Map overlay in G.I.S.

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Abstract. *Map Overlay is* **the process of taking two different thematic maps of the same area and overlaying them one on top of the other to form a new map layer. Map overlay can be defined as** *"The ability to integrate data from two sources using map over is perhaps the key GIS analysis function".* **Overlay analyses creates some combinations between graphic primitives from the different layers in accordance with certain imposed conditions (based on the Boolean algebra). OVERLAY operations represent the core of the GIS analyze that combines more spatial entities and offer new information, which can be accomplished with vector and raster data. These operations combine some maps by using arithmetical, relation and conditional operators' functions or other types of functions.**
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1. VECTOR OVERLAY OPERATIONS

Vector Overlay is a process that allows being identified the relations between 2 or more entities type polygon that have a common area.

The result is a layer type vector where it is found a combination of the inlet data attributes. The types of vector overlay are as follows:

• **Intersection**: all areas where the both layers are over posed.

• **Union**: all areas of the combined inlet layers.

• **Symmetrical difference**: all areas of the inlet layers, less the ones that intersect each other.

• **Difference**: all areas of the first layer, less the ones that intersect with the second one.

The results of the 4 functions standard of overlay are present into the following figure for the particular case when it is used 2 layers type vector.
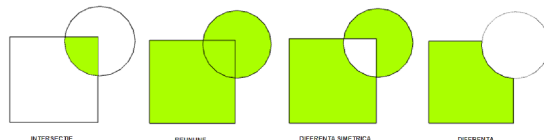

Fig.1 Vector Overlay Operations

2. RASTER OVERLAY OPERATIONS

The overlay raster into GIS may be accomplished automatically if there are known the layers and mathematical functions. This is important because into some models there are combined many maps by using different mathematical functions or conditional operators.

The mathematical operators apply one or more mathematical operations on one or more raster maps; the mathematical functions apply a mathematical function on values of a single raster map.

There are three **groups of mathematical operators** into Map Calculator: Arithmetic, Boolean and Relational.

• **Arithmetic Operators** (*, /, -, +) allows operations of sum, SCADERE, multiplying or dividing of two raster map or number or a combination of them.

• **Boolean Operators** (And, Not, Or, and Xor) use the Boolean logics (TRUE or FALSE) on the input values. The output values with the value TRUE are represented with 1 and FALSE with 0.

• **Relational Operators** ($<$, $<=$, $<>$, $=$, $>$ and $>=$) evaluates the specific relational conditions. If the condition is available (TRUE), the output value will be 1; if the condition is FALSE, the value will be 0.

Some raster layers used as input data may have a different ponder into the wanted result. Due to this a simple sum of the values for the input data is not enough.

For example, for a construction, to use the field is less important than its declination SLOPE. Into such cases, the ponder of each input raster may be set depending on its influence. This operation is called "**weighted overlay**".

The neighborhood analyses - buffer. The Buffer delimits an area that is at a certain distance over the entities where it is applied the operation. A buffer divides the space in two parties: the buffer area and the exterior area. The buffers are used in order to make neighborhood analyses and they are necessary for protecting the environment or the residential areas and appear under green lines; into GIS application the buffers are represented always by polygons that include other entities of any type.

3. CASE STUDY - DETERMINING THE AVALANCHE RISK INTO THE MOUNTAIN AREAS

The **distance mapping functions** are global functions. They compute an output raster dataset

where the output value at each location is potentially a function of all the cells in the input raster datasets.

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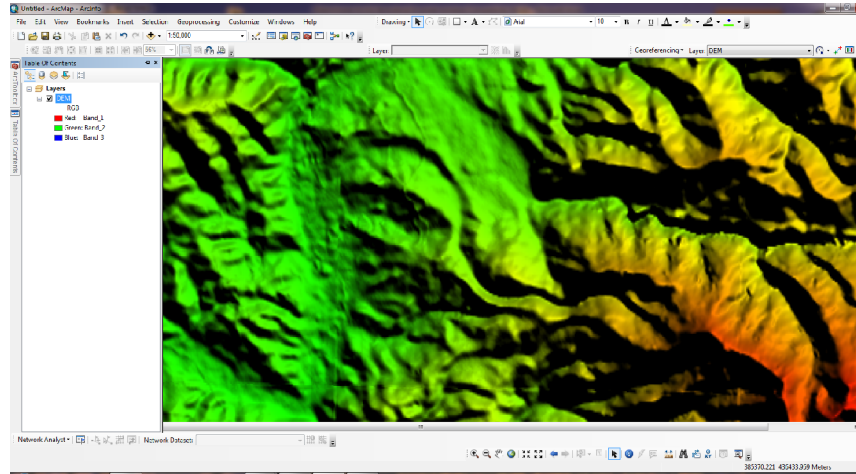➢ The layers that contain the roads from the studied area.

