Getting started

Installing Jupyter Notebook

With Dr Hamidreza Omidvar

Aim: Installing Jupyter Notebook

• QGIS and Python already installed

So for installing Jupyter Notebook in Windows first, you need to install QGIS. And when you successfully install QGIS you need to type two comments that I will go through each of them individually.

So the first thing that you need to do is locate OSGEOW Shell in your terminal in Windows. So when you find that one you need to type 'py_env' and the next step is to just install Jupyter 'pip install notebook' and then it might take some time to install it.

Okay. Now the notebook is installed to start a new notebook. Whenever you want to start coding a notebook you first start the notebook kernel ('jupyter notebook'). So now for making a new notebook you need to click on the right hand at the top 'New' and 'Python ' and now you kind of start coding in this environment.

Summary

• Use command line OSGeoW Shell

• > Pip install Notebook

• > Jupyter Notebook

• Creating a new Notebook

First basics on using Jupyter Notebook

With Dr Hamidreza Omidvar

Aim: First basics on using Jupyter Notebook

• Cells for entering and running code

• Command mode and keyboard shortcuts

So when you open up a Jupyter Notebook there are various ways to start coding. And, the page that contains the whole Jupyter Notebook consists of different sections. These are basically some of the sections that you can for example, save Jupyter Notebook in different formats when you're done with coding and everything. For example, we can save it as a Python code or PDF or other versions. And there are some shortcuts also here for adding new cells or saving the Jupyter Notebook or running the cells.

In addition to these buttons here there are another way of using keyboards to do different tasks in Jupyter Notebook. To do that you need to understand what are different modes when you're in the Notebook. When you are in the writing mode you are able to write inside any of the cells. For example, here, I just write anything I want for example, importing pandas package. But if, instead of being in the writing mode you use the escape button in your keyboard, ESC then you go to the command mode of the Jupyter Notebook. In this mode there are many ways to manipulate the Jupyter Notebook.

For example, when you are in the command mode if you click in your keyboard 'A' a new cell appears above the cells that you were already in. Or if you click 'B' we'll see that new cells comes under the current cell that you are clicking. To get all the shortcut methods that you can use through your keyboard to manipulate different parts of Jupyter Notebook when you are in the command mode you need to press 'H' as you can see here and there are various ways to manipulate a Jupyter Notebook here are the commands that I just talked about. You can use 'X' to remove a cell etc.

Another mode that Jupyter Notebook has is the writing mode. When you are not coding, for example if you're explaining your code or you're writing equations Jupyter Notebook uses Markdown style for writing that is not code. To do that when you are in the command mode again, to remind you, you need to press escape and then press M. You see that now you're in the command mode. When you're in the command mode you can write whatever you want in the Markdown style. And then you can here click 'run'. We can see that it runs as text, not as code. But if you run this cell you see that it's running. So when you run a cell here, this is the line number. When it's running it is substituted with a star. As long as the star exists there it means that your cell is running.

Summary

• Editing and saving a Notebook

• Adding and running cells

• 'Esc' for command mode

• 'H' for command mode keyboard shortcuts

• 'M' to write comments/text around code

• Markdown is used for non-code

Second basics on using Jupyter Notebook

With Dr Hamidreza Omidvar

Aim: A little more on using Jupyter Notebook

• The Kernel

• Simple formatting

• Terminal commands

In addition to shortcuts that you can use you can also use this button to add cells or remove cells or copy cells. For example, here this button adds another cell below the one that you already working on. Or this scissors button removes the cell. You can also change the name of your Jupyter Notebook here.

And then for example, consider you're running a very long code and it's taking a long time to run. And for some reason you realize that your code is incorrect and you want to edit it. But the code is still running. When you go to 'Kernel' this is where you will be able to stop your run or restarting your Jupyter Notebook. 'Interrupt' basically stops the code that is running. 'Restart' will restart the entire Jupyter Notebook and it will remove any variables or parameters saved inside the Jupyter Notebook. This 'Restart and Clear' clears all the output of the Jupyter Notebook. This 'Restart (Jupyter Notebook) and Run All' can run all the cells at the same time. These are for 'Reconnect' to the Kernel and shutting down the Kernel.

