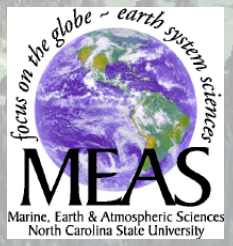
Markus Neteler
Fondazione E. Mach – CRI, Italy
http://gis.cri.fmach.it
& GRASS Development Team

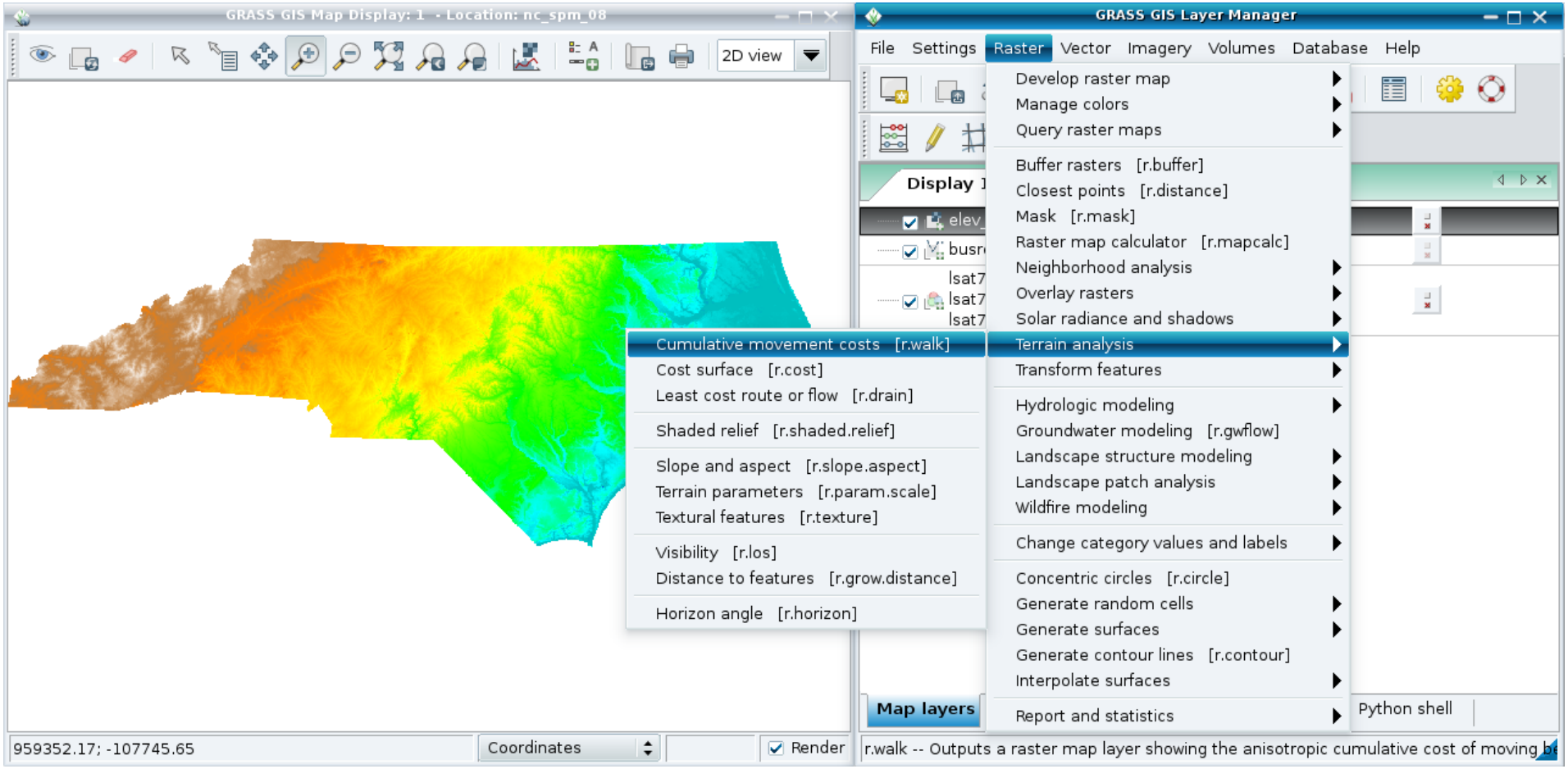
News in GRASS GIS 7

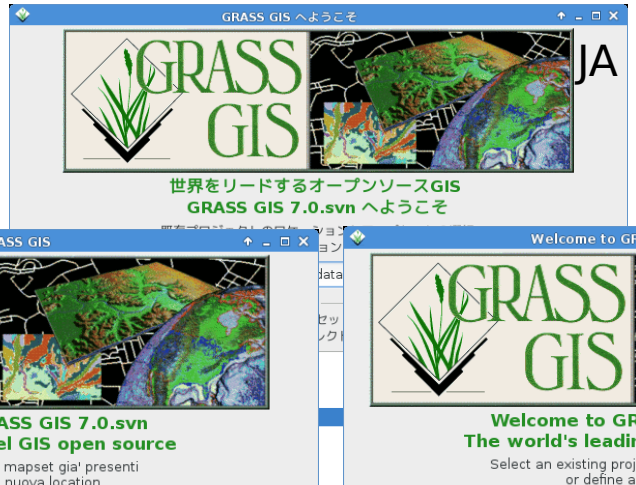
FOSS4G-CEE 2013
Bucharest, Romania

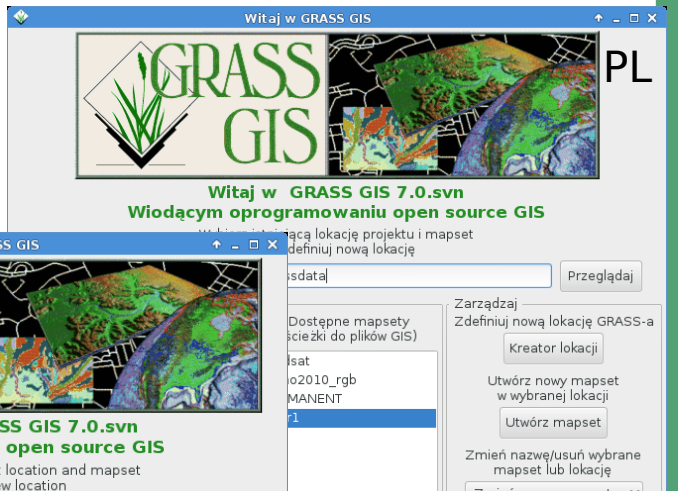
FONDAZIONE
EDMUND
MACH

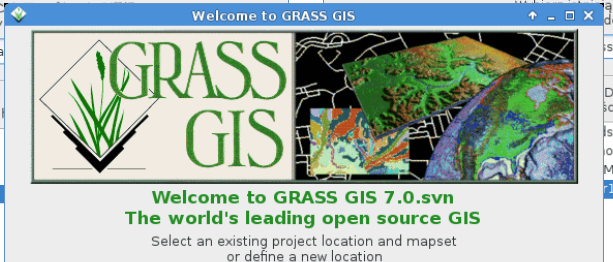


GRASS GIS 7 User interface

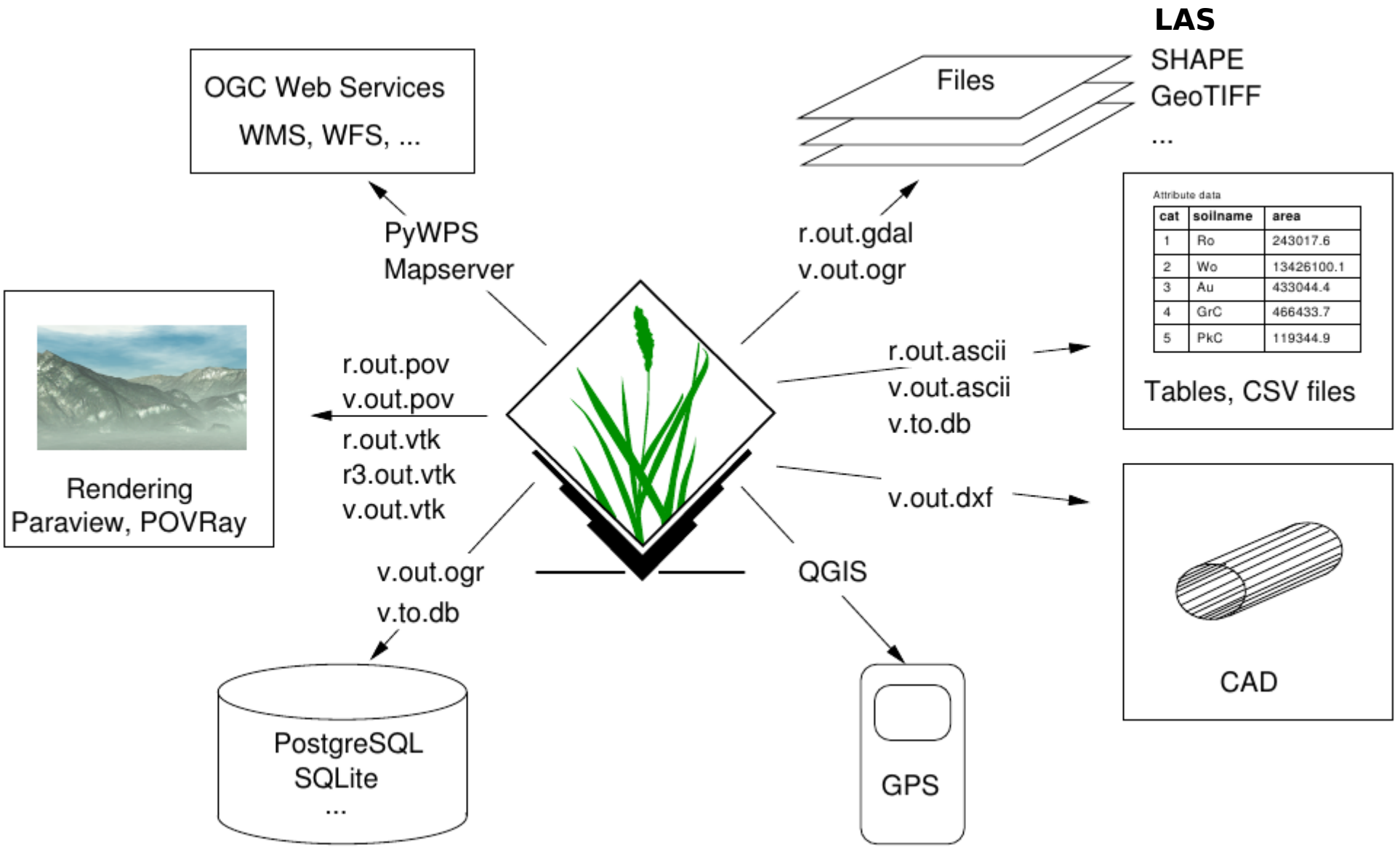




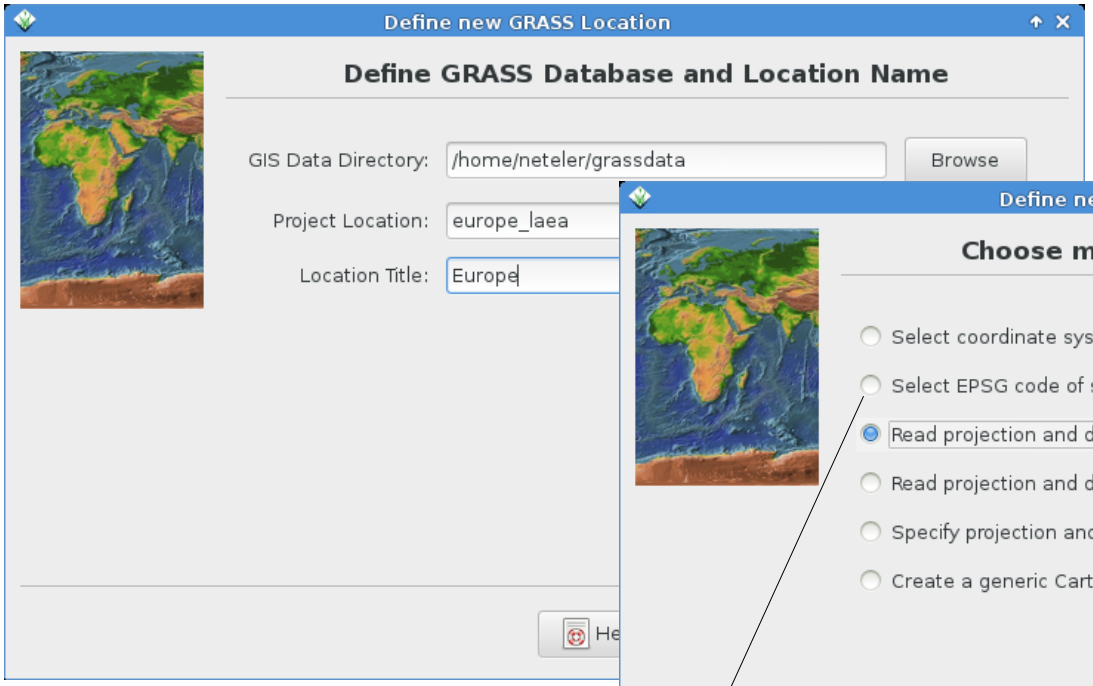


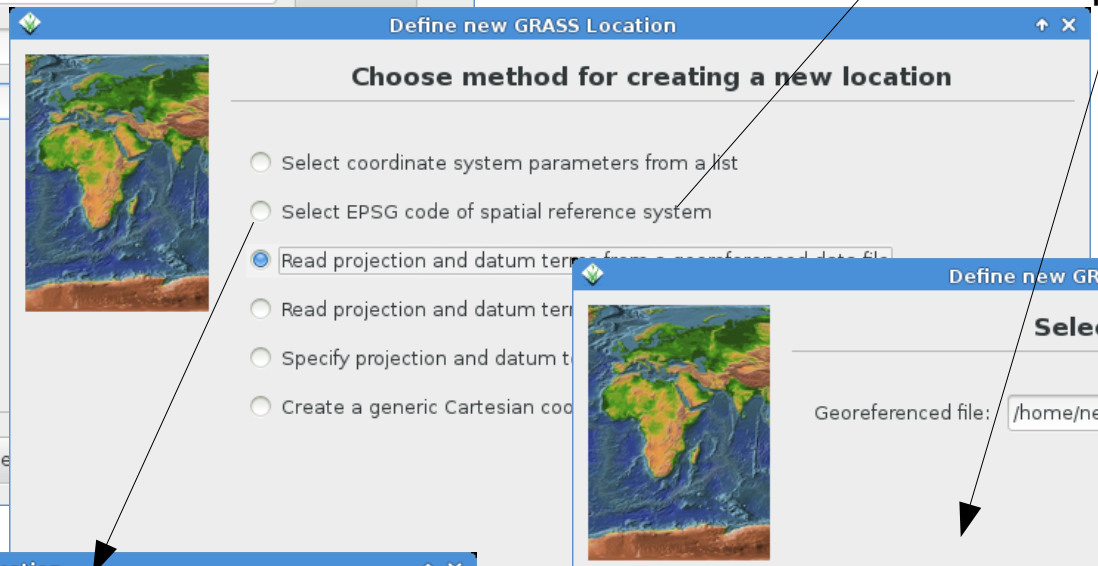


GRASS GIS: Interoperability

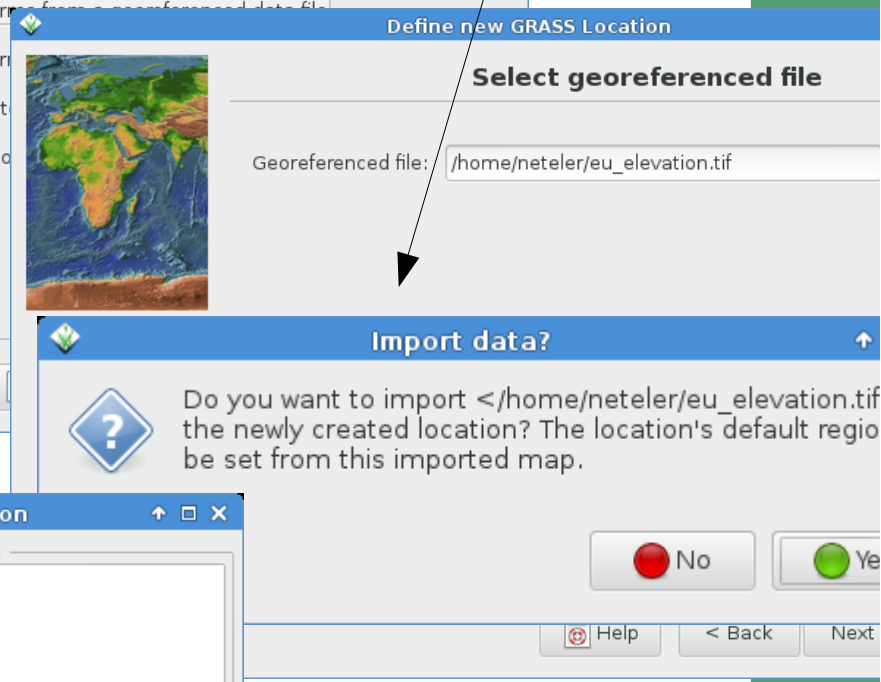


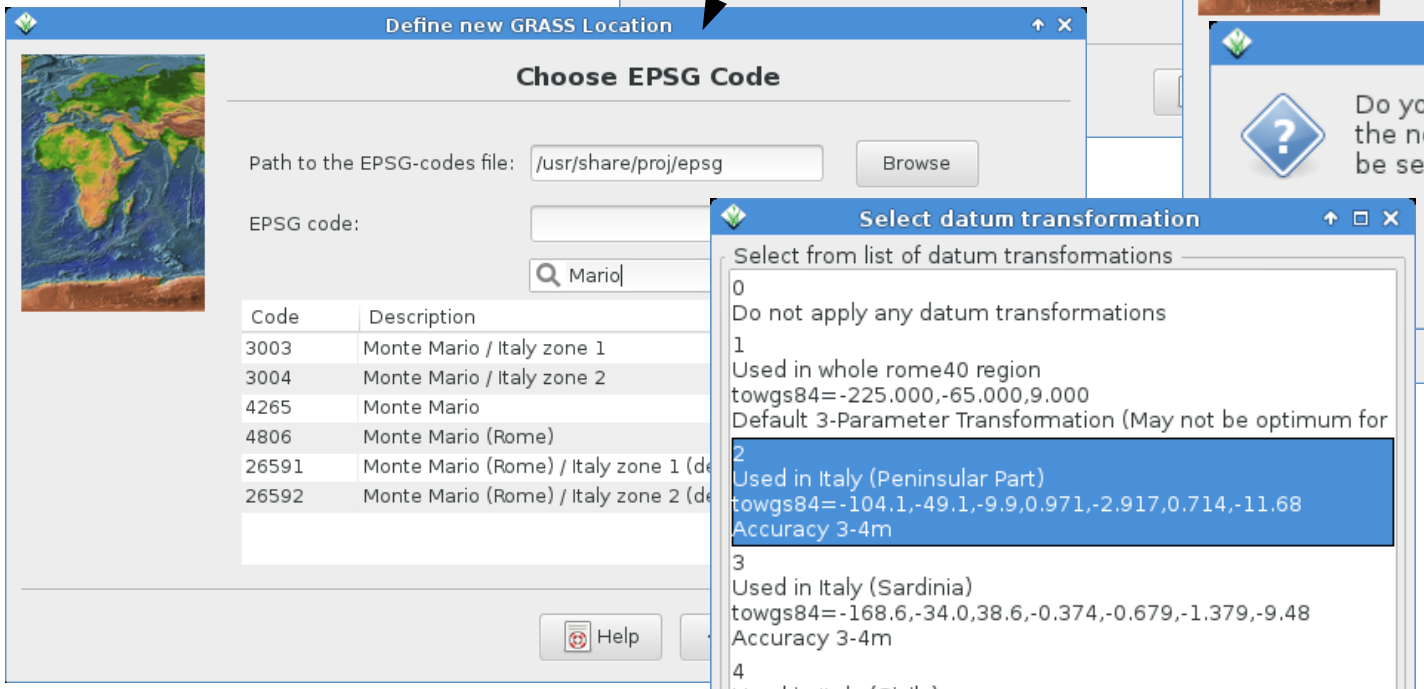
GRASS: Project database (Location) wizard





