GIS: Introduction and Application

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E1-04-09, PC Cluster 1

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What is GIS?

A geographic information system (GIS) is a computer system built to capture, store, manipulate, analyze, manage and display geographical data.

"Throughout its history, the application of GIS technologies has been characterized by diversity: urban planning, urban architecture, environmental protection, transport and logistics, engineering networks, real estate and military planning are the areas where GIS is most commonly applied." (Maliene et al., 2016)

GIS software products

COTS - AutoCAD (Autodesk)
- ArcGIS (ESRI)
- Surfer (Golden Software)

Open Source - QGIS
- Google Earth (Google)



Coordinate Systems

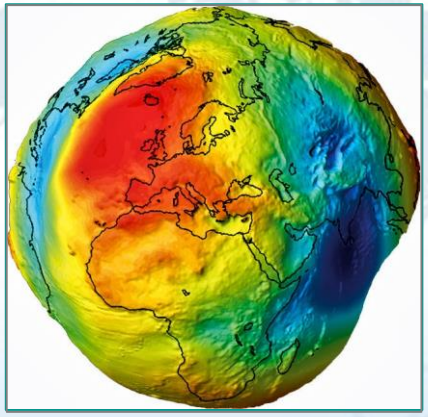
Earth's topographic surface is a complex shape

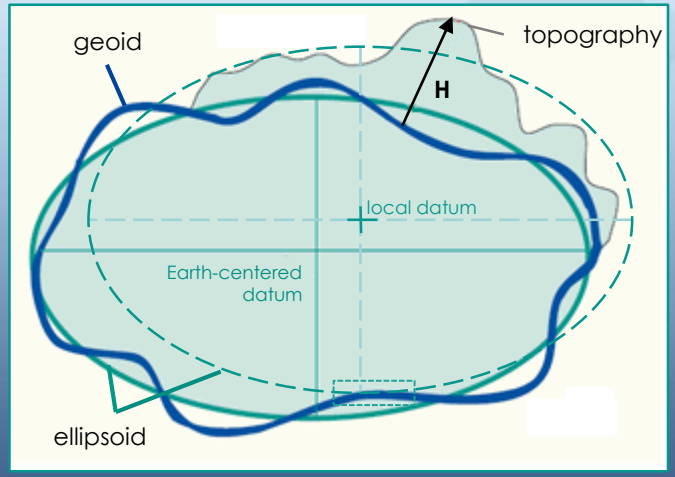
Geoid

"equipotential surface that most closely corresponds to mean sea level" (Iliffe and Lott 2008).

Ellipsoid

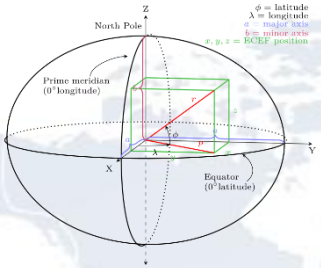
- WGS84 (global datum – Earth centered datum)
- Everest 1830 Modified(local datum used for West Malaysia & Singapore)



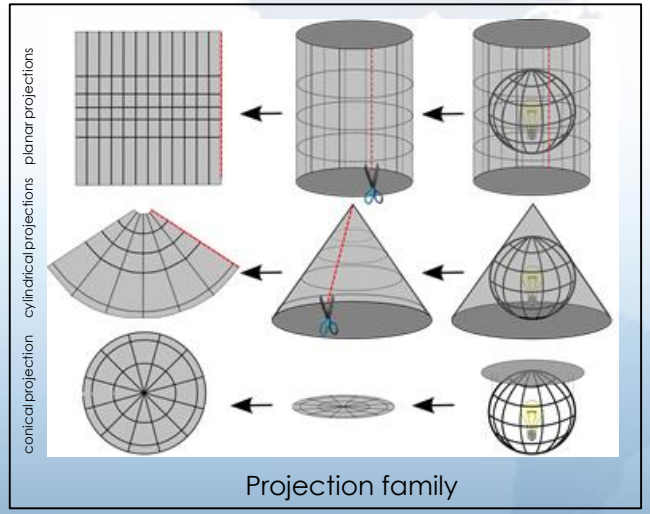


Coordinate Reference Systems (CRS)