And if you have different kernels you'll be able to also change it here. But in this case, I only have one kernel. In Jupyter Notebook when you're printing anything or plotting any data it will appear below the cell that you are in. For example, here I print and if I run it you see that the output is here. Another way to run any cell instead of just using this 'Run' is using shift plus 'Enter' key on keyboard. For example, if I want to run this again I can 'Shift Enter' and again 'Shift Enter'. You can also merge any cells together. If you use the command shift 'M'.

So, for example if you want to match this cell with this cell and run them together go to the command mode with 'Esc' and then press shift and M at the same time. You see that these two cells merge and now you can run them together using shift 'Enter'.

When you're in the Markdown mode you'll be able to change the style of the text using the Markdown way. For example, here first I go to the command mode, like press M. Now I am in the Markdown mode. And for example, I want to have a header you use the symbol for the heading and then you can have then next one and the next one. As you can see, you can change the style of the text when you're in the Markdown mode.

A very powerful aspect of Jupyter Notebook is that you will be able to use the commands that you usually use in a terminal here. And you will speed up your workflow and your coding process. To do that, you need to use this symbol '!'. So when you start a line with the '!' symbol then you can use any command that you usually use in a terminal here. For example, you can use 'pip' for installing any package inside the Jupyter Notebook. I just type 'pip' but it shows how to use 'pip'. But for example, I can say 'pip install' and run the cell. And it shows that I already have pandas installed in my computer.

Summary

- Use Kernel to stop code running
- Printing output or plots are placed below the cell
- Formatting Markdown text
- '!' for using terminal commands in the notebook
- Pip is the Python package manager
- Pandas is an open source Python library for data structures and analysis

Downloading Anaconda

With Dr Ting Sun

Aim: Download Anaconda

Today I'm going to show you how we can install a Jupyter notebook environment using the Anaconda package.

First let's navigate to the Anaconda website.

In the Products panel let's go to the Individual Edition and then click the download button.

You will be redirected to the binaries for different platforms. Here, let's use Python 3 specifically Python 3.7 and let's use a 64-bit Graphical Installer. This might take several seconds or minutes to download.

Summary

• Visit anaconda.com

• In the product panel select 'Individual Edition'

• Click 'Download' and be redirected to 'Anaconda Installers'

• Choose your operating system and Python 3.7 to download

Installing Anaconda

With Dr Ting Sun

Aim: Install Anaconda

Once the package is downloaded let's follow the steps provided by the installer to install Anaconda. Basically, it's quite simple. We can just follow all the steps as shown in this graphical installer to install it. It might take several seconds to install it.

Okay. Once the main package is installed you can choose if you'd like to install optional software provided by Anaconda.

Here, we can just continue.

Okay, all done.

Summary

• Open the downloaded package

• Follow the steps

• Click 'Continue' and 'Install'

Launching Jupyter-Notebook

With Dr Ting Sun

Aim: Learn to launch Jupyter Notebook

Once we have Anaconda installed let's launch Anaconda Navigator.

Then you should have an interface like this.

In the Anaconda Navigator you should have one panel showing the Jupyter notebook. Let's click the launch button.

Then the program will be launched in a separate window.

Summary

• Launch 'Anaconda Navigator'

• Click 'Launch' on the Jupyter- Notebook panel

Installing QGIS on a Windows computer:

A screencast from the Climate Science for Service Partnership (CSSP) China project with Dr Fredrik Lindberg.

Aim: install QGIS

This video will show you how to install QGIS on a Windows computer.

First open a browser and go to QGIS.org. This is the website for the QGIS project. Down here you have a green button where it says, 'download now'.

Click on this button and you will get this page. We recommend that you use theOSGeoW Network Installer 64 bit or 32 bit depending on your computer. Most computers are 64 bit. This will download executable file on your computer.

Open that file and the installation process will begin. Here, you are recommended to choose express desktop install and follow the instructions in the setup process. Click 'okay' or 'yes' whenever you are faced with a question. I will not do this since I have already installed QGIS on my computer.

