DETERMINING THE AVALANCHE RISK INTO THE PARANG MOUNTAIN

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Abstract: *Known as* **GIS** (**G**eographical **I**nformatic **S**ystems), *the instruments of visualizing and analyzing the geographical information constitute today a field with a spectaculars evolution.*
The special GIS operations over the spatial information make from these instruments not only some efficacy instruments for making maps, but especially, irreplaceable instruments for analyzing the information that refer to the terrestrial surfaces.
Also, the existent information can be reused, due to the fact that one of the main purposes of introducing the GIS technology consists in creating – by conversion in digital form – some efficient possibilities of maintaining and updating the information.
During the last quarter of century, the GIS applications have been extended quickly into the following fields: natural resources, energy, transports, business, and public safety.

KEY WORDS: **g**eographical **i**nformatic **s**ystems, spatial information, maps

1. MATERIALS AND METHODS

This type of problem imposes to be determined the areas exposed to the risk for avalanche in a mountain area.

The input data in order to accomplish this application were as follows:

➢ The use categories for the field - Landuse (Corine Land Cover 2000, CLC) that covers the studies area.

➢ DEM – the digital elevation model generated for the studied area with the Global Mapper software.

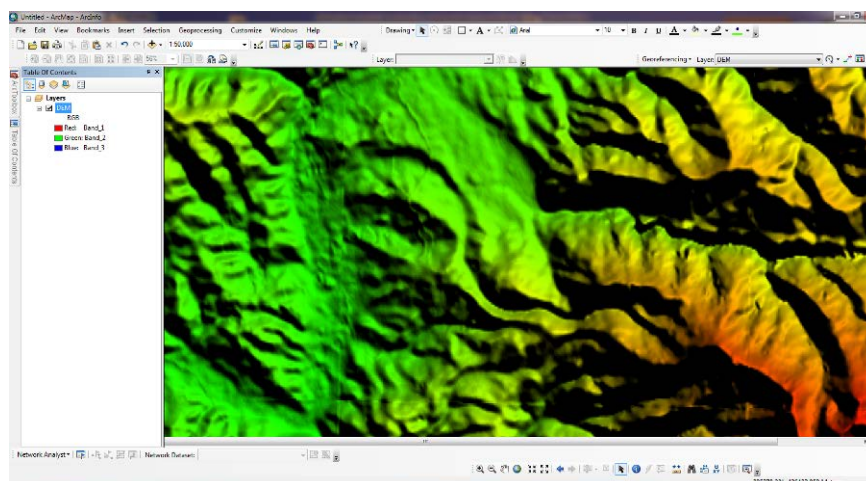➢ The layers that contain the roads from the studied area.

Fig. 1 The digital elevation model – Petrosani area – Parâng Mountains

THE METHODOLOGY WAS AS FOLLOWS:

➕ **Slope calculation**

This operation will be made from **ArcToolbox** – **Spatial Analyst Tool** – *Surface- Slope*. The raster image from where it is calculated the slope (Input raster) is the DEM – digital elevation model, and the result (Output) represents the slope map.
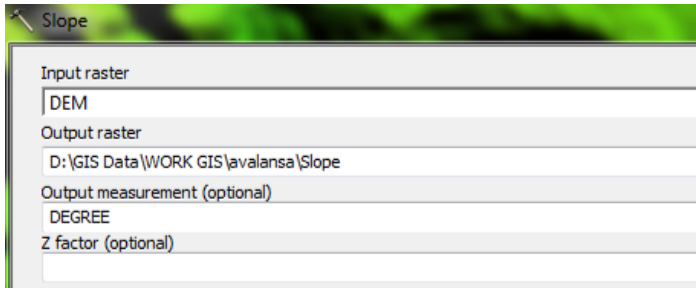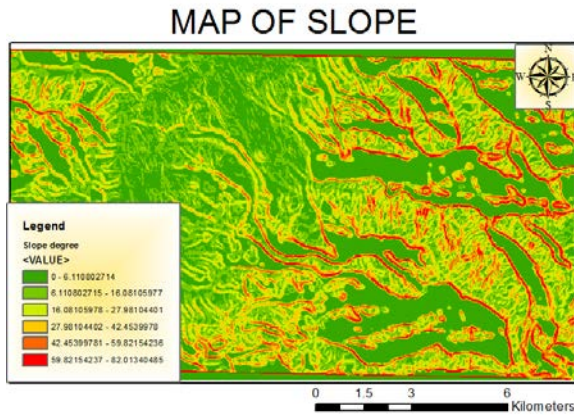
Fig. 2 Generating the map of slope

