ITC Faculty of Geo-Information Science and Earth Observation

UNIVERSITY OF TWENTE.

Report on "MATRA" project of

National Flood Susceptibility Map of Georgia

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1. Introduction

In Georgia exists 25 075 rivers with total length 54 768 km. They belong to Caspian and Black Sea Basins. More than 17 000 rivers (total length 32 574 km) belong to the Black Sea basin's They are nourished through:

- Precipitation and Swamp – Small Rivers of Kolkheti Lowland, they flow into Black Sea;
- Glaciers, Continuous Snow and Rain – Large Rivers Rioni and Chorokhi are abounding in water and have many tributaries;

In Georgia exists about 856 lakes, most of them are very little and nameless and are located near the border of Turkey. Lakes are River, Shore, Karst, Dike and Landslide origin.

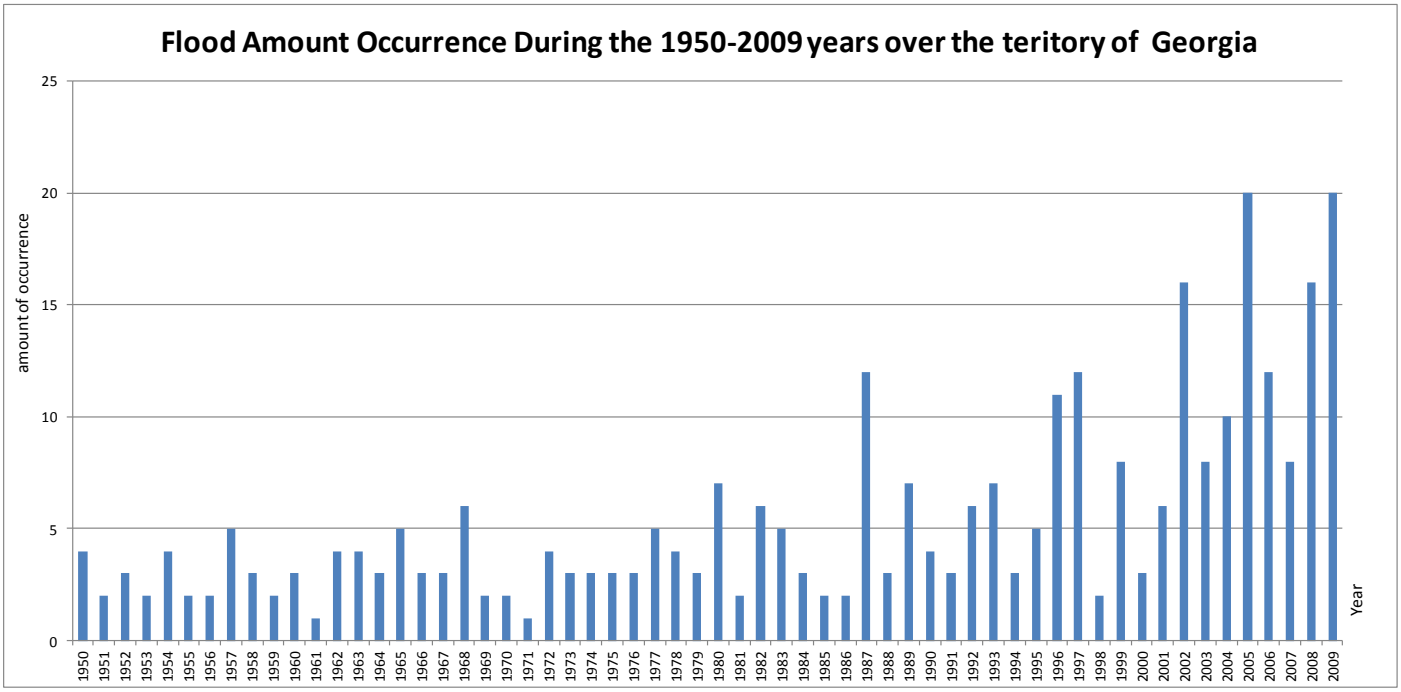
In the western Georgia are located many Reservoirs they are used for energy supply.

Swamp occupies 225 000 Ha of the territory of Western Georgia. Kolkheti lowland's high at the sea level, precipitation amount and the waterproof layer nearness to the surface are major factors for the swamp.

In Georgia exists 786 Glaciers with total area – 556 km^2, most strong and huge of them are located in the Great Caucasus Region, which are nourished big rivers of Black Sea Basin.

Due to complicated topography, different climate conditions and hydrographic situation (dens network of rivers), the natural catastrophes, such as landslides, mudflows, floods and avalanches are frequent in Georgia.