When the installation is done you will find your QGIS installation either by going down to the bottom left and search for QGIS. There you find QGIS Desktop 3.12.3, in my case and here you can start the software.

For other operating systems on the same page you can find instructions to download in different operating systems such as Mac and Linux. There are for example, installation files for Mac and here you can find installation instructions for various Linux operating system.

This is the end of the first video where we have shown you how to install QGIS on a Windows computer.

Summary

• Visit QGIS.org

• 'Download now'

• Follow instructions & recommended settings

• When installed will appear as an app on your computer.

Find more on GitHub

Installing UMEP QGIS plug-in

With Dr Fredrik Lindberg

Aim: Start QGIS and install UMEP

This video will show you how to start your QGIS software, and how to install UMEP.

QGIS is found in your start menu under OSGeoW, which is the organization for open source geospatial software. Here you find QGIS Desktop 3.12.3, in my case.

You can also find QGIS by using this search button, down in the left corner, typing QGIS. I will open this software. This is what it looks like, a traditional layout of any GIS software. Having a map canvas here in the middle, where maps is shown later on. And you have a layers panel down to the left, where the loaded geographical data will be shown. You also have a browser where you can see your spatial data, that you can load on your computer and other resources. And to the right, you have the processing toolbox, which can be used to analyze your geographical data.

QGIS is open source software, and it can include plugins that users and developers can develop, and share with others within the QGIS community. So to install a plug-in, and in this case, we will install the UMEP plug-in. You go to 'plug-ins' in the menu toolbar, and go to 'manage and install plug-ins'. Here you have all the plug-ins that are available at the moment, and we want to install UMEP. So we search for 'UMEP'. Here we have UMEP and click on 'UMEP', and then click on 'install plug-in'.

UMEP is written in the Python programming language, which also is an open source programming language. And what you also have is that Python can include, different libraries and dependencies. And when you install UMEP, you will be presented with this. This will ask you if you want to install, some Python packages that are needed for UMEP. And we recommend that you click 'OK' here, because this will help you get your UMEP exploration going. Click 'OK'.

And now we recommend you to restart QGIS before you continue. So I click, OK. I close this one, and I close QGIS up in the right corner. Then I restart it again. And now you see UMEP available, from the menu tool bar up here. It's finished this instruction with you, where we showed you how to start QGIS, and how to install the UMEP plug-in.

Summary

- Opening QGIS on your computer
- Install UMEP from QGIS menu
- Install Python packages
- Restart and UMEP appears on menu toolbar

Using UMEP

First activity on using QGIS and UMEP

With Dr Fredrik Lindberg

Aim: Applying QGIS and UMEP for building and vegetation shadow patterns

• Adding raster (image) layers and changing display properties

• Creating datasets using the UMEP solar radiation processor

Find the tutorial at https://umep-docs.readthedocs.io/projects/tutorial/en/latest/index.html
Additional dataset from https://umep-docs.readthedocs.io/
projects/tutorial/en/latest/Tutorials/DailyShading.html#dailyshading

This is the instruction video of the first example on how to use QGIS and UMEP. This exercise assumes that you have successfully installed QGIS and UMEP on your system. We start by opening QGIS from the start menu. If you have a windows computer here, QGIS desktop. I have this already open here. And if you have UMEP successfully installed you will see UMEP in the menu bar up here. To do this exercise we need some data and we will actually follow the tutorial found on the UMEP tutorial website.

First QGIS and UMEP activity where you will examine to cast a shadow and look at shadow patterns for pedestrians in Gothenburg, Sweden. Before we start this exercise we need to download some data over Gothenburg Sweden. So we click on this link here in the tutorial and we get the file here, which is a zip file. So you need to extract this zip file. The easiest way is to extract all here in your Explorer window. I will put this data on the desktop so I can easily find it, like this.

Okay, so go back to QGIS and now we're going to add our first datasets. One way to add data set is to add a layer and we're going to use some raster layers in this case. So we go to address the layer and point to the data that we just extracted which we have here. And we first, we're going to look at the data called DSM_KRbig.tif so we open this data and press 'add'. Here, we now have a digital surface model where each pixel in this dataset is representing the height. You can also see that we have now a coordinate system down here to the right, which is EPSG 3007. So the project now in queue QGIS have inherited the coordinate system that was coming with this raster file.

