GIS ANALYSIS OF MORPHOMETRIC FACTORS IN THE ZLATNA DEPRESSION, ALBA COUNTY

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Abstract: *The main objective of this paper consisted in creating a geospatial database in order to enable the analysis of the relief from different perspectives. We have chosen, in this sense, to analyze the morphometric factors (hypsometry, horizontal fragmentation, fragmentation depth, the map and the exposition of the slopes) which act upon the relief in the Zlatna depression, by using, mostly, the possibilities offered by the Geographic Information Systems. The reason for choosing this area as a case study is the fact that, here, the relief is visibly fragmented, not only horizontally, but also vertically, by numerous permanent and temporary watercourses (gullies, rills, torrents) that influence, through their existence, the morphometric factors.*

At present, in the Zlatna area, there is in progress a subprogram entitled The rehabilitation of highly polluted areas – Zlatna, one of the investment objectives from this framework being entitled The rehabilitation of the ecosystem in the areas severely affected by pollution. In order to stabilize or to stop the phenomena that occur in the area, a detailed analysis of the existing situation is required, in order to choose the best solutions and methods in this sense.

Keywords: GIS, land improvements, rehabilitation, hypsometry, fragmentation, slope map.

1. Introduction

The Zlatna depression is situated in the Apuseni Mountains, at an average altitude of approximately 420m, in the western part of Alba County, on the upper course of the Ampoi River, being bounded by its confluence with the Trâmpoiele brook upstream and downstream with Fenes brook. The area can be found on the list of areas exposed to natural and technological hazards, or to other types of risks and pollutions, within the first volume of "The national-environment-areas of risk framework", of the Territorial Arrangement Plan for Alba County (PATJ), since 31.03.2008. Within this plan, there are exposed a series of physico-geological existing phenomena in the area, such as: landslides (approximately 20ha), bank erosions (approximately 2km), dislocations of the cliffs and falling rocks, torrential river valleys (approximately 25ha), floodplains (approximately 9ha), marsh zones (in the sterile dump area, approximately 2ha). All this is due to the pollution coming from the AMPELUM enterprise, a factory profiled on copper metallurgy, which has affected the area, and whose effects are still felt, despite the fact that it has ceased its activity in 2004. Certainly, the altitudinal distribution of the relief has also, in this area, an important contribution.

2. Creating the geospatial database

In this respect, it was established in the early phase the data requirements, in order to fulfill the project requirements. Taking into account the physical characteristics of the respective area, which was visibly fragmented, it was decided the use of cartographic representations at large scales, for as faithful rendering of the relief as possible. For the behavior analysis over time, beside the existing cartographic materials in raster format, it was also considered necessary the use of data obtained from topographic measurements in the field. Taking into account the available data and the requirements for achieving this aim, there have been established the necessary thematic layers and the steps to be followed.

Primary data sources that formed the basis for the analysis consisted not only of two spatial data types, raster and vector, but also of descriptive data.

The raster data type used, are cartographic materials obtained from OCPI, mentioned in the previous chapter, respectively the planning worksheets at the scale of 1: 2000 and 1: 10000 (the aerophotography was realized in 1984) and the related orthophotoplans of the area.

SCALE	NAME	
1:10000	L-34-71-C-b-2	L-34-71-C-b-4
1:2000	L-34-71-C-b-4-I-1 L-34-71-C-b-4-I-2 L-34-71-C-b-4-I-3 L-34-71-C-b-4-I-4 L-34-71-C-b-4-II-1 L-34-71-C-b-4-II-2	L-34-71-C-b-4-II-3 L-34-71-C-b-4-II-4 L-34-71-C-b-4-IV-1 L-34-71-C-b-4-IV-2 L-34-71-C-b-4-IV-3 L-34-71-C-b-4-IV-4

