Evaluation of gvSIG and SEXTANTE Tools for Hydrological Analysis

6th gvSIG Conference, Valencia, SPAIN

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Introduction

Image taken from:
http://upload.wikimedia.org/wikipedia/commons/thumb/a/a0/G%C3%BCtenbach_in_VS.svg/300px-G%C3%BCtenbach_in_VS.svg.png

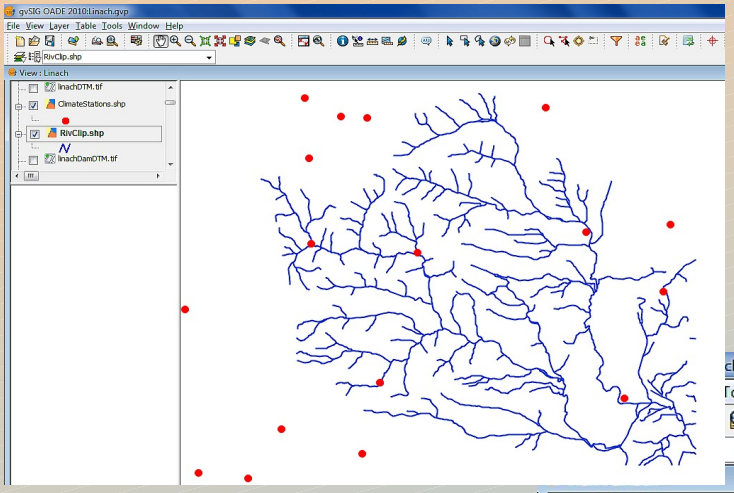
Image taken from:
http://www.statemaster.com/encyclopedia/Black-Forest

Image taken from:
http://www.the-english-guest-house.com/thedanube.htm

Data

ESRI Shapefiles

- Climate Stations
- Rivers
- Landcover



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yllcorner     5308250