Next step would be to add another dataset which is another raster dataset. So add raster data. This time, we're going to open the datasets CDSM_KRbig and press 'open'. And 'add'. In this, dataset is a dataset showing where we have trees in this area. But what you can see here when we opened this dataset we have a question mark, here and this means that the layer has no coordinate reference system set. So we need to set this before we continue. So you click on the question mark and we are going to use the same coordinate system as before as the first dataset. So it's 3007 . If this doesn't pop up here you can always search for your coordinate system and then it shows up. So here you

now have the dataset in the correct coordinate system. And what you can see now, this is the layer panel.

You can see that we have two datasets covered and the order of this is the one that shows on the top is the one that you can see. So if I drag this below, you see the digital surface model. What we can also do is to change colors and settings on how these data set looks like. And we will do this with a CDSM, C stands for canopy. So you right click on your layer and go to 'properties'. Here are the properties of this layer. And we first go to the symbology tab and here you can change the color of the dataset and such. So we will go to and use a 'singleband pseudocolor'. Take green, maybe because this is vegetation and usually are colored like, and click 'apply'.

We also want to show the buildings in between the vegetation so you can also go to the transparency tab and add, no additional no data value of zero and then click apply. This means that zero values will not be displayed at any color. This means that you now can see both the digital surface model of the ground and buildings and you can also see the trees.

So now let's do our first UMEP exercise by casting some shadows. We're going to use the tool called daily shadow patterns which is found here on the processor, solar radiation, daily shadow patterns. Here we are first going to include the digital surface model. And in this first example, we are not going to use the vegetation and we want to cast the shadows for one whole day. We're going to use the summer solstice, 21st of June 2020. We're going to cross one shadow every 30 minutes. We have daylight savings time here in Sweden. So we're going to use this. And the UTC offset is one hour from Greenwich Mean Time.

Let's select an output folder. And in this case, I have created a folder called 'daily shading' on my computer. In here we're going to create a number of different raster datasets in different runs of daily shading. So I'm going to create an additional folder and I'm going to call this June21_buildings. And this is where I'm going to save the data. And I can also click in this address of the project. This means that we are directly going to see some new generated raster data when the model is run. And now we can click 'run'. The model is working. And when it's done it says 'shadow grids successfully generated' click, 'okay'. And you can close this. What you see here now is a new layer that has come up in your data frame which is called shadow fraction on 2020 06 21.

This dataset is shown with a transparency because we also want to see the layer behind this. So what you can do is that you can take off your other layers like this and then you see only the shadow patterns generated. So this is the shadow fraction. So between zero and one for the day of June 21st in Sweden. What you can do is that you can now change this opacity because you would like to compare it to other datasets later on. So we can go into 'properties'.

Here you see the global opacity set that to 100 % instead, 'apply'. And 'okay'. This means when you're now ticking, for example the DSM, you don't see the DSM at all because now the shadow fraction map is covering the whole image. The next run we would like to do is to include vegetation. So we go to UMEP and the same pre-processor solar radiation, daily shadow pattern. We include the DSM as a 'building and ground DSM'. This time we tick 'use vegetation DSM' and use the CDSM. We leave everything else as it was before like this but now we also change the folder or where you save the data to a new folder which we call June 21_buildingsvegetation. Save the data here. And select folder add result to project and click 'run'. Now, this is finished and we can keep click 'close'. And if we just click so we only see the shadow fractions that was created now you can see that you can also see the shadows that are generated under the trees here.

To be able to compare the two datasets you can go to properties. And also change the opacity. What you also can do is to change the name of this dataset. So you remember that this includes vegetation. Vegetation, like this of a name in the source, click 'okay' So now you can tick in both layers and then just switch between them and see the difference of shadow patterns on the ground. I will stop the video here and you can go on and do some more examples of shadow casting by concluding this tutorial 'A first QGIS and UMEP activity' on our tutorial website.

