|
| Parameters Log Help | | | |
| Points | | | |
| points [EPSG:23030] | | _ ▼ | |
| Grids | | | |
| 1 elements selected | | | |
| Interpolation | | | |
| [4] B-Spline Interpolation | | | • |
| Result | | | |
| [Save to temporary file] | | | |
| X Open output file after running algorithm | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| 0% | | | |
| | Run | Close | Cancel |

The raster layer to select (the algorithm supports multiple raster, but we just need one) is the resulting one from the interpolation. We have renamed it to *interpolate* and that layer name is the one that will be used for the name of the field to add.

Acum avem un strat vectorial care conține ambele valori, cu punctele care nu au fost utilizate pentru interpolare.

| Q A | 😧 Attribute table - Result :: Features total: 703, filtered: 703, selected: 0 📃 📃 🗙 | | | | | | | |
|-----|---|-----------------|-----------------|--|---|--|--|--|
| | | E 😼 🛅 | 🕸 😵 🔎 | | ? | | | |
| | ID 🛆 | VALUE | interpolate | | | | | |
| 1 | 6 | 1516.0000000000 | 1452.5041504000 | | | | | |
| 3 | 10 | 2096.0000000000 | 2073.7648926000 | | | | | |
| 4 | 12 | 582.0000000000 | 555.3154296900 | | | | | |
| 8 | 20 | 843.0000000000 | 863.375000000 | | | | | |
| 21 | 64 | 2224.0000000000 | 2136.8483887000 | | | | | |
| 24 | 66 | 749.0000000000 | 753.2822265600 | | | | | |
| 28 | 69 | 1635.0000000000 | 1644.0615234000 | | | | | |
| 31 | 75 | 726.000000000 | 704.6588134800 | | | | | |
| 36 | 96 | 927.0000000000 | 936.9505004900 | | | | | |
| 38 | 101 | 1320.0000000000 | 1305.3083496000 | | | | | |
| 39 | 102 | 2170.0000000000 | 2155.5400391000 | | | | | |
| 40 | 106 | 549.0000000000 | 544.8676757800 | | | | | |
| 42 | 108 | 641.0000000000 | 648.3961181600 | | | | | |
| 47 | 113 | 1534.0000000000 | 1525.2607422000 | | | | | |
| 54 | 141 | 775.0000000000 | 757.4203491200 | | | | | |
| 62 | 158 | 1915.000000000 | 1924.1274414000 | | - | | | |
| | Show All Features | | | | | | | |

Acum, vom folosi calculatorul de câmpuri pentru această sarcină. Deschideți algoritmul *Calculatorului de câmpuri* și-l vom rula cu următorii parametri.

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If your field with the values from the raster layer has a different name, you should modify the above formula accordingly. Running this algorithm, you will get a new layer with just the points that we haven't used for the interpolation, each of them containing the difference between the two elevation values.

Reprezentând stratul în conformitate cu acea valoare, vom avea o primă idee despre locația celor mai mari discrepanțe.

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| 0 | 4107 | 1243.0000000000 | 1199.6501465000 | 43.34985 | | | | |
| 1 | 6 | 1516.0000000000 | 1452.5041504000 | 63.49585 | | | | |
| 2 | 4112 | 1594.0000000000 | 1590.4835205000 | 3.51648 | | | | |
| 3 | 10 | 2096.0000000000 | 2073.7648926000 | 22.23511 | | | | |
| 4 | 12 | 582.000000000 | 555.3154296900 | 26.68457 | | | | |
| 5 | 4121 | 1101.0000000000 | 1103.0323486000 | 2.03235 | | | | |
| 6 | 6176 | 1258.0000000000 | 1260.9846191000 | 2.98462 | | | | |
| 7 | 4125 | 1241.0000000000 | 1225.0878906000 | 15.91211 | | | | |
| 8 | 20 | 843.0000000000 | 863.3750000000 | 20.37500 | | | | |
| 9 | 6179 | 1195.0000000000 | 1198.4991455000 | 3.49915 | | | | |
| 10 | 2075 | 1786.0000000000 | 1799.5468750000 | 13.54688 | | | | |
| 11 | 4133 | 1196.0000000000 | 1156.2314453000 | 39.76855 | | | | |
| 12 | 6188 | 1720.0000000000 | 1724.4638672000 | 4.46387 | | | | |
| 13 | 6189 | 1497.0000000000 | 1498.2706299000 | 1.27063 | | | | |
| 14 | 6191 | 1349.0000000000 | 1347.5555420000 | 1.44446 | | | | |
| 15 | 2086 | 1277.0000000000 | 1296.1885986000 | 19.18860 | - | | | |
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Interpolând acel strat veți obține un strat raster cu eroarea estimată în toate punctele din zona interpolată.



You can also get the same information (difference between original point values and interpolated ones) directly with $GRASS \succ v.sample$.

Your results might differ from these ones, since there is a random component introduced when running the random selection, at the beginning of this lesson.

17.24 Execuția iterativă a algoritmilor

Notă: Această lecție prezintă un mod diferit de a executa algoritmii care folosesc straturi vectoriale, prin rularea lor în mod repetat, iterând entitățile dintr-un strat vectorial de intrare

We already know the model designer, which is one way of automating processing tasks. However, in some situations, the modeler might not be what we need to automate a given task. Let's see one of those situations and how to easily solve it using a different functionality: the iterative execution of algorithms.

Deschideți datele corespunzătoare acestui capitol. Acesta ar trebui să arate astfel.



Veți recunoaște DEM-ul nostru bine-cunoscut din capitolele anterioare, și un set de bazine hidrografice extrase din el. Imaginați-vă că trebuie să reducem DEM-ul în mai multe straturi mici, fiecare dintre ele conținând doar datele de elevație corespunzătoare unui singur bazin hidrografic. Acest lucru va fi util dacă doriți mai târziu să calculați unii parametri ce țin de fiecare bazine hidrografice, cum ar fi cota de elevație sau curba hipsographică.

Acest lucru reprezintă o sarcină lungă durată și plictisitoare, mai ales în cazul în care numărul bazinelor hidrografice este mare. Cu toate acestea, este o sarcină care poate fi ușor automatizată, așa cum vom vedea.

Algoritmul utilizat pentru decuparea stratului raster după un strat poligonal este denumit *Decuparea grilei cu ajutorul poligoanelor*, și are următorul dialog cu parametri.

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Puteți să-l executați folosind stratul bazinelor hidrografice și DEM-ul ca intrare, apoi veți obține următorul rezultat.



După cum puteți vedea, se utilizează aria acoperită de toate poligoanele bazinelor hidrografice.

Puteți decupa DEM-ul după un singur bazin hidrografic, prin selectarea bazinului dorit, și apoi prin rularea algoritmului așa cum am făcut-o mai înainte.



Deoarece numai entitățile selectate sunt folosite, numai poligonul selectat va fi folosit pentru a decupa stratul raster.



Făcând acest lucru pentru toate bazinele, se va produce rezultatul pe care îl căutăm, dar aceasta nu arată ca un mod foarte practic de lucru. În schimb, să vedem cum automatizăm rutina *selectare și decupare*.

Mai întâi de toate, eliminați selecția anterioară, astfel încât toate poligoanele să fie utilizate din nou. Deschideți algoritmul *Decupare grilă după un poligon*, apoi selectați aceleași surse ca și înainte, dar de data aceasta faceți clic pe butonul pe care le veți regăsi în partea dreaptă a intrării stratului vectorial, în care ați selectat stratul bazinelor hidrografice.

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Acest buton va cauza divizarea stratului de intrare selectat în mai multe straturi, pe măsură ce se descoperă entitățile, fiecare dintre ele conținând câte un singur poligon. Algoritmul va fi solicitat în mod repetat, câte o dată pentru fiecare dintre aceste straturi cu un singur poligon. Rezultatul, în loc de un singur strat raster, va consta într-un set de straturi raster, fiecare dintre ele corespunzând câte unei execuții a algoritmului.

Iată rezultatul pe care îl veți obține, dacă ați rulat algoritmul de tăiere așa cum s-a explicat.



Pentru fiecare strat, paletă de culori alb-negru, (sau orice paletă pe care o utilizați), este ajustată în mod diferit, de la minim până la valorile sale maxime. Acesta este motivul pentru care puteți vedea diferite piese, iar culorile nu par a se potrivi la granița dintre straturi. Valorile, cu toate acestea, se potrivesc.

Dacă introduceți un nume pentru fișierul de ieșire, fișierele rezultate vor fi denumite folosind ca nume de fișier și, ca sufix, un număr corespunzător pentru fiecare iterație.

17.25 Mai multe utilizări ale execuției iterative a algoritmilor

Notă: Această lecție vă arată cum să combinați execuția iterativă a algoritmilor cu modelatorul, pentru a extinde automatizarea.

Execuția iterativă a algoritmilor este disponibilă nu doar pentru algoritmii încorporați, ci, de asemenea, și pentru algoritmii pe care îi puteți crea, cum ar fi modelele. Vom vedea cum putem combina un model cu executarea iterativă a algoritmilor, astfel încât să putem obține cu ușurință rezultate mai complexe.

Datele pe care le vom folosi sunt aceleași pe care le-am folosit deja în ultima lecție. În acest caz, în afară de decuparea DEM-ului în funcție de poligonul fiecărui bazin hidrografic, vom adăuga câțiva pași, în care vom calcula o curbă hipsometrică pentru fiecare bazin, pentru a studia modul în care este distribuită elevația în cadrul bazinelor hidrografice.

Din moment ce avem un flux de lucru care implică mai multe etape (decupare + calcul curbă hipsometrică), ar trebui să mergem la modelator și să creăm modelul corespunzător fluxului respectiv.

You can find the model already created in the data folder for this lesson, but it would be good if you first try to create it yourself. The clipped layer is not a final result in this case, since we are just interested in the curves, so this model will not generated any layers, but just a table with the curve data.

Modelul ar trebui să arate astfel:

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Add the model to you models folder, so it is available in the toolbox, and execute it.

Select the DEM and watersheds basins.

The algorithm will generate tables for all the basins and place them in the output directory.

We can make this example more complex by extending the model and computing some slope statistics. Add the *Slope* algorithm to the model, and then the *Raster statistics* algorithm, which should use the slope output as its only input.

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Dacă rulați acum modelul, în afară de tabele, veți obține un set de pagini cu statistici. Aceste pagini vor fi disponibile în caseta de dialog a rezultatelor.

17.26 Interfața de prelucrare în serie

Notă: Această lecție introduce interfața de prelucrare în serie, care permite executarea unui singur algoritm, cu un set de valori de intrare diferite.

Uneori, un anumit algoritm trebuie executat în mod repetat cu diverse intrări. Acest caz se întâmplă, atunci când un set de fișiere de intrare trebuie convertit dintr-un format în altul, sau atunci când mai multe straturi aflate într-o anumită proiecție trebuie convertite în altă proiecție.