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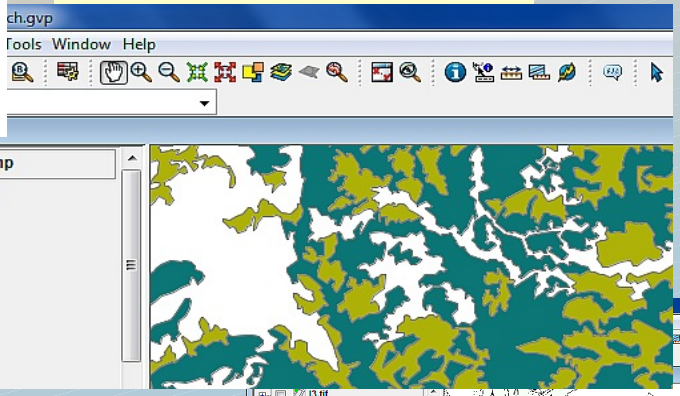
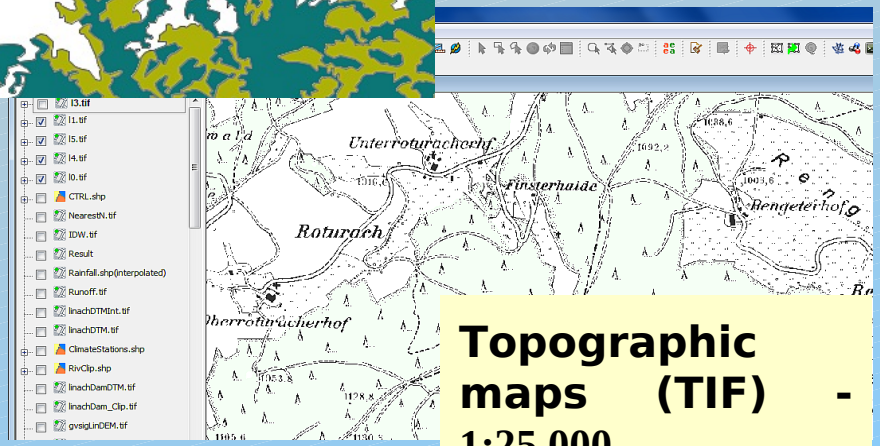
NODATA_value  -9999
440 430 430 430 440 450 460 46
440 440 430 425 408 400 400 39
```

DEM (ASCII)



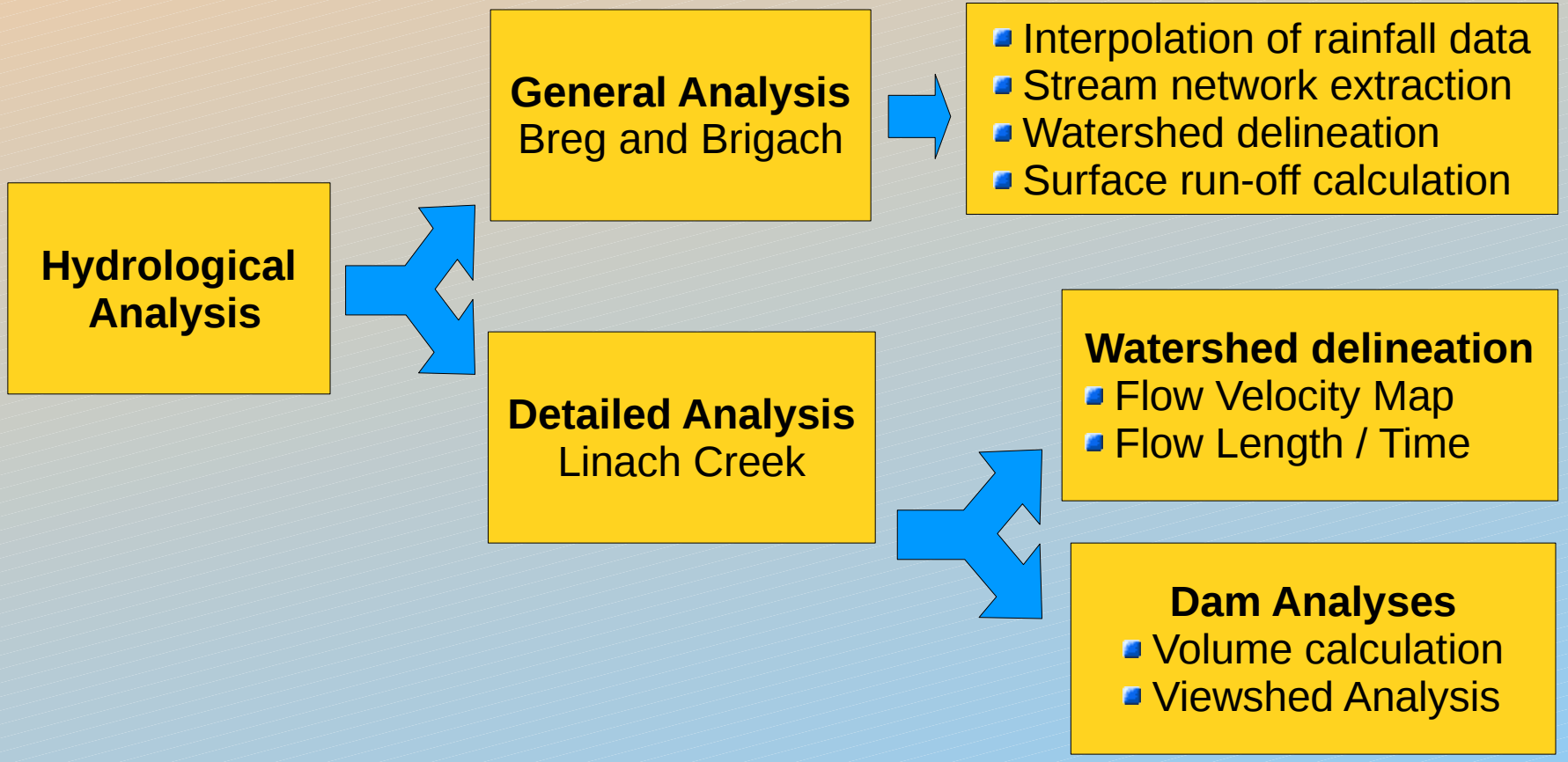
	A	B	C
1	**GN**	**height**	**annual rainfall**
2	Oberprechtal	480	1451
3	Schonach	904	1676
4	Triberg	683	1740

Rainfall Data (mm/m^2)



Topographic maps (TIF) - 1:25,000

Methodology

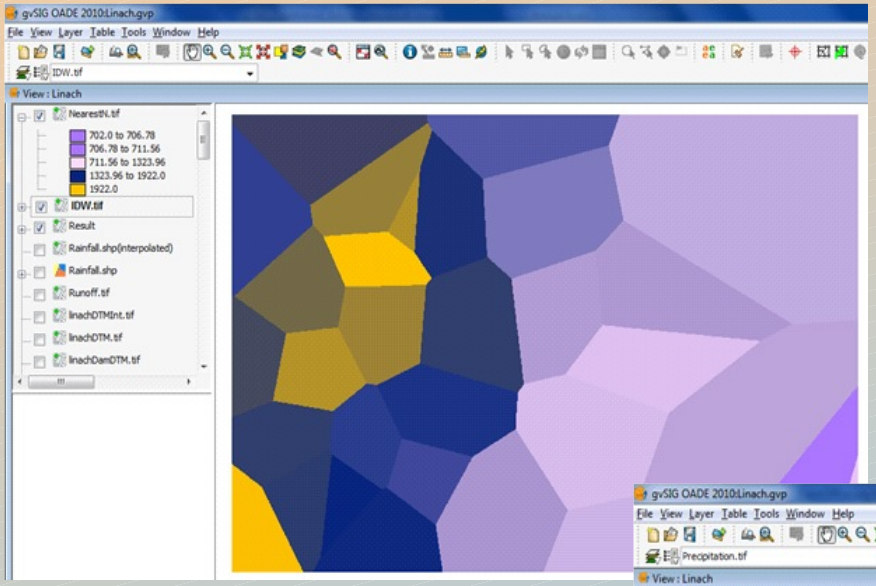


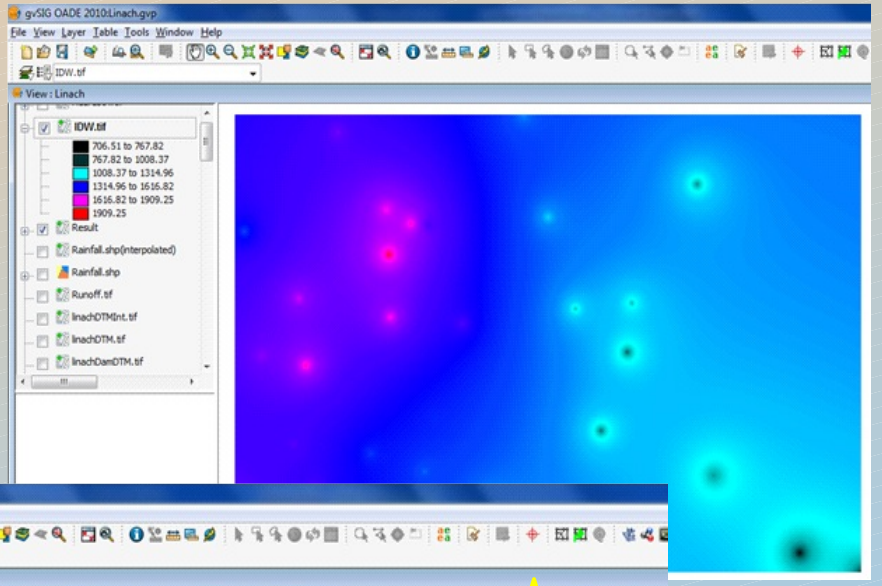
Breg and Brigach