Summary

- Using downloaded data
- Displaying raster layers with a coordinate system
- Changing layer properties
- Using UMEP daily shadow pattern
- Creating output files

You can continue this tutorial at https://umep-docs.readthedocs.io/projects/tutorial/en/latest/index.html

Basics of QGIS and UMEP

With Dr Fredrik Lindberg

Aim: Basics of QGIS and UMEP

- Introducing UMEP

• Essentials of QGIS - vector data and coordinates

• DSM - digital surface model

This video will show you some basics of QGIS and UMEP. We assume that you have installed QGIS and also UMEP as well as going through the first exercise of 'A first activity of QGIS and UMEP'. You can find UMEP up in the menu bar. UMEP is divided into a pre-processor, processor, and post processor. UMEP also comes with a quite extensive manual that you can find here (https://umep-docs.readthedocs.io/en/latest/). Here, you can find information on all the tools.

For example, here you have something called a tree generator here you can find information on how to use this tool. UMEP is an open source project and you can help and contribute by for example, reporting issues. So when you have an issue something that is not working you can report this to our repository.

The repository is for example found through the 'About' section in UMEP. Here, you can report issues of different kinds we can fix them and help you with this. UMEP also comes with an email list that you can sign up for at the first page here on the UMEP manual, down here. Okay.

Going back to UMEP and QGIS. First, some small things about QGIS. We have as you have seen before a layers panel and also here is the map canvas, where you can see all the maps. And you also have a browser window here or the panel that is quite useful where you can add data directly instead of going up to layers and add your layers here. Here, they are shown directly. So for example, the data that I downloaded in the first exercise you can find them here and then you can just drag and drop these datasets down here. So for example, I can take this landcover dataset and drag it down here. So now it's added to my QGIS project.

There are different data types in GIS. And the two main ones that you should be aware of is the raster dataset. So an example is the one you see here where each pixel is representing something. In this case, we have the digital surface model (DSM) that shows the height of either ground or buildings in this area. Another type of datasets are vector datasets. And here we have a building dataset with building footprints. Vector datasets are built up from points, lines, and polygons. And the differences between these datasets the main different is that this raster is pretty much an image. A vector data can also have more attribute data connected to it. So here you have, for example when I right click on buildings, you have an attribute table, so we can open this and then we can see all different kinds of information table data that you can find for different objects. So for example, if I go back here and use this 'select features' here I can select this one. And now I have highlighted this one. I can go in again in the attribute table and then show selected features. And now you can see all the attributes that are assigned to this particular polygon here.

UMEP makes use mostly of raster data but in some cases, vector data is also required and needed. To de-select you can use this button over here. Close the buildings, or stop viewing the buildings dataset. The building datasets are still loaded but it's not viewed here in the map canvas. One main thing that is important when working with GIS data is coordinate reference systems. So each dataset has a coordinate reference system CRS in QGIS but also the project itself has a coordinate system. So here you see the coordinate system that we're using now and you can click on this one to get more information on this coordinate system. So we are using SWEREF 99 12 00 which is a national Swedish reference system. Here are all the details of this reference system, for example. So I strongly recommend you to have all your data in the same coordinate system and to get, if you don't have them in the same system you need to re-project them into the correct system.

Or if there are no coordinate system related to the datasets you need to define that dataset. That is either done here and you can reproject the data layer in this case a vector layer dataset or when it comes to raster dataset you can assign a projection or you can also re-project this data into another coordinate system.

QGIS has extensive documentation and I recommend for you who are not so into GIS in general and QGIS in particular you go into the documentation site here on the qgis.org website. You can find documentation you can find a user guide, you can find the extensive training manual and also a gentle introduction to GIS in general.

Going back to UMEP in you use a specific kind of data. And one of the most essential one is the one you see here, the digital surface model (DSM). We have also been acquainted with canopy digital surface model the CDSM, which is representing vegetation, high vegetation. And I also loaded a land cover dataset which includes state land cover of different so you have, for example, buildings and grass, asphalt or what we call paved surfaces. There are seven classes in the land cover datasets. You will find out more about this later on. Other information that is usually important are, for example population density, datasets, and also meteorological datasets. We will go through them later on also.