On the ellipsoid, coordinates define the position relative of information



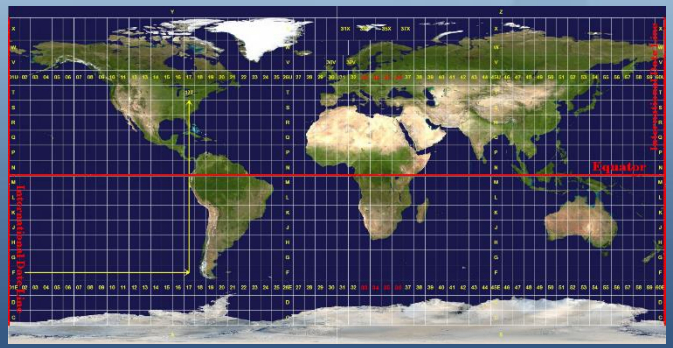
Map projections transform the latitudes and longitudes into a plane (distort the surface in some fashion)



Projection family

- Geographic Coordinate Systems (DMS)
  ex: WGS84
- Projected coordinate reference systems (XY-plane)
  ex: Universal Transverse Mercator (UTM – 60 zones)
  - Singapore is find in UTM 48 N

  ex: SVY21 Transverse Mercator projection based on the WGS84 ellipsoid with reference point at Pierce Reservoir (Better accuracy for data information relevant to Singapore).

