Procesamiento de series de tiempo en GRASS GIS

Aplicaciones en Ecología y Ambiente

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GRASS GIS: Overview of general capabilities

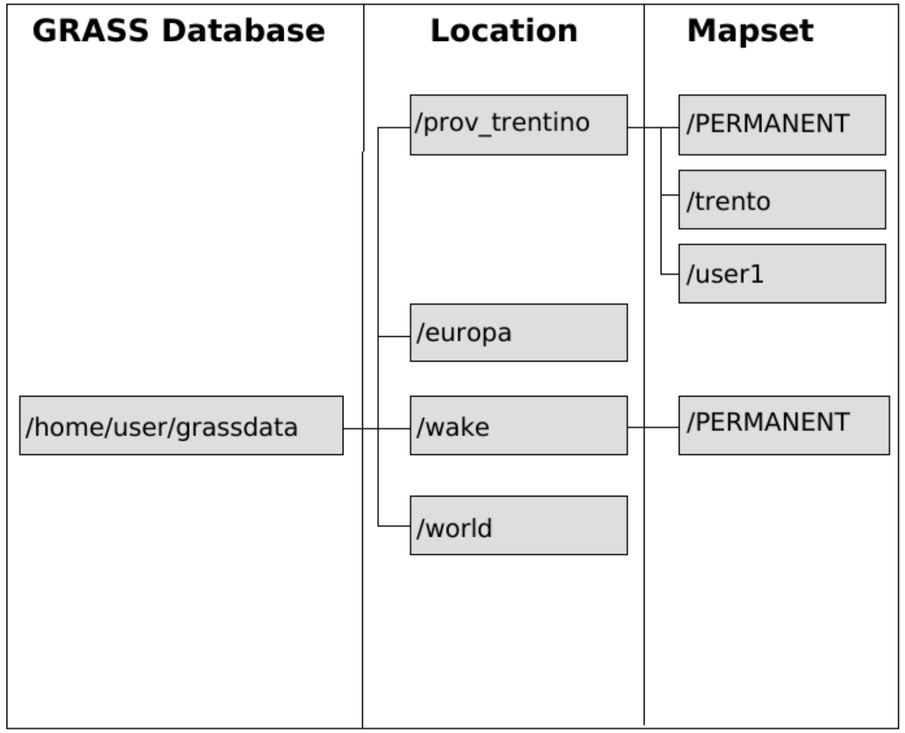
Interoperability

Raster
- GeoTIFF
- HDF
- NetCDF
- BIL
- ...

Vector
- SHAPE
- E00
- MapInfo
- Spatialite
- ...

Export

Import



Data in standard GIS formats.

Store in directory:
`/home/user/gisdata/`

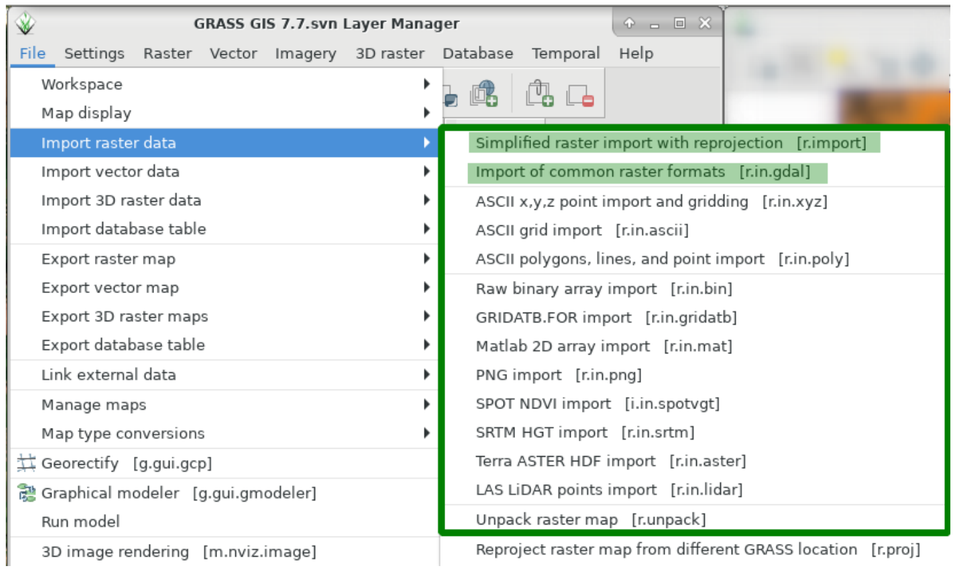
or a shared network directory

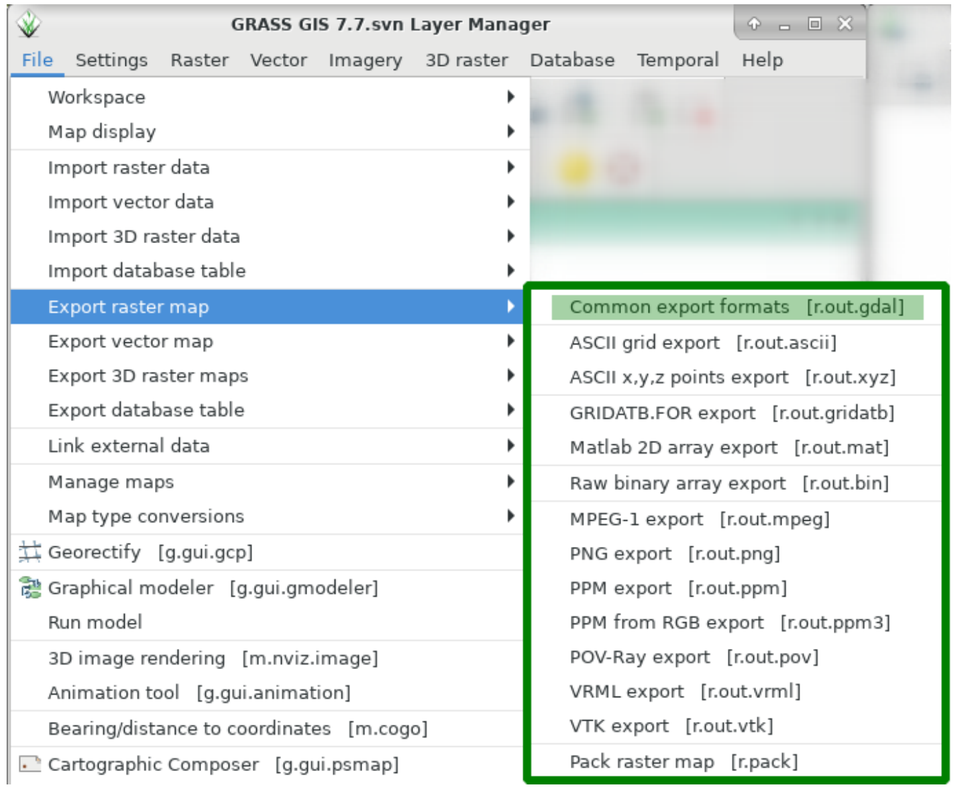
Data in GRASS GIS formats.

Store in directory:
`/home/user/grassdata/`

or a shared network directory

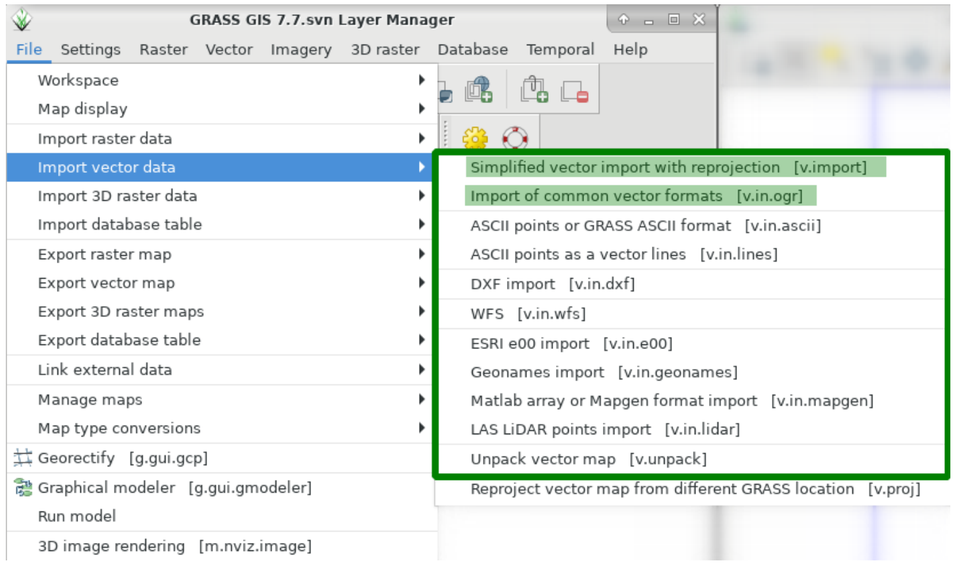
Modules for import/export of raster maps

