

Mapping natural hazards in gvSIG using the HortonMachine plugins



Silvia Franceschi and Andrea Antonello

gvSIG conference, 25th October 2018

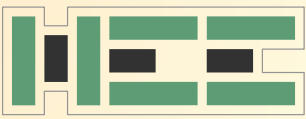
Who am I?

- environmental engineer specialized in hydrology, hydraulics, geomorphology and forestry
- PhD in Mountain Environment and Agriculture
- co-founder of HydroloGIS
- developer of scientific models contained in the JGrassTools library in the fields of: hydrology, hydraulic, forestry
- OSGeo Charter Member



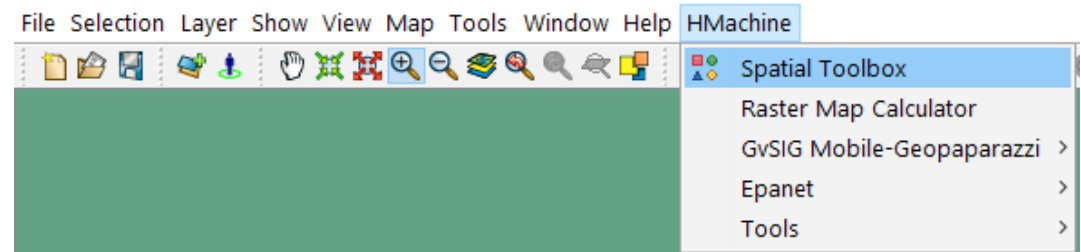
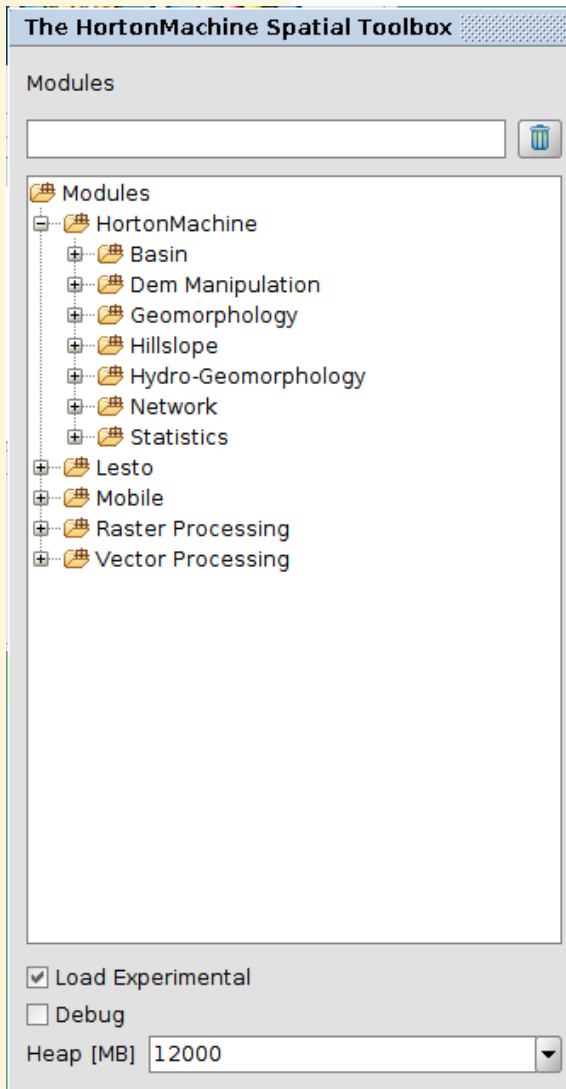
The HortonMachine library

- an Open Source geospatial library focused on hydro-geomorphological analysis and environmental modeling
- development started in 2002 at the University of Trento, Department of Civil and Environmental Engineering
- completely maintained by HydroloGIS
- from 2015 integrated as Spatial Toolbox in gvSIG
- available for installation as plugin through the gvSIG Update Manager



The HortonMachine library

HMachine package gvSIG:



Models are grouped in sections and subsections. Main sections are:

- HortonMachine: geomorphology analysis
- Raster and vector processing
- Mobile tools: support for Geopaprazzi application for digital field mapping
- LESTO: LiDAR Empowered Science Toolbox Open Source