Coarse, simplified hydrological modelling of greater region (40 x 55 km^2)

- Interpolation of the rainfall data
  - **IDW, Nearest Neighbour and Kriging**
- Stream network extraction
  - **‘Burn-in’ approach**
- Watershed delineation
- Surface run-off calculation

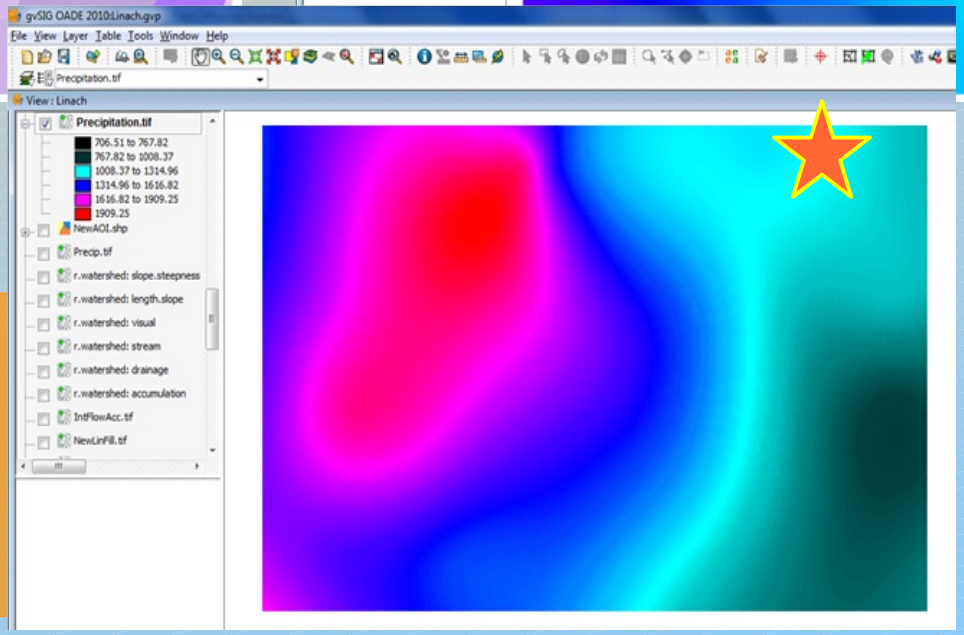
Interpolation of Rainfall





Nearest Neighbour

IDW

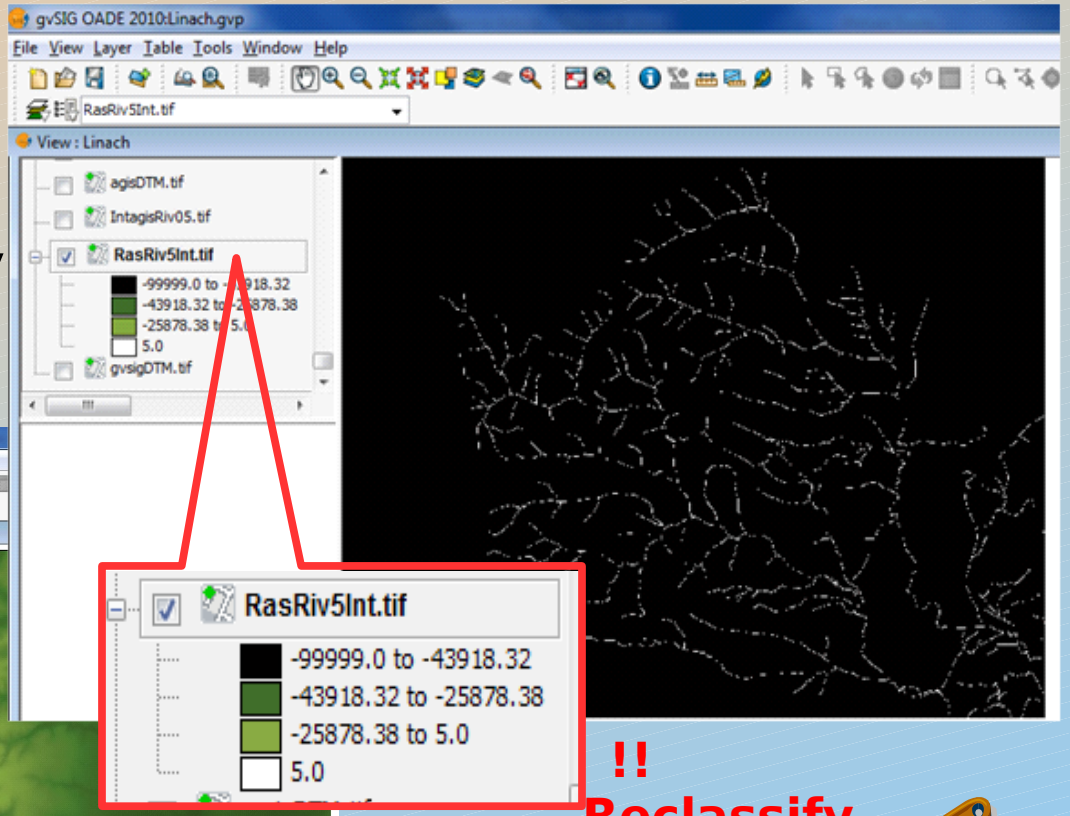


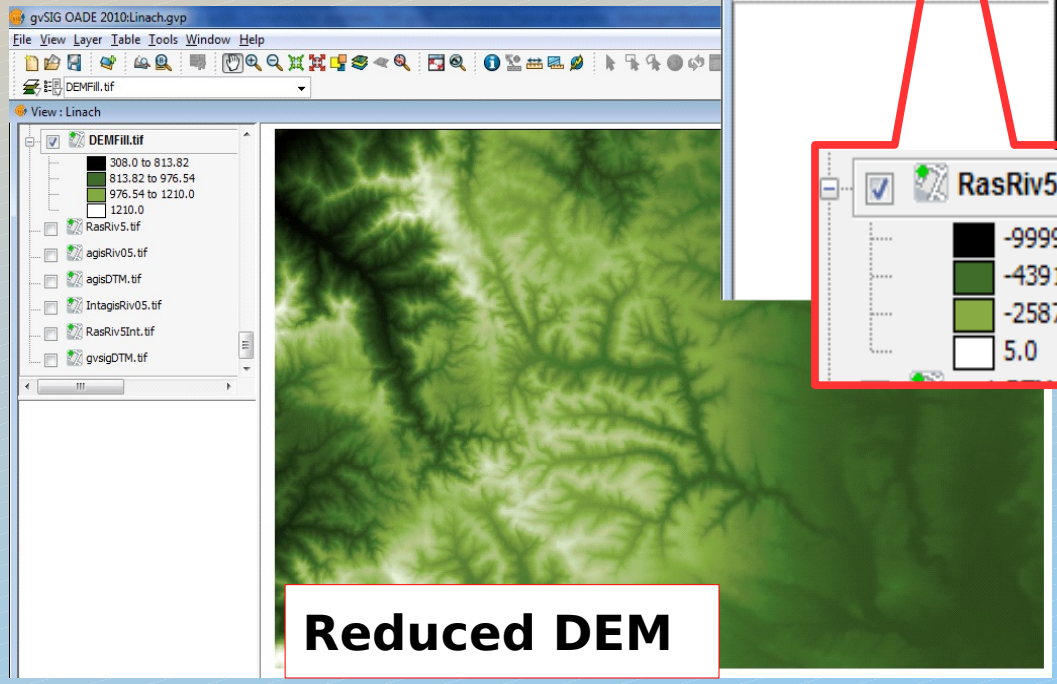
- IDW
- Nearest Neighbour
- Spatial Autocorrelation
- Kriging

Kriging

‘Burn-in’

- Rivers rasterized by defined value
- DEM reduced by rasterized rivers





Reduced DEM

!!