Table. 1 Planning worksheets used

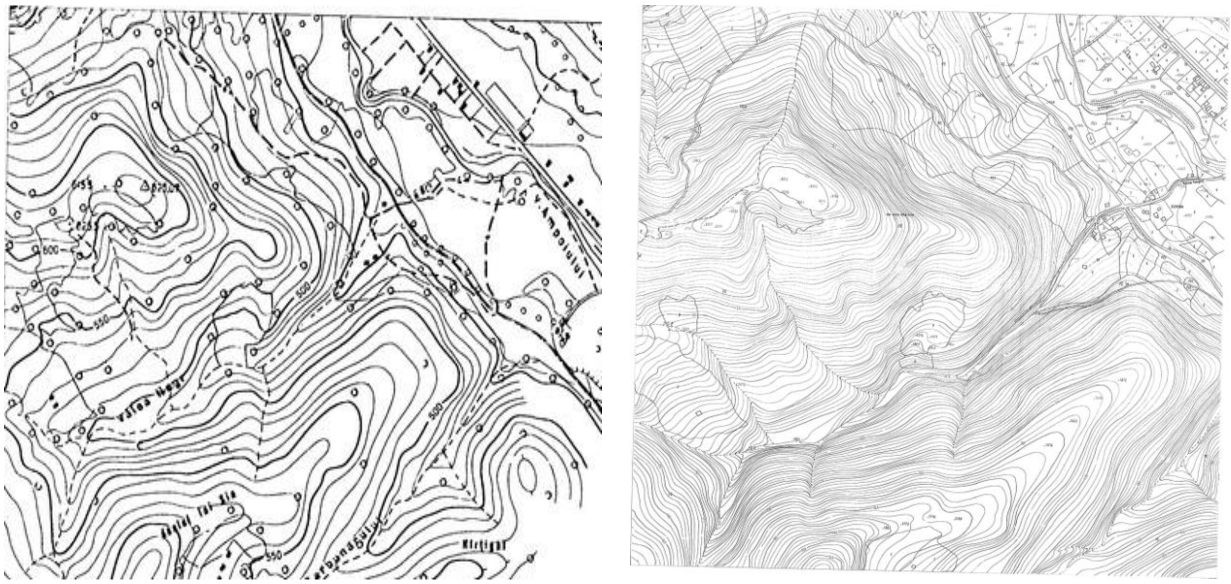


Fig. 1 The representation of the same area on the plan at the scale of 1:10000 (left - L-34-71-C-b-4), respectively at the scale of 1:2000 (right - L-34-71-C-b-4-I-1)

As primary vector data, there were used the topographical plans drawn up after carrying out measurements and data processing and corresponding trapeze networks in *.shp format.

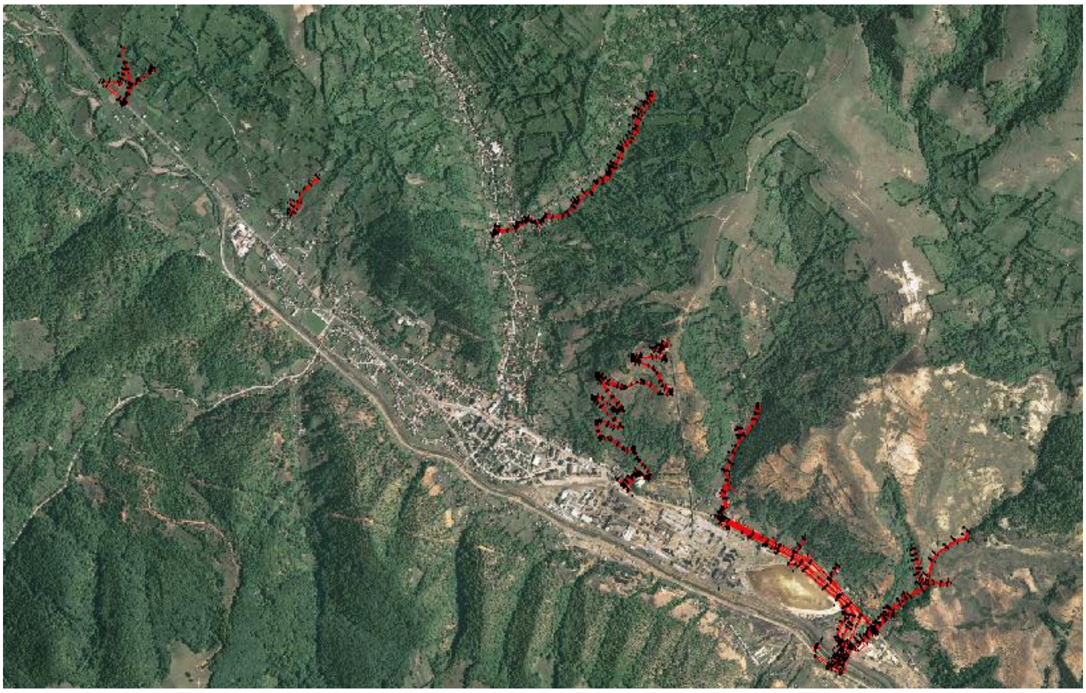


Fig. 2 Vector entities on raster background

3. The analysis of morphometric factors

The hypsometric map shows the altitudinal distribution of the relief in the Zlatna area. It can be noticed that the absolute altitudes, taken next to the Black Sea level, varies from 350 m, in the depression, and up to 1370m, in the Trascău Mountains, Dâmbău Peak. Also, on this map it is very well emphasized the progressive increase of the quotas, from the level of the water meadow, to those of the hills and then of the mountains that surround the depression.