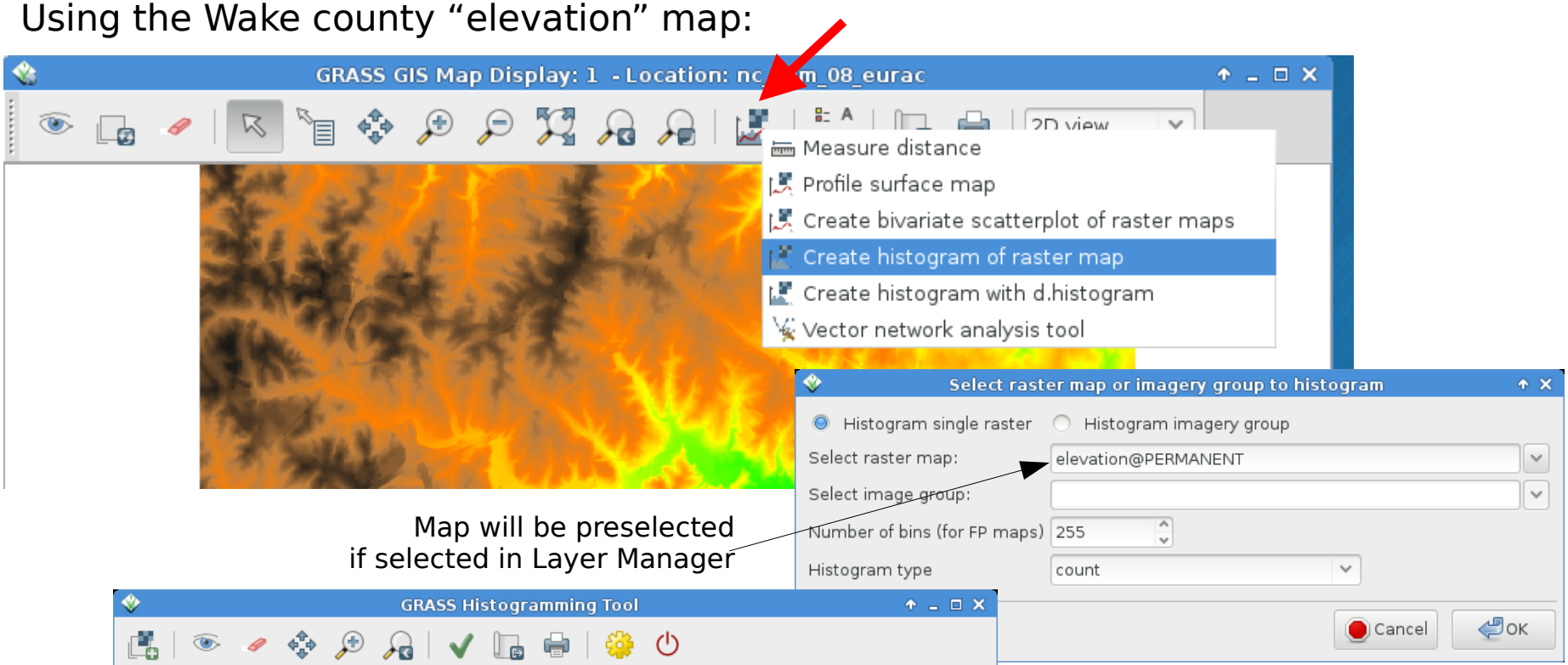
From GeoTIFF or SHAPE or ... And directly import file



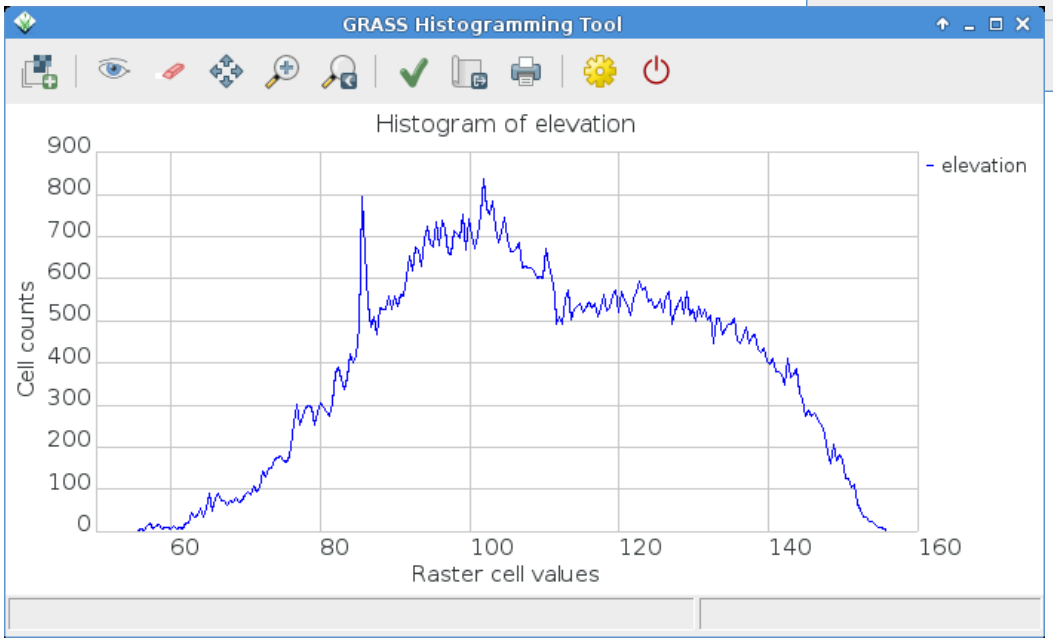


GRASS 7: New map histogram tool

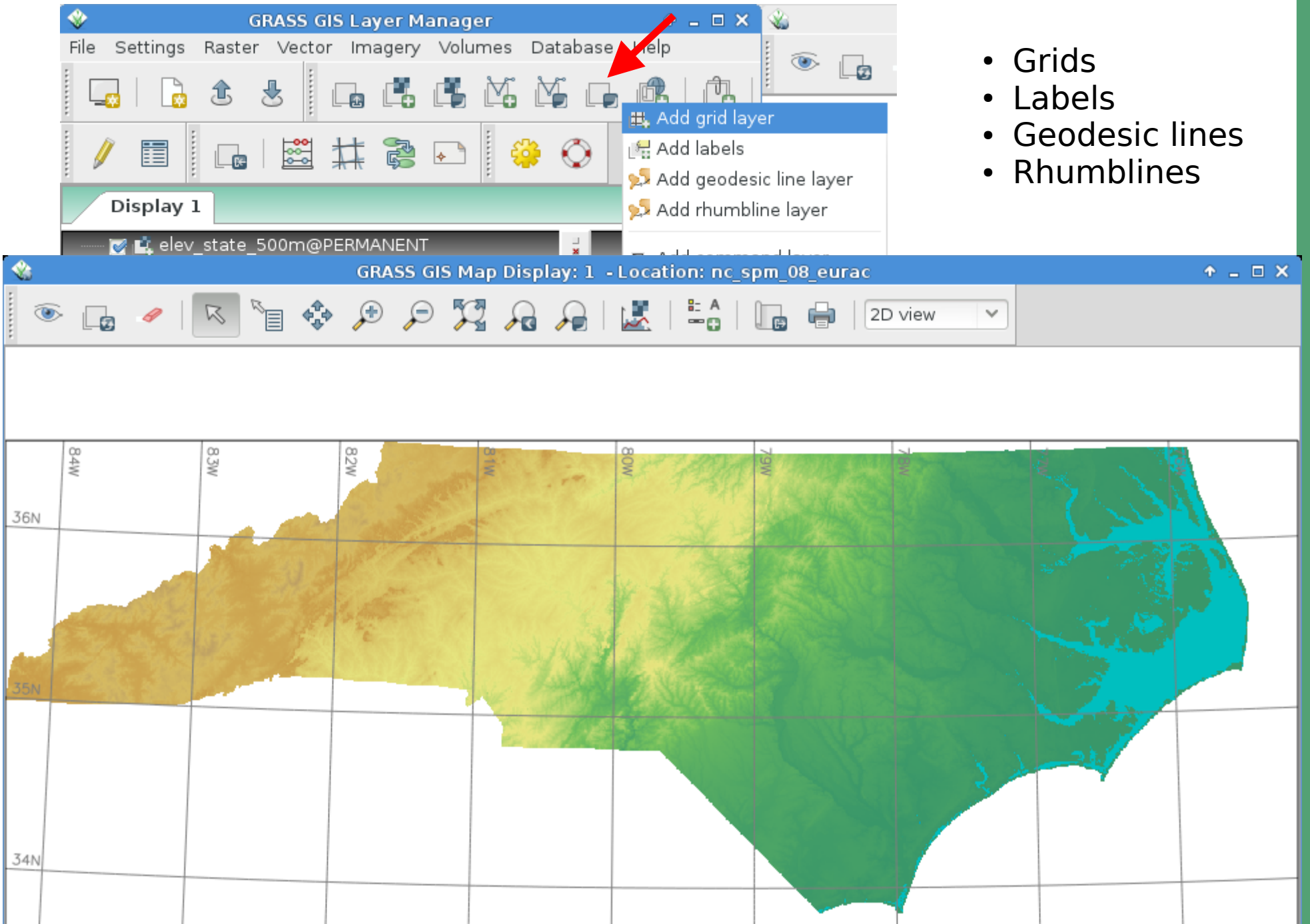
Using the Wake county “elevation” map:



Map will be preselected
if selected in Layer Manager

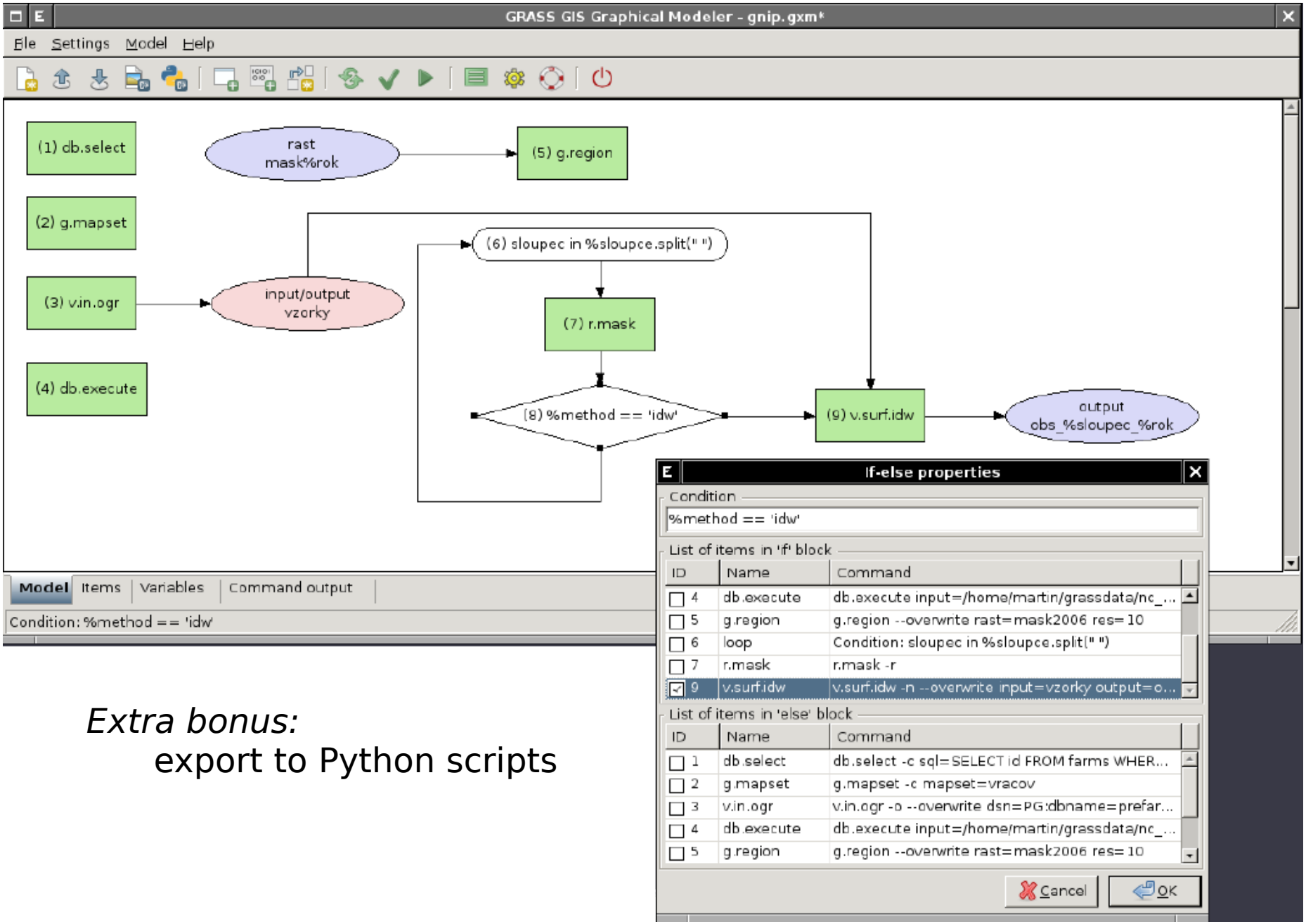


GRASS 7: Adding a grid to the map view



- Grids
- Labels
- Geodesic lines
- Rhumblines

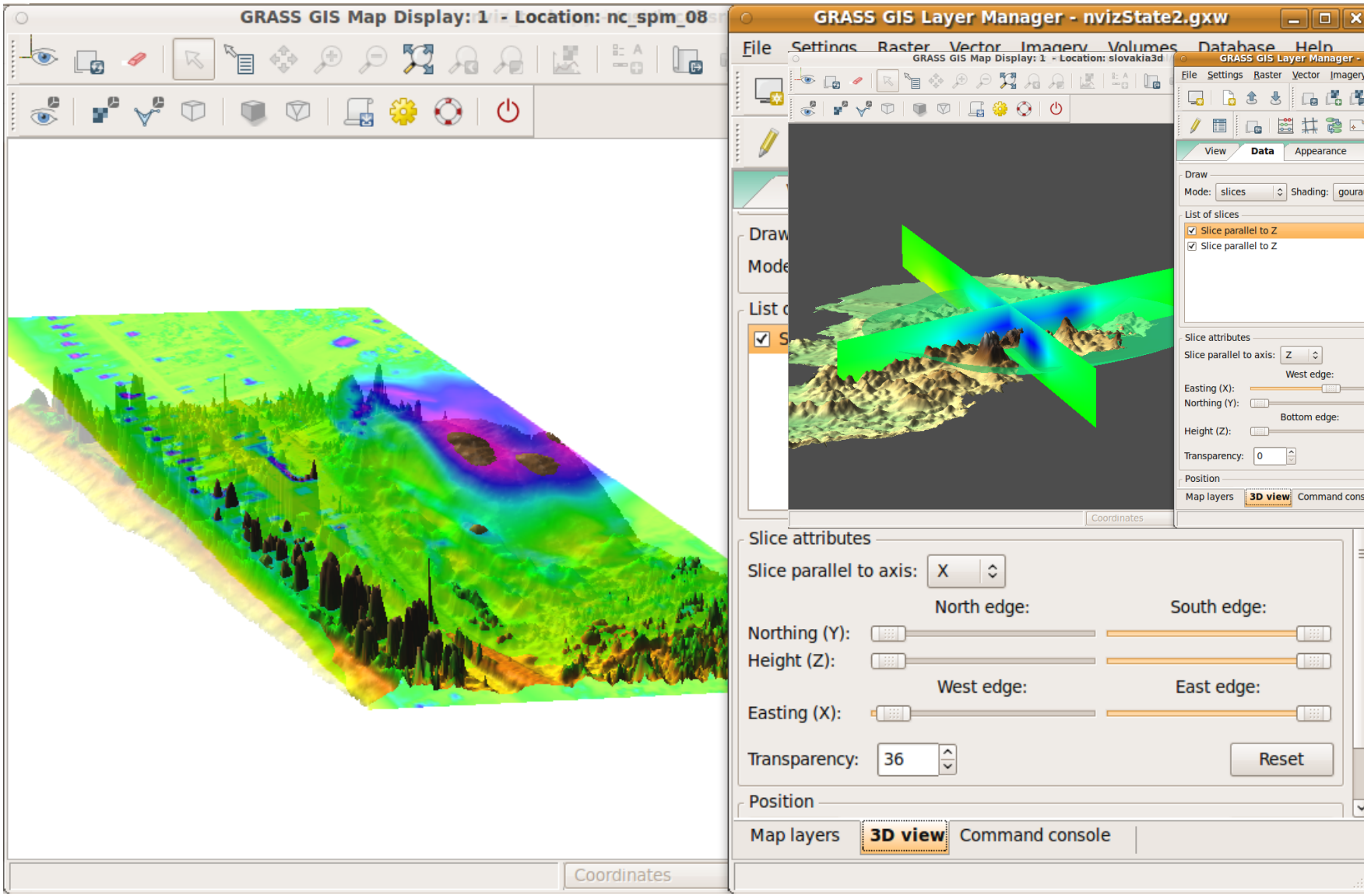
GRASS 7: New Geospatial Modeller



Extra bonus:

export to Python scripts

GRASS 7: New visualization tool: wxNVIZ



Programming/screenshot:
Anna Kratochvílová

http://grasswiki.osgeo.org/wiki/WxNVIZ

GRASS Topological 2D/3D Vector model

Vector geometry types

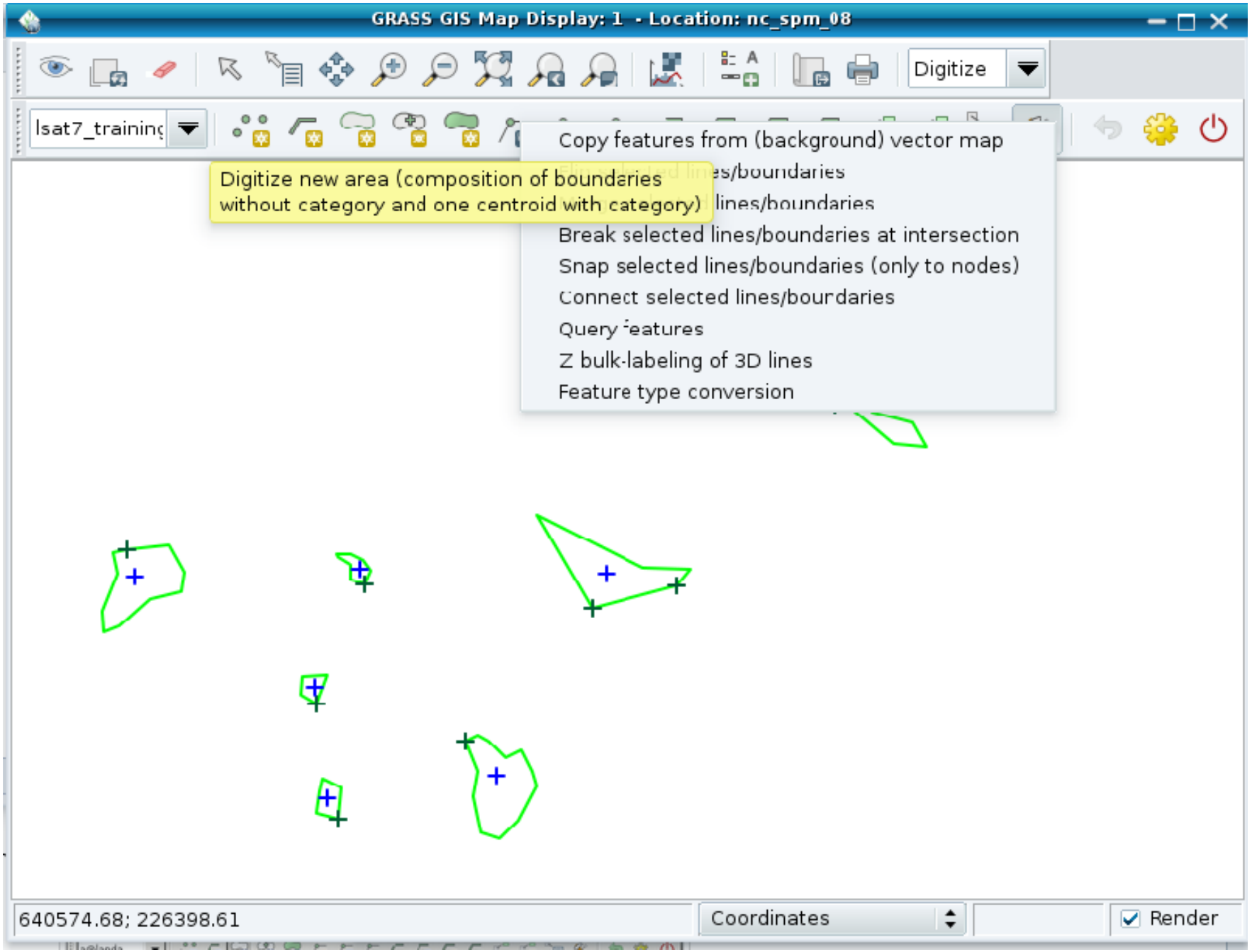
- Point
- Centroid
- Line
- Boundary
- Area (boundary + centroid)
- face (3D area)
- [kernel (3D centroid)]
- [volumes (faces + kernel)]

Geometry is **true** 3D when: x, y, z

not in all GIS!

