

PCA-5017

**INTRODUÇÃO AOS SISTEMAS DE
INFORMAÇÃO GEOGRÁFICA EM SOFTWARE
LIVRE**

CARLOS HENRIQUE GROHMANN

INSTITUTO DE ENERGIA E AMBIENTE - USP

GRASS

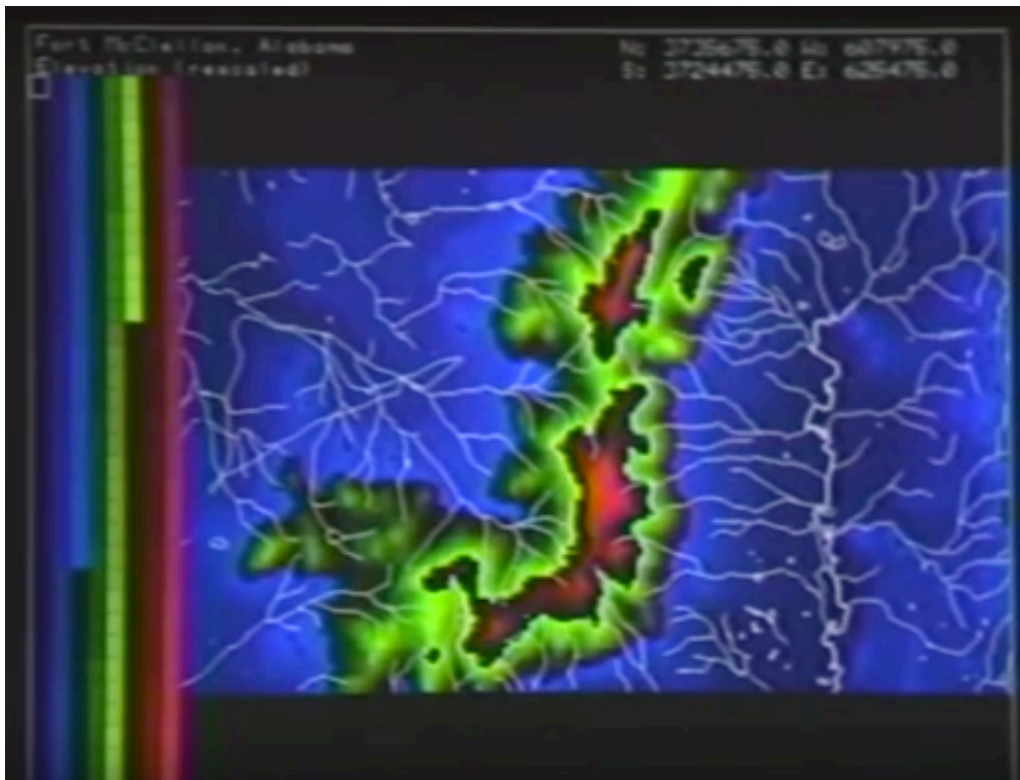
GRASS - histórico

- ▶ Geographic Resources Analysis Support System
- ▶ 1982 Fort Hood Information System (FHIS) (Vax11/780)
- ▶ 1983 Installation Geographic Information System (IGIS) (SUN-1)
- ▶ 1984 GRASS (SUN-1 and Masscomp)
- ▶ 1985 GRASS 1.0
- ▶ 1987 GRASS 2.0
- ▶ 1988 GRASS 3.0
- ▶ 1991 GRASS 4.0
- ▶ 1997 GRASS 4.2 Baylor University
- ▶ 1998 GRASS 4.2.1 Markus Neteler, University of Hannover, Germany
- ▶ 1999 GRASS 5.0 Baylor University and Markus Neteler

GRASS - histórico

- ▶ 2001 The GRASS Development Team
- ▶ 2002 GRASS 5.0 stable
- ▶ 2004 GRASS 5.4.0
- ▶ 2005 GRASS 6.0
- ▶ 2006 GRASS 6.1
- ▶ 2006/7 GRASS 6.2
- ▶ 2007/8 GRASS 6.3
- ▶ 2008 GRASS 6.4 (+ WinGRASS)
- ▶ 2012 GRASS 6.4.2
- ▶ GRASS 6.5 - bugfix + testing
- ▶ GRASS 7.0 - new stuff

GRASS - histórico - versão 2.0



```

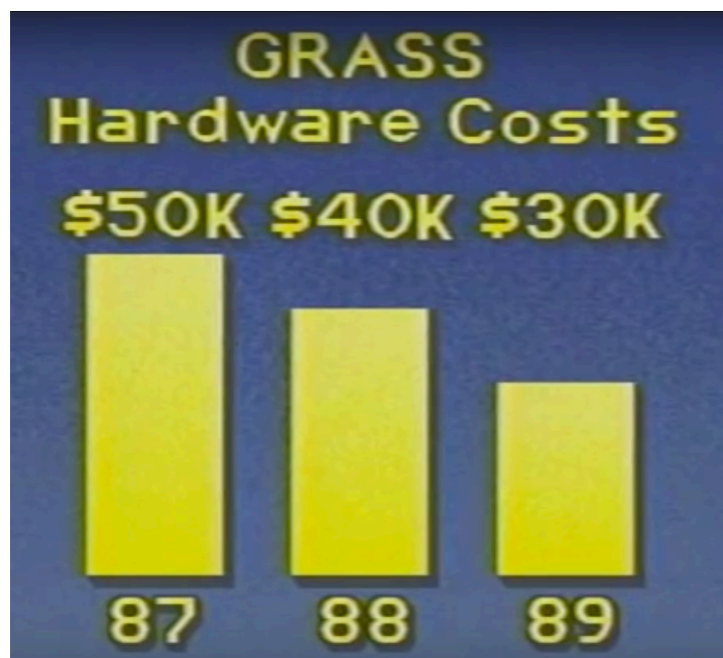
PLEASE SET GIS SESSION INFORMATION

LOCATION: This is the name of an available geographic location. -spearfish-
is the sample data base for which all tutorials are written.

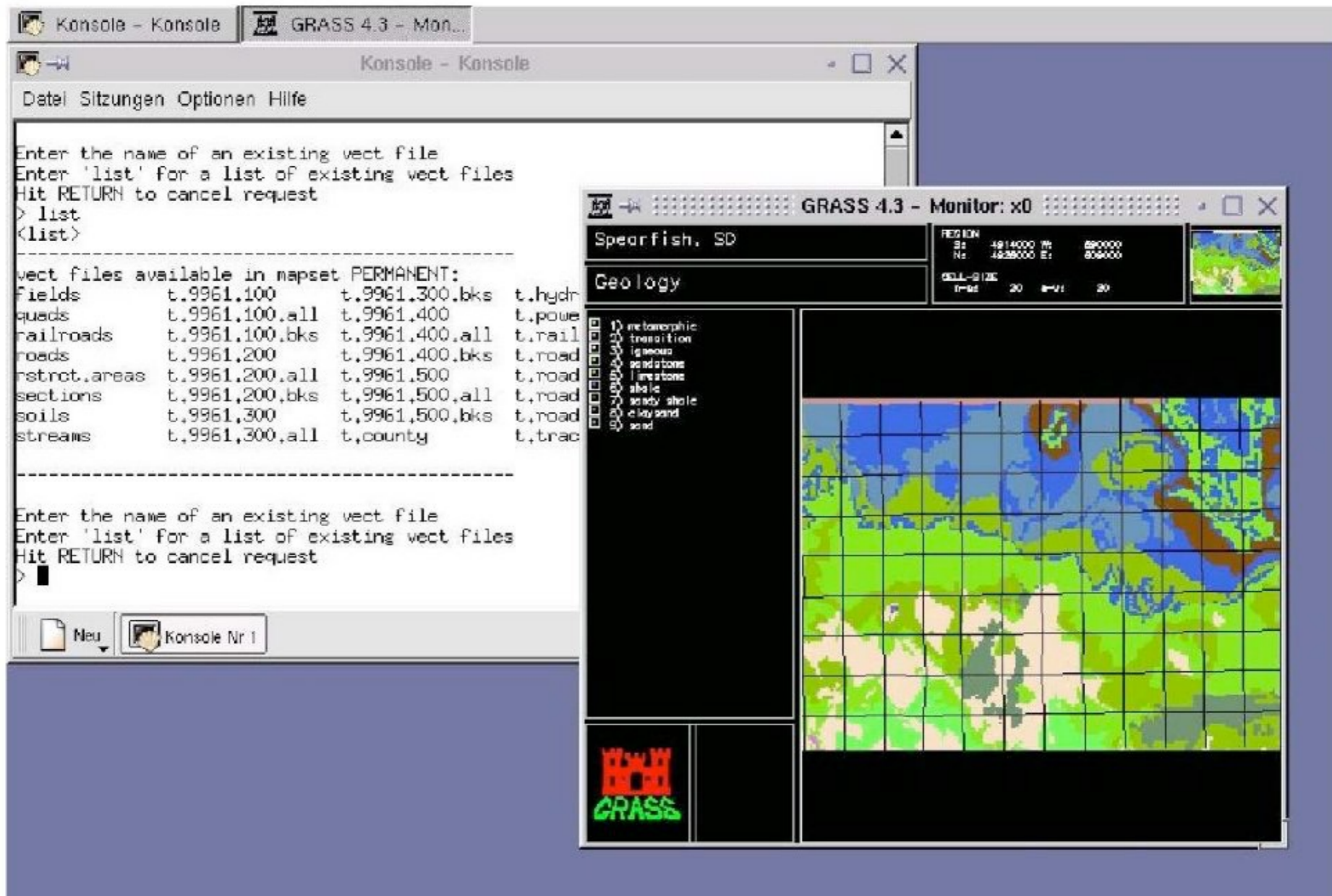
MAPSET: Every GIS session runs under the name of a MAPSET. Associated
with each MAPSET is a rectangular COORDINATE WINDOW and a list
of any new maps created.

The WINDOW defaults to the entire area of the chosen LOCATION.
You may change it later with the command: window
-----
LOCATION:..... hood.....
MAPSET:..... Johnson.....

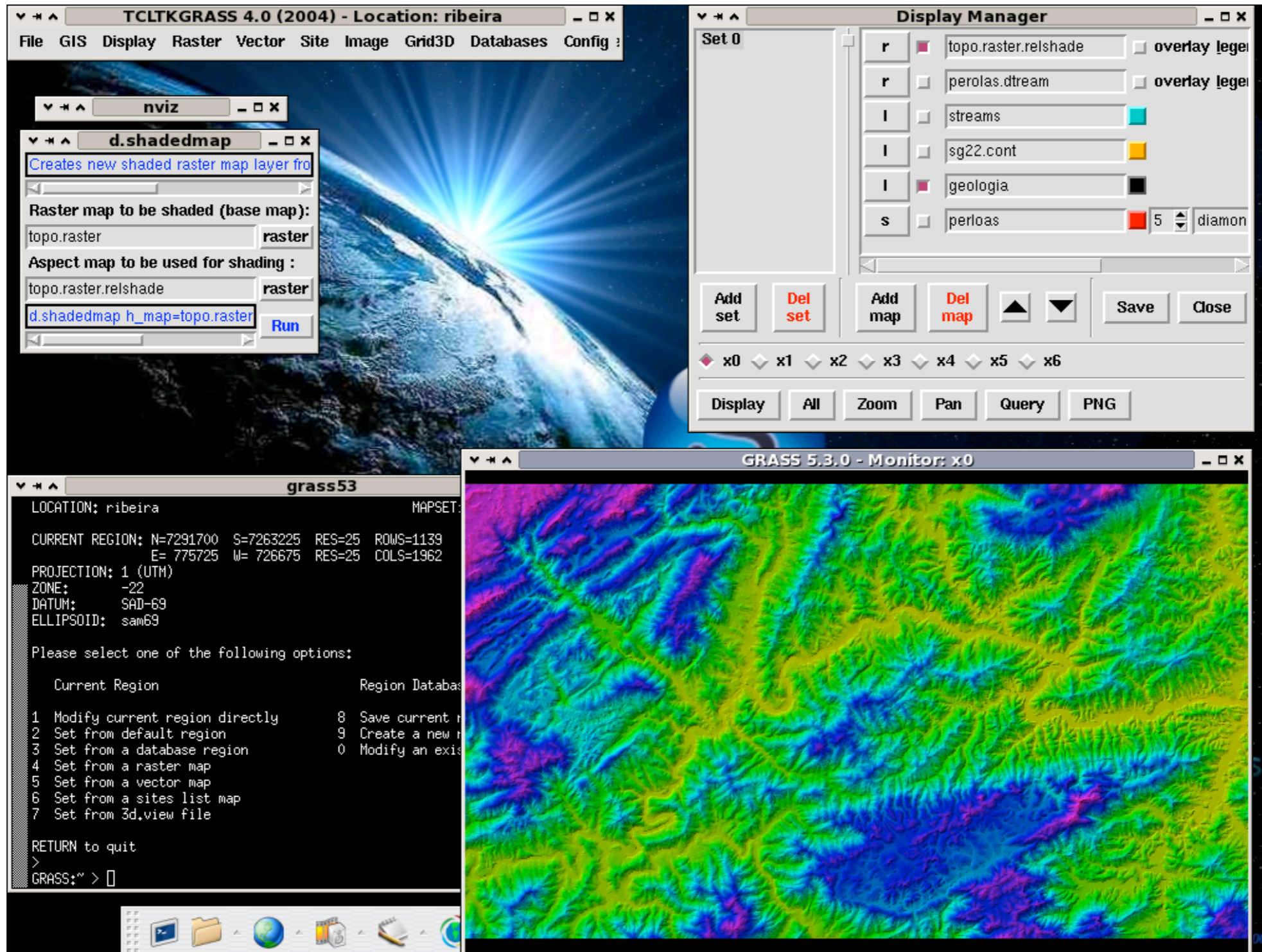
AFTER COMPLETING ALL ANSWERS, HIT (ESC) TO CONTINUE
(OB INTERRUPT TO CANCEL)
    
```



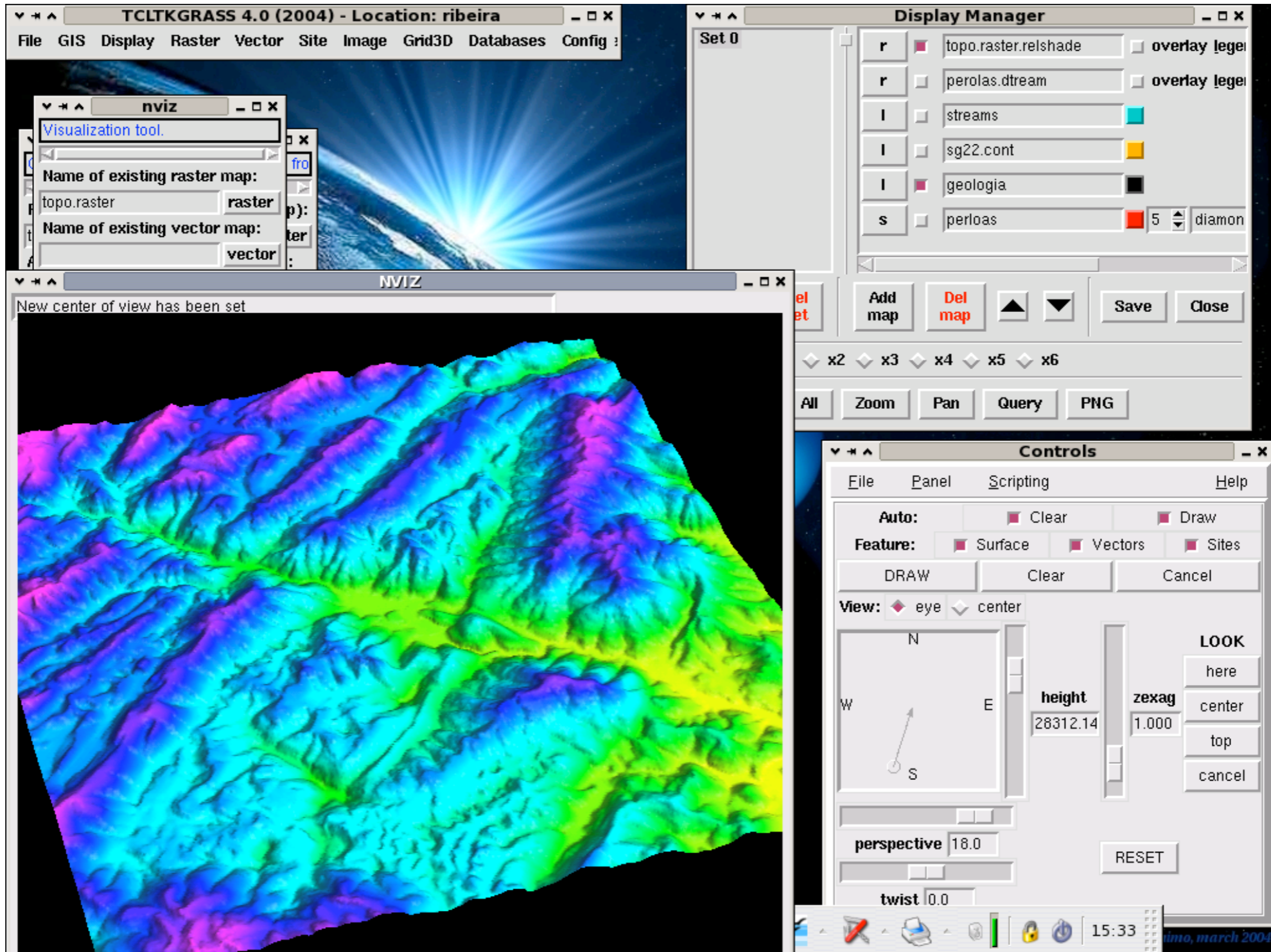
GRASS - histórico - versão 4.3



GRASS - histórico - versão 5.3



GRASS - histórico - versão 5.3



GRASS - histórico - versão 6.2

The image displays the GRASS GIS 6.3 interface, showing the Map Manager, Map Display, and Command Line windows.

Map Manager (GRASS6.3.svn GIS Manager - podecarda tf_lampiao): This window shows the "Map Layers for Display 1" section. It lists the layer "topo_fp@tf_lampiao" and provides options for "values to display", "Optional color draping", "drape map" (set to "topo_fp@tf_lampiao"), and "drape map brightness adjustment" (set to 0). A "Welcome to GRASS GIS" message is visible at the bottom.