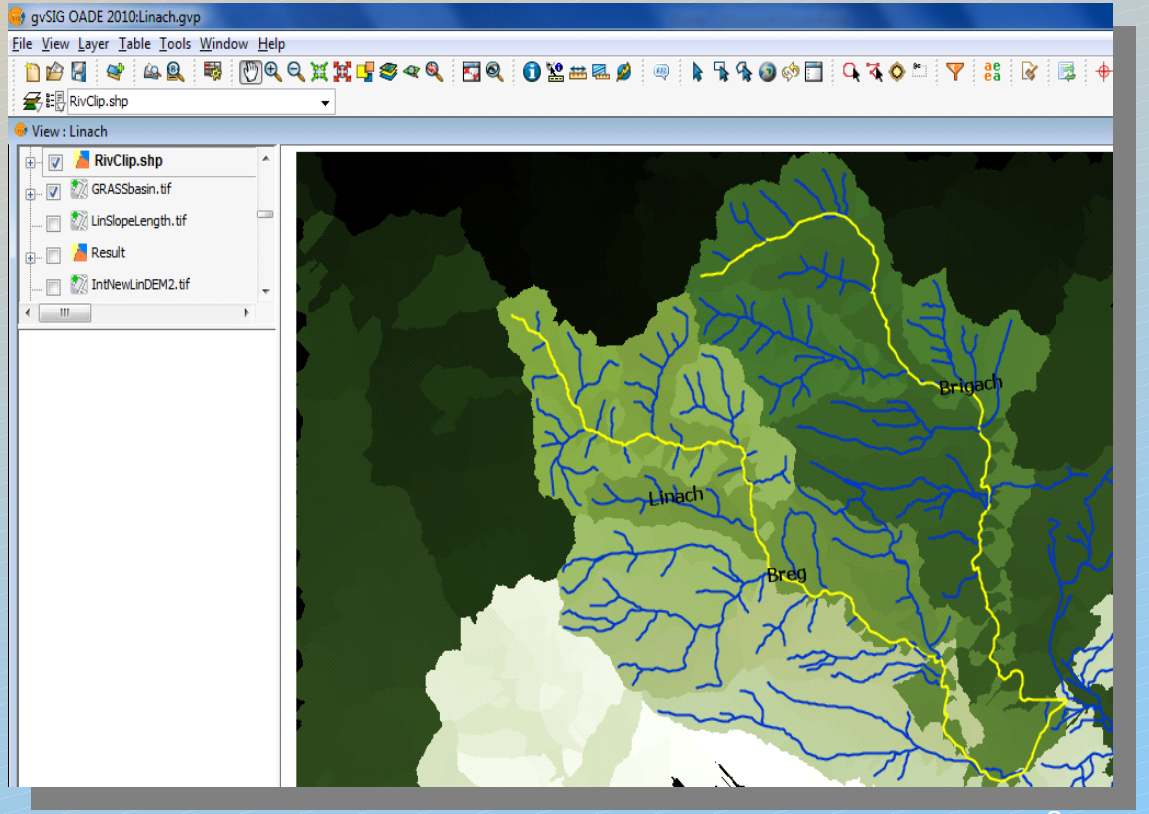
Reclassify

- **Buffer**
- **Rasterize Vector Layer**
- **Raster Difference (-)**

Watershed Delineation

Sink Filling → Flow Accumulation → Channel Network → Watershed

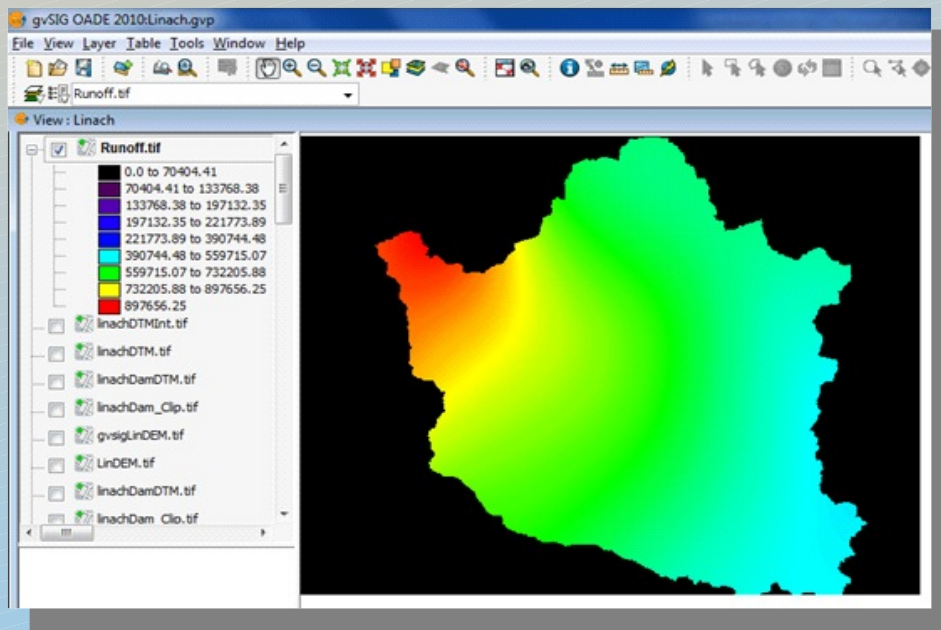
- **Generic error with Flow accumulation tool**
  Workaround using *r.watershed* tool in GRASS
- **Extracting only the Breg and Brigach rivers**
  Adopt results from external system

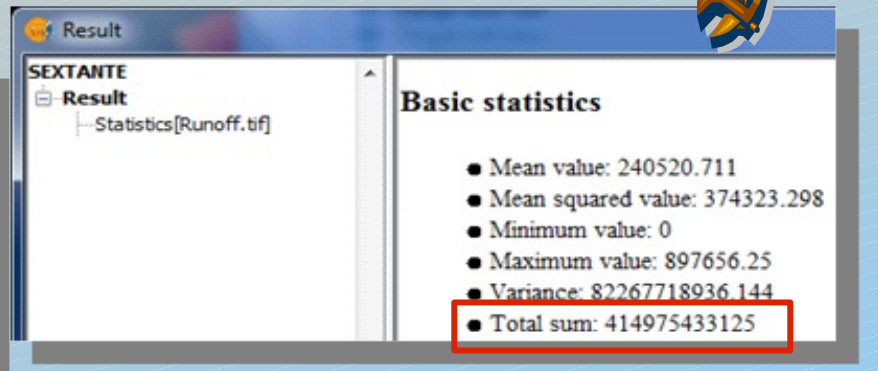


Surface Runoff

- Infiltration and evapo - transpiration are homogenous
- 75% of annual rainfall participates in the runoff
  - Invariable annual average temperature
  - Uniform vegetation of conifer forest and pasture land
  - The soil type doesn't change

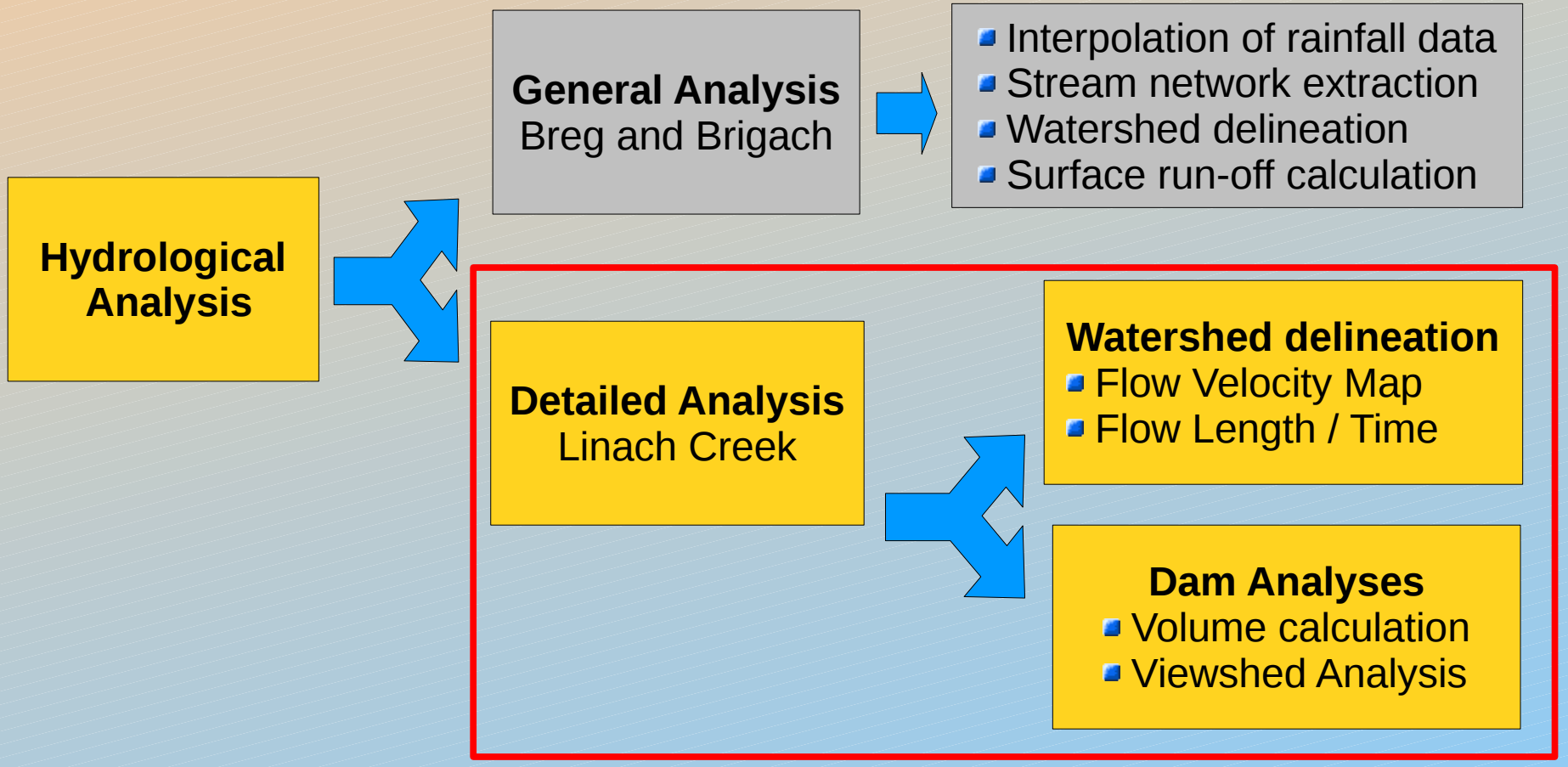