One of the main disaster, which challenges human catastrophes and loss amounted hundreds of millions of US dollars is **Flood**.



For the floods, Spring-Autumn period are characteristic event. The mentioned natural disasters represent high risk about 6 000 populated sights, different communication constructions, agricultural areas and others. It should be specially mentioned 1969-70 flood in the basin of the river Mtkvari (Kura) and floods in 1986-87 in western Georgia.

2. Purpose of the Project

Hydrological models are an important basis of flood forecasting and early warning systems. They provide significant data on hydrological risks. Flood hazard and flood risk maps are important tools to communicate flood risk to different target groups. They provide compiled information to relevant public bodies such as water management authorities, municipalities, or civil protection agencies, but also to the broader public.

For the EU member countries the flood risk map has been produced, now we have opportunity to publish the same map for Georgia.

If we look on above mentioned statistics, in last 15 years the amount of flood occurrence perceptibly increased. Governmental structures have to be informed about expected flood, to decide which actions to take, give out new building permits or take adequate measures to reduce the damage, also prepare evacuation schedules for possible flood disasters.

The purpose of a flood risk map is to:

- Increase public awareness of the areas at risk of flooding
- Provide information of areas at risk by defining flood risk zones to give input to spatial planning.
- Manage risks of floods to people, property and environment.

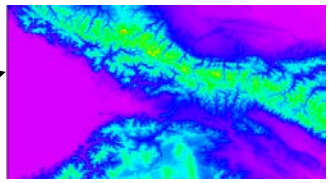
In flood modelling digital elevation data play very important role, so the accuracy of the DEM is very necessary to create the flood susceptibility map.

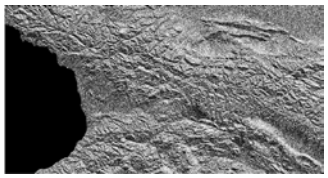
The map of National Flood Susceptibility gives the opportunity to analyse the flood risk on the territory of Georgia and to compare the real data with the modelling.

3. Data Description

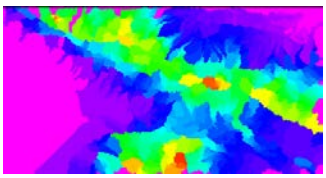
Required data and the steps which are utilized to the map creation:

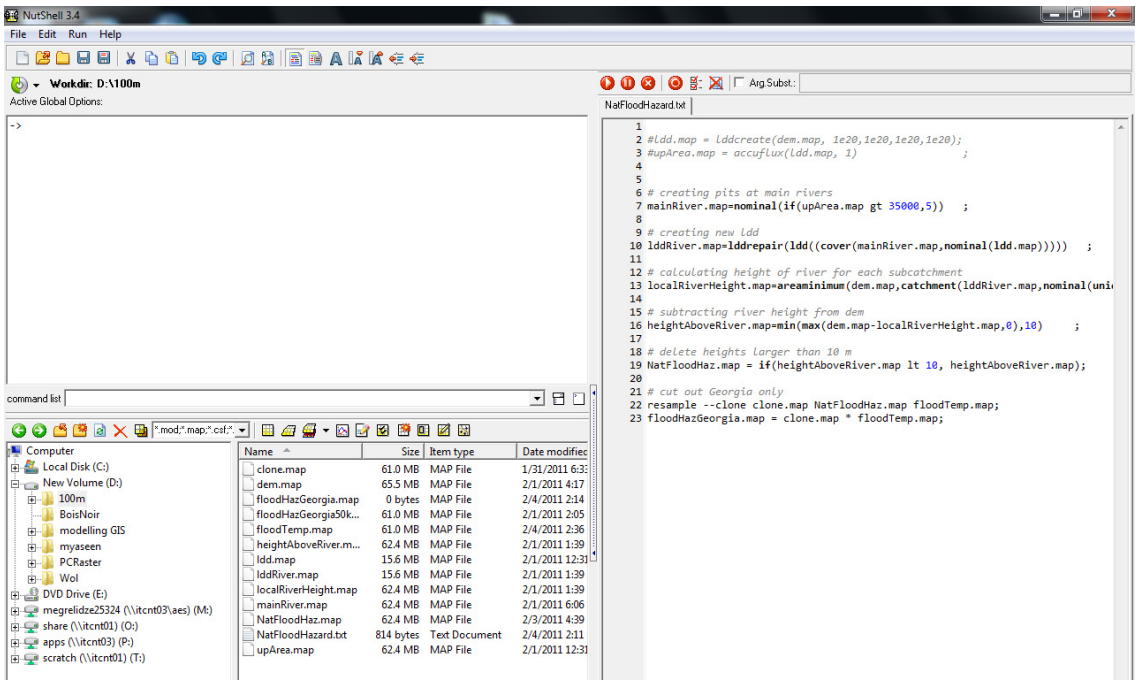
- DEM (Digital Elevation Model)
- LDD (Local Drain Direction)
- UpArea Map
- Main River Map
- LDDRiver Map
- Local River Height Map
- Height Above River Map