Map Display 1: This window displays a 3D topographic map with a color gradient from blue (low elevation) to red (high elevation). The map shows a complex terrain with a prominent ridge and a valley.

grass63 (Command Line): This window shows the GRASS 6.3 startup screen. It displays the "GRASS 6.3" logo and provides the following information:

```
Welcome to GRASS 6.3.svn (2008)
GRASS homepage: http://grass.osgeo.org/
This version running thru: Bash Shell (/bin/bash)
Help is available with the command: g.manual -i
See the licence terms with: g.version -c
If required, restart the graphical user interface with: gis.m
When ready to quit enter: exit

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

GRASS 6.3.svn (podecarda):~ > |
```

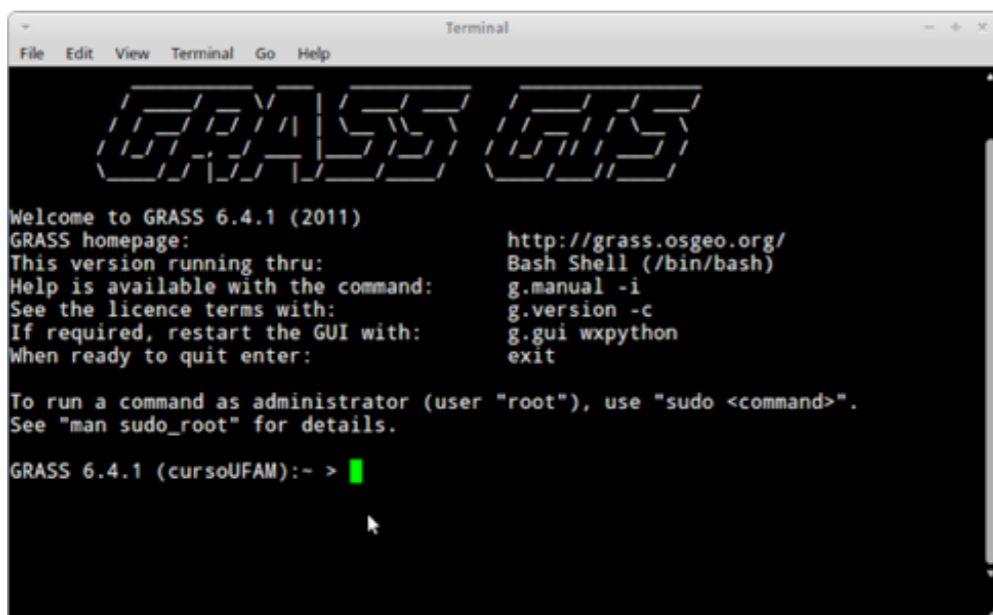
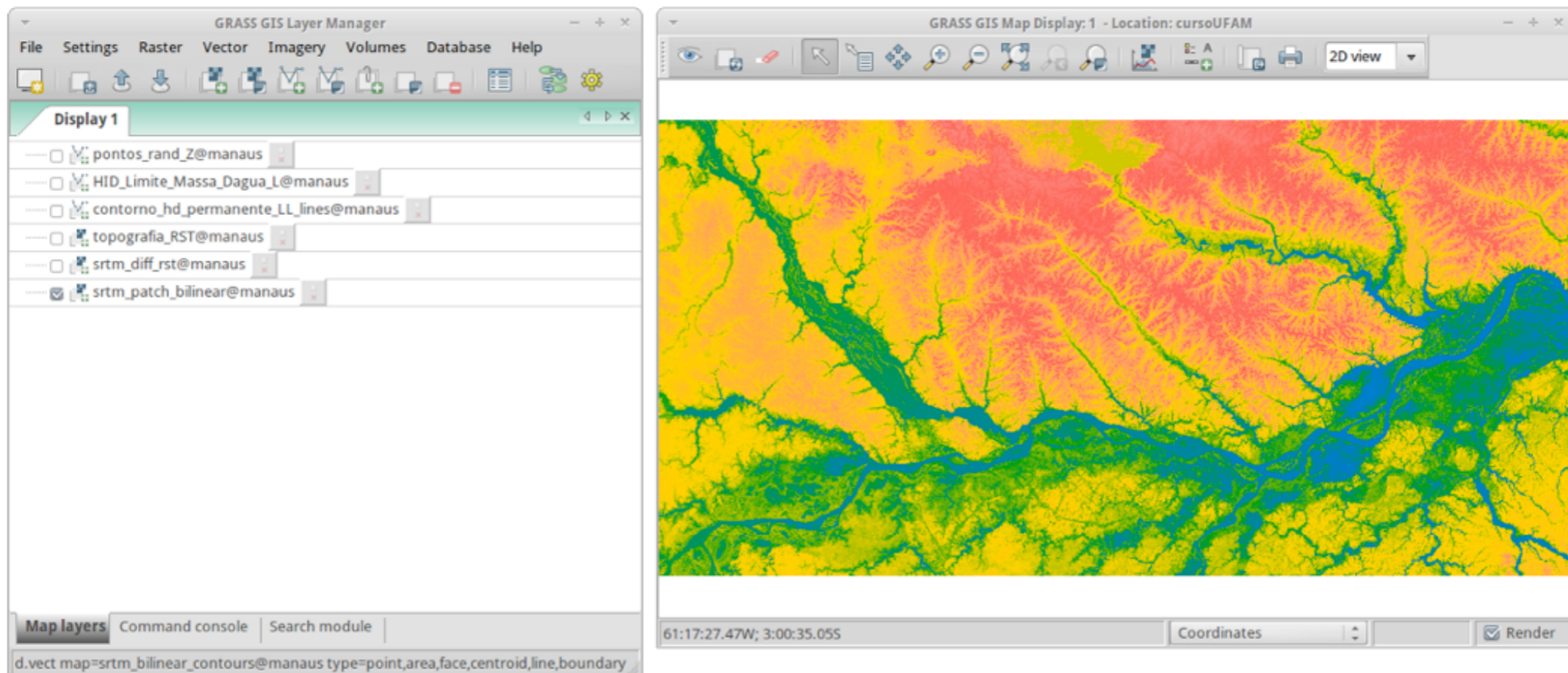
Output - GIS.m: This window shows the command executed in the terminal:

```
g.pnmcomp in=7442.2.ppm mask=7442.2.pgm opacity=1.0 background=255:255:255
width=521 height=459 output=7442.1.ppm
```

The window includes "Save" and "Clear" buttons, and a "Run" section with options: "Run", "Run (background)", "Run (GUI)", and "Run (in Xterm)".

The system tray at the bottom shows the date and time: "Sunday, February 10 - 18:49".

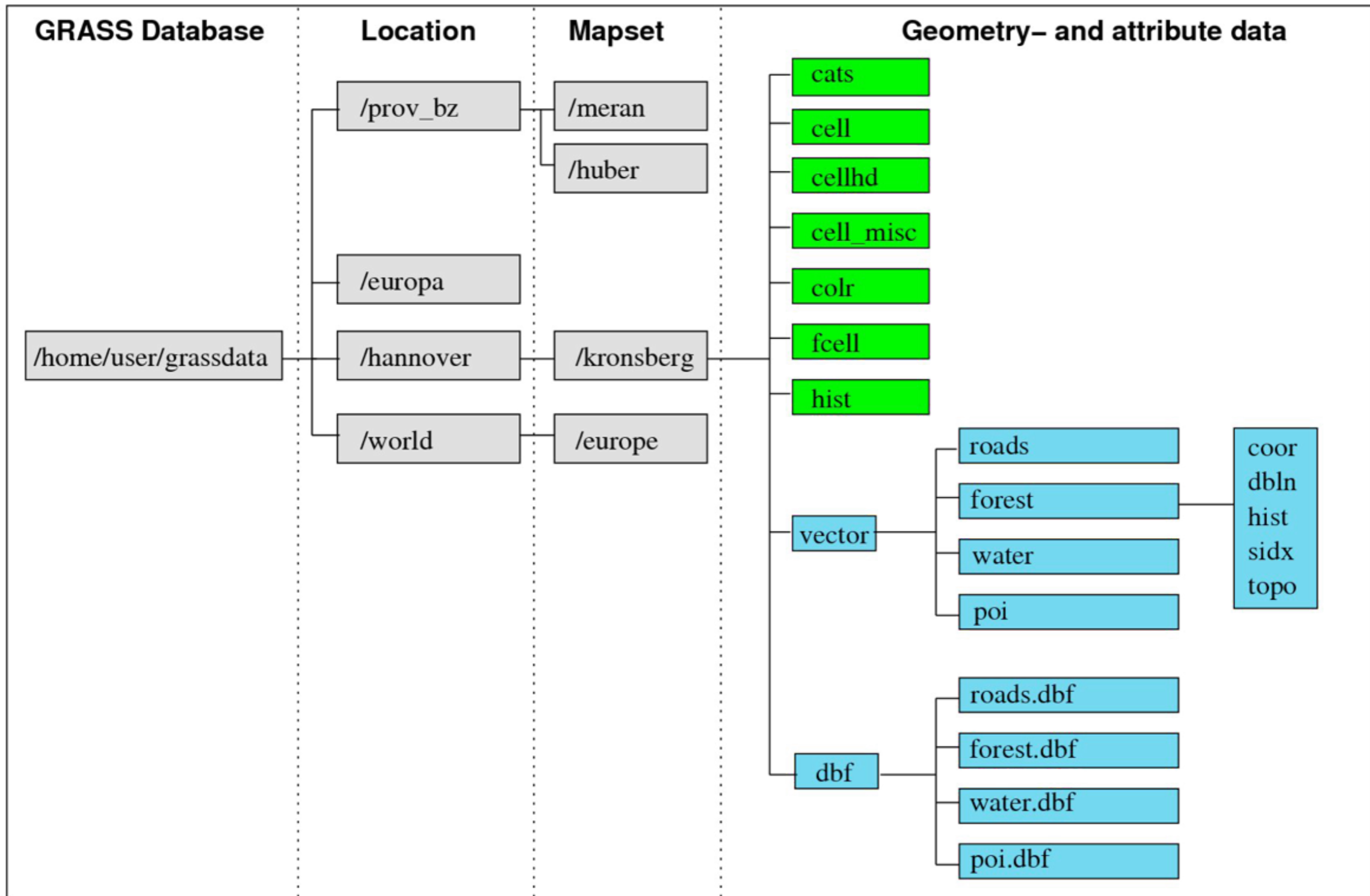
GRASS - histórico - versão 6.4 + 7.0



Organização dos projetos

- ▶ Hierarquia baseada em **Locations** e **mapsets**
- ▶ A **Location** compreende toda a área de trabalho (p.ex., **America_do_Sul**)
- ▶ O **mapset** é a porção ativa e utilizada para análise, que pode ser do mesmo tamanho ou menor que a location (p.ex., **Sao_Paulo**, **area_mestrado**, etc)
- ▶ Vários mapsets podem ser definidos para a mesma location.
- ▶ Dados de interesse comum (tais como modelos de relevo, imagens de satélite etc) podem ser armazenados em um mapset especial ao qual todos os usuários têm acesso, chamado de PERMANENT, que é criado automaticamente ao se criar uma nova Location

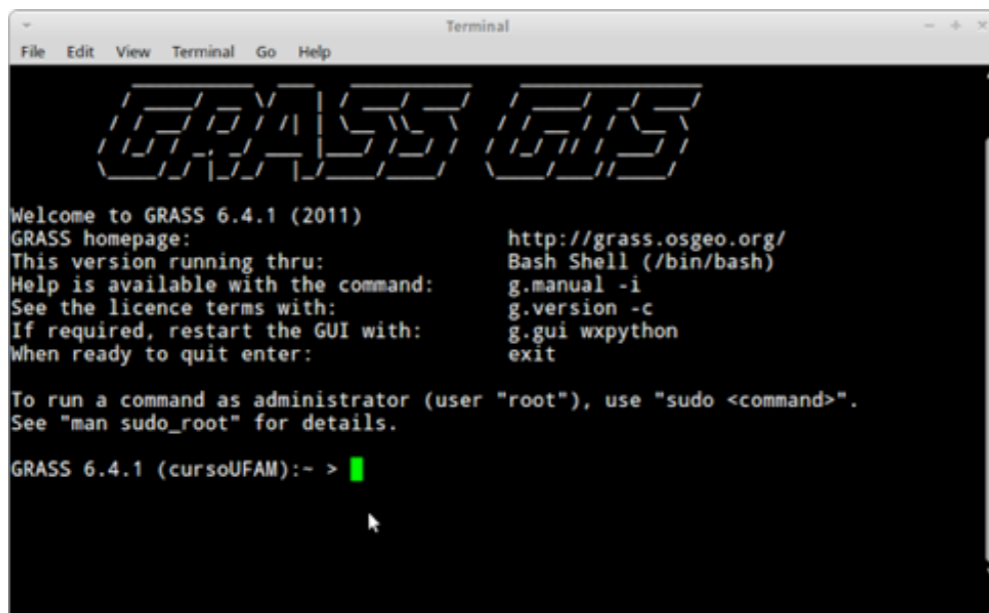
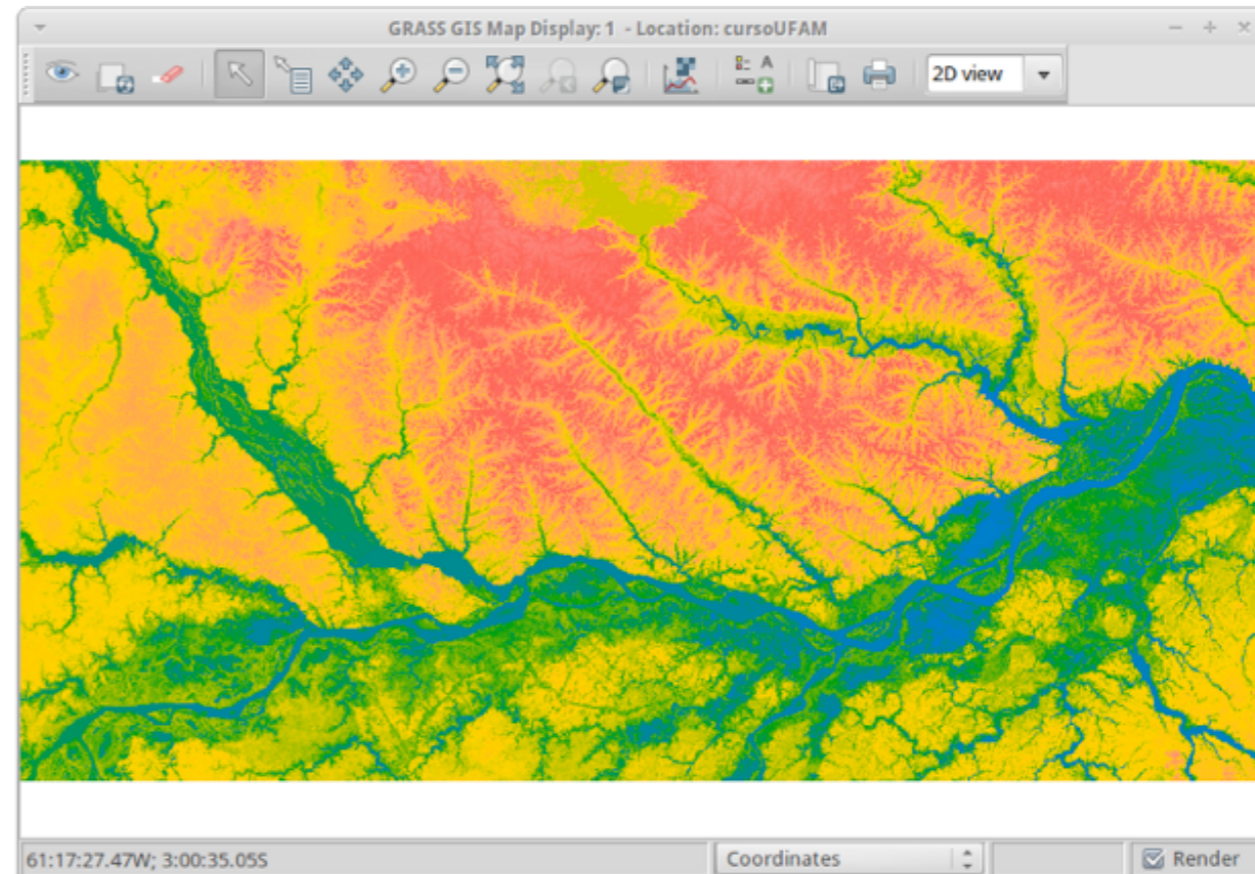
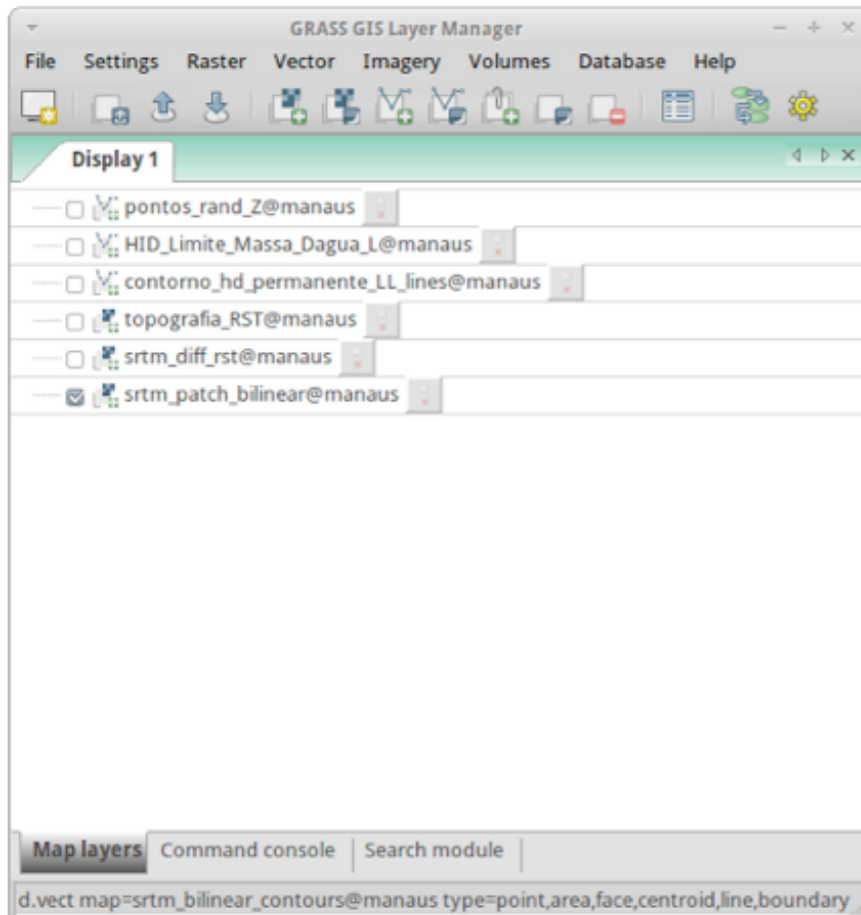
Organização dos projetos



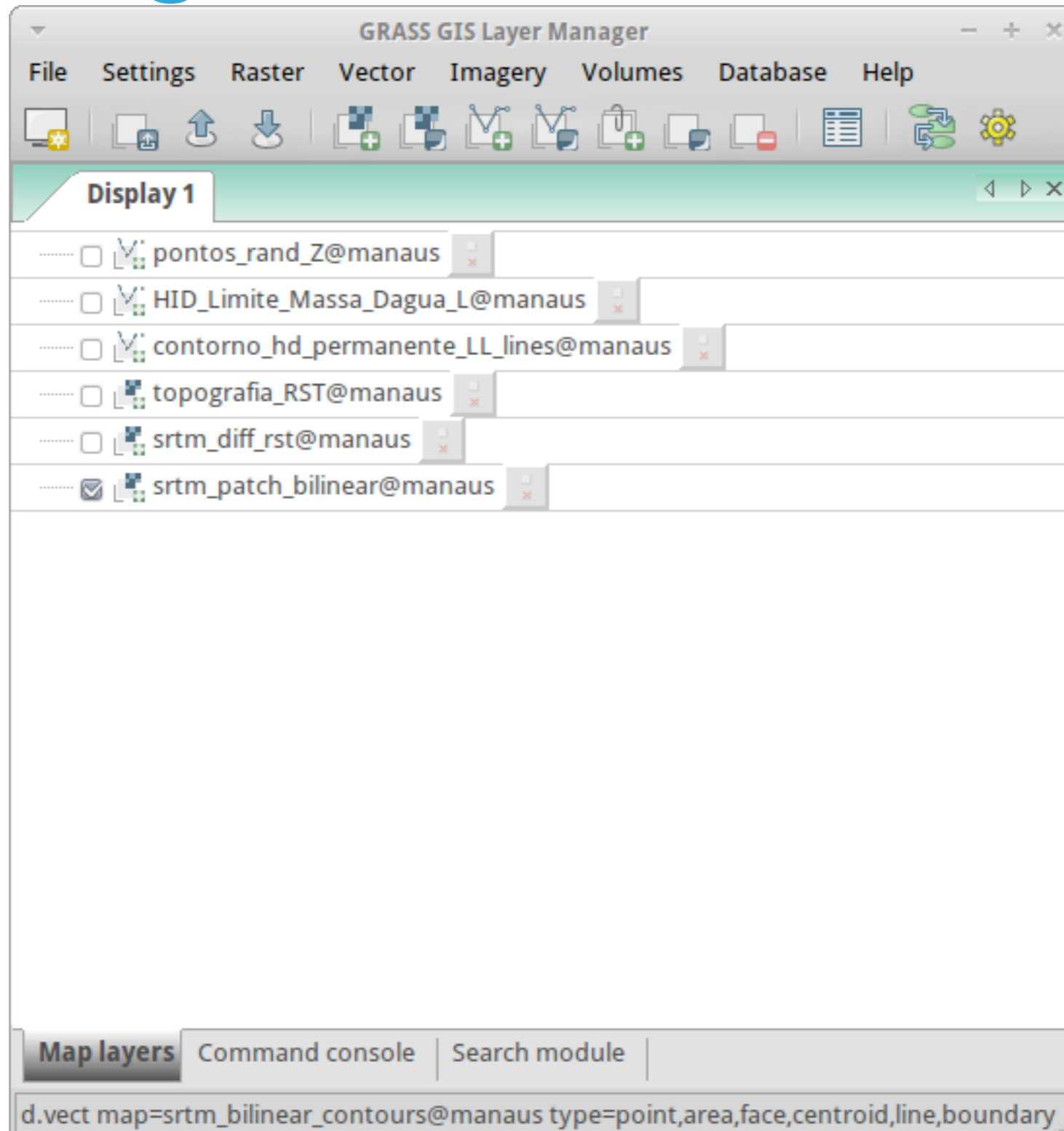
Region

- ▶ Um conceito importante dentro do GRASS é o de **region**, que define, dentro do mapset, a área de interesse e a resolução espacial dos mapas raster. Tanto a resolução espacial quanto as coordenadas do retângulo envolvente da region podem ser facilmente alteradas sem a necessidade de reinicialização do sistema ou a criação de novos projetos; é possível salvar as configurações da region para acessá-la facilmente quando necessário.
- ▶ É preciso frisar que todas as análises envolvendo mapas raster (análise de terreno, álgebra de mapas, interpolação de superfícies etc) são efetuadas de acordo com as configurações da region ativa, e que esta não necessariamente corresponde com as configurações do Display.