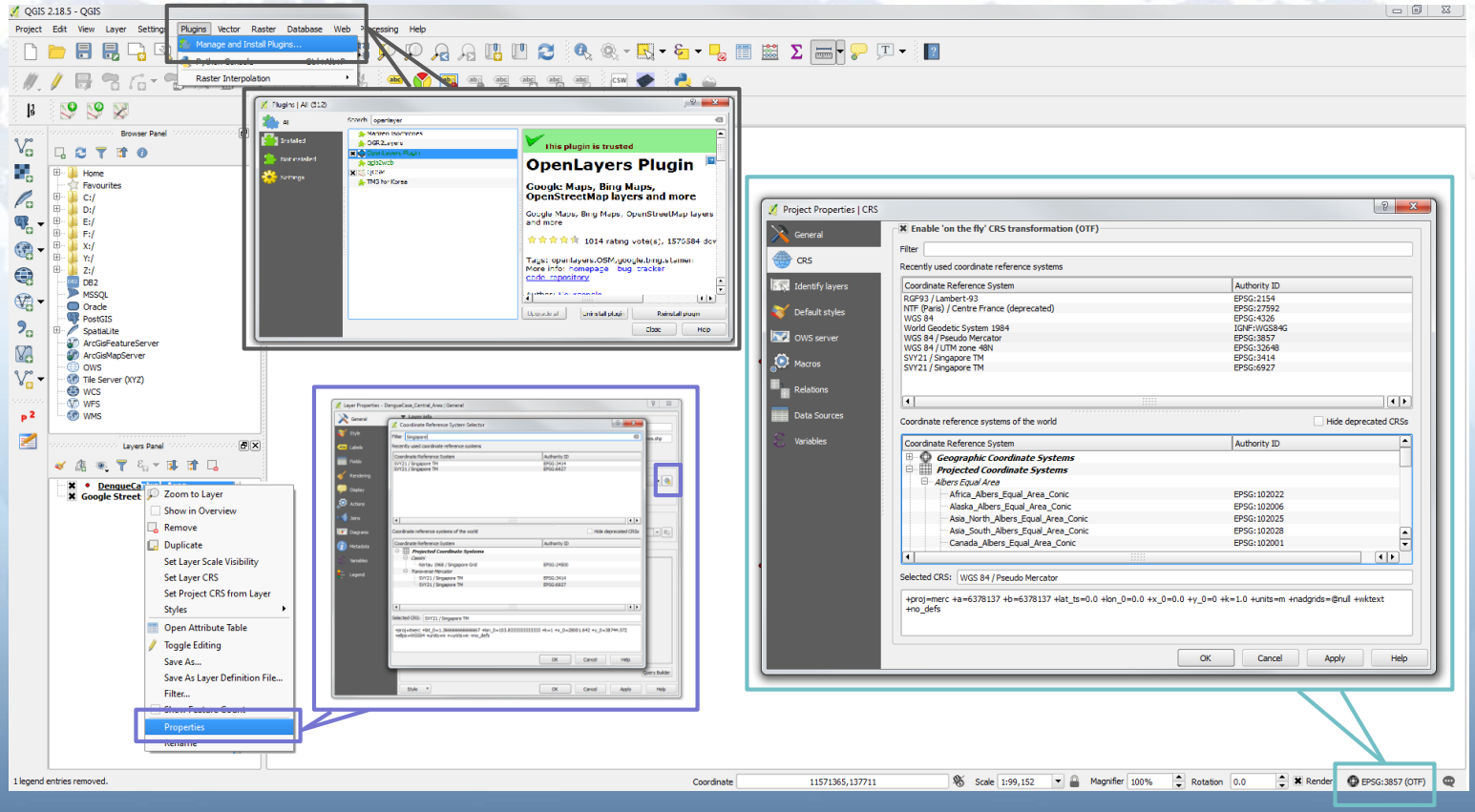


UTM zones

Projections with QGIS

Plugins

Plugins in QGIS add useful features to the software such as OpenLayers to render web based map.



Layer Properties | General | CRS

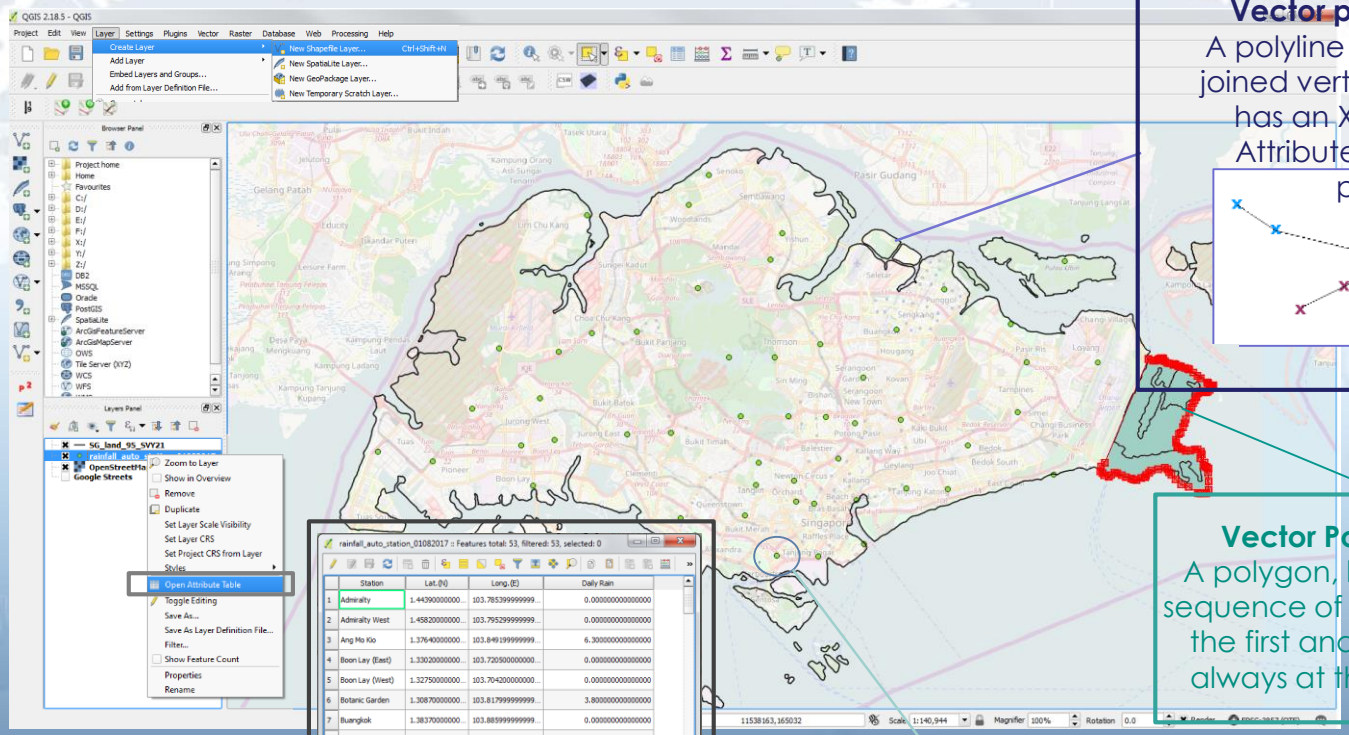
Choose the Coordinate Reference System (CRS) for layers. Layer properties dialog provides additional information about the layer, symbology settings and labeling options.