The HortonMachine library

Modules List

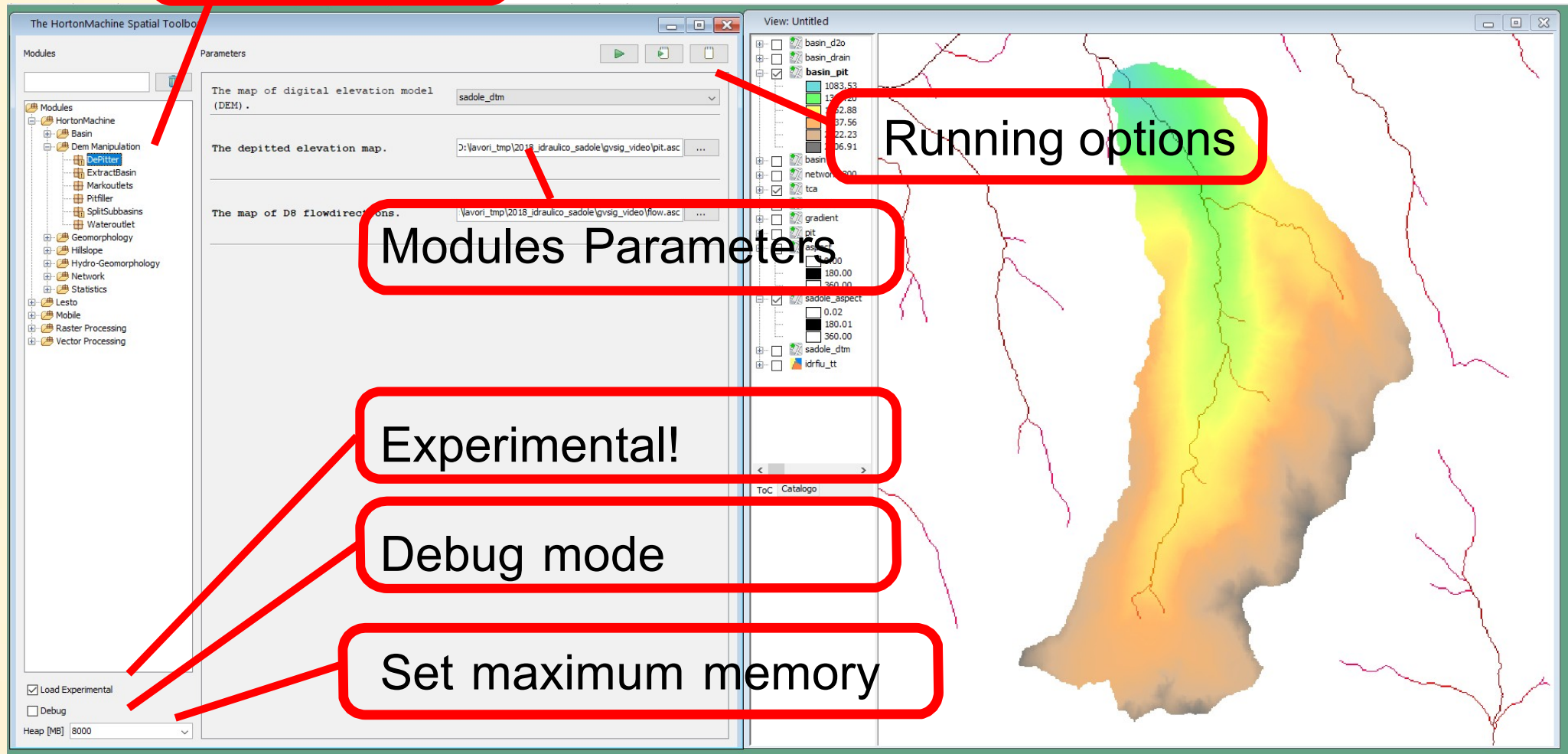
Running options

Modules Parameters

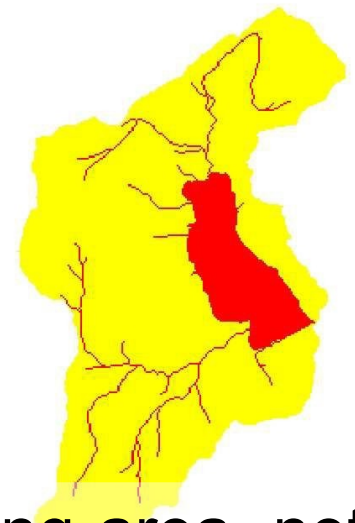
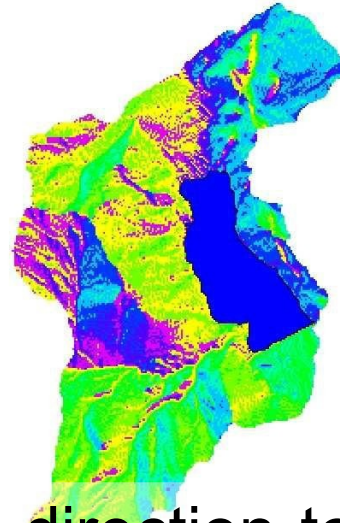
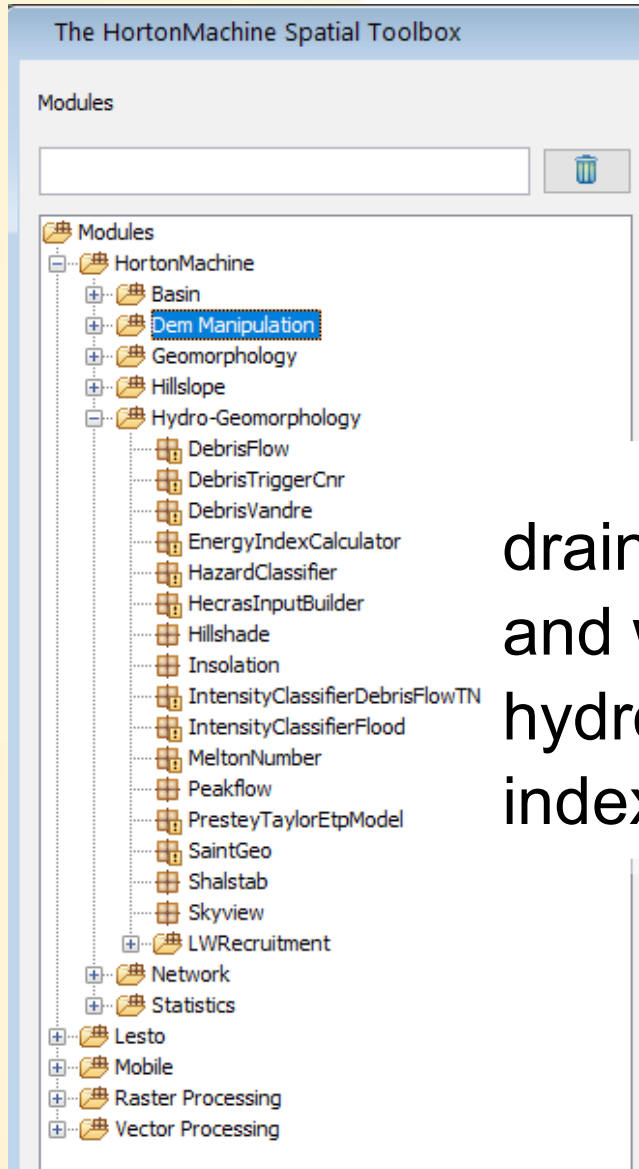
Experimental!

Debug mode

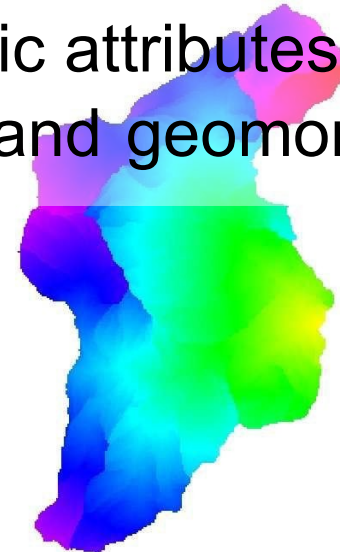
Set maximum memory



The HMachine library: geomorphology

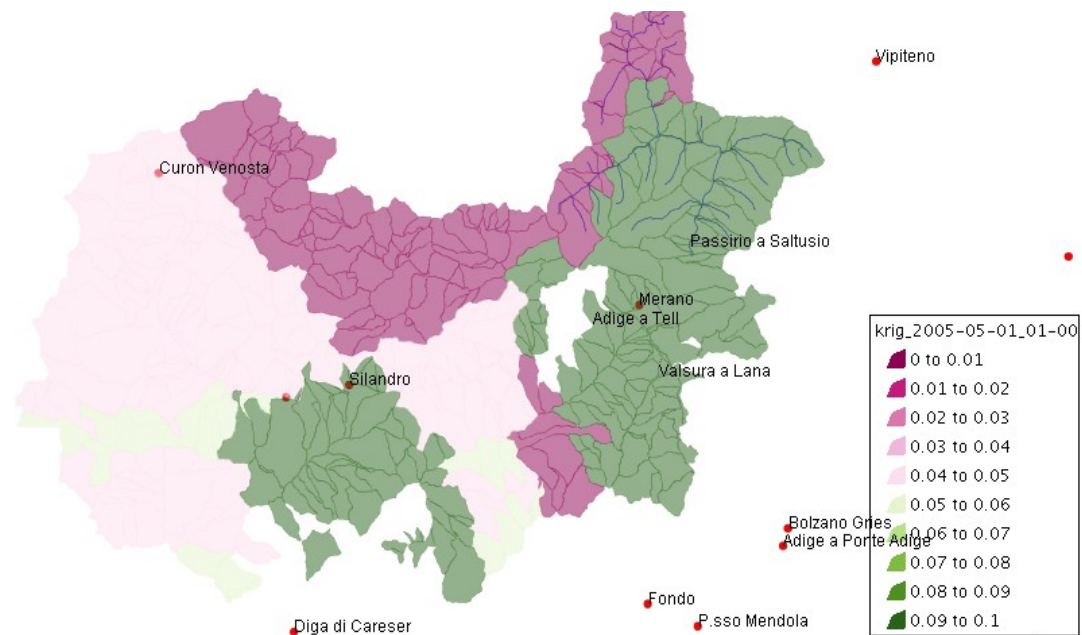
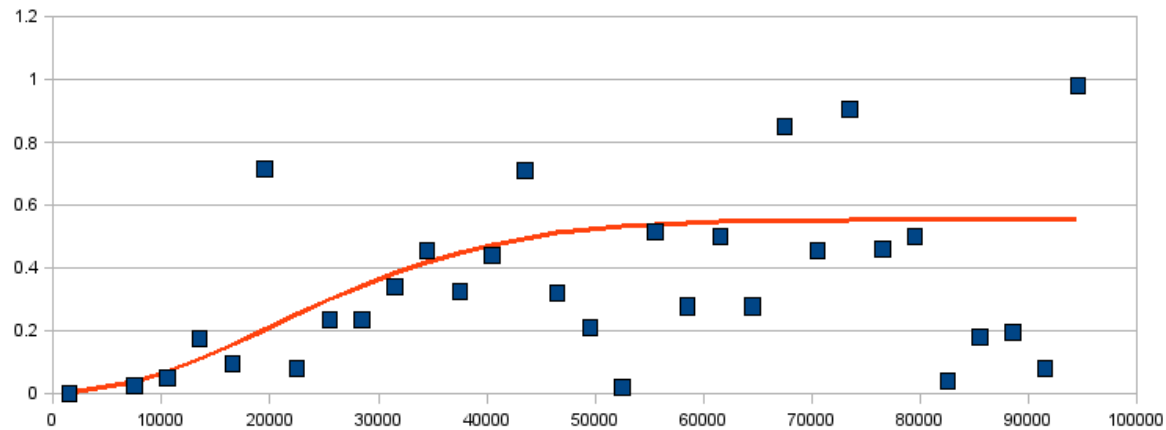
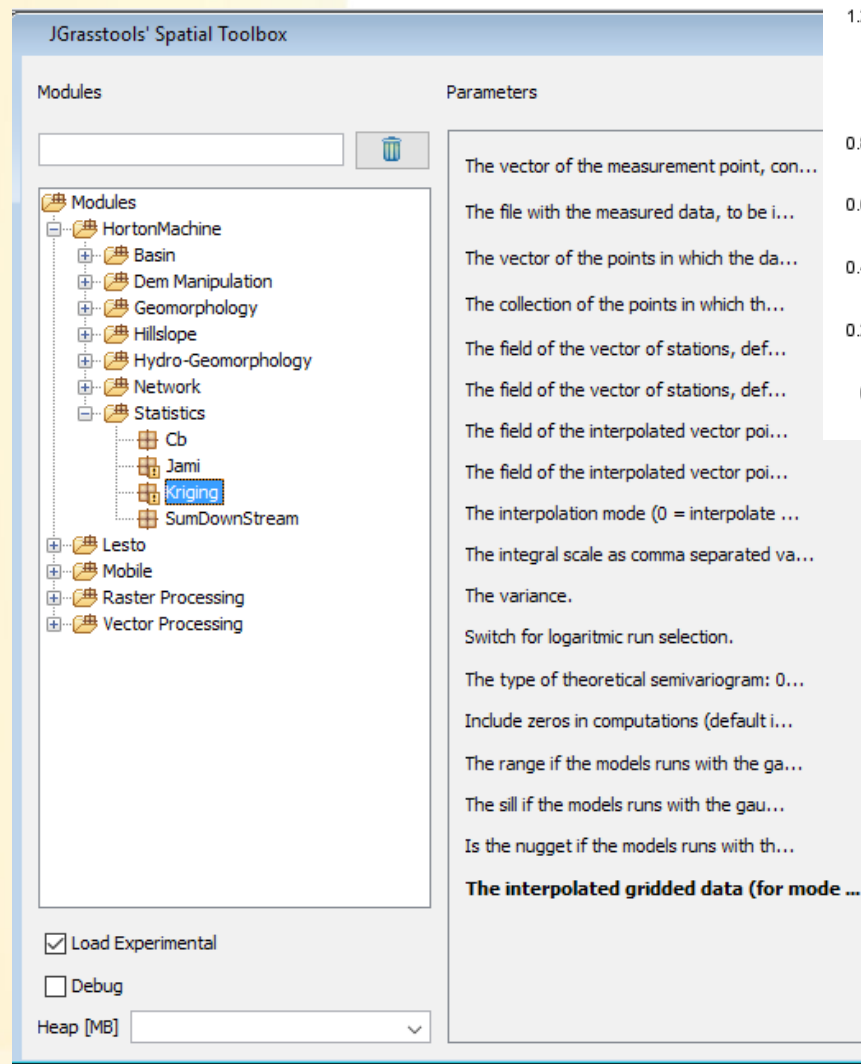