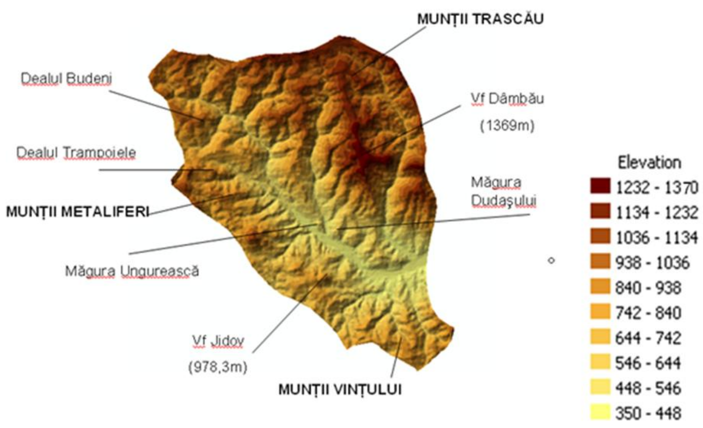


Fig. 3 The hypsometric map

The map of the horizontal fragmentation of the relief was made using as reference surfaces not only the surfaces of morphohydrographic basins, but also the 1km2 surfaces obtained by dividing the area into squares with sides of 1 km.

The generation of morphohydrographic basins was done automatically, using the File-Generated Watershed command from Global Mapper. Afterwards, it was calculated in ArcMap the value of the density fragmentation for each basin, as the ratio of the length of temporary and permanent water courses and of the surface of the basin, using Field Calculator. Values between 0,00001and 0,01403 km/km2 were obtained, the largest horizontal fragmentation being in the area of confluence between Morilor Valley and Valley of Lal, low values being recorded in the basins situated on both sides of the Ampoi River. Moreover, a significant horizontal fragmentation can be observed in the basins situated on both sides of the river of Morilor Valley.

