RM03: SPATIAL ANALYSIS AND MODELLING

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

Haifeng Niu

hn303@cam.ac.uk

Heeseo Rain Kwon

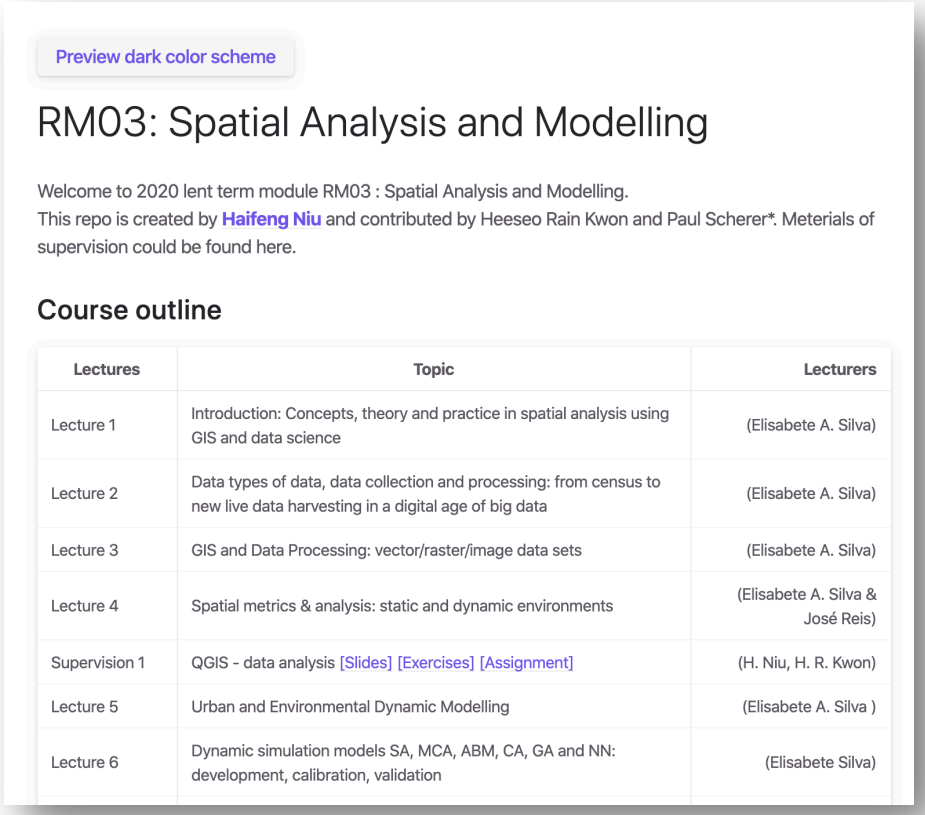
hk394@cam.ac.uk

Material for supervision1

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

- 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/



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*. Meterials 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)

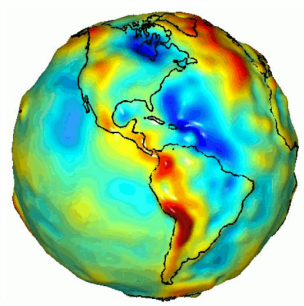
Spatial data

Why spatial feature matters?

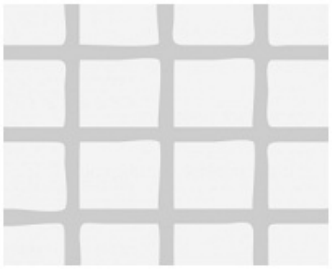
- First law of geography
  "Everything is related to everything else, but near things are more related than distant things." -- Waldo Tobler
- Real problems that spatial data may help
  - Urban Traffic (TfL, GoogleMap, …)
  - Healthcare (Body censor, GP location, …)
  - Politics (Propaganda, …)
  - Business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

Spatial Data

What makes data spatial?