Project Properties | CRS

Choose the Coordinate Reference System (CRS) for project display. Enable on-the-fly (OTF) re-projection when displaying layers from a different CRS.

Vector Data

A coordinate-based data model that represents geographic features by points, lines, and polygons. Vector are useful for large and diverse data storage, at representing discontinuous and discrete (thematic) data such has boundaries, vegetation, etc.



Vector polyline Feature
A polyline is a sequence of joined vertices. Each vertex has an X,Y coordinate. Attributes describe the polyline.

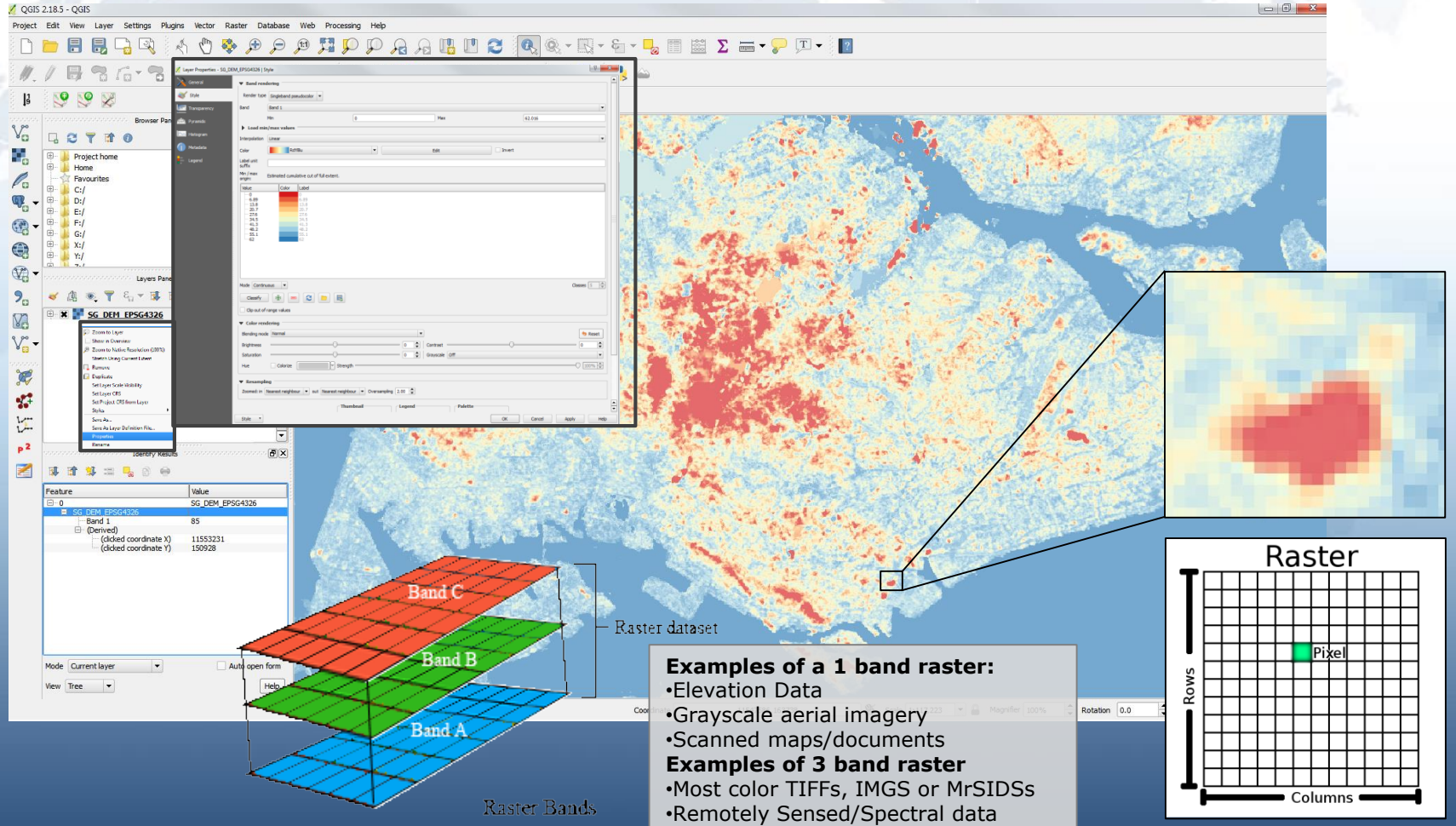
Vector Polygon Feature
A polygon, like a polyline is a sequence of vertices. However, the first and last vertices are always at the same position

Attribute table
displays features of a selected vector layer with specific information such as name, elevation, etc.