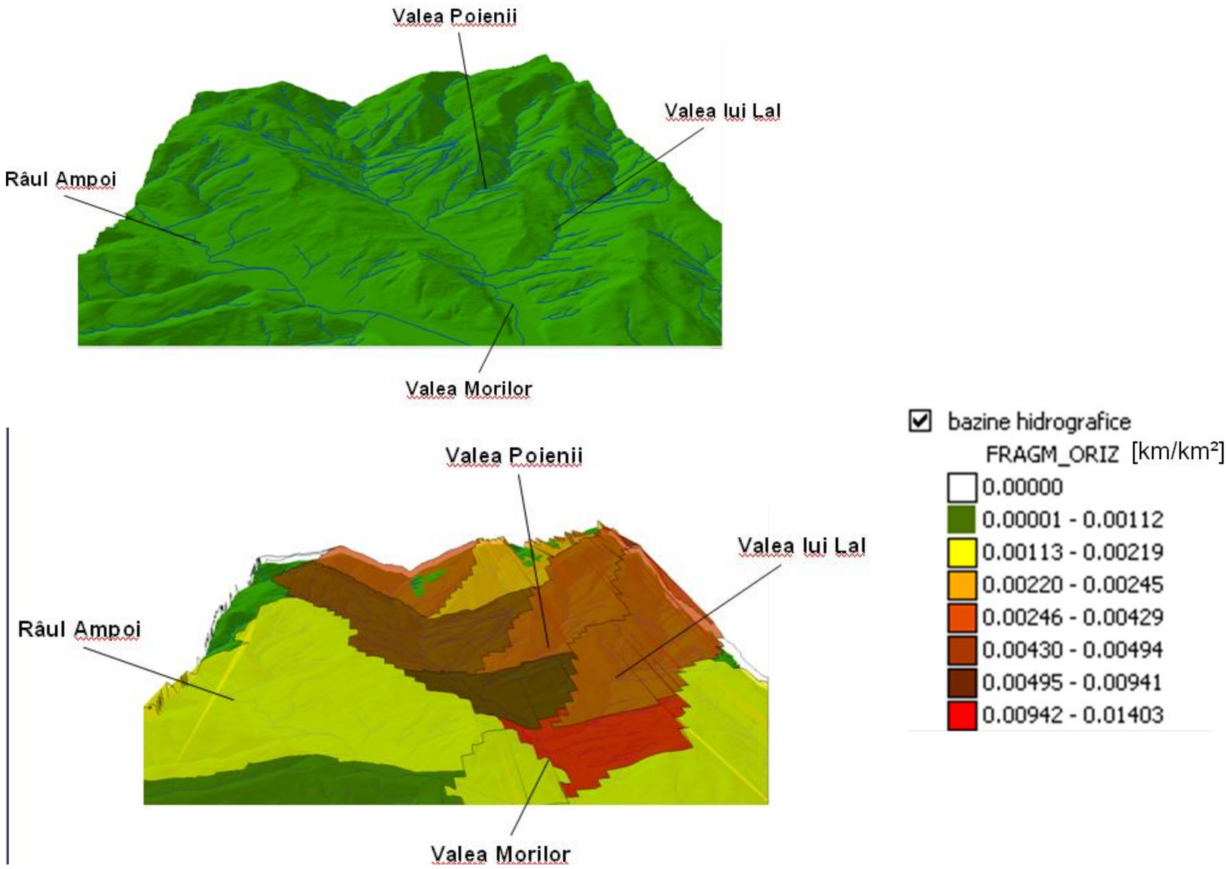


Fig. 4 The horizontal fragmentation of the relief on morphohydrographic basins

The network of squares with sides of 1km was created in ArcMap program using Fishnet Shapefile extension. Furthermore, it was similarly calculated the fragmentation density for each square with1km^2 surface, obtaining values between 0, 36034 and 8, 18657 km/km^2. The highest values were obtained also on the slopes, located on both sides of Morilor Valley and Valley of Lal. What is more, it can be noticed that there are portions with an increasing horizontal fragmentation on both sides of Ampoi River.