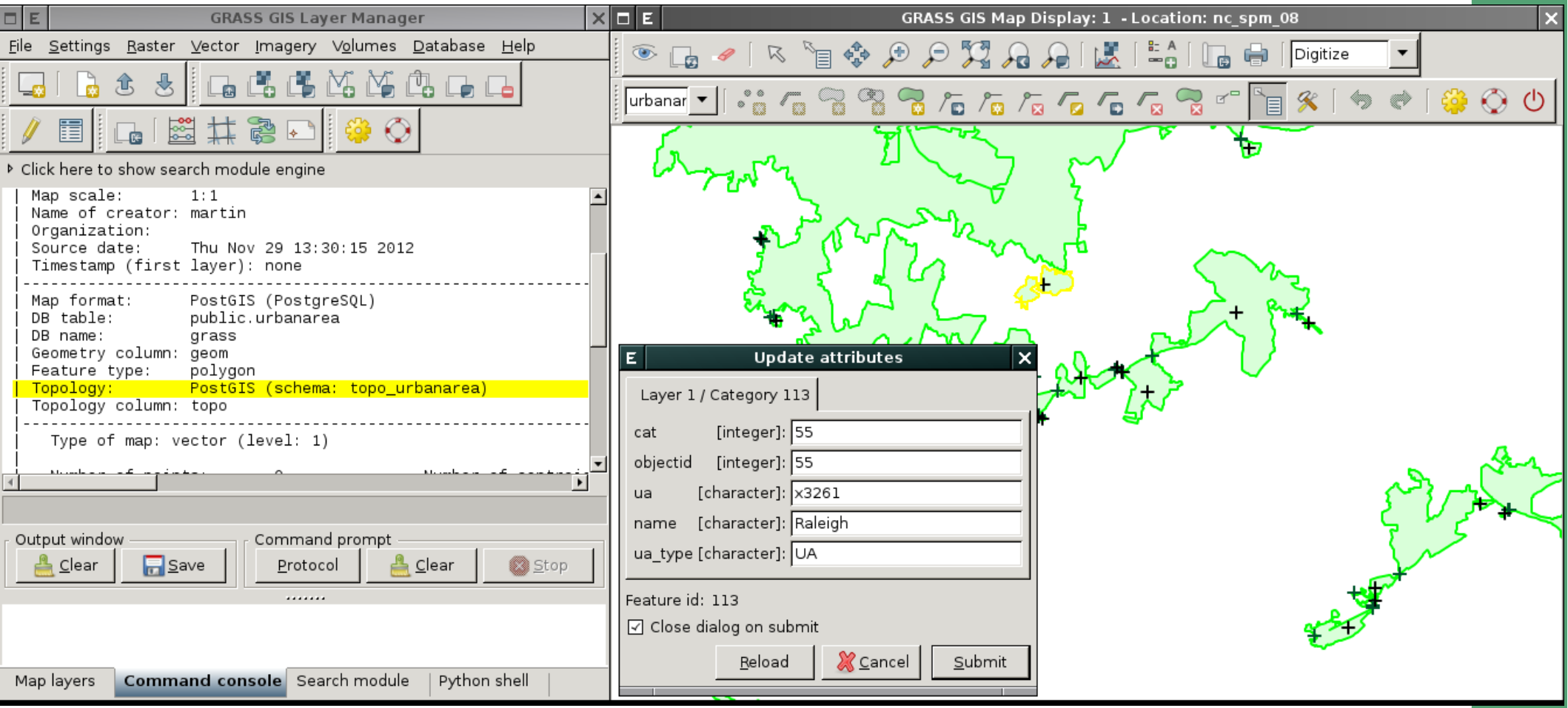
Faces

GRASS 7: Topological Vector Digitizer



GRASS 7: Topological Vector Digitizer in PostGIS 2 (under development)

Programmer: Martin Landa



http://grass.osgeo.org/grass70/manuals/v.out.postgis.html

http://grasswiki.osgeo.org/wiki/PostGIS_Topology

Cofunded by Municipality of Trento, Italy

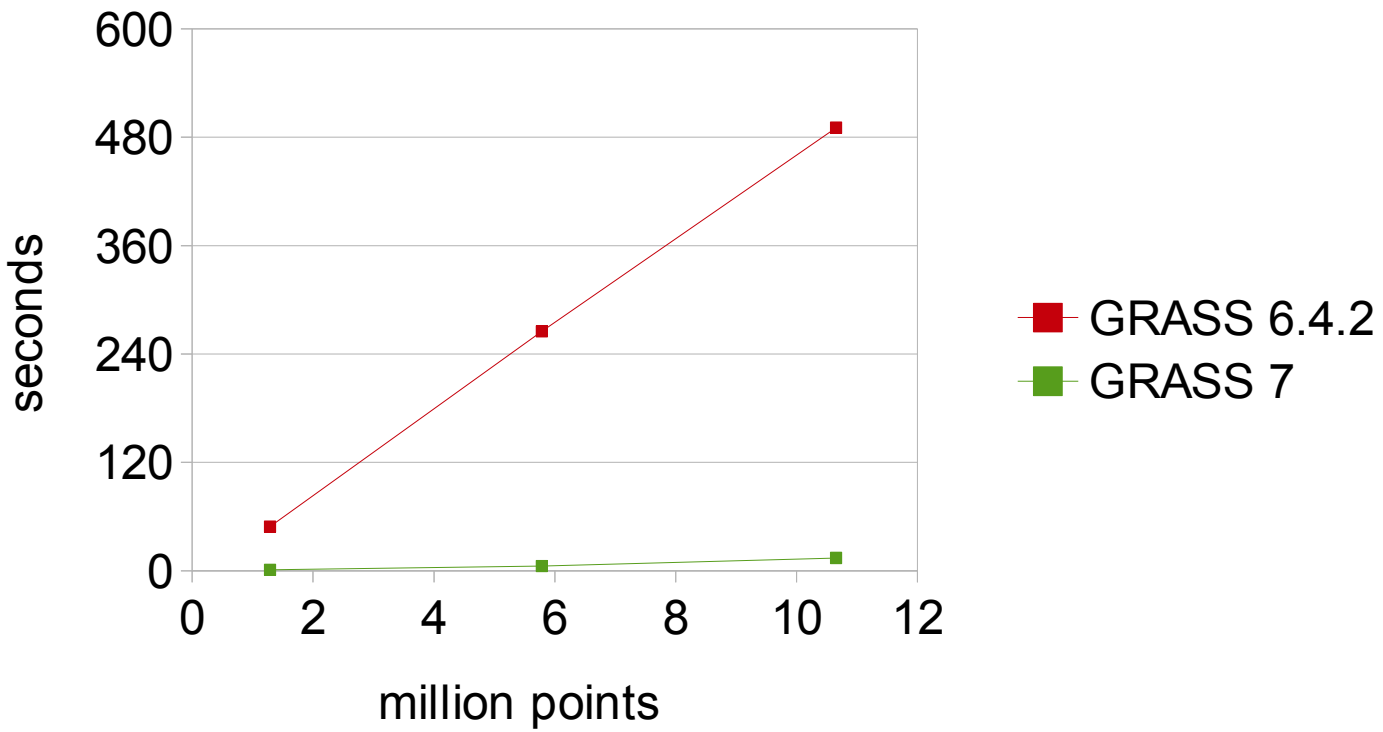
News in GRASS 7's Vector Topology

Spatial query example

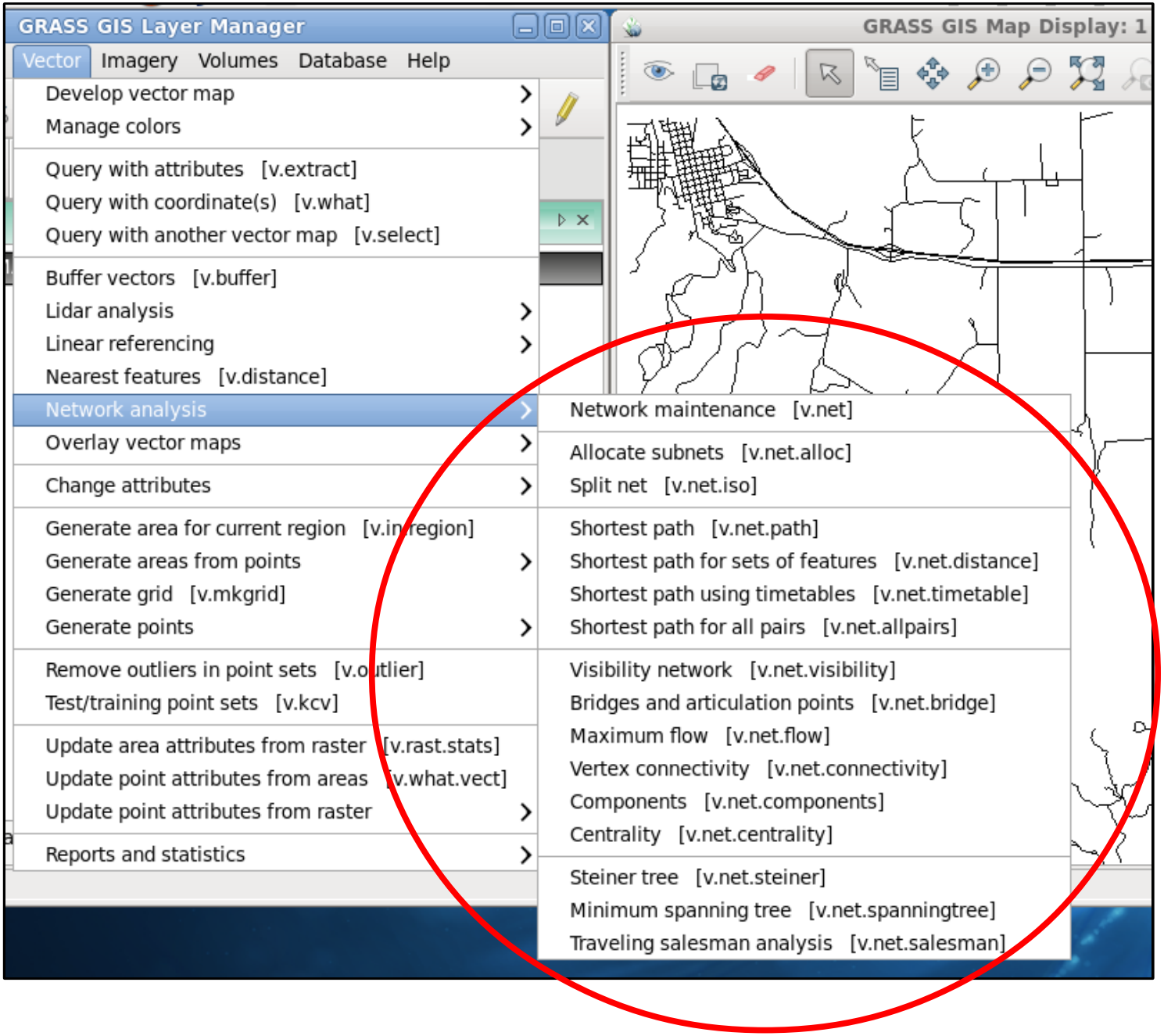
Query of vector point maps

GUI: click on vector map, what is there?

CLI: v.what east_north=east,north



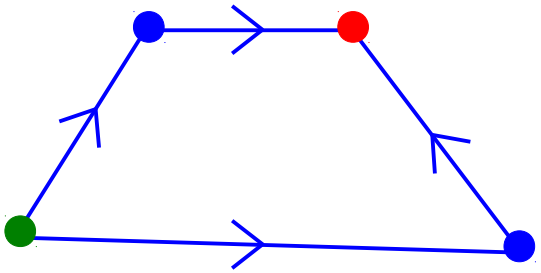
Vector network analysis in GRASS



Vector network analysis

General concept of a network graph

- Arcs connected by nodes
- Forward/backward costs assigned to each arc (oneway road)
- Starting point(s)
- Ending point(s)



Cost definition examples

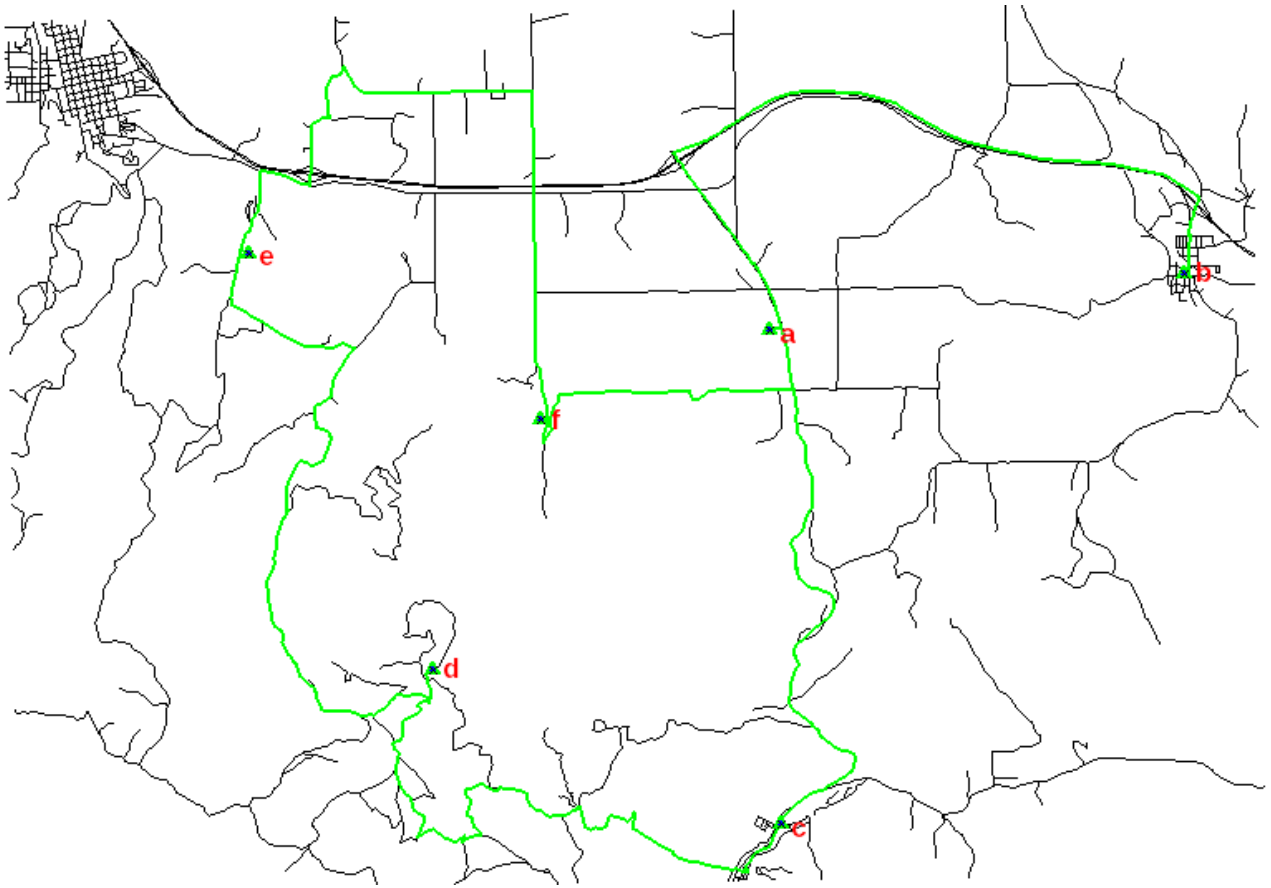
- Distance → shortest path
- Travelling time → fastest path
- Travelling costs (fuel, train ticket, etc) → cheapest path

GsoC 2013: implementation of turns support

Network analysis: traveling salesman

Traveling time as costs

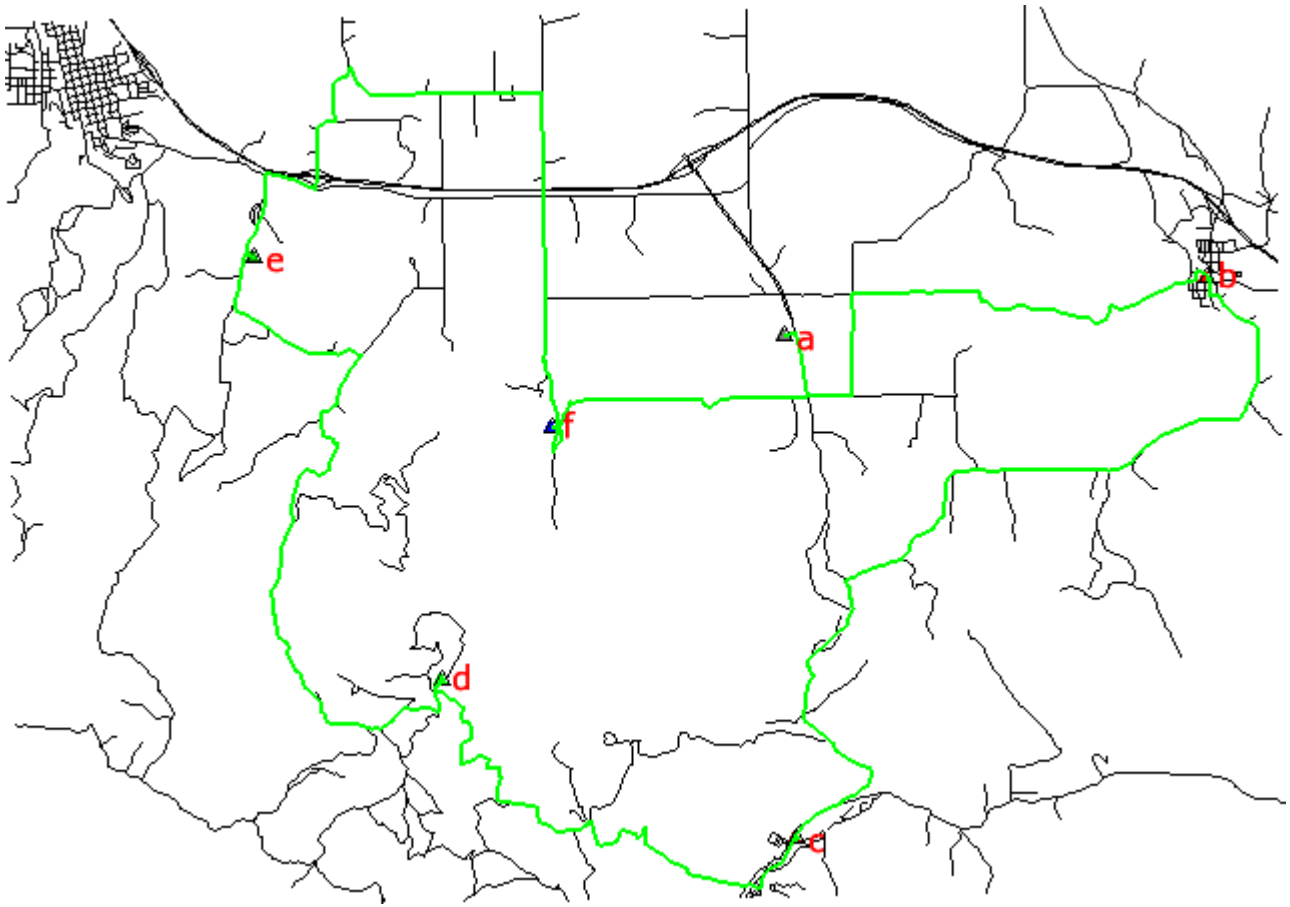
Result



Network analysis: traveling salesman

Distances as costs

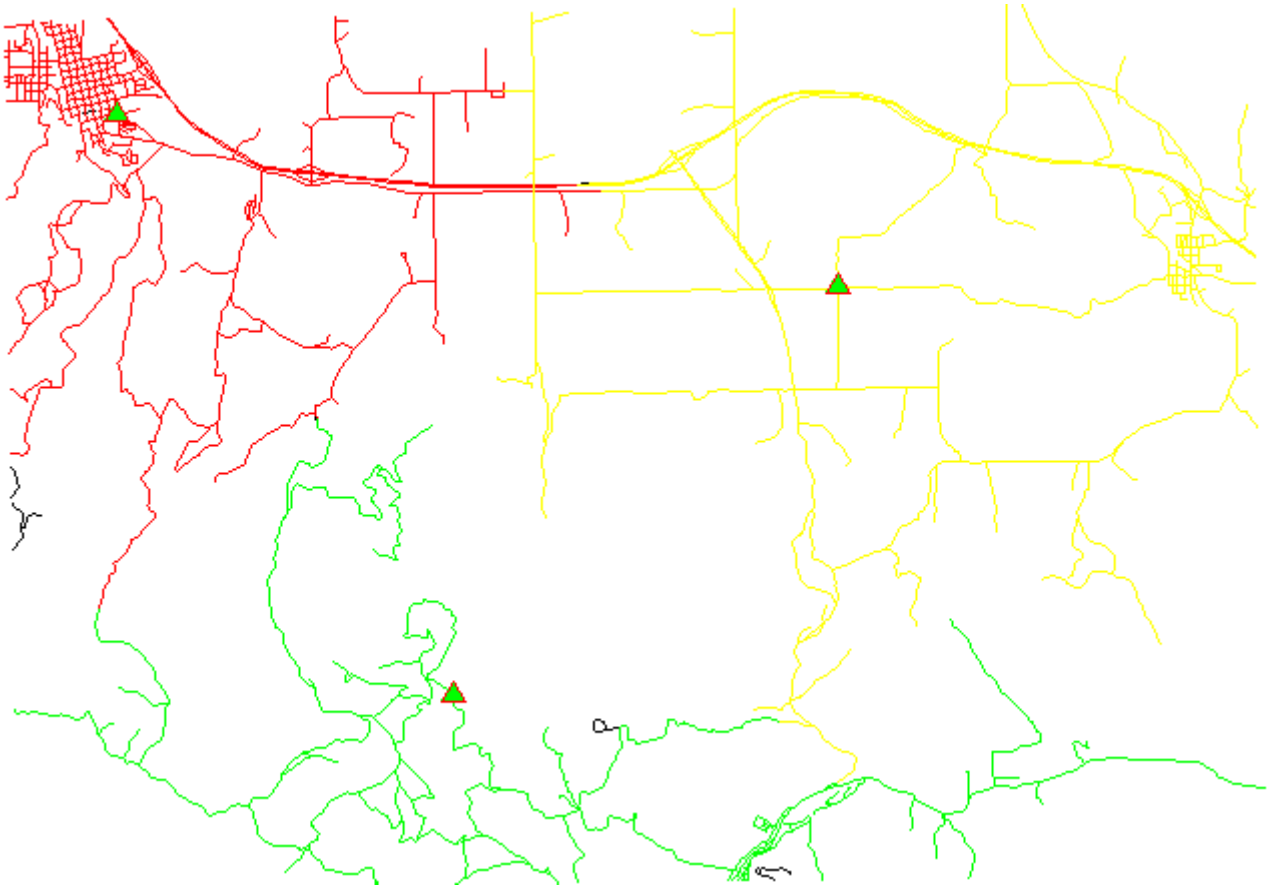
Result



Network analysis: allocate subnets

Distances as costs

Result



… and many more algorithms… see the manual!