National Flood Susceptibility Map



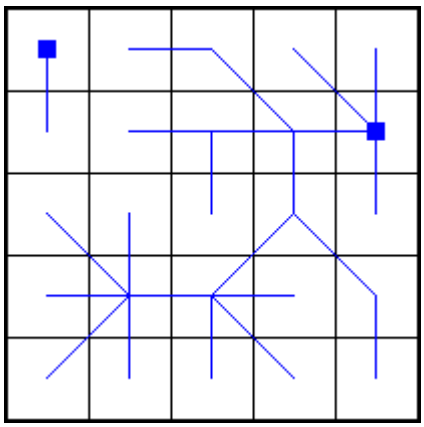


- **ldd.map = lddcreate(dem.map, 1e20,1e20,1e20,1e20);**

  from the DEM.map we are creating LDD (Locan Drain Direction) map.

  - lddcreate -- Local drain direction map with flow directions from each cell to its steepest downslope neighbour

Result1.map



Dem.map

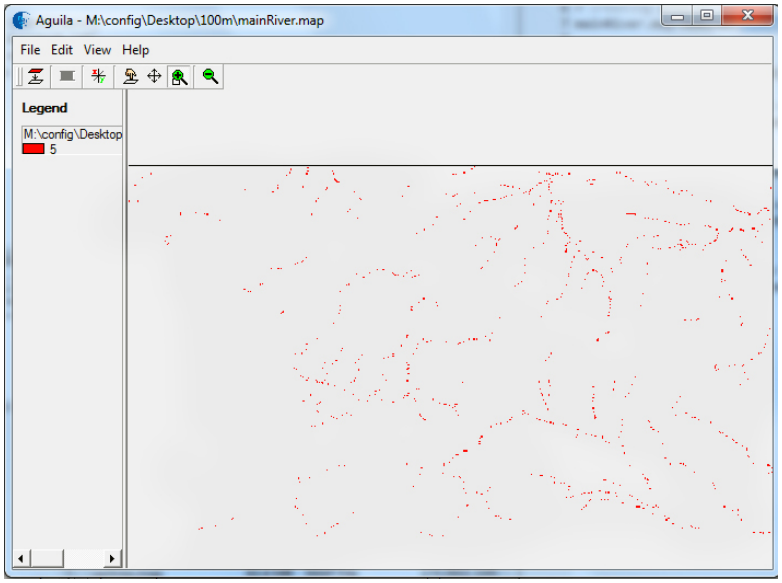
23	29	11	7	6
35	24	7	5	3
36	21	13	12	17
37	10	10	15	19
35	31	27	24	29

- **upArea.map = accuflux(ldd.map, 1)**

  Creating upArea.map from the LDD.map. This operation calculates for each cell the accumulated amount of material that flows out of the cell into its neighbouring downstream cell.

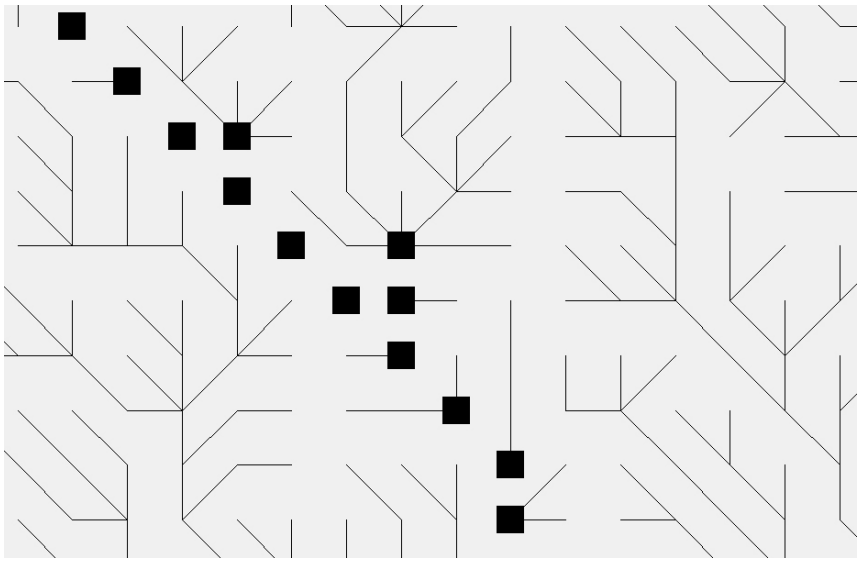
- **mainRiver.map=nominal(if(upArea.map gt 50000,5))**

  If upArea is greater then 5000, then we are giving the value 5.