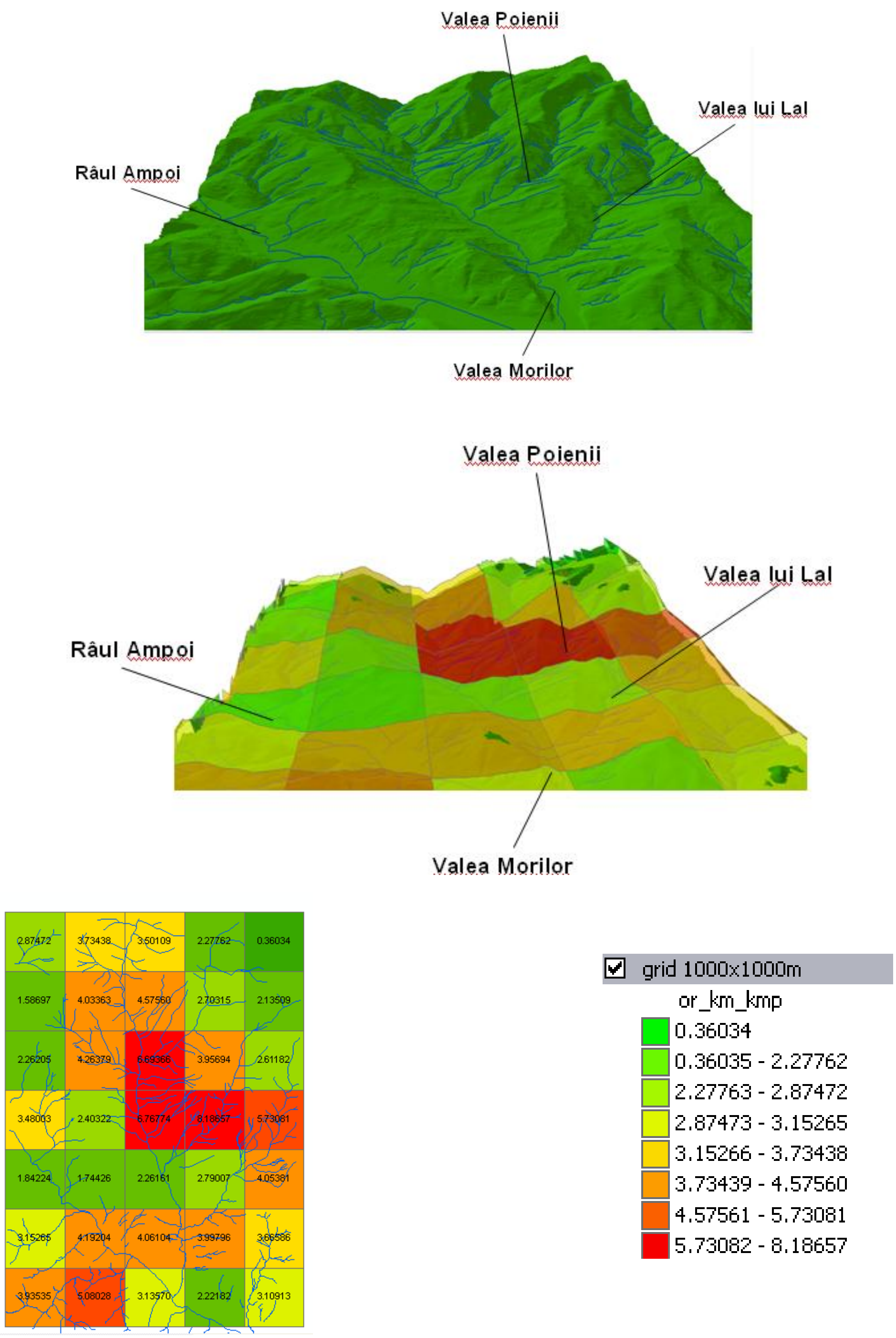


Fig. 5 The horizontal fragmentation of the relief – cartogram method

The map of the depth fragmentation of the relief was made similarly to the previous one, considering the same reference surfaces, for which the differences were calculated between the minimum and maximum altitude. Thus were obtained values of depth fragmentation between 0, 00001 and 314, 89158 m/km^2. The high values of energy relief can be noticed in the area of confluence between Morilor Valley and Ampoi River and in the morphohydrographic basins of the valleys situated on the high slopes from the left part of the Morilor Valley, where the water has dug deep.

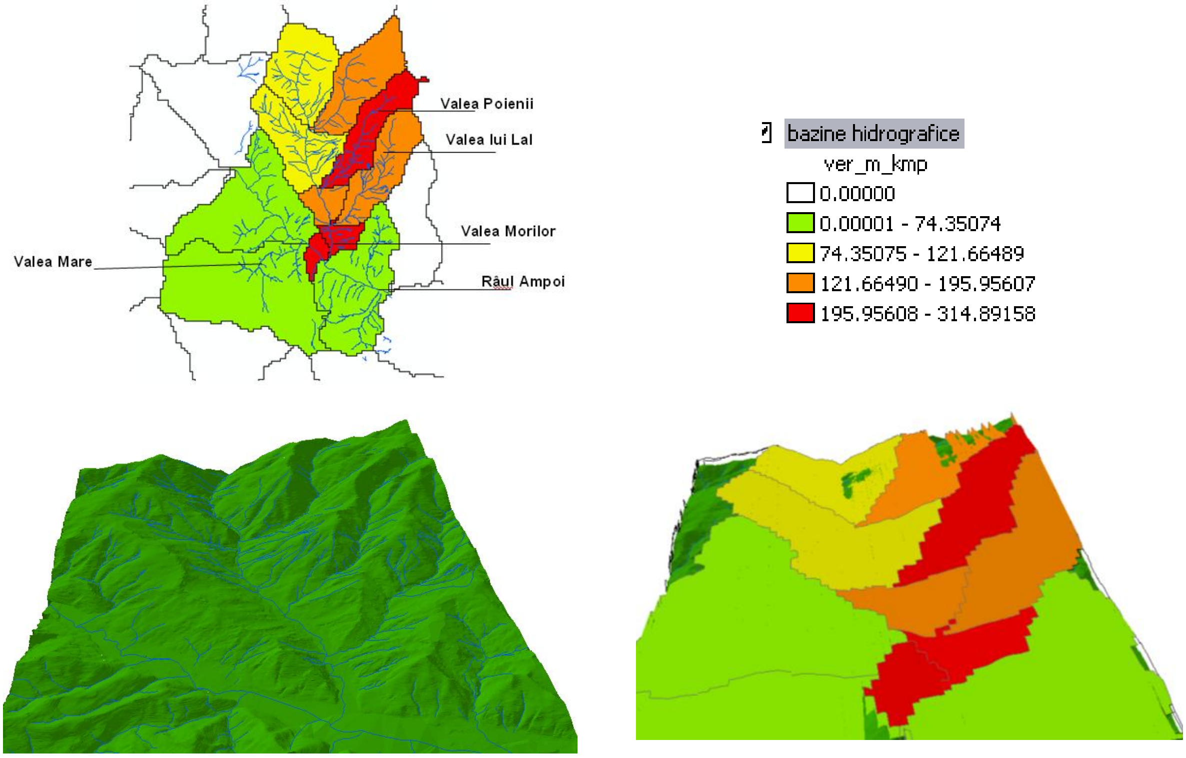


Fig. 6 The depth fragmentation of the relief on morphohydrographic basins

When using cartograms, there were obtained values of the depth fragmentation ranging between 0, 00001 and 540 m/km^2. As in the previous case, the maximum values were obtained on the high slopes from the left side of the Morilor Valley, but also in the area of some valleys on the left slope of the Ampoi River.