One thing that is very important when working with UMEP, is to use the appropriate scale when you are investigating a certain feature. When it comes to urban climatology this is a very detailed dataset. It's as a resolution of one metre for example, the DSM, as you see here we can go into the 'properties' and go to 'information'. You can find all kinds of information on this dataset. You can see that the units are in metres. This is the number of pixels in X and Y direction. And you can also find the pixel size down here. So it's a one metre dataset and I recommend to have all datasets in the same spatial resolution, if possible. Sometimes you need to aggregate your data by aggregating

them into larger spatial units that is usually done by adding or aggregate data into a grid. And that will be explained in another video later on.

Summary

- UMEP online manual and email list
- Reporting UMEP issues in GitHub
- Using QGIS browser• Features of raster and vector data
- Coordinate reference system (CRS)
- QGIS documentation at qgis.org
- Digital surface model (DSM)
- Use matching resolution data where possible

Creating a grid for local scale modelling in UMEP

With Dr Fredrik Lindberg

Aim: Create a grid for modelling in UMEP

In this video, I'll demonstrate how to create a grid for your local scale modeling in UMEP.

I have added a digital surface model of central London here to have us an example. It's quite easy. You go to the processing toolbox here on the right and you search for a tool called 'create grid'. Here you have it.

And to create the grid, you choose a polygon and then you choose a grid extent. You can do that in different ways. You can use the map canvas extent. You can draw on the canvas. And you can also calculate from layer.

One important thing to consider here is not to have grids outside of your data extent. So in this case, I will draw an area on my canvas, like this. This is a local scale grid that I want to create. So I take 500 metres for example, here. And then I would like to save it to file. I save it to my desktop 'grid_500m' I call it. Then run like this. And now I have a grid located like this.

So what it does is that it takes the extent from the left top and then create a grid like this. I was fortunate so that the grid was not outside of my data. If we look at the attribute table for this grid you can see that we have a unique ID and also the coordinates here for the different sites of each polygon. It is important when you do this grid that you have a coordinate system that is reference to metres. In this case, I'm using a UTM zone 31 north. If I would, for example, change this coordinate system to be a WGS84 so a geographical coordinate system and then try to make a grid again you see that you get a warning here that you have distances in geographic degrees.

That will be complicated to create the grid. So it's better to have a coordinate system that is referenced in metres. So I will change back set coordinate system and set coordinate project coordinate system from layer like this. So this ends how you create a grid for your local scale modelling.

Summary

- Use the Processing Toolbox to create a grid
- Do not have grids outside of the data extent
- Have grids in a coordinate system of metres
- Each grid cell is a polygon with a unique ID

Meteorological data for UMEP modelling

With Dr Fredrik Lindberg

Aim: Importing into QGIS existing meteorological data and using your own with UMEP

- Importing ERA meteorological data
- UMEP pre-processor for your own meteorological data

This video will talk about meteorological data for UMEP modelling. There are a number of ways to get meteorological data. And one could be that you have your own datasets and you need to reformat it into a format that UMEP is using. Or maybe you want to download data from some other source. We have both options included in UMEP.

I'll start by showing you how you can download data from ERA5 data. ERA5 is a Copernicus project where they've stored all kinds of climatological and meteorological and other data for researchers and others to download. What we have done is that we connected this to UMEP directly. So based

on where you are in the world. So in this case, I have added a digital surface model on London so QGIS knows where we are. Then I can click anywhere here and get the latitude and longitude for this point that I just clicked. And I have to set a time too from when to when I want to download. And then just simply click 'run'.

One thing to know about this data is that it takes a very long time to download. This is because how the data is stored and the big amount of data that exists. So if you want to download one year of data at hourly resolution, which this is it will take you about a couple of hours. So maybe something to do before you go home one day from your office. So I would not do that here now, I will close this.

One other possibility is that you have a dataset from another source that you have locally. Here, for example, I have some data with some columns of time and different meteorological variables and this is not formatted in the way that you want it. So we have made a tool that helps you to get the data into the correct format of UMEP. So prepare existing data.

