

RM03: SPATIAL ANALYSIS AND MODELLING

Supervision 1: Introduction of spatial analysis using Quantum GIS(QGIS)

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Department of Land Economy
RM03: Supervision 1
2019/2020



Material for supervision1

- Sup1-exercises (12-13 February, 2020)
- Sup1-assignment (13 February, 2020)
- Sup1-answers (20 February, 2020)

- Cambridge Moodle: RM03
<https://www.vle.cam.ac.uk/course/view.php?id=179012#section-2>
- Online:
<https://hn303.github.io/CamLandEc-RM03/>

**Short Lecture (15 mins)
QGIS exercises (60 mins)**

[Preview dark color scheme](#)

RM03: Spatial Analysis and Modelling

Welcome to 2020 lent term module RM03 : Spatial Analysis and Modelling.
This repo is created by [Haifeng Niu](#) and contributed by Heeseo Rain Kwon and Paul Scherer*. Materials of supervision could be found here.

Course outline

Lectures	Topic	Lecturers
Lecture 1	Introduction: Concepts, theory and practice in spatial analysis using GIS and data science	(Elisabete A. Silva)
Lecture 2	Data types of data, data collection and processing: from census to new live data harvesting in a digital age of big data	(Elisabete A. Silva)
Lecture 3	GIS and Data Processing: vector/raster/image data sets	(Elisabete A. Silva)
Lecture 4	Spatial metrics & analysis: static and dynamic environments	(Elisabete A. Silva & José Reis)
Supervision 1	QGIS - data analysis [Slides] [Exercises] [Assignment]	(H. Niu, H. R. Kwon)
Lecture 5	Urban and Environmental Dynamic Modelling	(Elisabete A. Silva)
Lecture 6	Dynamic simulation models SA, MCA, ABM, CA, GA and NN: development, calibration, validation	(Elisabete Silva)



Spatial data

Why spatial feature matters?

- First law of geography
“Everything is related to everything else, but near things are more related than distant things.” -- [Waldo Tobler](#)
- Real problems that spatial data may help
 - Urban Traffic (TfL, GoogleMap, ...)
 - Healthcare (Body censor, GP location, ...)
 - Politics (Propaganda, ...)
 - Business Intelligence/Market (Uber, Deliveroo, Strava, ...)
 - City Operation (Smart Bus, Facilities, ...)



FOURSQUARE



**Transport
for London**

STRAVA

NHS

Uber

 **smart
CAMBRIDGE**
Solutions for the city and beyond



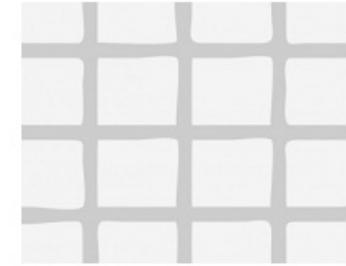
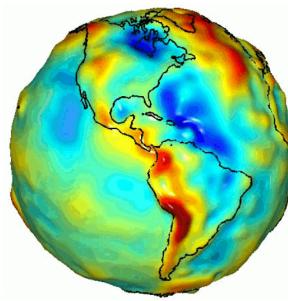
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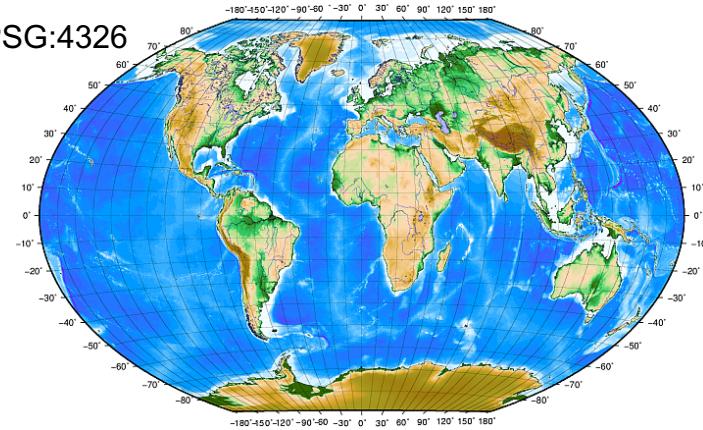
Spatial Data

What makes data spatial?