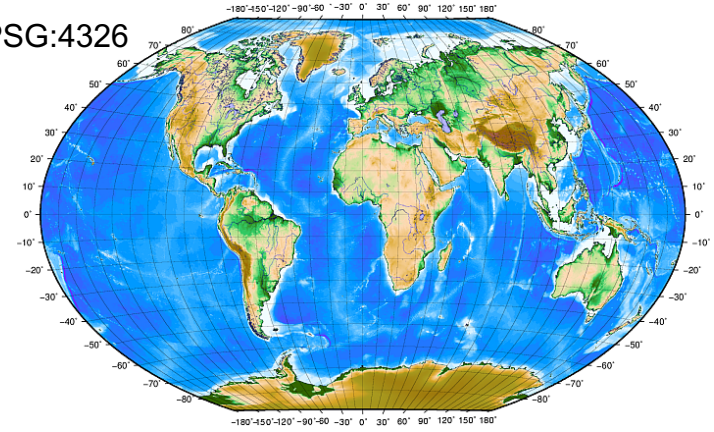
Geographic (3D)



Projected (2D)

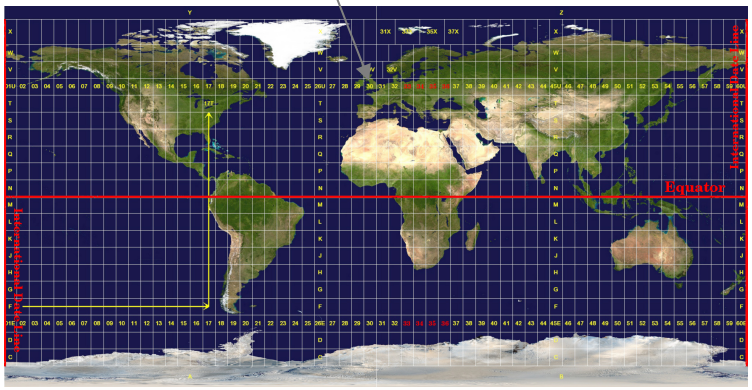
- Location, Coordinates and Georeferencing
- Coordinate reference system (CRS)
  - Definition: with the help of coordinates, how the two-dimensional, projected map in your GIS is related to real places on the earth.
  - Map projection
  - Two types:
    - Geographic Coordinate Systems: degree
    - Projected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

WGS84- EPSG:4326



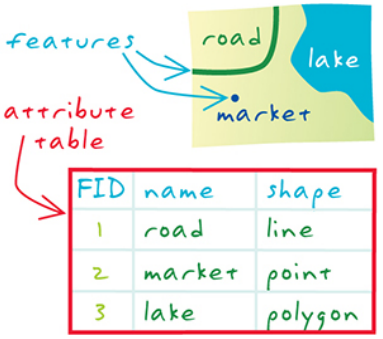
UTM

UK: UTM 30N

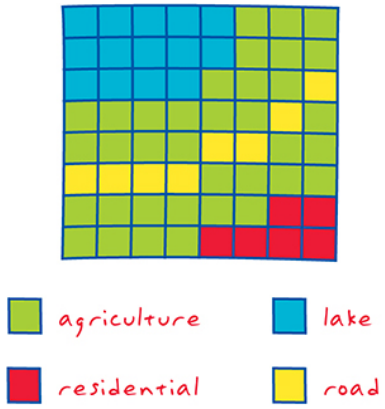


Spatial Data

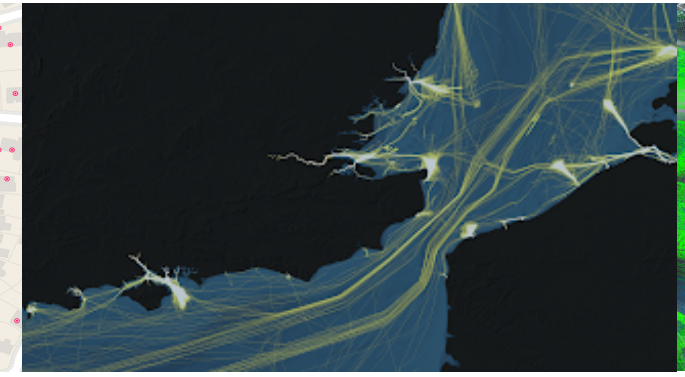
Vector Data and Raster Data



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



Geolocation of properties in UK @ Ordance 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 resources[1].
  - 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?