New Space-Time functionality in GRASS 7

Temporal data processing in GRASS GIS

The temporal GIS framework in GRASS introduces three new datatypes that are designed to handle time series data:

- *Space time raster datasets* (strds) are designed to manage raster map time series. Modules that process strds have the naming prefix *t.rast*.
- *Space time 3D raster datasets* (str3ds) are designed to manage 3D raster map time series. Modules that process str3ds have the naming prefix *t.rast3d*.
- *Space time vector datasets* (stvds) are designed to manage vector map time series. Modules that process stvds have the naming prefix *t.vect*.

Temporal data management in general

List of general management modules:

- t.connect
- t.create
- t.remove
- t.register
- t.unregister
- t.info
- t.list
- t.rast3d.list
- t.vect.list
- t.vect.db.select
- t.sample
- t.support
- t.topology

Export/import conversion

- t.rast.export
- t.rast.import
- t.rast.out.vtk
- t.rast.to.rast3
- r3.out.netcdf
- t.vect.export

Statistics and gap filling

- t.rast.gapfill
- t.rast.univar

Querying and map calculation

- t.rast.list
- t.rast.extract
- t.rast.gapfill
- t.rast.mapcalc
- t.rast3d.extract
- t.rast3d.mapcalc
- t.rast3d.univar
- t.vect.extract
- t.vect.import
- t.vect.observe.strds
- t.vect.univar
- t.vect.what.strds

Aggregation

- t.rast.aggregate.ds
- t.rast.aggregate
- t.rast.series

Space time datasets are stored in a temporal database. SQLite3 or PostgreSQL are supported as SQL database back end. Connection settings are performed with t.connect. As default a sqlite3 database will be created in the PERMANENT mapset that stores all space time datasets and registered time series maps from all mapsets in the location.

GRASS 7: New animation tool for time series

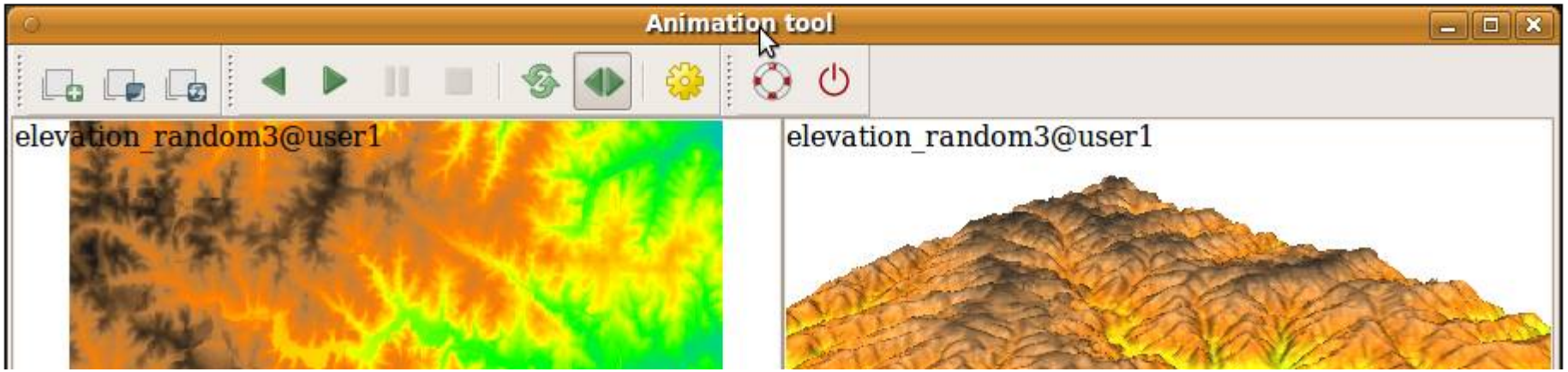
The **Animation Tool** is a *wxGUI* component for animating a series of GRASS raster maps or a space time raster dataset (created by t.* modules).

Animation Tool allows you to:

- display up to 4 synchronized animations
- control the animation speed
- interactively change active frame using a slider
- visualize space time datasets with unequally spaced intervals
- animate 3d view (partially implemented)

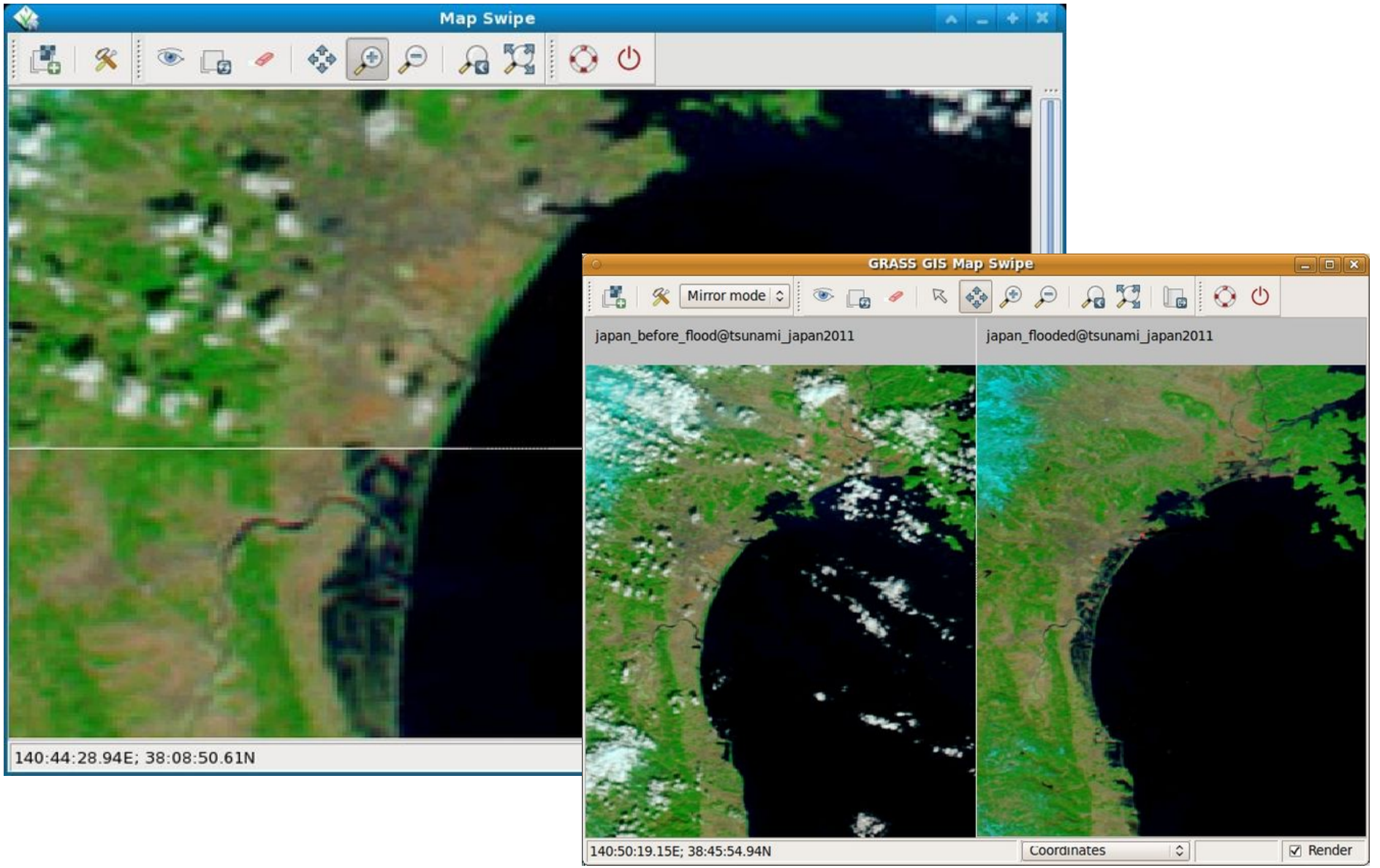
3D view animation enables to animate raster (as an elevation map or a color map) or vector map (points, lines). Internally, module m.nviz.image is used. To display 3D view animation follow these steps:

- open GRASS GUI, load maps and start 3D view
- set view, light and other parameters as you like
- save workspace file
- add new animation in Animation Tool, choose 3D view mode
- choose data (series of maps or space time dataset) used for animation
- set workspace file
- choose parameter (parameter of m.nviz.image) to animate (e.g. color_map)



http://grass.osgeo.org/grass70/manuals/g.gui.animation.html

New Map swiping tool for multitemporal maps

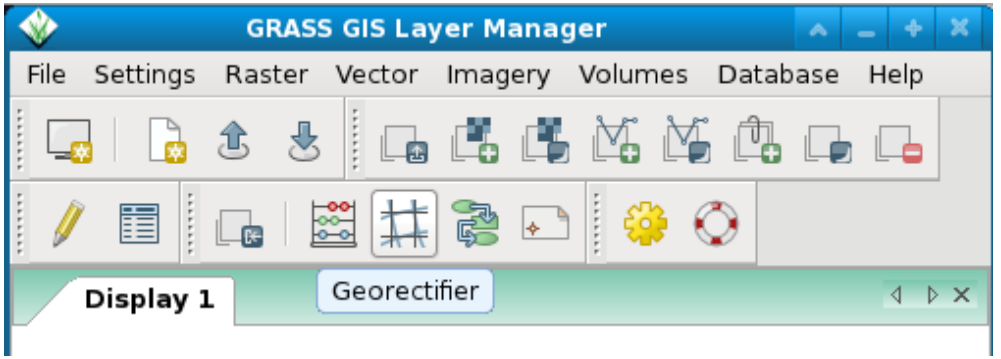


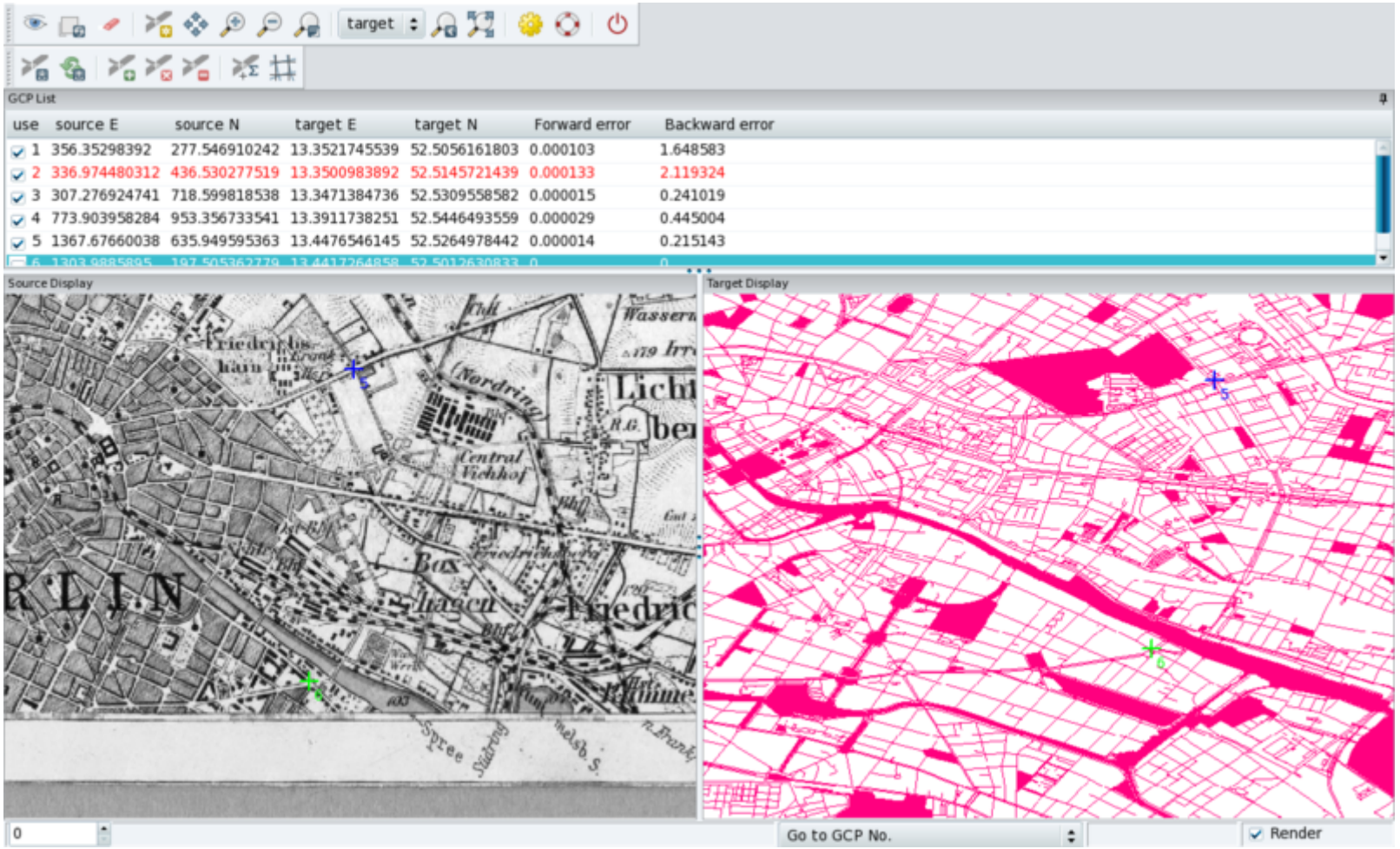
Pre and post disaster images of the tsunami in Japan in 2011
(MODIS images taken on February 26 and March 13, 2011)

GRASS 7: New geocoding tool

Image/Map rectifier

For raster (imagery, historic scans) and vector maps





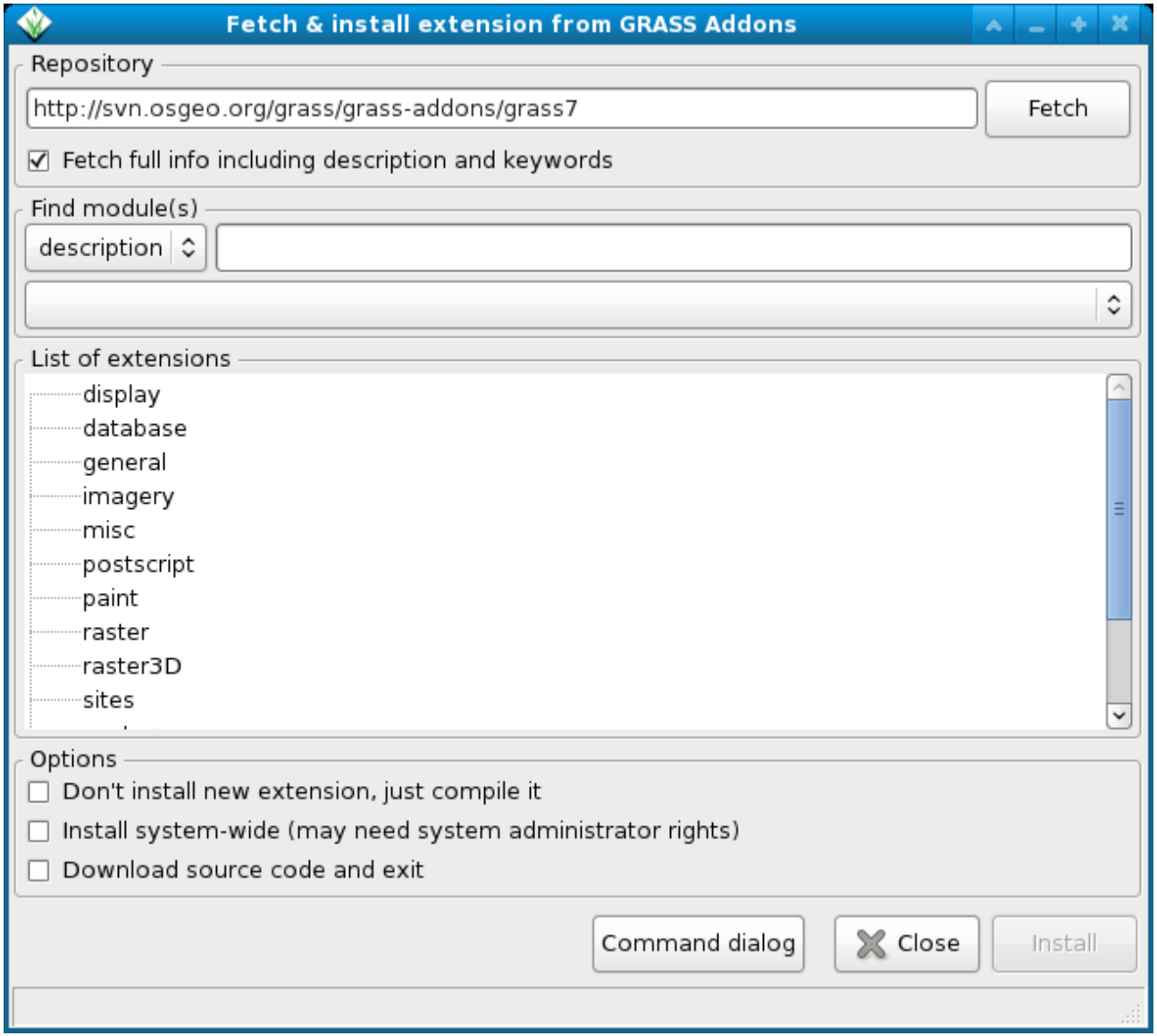
GRASS 7 Addons: User contributed extensions

The Addons repository is SVN based:
User can easily obtain **write** access to develop new functionality

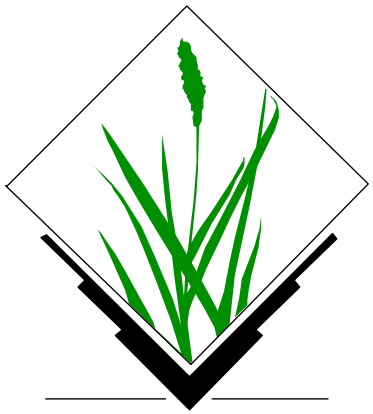
http://grass.osgeo.org/wiki/Addons

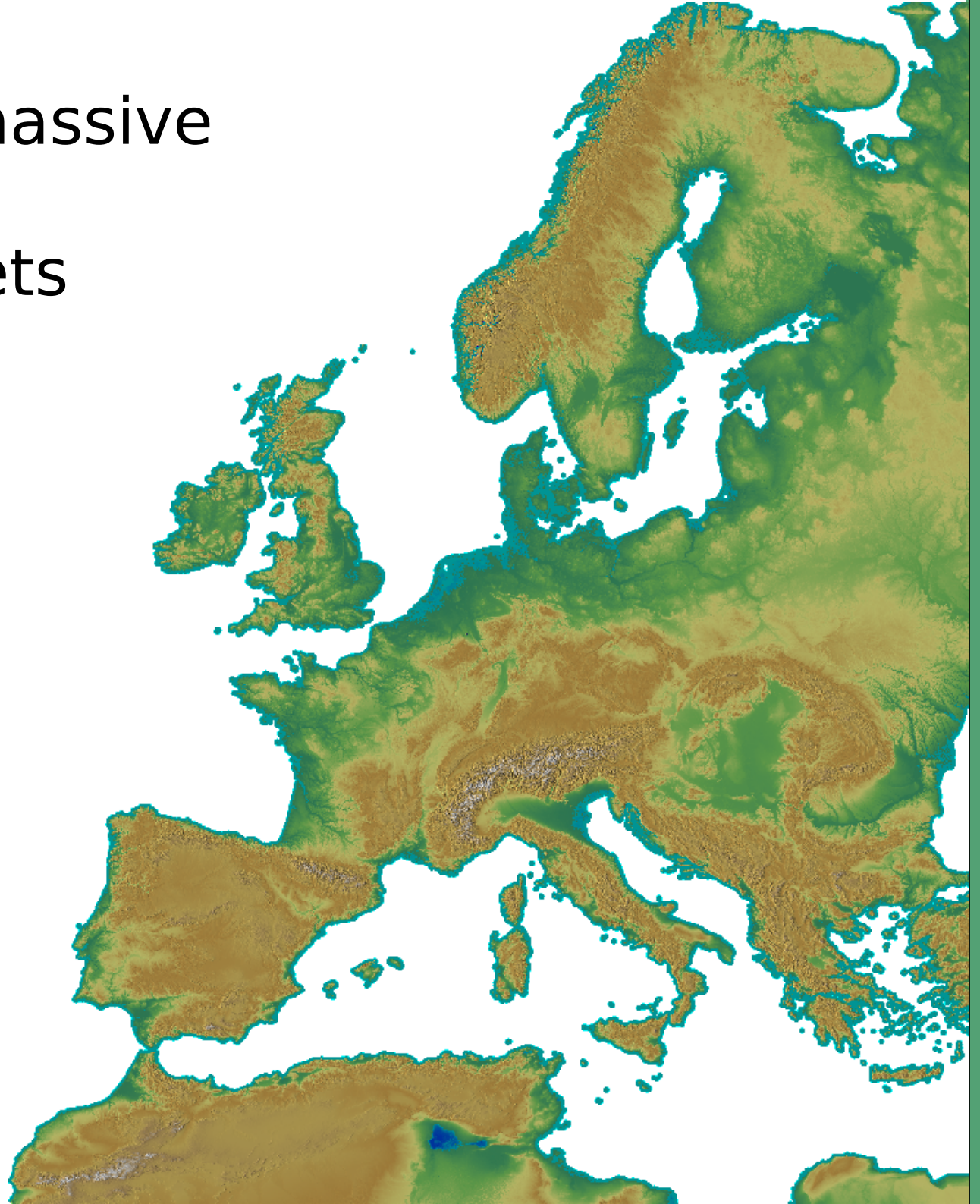
Installation with extension manager

Increasing inflow of Python scripts



Support for massive spatial datasets in GRASS GIS





GRASS 7: Support for massive datasets

What is massive?