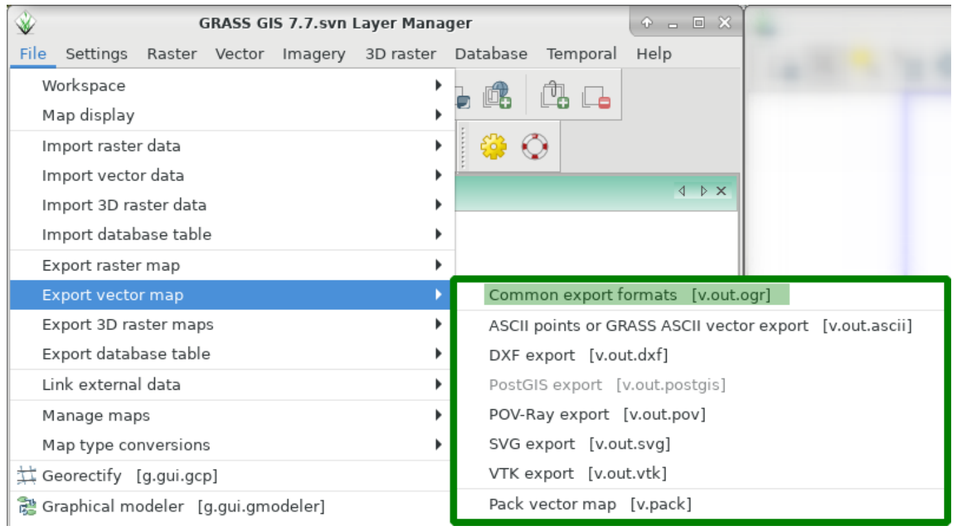




GRASS relies on GDAL to import and export raster data

Modules for import/export of vector maps

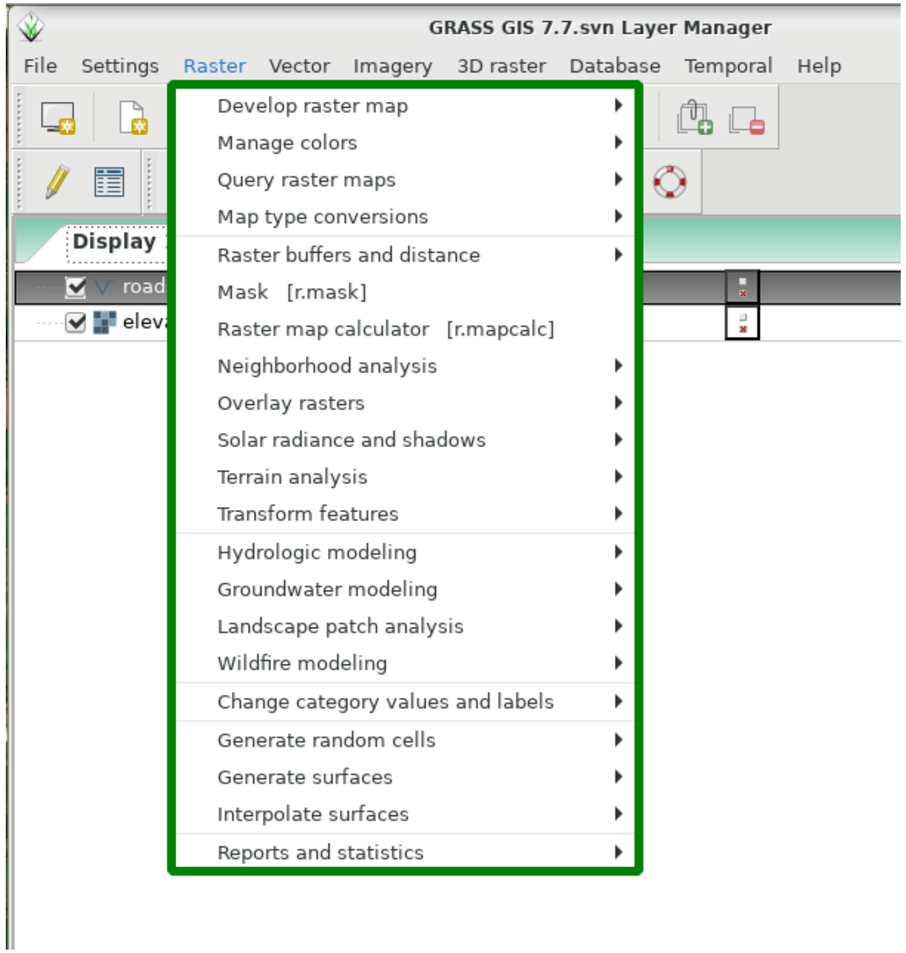




GRASS relies on OGR to import and export vector data

Raster data processing

Raster menu

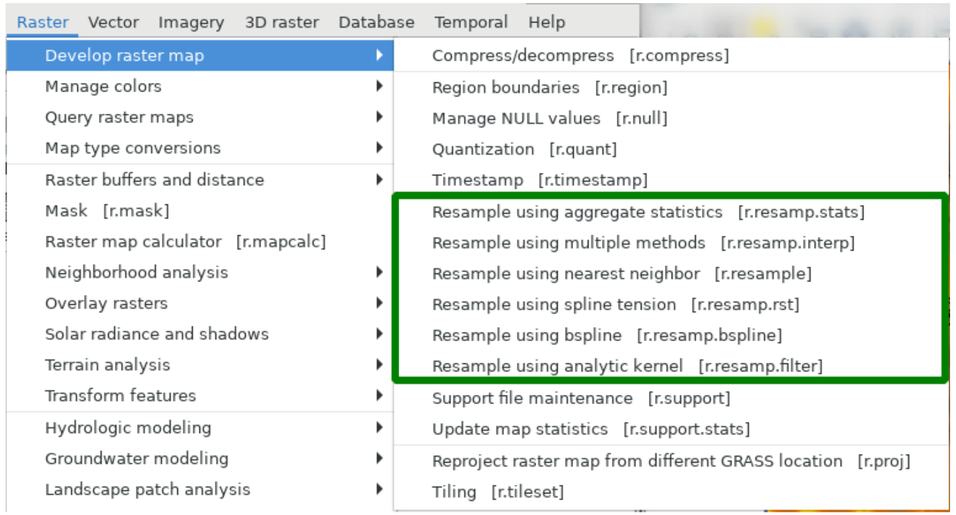


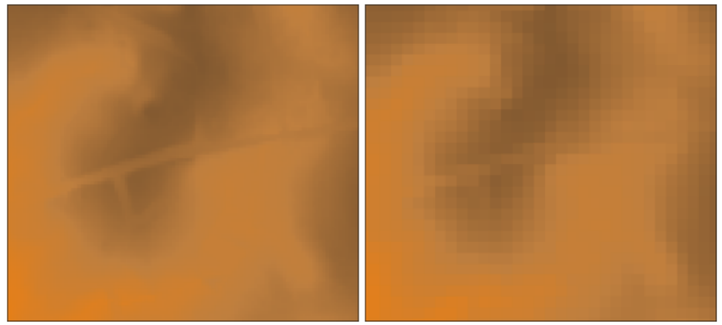
- Raster data: DEM, land cover, climatic maps, etc.
- Imagery data: Landsat, Sentinel, MODIS, SPOT, QuickBird, etc.

Raster processing manual

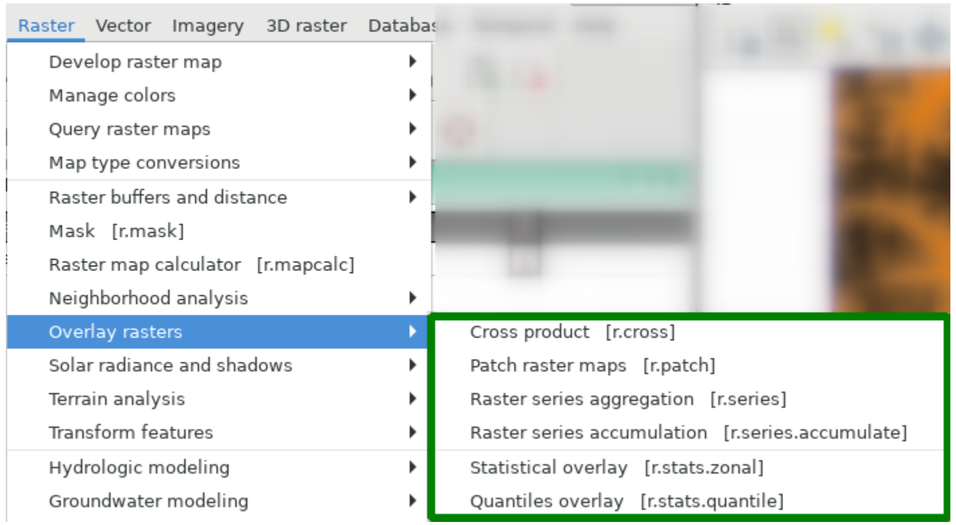
Resampling

- r.resamp.interp: Resamples raster map to a finer grid using different interpolation methods: nearest, bilinear, bicubic (downscaling)
- r.resamp.stats: Resamples raster map layers to a coarser grid using aggregation (i.e., upscaling)



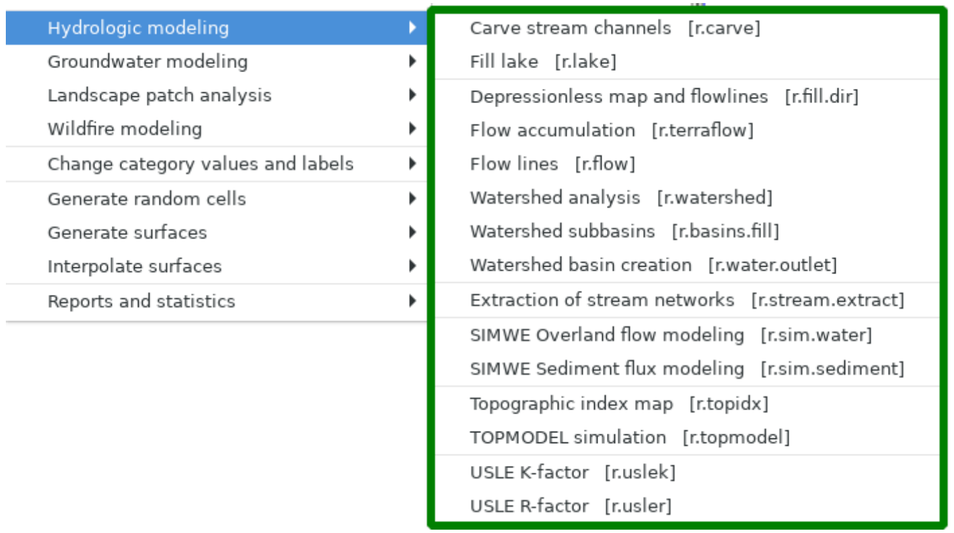


Raster overlay

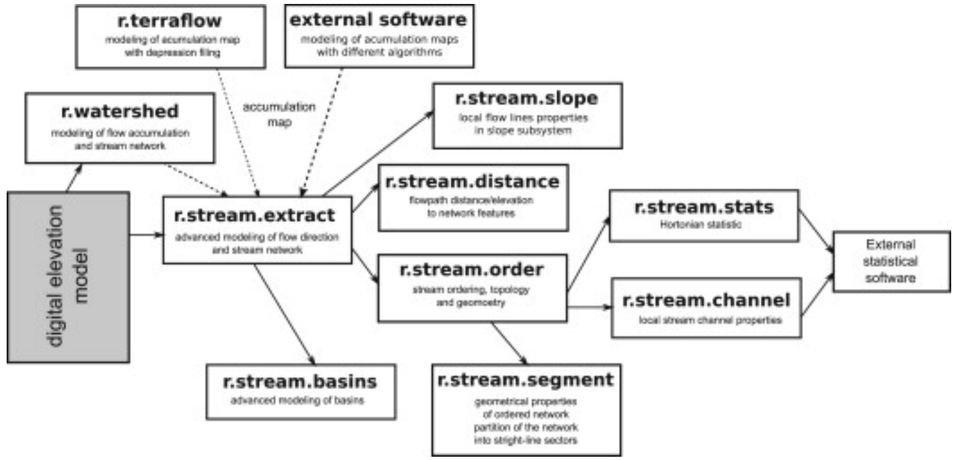


- r.series: Allows to aggregate a list of maps with different methods, i.e., average, min, max, etc.
- r.patch: Creates a composite raster map using category values from one (or more) map(s) to fill in areas of "no data" in another map

Hydrological modeling

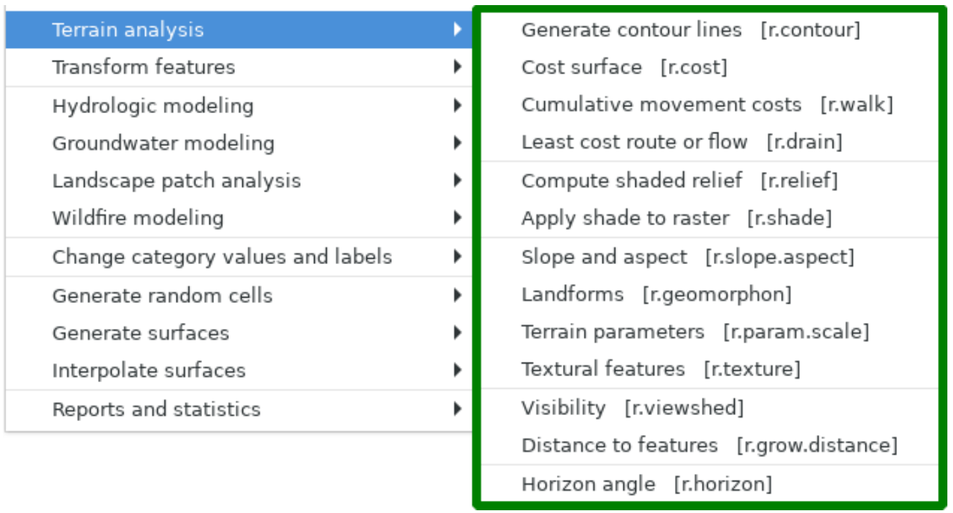


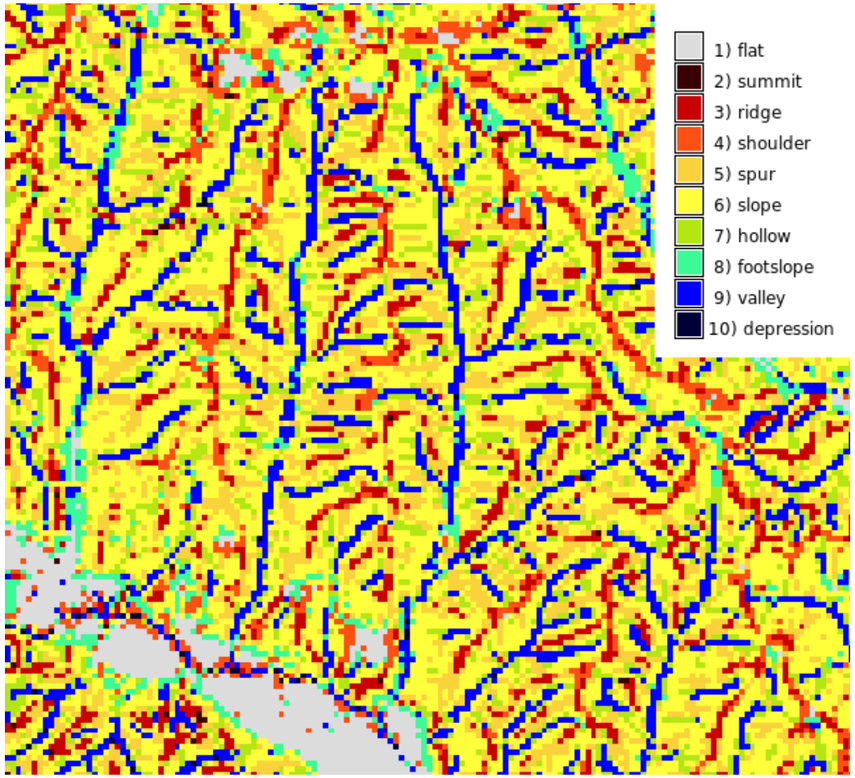
... plus several other add-ons, for example:



Jasiewics and Metz, 2011

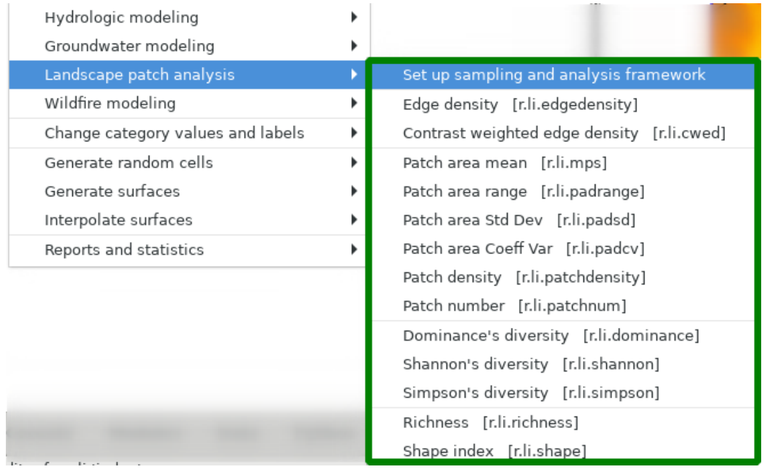
Terrain analysis





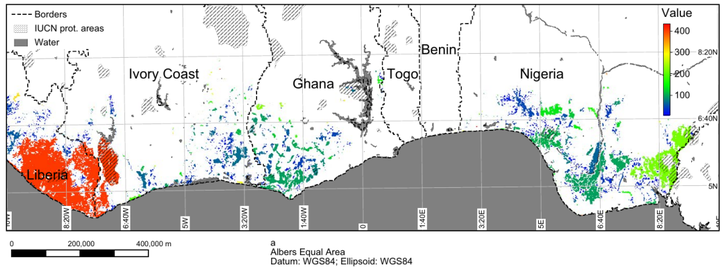
Output of r.geomorphon

Landscape analysis



... plus several add-ons for "patch analysis"