drainage direction, total contributing area, network and watershed extraction, rescaled distances and hydrologic attributes, slope, curvatures, hydrologic indexes and geomorphologic attributes



The HMachine library: Statistics

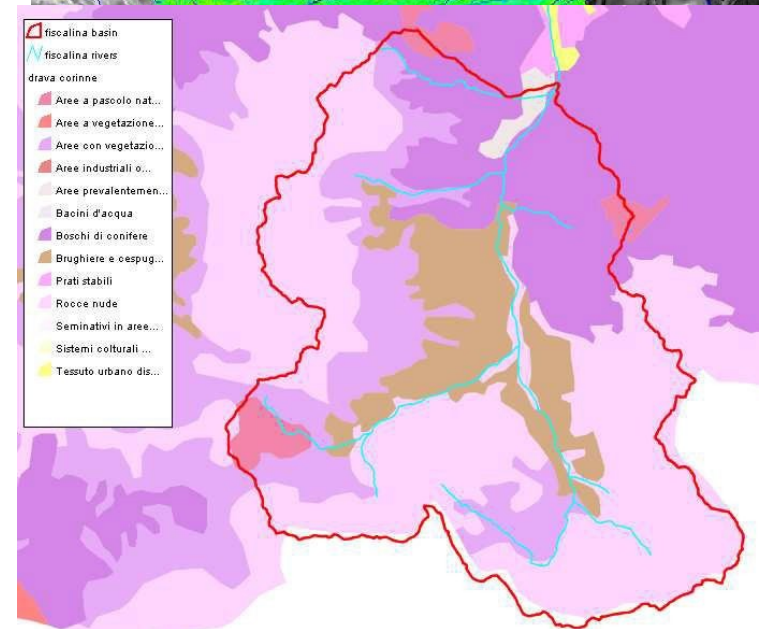
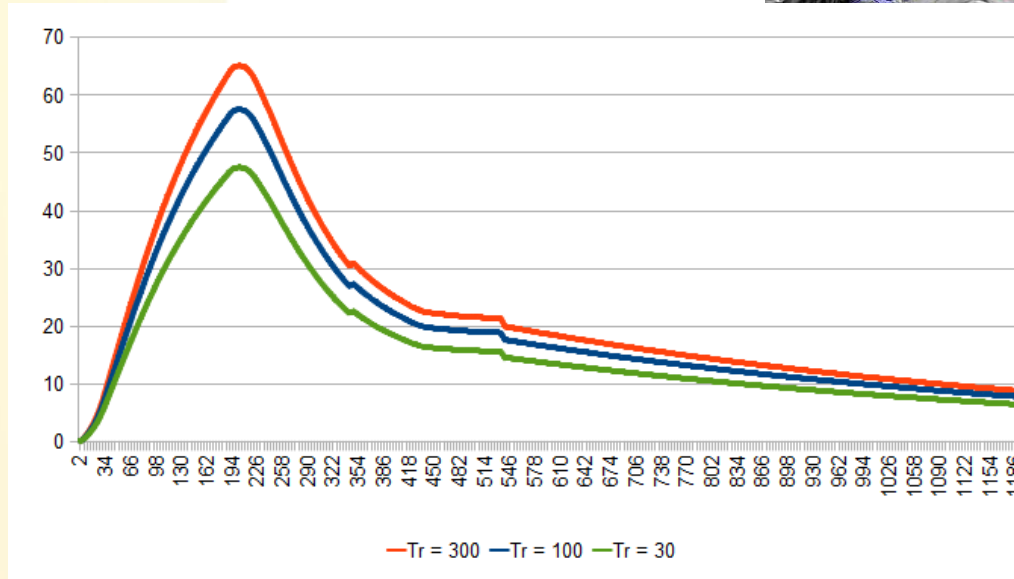
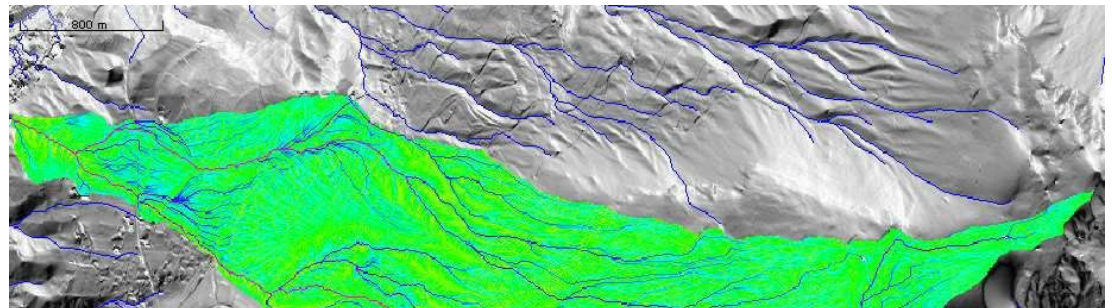
Interpolation of meteorological data with **Kriging** (rainfall and temperature) and **Jami** for all the variables depending on elevation



The HMachine library: HydroGeomorph

Evaluation of the maximum discharge for a given precipitation (works also with statistical information rainfall Intensity-Duration Curves or a for specific event)

Peakflow



Complete hydrological model for water management and emergency plans: precipitations (rain, snow), evapotranspiration, runoff, propagation along the stream network.