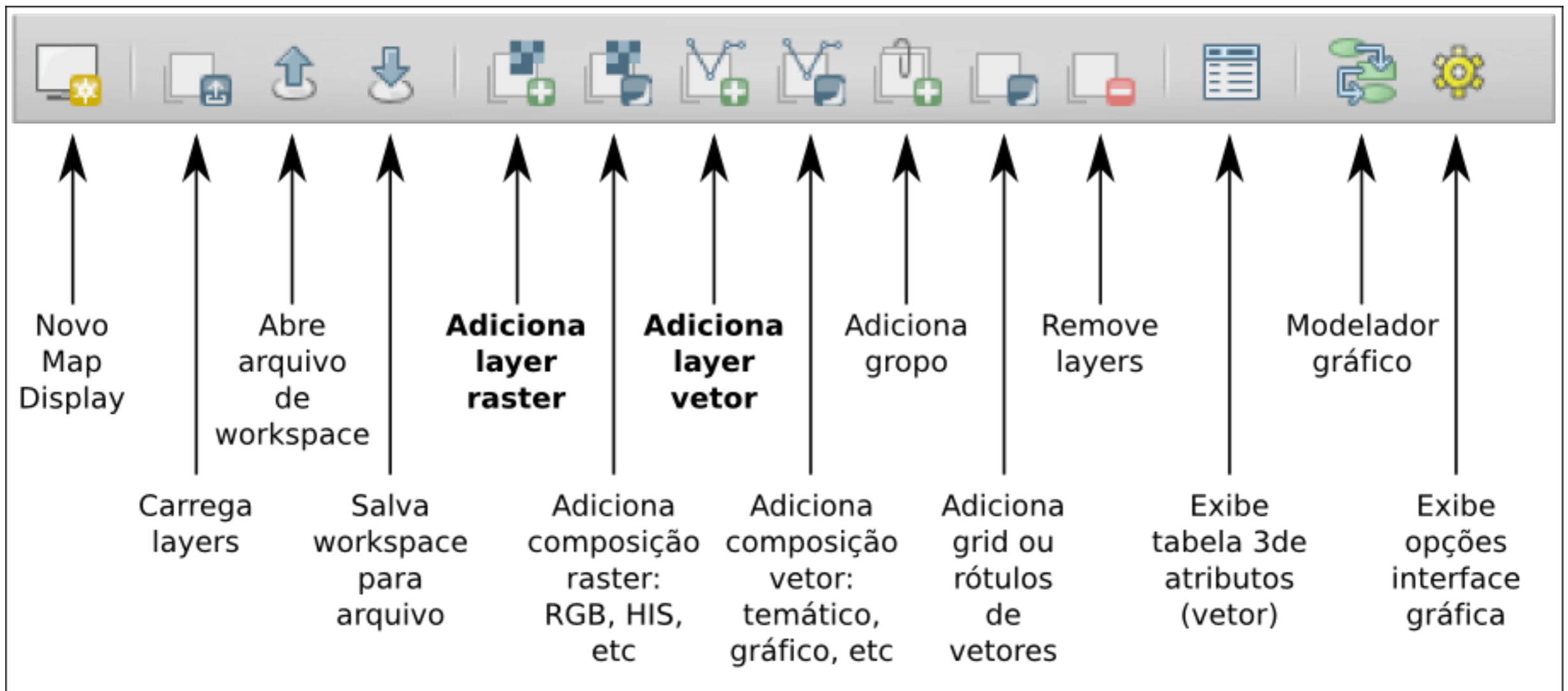
Interface gráfica



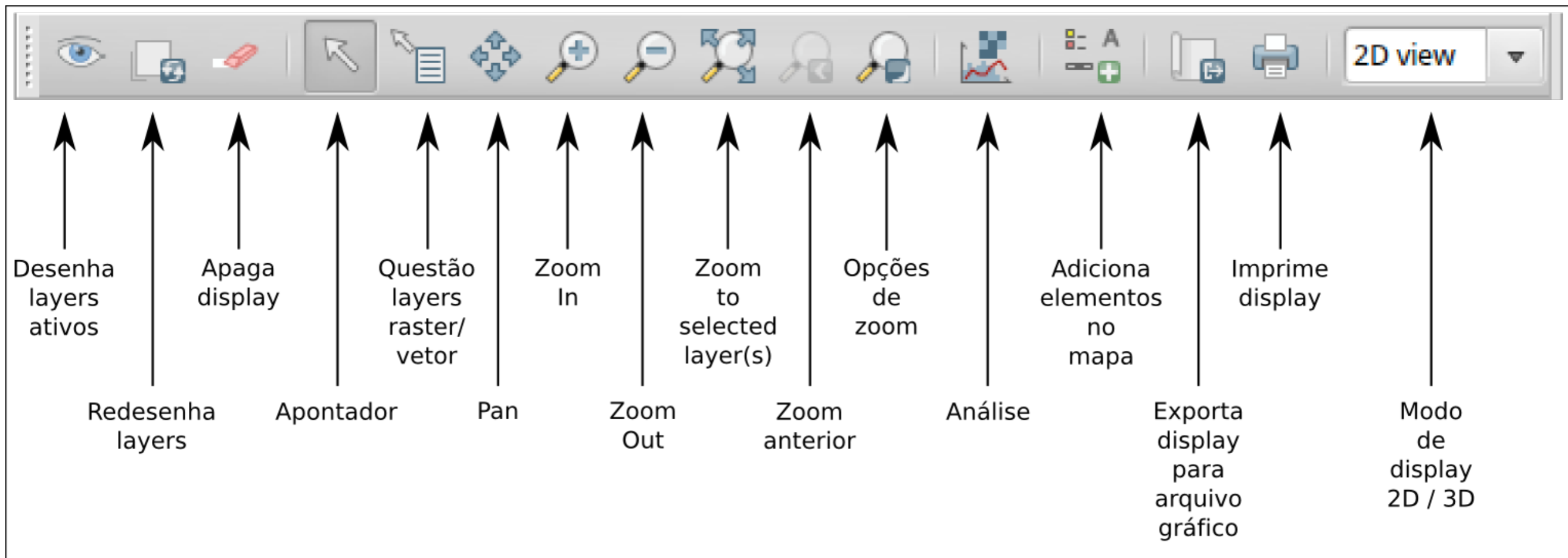
Layer manager



Ferramentas gism



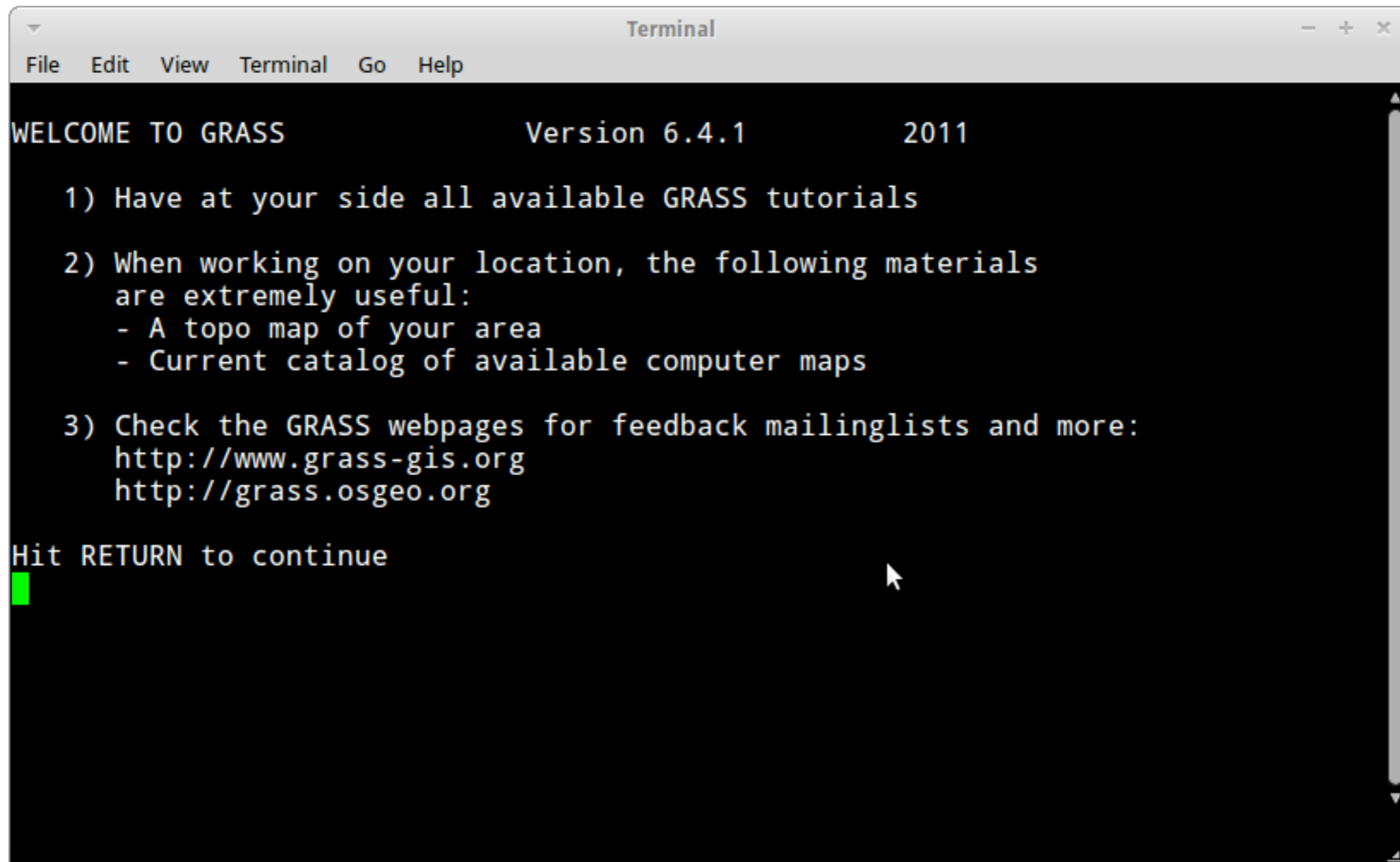
Ferramentas MapDisplay



The image shows a toolbar for MapDisplay with 17 icons. Below each icon is a label in Portuguese or English. The labels are: Desenha layers ativos, Redesenha layers, Apaga display, Apontador, Questão layers raster/vetor, Pan, Zoom In, Zoom Out, Zoom to selected layer(s), Zoom anterior, Opções de zoom, Análise, Adiciona elementos no mapa, Exporta display para arquivo gráfico, Imprime display, and Modo de display 2D / 3D. The '2D view' dropdown menu is also visible on the right side of the toolbar.

Icon Description	Label
Eye icon	Desenha layers ativos
Layers icon	Redesenha layers
Erase icon	Apaga display
Pointer icon	Apontador
Question mark icon	Questão layers raster/vetor
Four arrows icon	Pan
Zoom In icon	Zoom In
Zoom Out icon	Zoom Out
Zoom to selected layer(s) icon	Zoom to selected layer(s)
Zoom anterior icon	Zoom anterior
Options of zoom icon	Opções de zoom
Analysis icon	Análise
Add elements icon	Adiciona elementos no mapa
Export icon	Exporta display para arquivo gráfico
Print icon	Imprime display
2D view dropdown	Modo de display 2D / 3D

Welcome!

A terminal window titled "Terminal" with a menu bar containing "File", "Edit", "View", "Terminal", "Go", and "Help". The terminal displays a welcome message for GRASS 6.4.1 from 2011. The message includes three numbered instructions: 1) Have at your side all available GRASS tutorials; 2) When working on your location, the following materials are extremely useful: - A topo map of your area; - Current catalog of available computer maps; 3) Check the GRASS webpages for feedback mailinglists and more: <http://www.grass-gis.org> and <http://grass.osgeo.org>. The terminal ends with "Hit RETURN to continue" and a green cursor.

```
Terminal
File Edit View Terminal Go Help
WELCOME TO GRASS                Version 6.4.1                2011

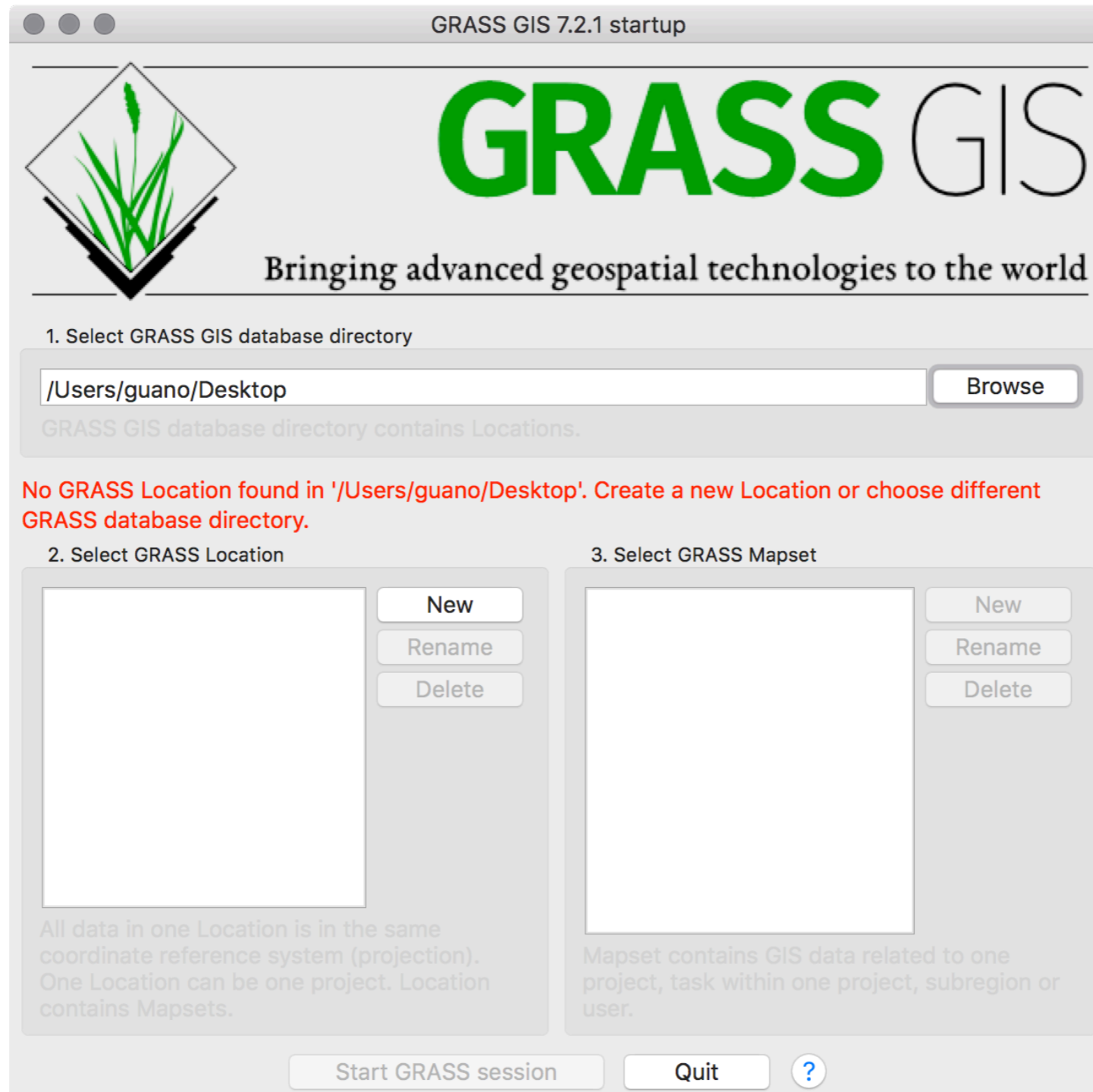
  1) Have at your side all available GRASS tutorials

  2) When working on your location, the following materials
     are extremely useful:
     - A topo map of your area
     - Current catalog of available computer maps

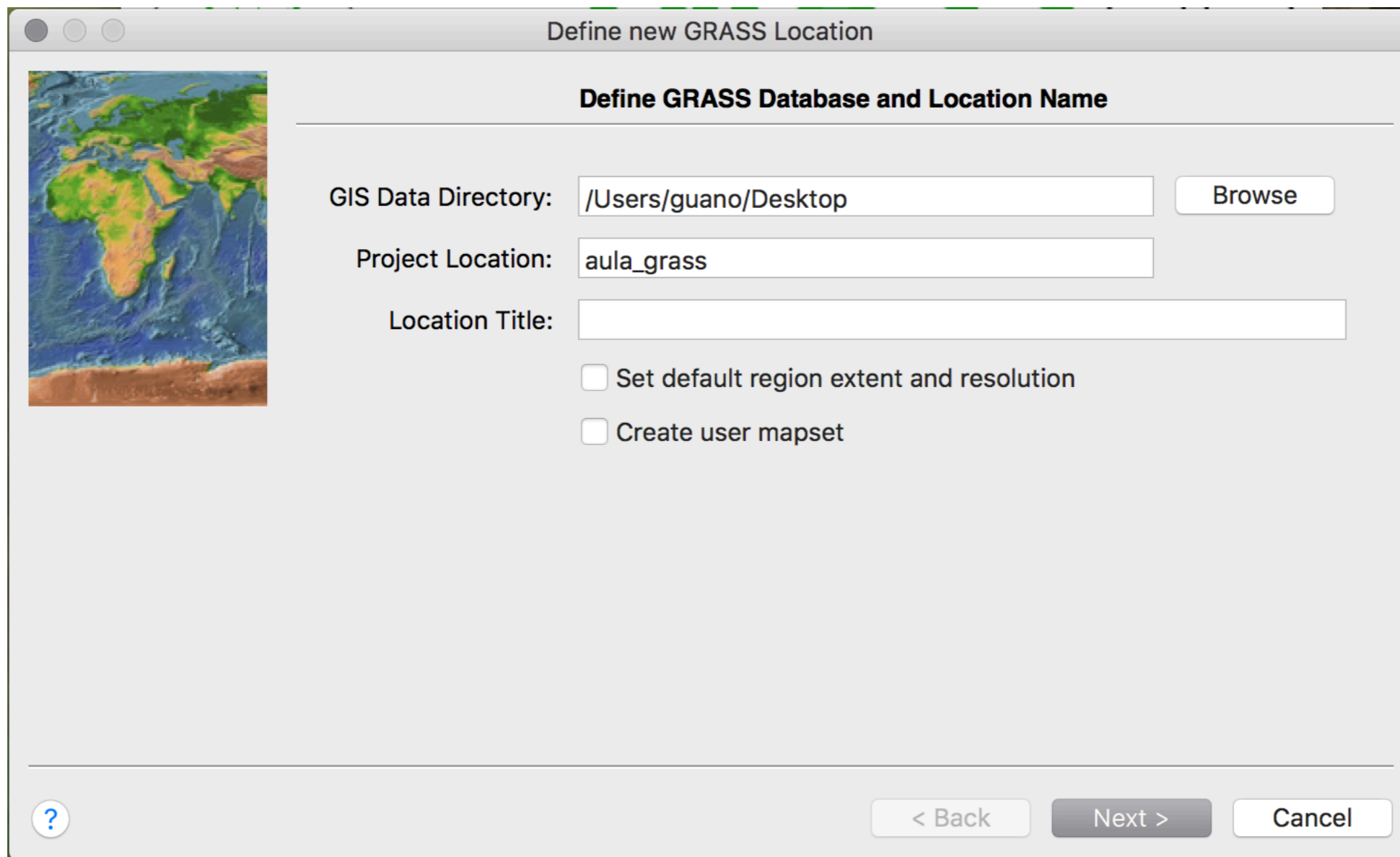
  3) Check the GRASS webpages for feedback mailinglists and more:
     http://www.grass-gis.org
     http://grass.osgeo.org

Hit RETURN to continue
█
```