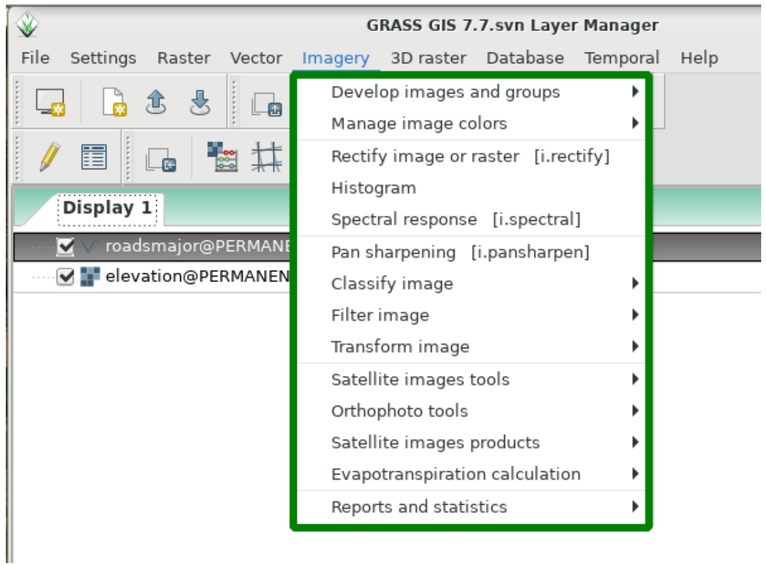
- *r.pi.rectangle* - Performs statistical analysis on values of patches from the given raster map.
- *r.pi.energy* - Individual-based dispersal model for connectivity analysis - energy based.
- *r.pi.energy.pr* - Individual-based dispersal model for connectivity analysis (energy based) using iterative patch removal.
- *r.pi.fragment.dist* - Calculates correlation of two raster maps by calculating correlation function of two corresponding rectangular areas for each raster point and writing the result into a new raster map.
- *r.pi.enn* - Determines patches of given value and performs a nearest-neighbor analysis.
- *r.pi.index* - Computation of fragmentation indices.
- *r.pi.enn.pr* - Patch relevance for Euclidean Nearest Neighbor patches.
- *r.pi.neigh* - Neighbourhood analysis - value of patches within a defined range.
- *r.pi.enn* - Analysis of n-th Euclidean Nearest Neighbor distance.
- *r.pi.nlm* - Creates a random generated map with values 0 or 1by given landcover and fragment count.
- *r.pi.nlm.circ* - Creates a random landscape with defined attributes.
- *r.pi.nlm.stats* - Neutral Landscape Generator - index statistics
- *r.pi.corearea* - Variable edge effects and core area analysis
- *r.pi.corr.mw* - Moving window correlation analysis.
- *r.pi.csr.mw* - Complete Spatial Randomness analysis on moving window.
- *r.pi.export* - Export of patch based information.
- *r.pi.graph* - Graph Theory for connectivity analysis.
- *r.pi.graph.pr* - Graph Theory - iterative removal (patch relevance analysis).
- *r.pi.graph.red* - Graph Theory - decreasing distance threshold option.
- *r.pi.grow* - Size and suitability based region growing.
- *r.pi.import* - Import and generation of patch raster data
- *r.pi.index* - Basic patch based indices
- *r.pi.lm* - Linear regression analysis for patches.
- *r.pi.prob.mw* - Probability analysis of 2 random points being in the same patch.
- *r.pi.rectangle* - Generates a rectangle based on a corner coordinate.
- *r.pi.searchtime* - Individual-based dispersal model for connectivity analysis (time-based)
- *r.pi.searchtime.pr* - Individual-based dispersal model for connectivity analysis (time-based) using iterative removal of patches
- *r.pi.searchtime.mw* - Individual-based dispersal model for connectivity analysis (time-based) using moving window



Wegman et al., 2017

Satellite imagery processing

Imagery menu



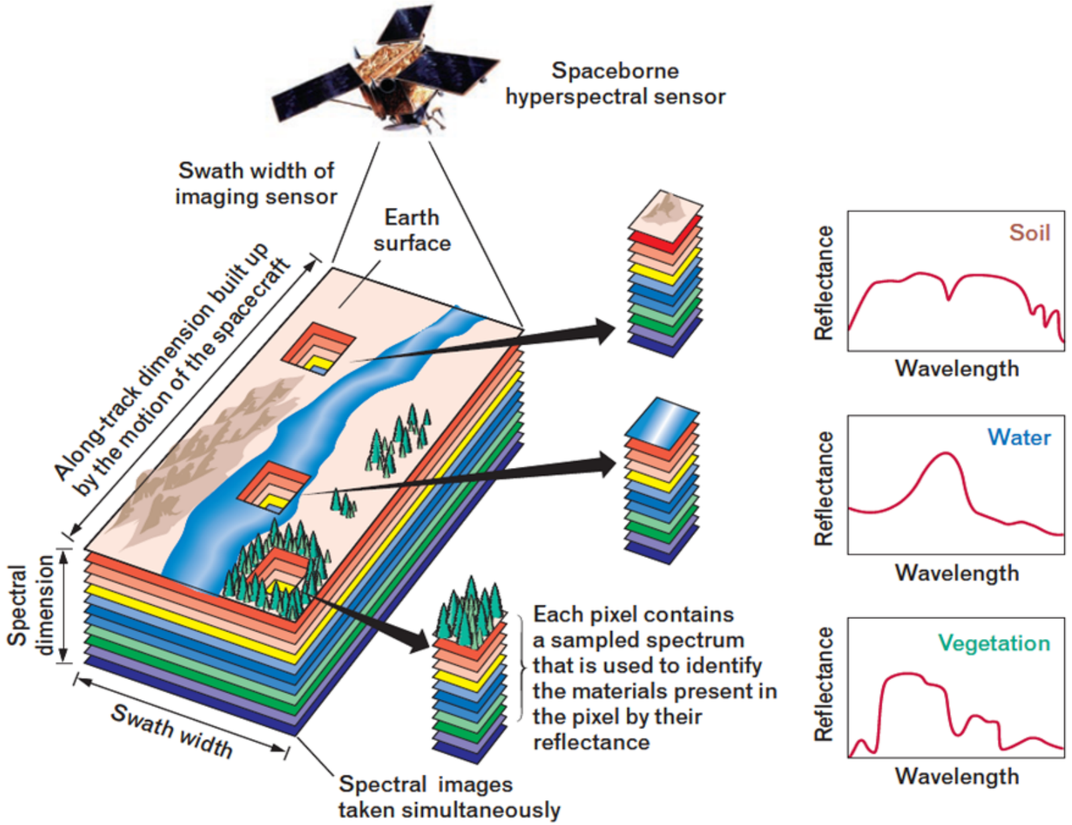
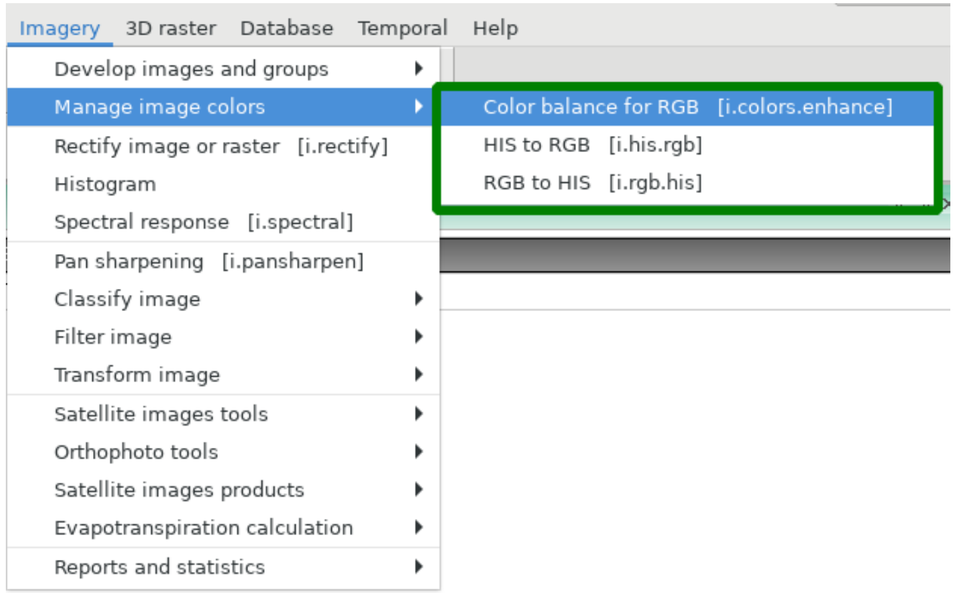
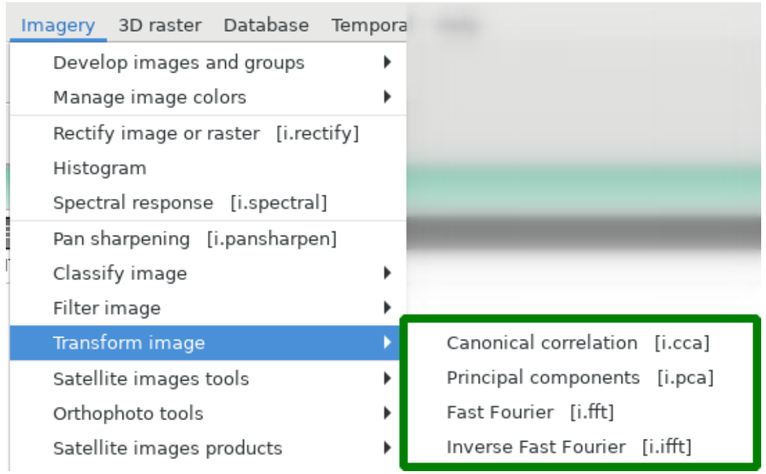


Image processing manual

Manage colors

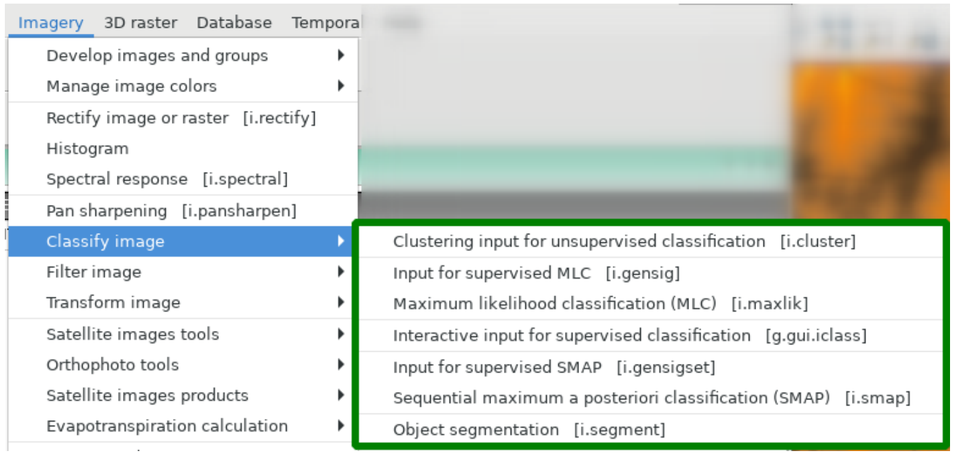


Transformations



- i.pca: Principal components analysis
- i.fft: Fast Fourier Transform
- i.pansharpen: Image fusion algorithms to sharpen multispectral with high-res panchromatic channels

Classification

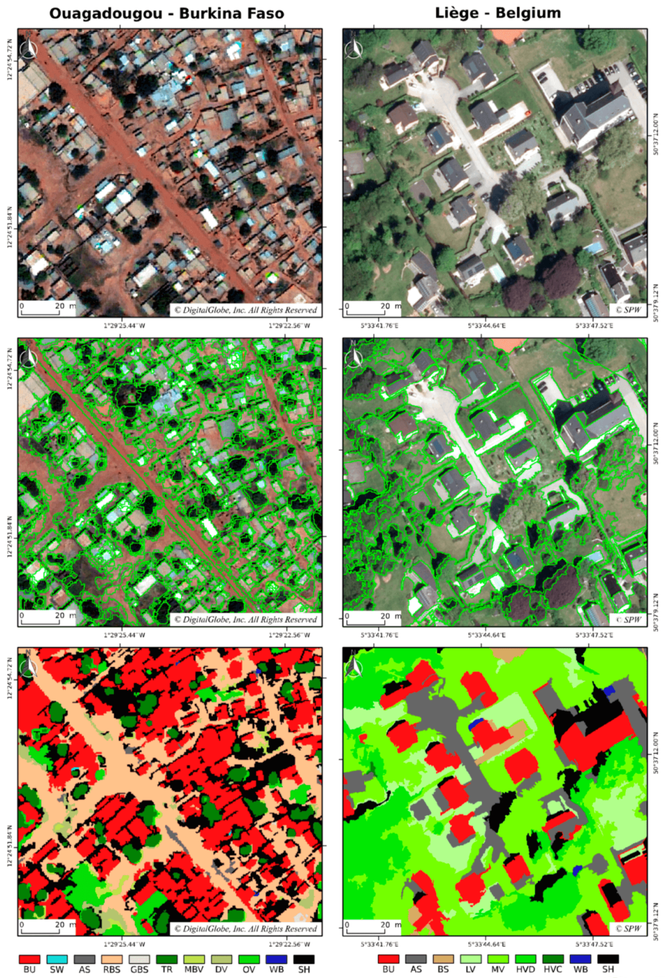


- r.learn.ml: Supervised classification and regression with Machine Learning
- r.fuzzy.system: Full fuzzy logic standalone classification system
- i.ann.maskrcnn: Supervised classification using convolutional neural networks
- i.object.activelearning: Active learning for classifying raster objects

Supervised and Unsupervised methods available. See Image classification wiki for details and mini tutorial