În acest caz, apelarea repetată a algoritmului din bara de instrumente nu este cea mai bună opțiune. În schimb, ar trebui folosită interfața de prelucrare în serie, care simplifică foarte mult efectuarea unei execuții multiple a unui algoritm dat. Pentru a rula un algoritm ca un proces în serie, identificați-l în bara de instrumente, și în loc de dublu-clic pe el, faceți clic pe el și alegeți *Rulare ca proces în serie*.



Pentru acest exemplu, vom utiliza *Reproiectare algoritm*, așa că găsiți-l și procedați așa cum este descris mai sus. Veți obține următorul dialog.

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Dacă aruncați o privire la datele acestei lecții, veți vedea că acestea conțin un set de trei fișiere shape, dar nici un fișier de proiect QGIS. Aceasta se datorează faptului că, atunci când un algoritm este rulat ca un proces în serie, intrările stratului pot fi selectate fie din proiectul QGIS curent, fie din fișiere. Asta face mai ușoară procesarea unei cantități mari de straturi, cum ar fi, de exemplu, toate straturile dintr-un folder dat.

Fiecare rând din tabelul dialogului de prelucrare în serie, reprezintă o singură execuție a algoritmului. Celulele dintrun rând corespund parametrului necesar algoritmului, ele nefiind dispuse una deasupra celeilalte, la fel ca într-un dialog normal de execuție singulară, ci orizontal în acel rând.

Definirea procesului care va rula în serie constă în completarea tabelului cu valorile corespunzătoare, iar dialogul în sine conține multe instrumente care ușurează această sarcină.

Să începem completarea, unul câte unul, a câmpurilor. Prima coloană de umplut este *Stratul de intrare*. În loc să introduceți numele fiecăruia dintre straturile pe care vrem să le procesăm, le puteți selecta pe toate, și să lăsăm dialogul să le ordoneze câte unul în fiecare rând. Faceți clic pe butonul din celula din stânga-sus, iar în dialogul care se va deschide, de selecție a fișierului, selectați trei dosare pentru a fi reproiectate. Din moment ce numai unul dintre ele este necesar pentru fiecare rând, cele rămase vor fi folosite pentru a umple rândurile de dedesubt.

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Numărul implicit de rânduri este de 3, care este exact numărul de straturi pe care le avem de convertit, dar dacă selectați mai multe straturi, noi rânduri vor fi adăugate automat. Dacă doriți să umpleți manua intrărilel, puteți adăuga mai multe rânduri folosind butonul *Adăugare rând*.

Vom converti toate acele straturi la CRS-ul EPSG:23029, așa că vom selecta acest CRS în al doilea câmp. Ne dorim același lucru pentru toate rândurile, dar nu trebuie să repetăm aceeași pași pentru fiecare rând. În schimb, stabilim CRS-ul pentru primul rând (cel din partea de sus), folosind butonul din celula corespunzătoare, și efectuând dublu clic pe antetul de coloană. Asta va face ca toate celulele din coloană să se completeze utilizând valoarea celulei superioare.

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În cele din urmă, trebuie să selectați un fișier de ieșire pentru fiecare execuție, care va conține stratul reproiectat corespunzător. Încă o dată, vom face acest lucru doar pentru primul rând. Faceți clic pe butonul dn celula de sus, iar în folderul în care doriți să puneți fișierele de ieșire, introduceți un nume de fișier (de exemplu, reprojected. shp).

Acum, când faceți clic pe OK pe dialogul de selecție a fișierului, denumirea fișierului nu va fi automat înscrisă în celulă, dar o casetă de intrare, similară cu următoarea, va fi afișată în loc.

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Dacă selectați prima opțiune, atunci doar celula curentă va fi umplută. Dacă o selectați pe oricare dintre celelalte, toate rândurile vor fi umplute cu un anumit model. În acest caz, vom selecta opțiunea *Umplere cu valoarea parametrului*, iar apoi valoarea *Stratului de intrare* din meniul derulant. Acest lucru va determina ca valoarea din *Stratul de intrare* (adică, numele stratului) să fie adăugat la numele fișierului pe care l-am adaugat, făcând diferit fiecare nume de fișier de ieșire. Tabelul de prelucrare în serie ar trebui să arate astfel.

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Ultima coloană stabilește dacă, sau nu, se vor adăuga straturile rezultate la proiectul QGIS curent. Lăsați implicită opțiunea *Da*, astfel încât să puteți vedea rezultatele, în acest caz.

Faceți clic pe *OK* pentru a rula procesarea în serie. Dacă totul a mers bine, toate straturile vor fi procesate, și vor fi create 3 straturi noi.

17.27 Modelele în interfața de prelucrare a loturilor

Atenționare: Atenție, deoarece acest capitol nu este bine testat, vă rugăm să raportați orice problemă; imaginile lipsesc

Notă: Această lecție prezintă un alt exemplu de interfață de prelucrare a loturilor, dar de data aceasta cu ajutorul unui model în locul unui algoritm încorporat

Modelele sunt similare oricărui alt algoritm, ele putând fi utilizate în interfața de prelucrare a loturilor. Pentru a demonstra aceasta, iată un scurtă exemplu în care folosim modelul nostru hidrologic, bine-cunoscut deja.

Asigurați-vă că aveți modelul adăugat la setul de instrumente, apoi rulați-l ca lot. Iată cum ar trebui sa arate dialogul de prelucrare a lotului:

Atenționare: todo: De adăugat imaginea

Adăugați un total de 5 rânduri. Selectați fișierul DEM corespunzător acestei lecții ca intrare pentru ele. Apoi introduceți 5 valori de prag diferite, așa cum se arată în continuare.

Atenționare: todo: De adăugat imaginea

După cum vedeți, interfața de prelucrare a lotului poate funcționa nu doar la rularea aceluiași proces pe diferite seturi de date, dar, de asemenea, și pe același set de date cu parametrii diferiți.

Faceți clic pe OK, după care ar trebui să obțineți 5 noi straturi, cu bazinele corespunzătoare celor 5 valoril de prag specificate.

17.28 Script de interceptare a pre- și post-execuției

Notă: Această lecție vă arată cum se utilizează scrípturile de interceptare a pre- și post-execuției, permițând astfel efectuarea unor operații adiționale înainte și după procesarea efectivă.

Scrípturile Processing de interceptare a pre și post-execuției se execută înainte și după prelucrarea datelor efective. Ele pot fi folosite pentru a automatiza sarcinile care ar trebui să fie efectuate, ori de câte ori un algoritm este executat.

The syntax of the hooks is identical to the syntax of Processing scripts, see the corresponding chapter in the QGIS User Guide for more details.

În plus față de toate caracteristicile scrípturilor, în codurile de interceptare puteți utiliza o variabilă globală specială dnumită alg, care reprezintă algoritmul care tocmai a fost (sau urmează să fie) executat.

Here is an example post-execution script. By default, Processing stores analysis results in temporary files. This script will copy outputs to a specific directory, so they won't be deleted after closing QGIS.

```
import os
import shutil
from processing.core.outputs import OutputVector, OutputRaster, OutputFile
MY_DIRECTORY = '/home/alex/outputs'
for output in alg.outputs:
    if isinstance(output, (OutputVector, OutputRaster, OutputFile)):
        dirname = os.path.split(output.value)[0]
        shutil.copytree(dirname, MY_DIRECTORY)
```

In the first two lines we import the required Python packages: os — for path manipulations, e.g. extracting file name, and shutil — for various filesystem operations like copying files. In the third line we import Processing outputs. This will be explained in more detail later in this lesson.

Then we define a MY_DIRECTORY constant, which is the path to the directory where we want to copy analysis results.

La sfârșitul scriptului, avem codul principal de interceptare. În cadrul unei bucle vom itera toate ieșirile algoritmilor și vom verifica dacă ele reprezintă fișiere și dacă pot fi copiate. Dacă da, determinăm directorul de nivel superior în care sunt localizate fișierele de ieșire, apoi le copiem în directorul nostru.

To activate this hook we need to open the Processing options, find the entry named *Post-execution script file* in the *General* group, and specify the filename of the hook script there. the specified hook will be executed after each Processing algorithm.

In a similar way, we can implement pre-execution hooks. For example, let's create a hook to check input vectors for geometry errors.

```
from qgis.core import QgsGeometry, QgsFeatureRequest
from processing.core.parameters import ParameterVector
```

(continues on next page)

(continuare din pagina precedentă)

As in the previous example, first we import required QGIS and Processing packages.

Then we iterate over all the algorithm parameters and if a ParameterVector parameter is found, we get the corresponding vector layer object from it. We loop over all the features of the layer and check them for geometry errors. If at least one feature contains an invalid geometry, we print a warning message.

To activate this hook we need enter its filename in the *Pre-execution script file* option in the Processing configuration dialog. The hook will be executed before running any Processing algorithm.

17.29 Alte programe

Module contributed by Paolo Cavallini - Faunalia

Notă: Acest capitol vă arată cum să utilizați programe suplimentare din interiorul Procesării. Pentru a finaliza, trebuie să aveți instalate pachetele relevante, cu ajutorul instrumentelor specifice sistemului de operare.

17.29.1 GRASS

GRASS este o suită GIS gratuită, cu sursă deschisă, pentru managementul și analiza datelor geospațiale, pentru prelucrare de imagine și grafică, producție de hărți, modelare și vizualizare spațială.

Acesta este instalat în mod implicit în Windows, cu ajutorul pachetului de instalare independent OSGeo4W (32 și 64 biți), existând pachete și pentru toate distribuțiile majore de Linux.

17.29.2 R

R este un mediu software cu sursă liberă și deschisă, pentru calcul statistic și grafică.

Trebuie instalate separat, împreună cu câteva biblioteci necesare (**LIST**). Pentru a permite utilizarea lui R în QGIS, trebuie instalat și pluginul *Processing R Provider*.

Frumusețea implementării Processing este că puteți adăuga propriile scrípturi, fie simple sau complexe, acestea putând fi apoi utilizate ca orice alt modul, conectate în fluxuri de lucru mai complexe, etc.

Testați unele dintre exemplele preinstalate, dacă aveți R deja instalat (amintiți-vă să activați modulele R din interfața de configurare generală a Processing).

17.29.3 Altele

LASTools reprezintă un set de comenzi mixte, libere și proprietare, pentru a procesa și analiza datele Lidar. Disponibilitatea în diferite sisteme de operare este variabilă.

Mai multe instrumente sunt disponibile, prin intermediul plugin-urilor suplimentare, cum ar fi:

- LecoS: o suită de statistici de acoperire a terenului și de ecologie a peisajului
- lwgeom: fostă parte din PostGIS, această bibliotecă aduce câteva instrumente utile pentru curățarea geometriei
- Animove: instrumente de analiză a unei serii de animale domestice.

Mai multe vor urma.