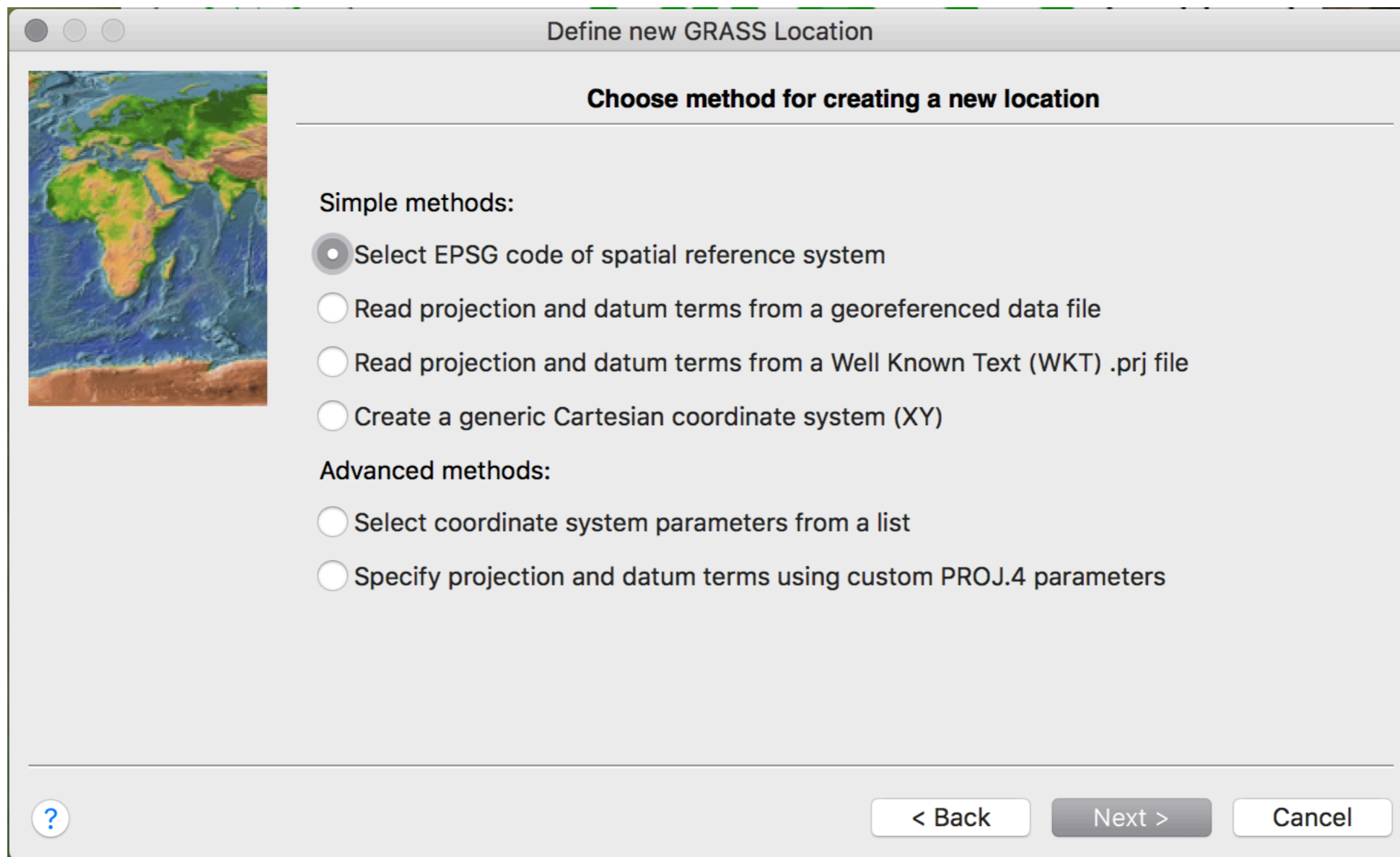
Welcome!



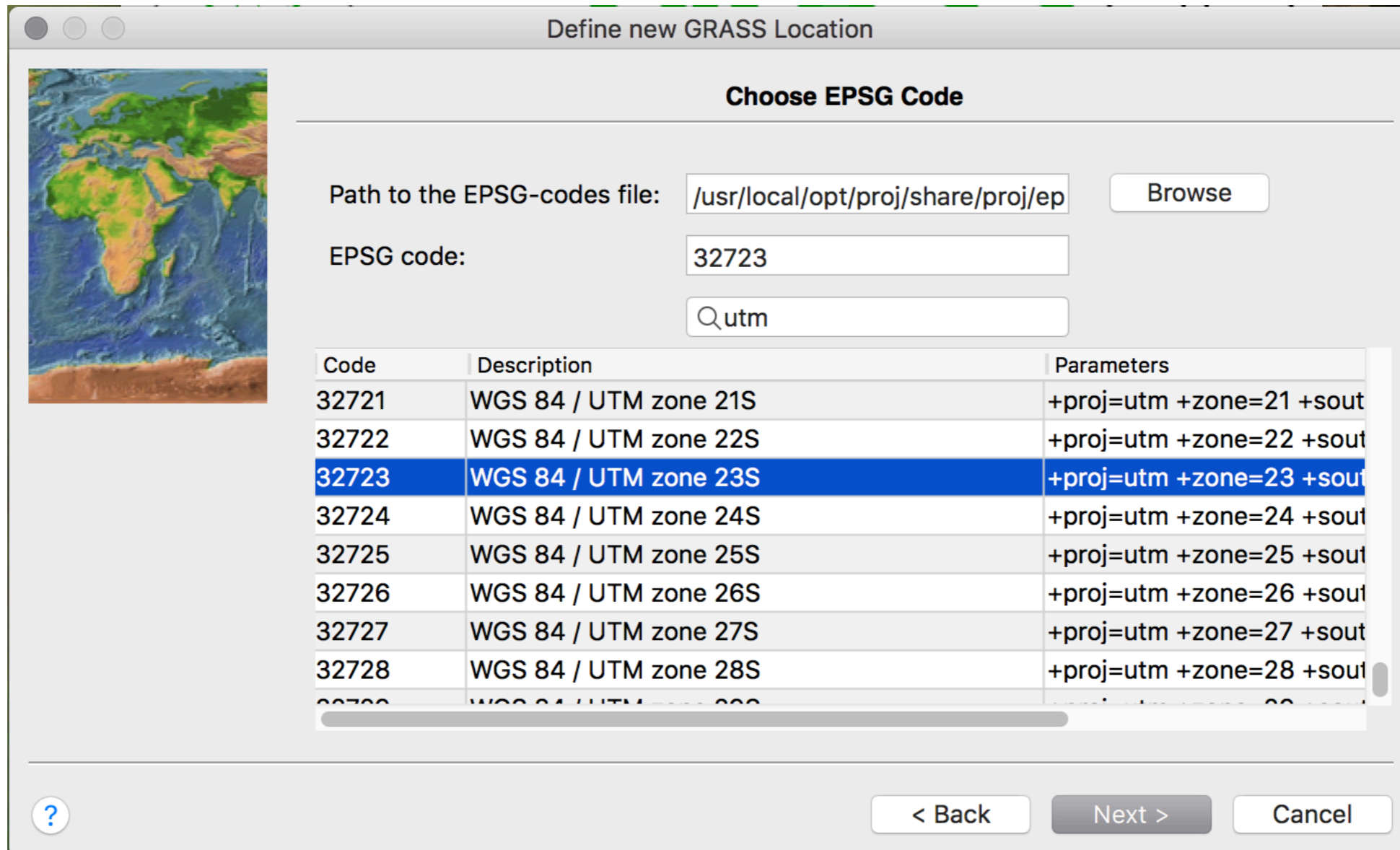
Criar Location e mapset



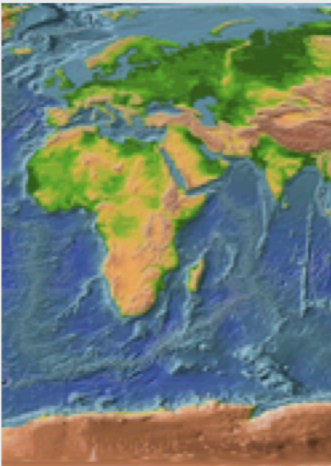
Criar Location e mapset



Criar Location e mapset



Criar Location e mapset



Define new GRASS Location

Choose

Path to the EPSG-codes file:

EPSG code:

Code	Description	Parameters
32721	WGS 84 / UTM zone 21S	+proj=utm +zone=21 +sout
32722	WGS 84 / UTM zone 22S	+proj=utm +zone=22 +sout
32723	WGS 84 / UTM zone 23S	+proj=utm +zone=23 +sout
32724	WGS 84 / UTM zone 24S	+proj=utm +zone=24 +sout
32725	WGS 84 / UTM zone 25S	+proj=utm +zone=25 +sout
32726	WGS 84 / UTM zone 26S	+proj=utm +zone=26 +sout
32727	WGS 84 / UTM zone 27S	+proj=utm +zone=27 +sout
32728	WGS 84 / UTM zone 28S	+proj=utm +zone=28 +sout

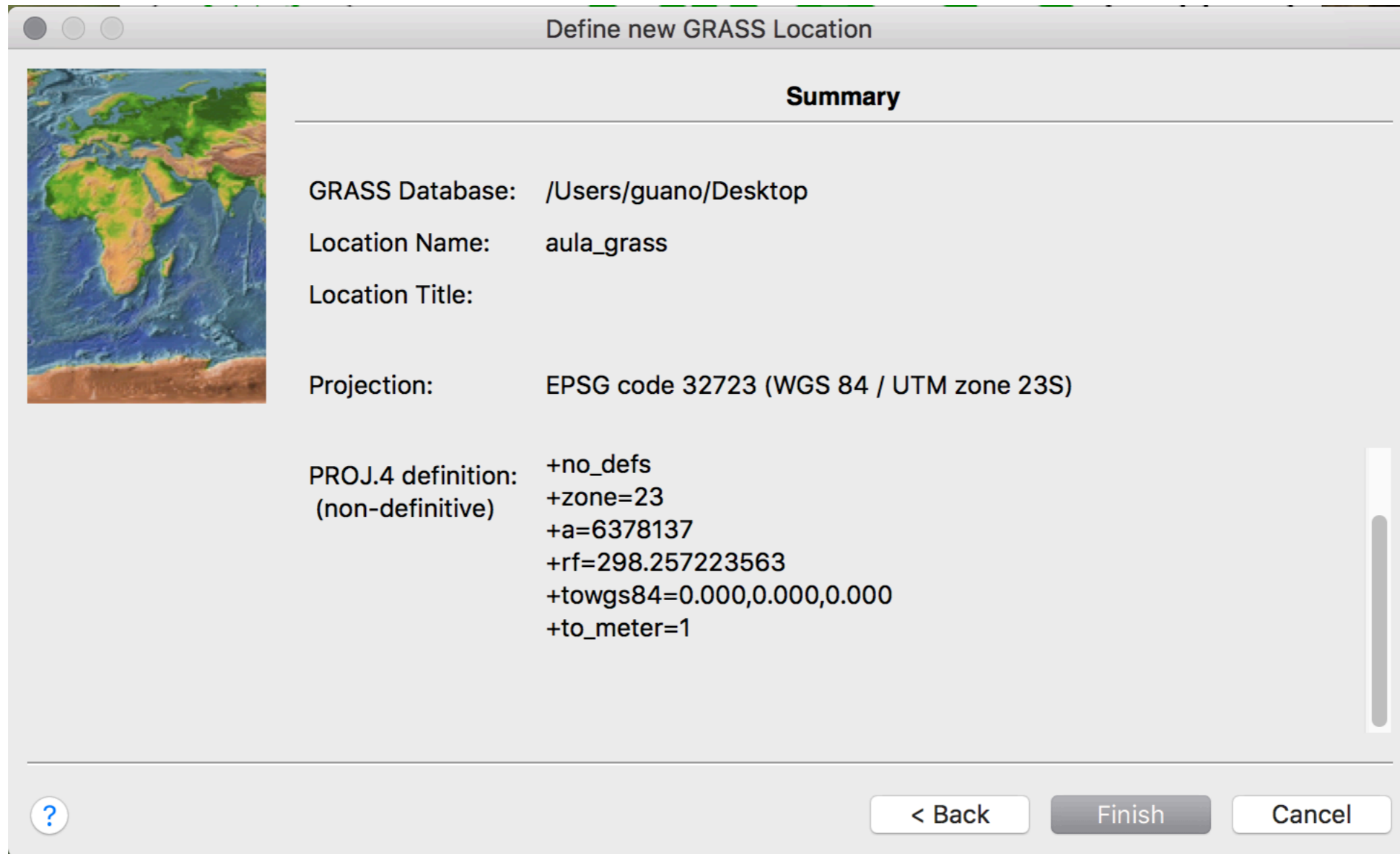
Select datum transformation

Select from list of datum transformations

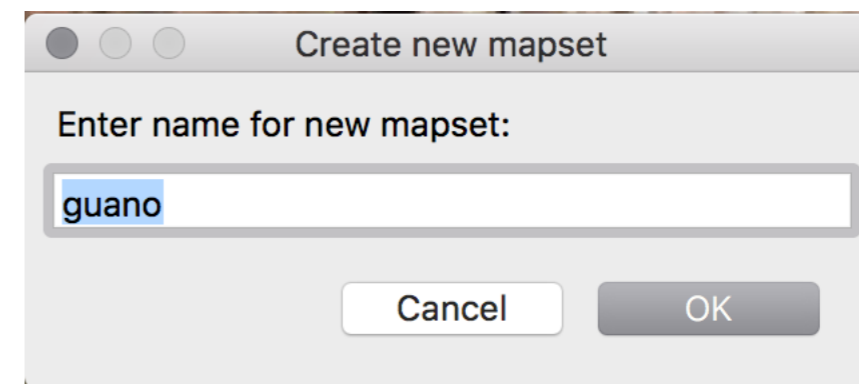
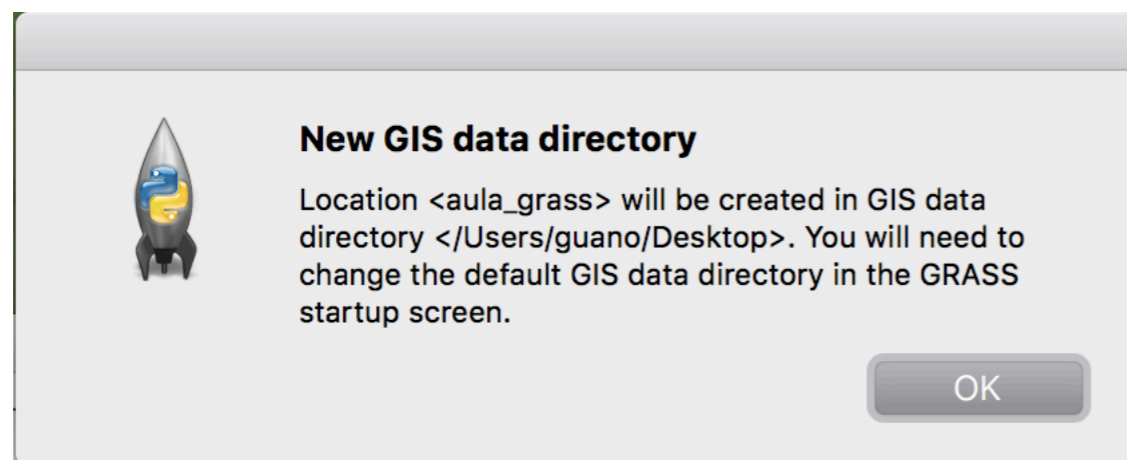
0
Do not apply any datum transformations