- **Raster Calculator**
- **Basic Statistics**





Result: 414,975m^3
Ref System: 410,835m^3

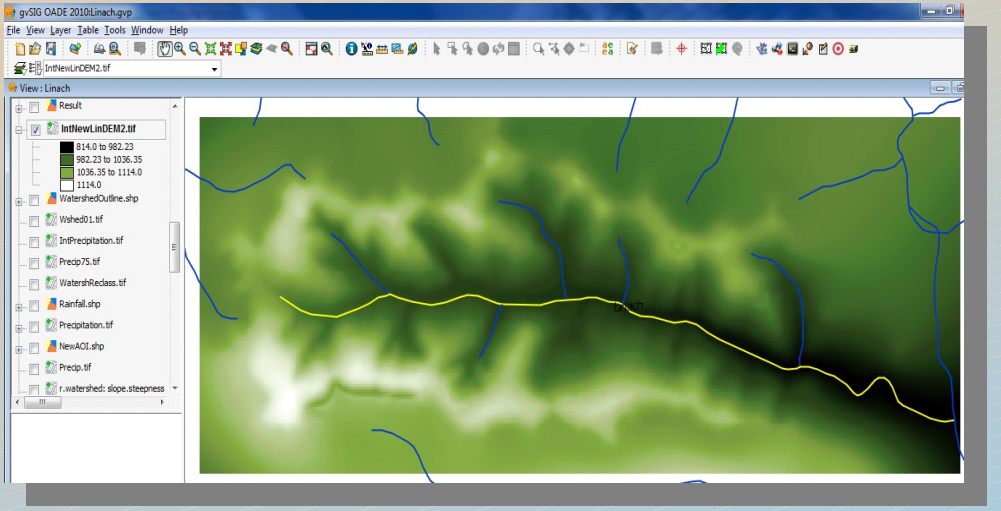
Linach Creek



DEM Creation

- Rasterize contour lines
- Random Bernoulli of

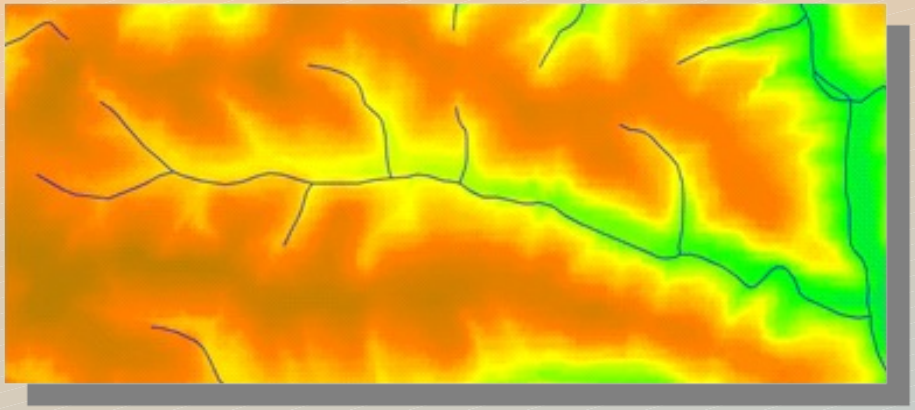
  (0 and 1)



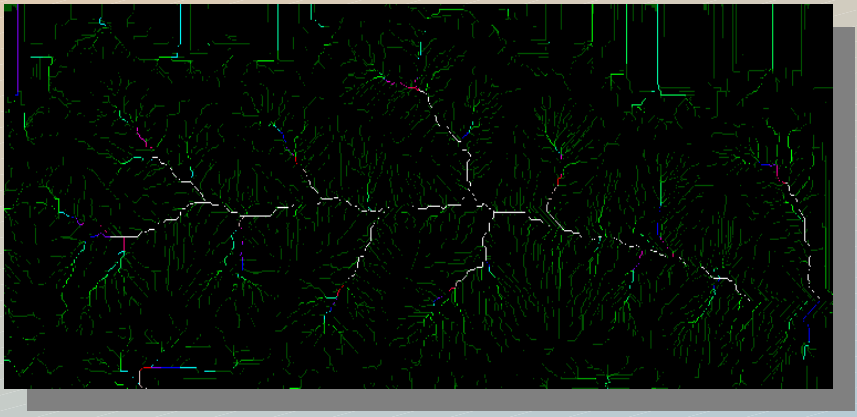
- Product of the two rasters to get random distribution of point information
- Remove NODATA values
- Interpolation using IDW with 5m interval

- **Rasterize Layer**
- **Random Bernoulli**
- **Raster Product (*)**

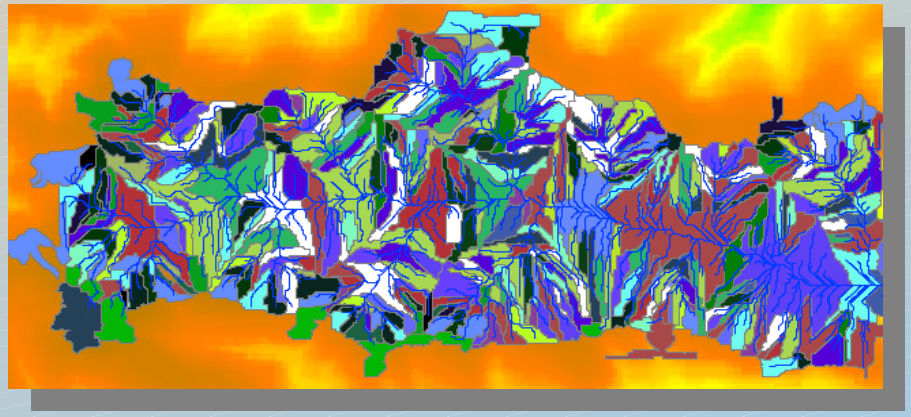
Watershed Delineation



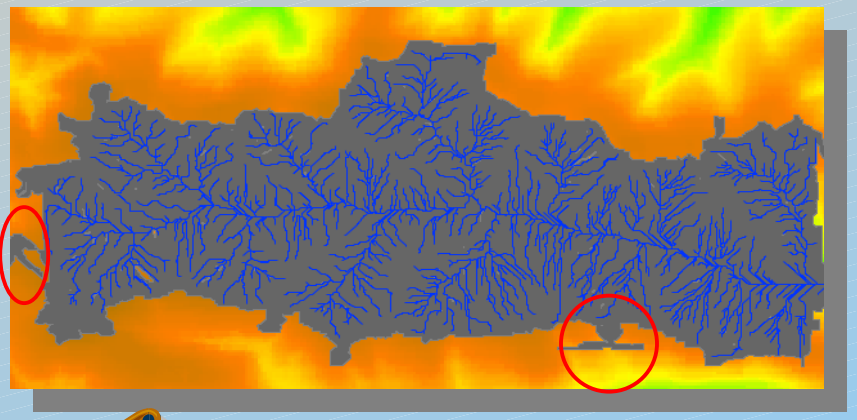
Sink Filling



Flow



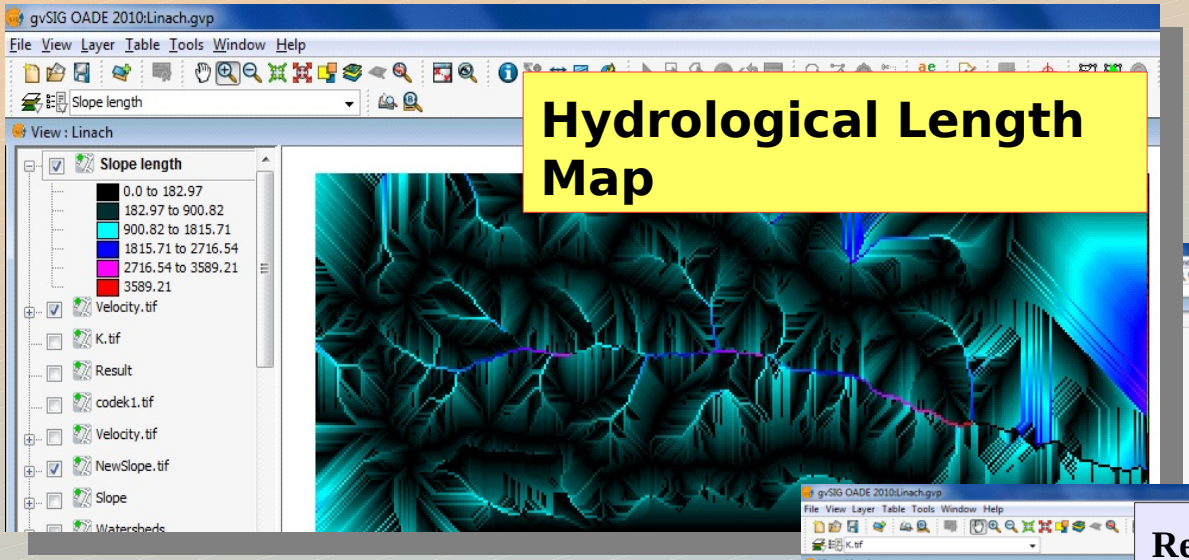
Watershed Tool



Merged watershed with channel network