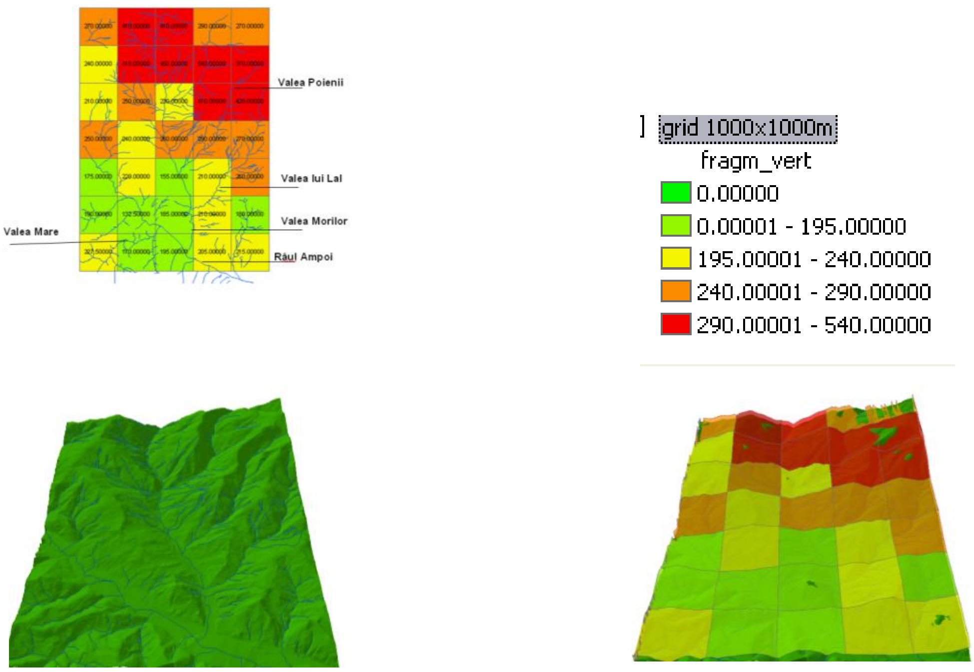
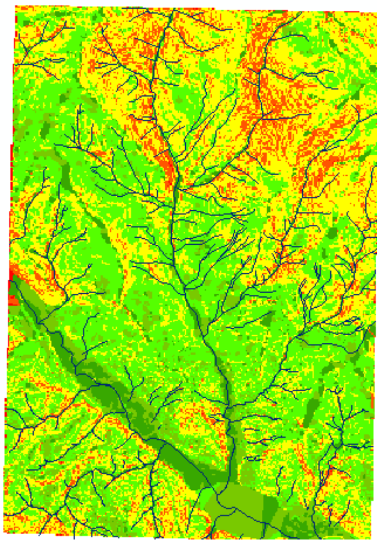
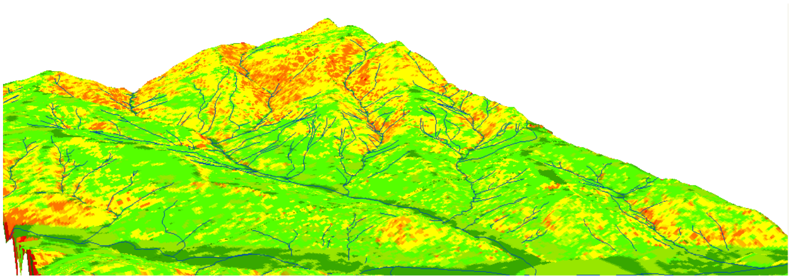


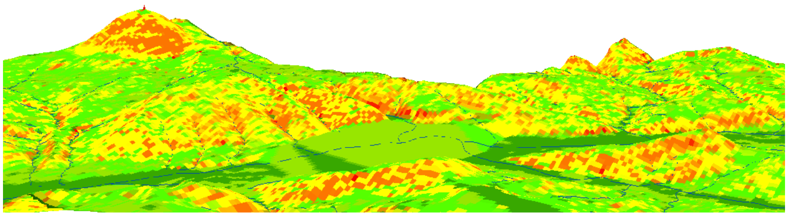
Fig. 7 The depth fragmentation of the relief – cartogram method

The map of the gradients was also created in ArcMap, using the 3D Analyst – Surface Analyst – Slope command. There were obtained values of the slopes from 0º up to 90º. The horizontal and very gently sloping surfaces (0-3º) can be found on both sides of the Ampoi River and Morilor Valley, which even favored the situation of the constructions and of the communication routes in these areas. The surfaces with low inclination (3-10º) can be found at the base of the slopes and they are affected by weak phenomena of solifluxion. The surfaces with moderate inclination (11-20º) are the most common, these being characterized by a higher rank of linear erosion (gullies, rills and torrents) and of pluviodenudation. The surfaces with high inclination (21-35º) and intense linear erosion occur most often in the upper slopes, from where the tributaries gather their main watercourses. The strongly inclined surfaces (36-55º) and the abruptnesses (56-90º) appear quite frequently on the slopes of the gullies situated at quotas over 550m.