17.29.4 Comparație între backend-uri.

Distanțe și tampoane

Haideți să încărcăm points.shp și să scriem "buf" în filtrul instrumentului din bara de instrumente, apoi faceți dublu clic pe el:

- Tamponul cu distanță fixă: Distanța 10000
- Tamponul cu distanță variabilă: MĂRIMEA câmpului distanță
- *v.buffer.distance*: distanța 10000
- v.buffer.column: MĂRIMEA bufcolumn
- Shapes Buffer: valoarea fixă 10000 (dissolve și not), câmpul atribut (cu scalare)

Vedeți câtă viteză diferă, și câte opțiuni sunt disponibile.

Exercițiul pentru cititor: găsiți diferențele din geometria rezultată prin metodele diferite.

Acum, tampoanele și distanțele:

- în primul rând, încărcați și rasterizați vectorul rivers.shp cu *GRASS* ► *v.to.rast.value*; **atenție:** mărimea celulelor trebuie să fie setată la 100 m, în caz contrar timpul de calcul va fi enorm; harta rezultată va conține 1 și NULL-uri
- la fel, cu SAGA ► Shapes to Grid ► COUNT (harta rezultată: de la 6 la 60)
- apoi, *proximitatea* (valoarea= 1 pentru GRASS, o listă de ID-uri de râuri pentru SAGA), *r.buffer* cu parametrii 1000,2000,3000, *r.grow.distance* (prima din cele două hărți; a doua va arăta suprafețele ce țin de fiecare râu, dacă se aplică pe un raster SAGA).

Dizolvare

Dizolvare entități pe baza unui atribut comun:

- *GRASS* ► *v.dissolve* municipalities.shp pe PROVINCIE
- *QGIS* ► *Dissolve* municipalities.shp **pe PROVINCIE**
- OGR ► Dizolvă municipalities.shp pe PROVINCIE
- SAGA ► Polygon Dissolve municipalities.shp pe PROVINCIE (NB: Păstrare granițe interioare trebuie să fie neselectat)

Notă: Ultima nu funcționează în SAGA <=2.10

Exercițiu pentru cititor: găsiți diferențele (de geometrie și de atribute) prin metode diferite.

17.30 Interpolarea și conturarea

Module contributed by Paolo Cavallini - Faunalia

Notă: Acest capitol prezintă folosirea diferitelor variante de calcularre a interpolărilor.

17.30.1 Interpolarea

Proiectul prezintă un gradient de precipitații, de la sud la nord. Să folosim metode diferite pentru interpolare, toate bazate pe vectorul points.shp, parametrul RAIN:

Atenționare: Setează dimensiunea celulei la 500 pentru toate analizele.

- $GRASS \rightarrow v.surf.rst$
- *SAGA* ► *nterpolare B-Spline Multinivel*
- SAGA ► Distanța Inversă Ponderată [Distanța inversă ridicată la o putere; Puterea: 4; Raza de căutare: Global; Intervalul de căutare: toate punctele]
- GDAL ► Grilă (Distanța Inversă ridicată la o putere) [Puterea:4]
- GDAL ► Grilă (Deplasări medii) [Raza1&2: 50000]

Apoi măsurați variația dintre metode și corelați-o cu distanța până la puncte:

- *GRASS* ► *r.series* [Deselectare NULL-uri Propagate, Operația de Agregare: stddev]
- GRASS ► v.to.rast.value asupra points.shp
- GDAL ► Proximitatea
- *GRASS* ► *r.covar* pentru a arăta matricea de corelație; verificați semnificația corelației, de exemplu, cu http: //vassarstats.net/rsig.html.

Astfel, zonele de puncte îndepărtate vor avea o interpolare mai puțin precisă.

17.30.2 Curbe de nivel

Diverse metode pentru a desena linii de contur [întotdeauna pasul= 10] în rasterul stddev:

- $GRASS \succ r.contour.step$
- $GDAL \succ Curbe \ de \ nivel$
- *SAGA* ► *Curbele de nivel dintr-o grilă* [**NB:** în unele versiuni mai vechi de SAGA, shp-ul nu este valid, ceea ce este o eroare cunoscută]

17.31 Simplificarea și netezirea vectorilor

Modulul a fost dezvoltat de Paolo Cavallini - Faunalia

Notă: Acest capitol prezintă modalitățile de simplificare a vectorilor, precum și de netezire a colțurilor ascuțite.

Uneori avem nevoie de o versiune simplificată a unui vector, pentru a avea o dimensiune mai mică de fișier și pentru a scăpa de detaliile inutile. Multe instrumente fac acest lucru într-un mod foarte brut, omițând uneori corectitudinea topologică și adiacența poligoanelor. GRASS este instrumentul ideal pentru acest lucru: fiind un GIS topologic, adiacența și corectitudinea sunt păstrate chiar și la niveluri foarte ridicate de simplificare. În cazul nostru, avem un vector rezultat dintr-un raster, fapt indicat de modelul "zimților" de la frontiere. Aplicarea simplificării va produce linii drepte:

• *GRASS* ► *v.generalize* [Valoarea toleranței maxime: 30 m]

De asemenea, putem proceda și invers, făcând un strat mai complex, prin netezirea colțurilor ascuțite:

• *GRASS* ► *v.generalize* [methoda: chaiken]

Încercați să aplicați această a doua comandă atât vectorului inițial, cât și celui de la prima analiză, pentru a vedea diferența. Rețineți că adiacența nu este pierdută.

Această a doua opțiune se poate aplica, de exemplu, curbelor de nivel care rezultă dintr-o raster grosier, la traseele GPS cu noduri rare, etc.

17.32 Planificarea unei ferme solare

Module contributed by Paolo Cavallini - Faunalia

Notă: Acest capitol arată cum să utilizați diverse criterii, în scopul localizării zonelor potrivite pentru instalarea unei centrale fotovoltaice

Mai întâi de toate, creați o hartă a aspectului dintr-un DTM:

• *GRASS* ► *r.aspect* [Tipul datei: int; cell size:100]

În GRASS, aspectul este calculat în grade, în sens invers acelor de ceasornic, pornind de la Est. Pentru a extrage numai pantele orientate spre Sud (270 de grade +- 45), putem să-l reclasificăm:

• GRASS ► r.reclass

cu următoarele reguli:

```
225 thru 315 = 1 south * = NULL
```

Puteți utiliza fișierul text furnizat, reclass_south.txt. De asemenea, rețineți că, folosind aceste fișiere text simple, putem crea reclasificări foarte complexe.

Dorim să construim o fermă mare, astfel încât vom selecta doar zonele învecinate mari (> 100 ha):

• GRASS ► r.reclass.greater

În final, le convertim într-un vector:

• *GRASS* ► *r.to.vect* [Tipul entității: arie; Colțuri netede: da]

Exercițiu pentru cititor: repetați analiza, înlocuind comenzile GRASS cu unele similare cu ale altor programe.

17.33 Utilizarea scrípturilor R în cadrul procesării

Module contributed by Matteo Ghetta - funded by Scuola Superiore Sant'Anna

Processing (with the Processing R Provider plugin) makes it possible to write and run R scripts inside QGIS.

Atenționare: R has to be installed on your computer and the PATH has to be correctly set up. Moreover Processing just calls the external R packages, it is not able to install them. So be sure to install external packages directly in R. See the related chapter in the user manual.

Notă: If you have *package* problems, it may be related to missing *mandatory* packages required by Processing, like sp, rgdal and raster.

17.33.1 Adăugarea scrípturilor

Adding a script is simple. The easiest way is to open the Processing toolbox and choose *Create new R script*... from the R menu (labelled with an R icon) at the top of the Processing Toolbox. You can also create the script in for instance a text editor and save it in your R scripts folder (processing/rscripts). When it has been saved there, it will be available for editing by right-clicking on the script name in the processing toolbox and then choose *Edit Script*...).



Notă: Dacă nu puteți vizualiza R în Processing, trebuie să îl activați din Processing - Opțiuni - Furnizori

Se va deschide o *fereastră de editare a scriptului* în care va trebui să specificați o serie de parametri, înainte de a putea adăuga corpul scriptului.

| | Untitled Script - R | Script Editor | ••• |
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17.33.2 Crearea diagramelor

În cadrul acestui tutorial vom crea o diagramă de tip **boxplot** pentru un câmp al unui strat vectorial.

Open the r_intro.qgs QGIS project under the exercise_data/processing/r_intro/ folder.

Parametrii scriptului

Deschideți editorul și începeți să scrieți.

Va trebui să specificați câțiva parametri înaintea editării scriptului:

1. The name of the group (*plots* in this case) in which you want to put your script (if the group does not exist, it will be created):

##plots=group

You will find your script in the plots R group in the Processing toolbox.

2. You have to tell Processing that you want to display a plot (in this example):

##showplots

You will then find a link to the plot in the **Result Viewer** panel (can be turned on / off in *View* \triangleright *Panels* and with *Processing* \triangleright *Results Viewer*).

3. You also need to tell Processing about your input data. In this example we want to create a plot from a field of a vector layer:

##Layer=vector

Processing now knows that the input is a vector. The name *Layer* is not important, what matters is the **vector** parameter.

4. Finally, you have to specify the input field of the vector layer (using the name you have provided above - Layer):

##X=Field Layer

Processing now knows that you need a field of Layer, and that you will call it X.

5. It is also possible to define the name of your script using name:

##My box plot script=name

If not defined, the file name will be used as the name of the script.

Corpul scriptului

O dată ce partea introductivă a scriptului a fost setată, puteți adăuga o funcție:

boxplot(Layer[[X]])

boxplot is the name of the R function, the parameter **Layer** is the name that you have defined for the input dataset and **X** is the name you have defined for the field of that dataset.

Atentionare: The parameter **X** has to be within double square brackets ([[]]).