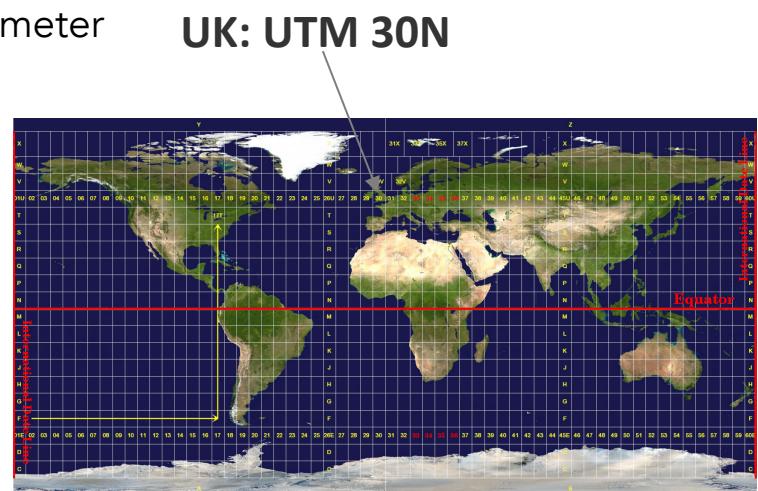


- Location, Coordinates and Georeferencing
- Coordinate reference system (CRS)
 - Definition: with the help of coordinates, how the two-dimensional, projected map in your GIS is related to real places on the earth.
 - Map projection
 - Two types:
 - Geographic Coordinate Systems: degree
 - Projected coordinate reference systems: meter

WGS84- EPSG:4326



UTM



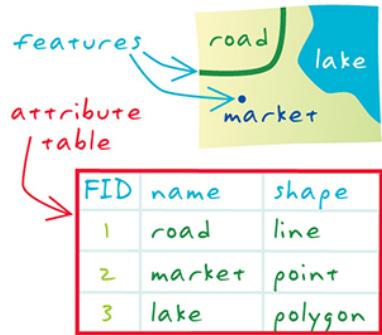
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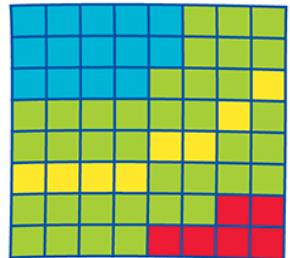


Spatial Data

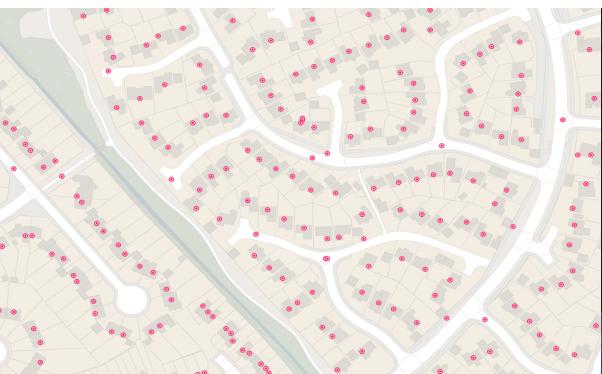
Vector Data and Raster Data



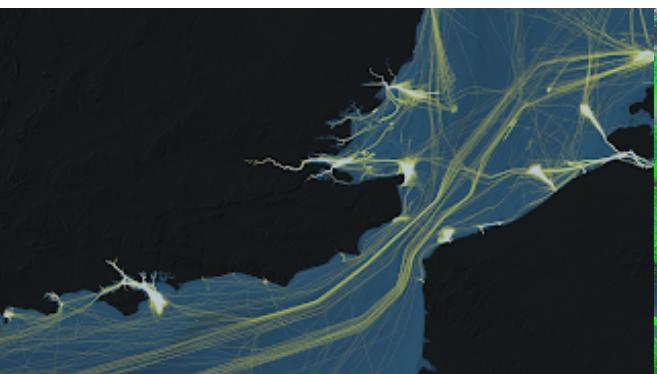
- Main categories:
 - Vector (Points, Polylines and Polygon)
 - Shapefile, GeoJSON, Geopackage, Geodatabase
 - Map features + attributes table
 - Raster Data
 - GeoTIFF, JPEG2000
 - Pixel + value



Legend:
■ agriculture ■ lake
■ residential ■ road



Geolocation of properties in UK @ Ordnance Survey



Port service traffic is quite busy in the English Channel@ ALASDAIR RAE



LiDAR data @ Leica CityMapper



Spatial Data

Shapefile

- **Three main files:**
 - **shp** — Main file (mandatory); a direct access, variable-record-length file in which each record describes a shape with a list of its vertices.
 - **shx** — Index file (mandatory). In the index file, each record contains the offset of the corresponding main file record from the beginning of the main file. The index file (.shx) contains a 100-byte header followed by 8-byte, fixed-length records.
 - **dbf** — dBASE Table file (mandatory); a constrained form of **DBF** that contains feature attributes with one record per feature. The one-to-one relationship between geometry and attributes is based on record number. Attribute records in the dBASE file must be in the same order as records in the main file.
- Others:
 - **prj** — Projections Definition file; stores coordinate system information.
 - ...