Vector Point Feature
A point feature is referenced by its X,Y coordinate.

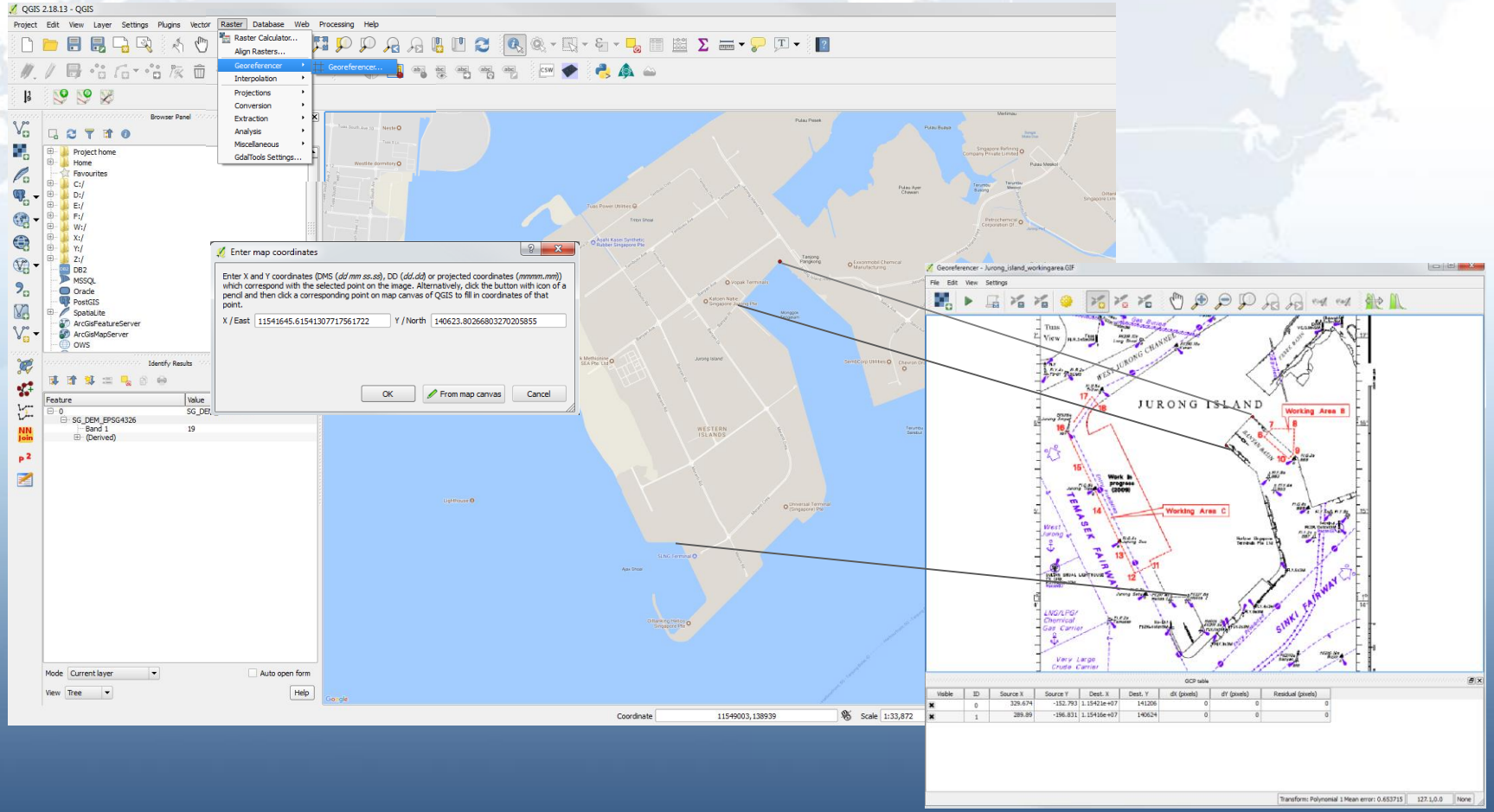
Raster Data

Rasters are made up of a matrix of pixels, each containing a value that represents the conditions for the area covered by that cell. It display information that is continuous across an area and cannot be easily divided into vector features.