Segmentation and OBIA

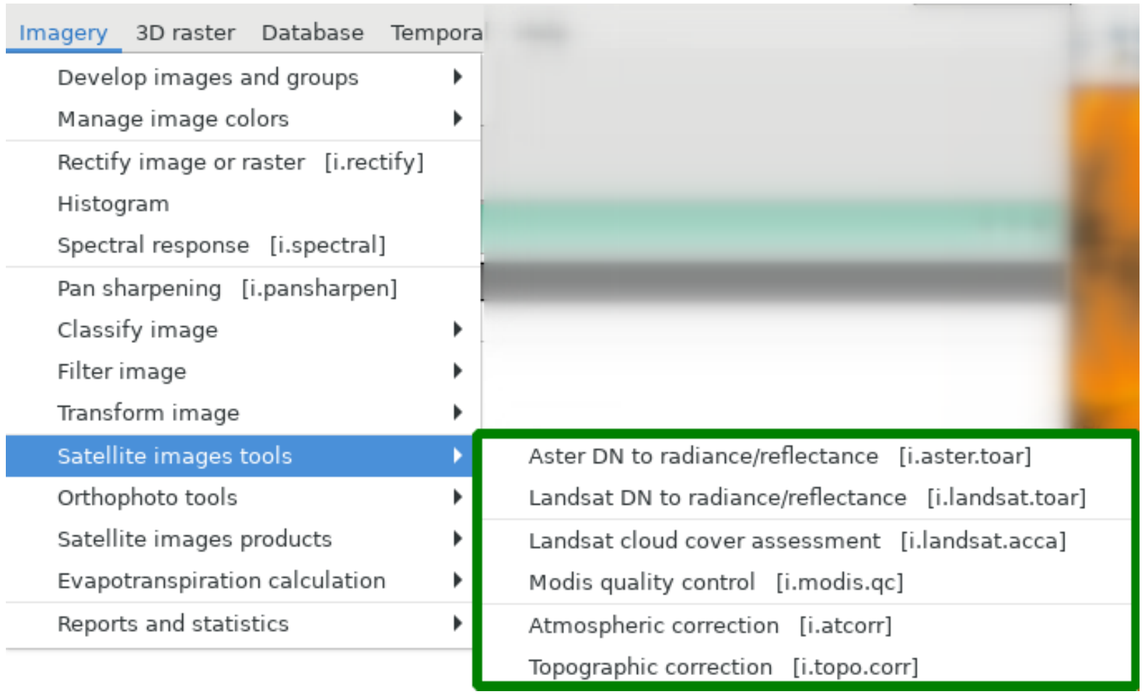
OBIA-automated classification



- i.segment: Identifies segments (objects) from imagery data
- i.segment.hierarchical: Hierarchical segmentation
- i.segment.stats: Calculates statistics describing raster areas
- i.segment.uspo: Unsupervised segmentation parameter optimization
- i.superpixels.slic: Performs image segmentation using SLIC method

OBIA processing chain

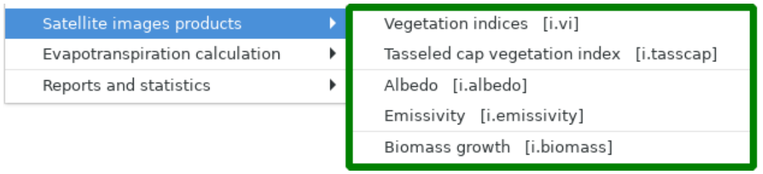
Generic RS tools and tools for specific sensors

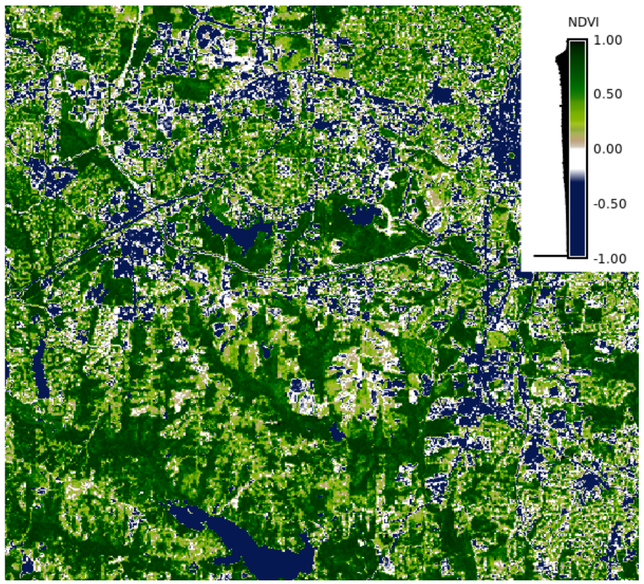


Sentinel-2A Band 02 after *i.atcorr*

... plus add-ons for MODIS, Sentinel2, Landsat, SRTM, GPM, etc.

RS derived products

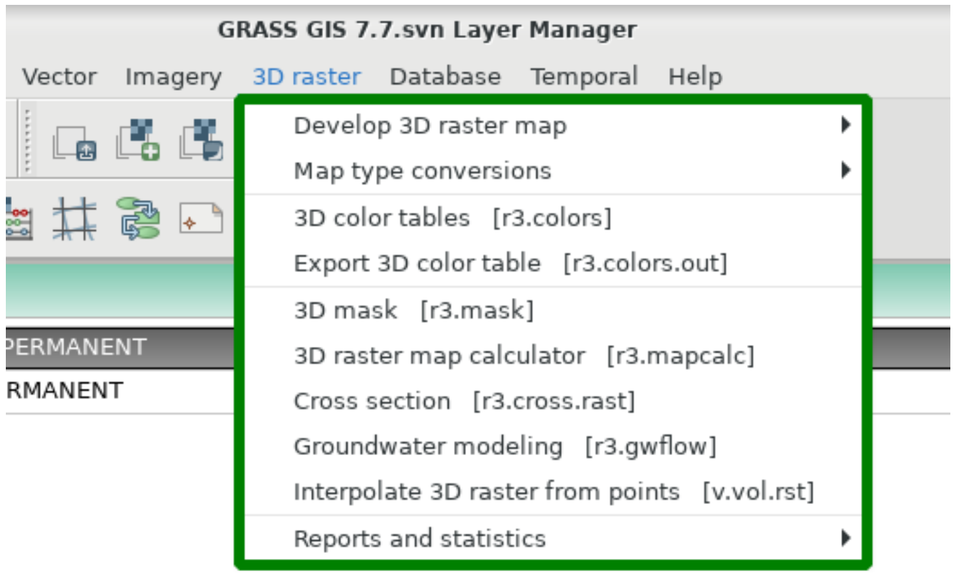


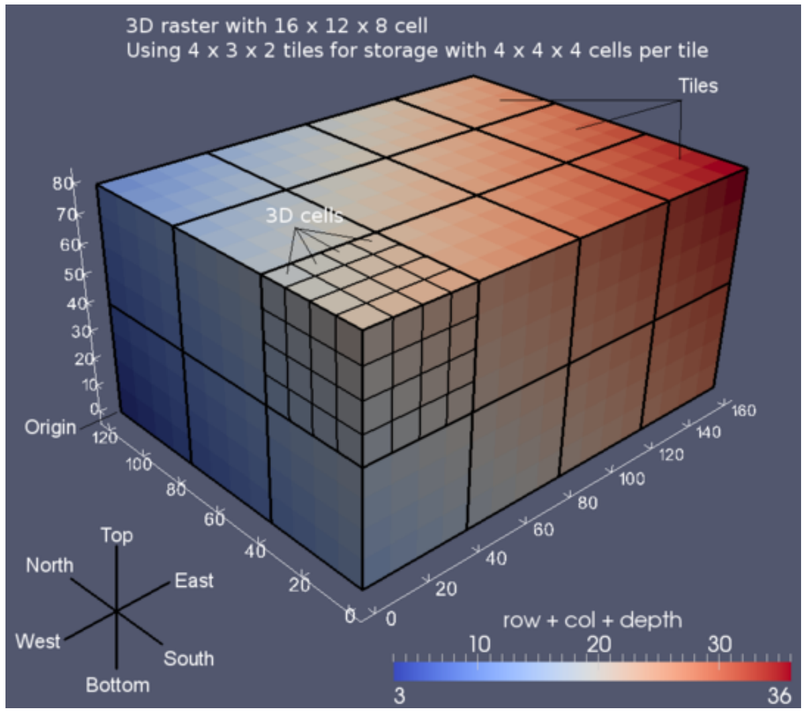


- i.wi: Calculates different types of water indices
- i.lswt: Computes Lake Surface Water Temperatures from TOA Brightness Temperatures
- i.landsat8.swlst: Split-window algorithm estimating LST from Landsat 8 OLI/TIRS
- i.rh: Water in atmosphere: relative humidity, water vapour
- i.water: Water detection from satellite data derived indices

3D raster processing

3D raster menu



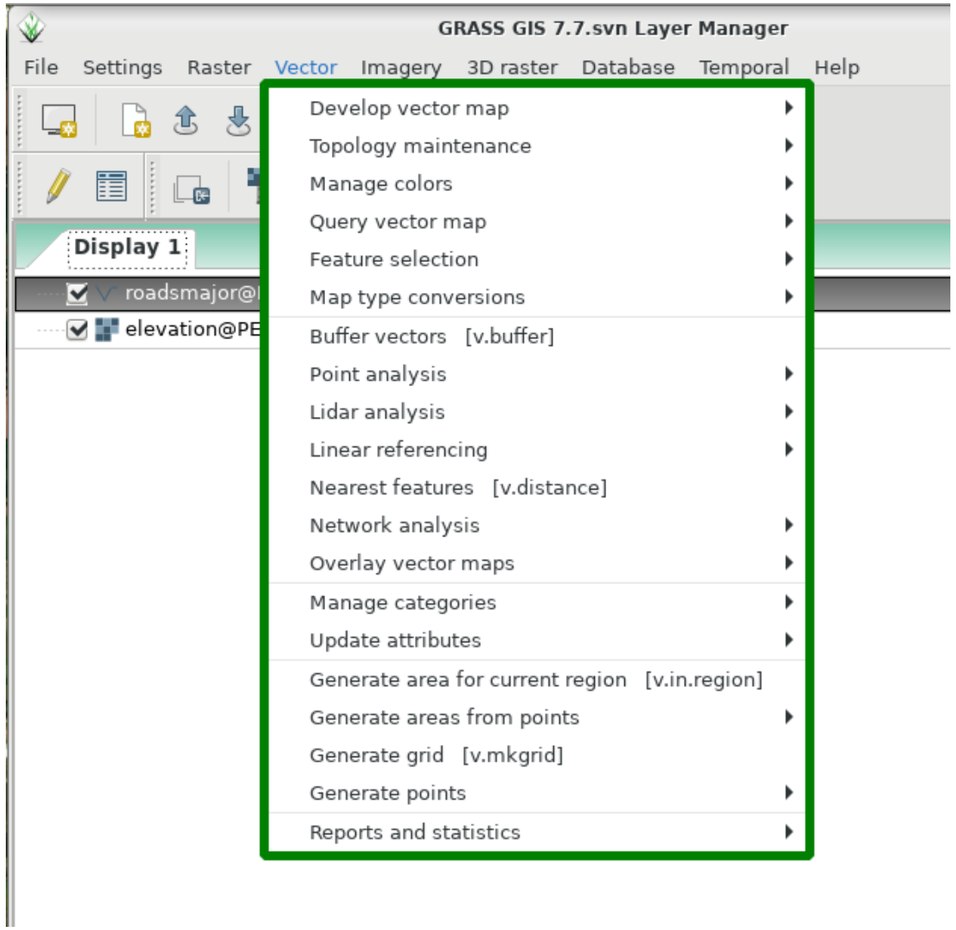


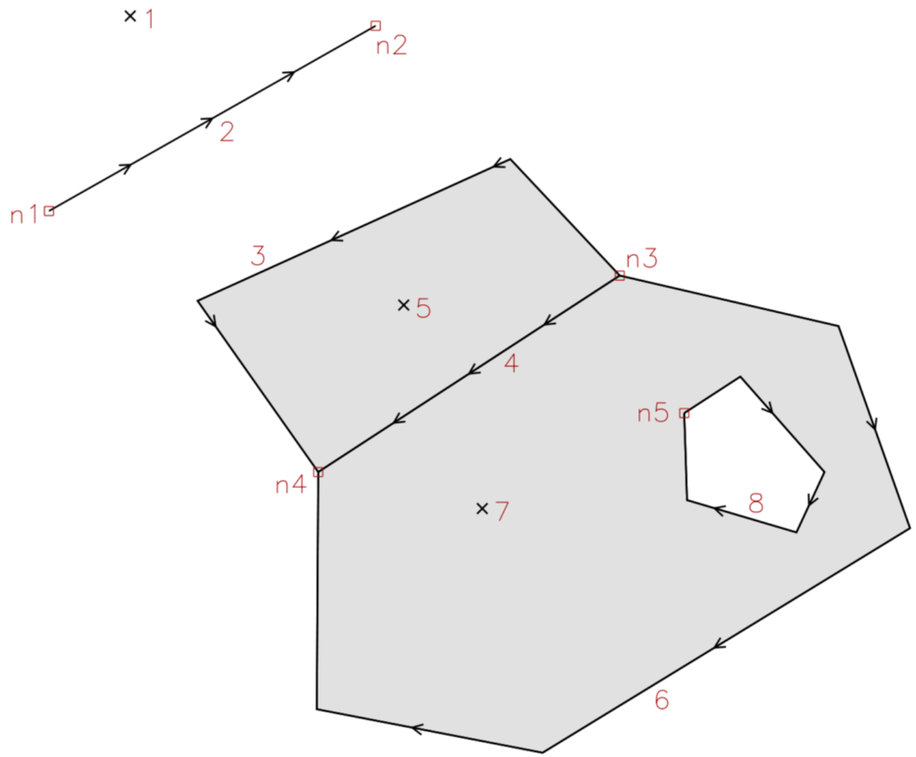
3D raster coordinate system and internal tile layout