¹ What is shapefile?:

<https://gislounge.com/what-is-a-shapefile/>



GIS Software

Why use QGIS?



- QGIS (Quantum GIS) is a major open-source GIS platform
 - Free and open-source: cost you zero money
 - Cross platform: macOS, Windows and Linux
 - User community: tons of plugins and help resources¹.
 - Programming language support: PyQGIS, R and so on.



¹ Geographic Information Systems in Stack Exchange:
<https://gis.stackexchange.com/?tags=qgis>



How to involve QGIS in your research?

Pre-processing/ Analysis/ Visualization

- Data preprocessing
 - Selection 
 - Extraction 
 - Calculation 
 - Clip 
 - Join 
- Spatial Analysis
 - Geoprocessing 
 - Spatial autocorrelation
 - Spatial interpolation
 - Spatial categorization
 - Network Analysis
- Geo-Visualization
 - Digitalization Map 
 - Mapping 



covered in supervision and assignment



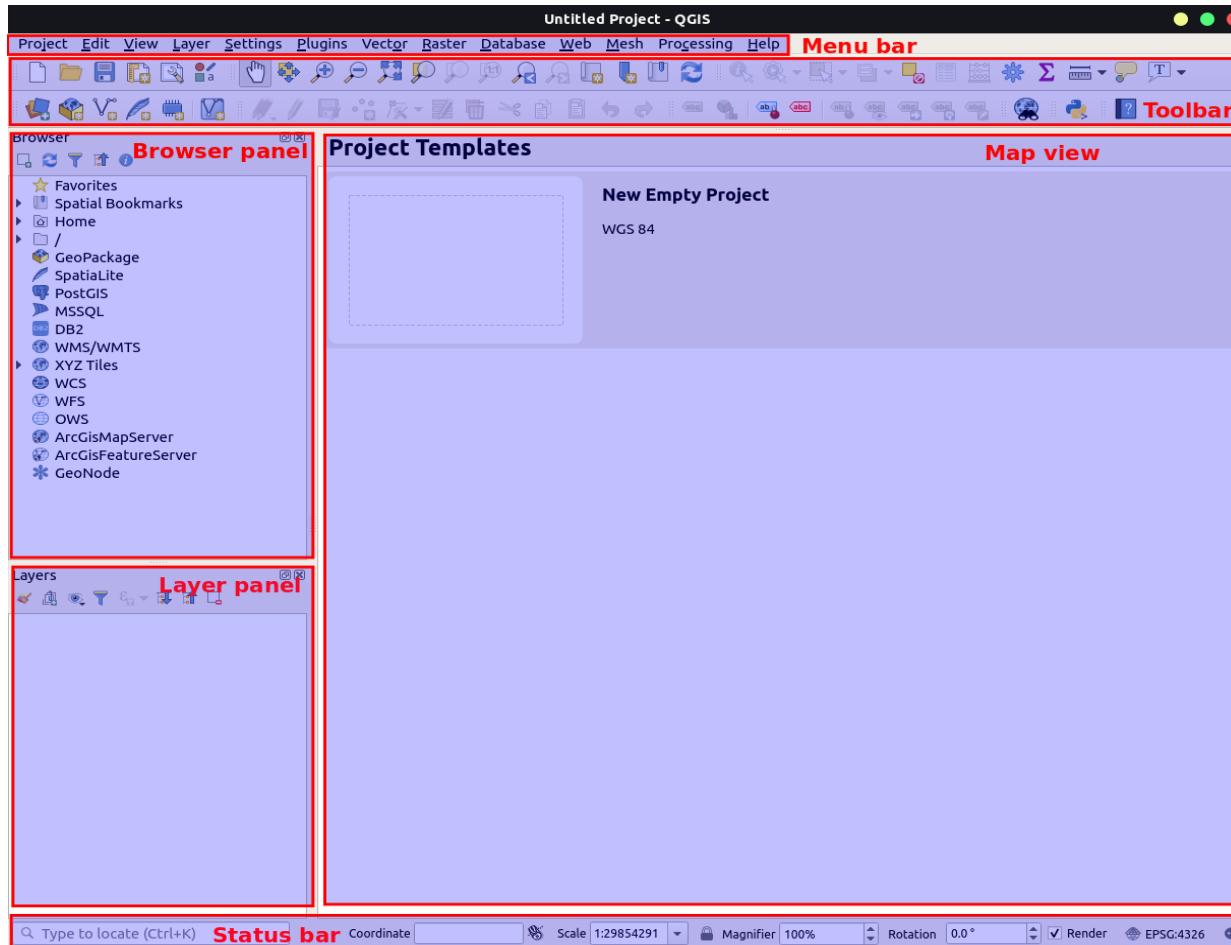
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QGIS