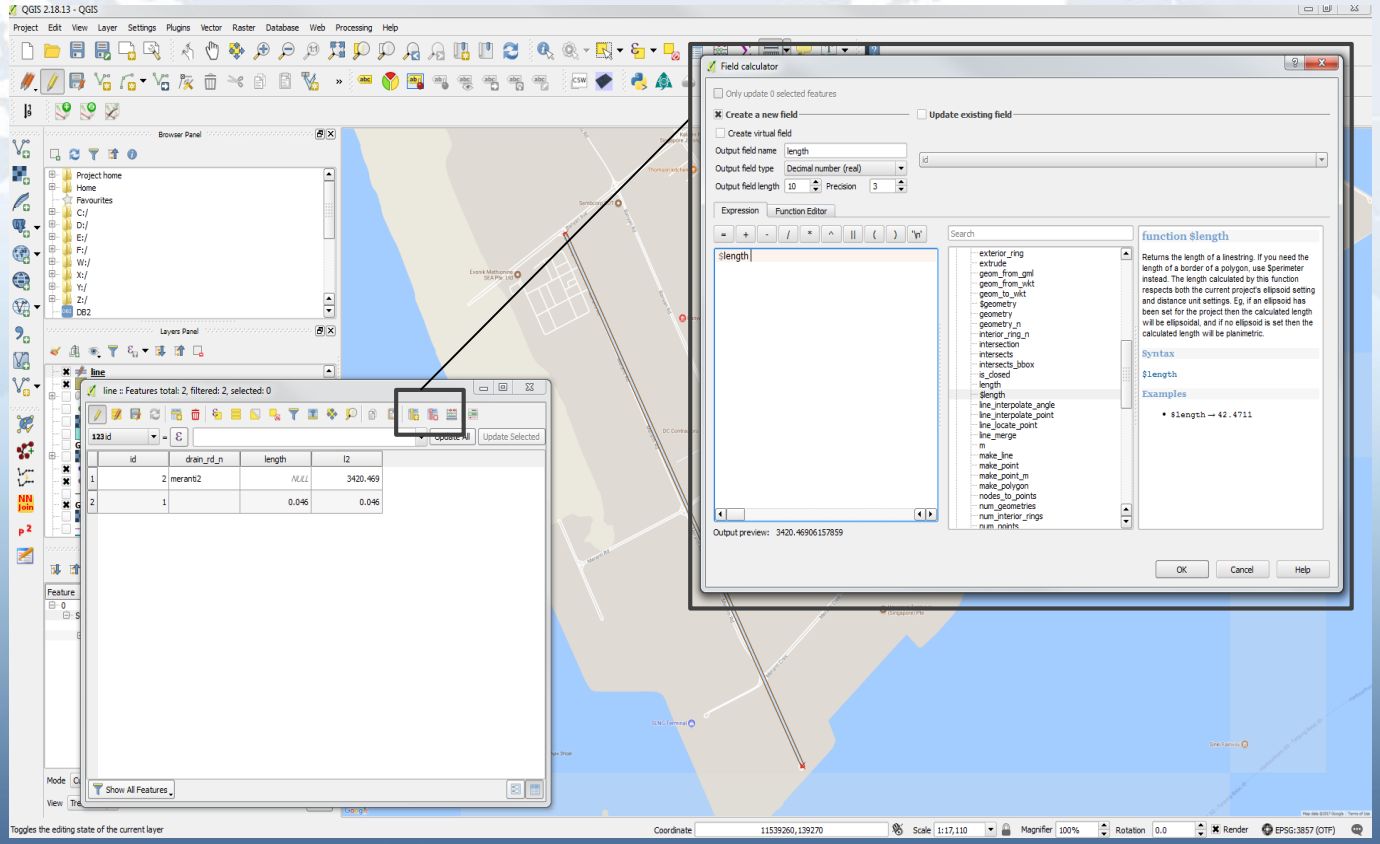
Georeferencer Plugin

The Georeferencer Plugin is a tool for generating rasters with geographic or projected coordinate systems. The basic approach to georeferencing a raster is to locate points on the raster for which you can accurately determine coordinates.



