

Lab Introduction 2

QGIS : Jupyter Notebook : Lab Content



Introduction

This module will cover a series of different concepts relating to palaeoglacial geomorphology. In today's session we will be looking at the layout and tools used in the second series of labs, from Lab 5 to Lab 8. This document will serve to introduce you to some of the tools we will use, offer some short exercises to carry out, and provide further reading and resources for each tool. Through the course of the second series of lab sessions, you will make use of QGIS, Python through Jupyter Notebook and R. The two focus points we will have in this session are Jupyter Notebook – in terms of setting up and making sure it works, and QGIS – to bring everyone to a reasonable level of knowledge with the software which we will develop further in the programme.

Throughout the labs, it is likely you will encounter errors, problems or get stuck with the software we need to use. It's recommended that before you come to teachers with a question, you attempt to troubleshoot it yourself first! For this, google and the documents below are your friend. Chances are if you have a problem, then someone else in the past has had the same problem, but possibly in a different concept. This is not foolproof, but it is often a good place to start! It also helps you think about how to phrase your question about how to find a solution to the issue!

Reading & Resources

- <https://docs.qgis.org/3.22/en/docs/index.html> QGIS Documentation - useful to find out how various tools work.
- <https://jupyter-notebook.readthedocs.io/en/stable/> Jupyter Notebook documentation - useful to understand the functionality of Jupyter Notebook.
- <https://gis.stackexchange.com/> GIS Stack Exchange - very useful when you are looking for the solution to specific
- problems in GIS. It's often a good idea to throw your question into google and find the answer first!
- <https://stackoverflow.com/questions/tagged/python> Stack Overflow - an important resource for finding the answer to many programming questions.
- <https://www.google.com/> The classic, and most effective starting point for all troubleshooting!

Part 1: Jupyter Notebook

Jupyter Notebook is a relatively user friendly and modular approach for working with Python. We will use this in the lab covering automated identification of landforms (Lab 7 or 8). It's relatively easy to learn, and is pretty accessible for anyone who has even a basic knowledge of programming languages, especially Python. In this session we will make sure we can:

- Launch Jupyter Notebook.
- Use a custom Jupyter Notebook environment.

Part 2: QGIS

Our primary focus in this session is to work within QGIS to bring everyone up to speed on how to use some basic tools in the software. The aim is to have everyone familiar with several key components:

- *Creating a Project*
 - The file system
 - Importing data
- *Delineating features & Symbology*
- *Using the toolbox*
 - Feature conversion
 - Geometric limitations
 - Raster calculation
 - Clipping
- *Using QGIS' custom plugin toolbox*
- *Creating a map & good practice*
- *Exporting a map as a high-resolution image*

2.1 Creating a Project

For this you need to open QGIS which should be installed on your lab computer and select the "New project" button. You should choose a sensible place to save the project and add a folder in this directory called "data" which you will add to your favourites for easy access. You will then import data and a WMS layer, all from GeoNorge.

- a. Open QGIS and create a new blank project.
- b. Set up your file system, and add the project directory as a favourite.
- c. Set up a new CRS for your project – This can be done by selecting the "EPSG" in the bottom right, and selecting for example – EPSG:5556 if you were to be studying Norway.
- d. Import the Norge i Bilder Ortofoto WMS from GeoNorge by copying the link, and adding a WMS layer.
- e. Import a DEM from GeoNorge in the region of Jutulhogget using the DTM 10m UTM 33 Terrengmodell. This should be the 6802-1 tile as a .tiff.

2.2 Creating some features as shapefiles (Vector Format)

So far, we have imported a web layer (the WMS) and a local raster layer (the DEM). These are both raster layers as they are made up of pixels of a fixed size and are displayed as an image. Now we will create some shapefiles, these are known as vectors and are the product of point or line features, rather than a series of pixels with individual values.

- a. Select the “Create new Shapefile Layer” button and save a new POINT geometry shapefile to your data folder. The CRS should be the same as your map.
- b. Do the same for a POLYGON geometry shapefile.
- c. Start editing with your points layer, and find Jutulhogget on the map – you can either compare to Google Maps, or use the OpenStreetMap XYZ layer to do so (Similar to the ortofoto WMS, but built-in to QGIS).
- d. You can create points by selecting “add point feature” clicking where you want to place a point, and then assigning a value on the pop-up.
- e. Save and stop editing your points layer, then start editing your polygon layer in the same manner.
- f. In the area around Jutulhogget, select something interesting you can see in the ortofoto imagery, and try and mark out as many of these items as you can, you could try rivers, scarps, settlements, lakes etc. **N.B. Right click to finish drawing a polygon.**
- g. Once you have selected a sufficient number, Open the symbology of your shapefile layers by right clicking on them and selecting “properties” – you can edit how your polygons and points look. Play with these tools for a while to create something that looks suitable for the features you have identified.

2.3 Testing out the toolbox and changing Raster Symbology

Now we will use some of the most basic QGIS tools, so you learn how the toolbox works. The toolbox is a wide and expansive series of different operations, which can be used to manipulate and extract data from your feature and raster layers, or connect them to each other and even create data networks!