1
Used in whole wgs84 region
towgs84=0.000,0.000,0.000
Default 3-Parameter Transformation (May not be optimum for old




Criar Location e mapset



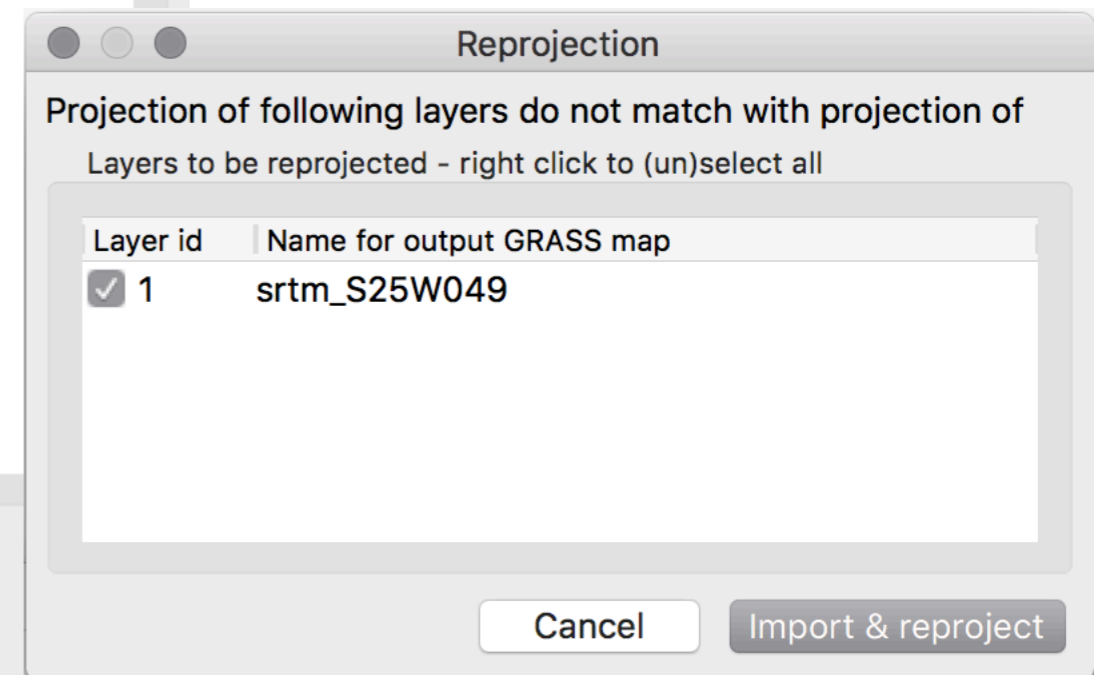
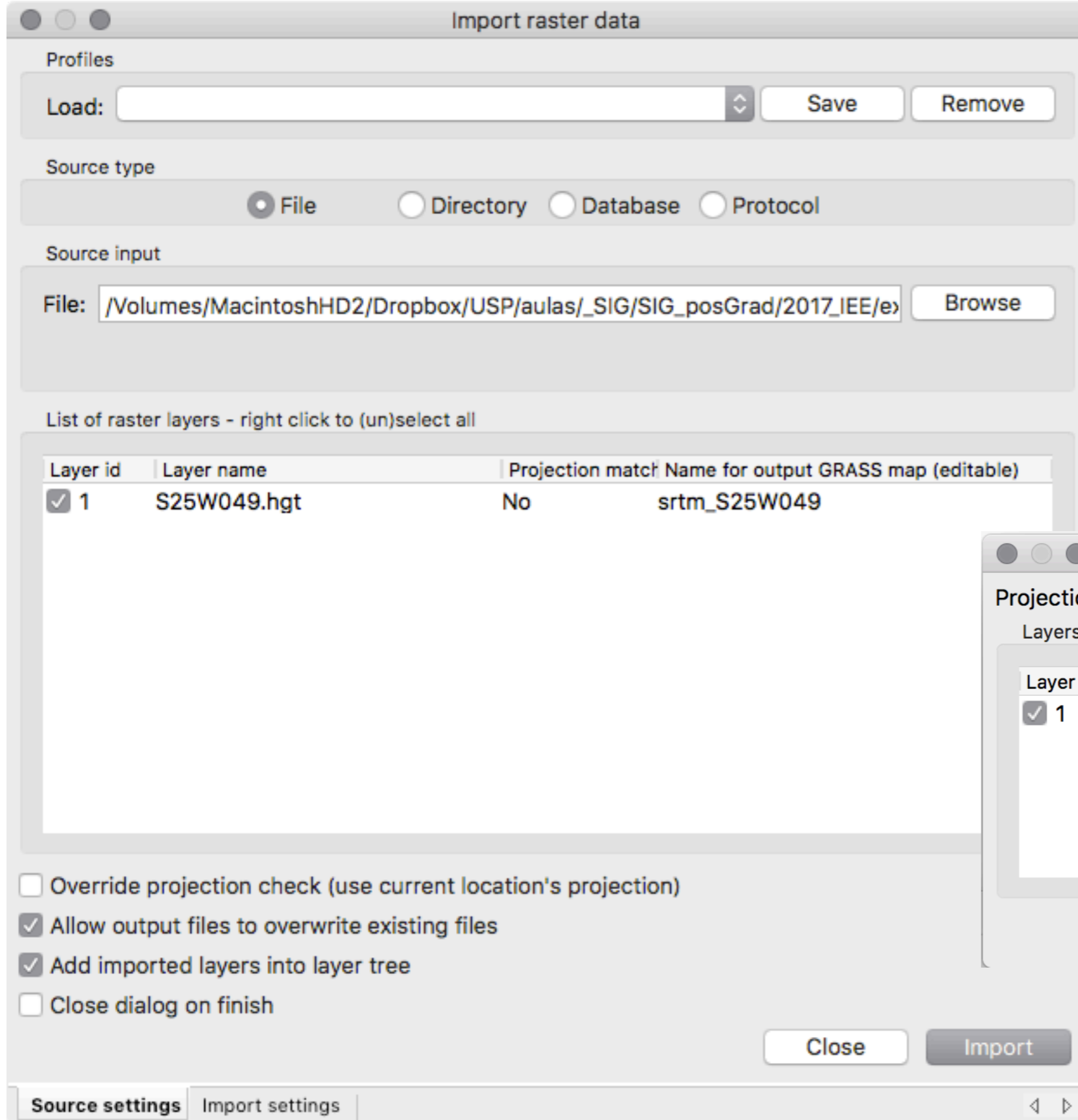
Criar Location e mapset



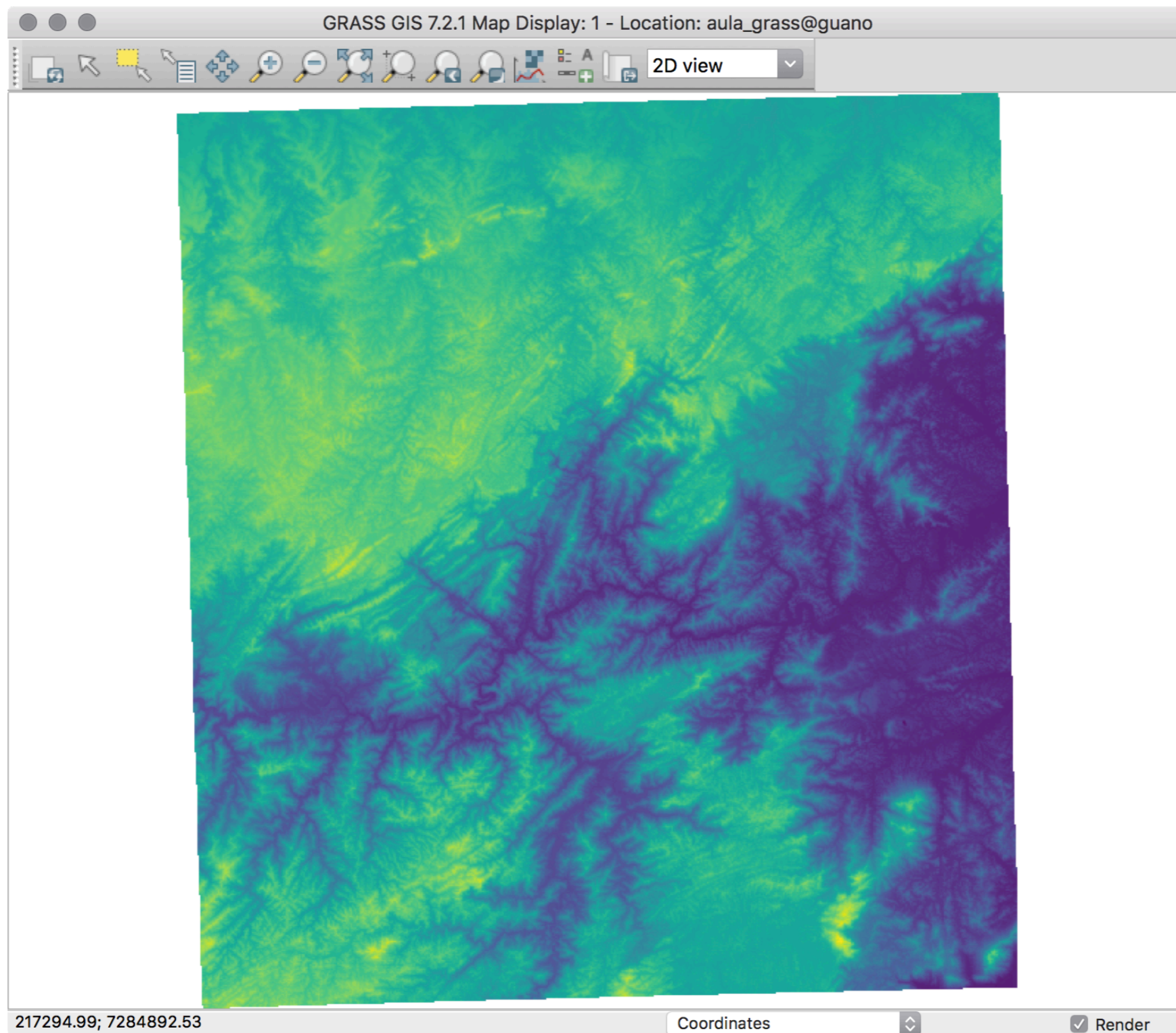
importar srtm

Workspace	▶
Map display	▶
Import raster data	▶
Import vector data	▶
Import 3D raster data	▶
Import database table	▶
Export raster map	▶
Export vector map	▶
Export 3D raster maps	▶
Export database table	▶
Link external data	▶
Manage maps	▶
Map type conversions	▶
 Georectify [g.gui.gcp]	
 Graphical modeler [g.gui.gmodeler]	
Run model	
3D image rendering [m.nviz.image]	
Animation tool [g.gui.animation]	
Bearing/distance to coordinates [m.cogo]	
 Cartographic Composer [g.gui.psmmap]	
Map Swipe [g.gui.mapswipe]	
Launch script	
Close GUI	⌘W

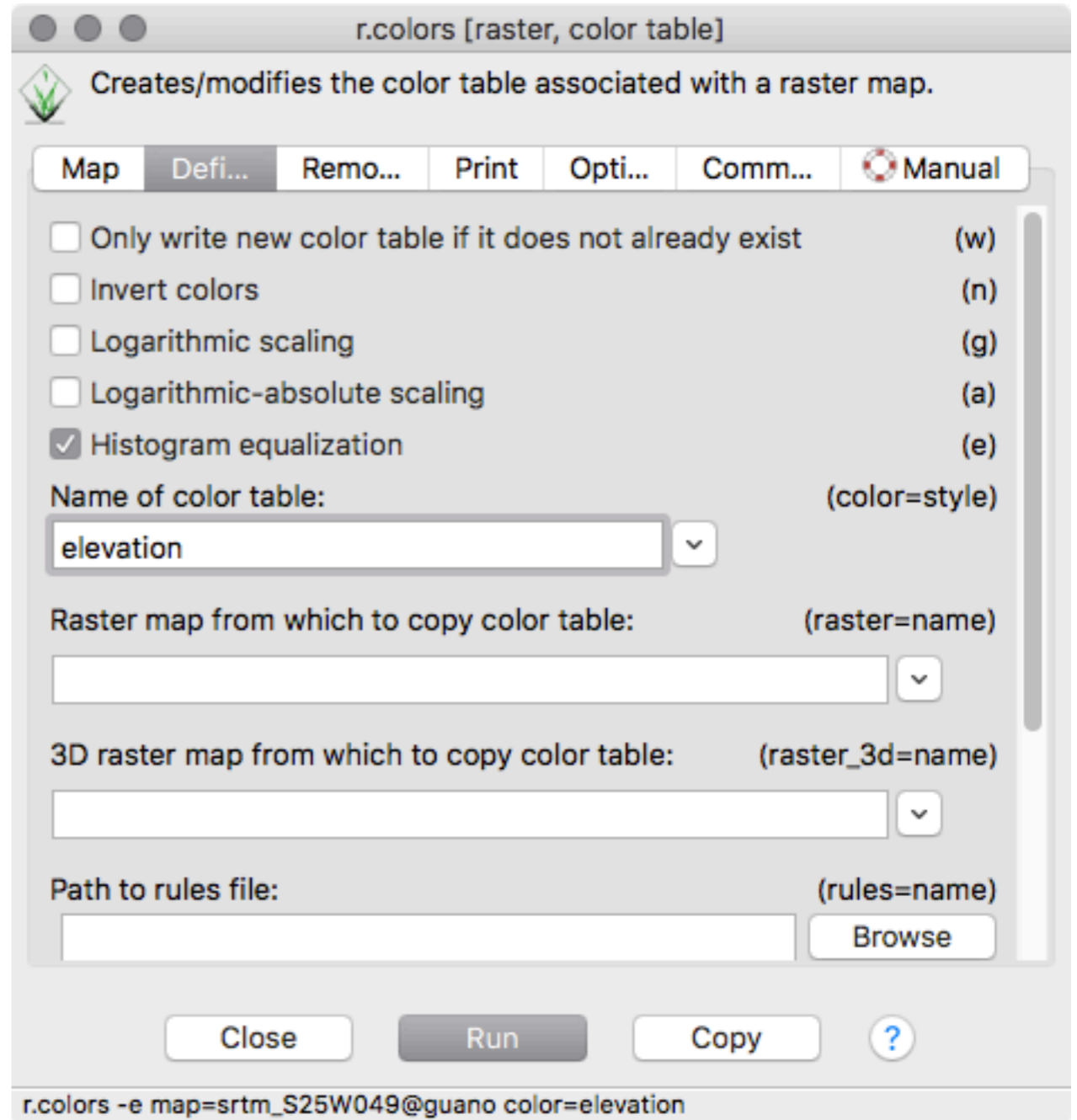
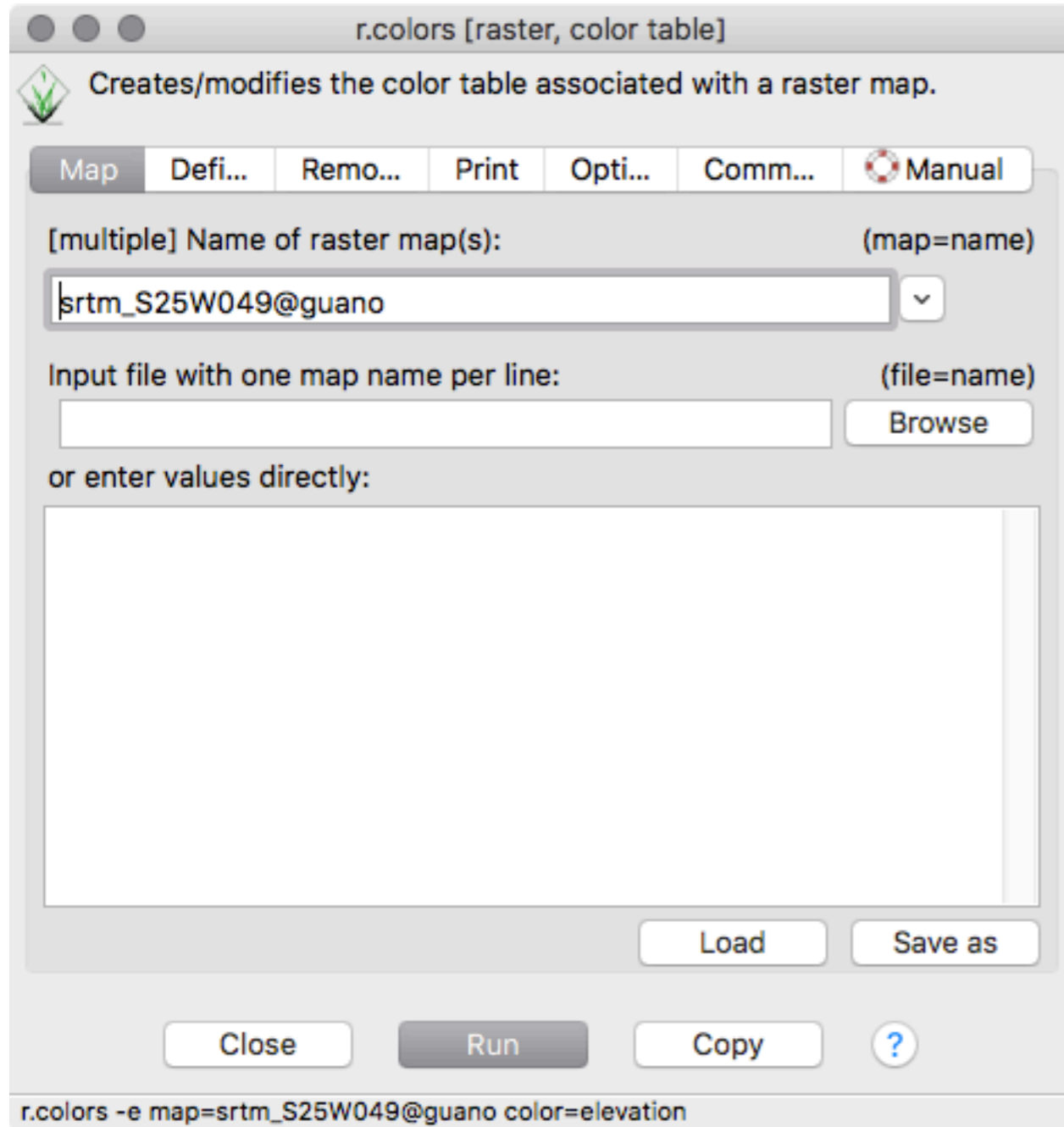
Common formats import [r.in.gdal]
Import of common formats with reprojection [r.import]
ASCII x,y,z point import and gridding [r.in.xyz]
ASCII grid import [r.in.ascii]
ASCII polygons, lines, and point import [r.in.poly]
Raw binary array import [r.in.bin]
GRIDATB.FOR import [r.in.gridatb]
Matlab 2D array import [r.in.mat]
PNG import [r.in.png]
SPOT NDVI import [i.in.spotvgt]
SRTM HGT import [r.in.srtm]
Terra ASTER HDF import [r.in.aster]
LAS LiDAR points import [r.in.lidar]
Unpack raster map [r.unpack]
Reproject raster map from different GRASS location [r.proj]



display raster



alterar cores (raster - manage colors - r.colors)



acertar region

- Region ▶
- GRASS working environment ▶
- Map projections ▶
- Addons extensions ▶

Display region [g.region -p]

Set region [g.region]

g.region [general, settings, computational region, extent, resolution, level1]

Manages the boundary definitions for the geographic region.

Existing
Bounds
Reso...
Effects
Print
Optional
Comm...
 Manual

Set from default region (d)

Save as default region (s)

Set current region from named region: (region=name)

▼

[multiple] Set region to match raster map(s): (raster=name)

▼

Set region to match 3D raster map(s) (both 2D and 3D values): (raster_3d=name)

▼

[multiple] Set region to match vector map(s): (vector=name)

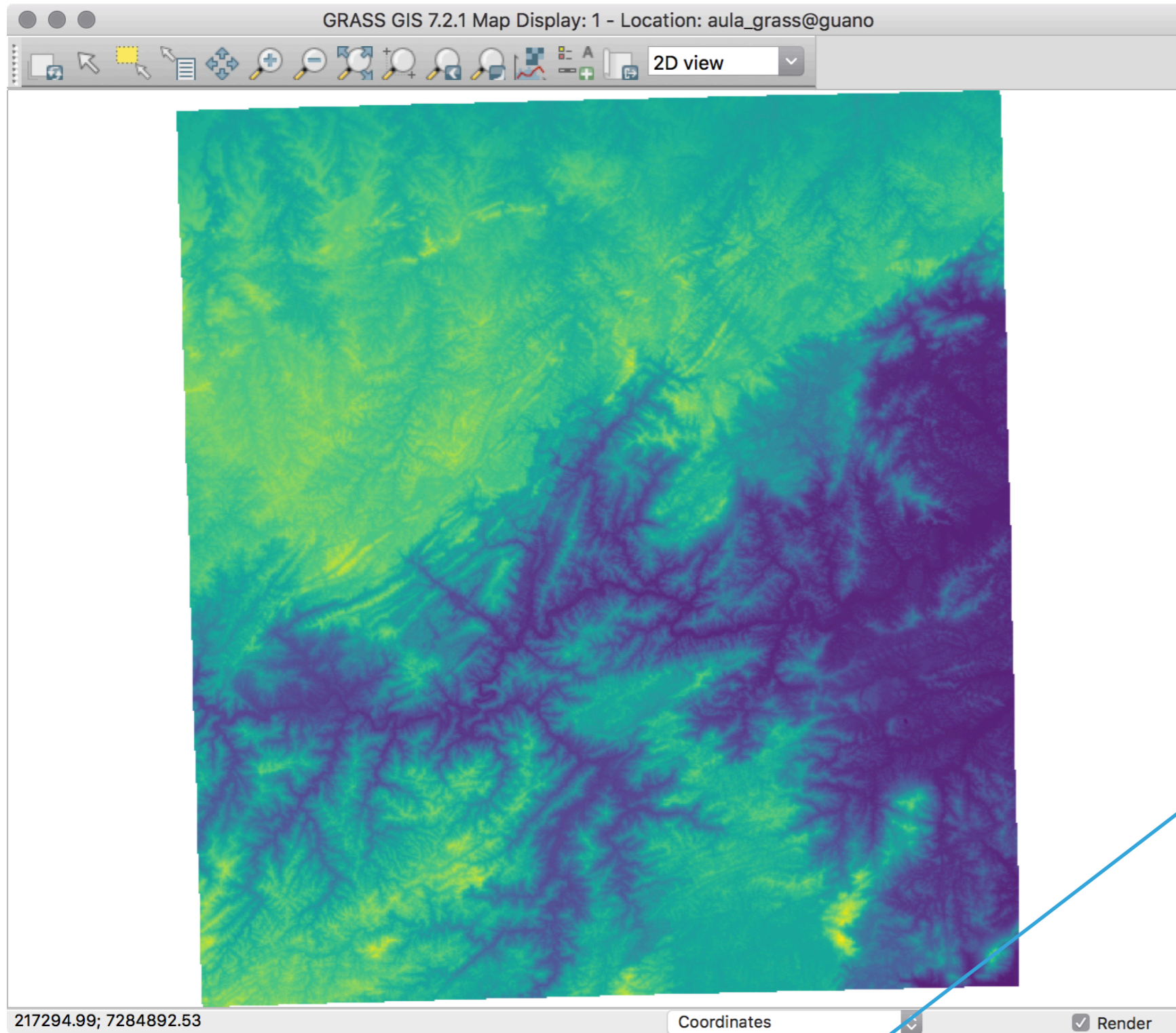
▼

Close
Run
Copy
?