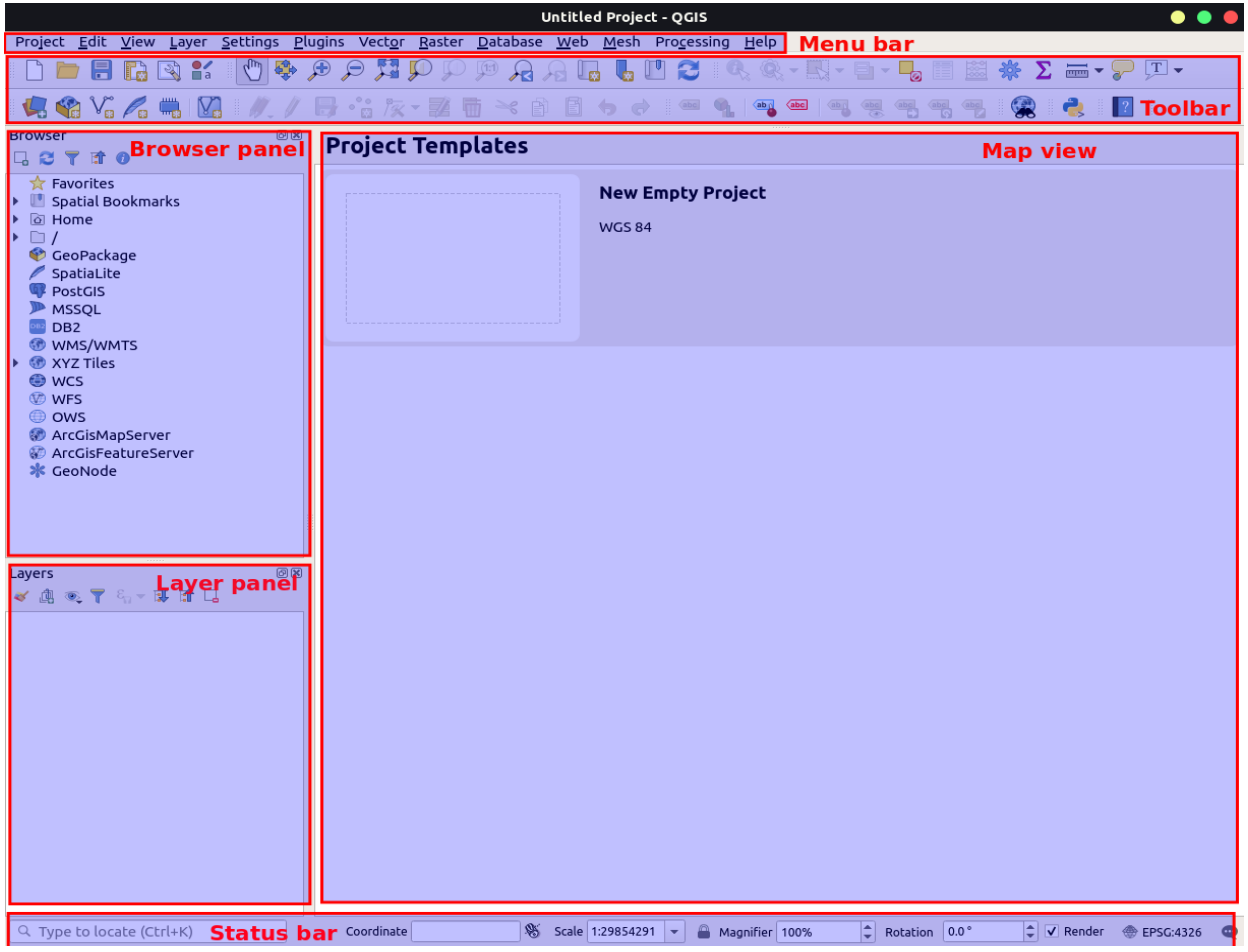
Pre-processing/ Analysis/ Visualization

- 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

QGIS

Interface

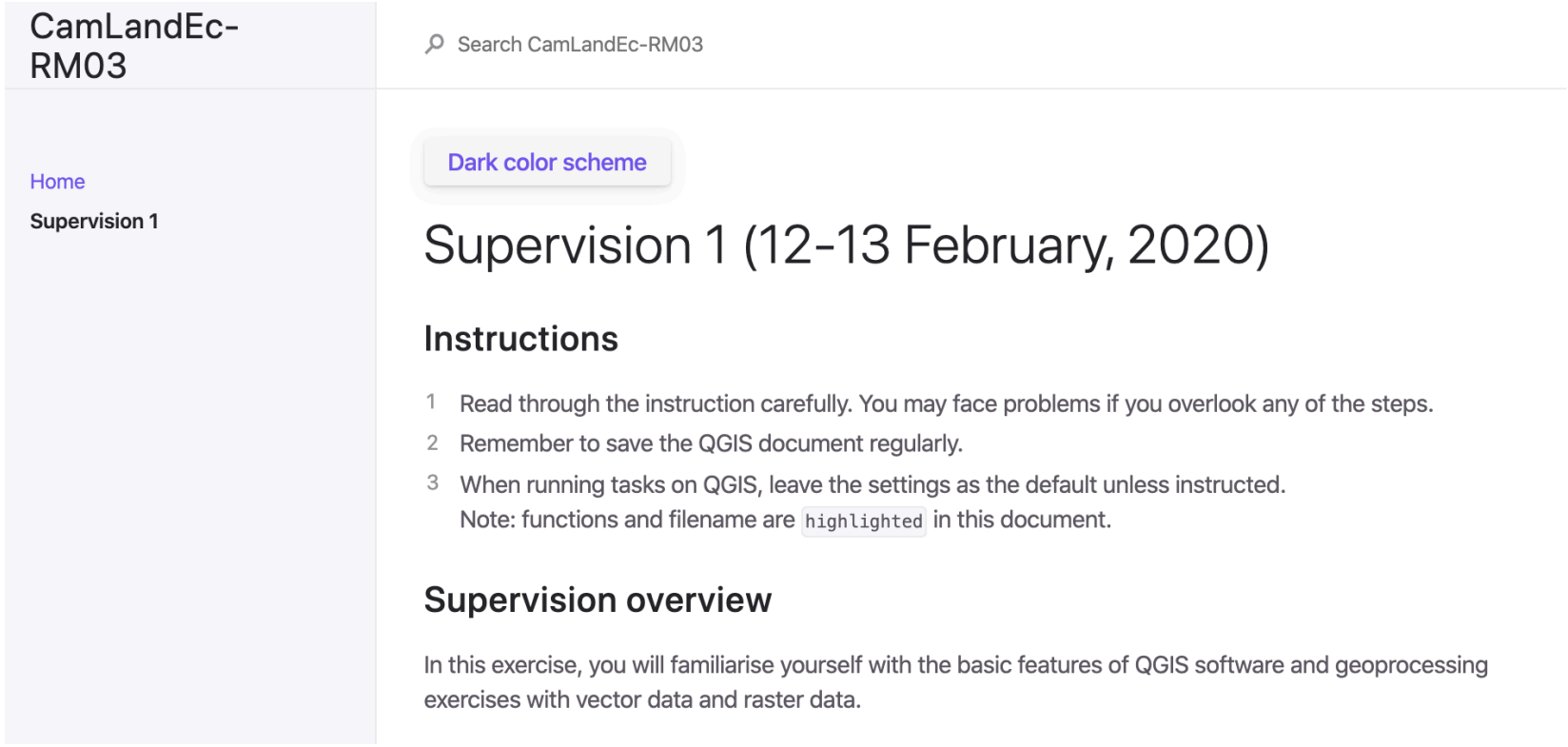


- Menu bar
- Toolbar
- Browser panel
- Layer panel
- Map window
- Status bar

QGIS

Exercises

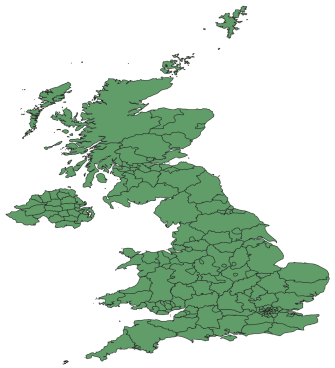
- Practice QGIS exercises with the instruction.