Scriptul final va trebui să arate astfel:

```
##Vector processing=group
##showplots
##Layer=vector
##X=Field Layer
boxplot (Layer[[X]])

*Untitled Script - R Script Editor

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```

Save the script in the default path suggested by Processing (processing/rscripts). If you have not defined a name in the script heading, the file name you choose will become the name of the script in the Processing toolbox.

Notă: You can save the script wherever you like, but Processing will then not be able to include it in the processing toolbox automatically, so you have to upload it manually.

Acum, doar rulați-l, folosind butonul din partea de sus a ferestrei editorului:

| *Untitled Script - R Script Editor | ● 🛛 😣 |
|---|-------|
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| <pre>1 ##Vector processing=group 2 ##showplots 3 ##Layer=vector 4 ##X=Field Layer 5 boxplot(Layer[[X]])</pre> | |
| • | ►. |

Once the editor window has been closed, use the text box of Processing to find your script:

| Project <u>E</u> dit <u>V</u> iew <u>L</u> ayer <u>S</u> ett | ings <u>P</u> lugins Vect <u>o</u> r <u>R</u> aster <u>D</u> atabase <u>W</u> eb Pro <u>c</u> essing <u>H</u> elp | |
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You can now fill the parameters required in the Processing algorithm window:

- for Layer choose sample_points
- for the **X** field choose *value*

Efectuați clic pe **Executare**.

| boxplot |
|---------------------------|
| Parameters Log Help |
| Layer |
| sample_points [EPSG:4326] |
| x |
| value |
| R Plots |
| [Save to temporary file] |
| |
| |
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| |
| |
| |
| 0% |
| <u>C</u> lose Run |

Fereastra rezultatelor ar trebui să fie deschisă în mod automat, dacă nu, doar faceți clic pe *Processing* ► *Result Viewer*....

Click on the link in the viewer and you will see:



Notă: You can open, copy and save the image by right clicking on the plot.

17.33.3 Crearea unui vector

You can also create a vector layer and have it automatically loaded into QGIS.

The following example has been taken from the Random sampling grid script that can be found in the online collection of R scripts (the scripts in this online collection can be found in https://github.com/qgis/QGIS-Processing/tree/master/rscripts).

The aim of this exercise is to create a random point vector layer using an input vector layer to restrict the extent using the spsample function of the sp package.

Parametrii scriptului

Ca și mai înainte, avem de stabilit câțiva parametri la începutul script-ului:

1. Specify the name of the group in which you want to put your script, in this case Point pattern analysis:

##Point pattern analysis=group

2. Define an input parameter (a vector layer) that will constrain the placement of the random points:

##Layer=vector

3. Set an input parameter for the number of points that are going to be created (Size, with a default value of 10):

##Size=number 10

Notă: Since a default value (10) is defined, the user can change this number or can leave the parameter without a number.

4. Specify that there is an output vector layer (called Output):

##Output=output vector

Corpul scriptului

Acum puteți adăuga corpul funcției:

1. Use the spsample function:

```
pts=spsample(Layer, Size, type="random")
```

The function uses the *Layer* to constrain the placement of the points (if it is a line layer, a points will have to be on one of the lines in the layer, if it is a polygon layer, a point will have to be within a polygon). The number of points is taken from the *Size* parameter. The sampling method is *random*.

2. Generate the output (the Output parameter):

```
Output=SpatialPointsDataFrame(pts, as.data.frame(pts))
```

Scriptul final va trebui să arate astfel:

```
##Point pattern analysis=group
##Layer=vector
##Size=number 10
##Output=output vector
pts=spsample(Layer, Size, type="random")
Output=SpatialPointsDataFrame(pts, as.data.frame(pts))
```



Save it and run it, clicking on the run button.

În noul tip de fereastră scrieți parametrii potriviți:

| Random sampling grid | | | |
|--|---------------|--------|----|
| Parameters Log Help | | | |
| Layer | | | |
| sample_points [EPSG:4326] | ~ | | 9 |
| Size | | | |
| 10.000000 | | ^ ~ | |
| Output | | | |
| [Save to temporary file] | | | |
| ✓ Open output file after running algorithm | | | |
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apoi faceți clic pe rulare.

The result layer will be added to the table of contents and its points will be displayed on the map canvas:



17.33.4 Text and graph output from R - syntax

Processing (with the Processing R Provider plugin) uses special syntax to get the results out of R:

- > înainte de comanda dvs., ca în >lillie.test (Layer[[Field]]) denotă că rezultatul ar trebui să fie trimis la ieșirea R (Vizualizatorul de rezultate)
- + after a plot enables overlay plots. For example plot(Layer[[X]], Layer[[Y]]) + abline(h=mean(Layer[[X]]))

17.34 Prezicerea alunecărilor de teren

Modulul a fost dezvoltat de Paolo Cavallini - Faunalia

Notă: Acest capitol vă arată cum să creați un model simplificat pentru a prezice probabilitatea alunecărilor de teren.

În primul rând, vom calcula panta (aleasă dintre diferite variante; cititorul interesat poate calcula diferența dintre rezultate):

- $GRASS \succ r.slope$
- SAGA ► Pantă, Aspect, Curbură
- Panta GDAL

Apoi vom crea un model de predicție a precipitațiilor, pe baza interpolării valorilor precipitațiilor de la stațiile meteo:

• GRASS ► v.surf.rst (rezoluția: 500 m)

Probabilitatea unei alunecări de teren va fi afectată atât de precipitații cât și de pantă (desigur, un model la scară reală va folosi mai multe straturi, și parametri mai potriviți), rezultând formula (precipitații * pantă) /100:

- SAGA ► Calculator raster precipitații, pantă: (a*b) /100 (sau: GRASS ► r.mapcalc)
- apoi vom calcula care sunt municipalitățile cu un mai mare risc de precipitații: SAGA ► Statistici pentru rastere cu poligoane (parametrii de interes fiind Maximum și Medie)

CAPITOLUL 18

Module: Using Spatial Databases in QGIS

În acest modul veți învăța despre modul de utilizare a bazelor de Date Spațiale în QGIS, pentru a gestiona, afișa și manipula datele, precum și pentru a le analiza prin efectuarea de interogări. Vom folosi în principal PostgreSQL și PostGIS (care au fost acoperite în secțiunile anterioare), dar aceleași concepte sunt aplicabile și altor implementări de baze de date spațiale, inclusiv SpatiaLite.

18.1 Lesson: Working with Databases in the QGIS Browser

În cele 2 module anterioare am prezentat conceptele de bază, facilitățile și funcțiile de bază ale bazelor de date relaționale, precum și extensiile care permit stocarea, administrarea, interogarea și manipularea datelor spațiale. Această secțiune va aborda, în detaliu, utilizarea eficientă a bazelor de date spațiale în QGIS.

Scopul acestei lecții: Utilizarea interfeței QGIS pentru a interacționa cu bazele de date spațiale.

18.1.1 ???? Follow Along: Adding Database Tables to QGIS using the Browser

Am văzut, pe scurt, cum pot fi adăugate, sub formă de straturi QGIS, tabelele dintr-o bază de date; haideți acum să intrăm în mai multe detalii și să vedem diverse moduri de a face acest lucru în QGIS. Să aruncăm, mai întâi, o privire la noua interfață a Navigatorului.

- Începeți o nouă hartă în QGIS.
- Deschideți Navigatorul efectuând un clic pe fila Navigator, din partea de jos a Panoului Straturilor
- Deschideți porțiunea PostGIS a arborelui, pentru a găsi conexiunea configurată anterior (poate fi necesar să faceți clic pe butonul Refresh, din partea de sus a ferestrei navigatorului).



- Un clic dublu pe oricare din tabelele/straturile listate aici va duce la adăugarea sa pe Canevasul Hărții.
- Făcând clic dreapta pe o tabelă/strat în această vizualizare veți observa câteva opțiuni. Alegeți *Proprietăți*, pentru a vedea proprietățile stratului.

| Display Name | lines |
|--|--|
| Layer Source | pg:/postgis_demo/public/lines |
| Provider | postgres |
| Metadata | |
| General | |
| Storage type o | f this layer |
| PostgreSQL da | atabase with PostGIS extension |
| Description of | his providor |
| PostgreSQL/P PostgreSQL 9. | bstGIS provider 3.1 on x86_64-apple-darwin12.5.0, compiled by i686-apple-darwin11-llvm-gcc-4.2 (GCC) 4.2.1 (Based on Apple |
| PostgreSQL/P PostgreSQL 9, Inc. build 5658 PostGIS 2.1 U Source for this dbname='postg | his provider sstGIS provider 3.1 on x86_64-apple-darwin12.5.0, compiled by i686-apple-darwin11-llvm-gcc-4.2 (GCC) 4.2.1 (Based on Apple (LLVM build 2336.11.00), 64-bit SE_GEOS=1 USE_PROJ=1 USE_STATS=1 layer gis_demo' host=localhost port=5432 sslmode=disable key='id_0' srid=32733 type=MULTILINESTRING |
| PostgreSQL/P PostgreSQL 9 Inc. build 5658 PostGIS 2.1 U Source for this dbname='post table="public". Geometry type | batGIS provider 3.1 on x86_64-apple-darwin12.5.0, compiled by i686-apple-darwin11-llvm-gcc-4.2 (GCC) 4.2.1 (Based on Apple) (LLVM build 2336.11.00), 64-bit SE_GEOS=1 USE_PROJ=1 USE_STATS=1 layer gis_demo' host=localhost port=5432 sslmode=disable key='id_0' srid=32733 type=MULTILINESTRING lines" (geom) sql= of the features in this layer |
| PostgreSQL/P PostgreSQL 9 Inc. build 5658 PostGIS 2.1 U Source for this dbname='post table="public". Geometry type Line | Ins provider astGIS provider 3.1 on x86_64-apple-darwin12.5.0, compiled by i686-apple-darwin11-llvm-gcc-4.2 (GCC) 4.2.1 (Based on Apple (LLVM build 2336.11.00), 64-bit SE_GEOS=1 USE_PROJ=1 USE_STATS=1 layer gis_demo' host=localhost port=5432 sslmode=disable key='id_0' srid=32733 type=MULTILINESTRING lines" (geom) sql= of the features in this layer |
| PostgreSQL/P PostgreSQL/P PostgreSQL 9 Inc. build 5658 PostGIS 2.1 U Source for this dbname='postg table="public". Geometry type Line Primary key at | bits provider astGIS provider 3.1 on x86_64-apple-darwin12.5.0, compiled by i686-apple-darwin11-llvm-gcc-4.2 (GCC) 4.2.1 (Based on Apple) (LLVM build 2336.11.00), 64-bit SE_GEOS=1 USE_PROJ=1 USE_STATS=1 layer gis_demo' host=localhost port=5432 sslmode=disable key='id_0' srid=32733 type=MULTILINESTRING lines" (geom) sql= of the features in this layer ributes |
| PostgreSQL/P PostgreSQL 9. Inc. build 5658 PostGIS 2.1 U Source for this dbname='post table="public". Geometry type Line Primary key at id_0 | his provider postGIS provider 3.1 on x86_64-apple-darwin12.5.0, compiled by i686-apple-darwin11-llvm-gcc-4.2 (GCC) 4.2.1 (Based on Apple) (LLVM build 2336.11.00), 64-bit SE_GEOS=1 USE_PROJ=1 USE_STATS=1 layer pis_demo' host=localhost port=5432 sslmode=disable key='id_0' srid=32733 type=MULTILINESTRING lines" (geom) sql= of the features in this layer ributes |
| PostgreSQL/P PostgreSQL 9 Inc. build 5658 PostGIS 2.1 U Source for this dbname='post table="public". Geometry type Line Primary key at id_0 | Ins prover bastGIS provider 3.1 on x86_64-apple-darwin12.5.0, compiled by i686-apple-darwin11-llvm-gcc-4.2 (GCC) 4.2.1 (Based on Apple (LLVM build 2336.11.00), 64-bit SE_GEOS=1 USE_PROJ=1 USE_STATS=1 layer gis_demo' host=localhost port=5432 sslmode=disable key='id_0' srid=32733 type=MULTILINESTRING lines" (geom) sql= of the features in this layer tributes |

Notă: Desigur, puteți folosi această interfață și pentru a vă conecta la bazele de date PostGIS găzduite pe un server extern . Făcând clic dreapta pe intrarea PostGIS din arbore, veți putea specifica parametrii unei noi conexiuni.

18.1.2 ???? Follow Along: Adding a filtered set of records as a Layer

Acum, că am văzut cum puteți adăuga în QGIS un întreg tabel, sub formă de strat, puteți continua, adăugând un set de înregistrări filtrate dintr-un tabel, utilizând interogările învățate în secțiunile anterioare.

- Începeți o hartă nouă, fără straturi
- Faceți clic pe butonul de Adăugare Straturi PostGIS sau selectați Strat- Adăugare Straturi PostGIS din meniu.
- În dialogul de Adăugare Tabel(e) PostGIS, care se deschide, folosiți conexiunea postgis_demo.
- Extindeți schema public și găsiți cele trei tabele cu care am lucrat anterior.
- Faceți clic pe stratul lines pentru a-l selecta, dar în loc să-l adăugați, apăsați butonul *Setare Filtru*, pentru a deschide dialogul *Constructorului de Interogări*.

| 000 | Query Builder |
|-------------------------------------|----------------------|
| nes Fielde | Values |
| | |
| id_0 | major |
| id roadtune | minor |
| Operators | Use unfiltered layer |
| = < > LIKE | % IN NOT IN |
| <= >= != ILIKE | AND OR NOT |
| Provider specific filter expression | |
| "roadtype" = 'major' | |

- Faceți clic pe OK pentru a încheia editarea filtrului, apoi pe Adăugare, pentru a adăuga pe hartă stratul filtrat.
- Redenumire strat lines din arborele roads_primary.

Veți observa că numai Drumurile Primare au fost adăugate pe hartă, și nu întregul strat.

18.1.3 În concluzie

Ați văzut cum se poate interacționa cu bazele de date spațiale folosind QGIS Browser, și modul în care se pot adăuga straturi pe hartă în funcție de un filtru de interogare.

18.1.4 Ce urmează?

În continuare, este prezentat lucrul cu interfața Managerului DB din QGIS, pentru o serie amplă de activități de gestiune a bazelor de date.

18.2 Lesson: Using DB Manager to work with Spatial Databases in QGIS

Am văzut deja cum se pot efectua în QGIS multe operații cu bazele de date, la fel de simplu ca și cu celelalte instrumente, dar acum este timpul să ne uităm la instrumentul DB Manager, care oferă o mare parte din aceeași funcționalitate, similar cu alte instrumente dedicate managementului.

Scopul acestei lecții: De a se învăța interacțiunea cu bazele de date raster, folosind interfața DB Manager din QGIS.

18.2.1 ???? Follow Along: Managing PostGIS Databases with DB Manager

You should first open the DB Manager interface by selecting Database ► DB Manager ► DB Manager on the menu

or by selecting the ^{DB Manager} icon on the toolbar.

You should already see the previous connections we have configured and be able to expand the myPG section and its public schema to see the tables we have worked with in previous sections.

Primul lucru care se remarcă este faptul că, de acum, puteți vedea unele metadate ale Schemelor conținute în baza de date.



Schemas are a way of grouping data tables and other objects in a PostgreSQL database and a container for permissions and other constraints. Managing PostgreSQL schemas is beyond the scope of this manual, but you can find more information about them in the PostgreSQL documentation on Schemas. You can use the DB Manager to create new Schemas, but will need to use a tool like pgAdmin III or the command line interface to manage them effectively.

De asemenea, DB Manager se poate folosi pentru a administra tabelele din baza de date. Am analizat deja diferite moduri de creare și gestionare a tabelelor din linia de comandă, dar acum dorim să vedem cum se poate face acest lucru în DB Manager.

First, its useful to just look at a table's metadata by clicking on its name in tree and looking in the Info tab.



In this panel you can see the *General Info* about the table as well the information that the PostGIS extension maintains about the geometry and spatial reference system.

If you scroll down in the *Info* tab, you can see more information about the *Fields*, *Constraints* and *Indexes* for the table you are viewing.
| 000 | | | 🥣 D | B Manager | | | |
|--|---|---|--|--|-------------------------|---------|-----------------------------------|
| | | | | | | | |
| Tree | | | | Info | Table F | Preview | |
| Tree PostGIS postgis_demo Geography_columns Geography_columns Geometry_columns Lines Lines Points Polygons Craster_columns Polygons Fraster_overviews Spatial_ref_sys | Rows Privil Pos Colun Geon Dime Spati Estim Exter | i (counted): eges: etGIS mn: netry: insion: al ref: nated exter nt: No spatial | : 7 select, MULTILI 2 WGS 84 ht: 162055 (unknow index defined | Into insert, update, d NESTRING / UTM zone 33S 1.12500, 69367: m) (find out) (create it) | (32733) 74.00000 - 1 | 1624197 | 7.25000, 6940707.00000 |
| | # | Namo | | Type | Longth | Null | Default |
| | 1 | id 0 | int4 | туре | A | N | nextual(lines id 0 segluregclass) |
| | 2 | geom | geometry (MultiLine | String,32733) | 1 | Y | nextrai(intes_td_o_seqegelass) |
| | 3 | id | int4 | | 4 | Y | |
| | 4 | roadtype | e varchar (5 |) | | Y | |
| | Cor N | I strain Iame Is_pkey | Type Primary key | Column(s) id_0 | | | |
| | | | | | | | |

Its also very useful to use DB Manager to simply look at the records in the database in much the same way you might do this by viewing the attribute table of a layer in the Layer Tree. You can browse the data by selecting the *Table* tab.

| Tree | | | Info | Table Preview |
|--|------|------------|------|---------------|
| PostGIS | id_0 | geom | id | roadtype |
| v 📀 public | 1 1 | MULTILINES | 1 | NULL |
| geography_columns geometry_columns lines | 2 2 | MULTILINES | 2 | minor |
| | 3 3 | MULTILINES | 3 | NULL |
| points | 4 4 | MULTILINES | 4 | major |
| raster_columns | 5 5 | MULTILINES | 5 | minor |
| spatial_ref_sys | 6 6 | MULTILINES | 6 | major |
| | 7 7 | MULTILINES | 8 | minor |
| | | | | |

Există, de asemenea o filă Preview, care vă va arăta datele stratului într-o hartă de previzualizare.

Click-dreapta pe unul dintre straturi și, făcând clic pe Add to Canvas, acesta se va adăuga pe hartă.

So far we have only been viewing the database its schemas and tables and their metadata, but what if we wanted to alter the table to add an additional column perhaps? DB Manager allows you to do this directly.

- 1. Selectați din arbore tabela pe care doriți să o editați
- 2. Select *Table* > *Edit Table* from the menu, to open the *Table Properties* dialog.

| Name id 0 | Type int4 | Null Default |
|--------------|-----------------------------------|---------------------------|
| aeom | aeometry (Multil ineString 32733) | True |
| id | int4 | True |
| roadtype | varchar (5) | True |
| Add co | lumn Add geometry column | Edit column Delete column |
| | | |

Puteți folosi acest dialog pentru a Adăuga Coloane, Coloane pentru geometrii, pentru a edita coloanele existente sau pentru a elimina complet o coloană.

Using the Constraints tab, you can manage which fields are used as the primary key or to drop existing constraints.

| Primary, fo | reign keys, un | ique and che | eck constraints: | |
|-------------|----------------|--------------|------------------|-------------------|
| Iines_pkey | Primary key | id_0 | | |
| Add prin | mary key / uni | que | | Delete constraint |

Fila Indecșilor poate fi folosită pentru a adăuga și șterge atât indicii spațiali, cât și cei normali.

| | Columns Constraints In | dexes |
|-----------------|------------------------|--------------|