3D raster processing manual

Vector data processing

Vector menu

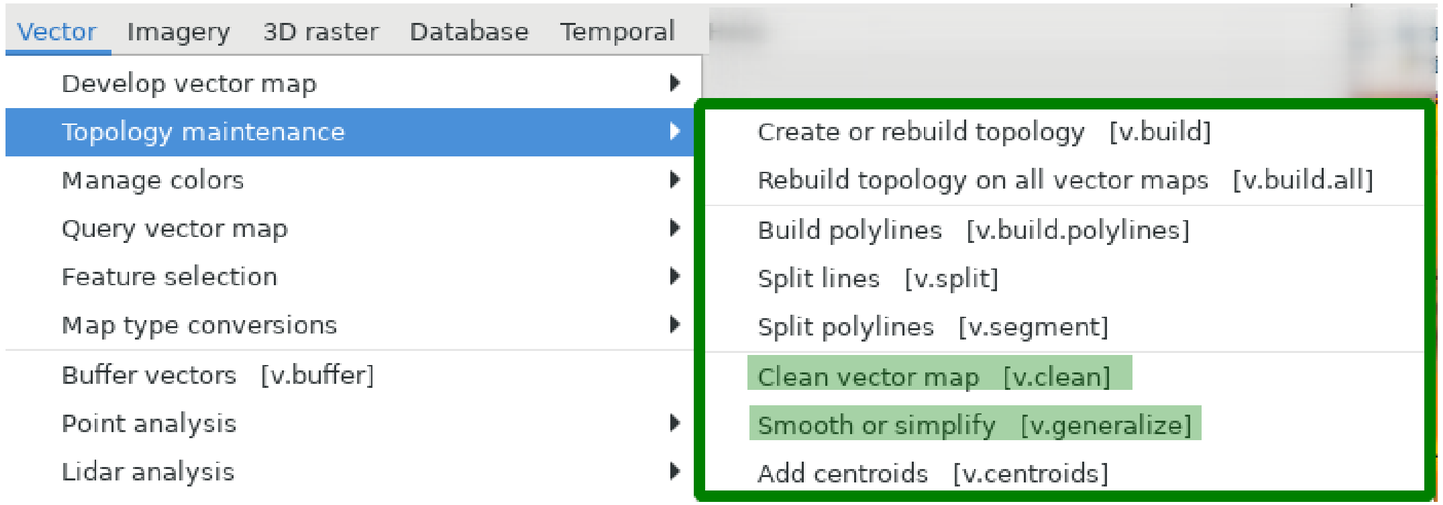


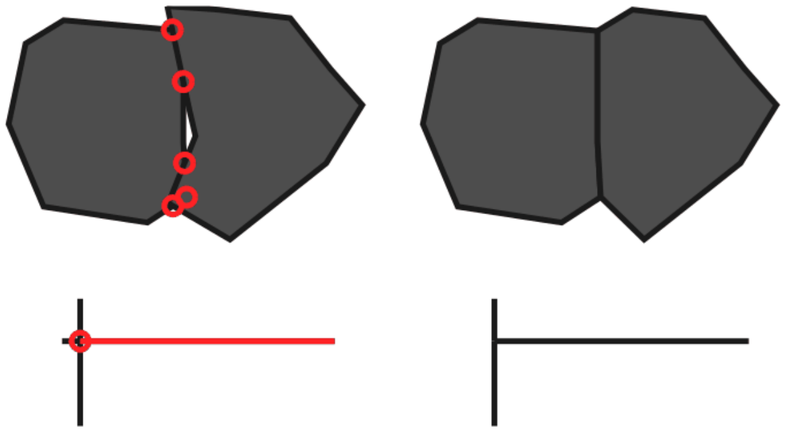


Topological vector formats in GRASS GIS

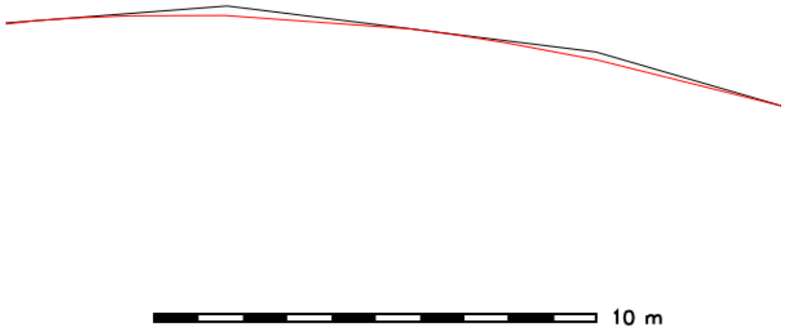
Vector processing manual

Topology maintenance



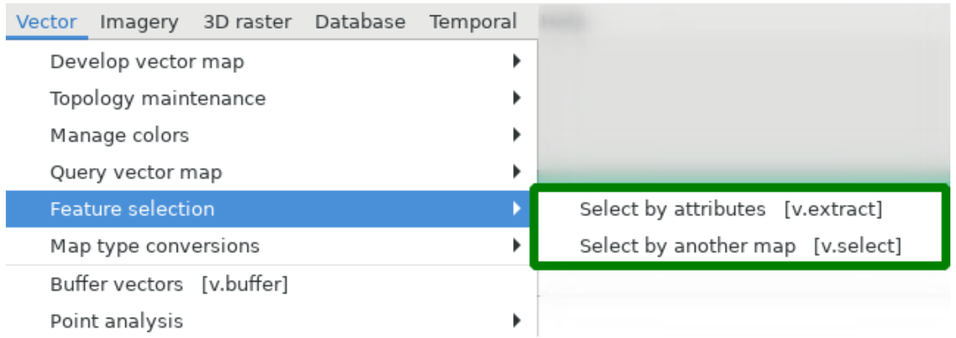


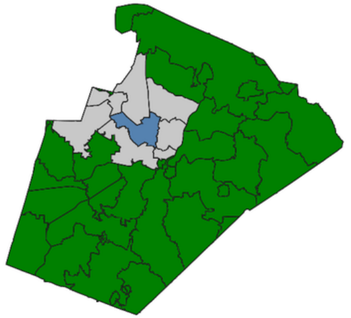
Cleaning topological errors in vector map



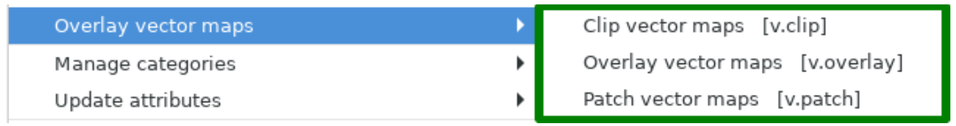
Smoothing. See also the v.generalize wiki