- **lddRiver.map=lddrepair(ldd((cover(mainRiver.map,nominal(ldd.map))))**

  This script showing local river direction, which stops at the river.

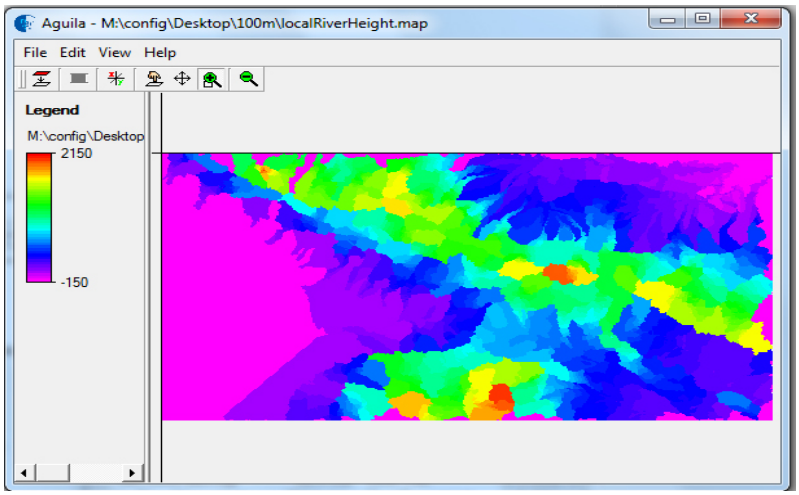


Black points are showing the place where the local river direction stops. **Nominal** means a cell with missing value on expression is assigned a missing value on Result. This operation belongs to the group of Conversion and assignment. **Cover -** Missing values substituted for values from one or more expression.

- **localRiverHeight.map=areaminimum(dem.map,catchment(lddRiver.map,nominal(uniqueid(boolean(mainRiver.map)))))**

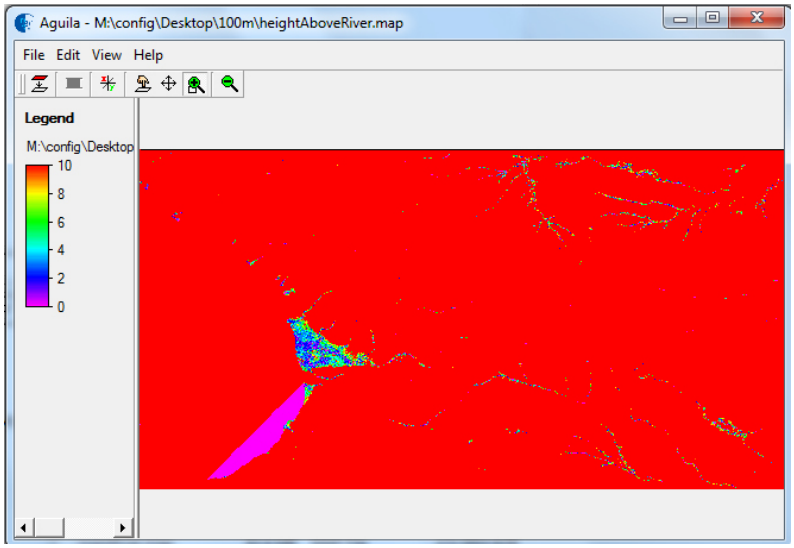
  Computing the height of the river. **Boolean(mainriver.map) –** giving the values 0 and 1, except 5 we took 1. Why we have done this, because to calculate the catchment.

  Uniqueid - For each cell that has a value 1 (TRUE) on expression assigns a unique whole positive value to Result, starting with 1. Cells that have a value 0 (FALSE) on expression are assigned a value 0.