| Indexes defined | for this table: | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Add index | Add spatial index | Delete index |
| | | |
| | | Clo |

18.2.2 ???? Follow Along: Creating a New Table

Acum, că am trecut prin procesul de lucru cu tabelele existente în baza noastră de date, haideți să folosim DB Manager pentru a crea o nouă tabelă.

- 1. If it is not already open, open the DB Manager window, and expand the tree until you see the list of tables already in your database.
- 2. Selectați meniul :guilabel: Table -> Create Table pentru a deschide dialogul de Creare a Tabelei.
- 3. Use the default Public schema and name the table places.
- 4. Add the id, place_name, and elevation fields as shown below
- 5. Make sure the id field is set as the primary key.
- 6. Click the checkbox to *Create geometry column* and make sure it is set to a POINT type and leave it named geom and specify 4326 as the *SRID*.
- 7. Faceți clic pe caseta de bifare de Creare a indexului spațial, apoi pe Create pentru a crea tabela.

| Name places | | | |
|--|--|------|----------------|
| places | | | 7 |
| Name | Type | Null | Add field |
| 1 id | serial | | Delete field |
| 2 place_name | text | | |
| 3 elevation | integer | | 1 |
| rimary key id | | | Up Down |
| Primary key id I Create geometry | column POINT | | Up Down |
| Primary key id I Create geometry | column POINT Name geom | | Up Down |
| Primary key id T Create geometry Dim | column POINT Name geom ensions 2 | | Up Down |
| Primary key id Create geometry Dim | column POINT Name geom ensions 2 SRID 4326 | | Up Down |
| Primary key id Create geometry Dim Create spatial inc | column POINT Name geom ensions 2 SRID 4326 dex | | Up Down |

8. Închideți dialogul care vă informează că tabela s-a creat cu succes, apoi faceți clic pe *Close* pentru a închide Dialogul de Creare a Tabelei.

You can now inspect your table in the DB Manager and you will of course find that there is no data in it. From here you can *Toggle Editing* on the layer menu and begin to add places to your table.

18.2.3 ??? Follow Along: Basic Database Administration

The DB Manager will also let you do some basic database administration tasks. It is certainly not a substitute for a more complete database administration tool, but it does provide some functionality that you can use to maintain your database.

Database tables can often become quite large and tables which are being modified frequently can end up leaving around remnants of records that are no longer needed by PostgreSQL. The *VACUUM* command takes care of doing a kind of garbage collection to compact and optional analyze your tables for better performance.

Let us take a look at how we can perform a VACUUM ANALYZE command from within DB Manager.

- 1. Select one of your tables in the DB Manager Tree
- 2. Select *Table* ► *Run Vacuum Analyze* from the menu

PostgreSQL will now perform the operation. Depending on how big your table is, this may take some time to complete.

You can find more information about the VACUUM ANALYZE process in the PostgreSQL Documentation on VACUUM ANALYZE.

18.2.4 ???? Follow Along: Executing SQL Queries with DB Manager

DB Manager also provides a way for you to write queries against your database tables and to view the results. We have already seen this type of functionality in the *Browser* panel, but lets look at it again here with DB Manager.

- 1. Select the lines table in the tree.
- 2. Selectați butonul SQL window din bara de instrumente DB Manager.

| 1.000 |
|-------|
| 121 |
| |
| |

3. Compuneți următoarea Interogare SQL în spațiul furnizat:

| elect * | from lines where roa | e = 'major'; |
|---------|----------------------|--------------|
|---------|----------------------|--------------|

- 4. Clic pe butonul Execute (F5) pentru a rula interogarea.
- 5. Ar trebui să vedeți acum înregistrările care corespund panoului Rezultate.

| select * from | lines where roadtype = 'major'; | | | |
|---------------|---------------------------------|-----|----------|-------|
| | | | | |
| | | | | |
| Evenute /F | 2 mm 0.0 mm da | | | Clear |
| Execute (F | 2 rows, 0.0 seconds | ~ | | Clear |
| Result: | | | | |
| id_0 | geom | id | roadtype | |
| 1 4 | 0105000020DD7F00000 | . 4 | major | |
| 2 6 | 0105000020DD7F00000 | 6 | major | |
| | | | / | |
| | | | | |
| 🗌 Load as r | new layer | | | |
| | | | | |

- 6. Faceți clic pe caseta de bifare Load as new layer pentru a adăuga rezultatele în harta dvs.
- 7. Select the id column as the Column with unique integer values and the geom column as the Geometry column.
- 8. Enter roads_primary as the Layer name (prefix).
- 9. Faceți clic pe Load now! pentru a încărca rezultatele ca un nou strat în harta dvs.

| elect * from li | nes where roadtype = 'major'; | | | | |
|-------------------------------|-------------------------------|----------|-------------|---|---------------------|
| Execute (F5) | 2 rows, 0.0 seconds | | | | Clear |
| esult: | | | | | |
| id_0 | geom | id | roadtype | | |
| 4 | 0105000020DD7F00000 | 4 | major | | |
| 2 6 | 0105000020DD7F00000 | 6 | major | | |
| Load as ne | w layer | | | | |
| Column with integer values | id via | Geometry | column geom | • | Retrieve columns |
| Layer name (p | prefix) roads_primary | | | | Load now! |
| <u> </u> | cting by feature id | | | | |
| | ting by feature id | | | | Load How: |

The layers that matched your query are now displayed on your map. You can of course use this query tool to execute any arbitrary SQL command including many of the ones we looked at in previous modules and sections.

18.2.5 Importarea datelor dintr-o Bază de date cu ajutorul DB Manager

We have already looked at how to import data into a spatial database using command line tools, so now let's learn how to use DB Manager to do imports.

1. Clic pe butonul Import layer/file din Bara de Instrumente a dialogului DB Manager.



- 2. Select the urban_33S.shp file from exercise_data/projected_data as the input dataset
- 3. Clic pe butonul Opțiunilor de actualizare pentru a pre-completa unele din valorile formularului.
- 4. Asigurați-vă că este selectată opțiunea Creare tabelă nouă.
- 5. Specify the Source SRID as 32722 and the Target SRID as 4326
- 6. Activați caseta de bifare pentru a Crea îndexul Spațial
- 7. Click OK to perform the import

| | Update options |
|----------------------------|---|
| Output ta | ble |
| Schema | public \$ |
| Table | urban_33S 🔹 |
| Action | |
| • Create | e new table |
| | Drop existing one |
| Apper | nd data to table |
| Options | |
| - Prima | ry key |
| | etry column |
| UEUIII | |
| | e SKID 32722 VI larget SKID 4326 |
| Source | |
| Source | ling UTF-8 |
| Source Encode Create | ling UTF-8 variable of multi-part e spatial index |

- 8. Închideți dialogul care vă informează că importul a avut loc cu succes
- 9. Click the Refresh button on the DB Manager Toolbar

You can now inspect the table in your database by clicking on it in the Tree. Verify that the data has been reprojected by checking that the *Spatial ref:* is listed as WGS 84 (4326).



Click-dreapta pe unul dintre straturile din Arbore și apoi, făcând clic pe *Adăugare la Canevas*, tabela se va adăuga pe hartă, sub formă de strat.

18.2.6 Exportul datelor cu DB Manager dintr-o Bază de date

De asemenea, DB Manager se poate utiliza pentru exportul datelor din bazele de date spațiale, așa că haideți să aruncăm o privire la modul în care se face aceasta.

- 1. Select the lines layer in the Tree and click the *Export to File* button on the toolbar to open the *Export to vector file* dialog.
- 2. Click the ... button to select the *Output file* and save the data to your exercise_data directory as urban_4326.
- 3. Set the *Target SRID* as 4326.
- 4. Clic OK pentru a inițializa exportul.

| • Create new file | |
|---------------------|------------------|
| Drop existing one | |
| Append data to file | |
| Options | |
| Source SRID 32733 | Target SRID 4326 |
| Encoding System | * * |
| | |

5. Închideți dialogul care vă informează că exportul a avut loc cu succes, apoi închideți DB Manager. Puteți inspecta de acum fișierul shape pe care l-ați creat cu panoul de Răsfoire.

| 80 | Browser | | | |
|---------|---|-----------------|---|--|
| C 🖬 Add | | | | |
| | 🔻 🚞 source | | | |
| | 🔻 🚞 docs | | | |
| | documentation_guidelines | 000 | Laver Properties | |
| | gentle_gis_introduction | 000 | eager rioperaes | |
| | pyqgis_developer_cookbook | | | |
| | 🔻 🚞 training_manual | Display Name | urban_4326.snp | |
| | answers | Laver Source | is/OGIS-Documentation/source/docs/training_manual/exercise_data/urban_4326.shp | |
| | appendix | | | |
| | assessment | Provider | ogr | |
| | basic_map | | | |
| | complete_analysis | Metadata | | |
| | create_vector_data | | | |
| | database_concepts | General | | |
| | ualabases | Storage type o | of this layer | |
| | enso4326 | | | |
| | ► informs | ESRI Shapetile | | |
| 1 | plugins | Description of | this provider | |
| | postgis | OGR data prov | vider (compiled against GDAL/OGR library version 1.10.1, running against GDAL/OGR library | |
| | projected_data | version 1.10.1) | | |
| | raster residential development | Source for this | layer | |
| | school_property_photos | /Volumes/Drob | po/sites/agis/QGIS- | |
| | styles | Documentation | n/source/docs/training_manual/exercise_data/urban_4326.shp | |
| | symbols | Geometry type | e of the features in this layer | |
| | 🗭 land_use.db | Line | | |
| | 🟳 urban_4326.shp | The number of | f features in this laver | |
| | foreword | The number of | ricalures in uns layer | |
| | grass | 7 | | |
| | ▶ 🚞 i18n | Editing capabil | lities of this laver | |
| | introduction | Luting capabil | | |
| | Infiniti-sphinx-theme | | | |
| | map_composer | | Close | |
| | online_resources | | Close | |
| | planning_uocs | | | |
| | python | | | |
| | ► asters | | | |
| | resources | | | |
| | spatial databases | | | |
| | vector_analysis | | | |
| | vector_classification | | | |
| | index.rst | | | |

18.2.7 În concluzie

You have now seen how to use the DB Manager interface in QGIS to manage your spatial databases, to execute SQL queries against your data and how to import and export data.

18.2.8 Ce urmează?

Next, we will look at how to use many of these same techniques with SpatiaLite databases.

18.3 Lesson: Working with SpatiaLite databases in QGIS

While PostGIS is generally used on a server to provide spatial database capabilities to multiple users at the same time, QGIS also supports the use of a file format called *SpatiaLite* that is a lightweight, portable way to store an entire spatial database in a single file. Obviously, these 2 types of spatial databases should be used for different purposes, but the same basic principles and techniques apply to both. Let's create a new SpatiaLite database and explore the functionality provided to work with these databases in QGIS.

The goal for this lesson: To learn how to interact with SpatiaLite databases using the QGIS Browser interface.

18.3.1 ???? Follow Along: Creating a SpatiaLite database with the Browser

Using the Browser panel, we can create a new SpatiaLite database and get it setup for use in QGIS.

- 1. Right click on the SpatiaLite entry in the Browser tree and select Create Database.
- 2. Specify where on your filesystem you want to store the file and name it qgis-sl.db.
- 3. Again right click on the *SpatiaLite* entry in the Browser tree and now select the *New Connection* item. Find the file you created in the last step and open it.

Acum, că v-ați configurat noua bază de date, veți descoperi că intrarea din arborele Navigatorului nu are nimic sub ea, iar singurul lucru pe care îl puteți face în acest moment este de a șterge conexiunea. Acest lucru se datorează faptului că, desigur, noi nu am adăugat nici un tabel în această bază de date. Haideți să mergem mai departe și să facem asta.

- 1. Find the button to create a new layer and use the dropdown to create a new SpatiaLite layer, or select *Layer* ► *New* ► *P* a *New SpatiaLite Layer*.
- 2. Selectați baza de date pe care am creat-o în pașii anteriori în meniul derulant.
- 3. Give the layer the name places.
- 4. Bifați caseta de lângă Create an auto-incrementing primary key.
- 5. Add two attributes as shown in below
- 6. Clic pe OK, pentru a crea tabela.

| aver name places | | | | | |
|--|-------------------------|------------------------|--|--|--|
| | | | | | |
| eometry columr Type | geometry | | | | |
| Point | 🔵 Line | O Polygon | | | |
| MultiPoint | OMultiline | Multipolygon | | | |
| PSG:4326 - WG | S 84 | Specify CRS | | | |
| Create an auto New attribute | incrementing prima | y key | | | |
| Name | | | | | |
| Туре | Whole number | * | | | |
| | | Add to attributes list | | | |
| | | | | | |
| Attributes list | | | | | |
| Attributes list Name | Туре | | | | |
| Attributes list Name place_name | Type real | | | | |
| Attributes list Name place_name elevation | Type real integer | | | | |
| Attributes list Name place_name elevation | Type real integer | | | | |
| Attributes list Name place_name elevation | Type real integer | Remove attribute | | | |

7. Click the refresh button at the top of the Browser and you should now see your places table listed.



Puteți să faceți clic dreapta pe tabelă și să-i vizualizați proprietățile, așa cum am făcut-o în exercițiul precedent.

De aici puteți începe o sesiune de editare și să adăugați date direct la noua bază de date.

We also learned about how to import data into a database using the DB Manager and you can use this same technique to import data into your new SpatiaLite DB.

18.3.2 În concluzie

You have seen how to create SpatiaLite databases, add tables to them and use these tables as layers in QGIS.

CAPITOLUL 19

Anexă: Contribuții La Acest Manual

To add materials to this course, you must follow the guidelines in this Appendix. You are not allowed to alter the conditions in this Appendix except for clarification. This is to ensure that the quality and consistency of this manual can be maintained.

19.1 Descărcare resurse.

Sursa acestui document se poate găsi la GitHub. Consultați GitHub.com pentru instrucțiunile de folosire a sistemului de versionare git.

19.2 Formatul Manualului

Acest manual este scris folosind Sphinx, un generator de documente Python, care folosește limbajul de marcare **`reStructuredText <https://docutils.sourceforge.io/rst.html >`_**. Instrucțiuni despre cum să utilizați aceste instrumente sunt disponibile pe respectivele site-uri.

19.3 Adăugarea unui Modul

To add a new module:

- 1. First create a new directory (directly under the top-level of the qgis-training-manual directory) with the name of the new module.
- 2. Under this new directory, create a file called index.rst. Leave this file blank for now.
- 3. Open the index.rst file under the top-level directory. Its first lines are:

```
.. toctree::
    :maxdepth: 2
    foreword/index
    introduction/index
```

You will note that this is a list of directory names, followed by the name index. This directs the toplevel index file to the index files in each directory. The order in which they are listed determines the order they will have in the document.

- 1. Add the name of your new module (i.e., the name you gave the new directory), followed by /index, to this list, wherever you want your module to appear.
- 2. Amintiți-vă să mențineți ordinea modulelor logice, astfel încât modulele ulterioare se construiesc pe cunoștințele prezentate în modulele anterioare.
- 3. Open your new module's own index file (module_name/index.rst).
- 4. Along the top of the page, create the module heading:
 - 1. write a first line of asterisks (*).
 - 2. Follow this with a line containing the markup phrase Module:, followed by the name of your module.
 - 3. End this off with another line of same number of asterisks.

Notă: The underline and the overline should not be shorter than the line containing the module title.

- 5. Lăsați o linie deschisă după aceasta.
- 6. Scrieți un scurt paragraf, explicând scopul și conținutul modulului.
- 7. Lăsați o linie deschisă, apoi adăugați următorul text:

```
.. toctree::
    :maxdepth: 2
    lesson1
    lesson2
```

... where lesson1, lesson2, etc., are the names of your planned lessons.

Fișierul index la nivel de modul va arăta astfel:

19.4 Adăugarea unei Lecții

Pentru a adăuga o lecție pentru un modul nou sau existent:

- 1. Deschideți directorul modulului
- 2. Open the index.rst file (created above in the case of new modules).
- 3. Ensure that the name of the planned lesson is listed underneath the toctree directive, as shown above.
- 4. Creați un nou fișier în directorul modulul.
- 5. Name this file exactly the same as the name you provided in the module's index.rst file, and add the extension .rst.

Notă: For editing purposes, a .rst file works exactly like a normal text file (.txt).

- 1. To begin writing the lesson, write the markup phrase Lesson, followed by the lesson name.
- 2. In the next line, write a line of equal signs (=), not shorter than the lesson title.
- 3. Lăsați o linie deschisă după aceasta.
- 4. Scrieți o scurtă descriere asupra scopului lecției.
- 5. Includeți o introducere generală în subiect. Parcurgeți lecțiile existente în acest manual, pentru exemple.
- 6. Sub aceasta, începeți un nou alineat, începând cu această frază:

The goal ${\it for}$ this lesson:

- 7. Explicați pe scurt rezultatul intenționat al completării acestei lecții.
- În cazul în care obiectivul lecției nu se poate descrie într-una sau două propoziții, luați în considerare împărțirea subiectului în mai multe lecții.

Fiecare lecție va fi împărțită în mai multe secțiuni, care vor fi abordate în continuare.

19.5 Adăugarea unei Secțiuni

Există două tipuri de secțiuni: "procedați în mod similar" și "încercați singuri".

- O secțiune de "urmărire" reprezintă un set detaliat de instrucțiuni, menite să învețe cititorul cum să folosească un anumit aspect din QGIS. Acest lucru se face, de obicei, oferind instrucțiuni clic cu clic, cât mai clar posibil, intercalate cu capturi de ecran.
- A "try yourself" section gives the reader a short assignment to try by themselves. It is usually associated with an entry in the answer box beneath, which will show or explain how to complete the assignment, and will show the expected outcome if possible.

Every section comes with a difficulty level. An easy section is denoted by $\star \star \star$, moderate by $\star \star \star$, and advanced by $\star \star \star$.

19.5.1 Adăugați o secțiune "procedați în mod similar"

- 1. Pentru a începe această secțiune, scrieți fraza de marcare a nivelului de dificultate intenționat (după cum se arată mai sus).
- 2. Leave a space and then write Follow Along:.
- Lăsați un alt spațiu şi scrieți numele secțiunii (folosiți doar o literă mare, precum şi majuscule pentru substantive proprii).
- 4. In the next line, write a line of minuses/dashes (-), not shorter than the section title.
- Scrieți o scurtă introducere a secțiunii, explicându-i scopul. Apoi oferiți instrucțiuni detaliate (clic-după-clic) privind procedura care trebuie demonstrată.
- 6. În fiecare secțiune, includeți link-uri interne, link-uri externe și capturi de ecran după cum este necesar.
- Încercați să terminați fiecare secțiune cu un scurt paragraf, care să se încheie şi să conducă în mod natural la secțiunea următoare, dacă este posibil.

19.5.2 Adăugați o secțiune "încercați singuri"

- 1. Pentru a începe această secțiune, scrieți fraza de marcare a nivelului de dificultate intenționat (după cum se arată mai sus).
- 2. Leave a space and then write Try Yourself:.
- 3. In the next line, write a line of minuses/dashes (-), not shorter than the section title.
- 4. Explicați exercițiul pe care doriți ca cititorul să-l finalizeze. Consultați secțiunile anterioare, lecțiile sau modulele, dacă este necesar.
- Includeți capturi de ecran pentru a clarifica cerințele, în cazul în care o descriere textuală simplă nu este de ajuns.

In most cases, you will want to provide an answer regarding how to complete the assignment given in this section. To do so, you will need to create and feed an answer block beneath the instructions.

1. First, create the custom collapsible widget that contains the answer:

```
.. admonition:: Answer
:class: dropdown
```

2. Keeping an indentation with regard to the above block, write the instructions on how to complete the assignment, using links and images where needed.

19.6 Adăugarea unei Concluzii

To end a lesson:

- 1. Write the phrase In Conclusion, followed by a new line of minuses/dashes (-).
- 2. Write a conclusion for the lesson, explaining which concepts have been covered in the lesson.

19.7 Adăugarea unei Secțiuni de Lecturi suplimentare

Această secțiune este opțională.

- Write the phrase Further Reading, followed by a new line of minuses/dashes (-).
- Includeți trimiteri către site-urile externe corespunzătoare.

19.8 Adăugarea Secțiunii "Ce Urmează"

- 1. Scrieți expresia Ce urmează?, urmată de o nouă linie de minusuri/liniuțe (-).
- 2. Explicați modul în care a pregătit această lecție studenții pentru lecția sau modulul următor.
- Nu uitați să schimbați secțiunea "ce urmează" din lecția anterioară, dacă este necesar, astfel încât să se refere la noua dvs. lecție. Acest lucru va fi necesar dacă ați introdus o nouă lecție printre lecțiile existente sau după o lecție existentă.

19.9 Utilizarea Marcajelor

Pentru a adera la standardele acestui document, va trebui să adăugați marcajul standard textului dvs.

19.9.1 Noi concepte

If you are explaining a new concept, you will need to write the new concept's name in italics by enclosing it in asterisks (*).

This sample text shows how to introduce a *new concept*.

19.9.2 Atenție specială

- To emphasize a crucial term which is not a new concept, write the term in bold by enclosing it in double asterisks (**).
- Folosiți-le cu moderație! Dacă utilizați prea multe, cititorul ar putea avea impresia că strigați sau ca aveți un aer de superioritate.

```
This sample text shows how to use **emphasis** in a sentence. Include the punctuation mark if it is followed by a **comma,** or at the **end of the sentence.**
```

19.9.3 Images

- When adding an image, save it to an img folder next to the lesson file.
- Includeți-l în document, în felul următor:

• Nu uitați să lăsați o linie, deasupra și dedesubtul marcajului imaginii.

19.9.4 Legături interne

Pentru a crea o ancoră pentru un link, scrieți următoarea linie deasupra locului către care doriți să indice linkul:

```
.. _link-name:
```

- Nu uitați să lăsați o linie, deasupra și dedesubtul acestei linii.
- To create a link, refer to it as below:

```
:ref:`Descriptive link text <link-name>`
```

19.9.5 Legături externe

• Pentru a crea o legătură externă, scrieți-o astfel:

`Descriptive link text <link-url>`_

19.9.6 Utilizați text monospațiat

• When you are writing text that the user needs to enter, a path name, or the name of a database element such as a table or column name, you must write it in monospaced text. For example:

```
Enter the following path in the text box: ``path/to/file``.
```

19.9.7 Etichetarea elementelor GUI

• Dacă vă referiți la un element GUI, cum ar fi un buton, trebuie să scrieți numele acestuia în *formatul etichetei GUI*. De exemplu:

To access this tool, click on the :guilabel:`Tool Name` button.

• Acest lucru se aplică, de asemenea, dacă menționați numele unui instrument fără a cere utilizatorului să efectueze clic pe un buton.

19.9.8 Selecția meniului

• Dacă ghidați un utilizator prin meniuri, trebuie să utilizați *menu* ► *selection* ► *format*. De exemplu:

```
To use the :guilabel:`Tool Name` tool, go to :menuselection:`Plugins --> Tool Type --> Tool Name`.
```

19.9.9 Adăugarea notelor

• You might need to add a note in the text, which explains extra details that can't easily be made part of the flow of the lesson. This is the markup:

```
[Normal paragraph.]
.. note:: Note text.
New line within note.
New paragraph within note.
[Unindented text resumes normal paragraph.]
```

19.9.10 Adăugarea o notă de sponsorizare/drepturi de autor

Dacă scrieți un nou modul, o lecție sau o secțiune în numele unui sponsor, trebuie să includă un scurt mesaj, la alegerea sponsorului. Acesta trebuie să informeze cititorul despre numele sponsorului și trebuie să apară sub titlul modulului, lecției sau secțiunii sponsorizate. Totuși, mesajul nu poate consta într-o reclamă pentru compania sponsorului.

If you have volunteered to write a module, lesson or section in your own capacity, and not on behalf of a sponsor, you may include an authorship note below the heading of the module, lesson or section that you authored. This must take the form This [module/lesson/section] contributed by [author name]. Do not add further text, contact details, etc. Such details are to be added in the "Contributors" section of the Foreword, along with the name(s) of the part(s) you added. If you only made enhancements, corrections and/or additions, list yourself as an editor.

19.10 Mulţumiri!

Vă mulțumim pentru contribuția la acest proiect! Procedând astfel, faceți QGIS mai accesibil pentru utilizatori și adăugați valoare întregului proiect QGIS.

CAPITOLUL 20

Pregătirea Datelor pentru Exerciții

Important: Acest proces este destinat profesorilor sau utilizatorilor de QGIS experimentați care doresc să creeze seturi cu eșantioane de date localizate pentru cursurile lor. Seturile de date implicite sunt furnizate cu Manualul de instruire, dar este posibilă utilizarea acestor instrucțiuni dacă doriți să înlocuiți seturile de date implicite.

The *sample data provided* with the Training Manual refers to the town of Swellendam and its surroundings. Swellendam is located about 2 hours» east of Cape Town in the Western Cape of South Africa. The dataset contains feature names in both English and Afrikaans.

Oricine poate utiliza, fără dificultate, acest set de date, dar este posibil să preferați să utilizați date din propria țară sau din orașul natal. În cazul în care alegeți să faceți acest lucru, datele dvs. localizate vor fi utilizate în toate lecțiile, de la Modulul 3 până la modulul 7.2. Modulele ulterioare folosesc surse de date mai complexe, care pot fi valabile, sau nu, pentru regiunea dumneavoastră.

Notă: Aceste instrucțiuni presupun că aveți o bună cunoaștere a QGIS, nefiind destinate utilizării ca material didactic.

20.1 Create OSM based vector files

If you wish to replace the default data set with localised data for your course, this can easily be done with tools built into QGIS. The region you choose to use should have a good mix of urban and rural areas, containing roads of differing significance, area boundaries (such as nature reserves or farms) and surface water, such as streams and rivers.

- 1. Deschideți un nou proiect QGIS
- 2. Select Layer ► Data Source Manager to open the Data Source Manager dialog
- 3. In the Browser tab, expand the XYZ Tiles drop-down menu and double-click the OpenStreetMap item.



A map of the world is now visible on the map canvas.

- 4. Close the Data Source Manager dialog
- 5. Move to the area you'd like to use as study area



Now that we have the area we'll extract the data from, let's enable the extraction tools.

- 1. Go to Plugins ► Manage/Install Plugins...
- 2. In the *All* tab, type QuickOSM in the search box
- 3. Select the QuickOSM plugin, press Install Plugin and then Close the dialog.

| | | Plugins All (259) | | |
|--------------------------------------|--|---|--|--|
| 🏠 All | Q. quic | | | |
| installed | EasyCustomLabeling | QuickOSM | | |
| Not installed Install from ZIP | Indicatrix mapper Quick Attribution QuickMapServices | Download OSM data thanks to the Overpass API. You can also open local OSM or PBF files. A special parser, on top of OGR, is used to let you see all OSM keys available. | | |
| 🔆 Settings | QuickMultiAttributeEdit3 QuickOSM QuickOFint QuickWKT Species Explorer | Execute customs Overpass queries in QGIS to get OSM data. ☆☆☆☆☆ 144 rating vote(s), 234125 downloads Tags openstreetmap,pbf,modeler,processing,remote,osmdownload,overpass,download,josm,osm More info homepage by tracker code repository Author Etienne Trimaille Available version 1.11.0 | | |
| | @Help | Upgrade All Install plugin | | |

- 4. Execute the new plugin from *Vector* \blacktriangleright *QuickOSM* \blacktriangleright *QuickOSM*... menu
- 5. In the Quick query tab, select building in the Key drop-down menu
- 6. Leave the Value field empty, meaning that you are querying all buildings.
- 7. Select Canvas Extent in the next drop-down menu
- 8. Expand the Advanced group below and uncheck all geometry types on the right except Multipolygons.
- 9. Press Run query

| | | QuickOSM | 8 | | |
|------------------|----------------------------------|---------------------|-------|--|--|
| 👂 Quick query | Help with key/valu | e | Reset | | |
| 🥖 Query | Key | building | • | | |
| 🦰 OSM File | Value | Query on all values | • | | |
| | Canvas Extent 👻 | | | | |
| A Parameters | ▼ Advanced | | | | |
| i About | Node 🗸 | Points | | | |
| | Way 🗸 | Lines | | | |
| | Relation 🗸 | Multilinestrings | | | |
| | | Multipolygons 🗸 | | | |
| | Timeout 25 | | | | |
| | Directory Save to temporary file | | | | |
| | File prefix | | | | |
| | Show q | uery Run quer | у | | |
| Successful query | | | | | |
| | 100% | | | | |
| | | | | | |

A new building layer is added to the Layers panel, showing buildings in the selected extent.

- 10. Proceed as above to extract other data:
 - 1. Key = landuse and Multipolygons geometry type.
 - 2. Key = boundary, Value = protected_area and Multipolygons geometry type.
 - 3. Key = natural, Value = water and Multipolygons geometry type.
 - 4. Key = highway and check Lines and Multilines geometry types.

- 5. Key = waterway, Value = river and check Lines and Multilines geometry types.
- 6. Key = place and Points geometry type.

This process adds the layers as temporary files (indicated by the icon next to their name).



You can sample the data your region contains in order to see what kind of results your region will yield.

We now need to save the resulting data to use during your course. We'll be using ESRI Shapefile, GeoPackage and SpatiaLite formats depending on the data.

To convert the *place* temporary layer to another format:

1. Click the I icon next to the *place* layer to open the *Save Scratch Layer* dialog.

Notă: If you need to change any of the temporary layer's properties (CRS, extent, fields...), use the *Export* ► *Save Features as...* contextual menu instead, and ensure the *Add saved file to map* option is checked. This adds a new layer.

- 2. Select the ESRI Shapefile format
- 3. Use the ... button to browse to the exercise_data/shapefile/ folder and save the file as places. shp.

| Save Scratch Layer 🛛 😣 | | | | | |
|------------------------|---|--|--|--|--|
| | | | | | |
| Format | ESRI Shapefile 🔹 | | | | |
| File name | name aining-Data/exercise_data/shapefile/places.shp 🛛 | | | | |
| Layer name | | | | | |
| | | | | | |
| Encoding | UTF-8 • | | | | |
| 🔻 Layer O | ▼ Layer Options | | | | |
| RESIZE | • 00 | | | | |
| SHPT | | | | | |
| Sint | | | | | |
| Custom Options | | | | | |
| Help | ≭ <u>C</u> ancel ✓ <u>O</u> K | | | | |

4. Apăsați pe OK

In the *Layers* panel, the temporary *place* layer is replaced with the saved *places* shapefile layer and the temporary icon next to it removed.

- 5. Double-click the layer to open its *Layer Properties* ► *Source* tab and update the *Layer name* property to match the file name.
- 6. Repeat the process for other layers, renaming them as follows:
 - natural_water into water
 - waterway_river into rivers
 - boundary_protected_area into protected_areas

Each resulting data set should be saved in the exercise_data/shapefile/ directory.

The next step is to create a GeoPackage file from the building layer to use during the course:

- 1. Click the icon next to the *building* layer
- 2. Select the GeoPackage format
- 3. Save the file as training_data.gpkg under the exercise_data/ folder
- 4. By default, the Layer name is filled as the file name. Replace it with buildings.

| | | Save Scratch Layer 😞 | | | |
|---------------------------------------|----------------|--|--|--|--|
| Format | GeoPack | sage 🔹 | | | |
| File name -Training | | -Data/exercise_data/training_data.gpkg 🚳 🛄 📖 | | | |
| Layer name buildings | | | | | |
| Encoding Layer Op | Encoding UTF-8 | | | | |
| DESCRIPTIO | ON | | | | |
| FID | | fid | | | |
| GEOMETRY | _NAME | geom | | | |
| IDENTIFIER | 2 | | | | |
| SPATIAL_INDEX | | YES 👻 | | | |
| Custom Options | | | | | |
| Help | | ≭ <u>C</u> ancel ✓ <u>O</u> K | | | |

- 5. Apăsați pe OK
- 6. Rename the layer in its properties dialog
- 7. Repeat the process with the *highway* layer, saving it as roads in the same GeoPackage database.

The last step is to save the remaining temporary file as a SpatiaLite file.

- 1. Click the icon next to the *landuse* layer
- 2. Select the SpatiaLite format
- 3. Save the file as landuse.sqlite under the exercise_data/ folder. By default, the *Layer name* is filled as the file name. Do not change it.

| Save Scratch Layer 🧧 | | | | | |
|---------------------------|--|------|--|--|---|
| Format | Format SpatiaLite - | | | | |
| File name | File name -Data/exercise data/landuse.sqlite @ | | | | |
| Layer name | aver name landuse | | | | |
| | | | | | |
| Encoding | JTF-8 | | | | |
| ▼ Datasou | rce Opt | ions | | | |
| INIT_WITH | INIT_WITH_EPSG YE | | | | • |
| METADATA | METADATA YES | | | | • |
| 🔻 Layer Op | ▼ Layer Options | | | | |
| COMPRES | COMPRESS_COLUMNS | | | | |
| COMPRES | COMPRESS_GEOM | | | | • |
| LAUNDER | LAUNDER | | | | • |
| SPATIAL_II | SPATIAL_INDEX | | | | • |
| SRID | | | | | |
| Custom Options | | | | | |
| <pre>@Help</pre> ★ Cancel | | | | | |

4. Apăsați pe OK

You should now have a map which looks something like this (the symbology will certainly be very different, because QGIS randomly assigns colors when layers are added to the map):



The important thing is that you have 7 vector layers matching those shown above and that all those layers have some data.

20.2 Create SRTM DEM tiff files

For modules *Module: Creating Vector Data* and *Modulul: Rastere*, you'll also need raster images (SRTM DEM) which cover the region you have selected for your course.

The CGIAR-CGI provides some SRTM DEM you can download from https://srtm.csi.cgiar.org/srtmdata/.

You'll need images which cover the entire region you have chosen to use. To find the extent coordinates, in QGIS

, \checkmark zoom to the extent of the largest layer and pick the values in the \textcircled *Extents* box of the status bar. Keep the GeoTiff format. Once the form is filled, click on the *Click here to Begin Search* >> button and download the file(s).

Once you have downloaded the required file(s), they should be saved in the <code>exercise_data</code> directory, under <code>raster/SRTM</code> subfolders.

20.3 Create imagery tiff files

In Module *Module: Creating Vector Data*, *PPP Follow Along: Data Sources* lesson shows close-up images of three school sports fields which students are asked to digitize. You'll therefore need to reproduce these images using your new SRTM DEM tiff file(s). There is no obligation to use school sports fields: any three school land-use types can be used (e.g. different school buildings, playgrounds or car parks).

For reference, the image in the example data is:



20.4 Replace tokens

Having created your localized dataset, the final step is to replace the tokens in the substitutions.txt file so that the appropriate names will appear in your localized version of the Training Manual.

The tokens you need to replace are as follows:

- majorUrbanName: this defaults to "Swellendam". Replace with the name of the major town in your region.
- schoolAreaType1: this defaults to "athletics field". Replace with the name of the largest school area type in your region.
- largeLandUseArea: this defaults to "Bontebok National Park". Replace with the name of a large landuse polygon in your region.
- srtmFileName: this defaults to srtm_41_19.tif. Replace this with the filename of your SRTM DEM
 file.
- localCRS: this defaults to WGS 84 / UTM 34S. You should replace this with the correct CRS for your region.