So as you saw in the text file there was one number of header and it was a tab separated. And first we need to locate that data. And I have it here on my computer or somewhere. Here we have it. This window is just for information telling you if there were some invalid data in the file that was loaded.

Then you can use this to actually then decide on what columns that should go into what column in your UMEP formatted file later on. So in this case, I had all the time related columns here and then I know I have some incoming radiation for example, I know I have some wind speed and so on. So here you can then choose which one that you want to include in your UMEP dataset.

You can see that there is an asterisk in some of them. This means that they are usually those that are required to process any of the or use any of the UMEP models later on. So when you have, when you are fine with this for example like this you can then export the data. We also have a quality control. So a basic check to see if the data that you are using are reasonable. So for example, that they use the correct units, for example, barometric pressure in UMEP we are using kilo Pascal, for example.

Then you click on export data and then you can just go on here.

Summary

Gaining meteorological data

- For ERA5 start with your location and period of interest

- Downloading will take a while
- Process your own data into the UMEP format
- E.g., tab separated text file
- Asterisk for required data
- Includes a quality control

Web Services

With Dr Fredrik Lindberg

Aim: Viewing and downloading online data in QGIS to use in UMEP

In this video, I will demonstrate how to make use of different online web services to download data and use them in UMEP processing. QGIS comes in this browser panel with different capabilities of adding different kinds of data. For example, you have something called WMS is a web mapping service. It's usually data that you can just look on in your map canvas or web coverage services which is data that you actually also can download down to your local computer and then use it. They also have actually XYZ Tiles of OpenStreetMap which could be quite useful to know about. So if I just double click on this, you can see that the OpenStreetMap is downloaded from the area.

In this case, I'm using a digital surface model of central London. If you want to know a little bit more about what area looks like you can add this kind of data just by adding it directly here. And you, of course you need an internet connection. But what we will look into now is to download population density data which is one dataset that is used very often in UMEP.

We will use web coverage services and we will add a new connection. This data is host by SEDAC the socioeconomic data and application center at NASA. And they provide this service. So they have a big server with their data on and we're going to make use of that. Simply only thing you need here is a URL to the extra server where they have this data. And I have put this here so I don't have to type it and I need to give it a name. So maybe I give it SEDAC, and then click 'okay'. Now you see that I have a new feature here in the browser panel and I can actually click here. And then you can see all the datasets which are available from this server that they have. And one that we use quite a lot is the population data.

So we can see here is a gridded population of the world version four. So for example, I take population density from 2000. And what you seem to do is just that you drag it down into your layer

panel and then it starts now to download and prepare the data to be visualized in your map canvas. This can take a while based on the traffic your internet connection and also how much data or how detailed data you are want to download. So this means that we have to wait for a little bit until the data is actually arrived so that we can see it.

There are also other web cover services for other kinds of data. So if you see this, it's a very good option to use. So you can actually download it directly to your computer. Just have to wait for a little bit more. Hopefully it will turn up soon. And here it is, it says it has a network request error but you see that you have some thing coming into your map, canvas. This is all black now. And you see that, it seems like it's only have zeros this data but this is because it's all taking the scale of this from the whole world's population data set. And then it has some issues with the scaling here. But what we want to do is to download this to our computer for the area that we have on our map canvas. So what we do is that we take a file name. I already done this. So, I will overwrite this. We did population for 2000 and then I click to download it for the map canvas extent. And then you get to some extent lat longs here and then I click 'okay'.

Now you see that you actually get the datasets with some values and number of people per square kilometre or hectare. I don't remember really. So now I remove the web coverage service from my map canvas. And now you can see that I have downloaded a dataset with population data that you can now use because it's locally stored on your computer.