Massive is relative to

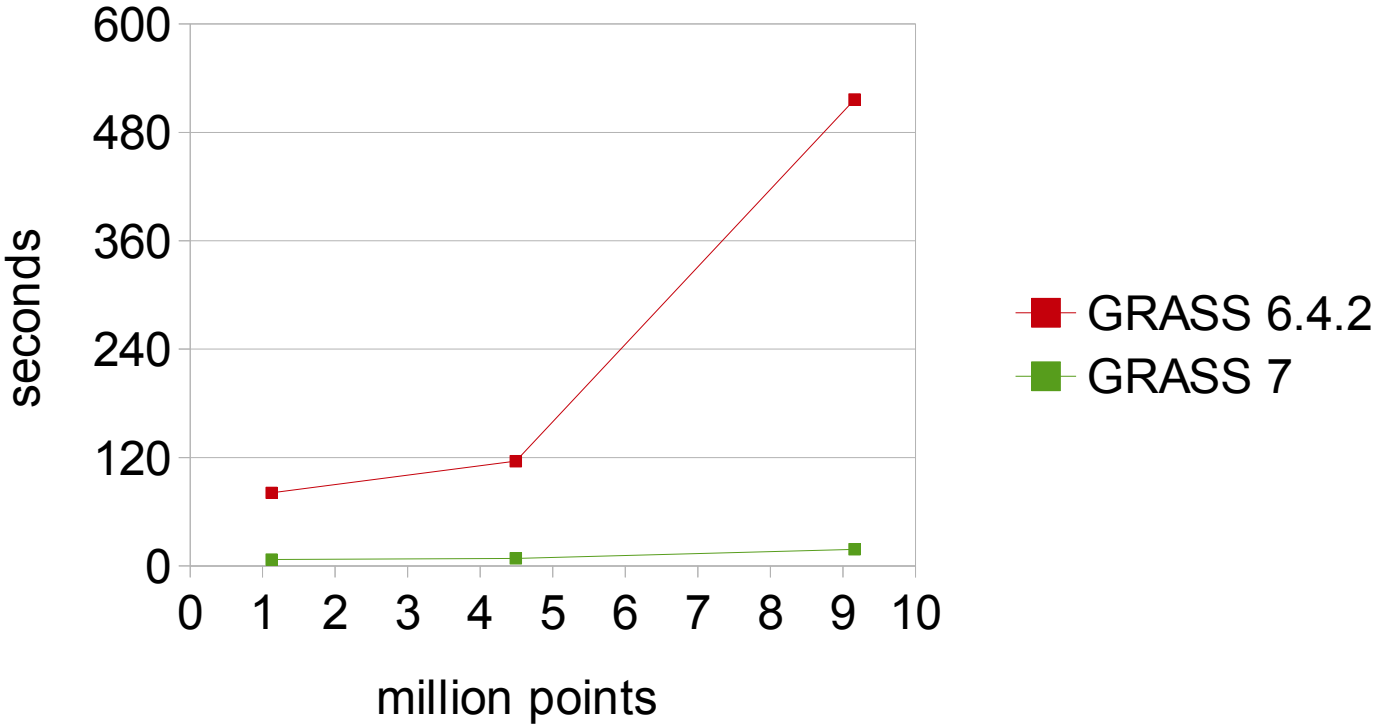
- Hardware resources
- Software capabilities
- Operating system capabilities

Limiting factors

-  RAM
-  Processing time
- ✔ Disk space
- ✔ Largest supported file size

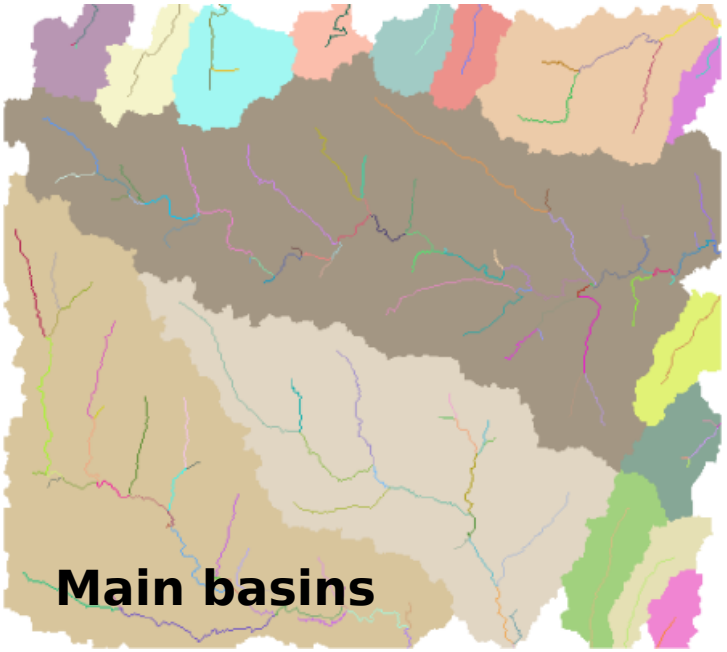
GRASS 7: Support for massive datasets

Cost surfaces: *r.cost*



Other speed figure:
PCA of 30 million pixels in 6 seconds on this small presentation laptop...

New tools for hydrological modelling



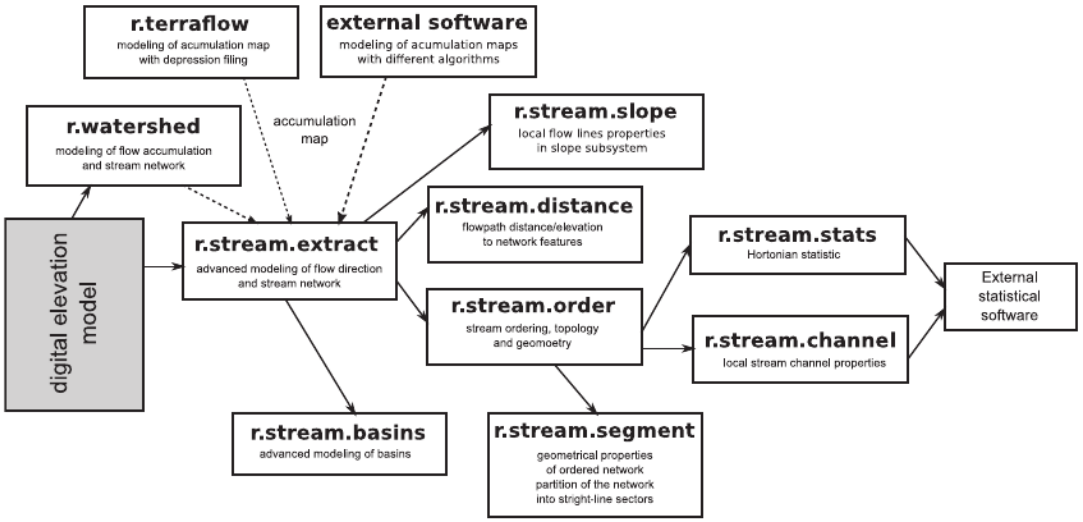
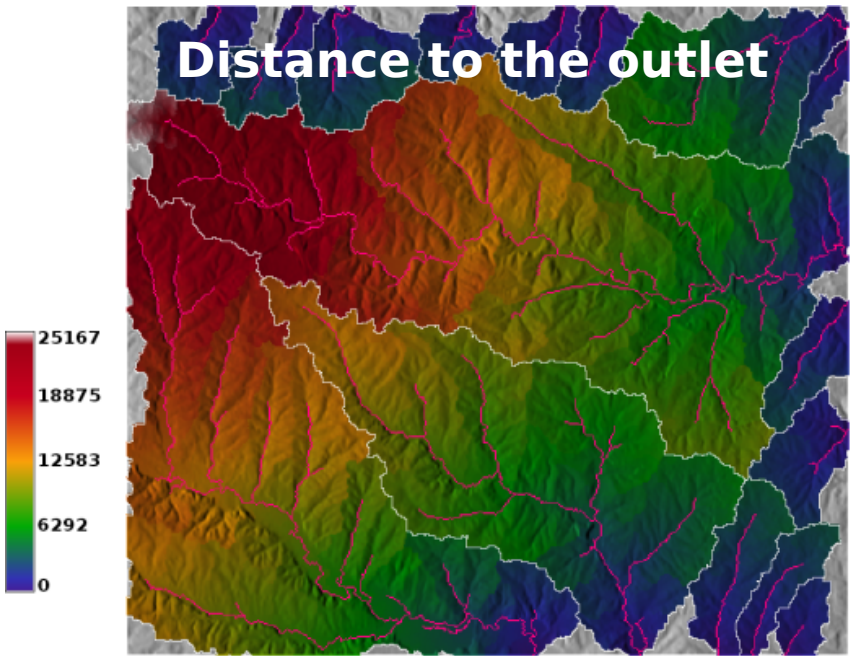


Fig. 2. The structure of the r.stream toolset and data flow between particular modules and external software.



ARTICLE IN PRESS

Computers & Geosciences ▮ (▮▮▮▮) ▮▮▮–▮▮▮

Contents lists available at ScienceDirect

Computers & Geosciences

journal homepage: www.elsevier.com/locate/cageo

A new GRASS GIS toolkit for Hortonian analysis of drainage networks

Jarosław Jasiewicz [a,*], Markus Metz [b]

[a] Adam Mickiewicz University, Geoekology and Geoinformation Institute, Dzięgielowa 27 60-681 Poznań, Poland
[b] University of Ulm, Institute of Experimental Ecology, Alber 11, 89069 Ulm, Germany

ARTICLE INFO

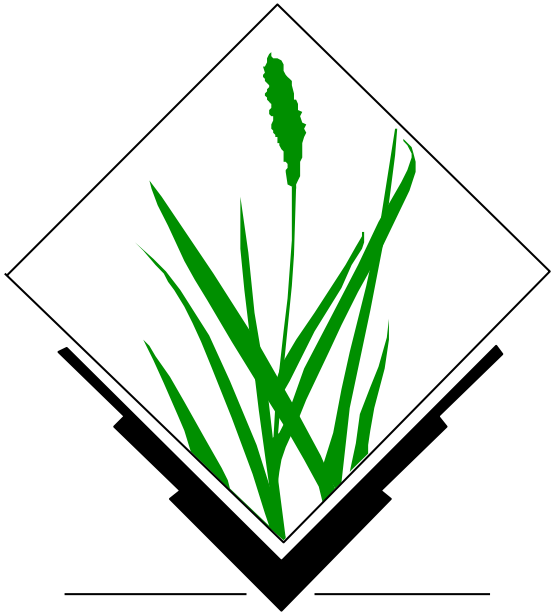
Article history:
Received 8 March 2010
Received in revised form
24 February 2011
Accepted 2 March 2011

Keywords:
Drainage network
Multiple flow direction
Basin delineation
GRASS GIS
Network topology

ABSTRACT

The aim of this paper is to present a new GRASS GIS toolset designed for Hortonian analysis of drainage networks. The r.stream toolset uses a multiple flow direction algorithm for stream network extraction as well as for calculating other hydrogeomorphological features in the catchment's area. As all GRASS GIS toolsets, r.stream consists of several separate modules that can extract stream networks from a spectrum of accumulation maps, order the extracted network using several ordering methods, do advanced modeling of basin's boundary, perform Hortonian statistics, calculate additional parameters such as flow path distance to watershed elements, partition ordered and unordered networks into near-straight-line sectors, and calculate sector directions. The package is free and open-source software, available for GRASS version 6.4 and later.

Programming own applications with GRASS GIS 7



GRASS and Python

Parser part (for GUI autocreation and command line support):

```
#%Module
#% description: Drapes a color raster over a shaded relief map using d.his
#%End
#%option
#% key: reliefmap
#% type: string
#% gisprompt: old,cell,raster
#% description: Name of shaded relief or aspect map
#% required : yes
#%end
#%option
#% key: drapemap
#% type: string
#% gisprompt: old,cell,raster
#% description: Name of raster to drape over relief map
#% required : yes
#%end
```

Script part:

```
import sys
from grass.script import core as grass

def main():
    drape_map = options['drapemap']
    relief_map = options['reliefmap']
    brighten = options['brighten']
    ret = grass.run_command("d.his", h_map = drape_map,  i_map = relief_map, brighten = brighten)
    sys.exit(ret)

if __name__ == "__main__":
    options, flags = grass.parser()
    main()
```

New GRASS 7 Python API

Neteler My talk My preferences My watchlist My contributions Log out

Page Discussion Read Edit View history Go Search

GRASS and Python

Contents [hide]

1 Python SIGs
2 Writing Python scripts in GRASS
2.1 Python script editor
2.2 Using the GRASS Python Scripting Library
2.3 Creating Python scr
2.3.1 MS-Windows
2.3.2 Linux
2.4 Running external c
2.5 Testing and installi
2.5.1 Debugging
2.5.2 Installation
3 Python extensions in GRA
3.1 Python Scripting Lib
3.2 Python Ctypes Inter
3.3 wxPython GUI deve
3.4 Python-GRASS ad
3.5 Using GRASS gui.t
4 FAQ
5 Links
5.1 General guides
5.2 Programming
5.3 Presentations

Navigation

Main Page
Community
Development
Documents
GRASS Help
Recent changes
Help

Toolbox

What links here
Related changes
Upload file
Special pages
Printable version
Permanent link

Table Of Contents

Welcome to PyGrass's documentation!
Indices and tables

Next topic

Raster

This Page

Show Source

Quick search

Go

Enter search terms or a module, class or function name.

Welcome to PyGrass's documentation!

Since in the 2006 GRASS developers start to adopt python for the new GUI, python becoming more and more important and developers plan to convert all the bash scripts in to python for the next major release GRASS 7.

`pygrass` want to improve integration between GRASS and python, make the use of python under GRASS more consistent with the language itself and make the GRASS scripting and programming activity easier and more natural to the final users.

This project has been funded with support from the google Summer of Code 2012.

Contents:

- Raster
  - Categories
  - RastRow
  - RasterRowIO
  - RastSegment
  - RasterNumpy
  - Buffer
  - RowIO
  - Segment
  - History
  - Category
- Vector
  - VectorTopo
  - Vector

http://grass.osgeo.org/wiki/GRASS_and_Python

New GRASS 7 Python API

ISPRS Int. J. Geo-Inf. **2013**, *2*, 201-219; doi:10.3390/ijgi2010201

OPEN ACCESS

ISPRS International
Journal of
Geo-Information
ISSN 2220-9964
www.mdpi.com/journal/ijgi

Article

Pygrass: An Object Oriented Python Application Programming Interface (API) for Geographic Resources Analysis Support System (GRASS) Geographic Information System (GIS)

Pietro Zambelli [1,*], Sören Gebbert [2] and Marco Ciolli [1]

[1] Department of Civil, Environmental and Mechanical Engineering, University of Trento, via Mesiano 77, Trento 38123, Italy; E-Mail: marco.ciolli@ing.unitn.it

[2] Thünen Institute of Climate-Smart Agriculture, Bundesallee 50, Braunschweig 38116, Germany; E-Mail: soerengebbert@googlemail.com

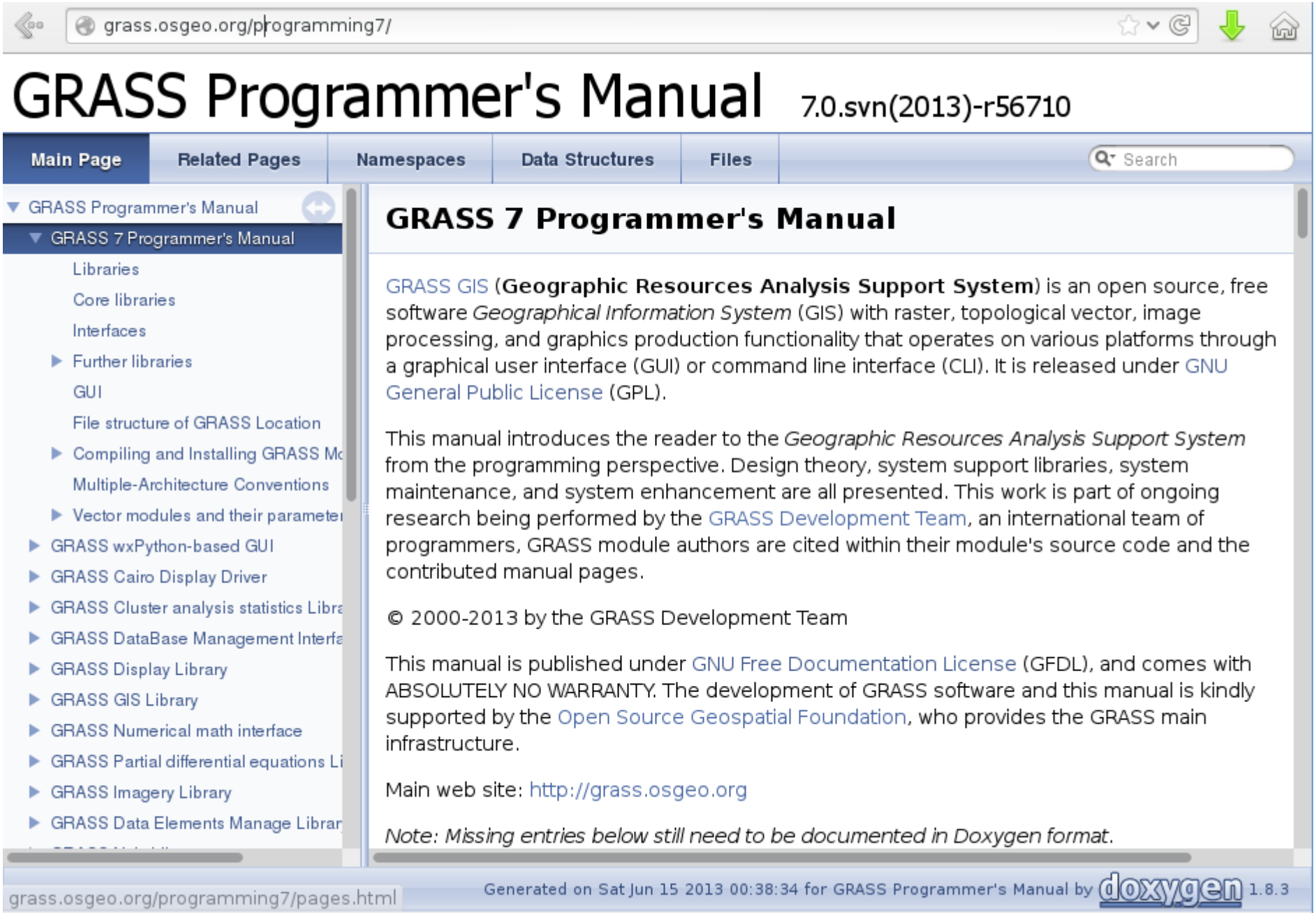
* Author to whom correspondence should be addressed; E-Mail: pietro.zambelli@ing.unitn.it; Tel.: +39-46-128-2696.