Close dialog on finish

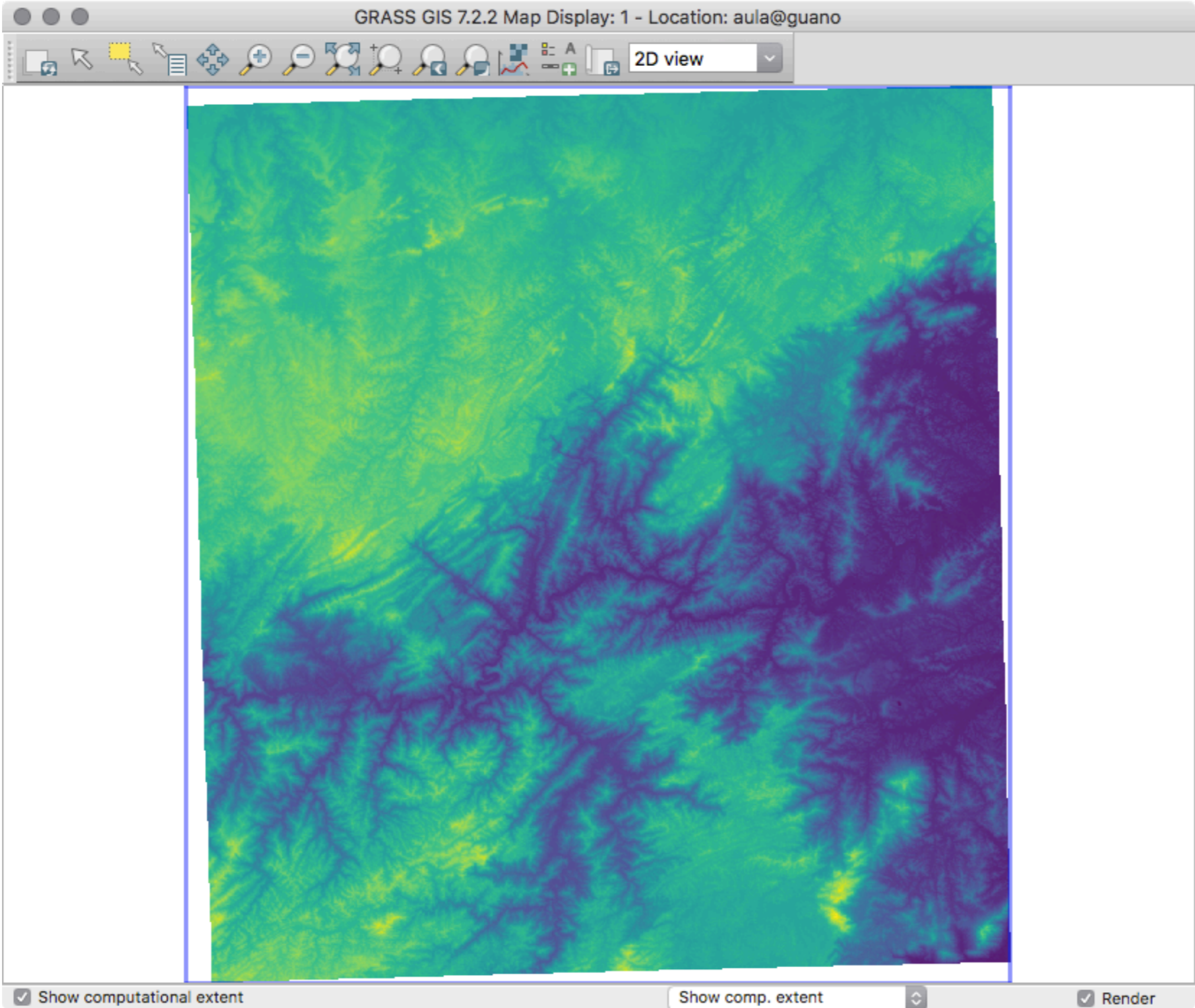
g.region --overwrite raster=srtm_S25W049@guano

ver region no map display

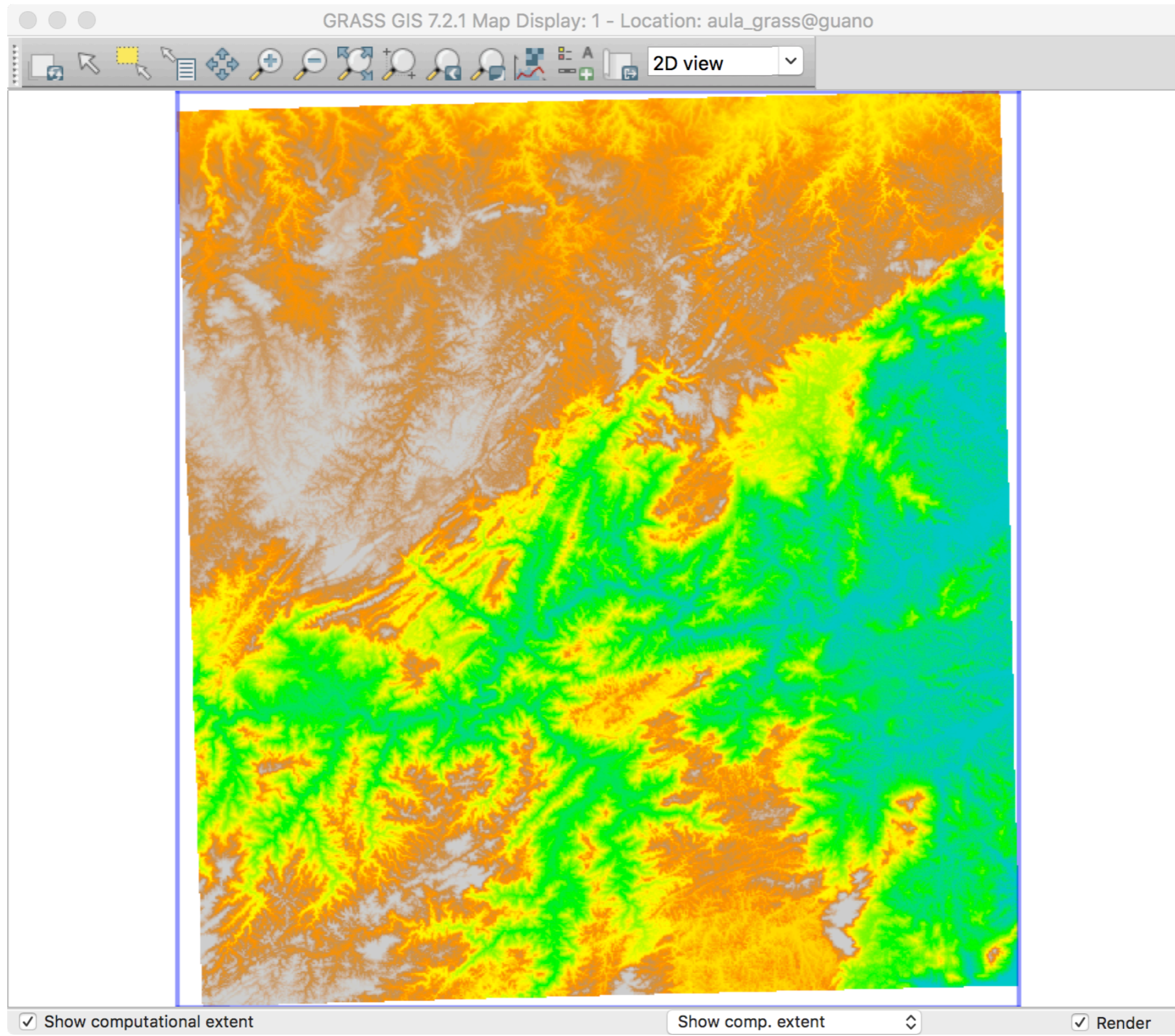


- ✓ Coordinates
- Extent
- Computational region
- Show comp. extent
- Display mode
- Display resolution
- Display geometry
- Map scale
- Go to
- Projection

ver region no map display



escala de cores (funcionando)



relevo sombreado

Develop raster map	▶
Manage colors	▶
Query raster maps	▶
Map type conversions	▶
Raster buffers and distance	▶
Mask [r.mask]	
Raster map calculator [r.mapcalc]	
Neighborhood analysis	▶
Overlay rasters	▶
Solar radiance and shadows	▶
Terrain analysis	▶
Transform features	▶
Hydrologic modeling	▶
Groundwater modeling	▶
Landscape patch analysis	▶
Wildfire modeling	▶
Change category values and labels	▶
Generate random cells	▶
Generate surfaces	▶
Interpolate surfaces	▶
Reports and statistics	▶

Generate contour lines [r.contour]
Cost surface [r.cost]
Cumulative movement costs [r.walk]
Least cost route or flow [r.drain]
Compute shaded relief [r.relief]
Apply shade to raster [r.shade]
Slope and aspect [r.slope.aspect]
Terrain parameters [r.param.scale]
Textural features [r.texture]
Visibility [r.viewshed]
Distance to features [r.grow.distance]
Horizon angle [r.horizon]

relevo sombreado

- ▶ 1) zoom em uma área pequena
- ▶ 2) MapDisplay - set region to display

Zoom to default region
Zoom to saved region

Set computational region extent from display
Set computational region extent interactively
Set computational region from named region

Save display geometry to named region
Save computational region to named region

relevo sombreado

r.relief [raster, elevation, relief, terrain, hillshade]

Creates shaded relief map from an elevation map (DEM).

Required Sun position Optional Command output Manual

Name of input raster map: * (input=name)
srtm_S25W049@guano

Name for output shaded relief map: * (output=name)
srtm_S25W049_shade_315_25

Close Run Copy ?

Add created map(s) into layer tree
 Close dialog on finish

```
r.relief --overwrite input=srtm_S25W049@guano output=srtm_S25W049_shade_315_25 altitude=25 azimuth=315
```

r.relief [raster, elevation, relief, terrain, hillshade]

Creates shaded relief map from an elevation map (DEM).

Required Sun position Optional Command output Manual

Altitude of the sun in degrees above the horizon (valid range 0-90): (altitude=float)
25

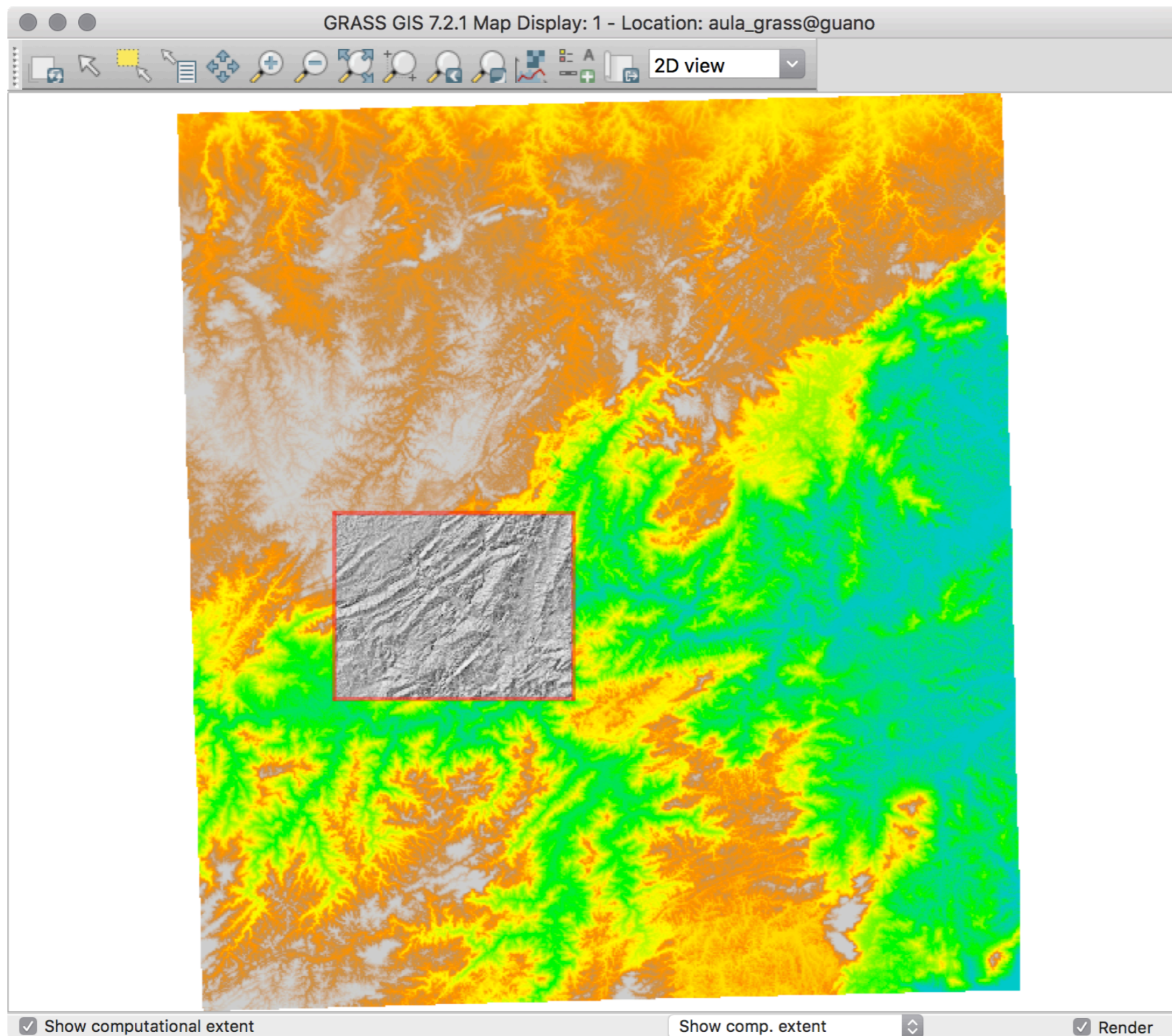
Azimuth of the sun in degrees to the east of north (valid range 0-360): (azimuth=float)
315

Close Run Copy ?

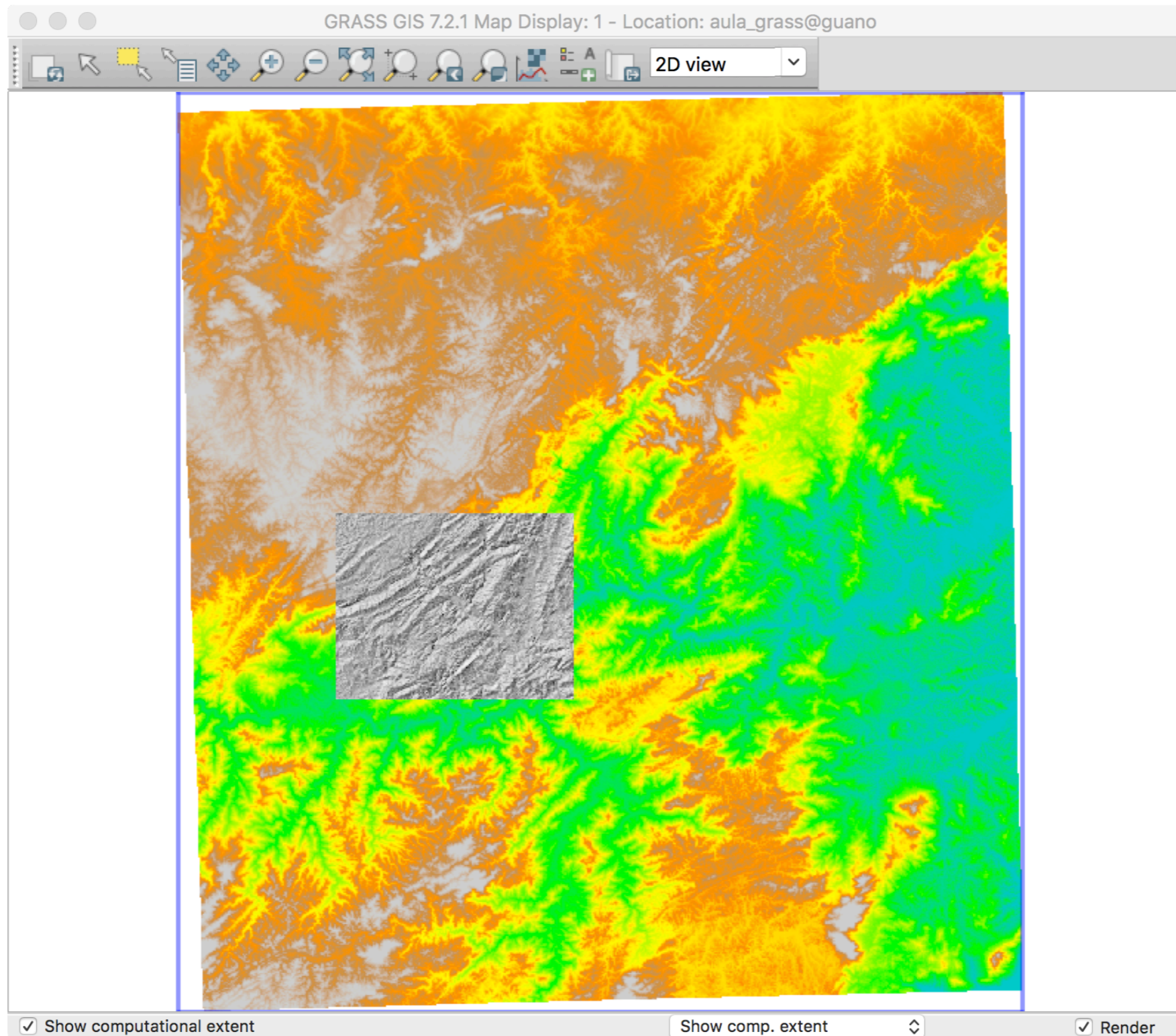
Add created map(s) into layer tree
 Close dialog on finish

```
r.relief --overwrite input=srtm_S25W049@guano output=srtm_S25W049_shade_315_25 altitude=25 azimuth=315
```

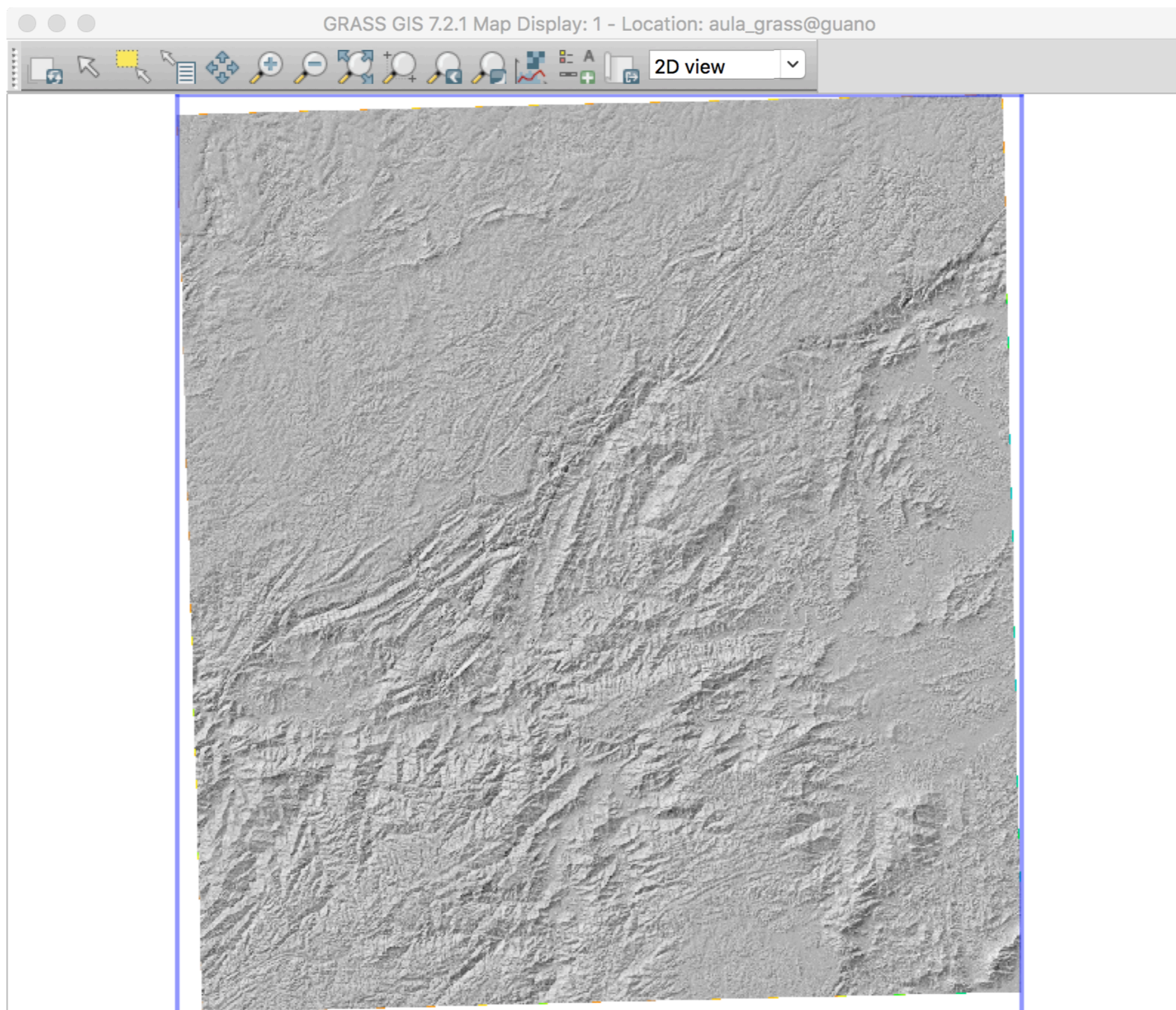
relevo sombreado



relevo sombreado - definir region para layer



relevo sombreado



region - mudar resolução para 250m

g.region [general, settings, computational region, extent, resolution]

Manages the boundary definitions for the geographic region.