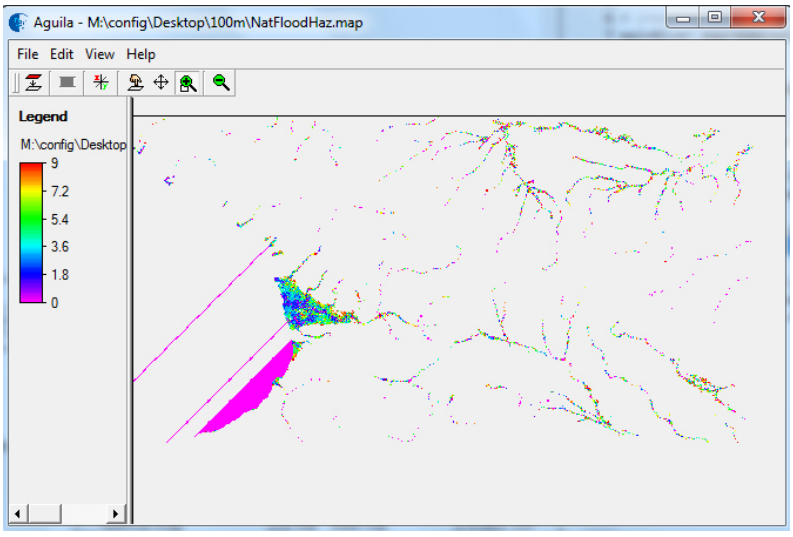
- **heightAboveRiver.map=min(max(dem.map-localRiverHeight.map,0),10)**

If height river is less than 10, then we take height above the river map, else do nothing.



- **NatFloodHaz.map = if(heightAboveRiver.map lt 10, heightAboveRiver.map)**

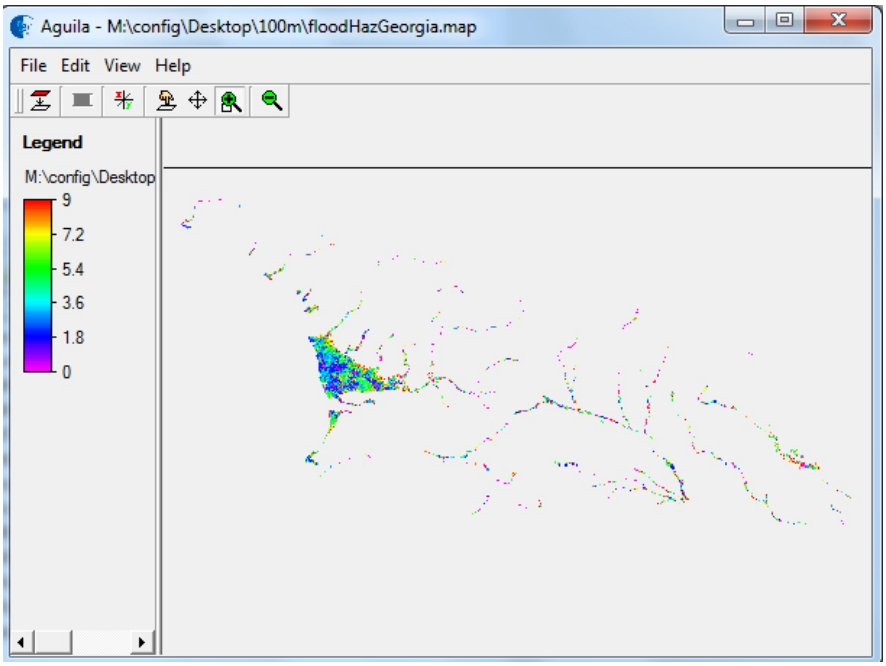
If the cell value on expression1 is less than the value on expression2 Result has a cell value 1 (condition is TRUE) on the corresponding cell; if the cell value on expression1 equals or is greater than the value on expression2 Result has a cell value 0 (condition is FALSE).



- **resample --clone clone.map NatFloodHaz.map floodTemp.map**

Use the clone map to resample the data which is inside the flood hazard map to create flood temporary map.

- **floodHazGeorgia.map = clone.map * floodTemp.map**



The first step what we did is that we converted the Raster map to ASCII file. We tried to create and use that kind of maps which result after overlaying is National Flood Susceptibility Map. All maps were created on each other basis. Special scripts we run in NutShell and the output data format was also available for the Arc GIS.

The same steps we tried to do in Arc GIS – Special Analyst Tools – Hydrology, but the result was later than in PCRaster.

Our main goal wasn`t establishing the flood inundation map, but making that kind of map where would be represented the level of flood susceptibility. The final product of the map is composed in Arc GIS. For the visualisation of the map was created Hillshade and added other layers: border, settlement, roads.

4. Conclusion

In hence of National Environmental Agency hasn`t the map of vulnerability territories, unfortunately it`s impossible to compare our map with the existed. The collaborators of agency are working with this subject and in the near future we would have opportunity to compare the real map with our output.