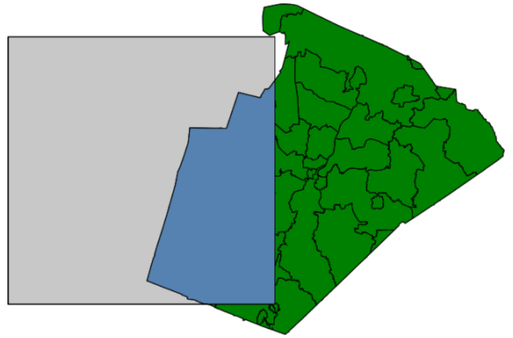
Selection and overlaying





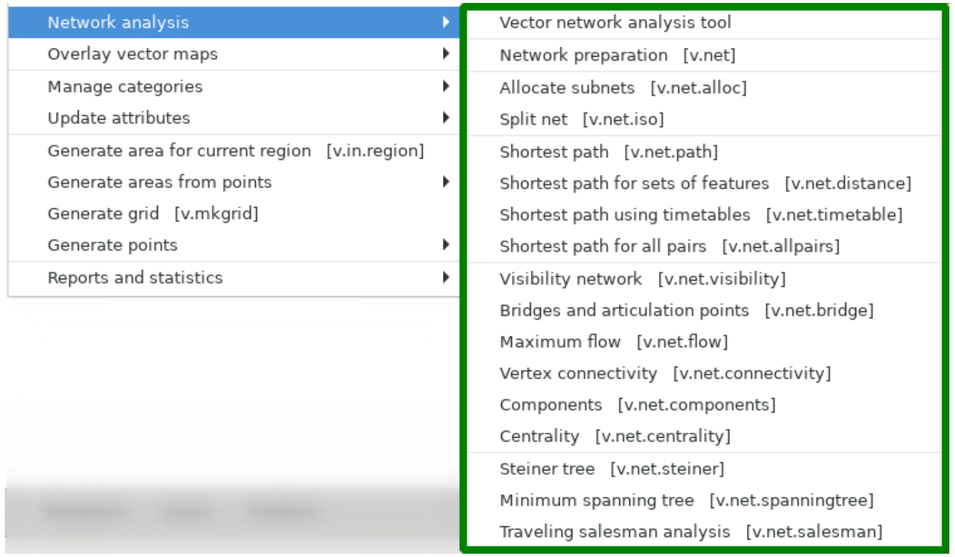
v.select operator *TOUCHES*

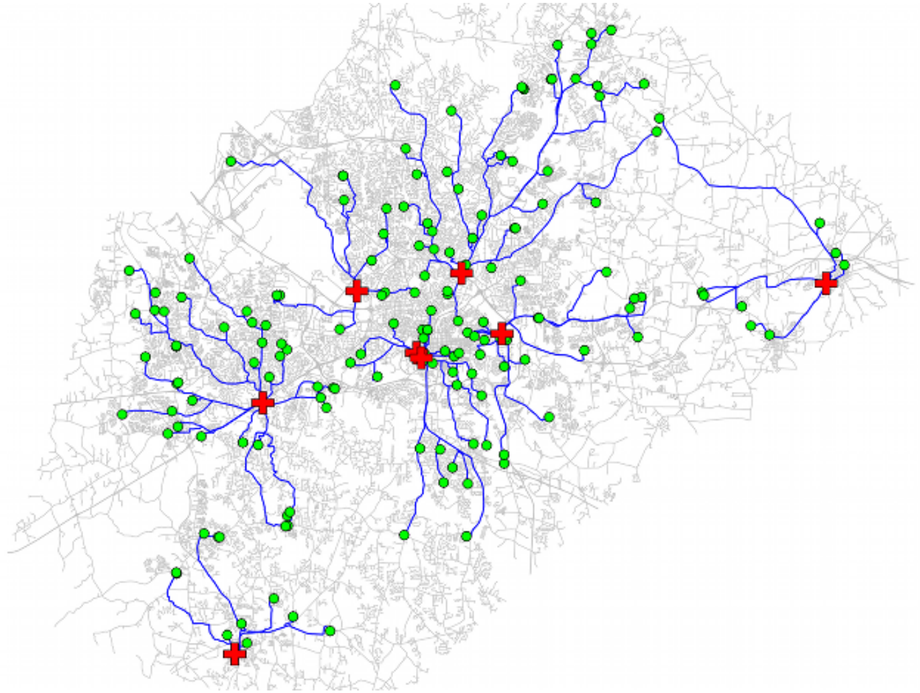




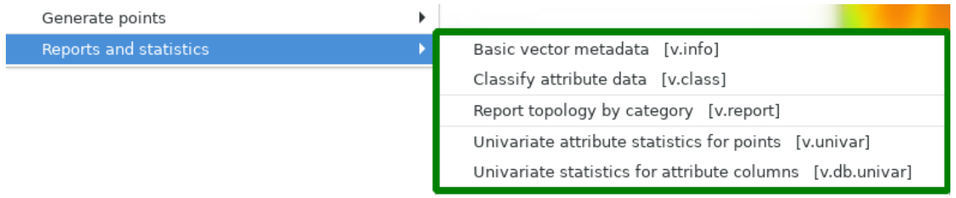
v.overlay operator *NOT*

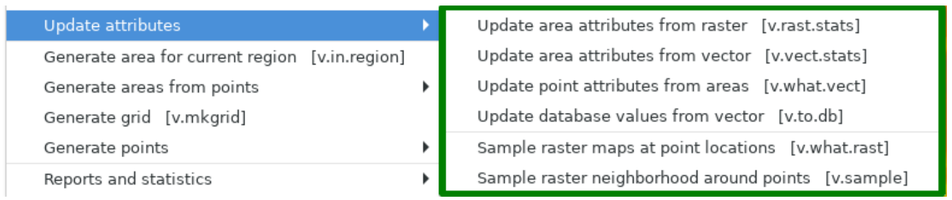
Network analysis

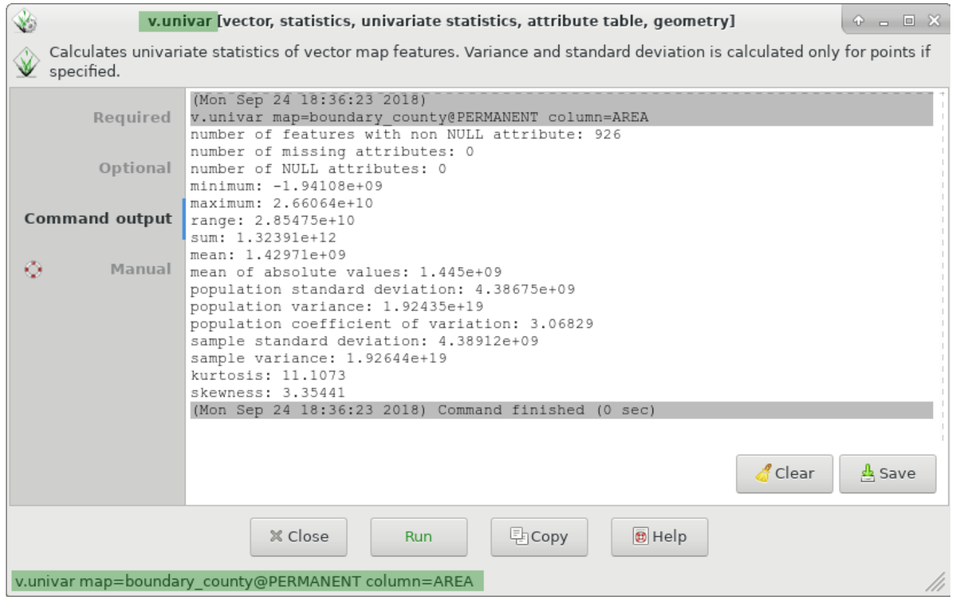


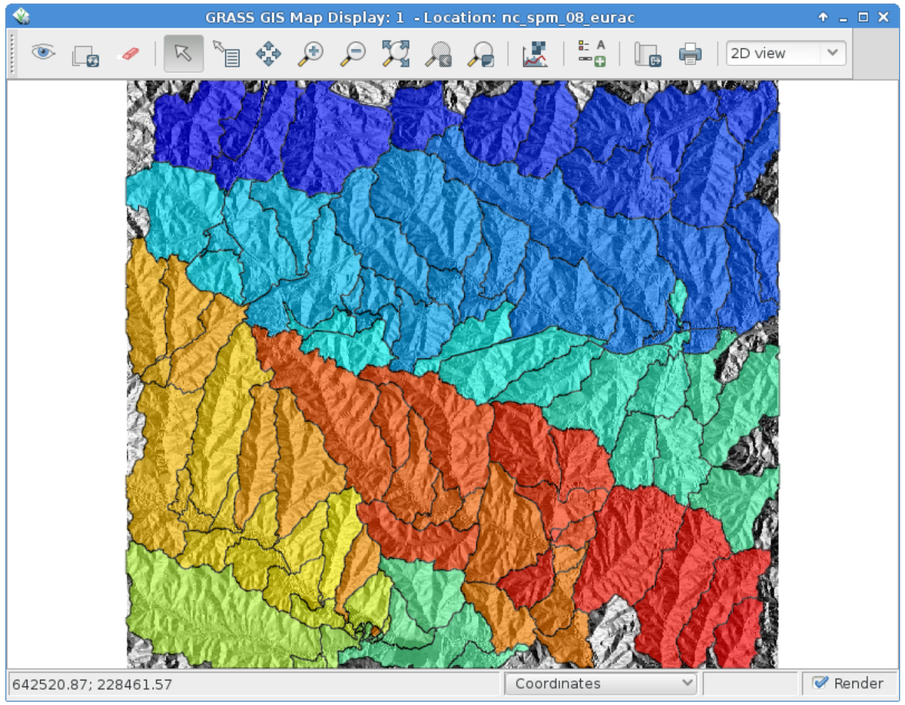


Reporting, stats and update of attributes



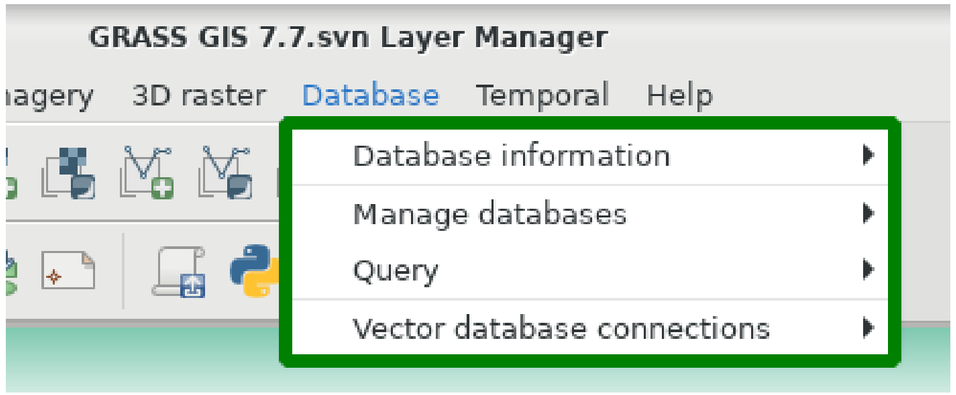


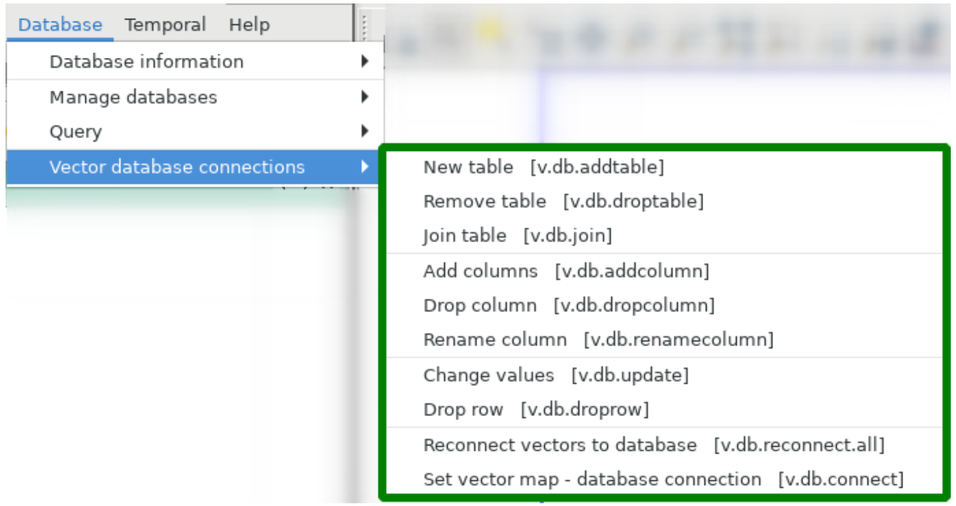


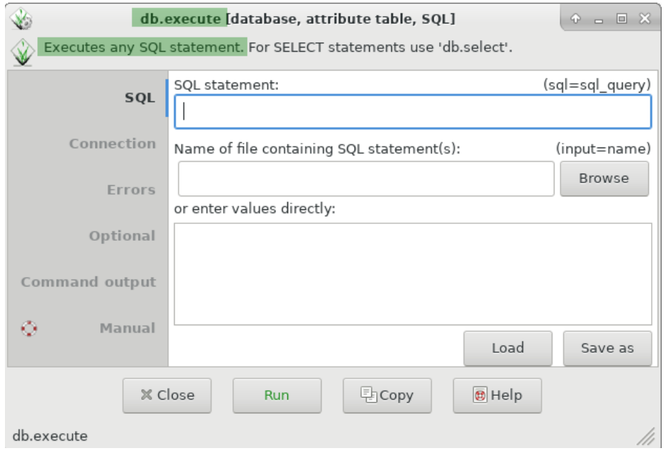


Database management

Database management menu

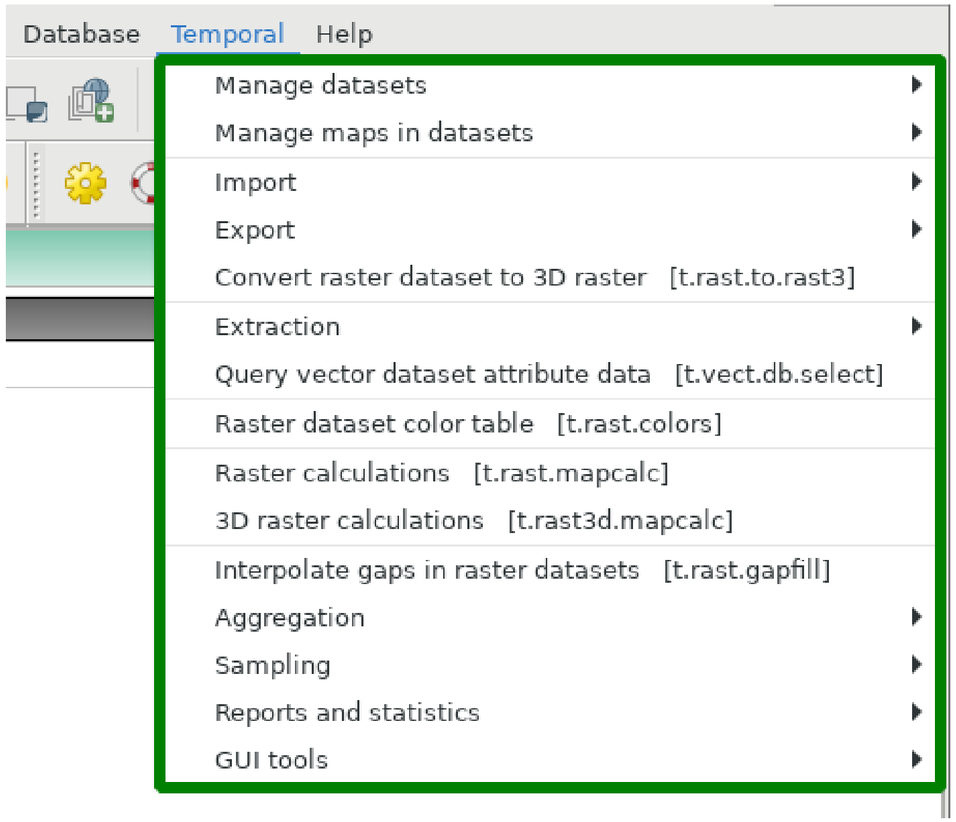






Temporal data processing

Temporal menu

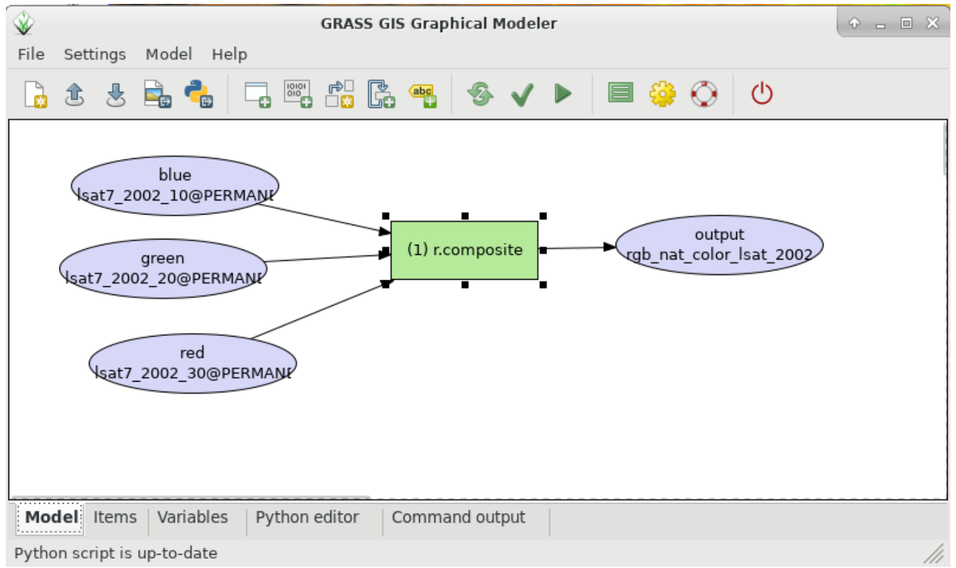


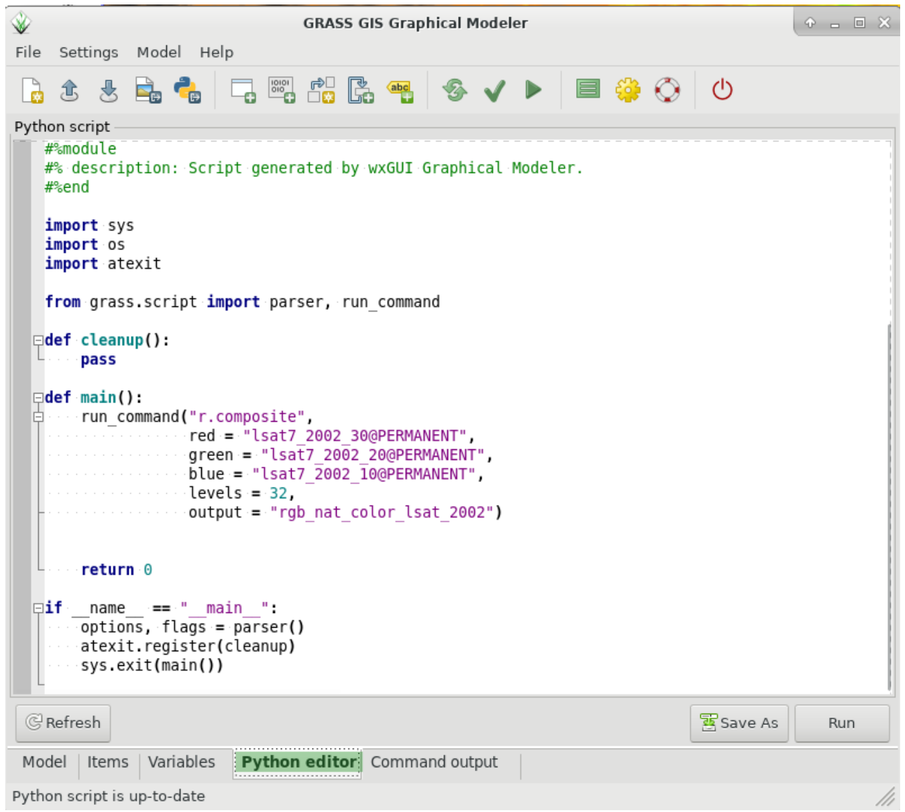
- import/export
- temporal topology
- aggregation
- accumulation
- temporal algebra
- temporal interpolation

We'll see this in more detail on Thursday :)