Fig. 2 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.
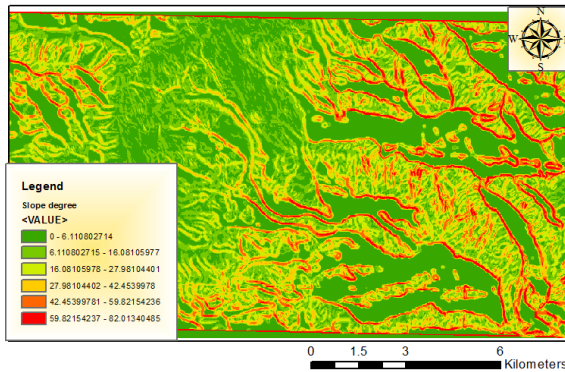

Fig. 4 Reclassification of slope maps depending on the risk

MAP OF SLOPE

Fig. 3 Map of slope – Parâng mountains

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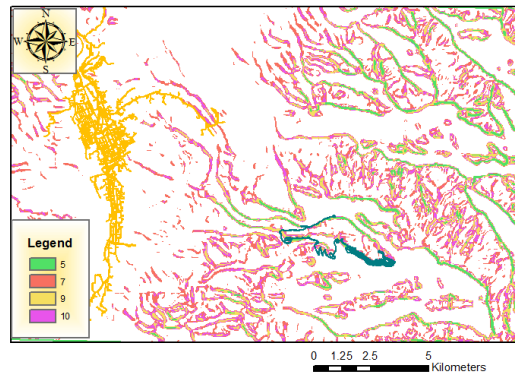
Fig. 5 The reclassified map of slope depending on the risk for producing an avalanche

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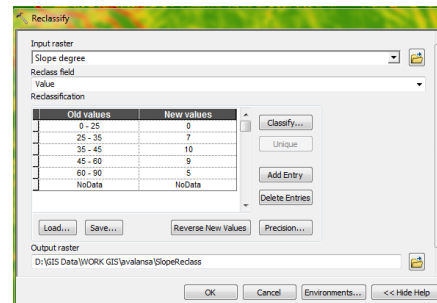The input raster is the previous Slope raster and the obtained raster (Output) will be SlopeReclass.

🔸 Making a single layer

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

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 (the layer of roads) , 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).
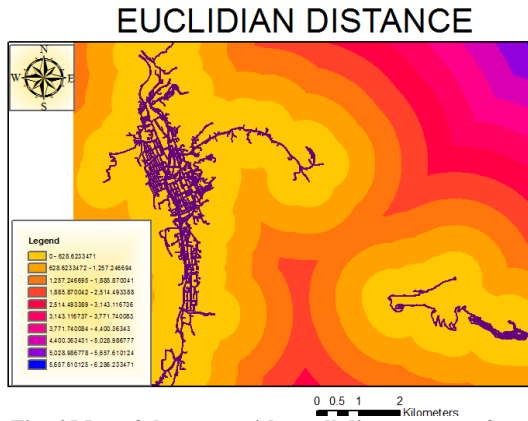
EUCLIDIAN DISTANCE

Fig. 6 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
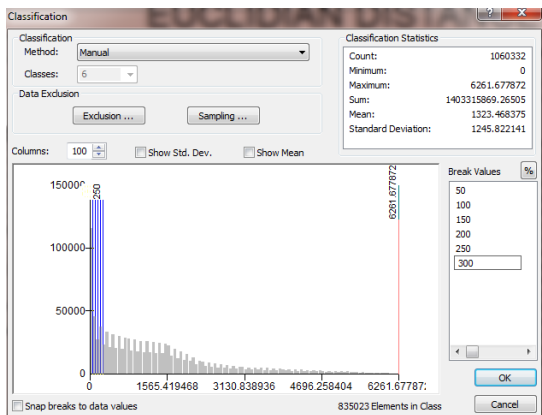- *Break Values*: values from 50 in 50: 50 (10), 100 (9), 150 (7), 200 (6), 250 (5), 300 (6)