a. the slopes on the left side of the Ampoi river



b. the slopes on the right side of the Ampoi river

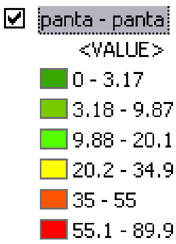
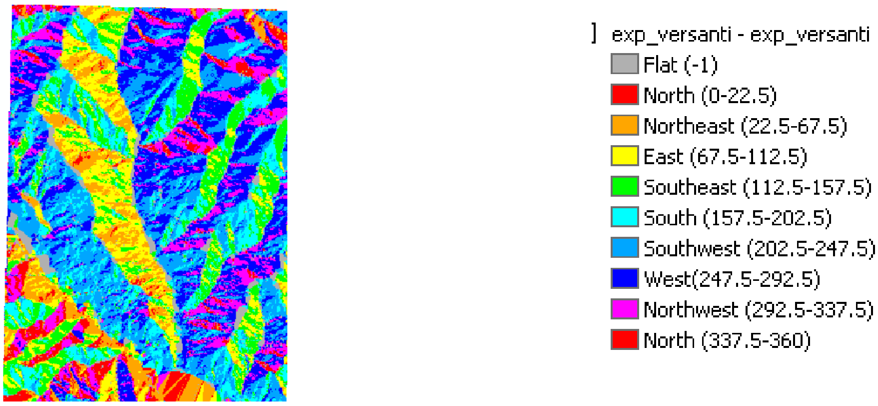
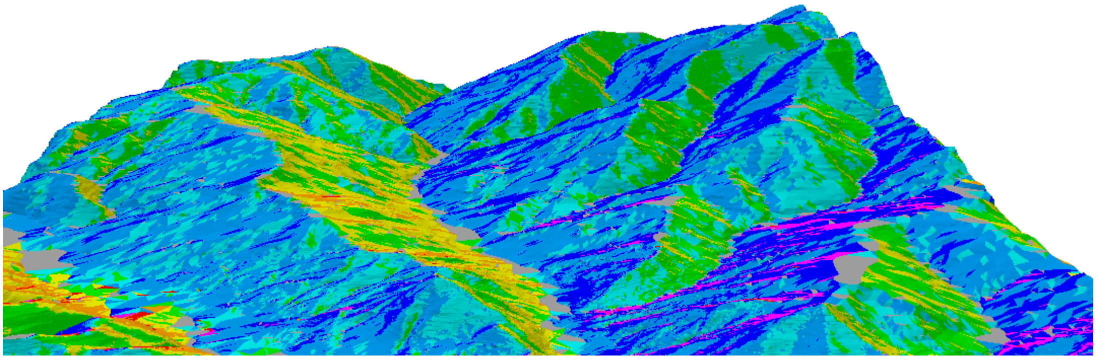


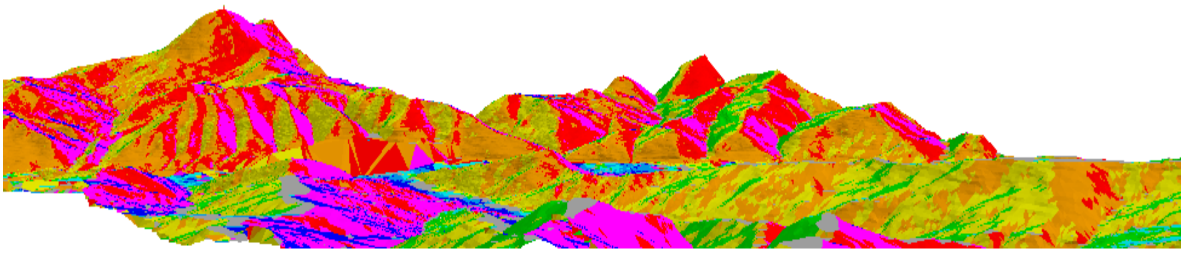
Fig. 8 The slope map of the relief

The exposition of the slopes was created in ArcMap, using the 3D Analyst - Surface Analyst – Aspect command. It can be observed that the slopes on the left side of the Ampoi River have southern, eastern, western, south-eastern and south-western exposition, these being sunny and semi-sunny surfaces. Special attention should be paid to the slopes with southern exposition, which are at risk of flooding in the spring. The slopes on the right side of the Ampoi River have northern, northwestern, northeastern, southeastern, northeastern exposition, these being shaded and semi-shaded surfaces.





a. the slopes on the left side of the Ampoi river



b. the slopes on the right side of the Ampoi river

Fig. 9 The exposition of the slopes

4. Conclusions

From the results obtained, it can be easily remarked that the analyzed area, namely the Zlatna depression, presents complex morphometric characteristics. This is due both to the altimetric configuration of the area, specific to intermountain depressions, and to the effects of pollution from the area, which has put its mark deeply on the relief. Due to pollution, the soil fertility has decreased, which has lead implicitly to premature drying or even to the disappearance of vegetation in some areas. It followed, naturally, the erosion and degradation of the soil, all the more the land is sloping (the exposition of the slopes should not be neglected). During torrential rains, the amount of water fallen exceeds the quantity of water that may infiltrate, appearing, therefore, the torrents which lead to soil degradation.