Existing Bounds **Reso...** Effects Print Optional Comm... Manual

Number of rows in the new region: (rows=value)

Number of columns in the new region: (cols=value)

2D grid resolution (north-south and east-west): (res=value)

3D grid resolution (north-south, east-west and top-bottom): (res3=value)

North-south 2D grid resolution: (nsres=value)

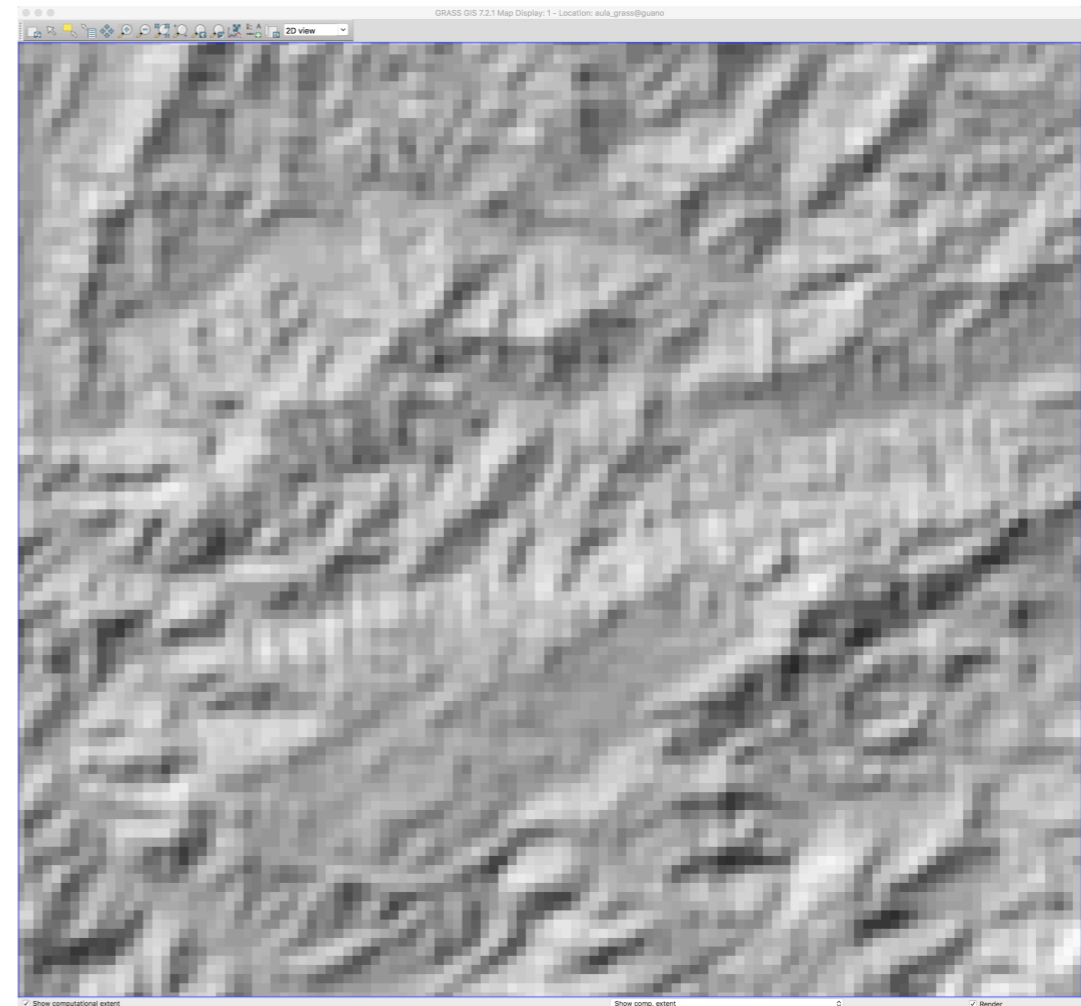
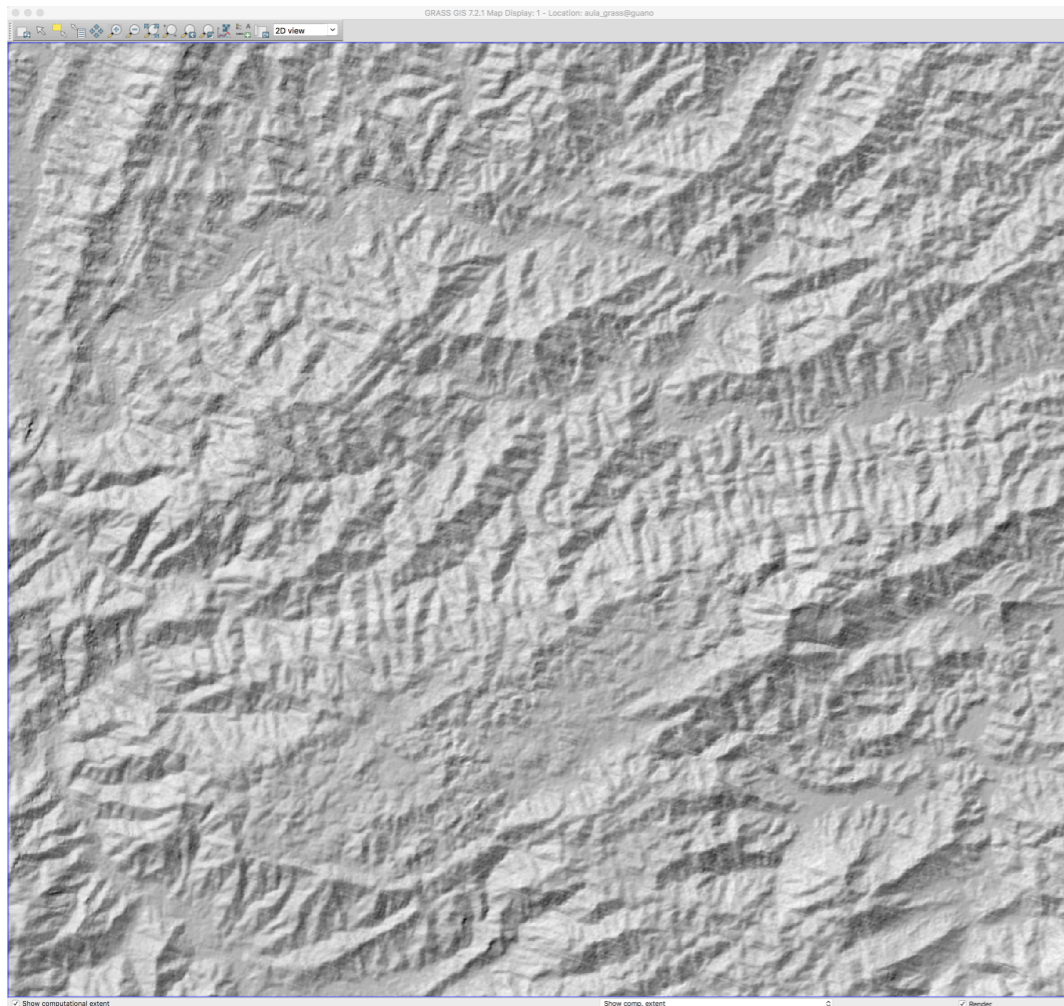
East-west 2D grid resolution: (ewres=value)

Top-bottom 3D arid resolution: (tbres=value)




Close dialog on finish

g.region --overwrite res=250

Criar Location e mapset



importar vetor (pontos - davis.dat)

Workspace	▶
Map display	▶
Import raster data	▶
Import vector data	▶
Import 3D raster data	▶
Import database table	▶
Export raster map	▶
Export vector map	▶
Export 3D raster maps	▶
Export database table	▶
Link external data	▶
Manage maps	▶
Map type conversions	▶
 Georectify [g.gui.gcp]	
 Graphical modeler [g.gui.gmodeler]	
Run model	
3D image rendering [m.nviz.image]	
Animation tool [g.gui.animation]	
Bearing/distance to coordinates [m.cogo]	
 Cartographic Composer [g.gui.psmmap]	
Map Swipe [g.gui.mapswipe]	
Launch script	
Close GUI	⌘W

Common import formats [v.in.ogr]
Import of common formats with reprojection [v.import]
ASCII points or GRASS ASCII format [v.in.ascii]
ASCII points as a vector lines [v.in.lines]
DXF import [v.in.dxf]
WFS [v.in.wfs]
ESRI e00 import [v.in.e00]
Geonames import [v.in.geonames]
Matlab array or Mapgen format import [v.in.mapgen]
LAS LiDAR points import [v.in.lidar]
Unpack vector map [v.unpack]
Reproject vector map from different GRASS location [v.proj]

importar vetor

v.in.ascii [vector, import, ASCII]

Creates a vector map from an ASCII points file or ASCII vector file.

Required Input format Points Optional Command output Manual

Name of input file to be imported: * (input=name)
 Browse

or enter values directly:

Load Save as

Name for output vector map: * (output=name)

Close Run Copy ?

Add created map(s) into layer tree
 Close dialog on finish

v.in.ascii --overwrite input=/Volumes/MacintoshHD2/Dropbox/USP/aulas/_SIG/SIG_posGrad/2017_IEE/exe

v.in.ascii [vector, import, ASCII]

Creates a vector map from an ASCII points file or ASCII vector file.

Required Input format Points Optional Command output Manual

Do not expect a header when reading in standard format (n)

Input file format: (format=string)

Field separator: (separator=character)

Text delimiter: (text=character)


Close Run Copy ?


Add created map(s) into layer tree
 Close dialog on finish

v.in.ascii --overwrite input=/Volumes/MacintoshHD2/Dropbox/USP/aulas/_SIG/SIG_posGrad/2017_IEE/exe

importar vetor

v.in.ascii [vector, import, ASCII]

 Creates a vector map from an ASCII points file or ASCII vector file.

Required Input format **Points** Optional Command output  Manual

Do not create table in points mode (t)

Do not build topology (b)

Only import points falling within current region (points mode) (r)

Ignore broken line(s) in points mode (i)

Number of header lines to skip at top of input file (points mode): (skip=integer)

Column definition in SQL style (points mode): (columns=string)

Number of column used as x coordinate (points mode): (x=integer)

Number of column used as y coordinate (points mode): (y=integer)

Number of column used as z coordinate (points mode): (z=integer)

Number of column used as category (points mode): (cat=integer)

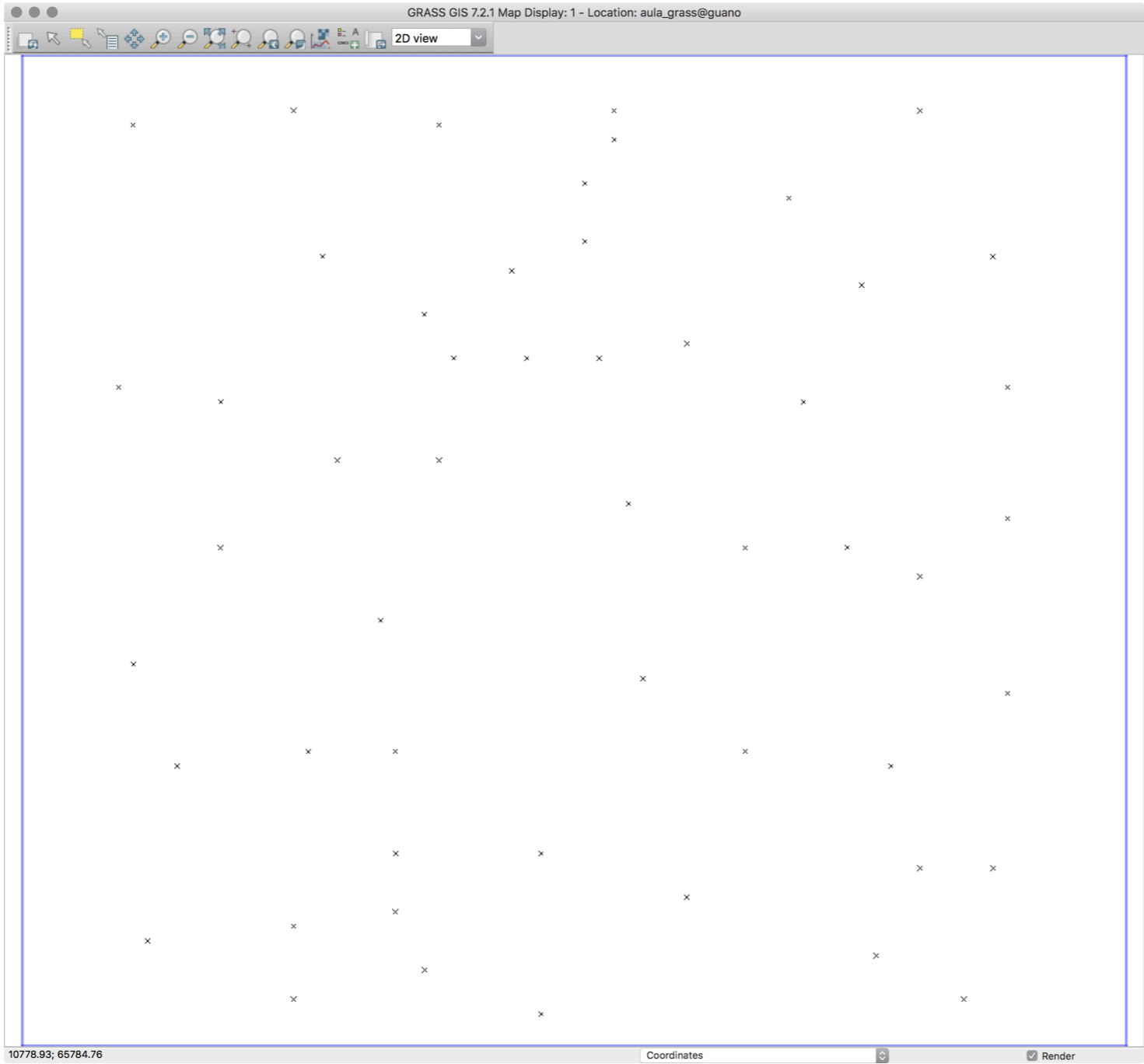
Close Run Copy ?

Add created map(s) into layer tree

Close dialog on finish

v.in.ascii -b --overwrite input=/Volumes/MacintoshHD2/Dropbox/USP/aulas/_SIG/SIG_posGrad/2017_IEE/€

veter



interpolator superficie

Develop raster map	▶
Manage colors	▶
Query raster maps	▶
Map type conversions	▶
Raster buffers and distance	▶
Mask [r.mask]	
Raster map calculator [r.mapcalc]	
Neighborhood analysis	▶
Overlay rasters	▶
Solar radiance and shadows	▶
Terrain analysis	▶
Transform features	▶
Hydrologic modeling	▶
Groundwater modeling	▶
Landscape patch analysis	▶
Wildfire modeling	▶
Change category values and labels	▶
Generate random cells	▶
Generate surfaces	▶
Interpolate surfaces	▶
Reports and statistics	▶

Bilinear and bicubic from vector points [v.surf.bspline]
IDW from raster points [r.surf.idw]
IDW from vector points [v.surf.idw]
Raster contours [r.surf.contour]
Regularized spline tension [v.surf.rst]
Raster series interpolation [r.series.interp]
Fill NULL cells [r.fillnulls]

interpolated surface

v.surf.rst [vector, surface, interpolation, 3D]

Performs surface interpolation from vector points map by splines. Spatial approximation and topographic analysis from given point or isoline data in vector format to floating point raster form using regularized spline with tension.

Required Selection **Parameters** Outputs Optional Command out... Manual

Perform cross-validation procedure without raster approximation (c)

Use scale dependent tension (t)

Name of the attribute column with values to be used for approximation: (zcolumn=name)

Name of raster map used as mask: (mask=name)

Tension parameter: (tension=float)
 40.

Smoothing parameter: (smooth=float)

Name of the attribute column with smoothing parameters: (smooth_column=string)

Maximum number of points in a segment: (segmax=integer)
 40

Minimum number of points for approximation in a segment (>segmax): (nmin=integer)
 300

Minimum distance between points (to remove almost identical points): (dmin=float)

Maximum distance between points on isoline (to insert additional points): (dmax=float)

Conversion factor for values used for approximation: (zscale=float)
 1.0

Anisotropy angle (in degrees counterclockwise from East): (theta=float)

Anisotropy scaling factor: (scalex=float)

Close Run Copy ?

Add created map(s) into layer tree
 Close dialog on finish

v.surf.rst --overwrite input=davis@guano elevation=davis_dem

v.surf.rst [vector, surface, interpolation, 3D]

Performs surface interpolation from vector points map by splines. Spatial approximation and topographic analysis from given point or isoline data in vector format to floating point raster form using regularized spline with tension.

Required Selection Parameters **Outputs** Optional Command out... Manual

Output partial derivatives instead of topographic parameters (d)

Name for output surface elevation raster map: (elevation=name)
 davis_dem

Name for output slope raster map: (slope=name)

Name for output aspect raster map: (aspect=name)

Name for output profile curvature raster map: (pcurvature=name)

Name for output tangential curvature raster map: (tcurvature=name)

Name for output mean curvature raster map: (mcurvature=name)

Name for output deviations vector point map: (deviations=name)

Name for output cross-validation errors vector point map: (cvdev=name)

Name for output vector map showing quadtree segmentation: (treeseg=name)

Name for output vector map showing overlapping windows: (overwin=name)

Close Run Copy ?

Add created map(s) into layer tree
 Close dialog on finish

v.surf.rst --overwrite input=davis@guano elevation=davis_dem

gerar curvas de nivel

r.contour [raster, surface, contours, vector]

Produces a vector map of specified contours from a raster map.

Required Contour levels Optional Command output Manual

Name of input raster map: * (input=name)
davis_dem@guano

Name for output vector map: * (output=name)
davis_dem_r50m_c10m

Close Run Copy ?