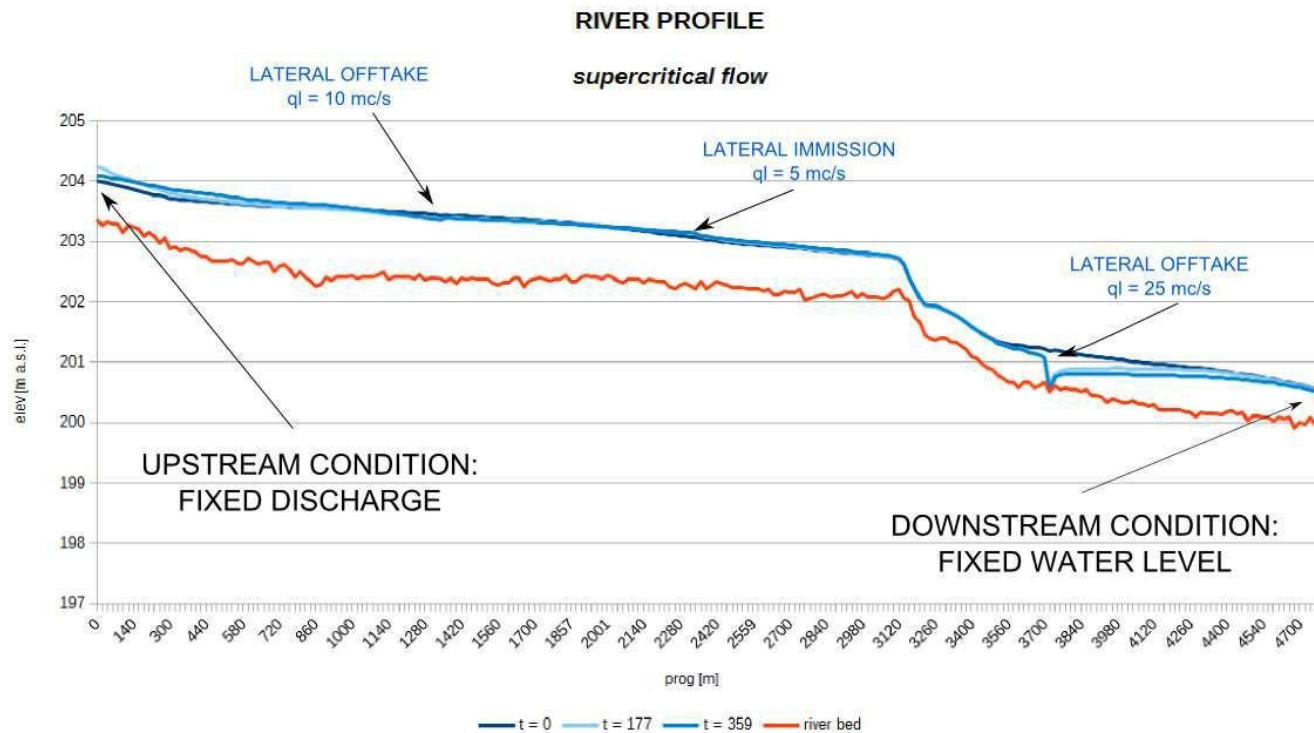
Discharge can be calibrated with stream gauge data.



The HMachine library: HydroGeomorph

Simplified 1D hydraulic model:

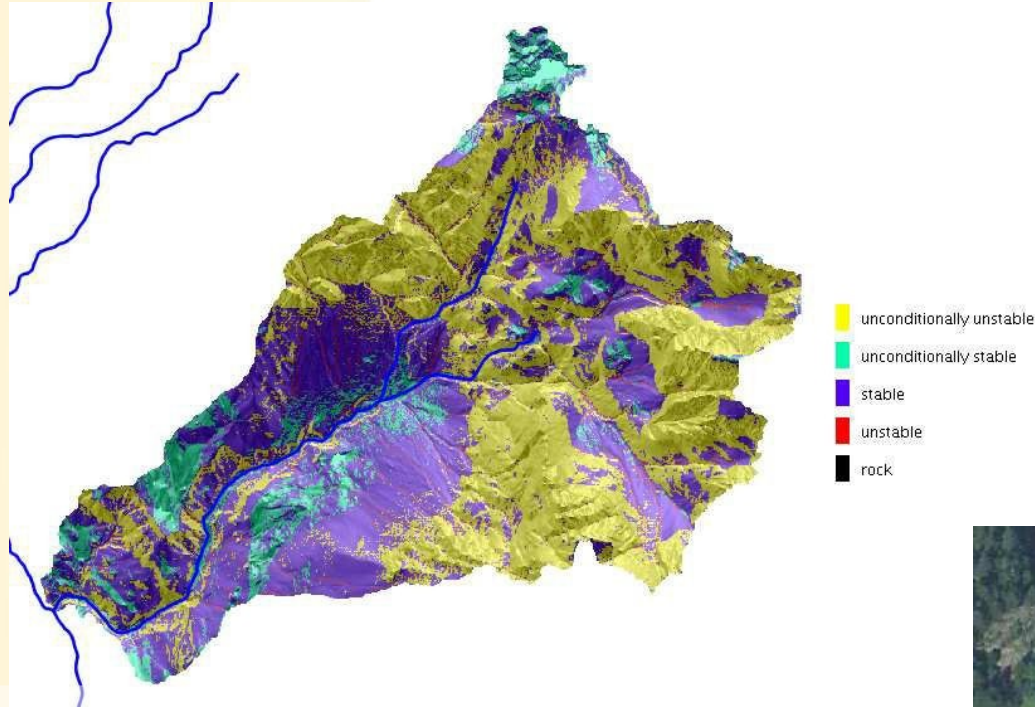
- based on Saint Venant equations
- GIS based: input and output are GIS layers
- calculates the water depth and velocity for each section
- can handle lateral contributes: inflow and outtakes



Data preparation
for the **Hecras**
hydraulic software
for channels.

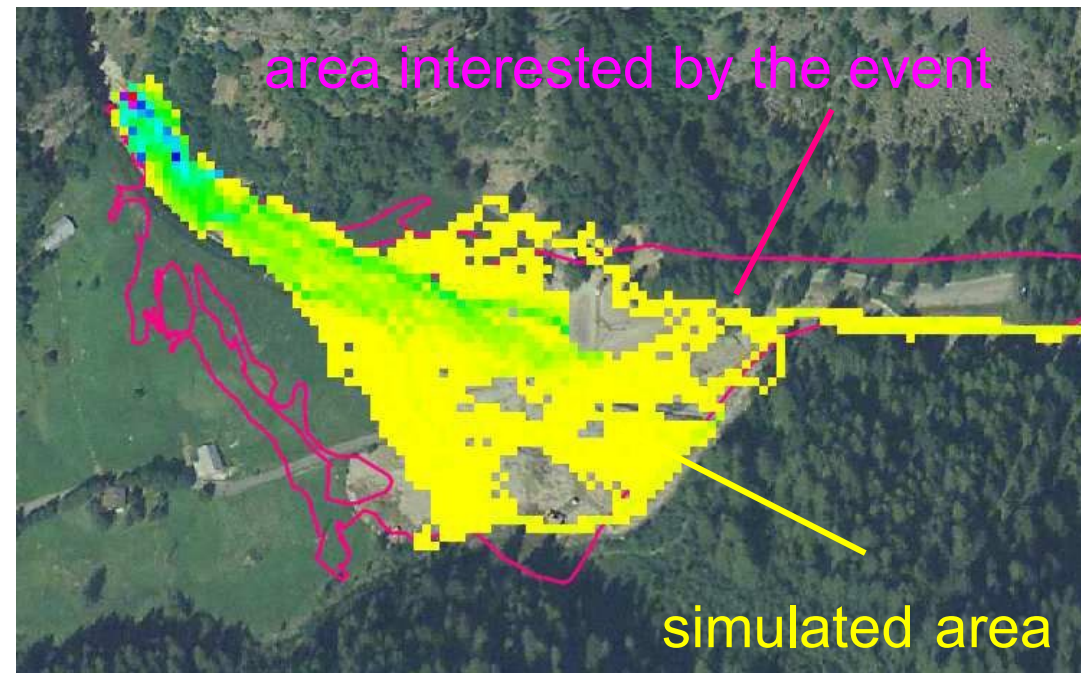
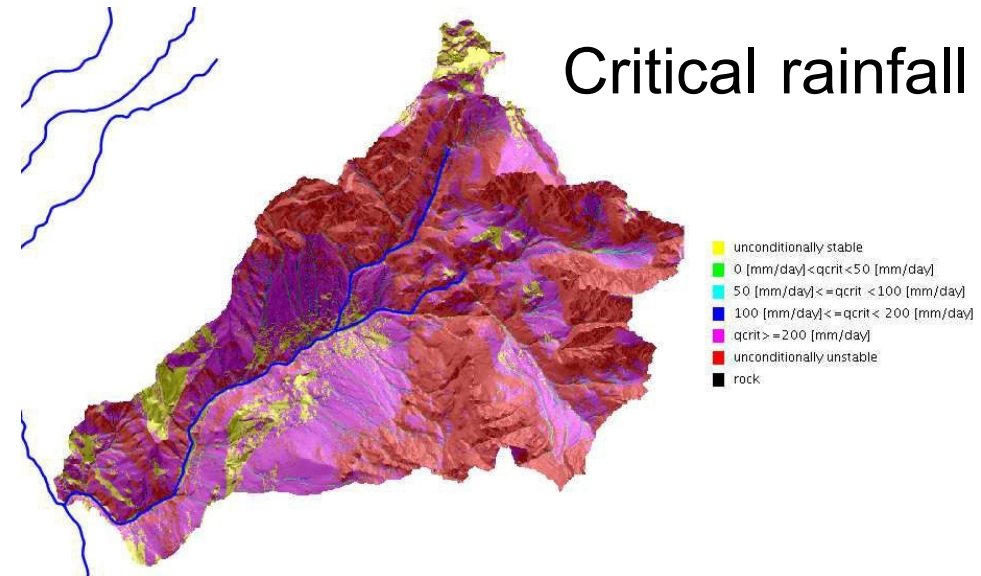
The HMachine library: HydroGeomorph