Spatial analysis

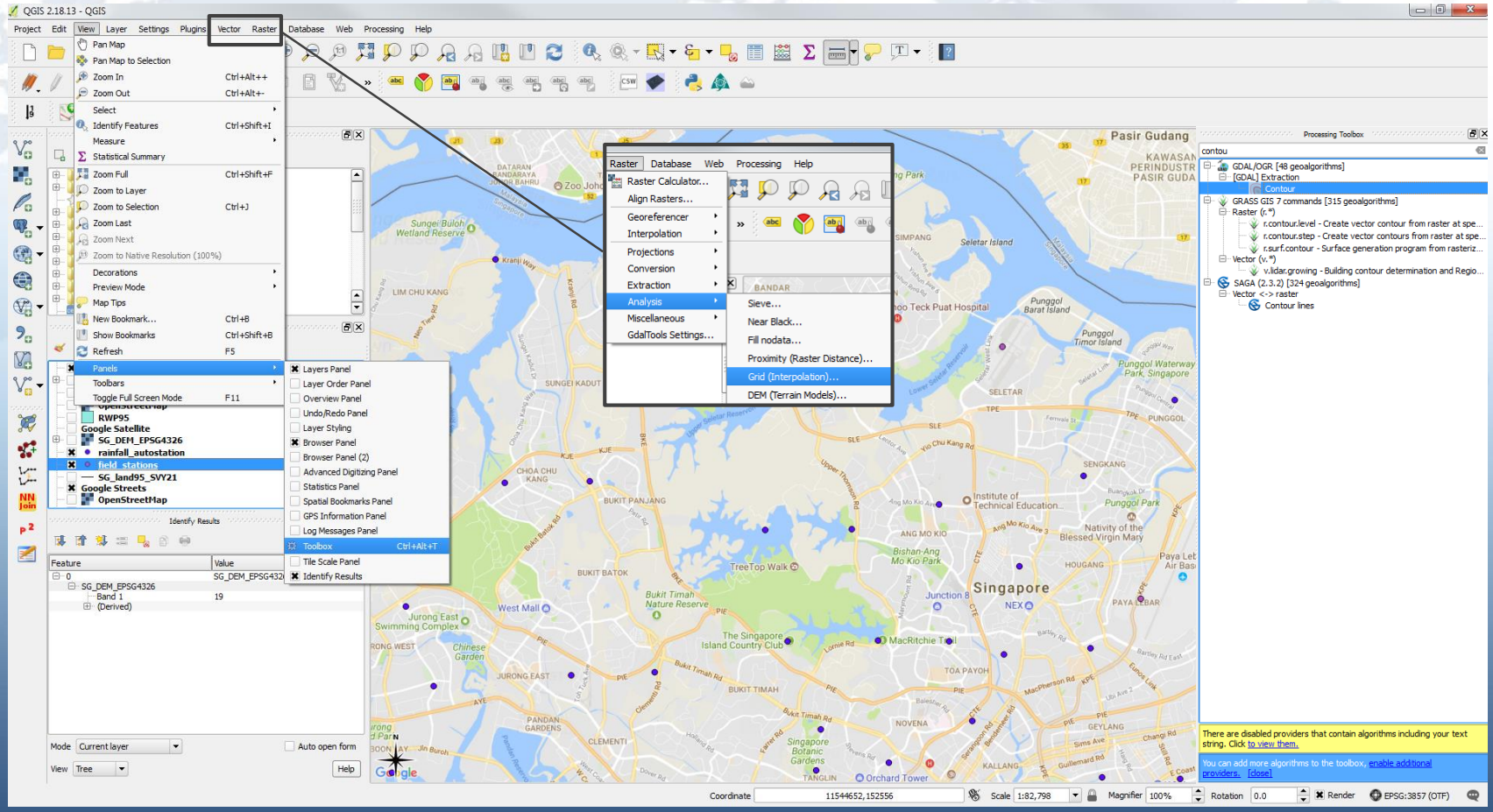
Spatial analysis is the process of manipulating information to extract new information and meaning from the original data. In hydrology, you will likely emphasize the importance of terrain analysis and hydrological modelling.



Field Calculator in the attribute table allows to perform calculations on basis of existing attribute values or defined functions, e.g to calculate length or area of geometry features. The results can be written to a new attribute column or it can be used to update values in an already existing column.