Interface



- Menu bar
- Toolbar
- Browser panel
- Layer panel
- Map window
- Status bar



QGIS

Exercises

- Practice QGIS exercises with the [instruction](#).

CamLandEc-RM03

Search CamLandEc-RM03

Home Supervision 1 Dark color scheme

Supervision 1 (12-13 February, 2020)

Instructions

- 1 Read through the instruction carefully. You may face problems if you overlook any of the steps.
- 2 Remember to save the QGIS document regularly.
- 3 When running tasks on QGIS, leave the settings as the default unless instructed.
Note: functions and filename are **highlighted** in this document.

Supervision overview

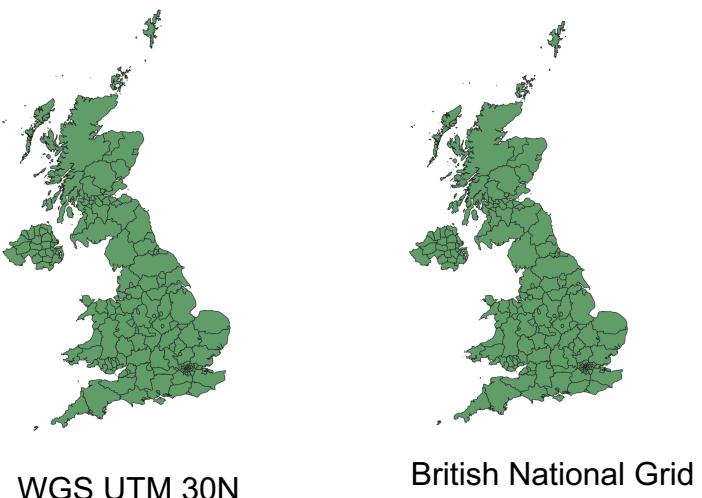
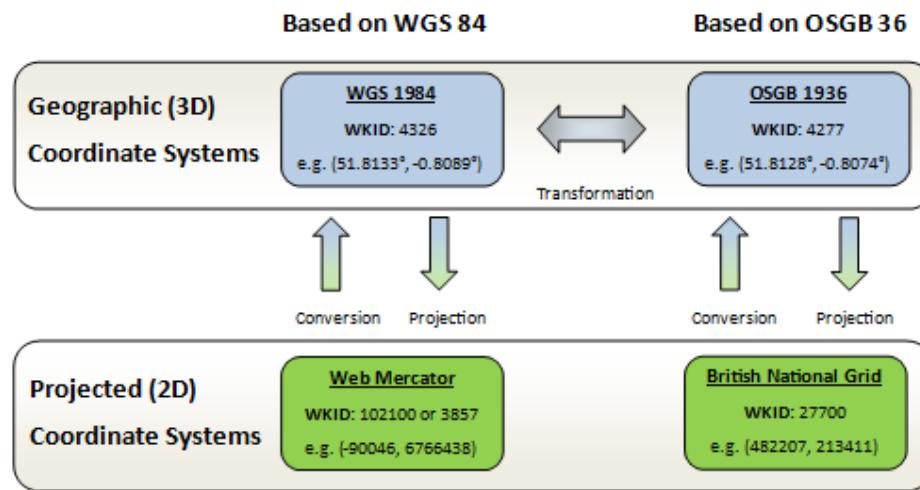
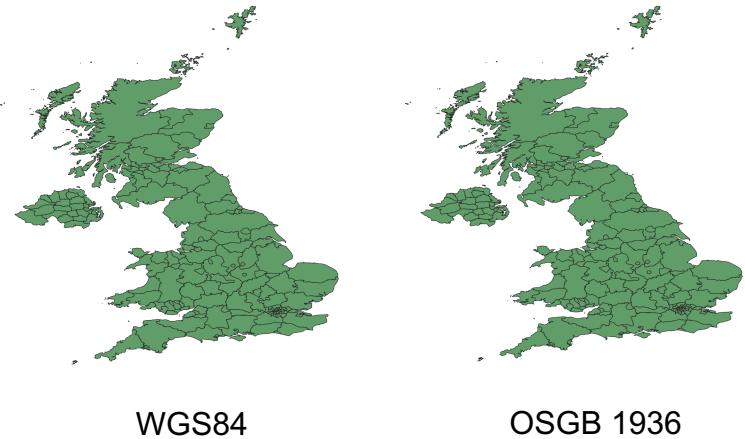
In this exercise, you will familiarise yourself with the basic features of QGIS software and geoprocessing exercises with vector data and raster data.