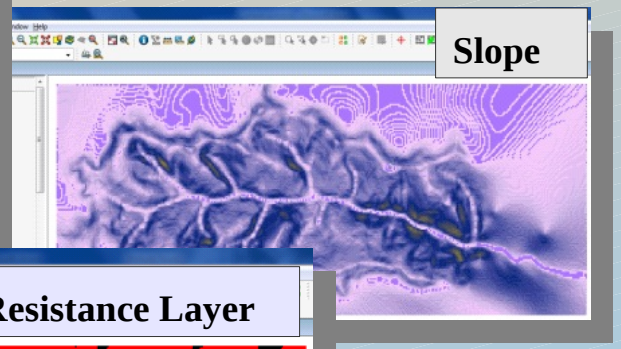
- Raster to Vector
- GeoProcessing Toolbox
- Dissolve

Flow Maps

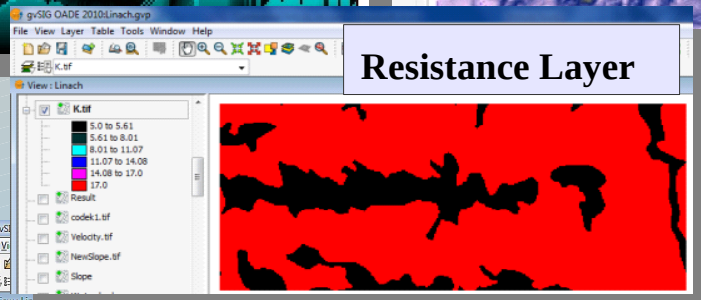


Hydrological Length Map

- Slope Length
- Slope
- Raster Calculator



Slope



Resistance Layer

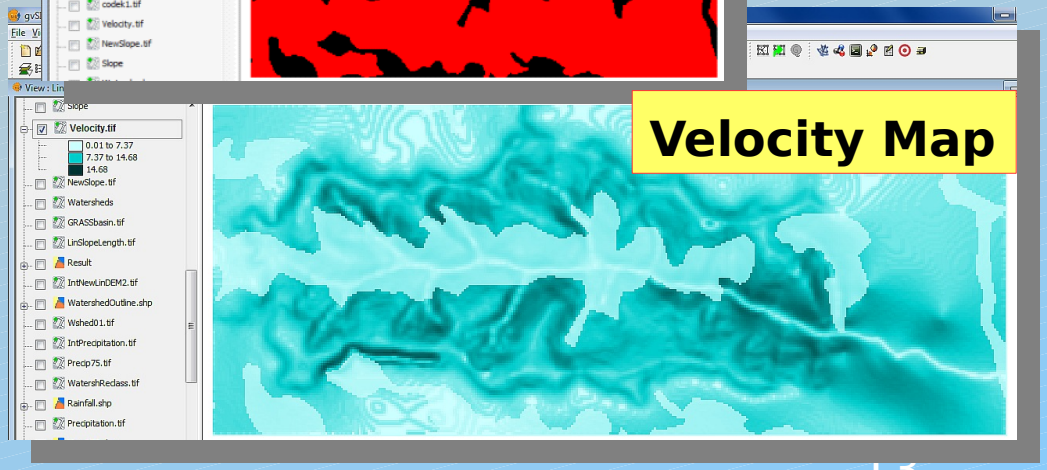
Velocity calculated using Manning Strickler Eq.

$$V = K_{st} * R^{2/3} * S^{1/2}$$

K_{st} =Resistance Layer

R = Hydraulic Radius

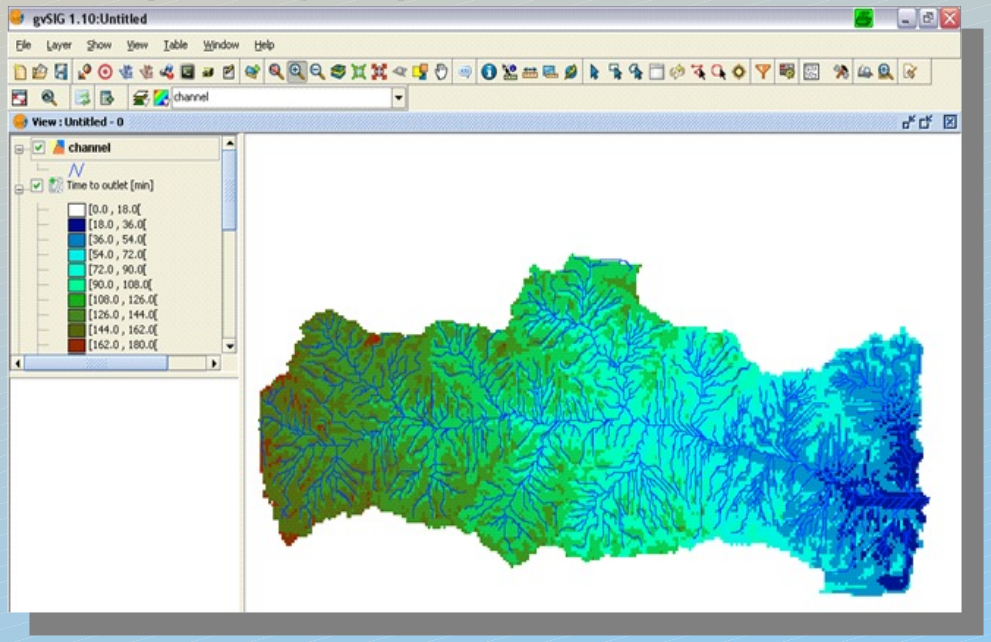
S= Slope raster

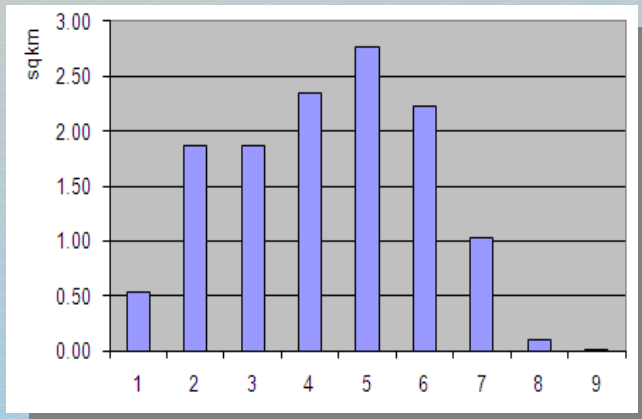


Velocity Map

Flow Time Map & Time-area Diagram

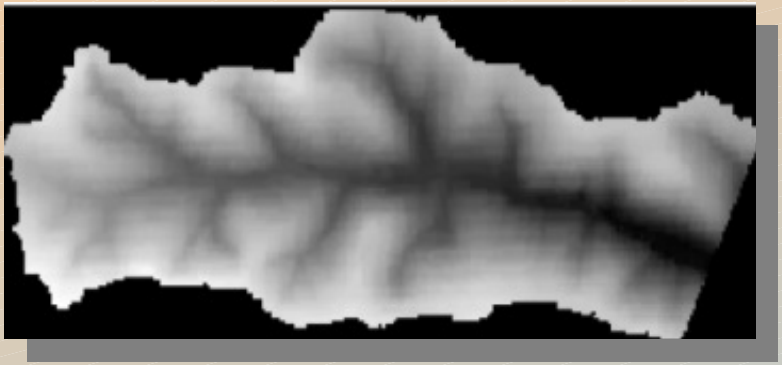
- Time Map created using DEM and Channel Network
- Reclassification flow time map into constant time intervals
- Derive area for each time interval