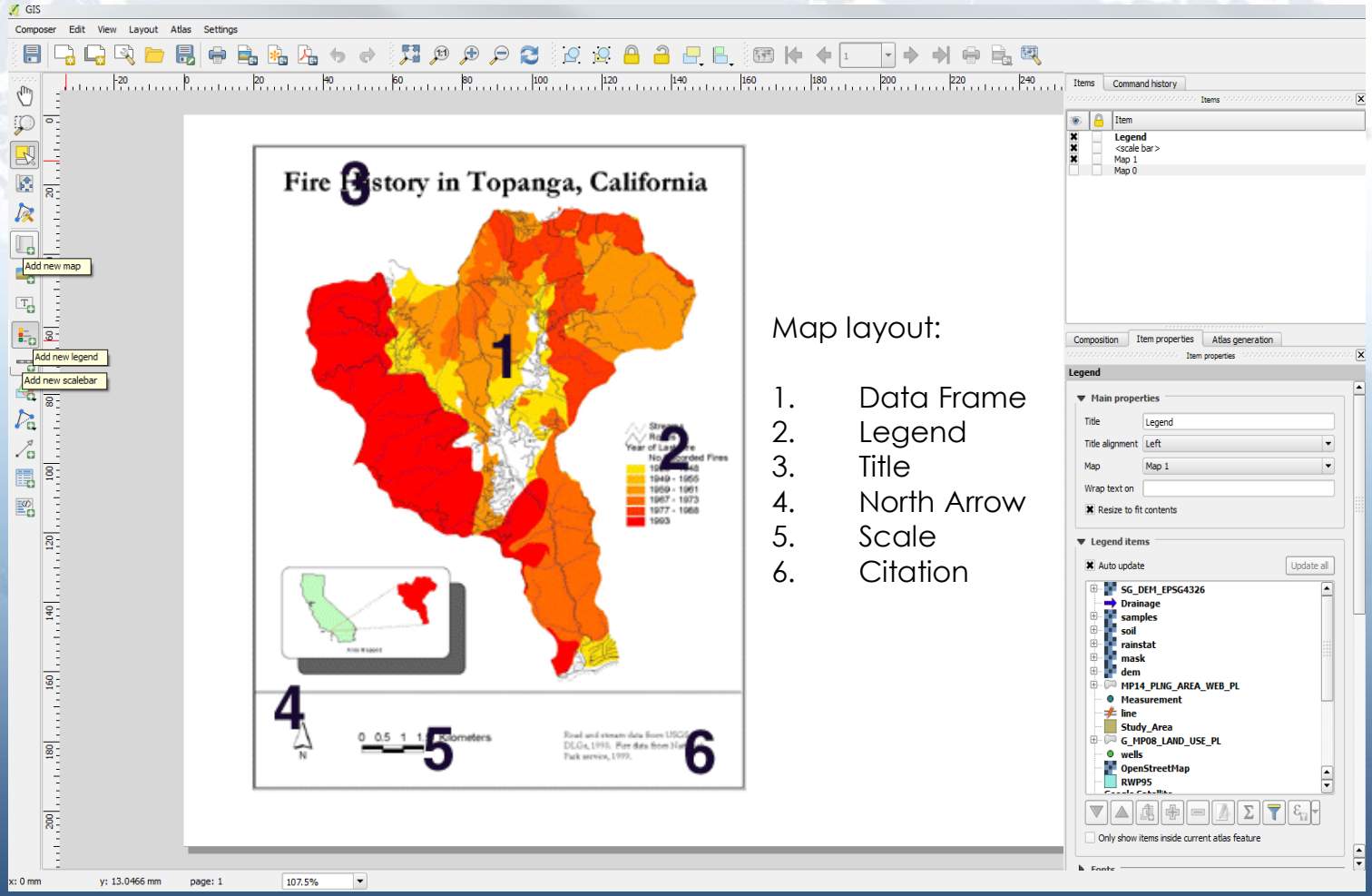
The toolbox

The toolbox is the main element of the processing GUI, and the one that you are more likely to use in your daily work. The toolbox contains all the available algorithms, divided into predefined groups. The groups represent algorithms from native QGIS algorithms and third-party applications (like SAGA, GRASS or R)



Print Composer

The print composer provides growing layout and printing capabilities. It allows you to add elements such as the QGIS map canvas, text labels, images, legends, scalebars, basic shapes, arrows, attribute tables and HTML frames.



Map layout:

1. Data Frame
2. Legend
3. Title
4. North Arrow
5. Scale
6. Citation

Thank you