Graphical modeler

Graphic model and Python translation

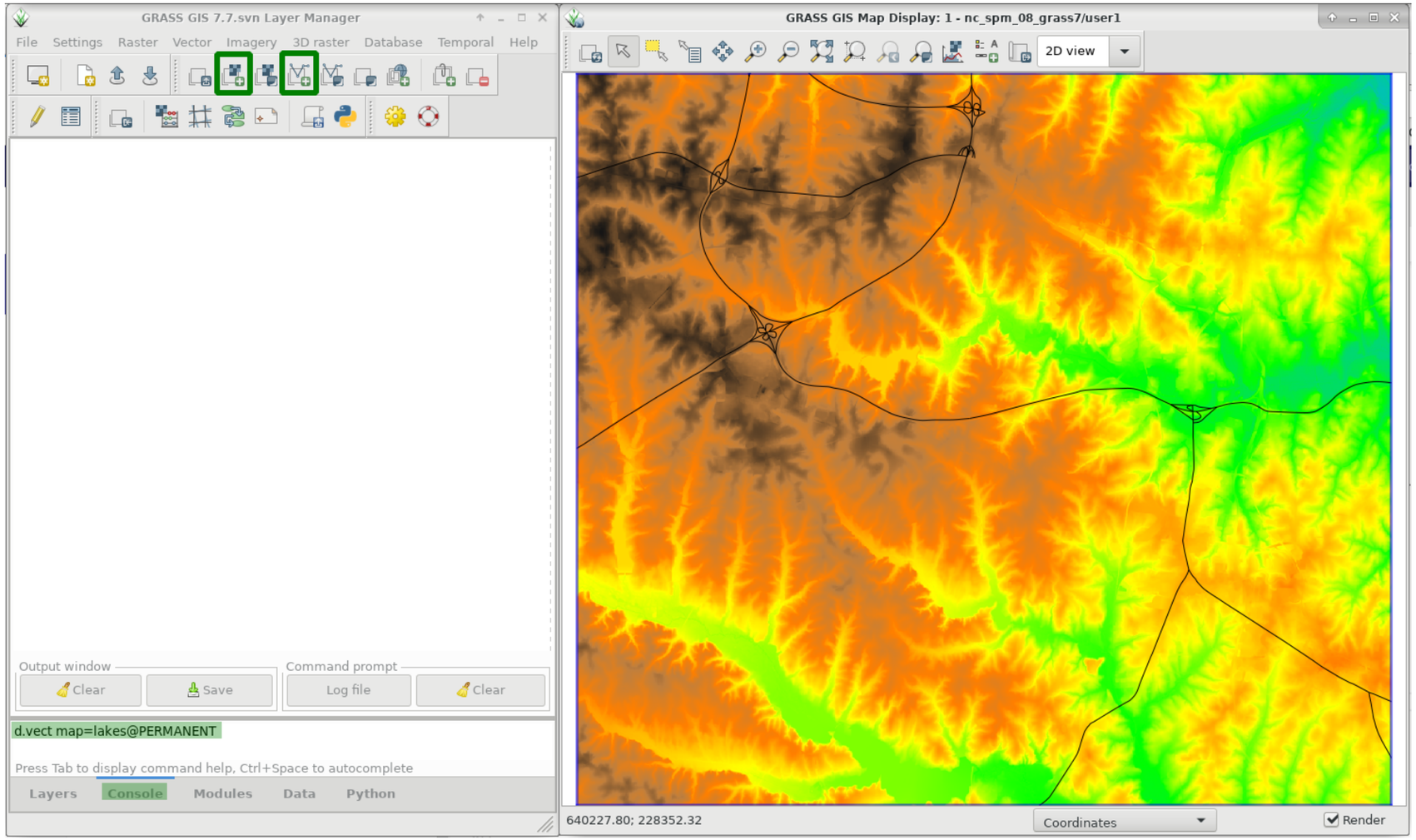




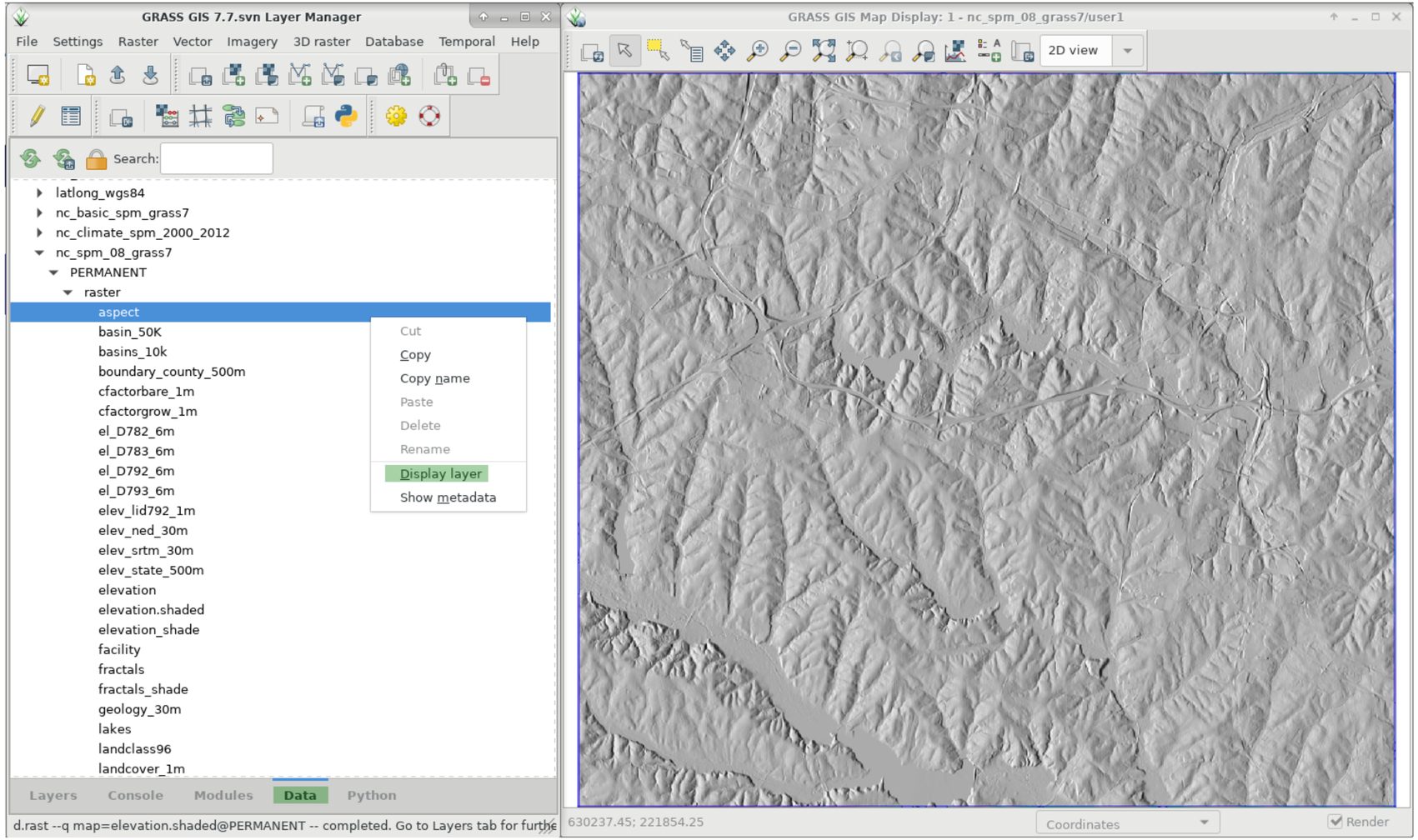
See g.gui.gmodeler manual page for further details.