Hillslope stability: Shalstab



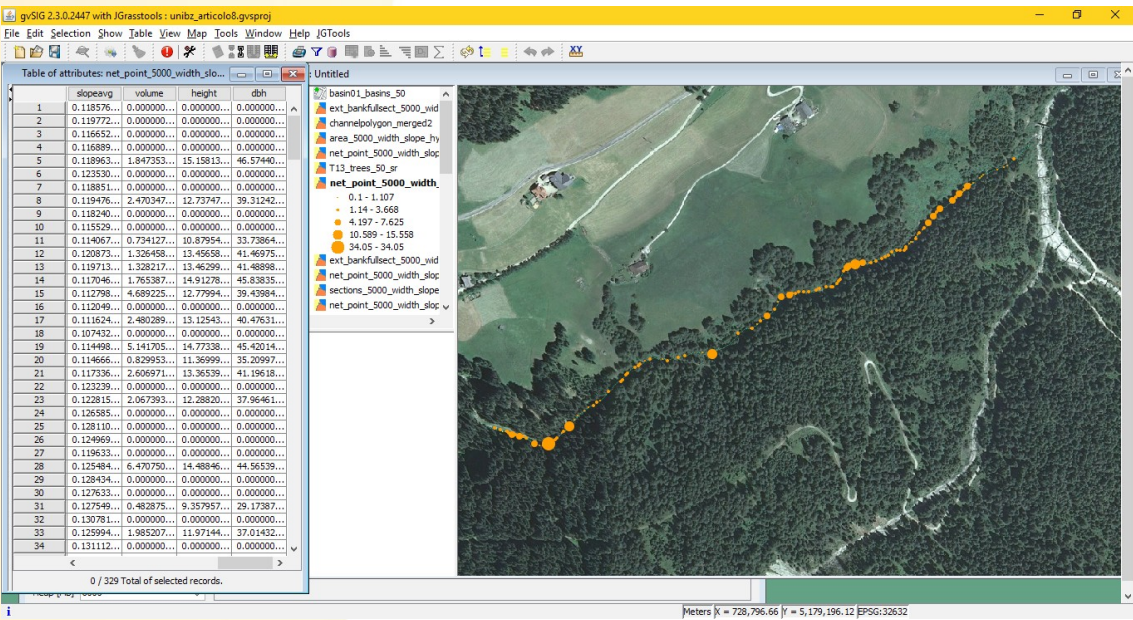
Stability condition for the given precipitation

DebrisFlow: triggering, propagation in network and final propagation on the fan



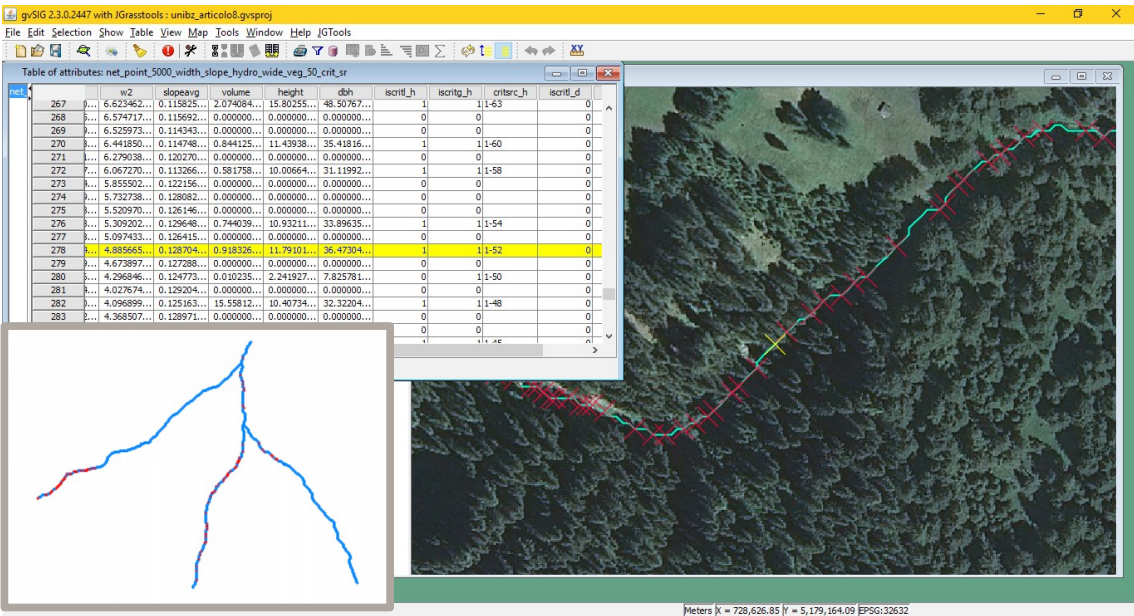


The HMachine library: LW floods model



Local contribute of LW from hillslopes instabilities and bank erosion: amount and dimensions of LW in each section of the river network.

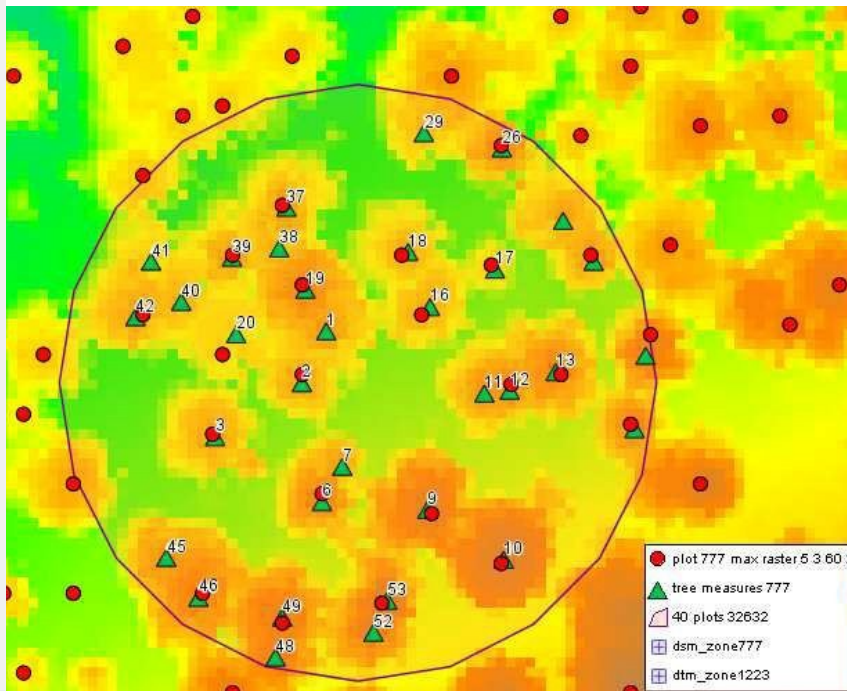
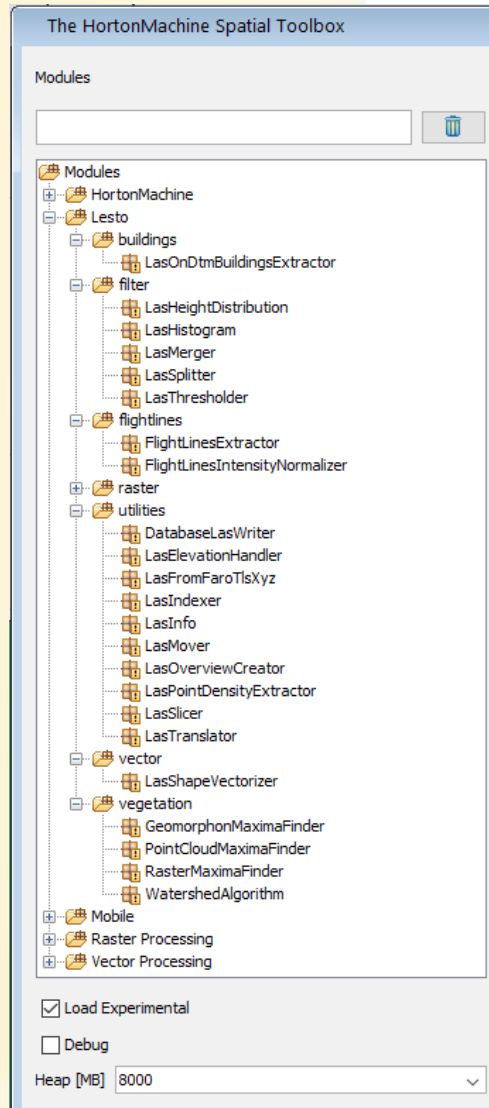
Propagation of the logs: identification of the clogging sections.