Summary

- Using the QGIS Browser for OpenStreetMap and other data
- Adding data from SEDAC (from NASA) by URL into a layer
- Example: downloading population data

Morphological parameters - representing urban spatial structures using UMEP and GIS

With Dr Fredrik Lindberg

Aim: Representing urban spatial structures using UMEP and GIS

- Using the Pre-Processor for Urban Morphology on a local scale grid
- Step by step calculation of the urban height (buildings) to width (streets) ratio

Hardy-Weinberg Equation: $p + pq + q = 1$

In this video, we will talk about morphological parameters that is essential for local scale climate modelling in urban areas and how to use UMEP and QGIS to extract some of these values and parameters. In UMEP you have a number of tools to do this.

Under 'urban morphology' you can either calculate for a grid or a point, or even as a source area. And if we open the grid morphometric calculator you can see that you need a local scale grid that was created in a previous video for this and in this one, you need an ID unique feature, which is the ID that automatically comes with the grid when you create it. And you need your digital surface model and elevation models. And what is good here is that you can click in this tick box here and then you get the values directly into your attribute table for your grid. I have already done this so I will open the attribute table for this grid.

We can see what we have got here. These are the parameters that are calculated with this morphometric calculator. So we have plan area index, frontal area index and so on and at the end also we have zero place displacement height and roughness length. One other feature or parameter that is usually interesting to derive is what we call the height to width ratio. So the mean width of streets and the mean height of buildings. To do this, we can make use of different tools both in UMEP and in QGIS to extract this.

To do this, we are going to use an equation which transforms the 3D environment into the non-dimensional height to width ratio. This is the equation you see here. It's a little bit complicated. I will not go through how it's derived but what we need here is the two items from equation three and four which is lambda p, which is the plan area index and lambda w, which is the same thing but instead of the area on the fraction of buildings we need the fraction or the height, the area of the walls.

To derive this we can actually use the tool in UMEP which is found here called 'wall height and aspect' where you can calculate from a digital surface model the height and aspect of all wall pixels. I have already created this wall height grid digital raster so if we can zoom in a bit here you can see that it has identified a number of walls and calculated the height for each.

Now we want to extract all this information into the grids and that we can do by using the processing toolbox. So we use a tool called 'zonal statistics'. So I have searched for zonal here and then comes up here. So I click on this and we want to use our wall height raster to calculate this and let's use 'wall' as a prefix. And then we want to calculate the sum and then click 'run'. Then in each of these vector polygons the total area of the walls is calculated. So if we now look at the attribute

table we see a new column here with numbers, quite high numbers. So these should now be normalized by the total area of the grid.

So this is one of the main advantages of using vector data in GIS that you can use and manipulate the data using this attribute table which is connected to the spatial data. So what we want to do now is to create a lambda w column here next to it. Then we can use the 'field calculator' found here. We want to create a new field. We want to call it 'lambdaw' we can have it as a decimal number with maybe two decimals. And what we want to do here is that we want to take the area of the walls then we would like to divide it by the area of the actual polygons. And this can be found in 'Geometry' and '$area'. And now you can calculate and you take the set for a new attribute that you see here in the end. And you can see here also that lambda w can be actually higher than one since the total area of walls is not related to the actual lot area or the actual area of the polygon.

So now we have the plan area index (lo_pai) and lambdaw. So now we can go back and try to calculate the height to width ratio according to this. This is done again, by using the 'field calculator' create a new field, let's maybe call it 'hw' and go to make it a real, maybe with two decimals.

So now it's a little bit of the tricky part. So we need to try to get all the correct settings as they were. So what we want to do is take lambda p (lo_pai) times lambdaw and we want to divide this by two times lambda p times one minus lambda p like this. So this is now, should be the same as the equation below. Just checking I did the right thing and it looks okay and then we can click 'okay'. And now we have the next column with height to width ratio (hw) and we can go back too.

I just want to save the editings here of this layer, stop editing. Now we can go in and actually make them look or color them based on height to width ratio. So we go to symbology, and use graduated color. We want to use height to width ratio we need to have a brush here. So we see extra values. Then we take classify and we can take apply. And here we have a variation of height to width ratios within the 500 times 500 metres. This was just some small examples on how to derive these morphological parameters using UMEP and QGIS.

Summary

using UMEP to:

• create parameters including roughness length and plan area index

• calculate and display the height to width ratio (H/W) by using the field calculator in the attributes table