Coordinate reference system

How to deal with CRS in your project?

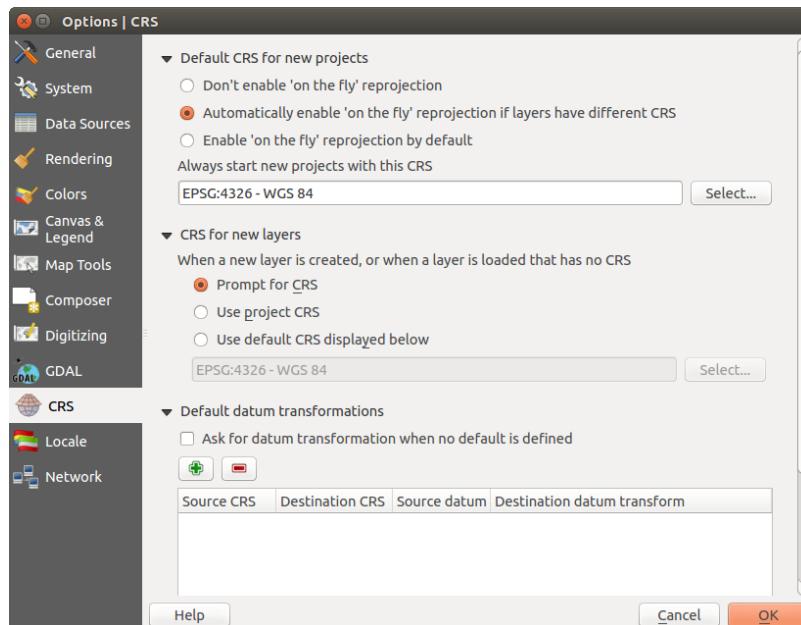
- Different units
 - Degree/Meters
- Setting CRS
 - Project CRS
 - Layer CRS
 - Export CRS



Coordinate reference system

How to deal with CRS in your project?

- **On-The-Fly Projection**
 - QGIS supports “on the fly” CRS transformation for both raster and vector data. This means that regardless of the underlying CRS of particular map layers in your project, they will always be automatically transformed into the common CRS defined for your project.



- **Global**
 - WGS 84 (Geographic)
 - UTM (Projected)
- **UK**
 - OSGB 36 (Geographic)
 - British National Grid (Projected)



Join

How to join layer?

- Shapefile and Table (By unique identifier)
- Shapefile and shapefile (By unique identifier)

The screenshot shows the QGIS interface with three main windows:

- Browser:** Shows the project structure with a folder named "supervision1" containing a "dataset" folder, which in turn contains "Cam_City.shp" and "Cambridge-City.csv".
- Table:** A data grid titled "Cambridge-City-Ward-Population-Forecasts-2015 :: Features Total: 14, Filtered: 14, Selected: 0". It has columns for "Ward Code" (e.g., E05002709), "Ward name" (e.g., Market, Newnham, Petersfield, Queen Edith's, Cherry Hinton, Coleridge, East Chestert..., King's Hedges, Abbey, Arbury, Castle), and years Y2011, Y2016, Y2021. The first row (Market) is highlighted with a green border.
- Shapefile:** A data grid titled "Cam_City :: Features Total: 14, Filtered: 14, Selected: 0". It has columns for "wd15cd" (e.g., wd15nm, wd15nmw, lad15cd, lad15nm), "objectid", "st_lengths", and "st_area". The same set of 14 rows as the table are listed here, with the same red borders highlighting the first row (Abbey).

Red arrows point from the "Ward name" column in the Table to the "Ward name" column in the Shapefile, indicating the join relationship based on the unique identifier (Ward name). The "Cam_City" layer is also selected in the Layers panel.



Join

What if there is no identifier?

- Shapefile and shapefile (By location)