Fig. 7 Reclassification of Euclidian raster
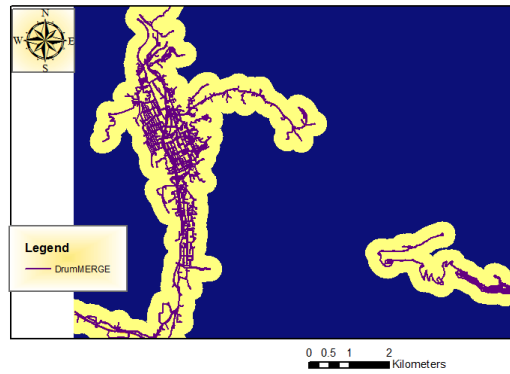
EUCLIDIAN DISTANCE RECLASSIFY

Fig. 8 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).

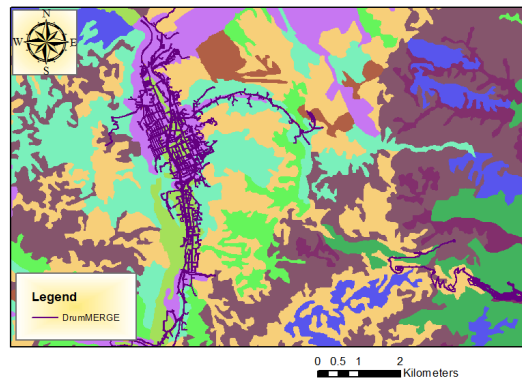## RASTER CORINE LAND COVER

Fig. 9 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
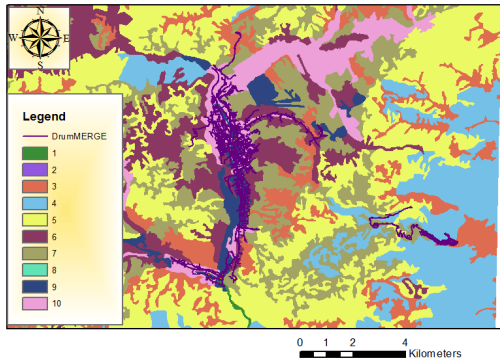
RASTER RECLASSIFY EXTRACT CLC

Fig. 10 Raster map of the categories for using the field into the studied reclassified area

➕ **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.

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.

MAP OF RISK OF AVALANCHE
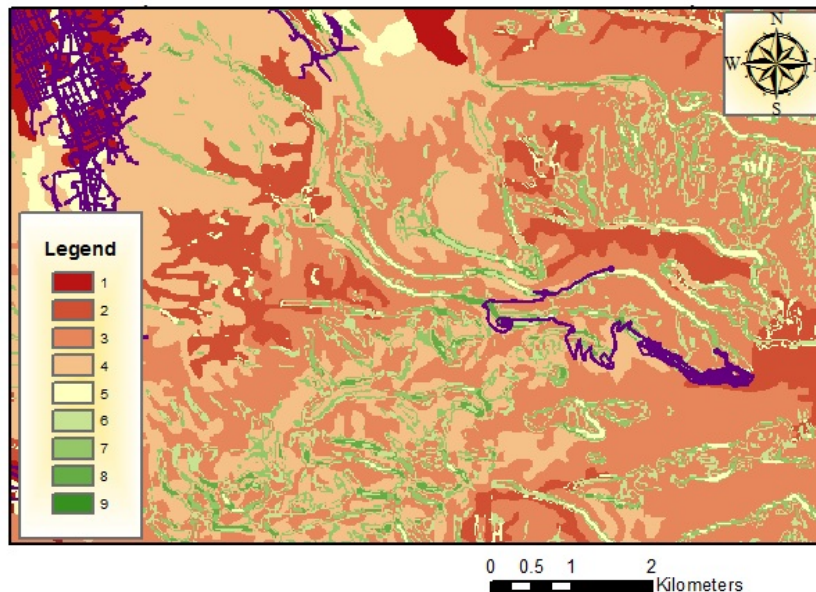### (1 MINIMUM RISK - 9 MAXIMUM RISK)

Fig. 11 Map of risk of avalanche in Parang Mountains

4. 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.

REFERENCES

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