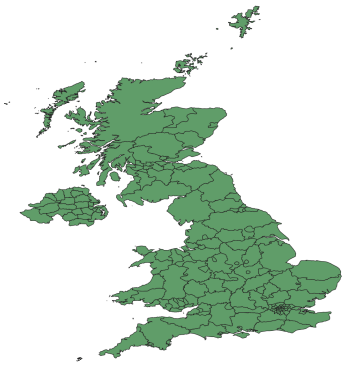
Coordinate reference system

How to deal with CRS in your project?

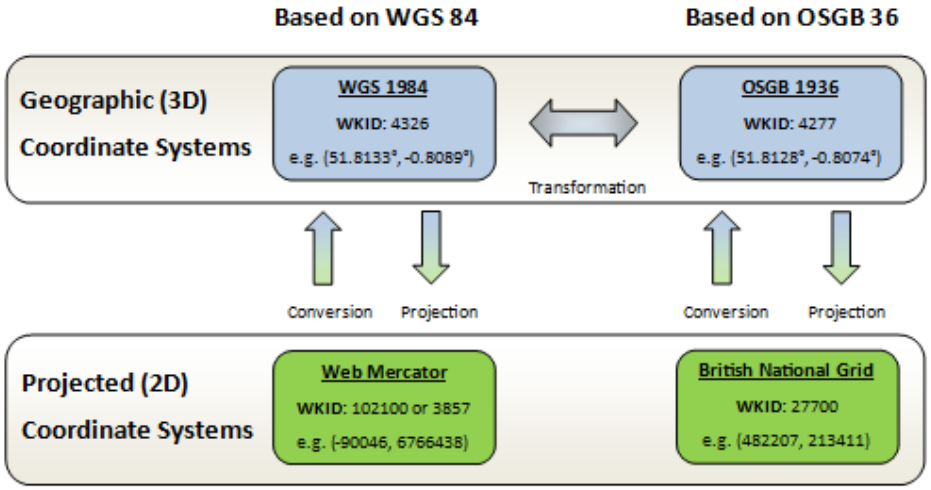
- Different units
  - Degree/Meters
- Setting CRS
  - Project CRS
  - Layer CRS
  - Export CRS