Fig. 3 Map of slope – Petrosani area – Parâng mountains

The obtained raster (Slope) will be reclassified depending on the risk degree. The operation of reclassification is made from **ArcToolbox – Spatial Analyst Tool** – *Reclass – Reclassify* as follows:

- Great risk: 35-45 degrees (10)
- Average risk 45-60 degrees (9)
- Small risk 25-35 degrees (7)
- Small risk 60-90 degrees (5)
- Inexistent risk 0-25 degrees (NoData).

The input raster is the previous Slope raster and the obtained raster (Output) will be SlopeReclass.
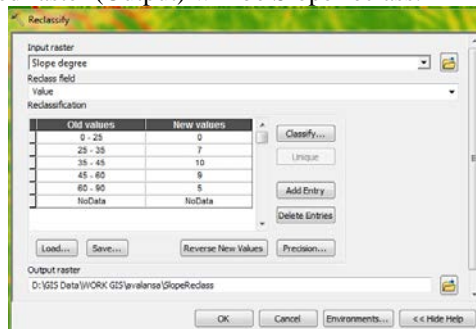

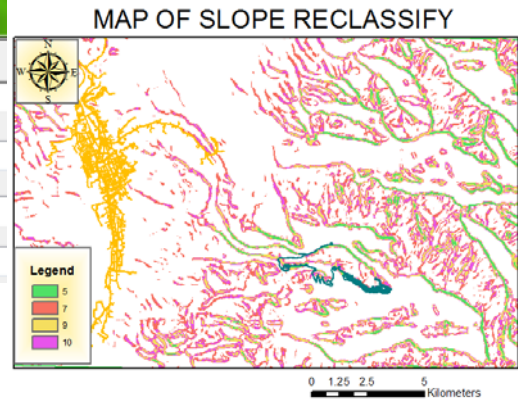*Fig. 4 Reclassification of slope maps depending on the risk*

Fig. 5 The reclassified map of slope depending on the risk for producing an avalanche

✦ Making a single layer DRUM (ROAD)

By using this procedure it was wanted to merge all the layers that contained different roads in a single layer.

This operation is made from **ArcToolbox – Data Management Tools –** *General – Merge*, by completing the field *Input* with the layers that contain the roads and the field Output with the place and name where it will be saved the new layer (eg.: DrumMERGE).
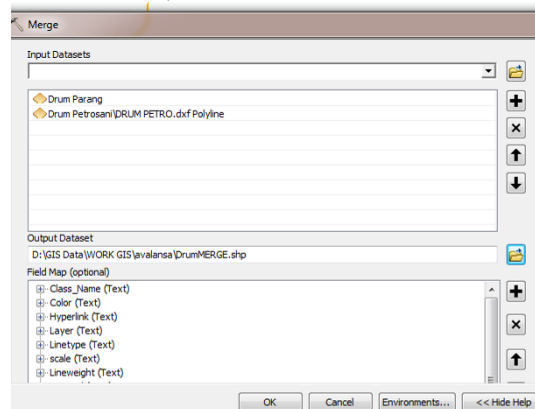

Fig. 6 Making the layer with the roads from the studied area

✦ Determining the areas with small distance away from the road and their reclassification