Received: 1 January 2013; in revised form: 21 January 2013 / Accepted: 21 February 2013 / Published: 11 March 2013

Abstract: PyGRASS is an object-oriented Python Application Programming Interface (API) for Geographic Resources Analysis Support System (GRASS) Geographic Information System (GIS), a powerful open source GIS widely used in academia, commercial settings and governmental agencies. We present the architecture of the PyGRASS library, covering interfaces to GRASS modules, vector and raster data, with a focus on the new capabilities that it provides to GRASS users and developers. Our

http://dx.doi.org/10.3390/ijgi2010201

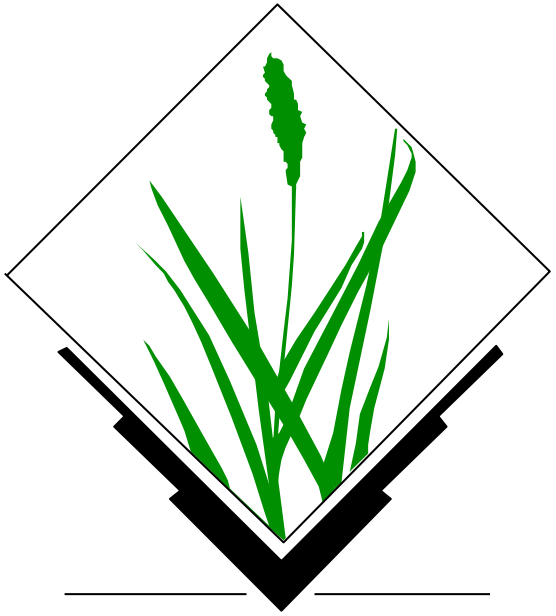
GRASS 7 Programmer's manual



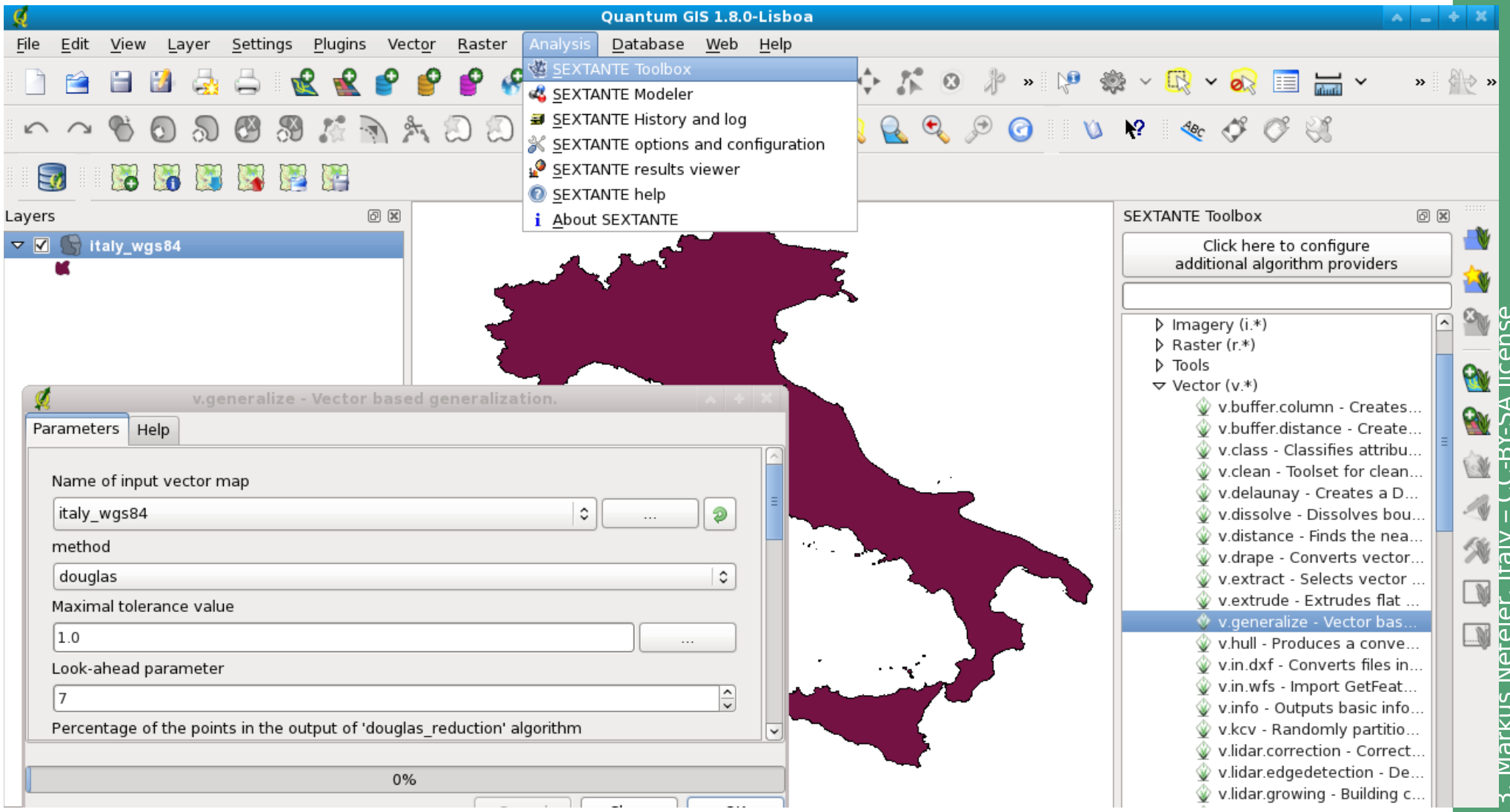
http://grass.osgeo.org/programming7/

GRASS GIS as Open Source GIS backbone:

Connecting to other software packages

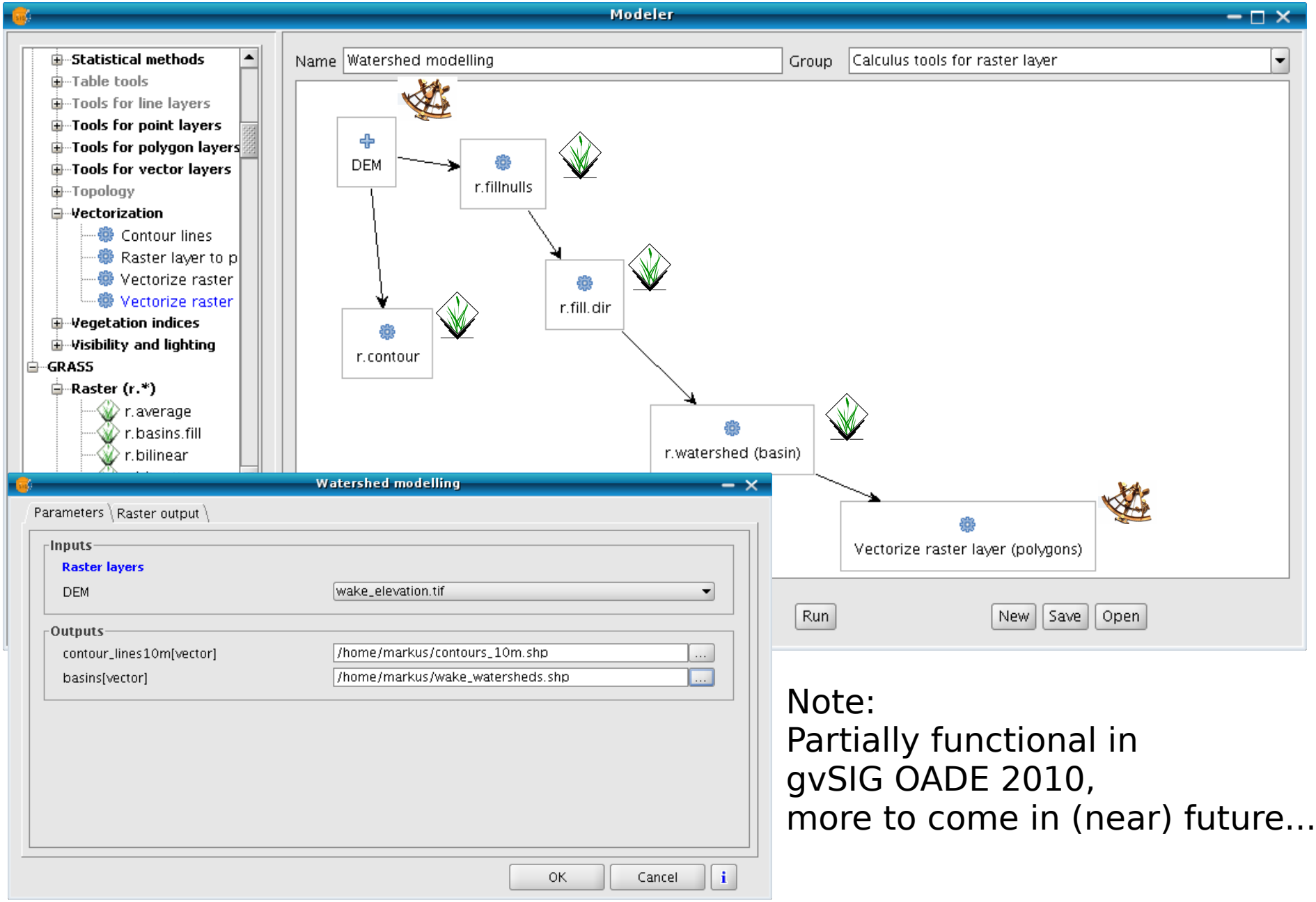


New GRASS and QGIS Integration: Sextante



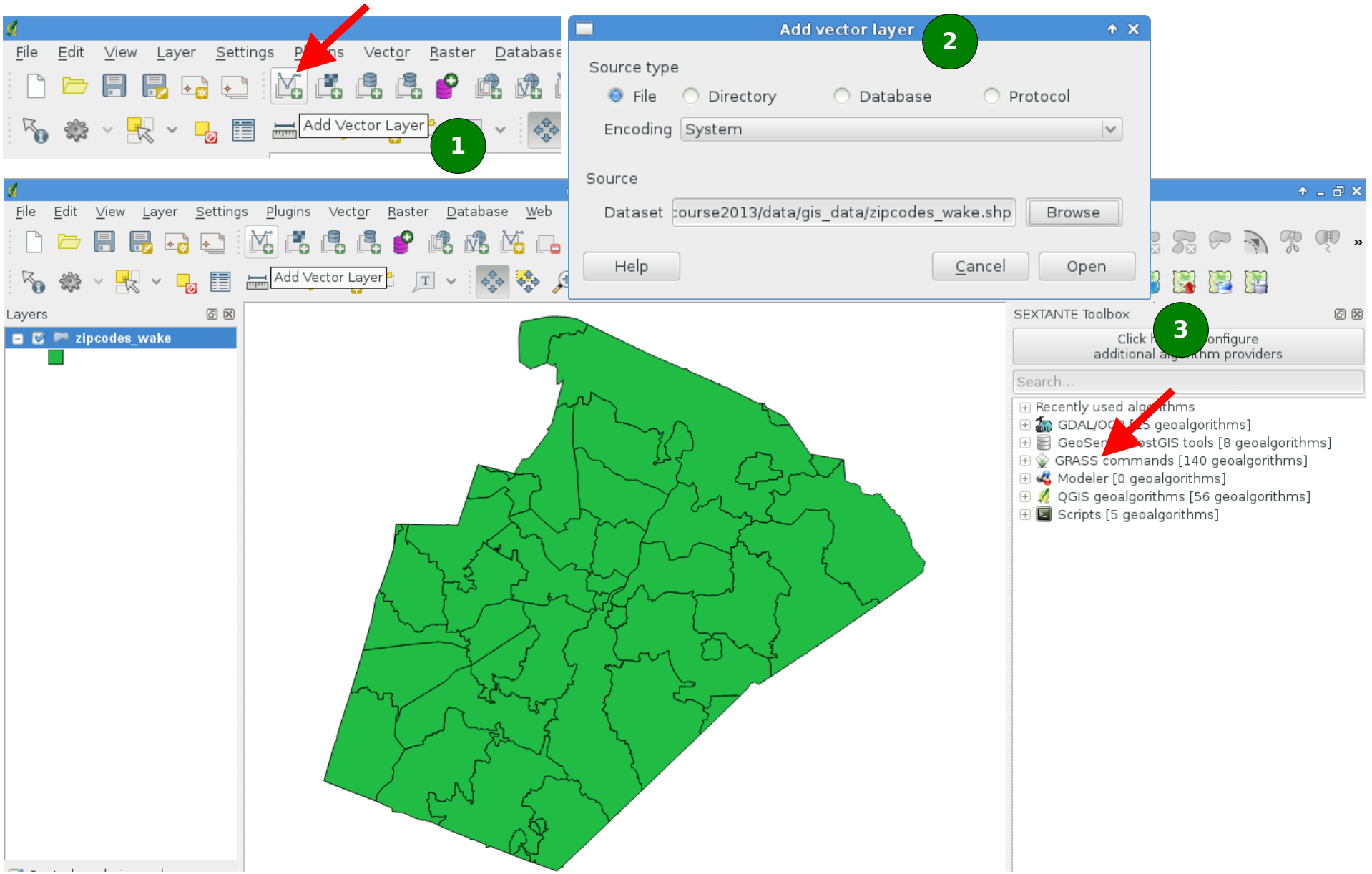
http://grass.osgeo.org/wiki/GRASS_and_Sextante

SEXTANTE – GRASS Integration: Modeller



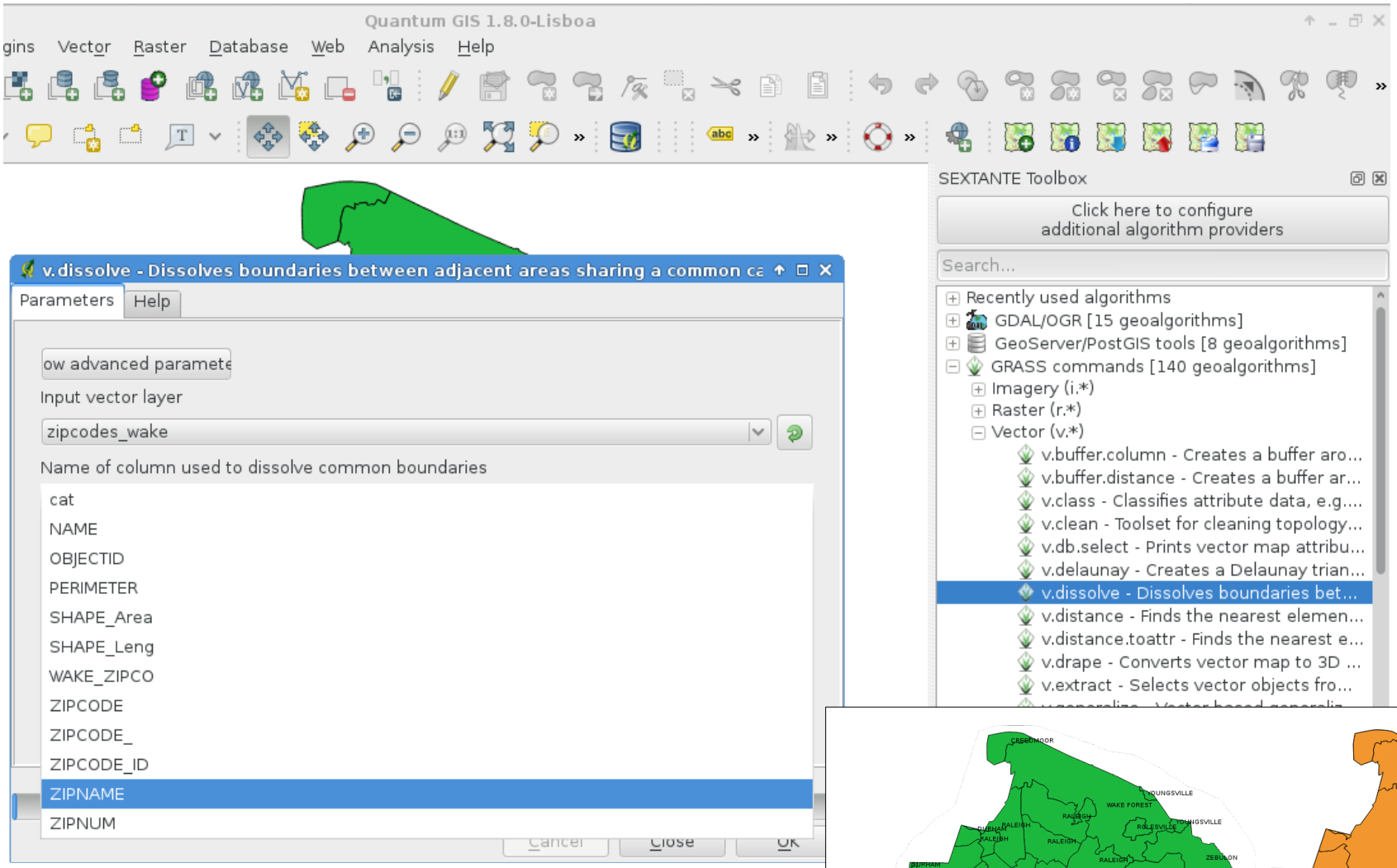
Note:
Partially functional in gvSIG OADE 2010,
more to come in (near) future...

QGIS-Sextante – Using GRASS in QGIS via Sextante



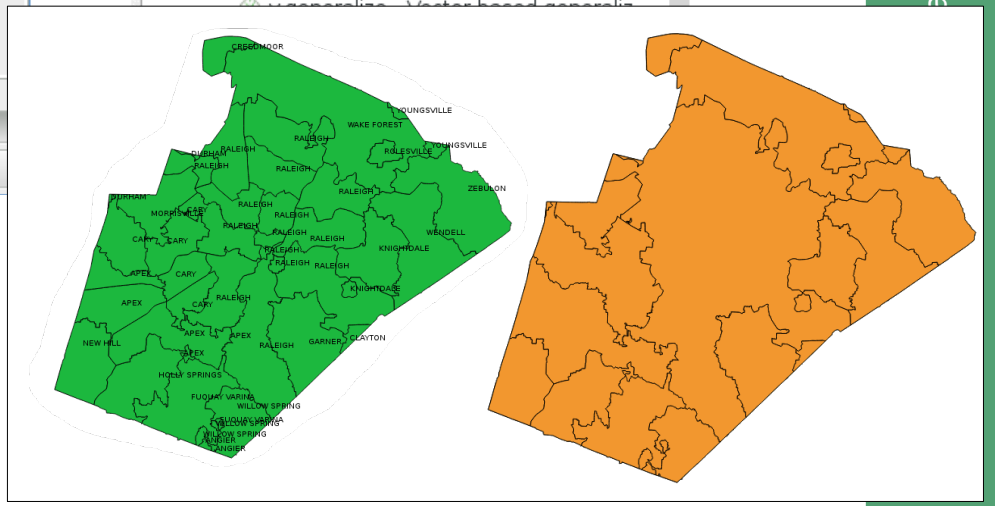
http://grasswiki.osgeo.org/wiki/GRASS_and_Sextante

QGIS-Sextante – Vector dissolving example



Dissolving geometry by string column attributes:

Sextante calls GRASS GIS in a virtual session which deliver the result back (here SHAPE file)