- Time-area diagram calculation
- Hydrograph





- **Time to Outlet**
- **Reclassify**
- **Class Statistics**
- **Geomorphological Instantaneous Unit Hydrograph**

Volume Calculations



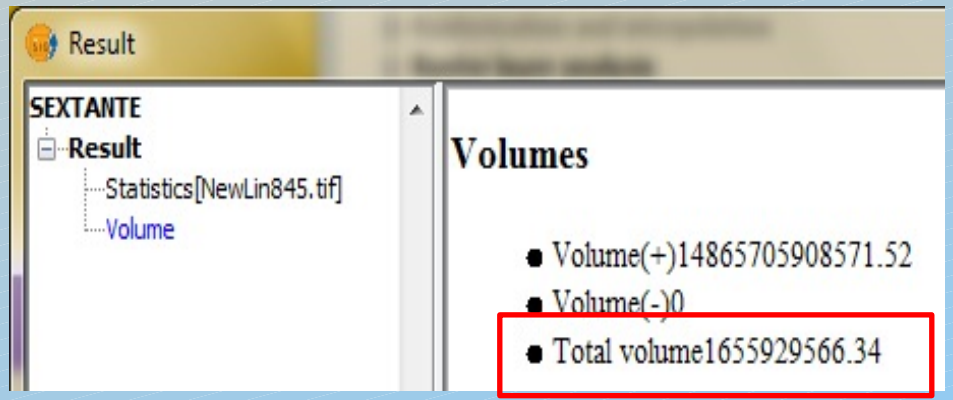
DEM for DAM

Free-board Layer of 845 m

Volume Between Two layers

gvSIG: 1,655,929,566 m^3

Ref: 1,655,925,131m^3



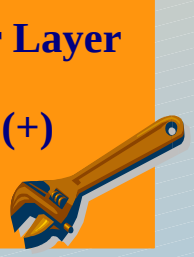
- Constant Grid
- Volume Between Two Layers

Viewshed Analysis

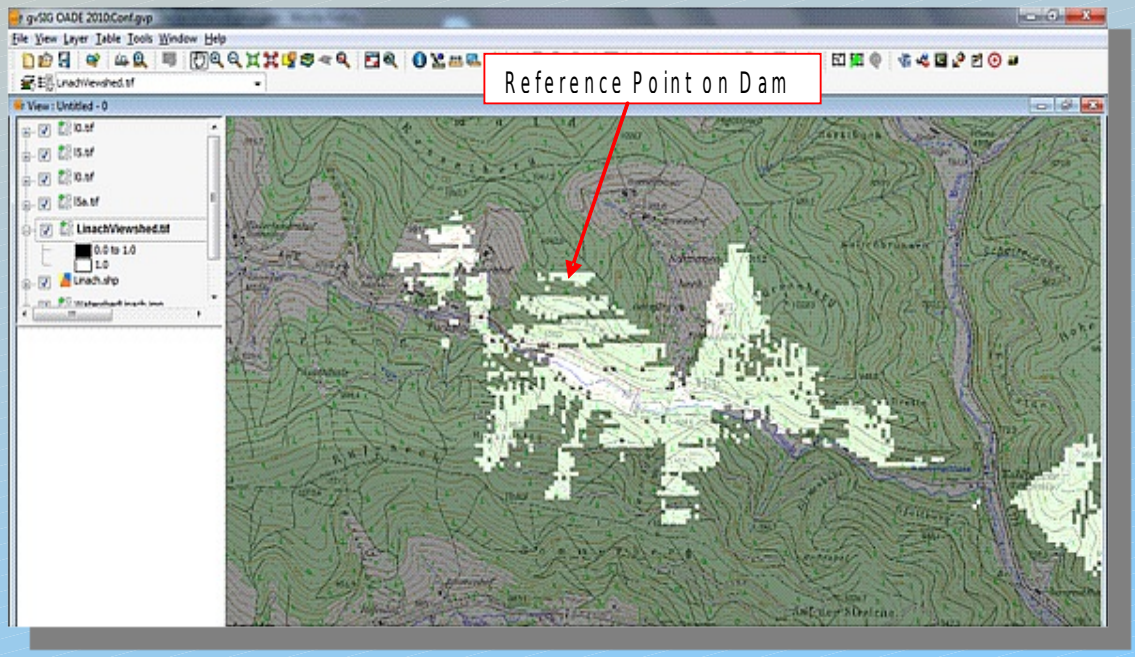
To establish the location of control points for surveying the dam

- Conifers from Landcover used as an obstacle layer of 10m
- Visibility radius was set to 3km

- **Rasterize Vector Layer**
- **Raster Addition (+)**
- **Visibility Tool**



Tool only supports one observer position



Challenges

- Problems with interpretation of NODATA values
- NODATA values (often assigned -99,999) used in calculations therefore giving erroneous results
- Some tools are too time-consuming
- Some tools have an implied size limitation; they don’t run on large datasets but work well on smaller ones
- Bugs still exist in some tools

Conclusion

- gvSIG and SEXTANTE (with GRASS) interface are together very powerful tools
- Duplicate tools (GRASS and SEXTANTE) make up for each other
- In general:
  - 80% of tools worked well
  - 20% (Error report or Wrong output)
- Recommendations
  - Extend tool documentation (parameter clues, units etc)
  - Non modal mode for windows would enhance interaction between the tool and map interfaces

Thank You