The HMachine library: LESTO

Developed in collaboration with the Free University of Bolzano.
The toolbox is mainly dedicated to LiDAR and forestry analysis.

Vegetation: individual tree crown approach:
position and main characteristics of each single
tree (LW debris model, rock falls protection,
forestry).



Modules that
work on
**raster and point
clouds**

The HMachine library: Raster MapCalc

The *mapcalc* is a tool that can be use to perform map algebra on raster maps.

Let's assume you want to know which part of an elevation model between 1000 and 1300 meters a.s.l. looks towards (exposed) south.

Once you calculated the aspect map with the SpatialToolbox, you can use a formula like this in the RasterMapCalculator:

```
if (dtm_all>1000 && dtm_all<1300 && aspect >160 && aspect <200 ) {  
    result = dtm_all;  
} else {  
    result = -9999.0;  
}
```

The HMachine library: Raster MapCalc

formula history

maps to use

formula area

output map

The screenshot displays the gvSIG 2.4.0.2833 interface with the HortonMachine Raster Map Calculator plugin. The interface includes a console log, a formula history, a function area, and a view of the output map. Red arrows point to specific components: 'formula history' points to the Mapcalc History section, 'maps to use' points to the Available maps section, 'formula area' points to the Function Area section, and 'output map' points to the View: Untitled window showing a 3D terrain map with colored overlays.

Mapcalc History

```
if (dtm_all>1000 && dtm_all<1300 && aspect >160 && aspect <200 ) { result =
```

Function Area

```
if (dtm_all>1000 && dtm_all<1300 && aspect >160 && aspect <200 ) {
  result = dtm_all;
} else {
  result = -9999.0;
}
```

Available maps

| Map Name | Path |
|----------|-------------------------|
| dtm_all | /home/hydrologis/dat... |
| aspect | /home/hydrologis/dat... |

Syntax Help

processing area | general | logical | arithmetic | numeric | statistical

if con for while

run

View: Untitled

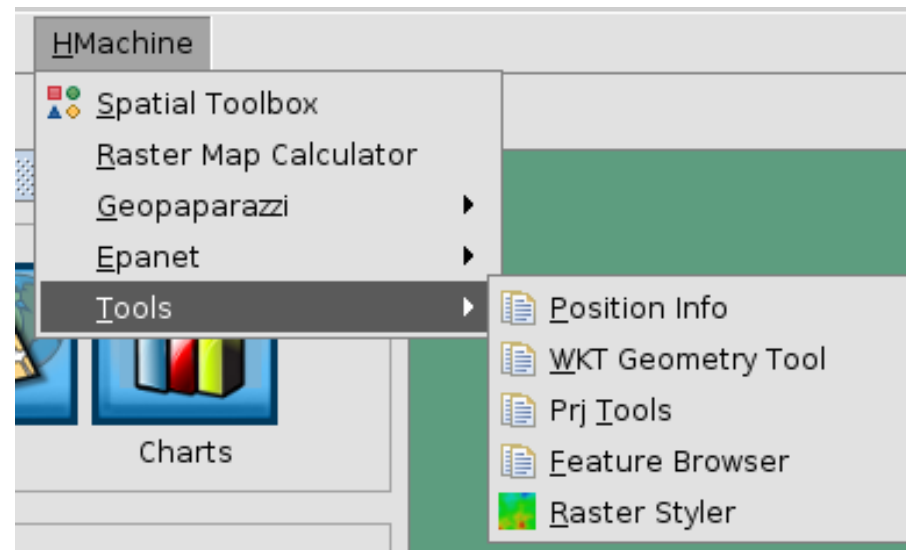
output
aspect
dtm_all

1: 26,953 Meters X = 683,424.42 Y = 5,133,645.41 EPSG:32632

The HMachine library: Tools and Utilities

The HMachine plugins contain a set of small tools and utilities that can be useful to manage data and analyze the results of the simulations.

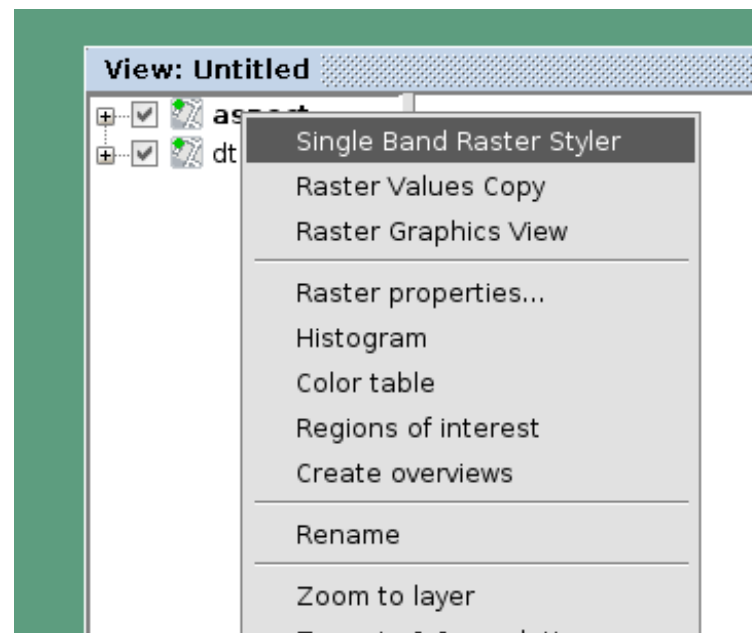
Most of them can be accessed from the main menu:



The HMachine library: Raster Styler

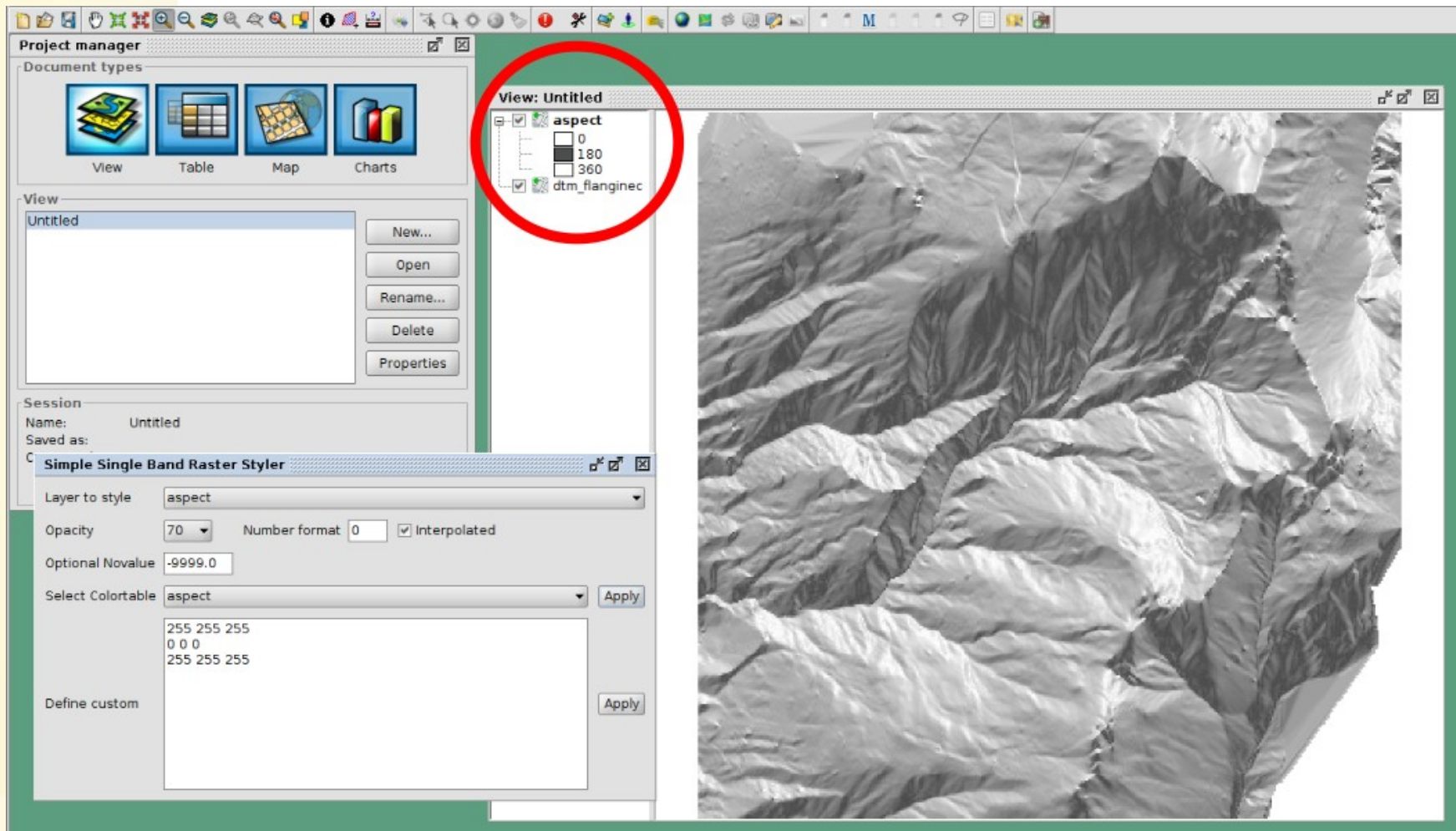
The ***Raster Styler*** helps to quickly define a color table for a raster layer. It is mainly dedicated to raster of data such as the DTM derived rasters and not to images.