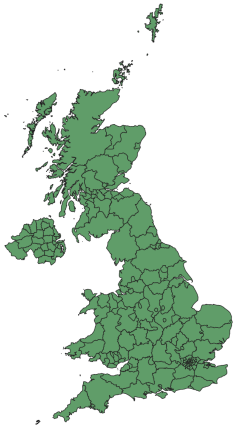


WGS84

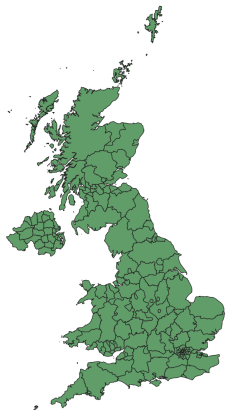


OSGB 1936





WGS UTM 30N

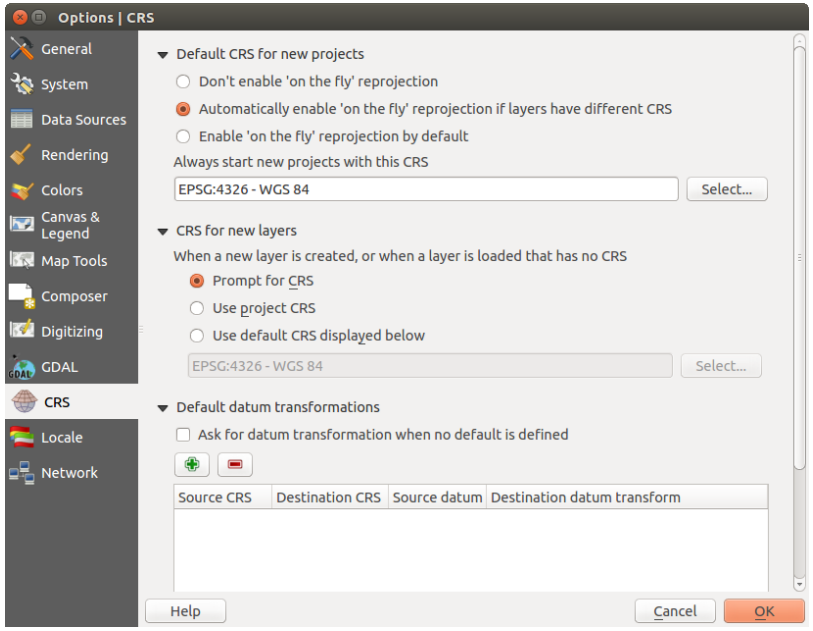


British National Grid

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.

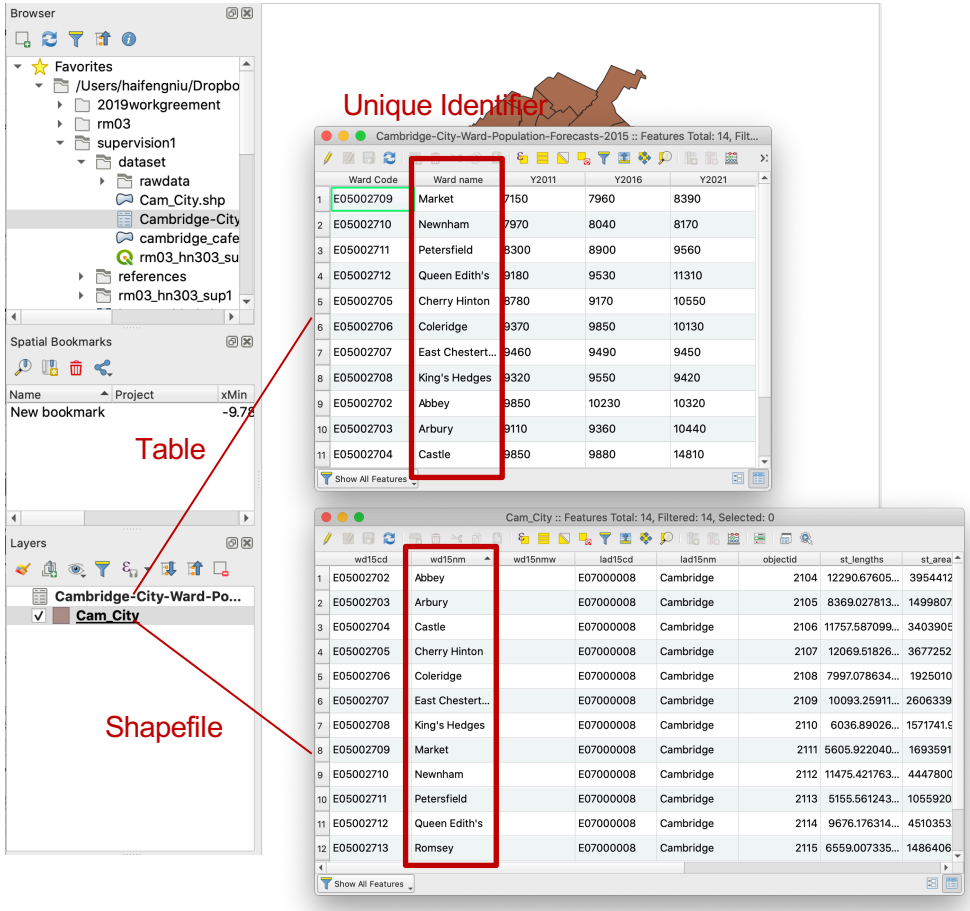


- Global
  - WGS 84 (Geographic)
  - UTM (Projected)
- UK
  - OSGB 36 (Geographic)
  - British National Grid (Projected)

Join

How to join layer?

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



Join

What if there is no identifier?

- Shapefile and shapefile (By location)