- a. Firstly, click on the cog icon in the QGIS toolbar, and in the new “Processing Toolbox” pane, search for the “Fix Geometries tool”. This tool repairs any problematic geometry in your shapefiles, for example overlapping lines in the same feature.
- b. Use your polygons as an input and save the output to a suitable place under a suitable name, you will notice little has changed – this is mainly administrative and allows you to work with polygons without worrying about geometric conflicts.
- c. Next, we will use the Rasterize (vector to raster) tool, because we want to visualise your polygon features as rasters – this can be useful if we want to calculate something based on where your polygons are and another raster, as we can assign a value to the polygon pixels.
 - a. Your input should be your Fixed Geometry features, and we will use a fixed burn in value to avoid any complexity right now.
 - b. Your output size units are georeferenced units, and your resolutions are 10 and 10. Your output extent should be your DEM (by selecting calculate from layer in the drop down) – this is important to stop the software from creating a raster that is out of scale with the rest of your dataset!
- d. Finally, we will use the hillshade tool. Open it and use your DEM as the input, select a reasonable Z factor, and azimuth, and save it sensibly!
 - a. Your z factor is vertical exaggeration for visualisation purposes, 10 is a good rule of thumb.
 - b. Your Azimuth is the orientation of the sun related to your DEM as a degree value – pick something reasonable for Jutulhogget.

- e. As you did with your shapefiles, you can edit the symbology of your rasters too – try this on your new raster first, by assigning min to 0 and max to your fixed burn in value. Afterwards, try again on your DEM as you can make it look a lot more interesting, for example green – brown white like a classical map.
- f. It would be helpful to change your DEM to semi-transparent, and put it on top of your Hillshade in the Layers pane transparency is adjusted in the DEM properties page as a slider (transparency). This way you can colour your hillshade relative to elevation!

2.4 The QGIS Plugin Manager

This short step will bring you up to date on installing plugins into QGIS. Plugins in QGIS are useful additional tools created by third-party users to fulfil specific tasks. These tasks are often hard to perform, or impossible to do in regular QGIS due to limitations of the software or existing toolset. The example we are going to use is the Profile Tool. This tool allows you to measure values from a raster along a line, so we are going to use it to quickly see the cross section of Jutulhogget.

- a. From the Plugins menu, select “Manage and Install Plugins”, and in the dialog which opens, go to “All” and search for “Profile Tool”. Click Install Plugin.
- b. A new icon should have appeared on your toolbar, select it and it should open the profile tool pane.
- c. Add your DEM as a layer. Then draw a line across the span of Jutulhogget. You should see a chart of the elevation. This can be exported as an image, or a .csv dataseries.

2.5 Creating a Map

Creating a map for export in QGIS is quite involved, but is easy once you get the hang of the software. When you create a map you need to consider a few important components: **north arrows, grids, scale bars, titles, legends, appropriate content, degrees of precision.**

- a. To open the map creation menu, select the “Create Print Layout” tool next to the Save button on the toolbar. To add your map to the export, select the page with the plus next to it. Draw a box for your map.
- b. Now, you can use the other tools on the left toolbar to add the required components to your map, and the pane on the right (Items & Item properties) to adjust the properties of your new components. **N.B. Grids are added by selecting the map, and then selecting “Grids”, clicking + and then editing the grid in there.**
- c. You can edit the legend and the names of all components by selecting it then playing with item properties!
- d. Grids are the most problematic component of most map making. As here we are looking at a small area, we will use a metre scale, use a reasonable grid scale, remember the default units are in metres.
- e. Make sure you draw co-ordinates and they are on your canvas – and they do not need decimals at this scale, remove them. It is also good practice to add “N” and “Ø” to your co-ordinates in the co-ordinate format drop down.
- f. You can export the map as an image (PNG) or document (PDF) using the buttons on the top toolbar.

3.0 Advanced exercise

For those of you who are familiar with QGIS, or who finish early, try this exercise!

In the "Data" folder on lagringshotell for this practical, you should find a shapefile box covering a 7x7km area around Jutulhogget called 'Jutulhogget_Mapbox.shp'. Import this into your GIS project. Use some time to interpret what you see in this data, and other data you wish to use (be creative!) to create a hiking map for the area. Try and be as detailed as you can, making out paths, roads etc. with different types of line features, and other interesting points, such as cliffs, outcrops, areas of dense woodland etc.

There will be a place to submit this on canvas, but it is not an assessed lab session. However, it would be interesting for you to submit it as it would:

- a) Allow me to give you feedback on your QGIS mapping ability.
- b) See any of the interesting and creative approaches you might take – and if any are particularly good they can be brought into other work!

The submission would need to include a **very brief** description of what you did (no more than 10 lines), and your map.

You will need:

- The DEM for the region around Jutulhogget.
- The Ortofoto WMS layer
- A hillshade of the DEM.
- Any other datasets you wish to use.
- **DO NOT** use OpenStreetMap, or Ut.no/norgeskart for this.

I look forward to seeing some of your submitted examples!