Raster Styler can be accessed from the main menu or from the context menu (right click) on raster layers:



The HMachine library: Raster Styler

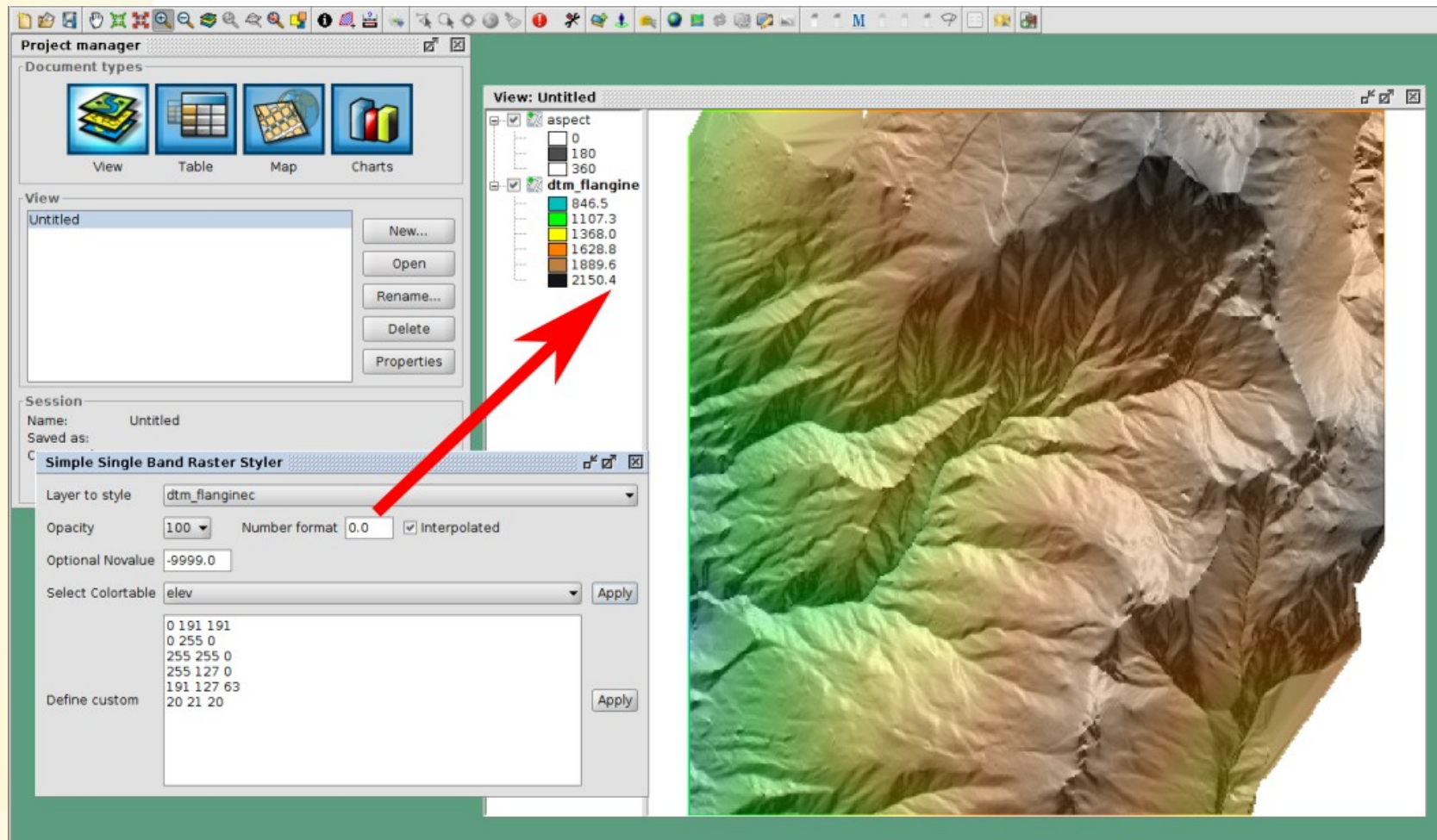
The map of aspect ranges between 0 and 360 degrees, usually colored from white to black between 0 and 180, and from black to white between 180 and 360 → 3 rules.



The HMachine library: Raster Styler

Raster Styler also supports transparency.

Example: the *elevation* color ramp for DTM with transparency on the aspect map.



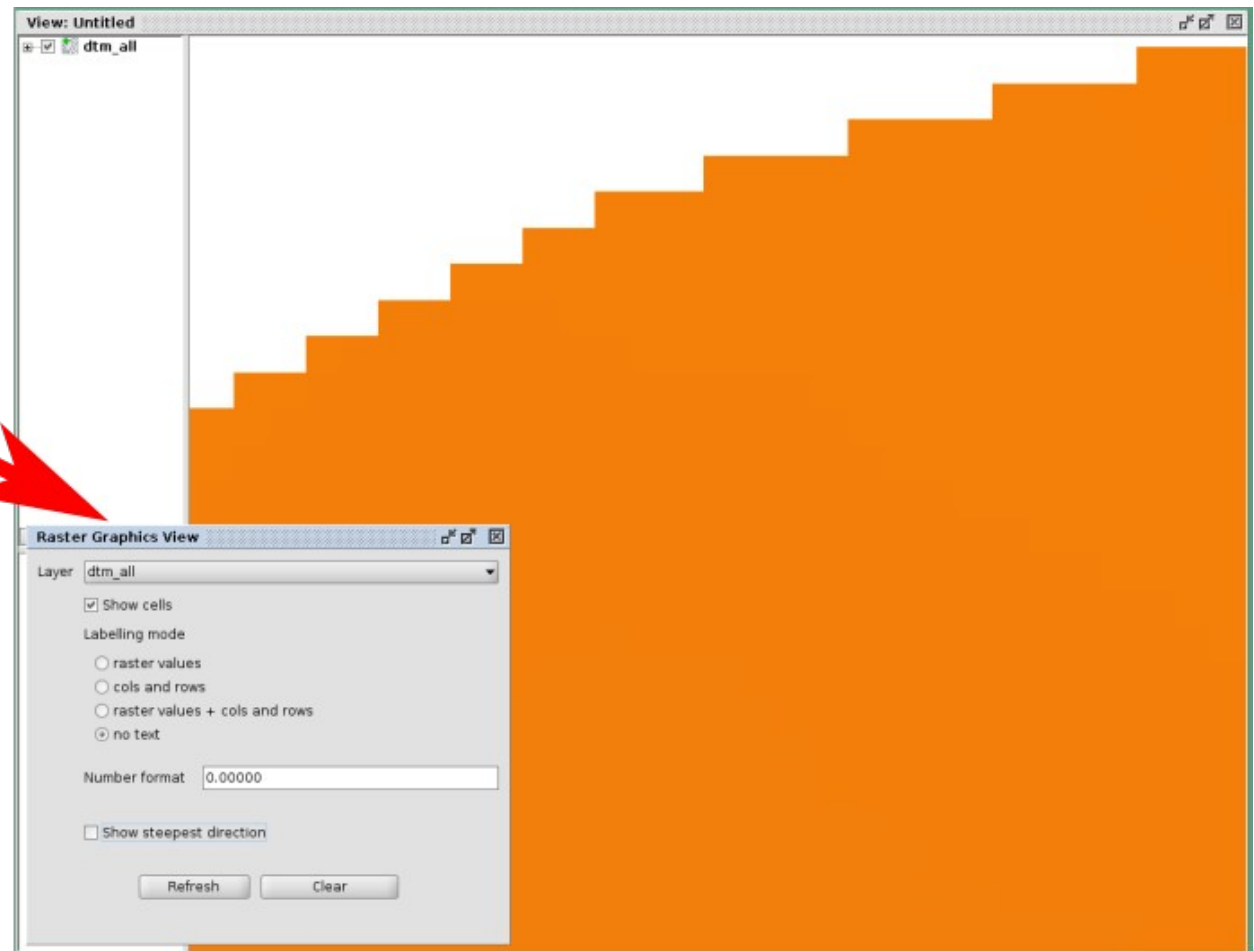
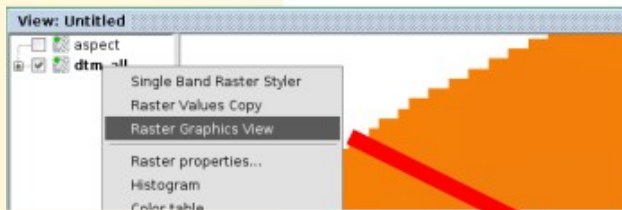
The HMachine library: Raster Graphic

The ***Raster Graphic View*** can be used to analyze small portions of large rasters where the colortable is not enough to understand the values.