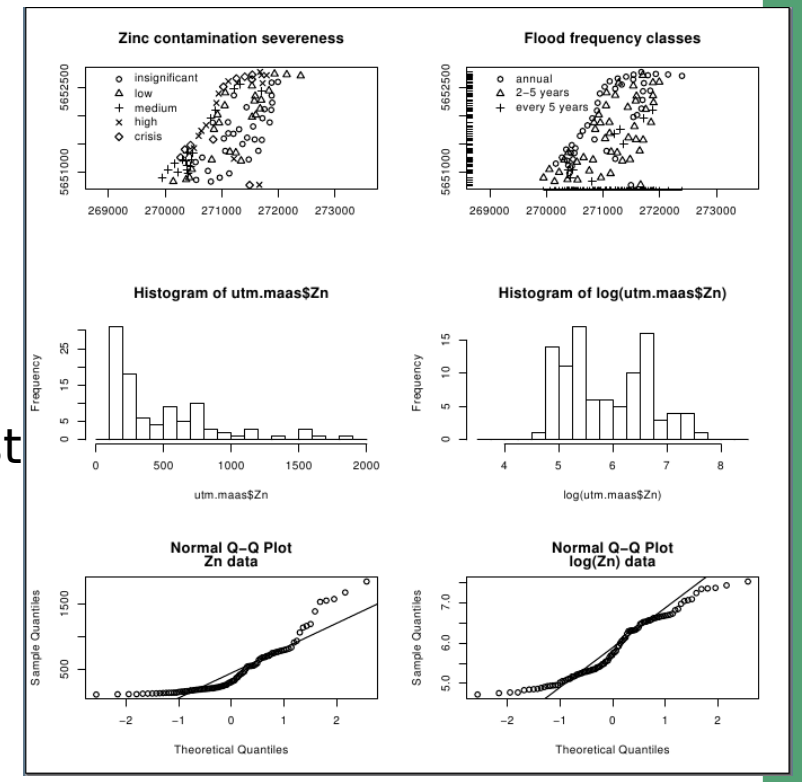


GRASS 7: Native WPS Support

```
r.grow --wps-process-description
```

```
<?xml version="1.0" encoding="UTF-8"?>
<wps:ProcessDescriptions xmlns:wps="http://www.opengis.net/wps/1.0.0"
xmlns:ows="http://www.opengis.net/ows/1.1"
xmlns:xlink="http://www.w3.org/1999/xlink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.opengis.net/wps/1.0.0
 http://schemas.opengis.net/wps/1.0.0/wpsDescribeProcess_response.xsd"
 service="WPS" version="1.0.0" xml:lang="en-US">
        <ProcessDescription wps:processVersion="1" storeSupported="true" statusSupported="true">
                <ows:Identifier>r.grow</ows:Identifier>
                <ows:Title>Generates a raster map layer with contiguous areas grown by one cell.</ows:Title>
                <ows:Abstract>The manual page of this module is available here: http://grass.osgeo.org/grass70/manuals/html70_use
                <ows:Metadata xlink:title="raster" />
                <DataInputs>
                        <Input minOccurs="1" maxOccurs="1">
                                <ows:Identifier>input</ows:Identifier>
                                <ows:Title>Name of input raster map</ows:Title>
                                <ComplexData maximumMegabytes="2048">
                                        <Default>
                                                <Format>
                                                        <MimeType>image/tiff</MimeType>
                                                </Format>
                                        </Default>
                                        <Supported>
                                                <Format>
                                                        <MimeType>image/tiff</MimeType>
                                                </Format>
                                                <Format>
                                                        <MimeType>image/geotiff</MimeType>
                                                </Format>
                                                <Format>
                                                        <MimeType>application/geotiff</MimeType>
```

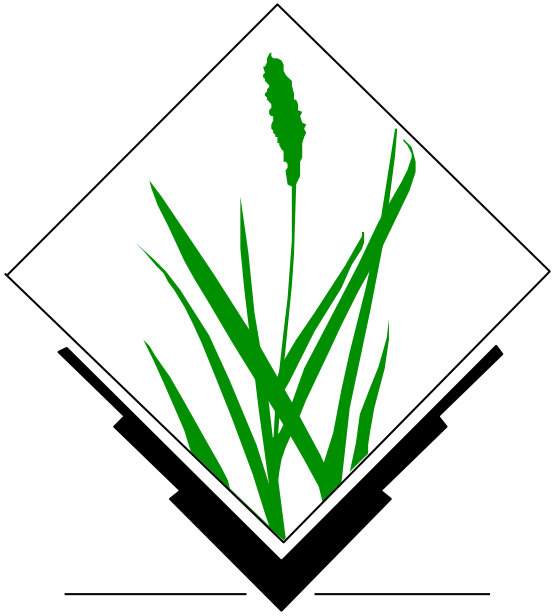
GRASS and R Integration



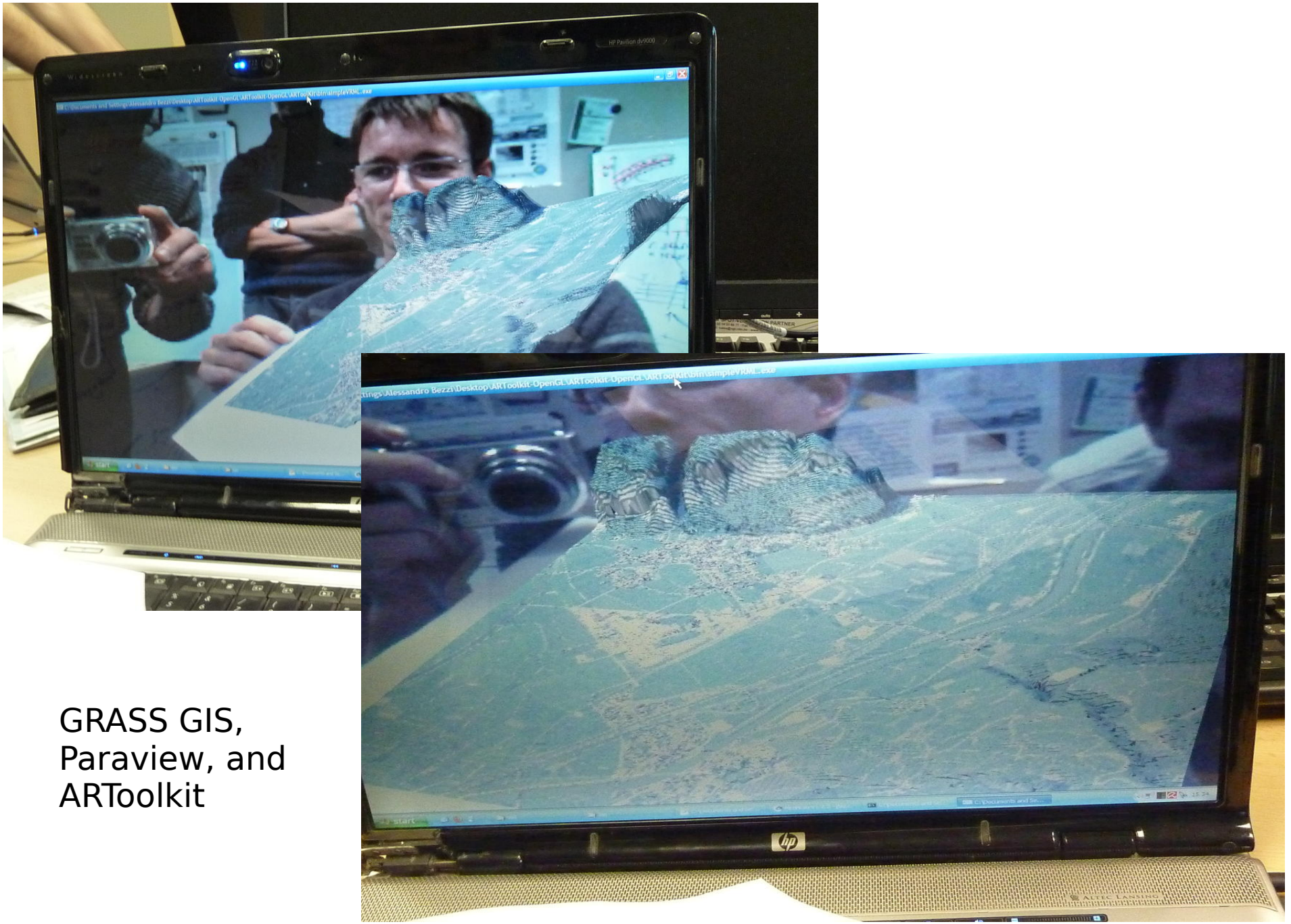

```
GRASS 7.0.svn (nc_spm_08_grass7):~ > R

R version 3.0.1 (2013-05-16) -- "Good Sport"
Copyright (C) 2013 The R Foundation for Statist
Platform: x86_64-redhat-linux-gnu (64-bit)

> library(spgrass6)
Loading required package: sp
Loading required package: XML
GRASS GIS interface loaded with GRASS version: GRASS 7.0.svn (2013)
and location: nc_spm_08_grass7
>
> myrast <- readRAST6(c("geology", "elevation"), cat=c(TRUE, FALSE))
> myvect <- readVECT6("roads")
...
> writeRAST6(myrast, "elev_filt", zcol="elev")
...
```

http://grass.osgeo.org/wiki/R_statistics

Visualization



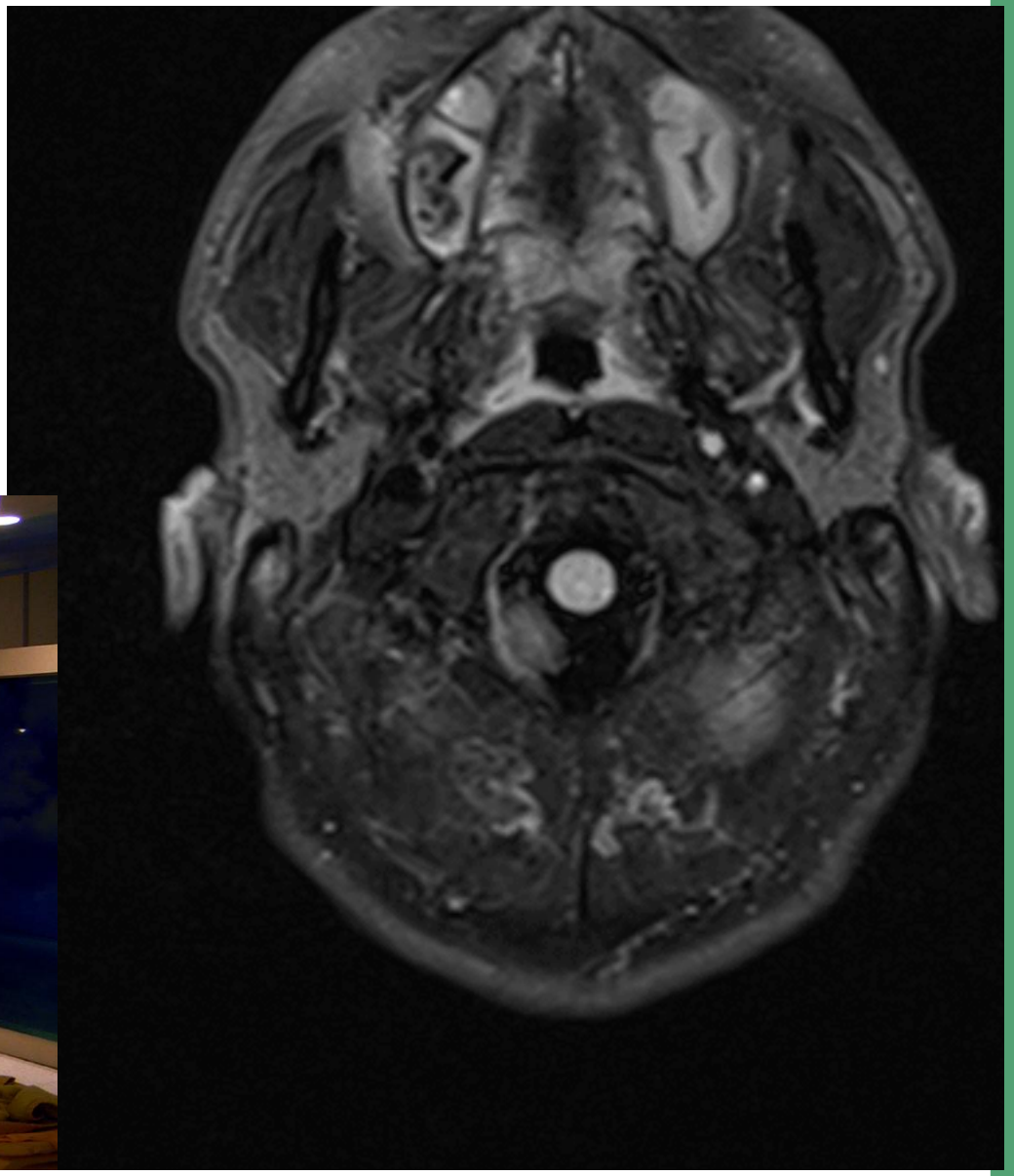
Visualization: GRASS data export to for Augmented Reality



GRASS GIS, Paraview, and ARToolkit

A researcher's brain... From MRT scan to Voxels

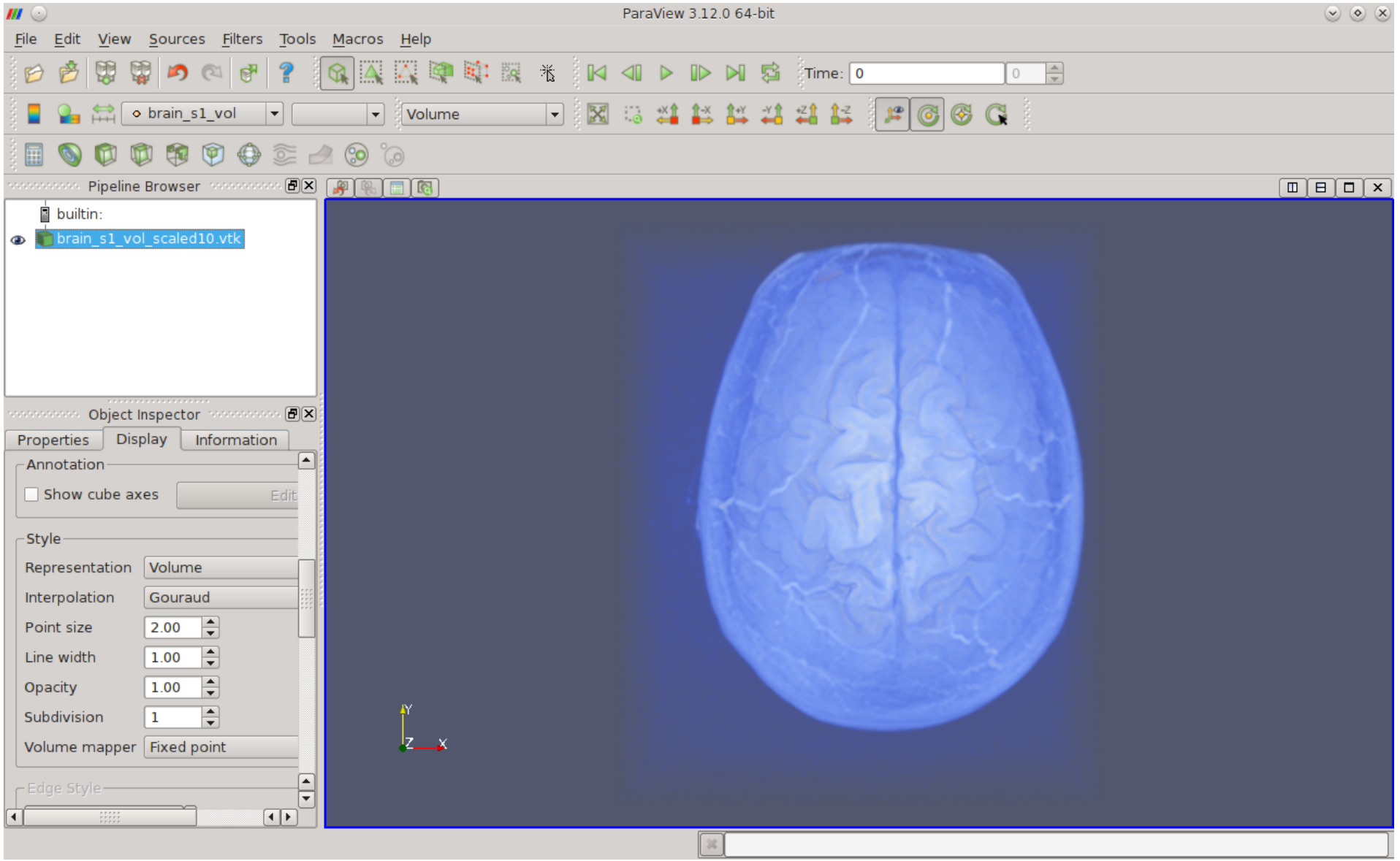
Our FEM colleague
-->



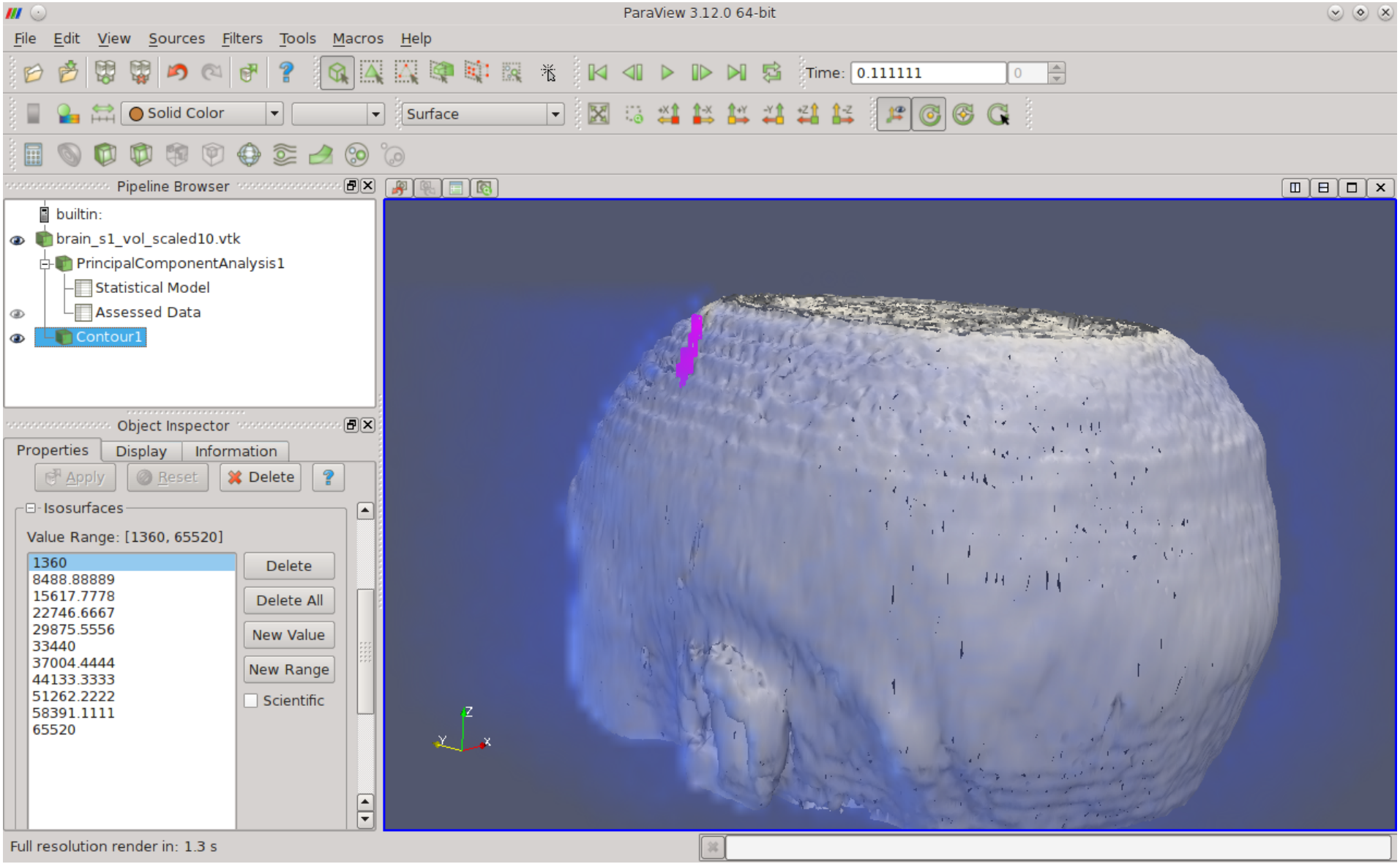
http://it.wikipedia.org/wiki/Imaging_a_risonanza_magnetica

Personal comm.