Add created map(s) into layer tree
 Close dialog on finish

```
r.contour --overwrite input=davis_dem@guano output=davis_dem_r50m_c10m step=10
```

r.contour [raster, surface, contours, vector]

Produces a vector map of specified contours from a raster map.

Required Contour levels Optional Command output Manual

Increment between contour levels: (step=float)
10

[multiple] List of contour levels: (levels=float)

Minimum contour level: (minlevel=float)

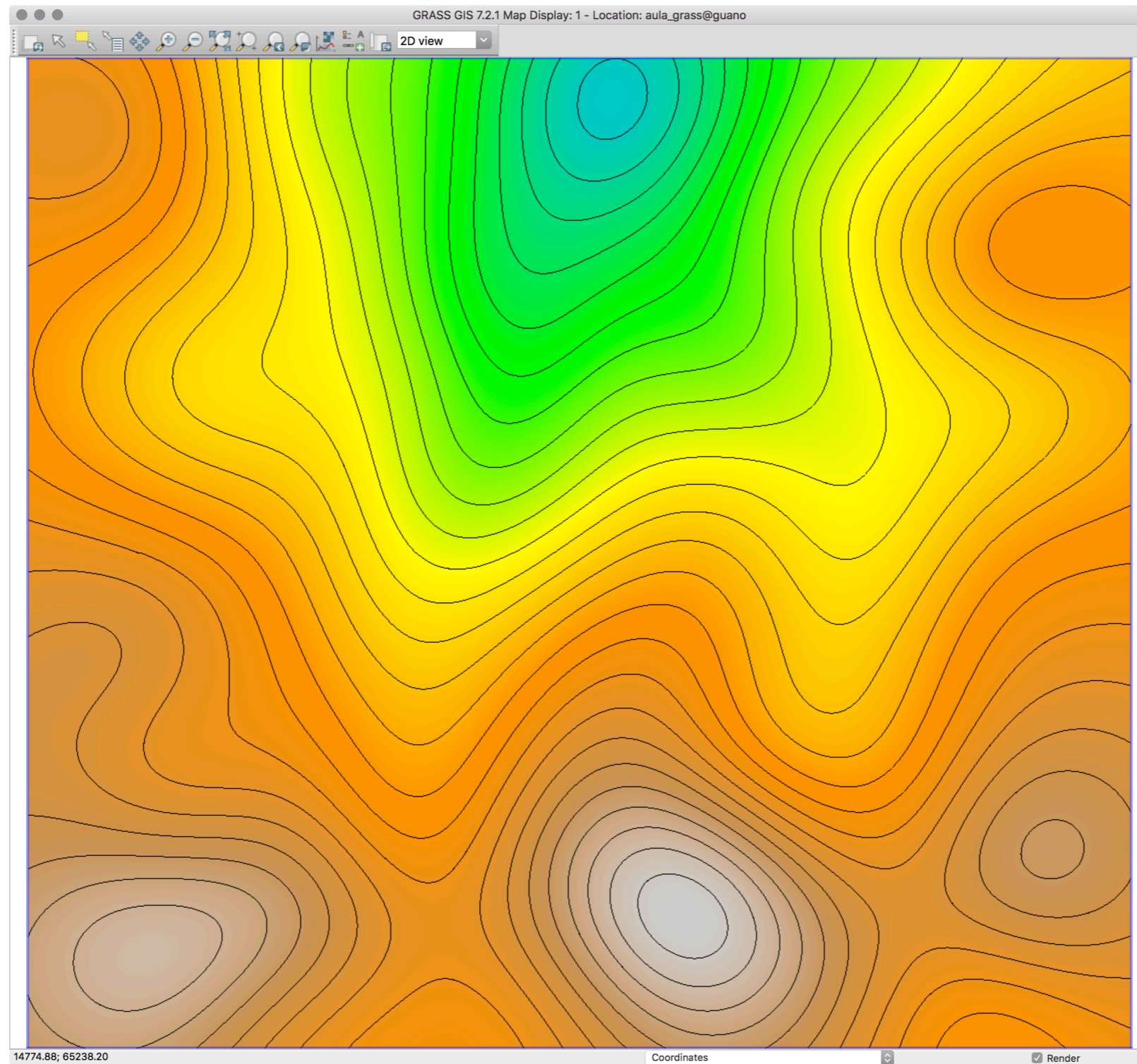
Maximum contour level: (maxlevel=float)

Close Run Copy ?

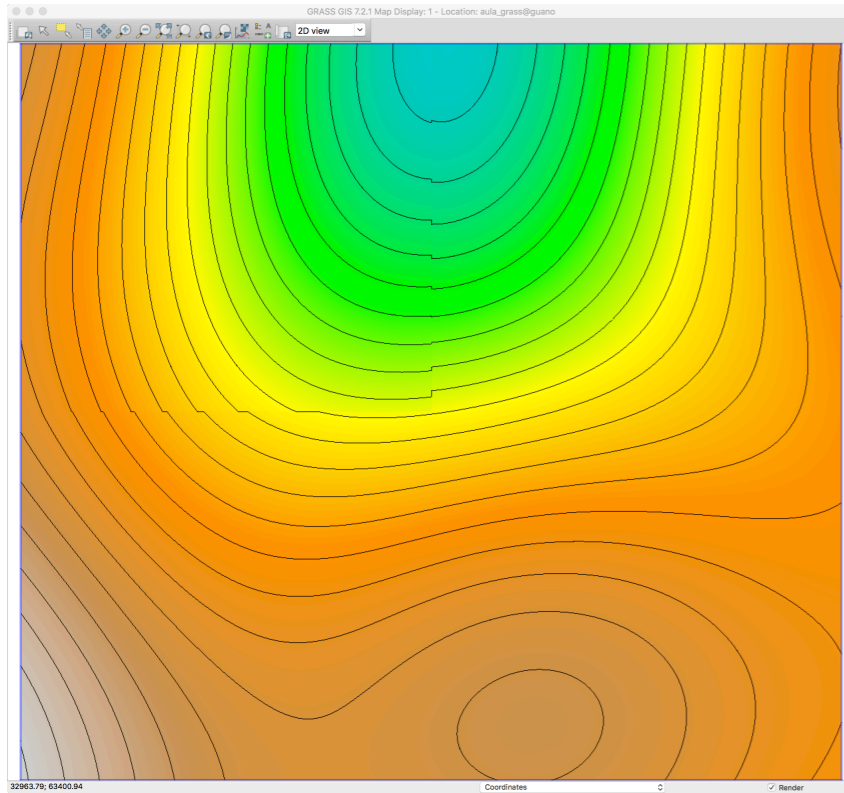
Add created map(s) into layer tree
 Close dialog on finish

```
r.contour --overwrite input=davis_dem@guano output=davis_dem_r50m_c10m step=10
```

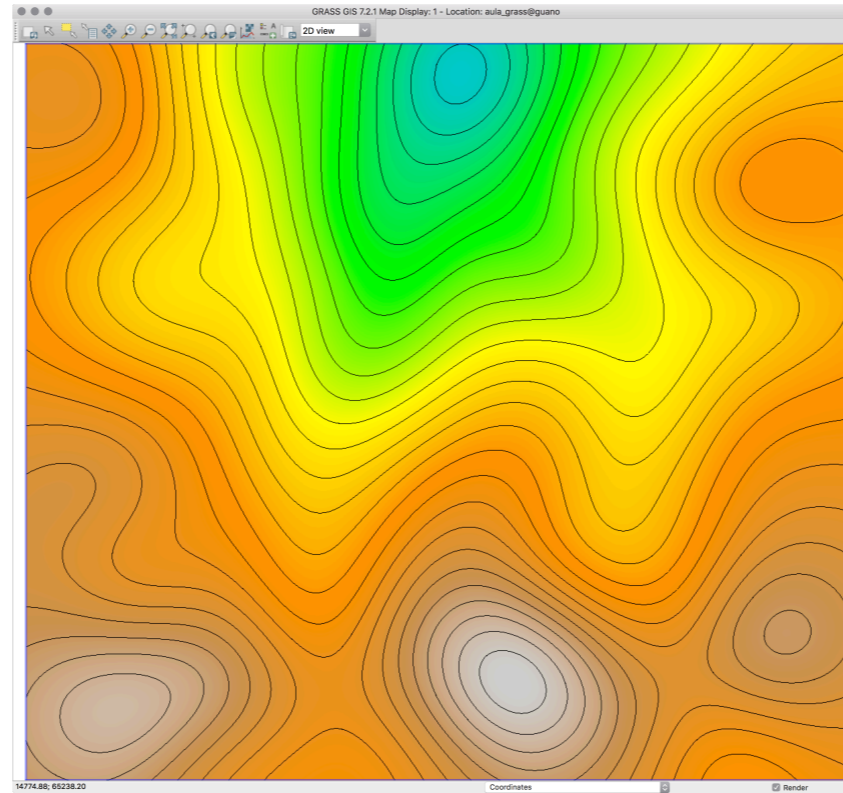
dem + curvas de nivel



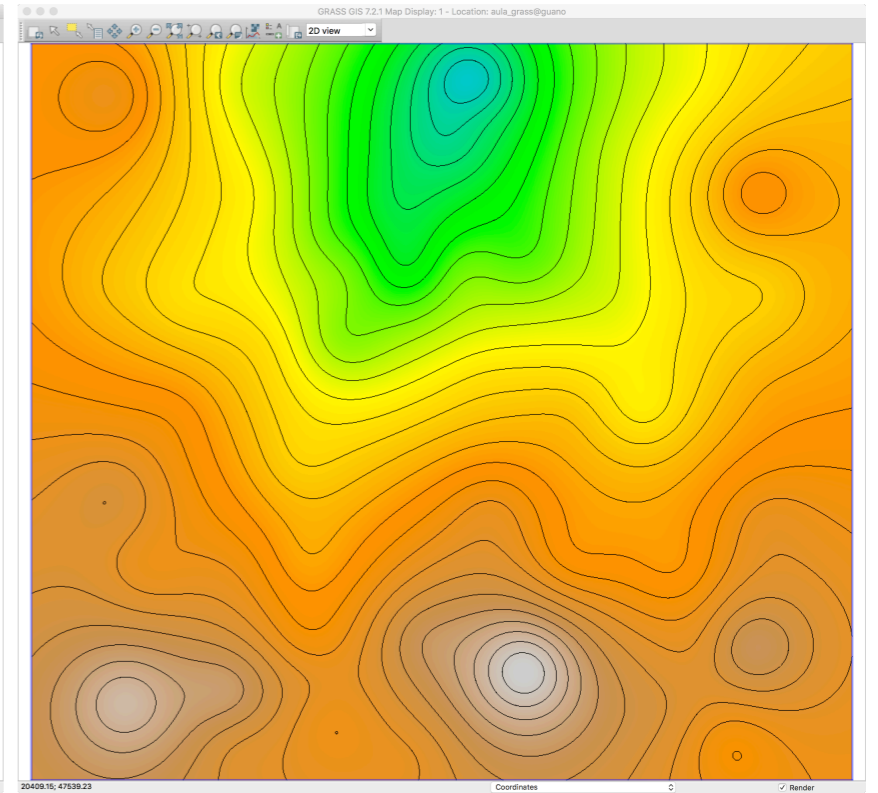
dem + curvas de nivel



t=10



t=40



t=100

interpolar superficie + derivadas

v.surf.rst [vector, surface, interpolation, 3D]

Performs surface interpolation from vector points map by splines. Spatial approximation and topographic analysis from given point or isoline data in vector format to floating point raster form using regularized spline with tension.

Required Selection Parameters **Outputs** Optional Command out... Manual

Output partial derivatives instead of topographic parameters (d)

Name for output surface elevation raster map: (elevation=name)
davis_dem_t40

Name for output slope raster map: (slope=name)
davis_dem_t40_slope

Name for output aspect raster map: (aspect=name)
davis_dem_t40_aspect

Name for output profile curvature raster map: (pcurvature=name)
davis_dem_t40_pcurv

Name for output tangential curvature raster map: (tcurvature=name)
davis_dem_t40_tcurv

Name for output mean curvature raster map: (mcurvature=name)

Name for output deviations vector point map: (deviations=name)

Name for output cross-validation errors vector point map: (cvdev=name)

Name for output vector map showing quadtree segmentation: (treeseg=name)

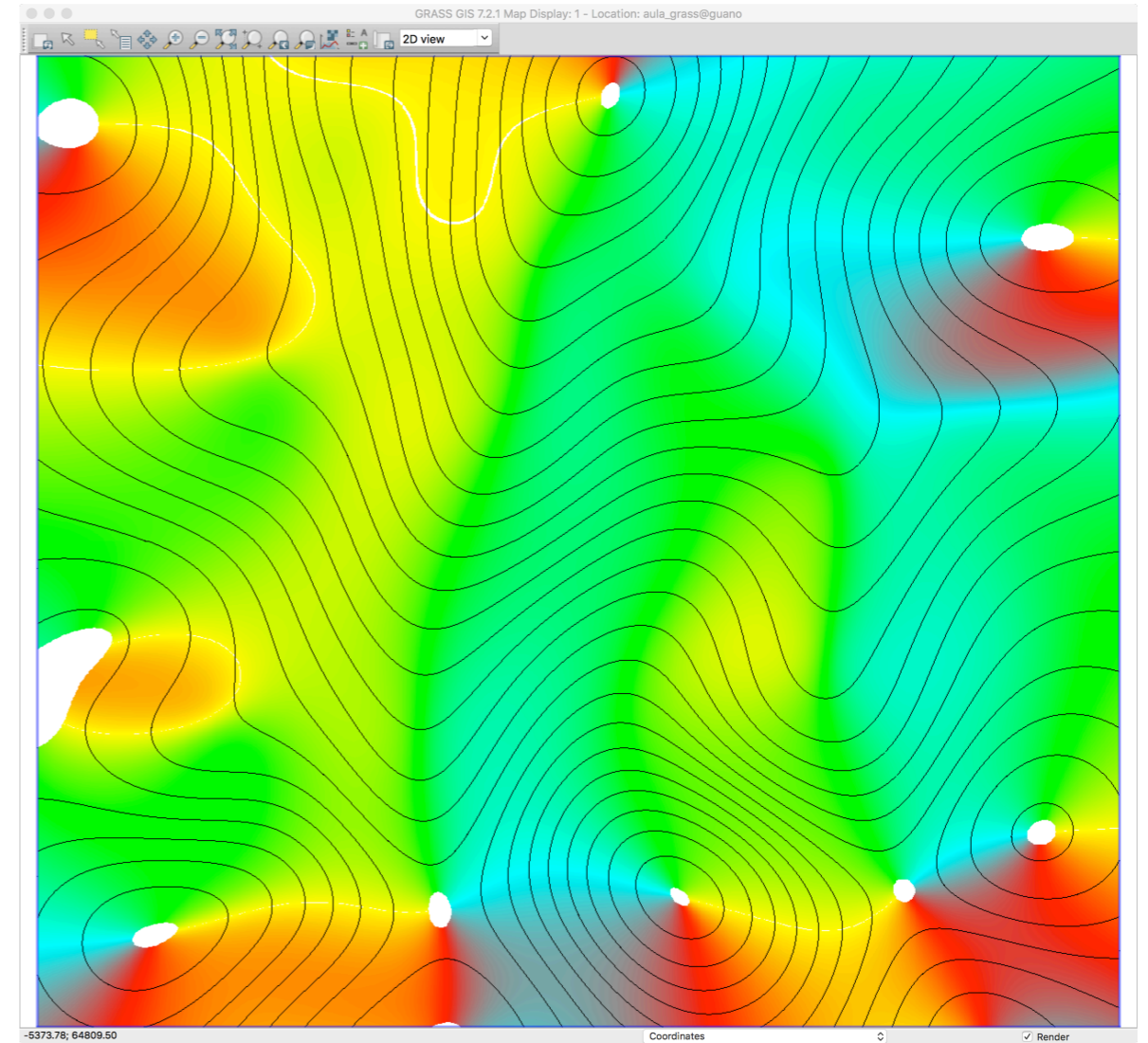
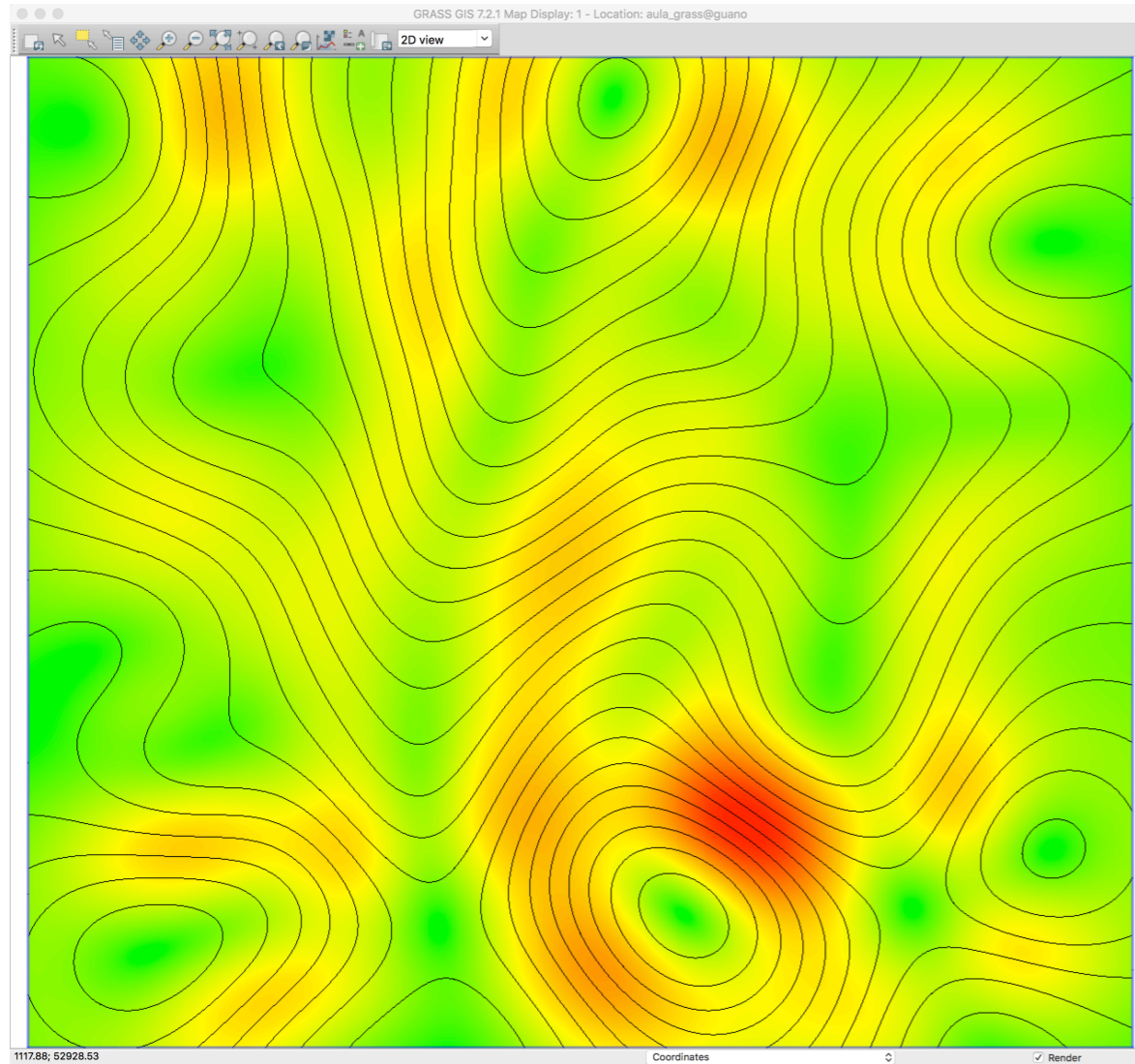
Name for output vector map showing overlapping windows: (overwin=name)

Close Run Copy ?

Add created map(s) into layer tree
 Close dialog on finish

v.surf.rst --overwrite input=davis@guano elevation=davis_dem_t40 slope=davis_dem_t40_slope aspect=davis_dem_t

declividade / aspecto



curvaturas