Visualization tools

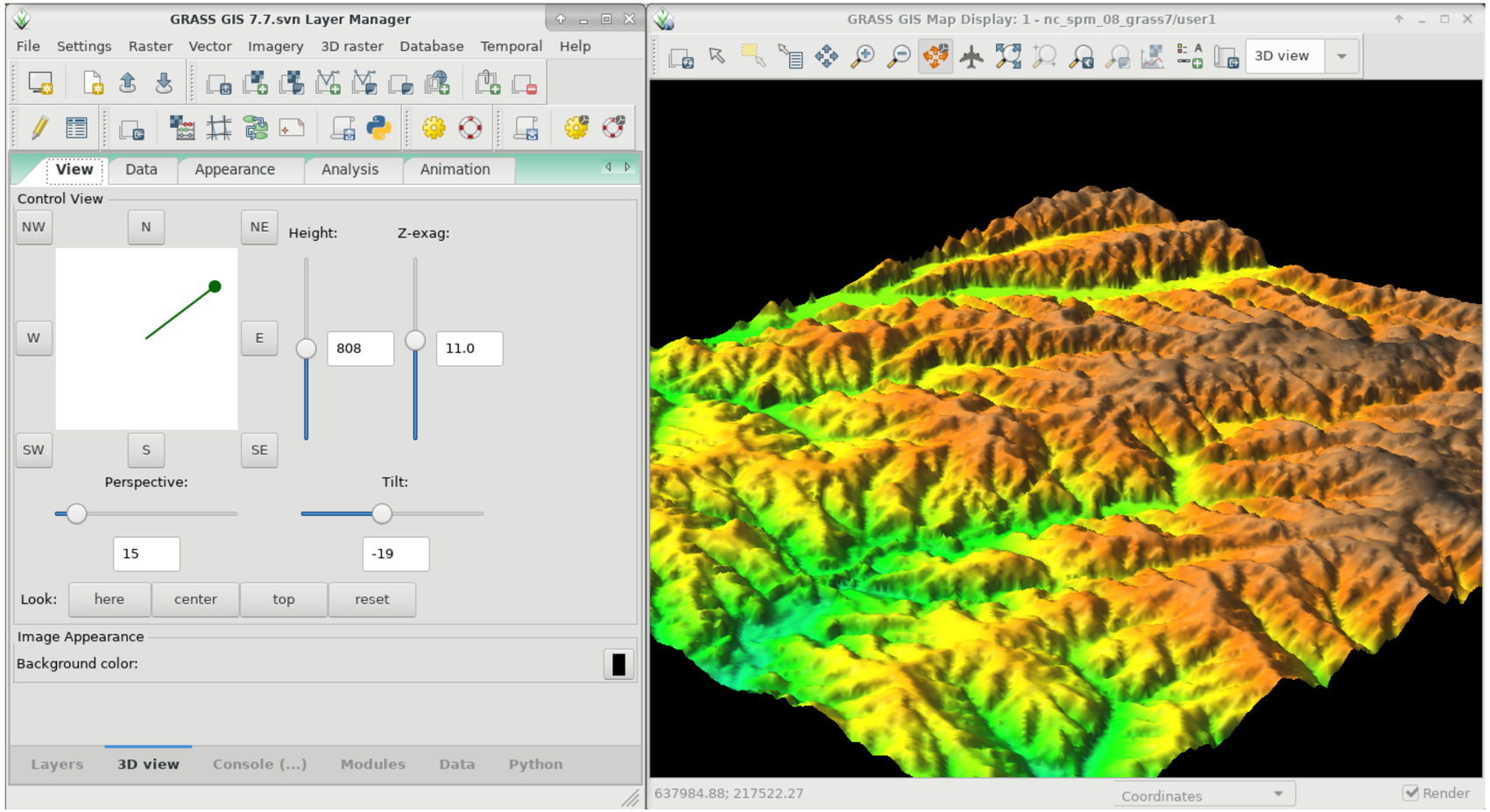
Map display: console tab



Map display: data tab

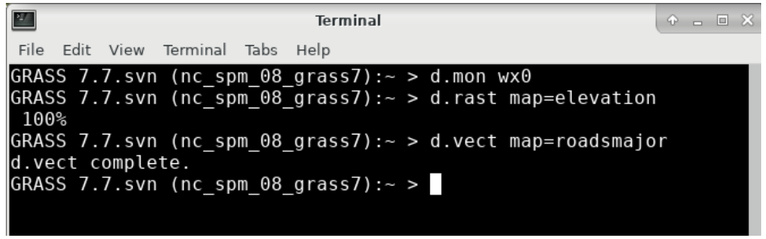


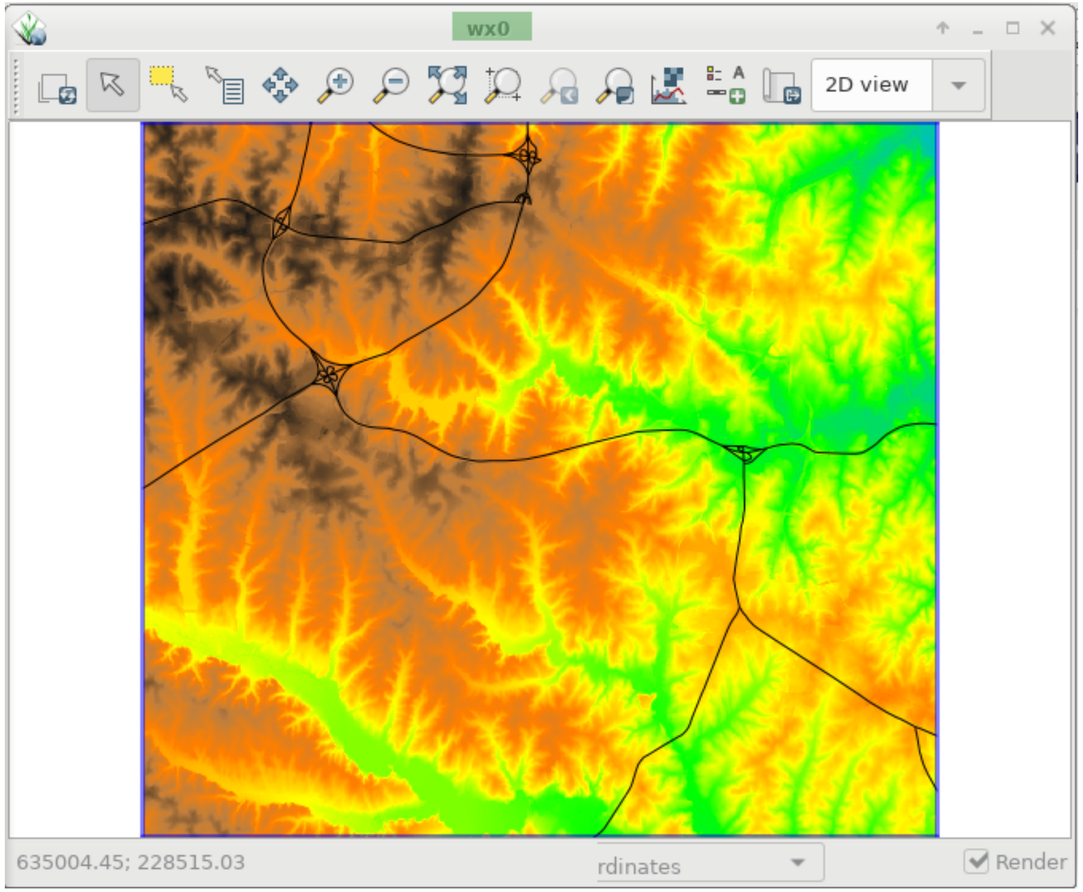
Map display: 3D view



Wx-monitors

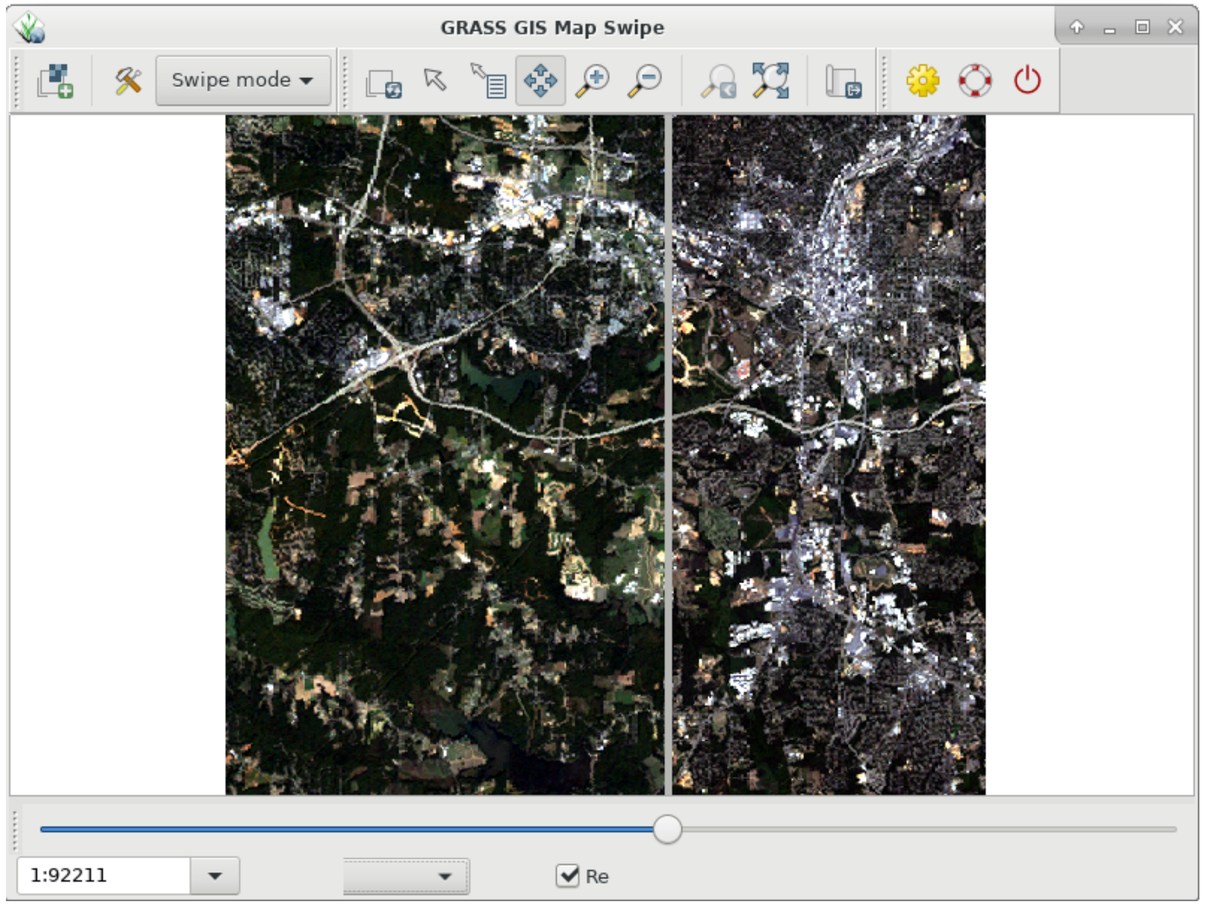
In the terminal:





The wx-monitors have the same **buttons** than the main Map Display in the GUI

Map-swipe

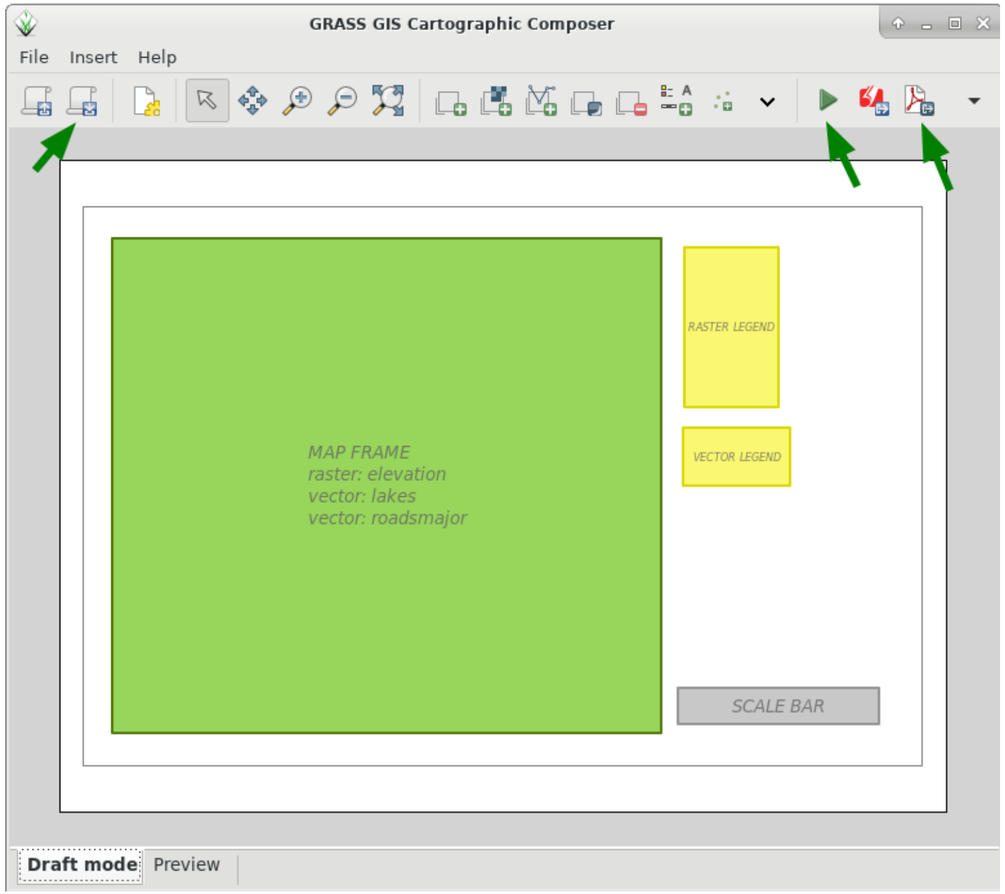


g.gui.mapswipe

Animation tool

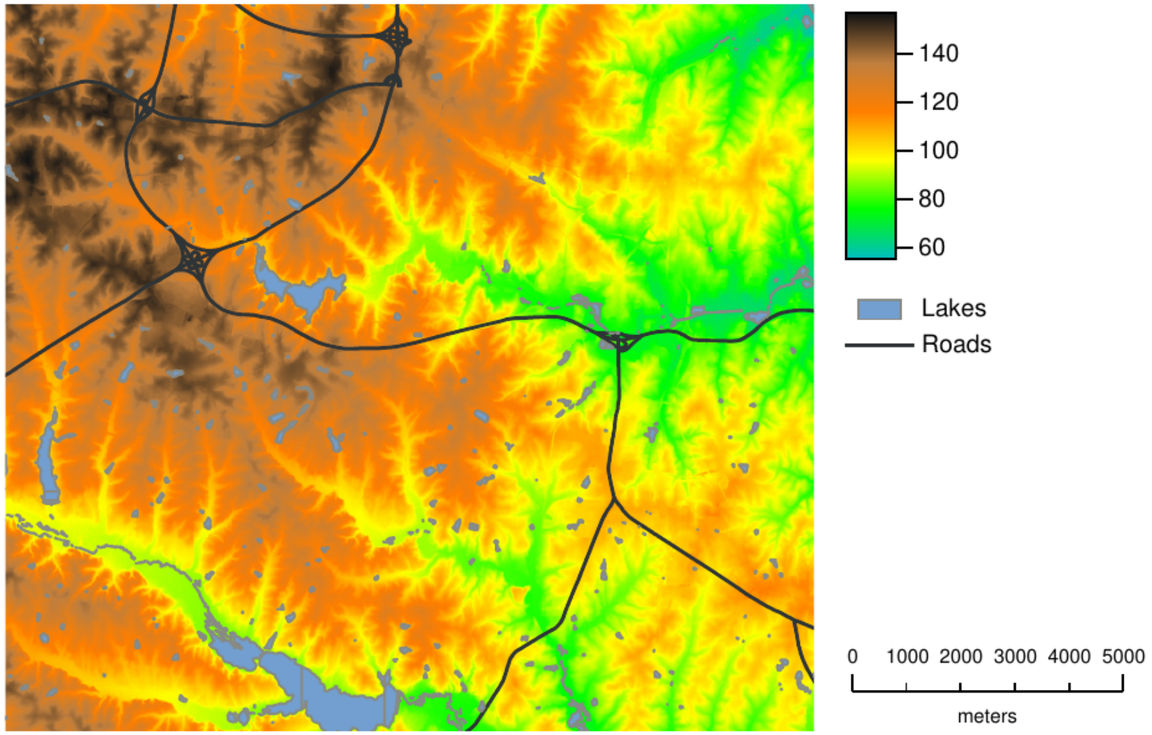
g.gui.animation

Cartographic composer



g.gui.psmap

Export as .ps .eps or .pdf



```
# timestamp: 2018-09-19 18:10
# location: nc_spm_08_grass7
# mapset: user1
# page orientation: Portrait
# g.region raster=elevation@PERMANENT nsres=10.75697211 ewres=10.752688

maploc 0.450 0.666  4.624 4.174
border n

paper
    width 7.48031496063
    height 5.51181102362
    left 0.196850393701
    right 0.196850393701
    bottom 0.393700787402
    top 0.393700787402
    end
```

```
paper
    width 7.48031496063
    height 5.51181102362
    left 0.19685039370l
    right 0.19685039370l
    bottom 0.393700787402
    top 0.393700787402
    end

raster elevation@PERMANENT

vareas lakes@PERMANENT
    layer 1
    masked n
    color 136:138:133
    width 1.0
    fcolor 114:159:207
    label Lakes
    lpos 1
```

raster map

```
    top 0.393700787402
    end

raster elevation@PERMANENT

vareas lakes@PERMANENT
    layer 1
    masked n
    color 136:138:133

    width 1.0
    fcolor 114:159:207
    label Lakes
    lpos 1
    end
vlines roadsmajor@PERMANENT
    type line
    layer 1
    masked n
```

vector of areas

```
    width 1.0
    fcolor 114:159:207
    label Lakes
    lpos 1
    end
vlines roadsmajor@PERMANENT
    type line
    layer 1
    masked n
    color 46:52:54
    width 1.5
    style solid
    linecap butt
    label Roads
    lpos 2
    end
colortable y
    raster elevation@PERMANENT
    where 5.245 0.735
```

vector of lines

```
    width 1.5
    style solid
    linecap butt
    label Roads
    lpos 2
    end
colortable y
    raster elevation@PERMANENT
    where 5.245 0.735
    discrete n
    tickbar n
    font Helvetica
    fontsize 10
    color black
    end
vlegend
    where 5.234 2.249
    font Helvetica
    fontsize 10
```

color table, i.e., raster legend

```
    discrete n
    tickbar n
    font Helvetica
    fontsize 10
    color black
    end
vlegend
    where 5.234 2.249
    font Helvetica
    fontsize 10
    width 0.4
    cols 1
    border none
    end
scalebar s
    where 6.040 4.591
    length 5000.0
    units auto
```

vector legend

```
vlegend
    where 5.234 2.249
    font Helvetica
    fontsize 10
    width 0.4
    cols 1
    border none
    end
scalebar s
    where 6.040 4.591
    length 5000.0
    units auto
    height 0.1
    segment 5
    numbers 1
    fontsize 8
    background y
    end
```

scale bar

Add-ons

Some (other) cool add-ons

- i.modis: Toolset for download and processing of MODIS products using pyModis
- i.sentinel: Toolset for download and processing of Copernicus Sentinel products
- r.hants: Approximates a periodic time series with harmonics
- r.seasons: Extracts seasons from a time series
- r.bioclim: Calcuates bioclimatic indices
- ... and **other 300+ more in the official repo!!**

 Don't forget to check https://grass.osgeo.org/grass7/manuals/addons/ from time to time

Thanks for your attention!!

Move on to:

Exercise 1: Getting familiar with GRASS GIS

Presentation powered by

GitPitch