This operation is made from **ArcToolbox – Spatial Analyst Tools** – *Distance - Euclidian Distance*, by completing the field *Input* with the layer previously resulted (DrumMERGE), the size of one cell with 10, and the field Output with the place and name where it will be saved the new layer (eg.: euclidist).
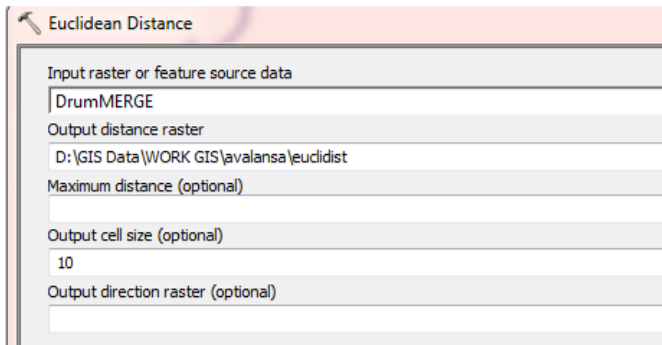
Fig. 7 Completing the cassette Euclidian Distance
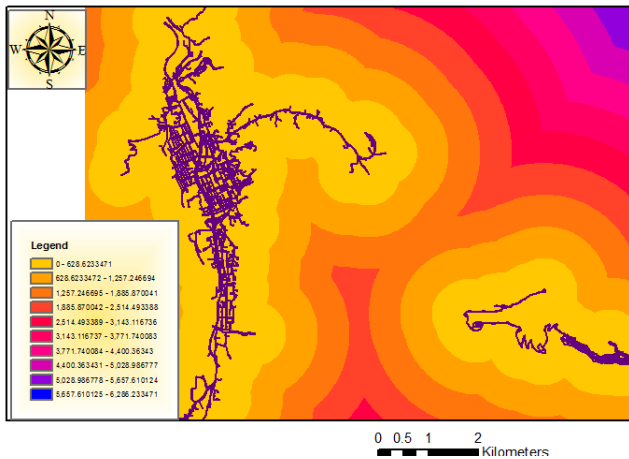
EUCLIDIAN DISTANCE

Fig. 8 Map of the areas with small distance away from the roads

The obtained raster will be reclassified depending on the distance with values from 10 to 1 with the help of the command **ArcToolbox – Spatial Analyst Tools** – *Reclass – Reclassify* by completing the field *Input* with the raster previously obtained (euclidist) and the field *Output* with the place and name where will be saved the new layer (eg.: ReclassEUCLID).

Reclassification was made as follows:

- *Classify – Method* : Natural Breaks
- *Classes:* 6
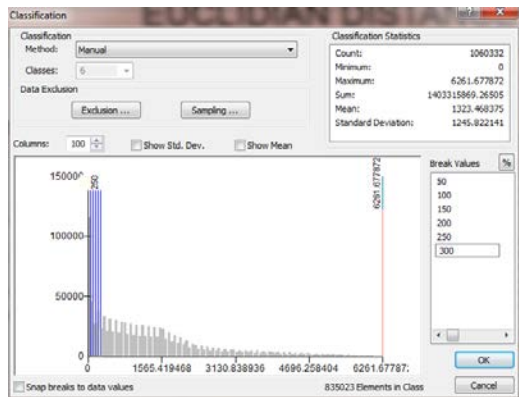- *Break Values*: values from 50 in 50: 50 (10), 100 (9), 150 (7), 200 (6), 250 (5), 300 (6)

Fig. 9 Reclassification of Euclidian raster
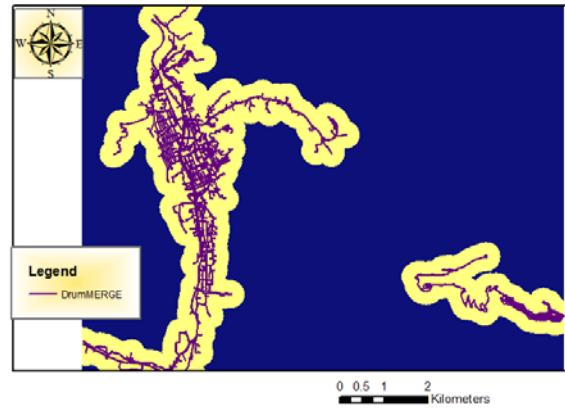
EUCLIDIAN DISTANCE RECLASSIFY

Fig. 10 The reclassified map with small distance over the roads

⚓ **The determination of using the field by using CLC 2000**

For this it is used **ArcToolbox** - **Conversion Tools** – *Features to Raster* - *Features to raster*, by completing the field *Input* with the layer L_34_095 (Corine Land Cover) the cell size with 10, and the field *Output* with the place and name where it will be saved the new raster (eg.: CLC095).
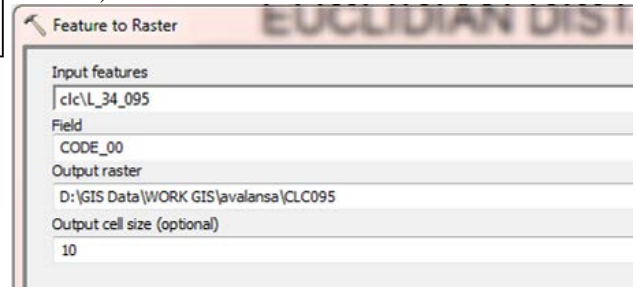