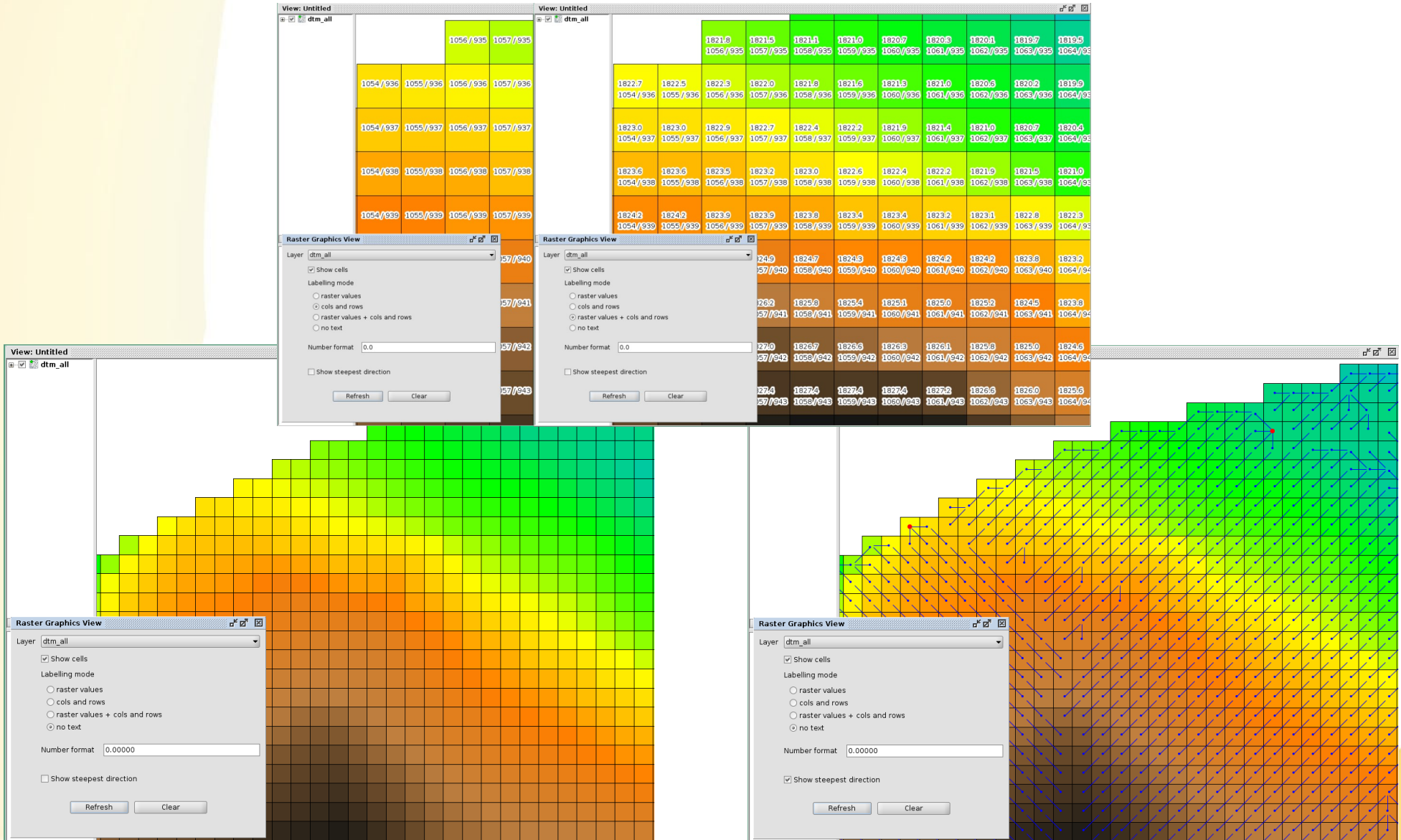
Raster Graphic View can show directly on the map view:

- the grid raster cells without text
- the raster values
- the cols and rows
- the steepest flow direction between cells

The HMachine library: Raster Graphic



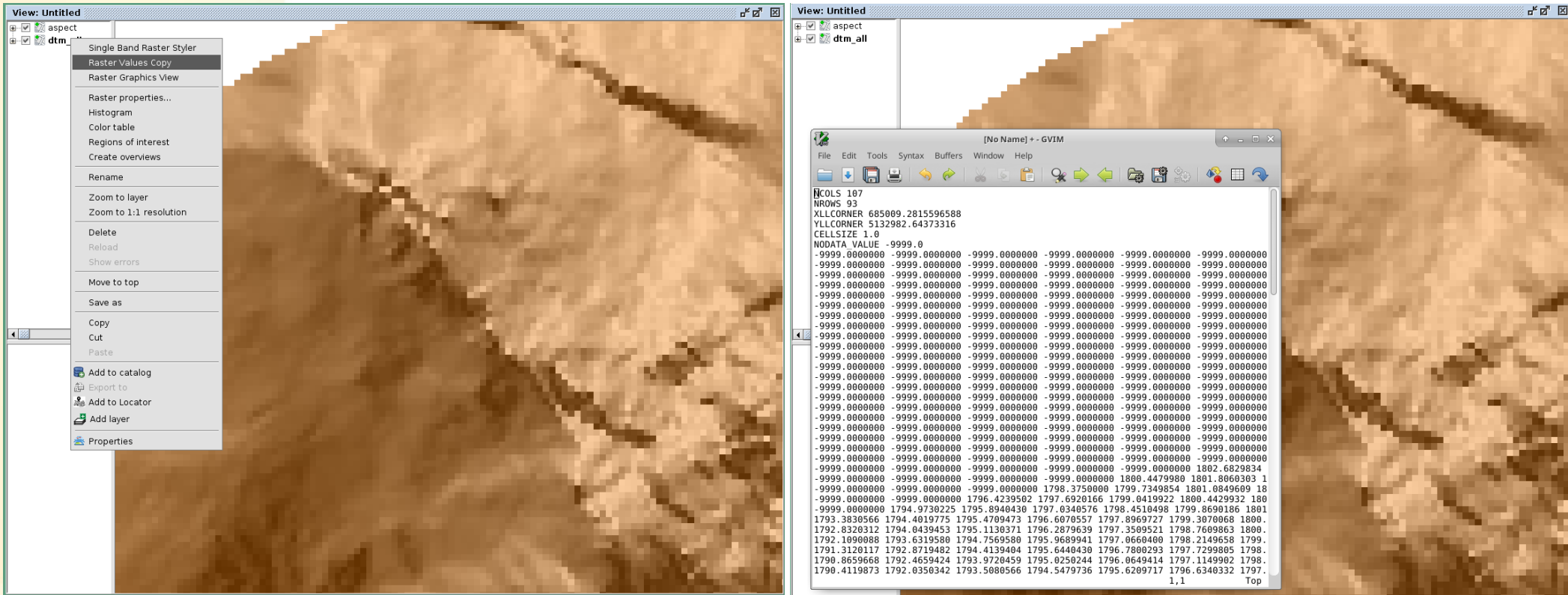
The HMachine library: Raster Graphic

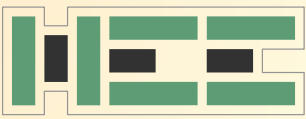


The HMachine library: Raster Values Copy

The Raster Values Copy is used to extract small portions of raster maps to faster investigate them.

Once triggered, it copies the visible portion of the map into the system clipboard as an ascii raster map, ready to be copied in a text file.





Useful links

Homepage

<http://www.hortonmachine.org>

Mailinglist

<http://groups.google.com/group/jgrasstools>

Updates and info

<https://www.slideshare.net/search/slideshow?q=jgrasstools>

<http://jgrasstechtips.blogspot.it>

THANKS FOR THE ATTENTION!

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