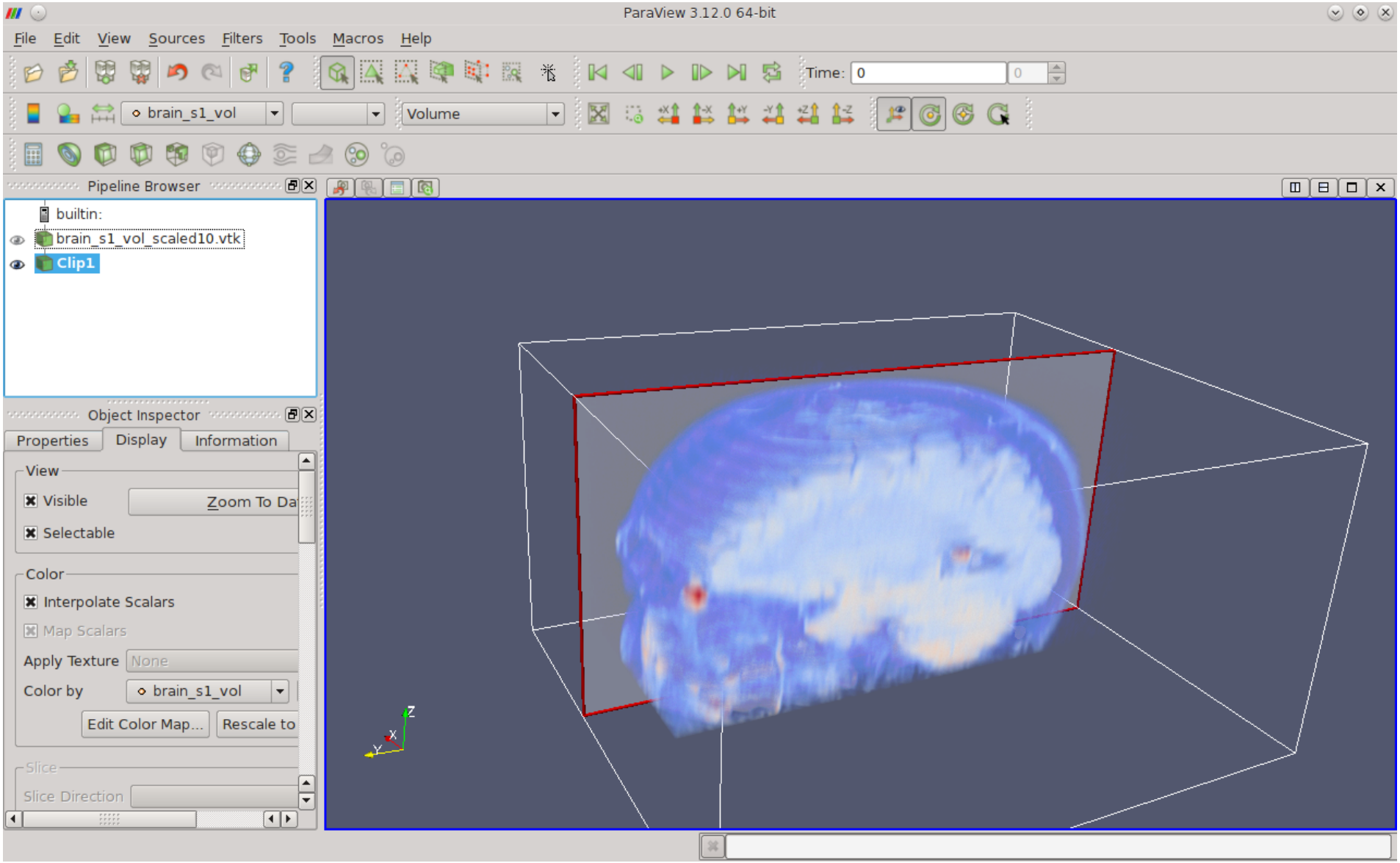
A researcher's brain... From MRT scan to Voxels



A researcher's brain... From MRT scan to Voxels



A researcher's brain... From MRT scan to Voxels



GRASS 7: News in Image processing

Improved modules:

Georectification

Orthorectification

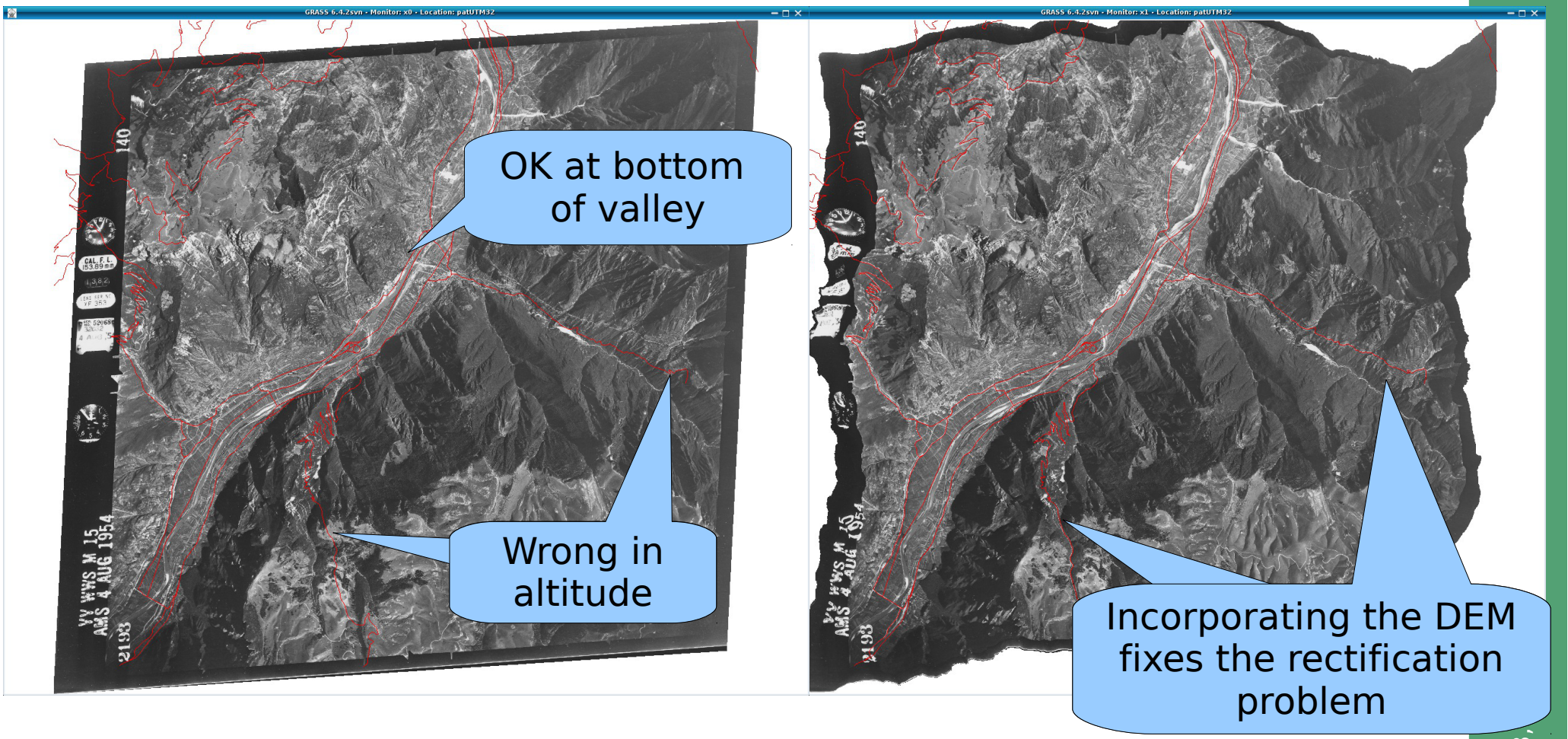
Atmospheric correction

Terrain correction

Landsat cloud detection

Ortho-rectification of aerial images

Why using the DEM for image rectification:



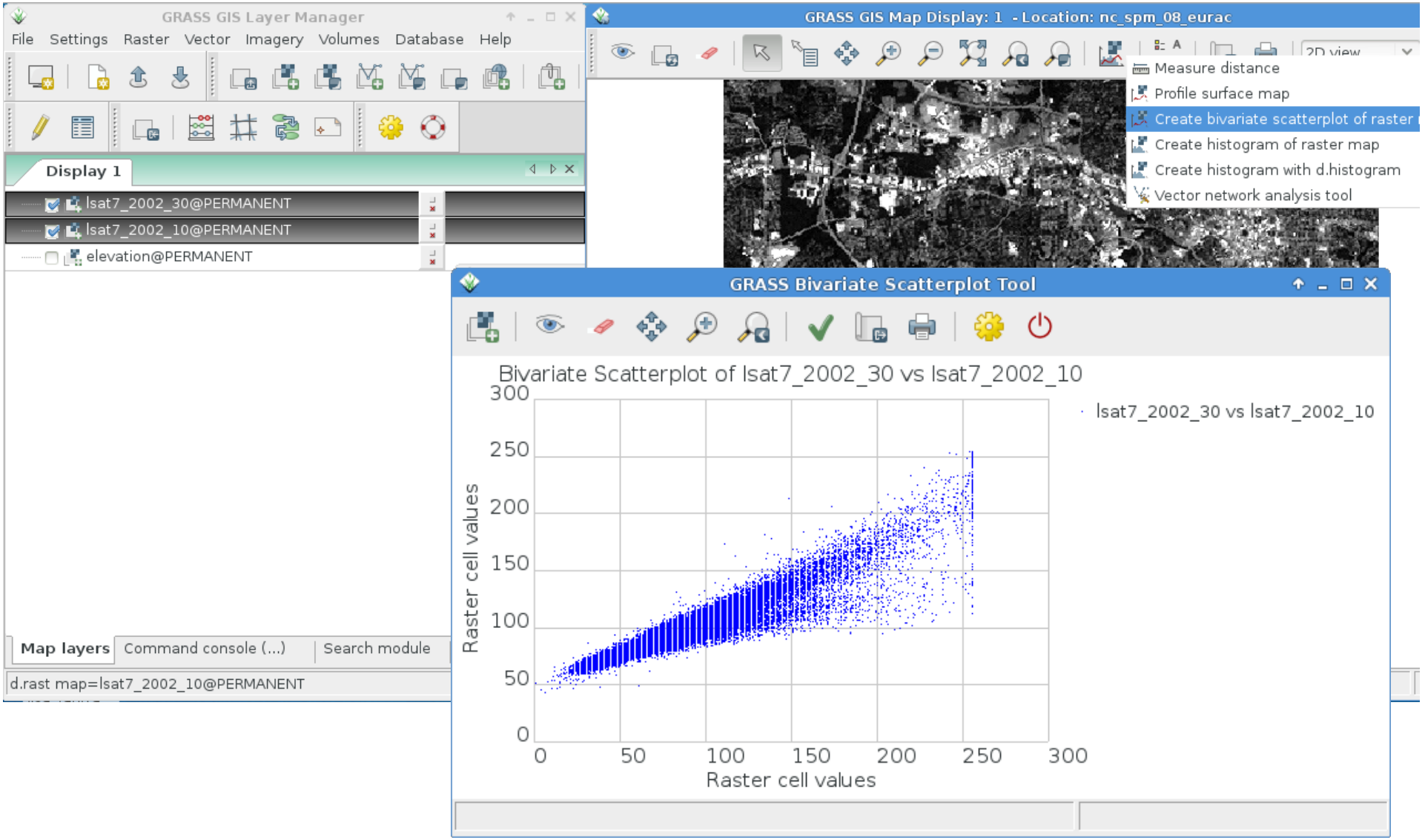
Linear rectification (insufficient)

(Problem commonly seen in Google Earth)

Ortho-rectification

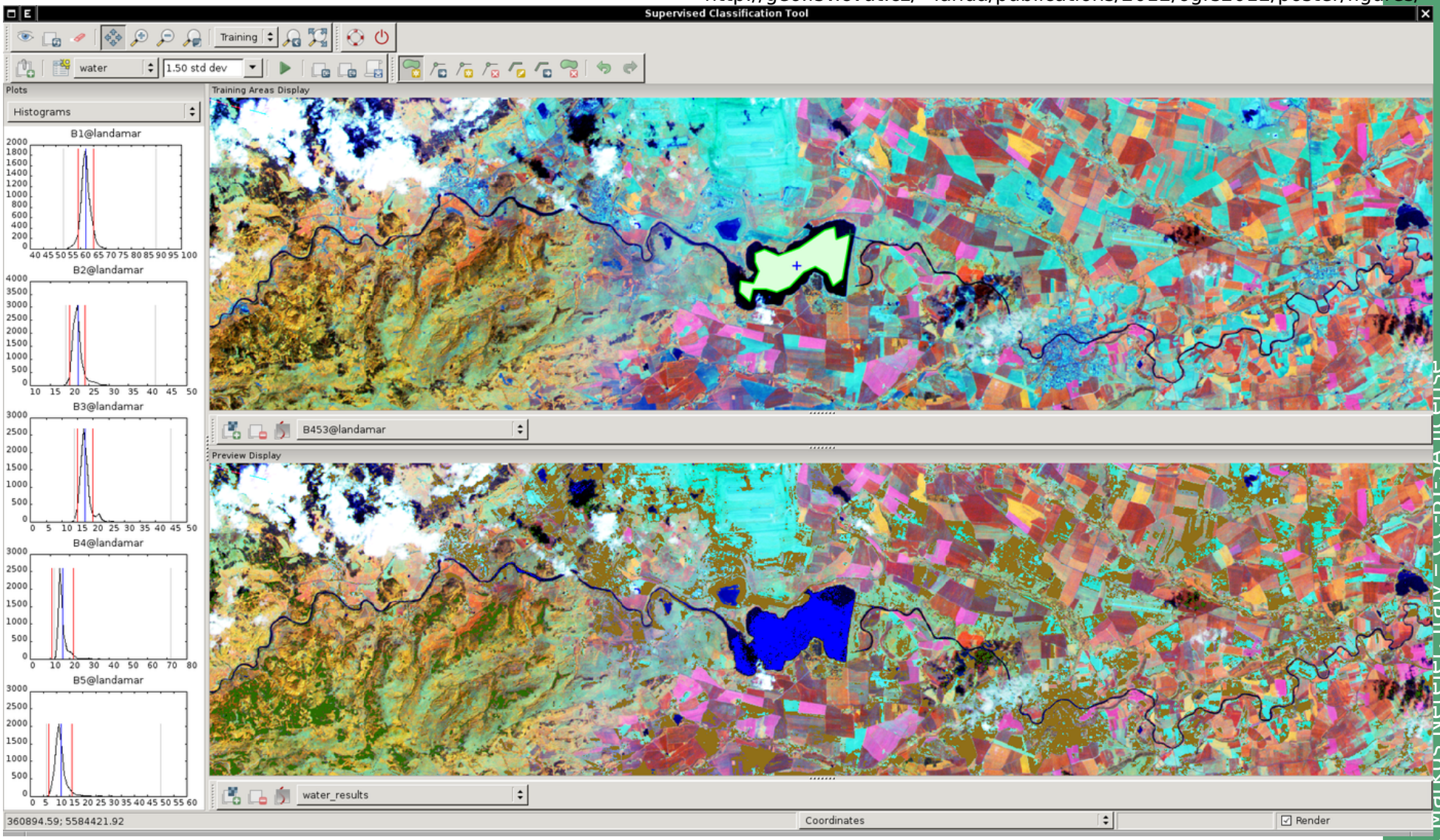
GRASS 7: New bivariate Scatterplots

LANDSAT 7 2002 **channels 1 and 3** of Wake county, NC



Supervised image classification

http://geo.fsv.cvut.cz/~landa/publications/2012/ogrs2012/poster/figures/

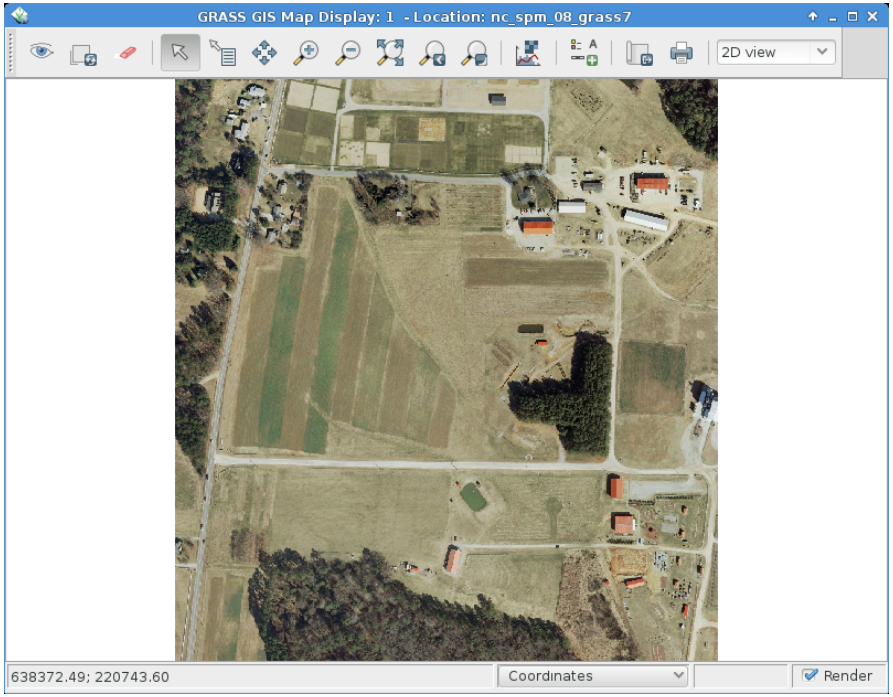


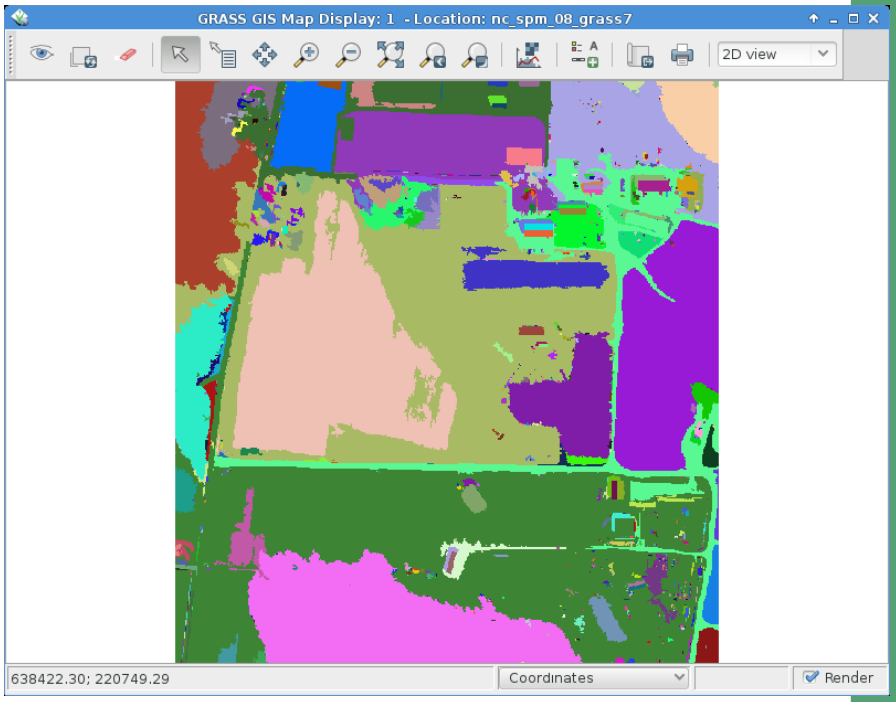
Tool for supervised classification of imagery data.

Generates spectral signatures for an image by allowing the user to outline regions of interest.

Unsupervised image classification – Segmentation

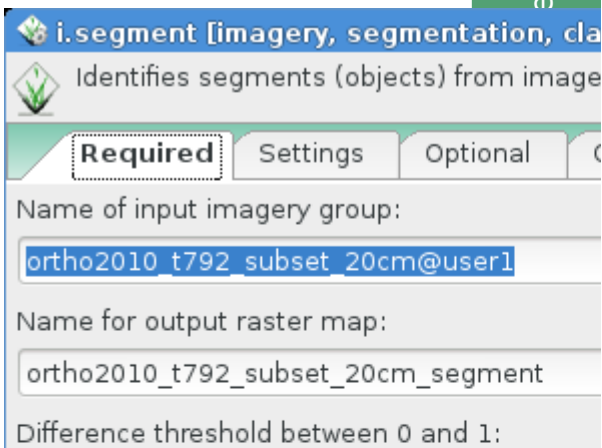
i.segment - Identifies segments (objects) from imagery data.






```
# set comp. region to orthophoto but align pixels to elevation map (for speed reasons in
# this demonstrational exercise – for real work please use the true resolution)
g.region rast=ortho2010_t792_subset_20cm.blue align=elev_lid792_1m -p

# Note: the RGB bands are organized as a group
i.segment group=ortho2010_t792_subset_20cm \
          output=ortho2010_t792_subset_20cm_segment \
          goodness=ortho2010_t792_subset_20cm_seg_fit \
          threshold=0.25
```

Finally vectorize with r.to.vect



Where is the stuff?

GRASS GIS Software:

Free download for MS Windows, MacOSX, Linux and source code:

http://grass.osgeo.org/download/

Addons (user contributed extensions):

http://grasswiki.osgeo.org/wiki/GRASS_AddOns

Free sample data:

Rich data set of North Carolina (NC)

... available as GRASS GIS location and in common GIS formats

http://grass.osgeo.org/download/sample-data/

User Help:

Mailing lists (also in different languages):

http://grass.osgeo.org/support/

Wiki:

http://grasswiki.osgeo.org/wiki/

Manuals:

http://grass.osgeo.org/documentation/manuals/

http://grass.osgeo.org

http://trac.osgeo.org/grass/wiki/Grass7/NewFeatures

Markus Neteler

Fondazione E. Mach (FEM)
Centro Ricerca e Innovazione
GIS and Remote Sensing Unit
38010 S. Michele all'Adige (Trento), Italy
http://gis.cri.fmach.it
http://www.osgeo.org

markus.neteler@fmach.it
neteler@osgeo.org

Enjoy GRASS GIS 7!

THANKS!

OSGeo
Your Open Source Compass