Fig. 11 Conversion of the layer L_34_095 (CLC) into raster
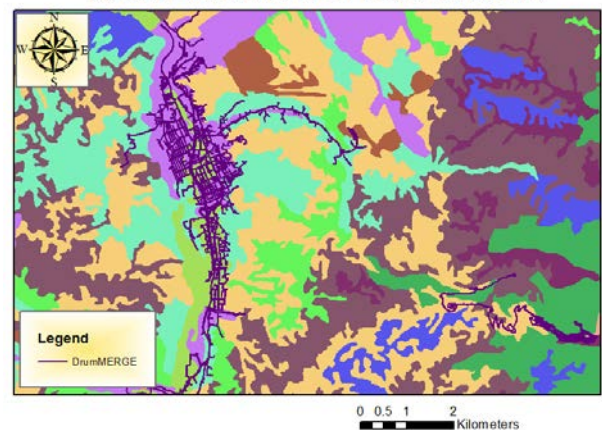
RASTER CORINE LAND COVER

Fig. 12 Raster Map of the use categories for the field from the studied area

So it will be extracted the layer CLC095 from the trapeze 1:100.000 with the command: **ArcToolbox – Spatial**

Analyst Tools – *Extract by Mask* by resulting a new raster (ExtractCLC01).

This raster will be classified in order of the cell values resulted from 10 in down, because the production of an avalanche is more probable in open spaces than in urban where the snow is cleaned. The reclassification is made as follows:

- Urban: value 112 - class 10
- Arable: value 211 - class 9
- Bushes: value 324 - class 3

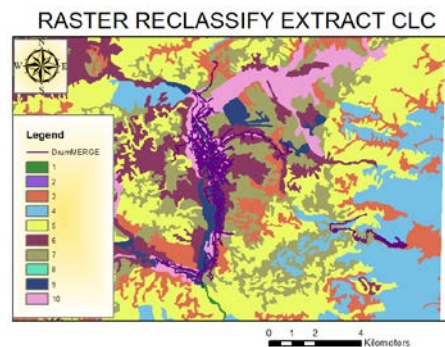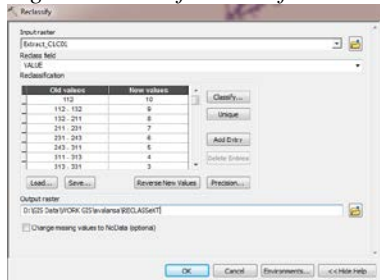*Fig. 13 Reclassification of Euclidian raster*

Fig. 14 Raster map of the categories for using the field into the studied reclassified area

2. RESULTS AND DISCUSSIONS

✚ Overlay analyze

In order to create an overlay, it will choose from **ArcToolbox - Spatial analyst tools** – *Overlay - Weighted overlay* and gradually the reclassified layers will be added as follows INPUT(1)= SlopeReclass, INPUT(2)= RECLASSeXT.

For each of them from the field *Influence* there will be introduced the correspondent percentages as follows: slope - 50%, the field usage – 50%. The final result will be „Weight_Slope", which means the map containing the most affected areas in case of avalanche having the values from 1 to 9, 1 being without any risk of avalanche and 9 representing the areas with maxim risk of avalanche.
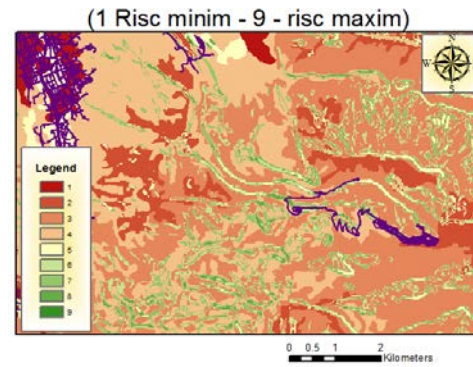

Fig. 15 Map of risk of avalanche in Parang Mountains

3. CONCLUSIONS

The overlay analyze allow to be analyzed the relations between the data sets that are localized in the same area. The different types of overlay analyze may be used for being solved some problems of complex spatial analyze.

The reclassification of raster data and using the ponders of each of them allow to be made the operations on layers with different influences. Other spatial operations, as the buffer, may facilitate the obtaining some input data based on the field data.

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