Analyzing comparatively or individually the created maps, we can identify the areas of concern, that will require other and more detailed studies. For example, through longitudinal profiles, we can study the evolution of a gully in time. Raising the basic level indicates the extinction of the torrent's action, while its lowering indicates the increase of the torrent's action.

Analyzing the evolution in time (1984-2000-present) of the gully longitudinal profiles of the depression, it was found that the majority has a continuous evolution, too few being those that tend to stabilize.

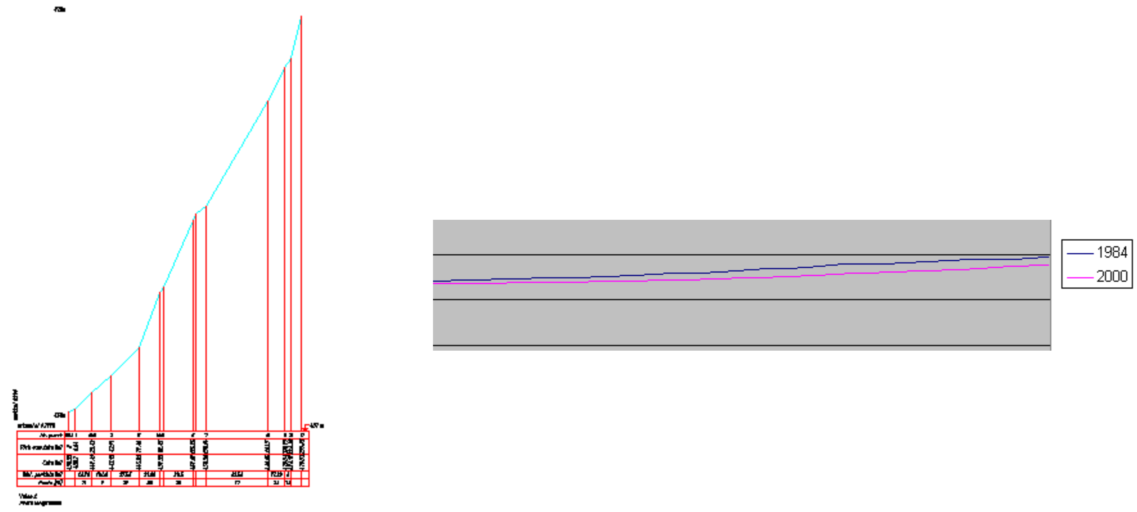


Fig. 10 Example of a gully whose action was accentuated in time

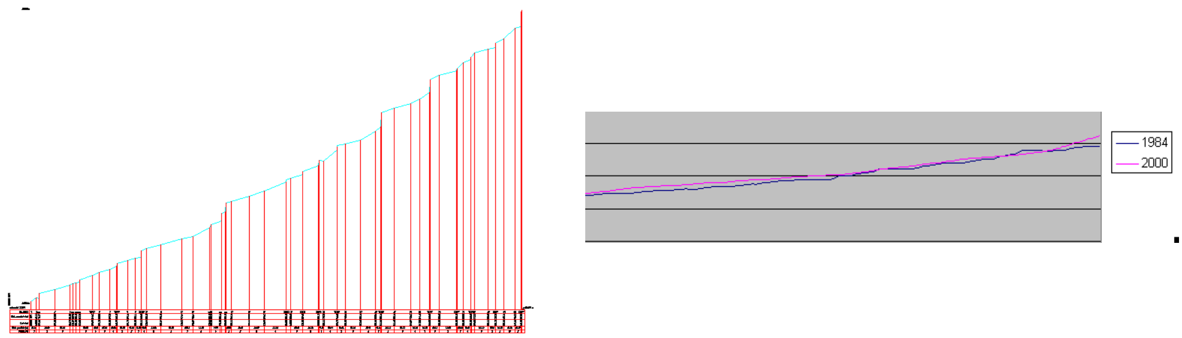


Fig. 11 Example of gully whose action tends to extinguish

Concretely, through the analysis of morphometric factors on a specific area, there can be distinguished the torrential organisms which require works that ensure the stability of the river bed, that hold the leakage section of the river beds, that landscape the banks (retaining walls, gabions), that regularize the water leakage, that protect the ways of communication and the constructions in their vicinity. All these works are carried out to reduce deep erosion, the transport and the deposit of the materials involved. The reduction of the transport capacity and of the erosion of the rills and gullies is realized through transversal work, which helps to reduce the slope drain (bottom skirts). In order to carry out the mentioned works, it is necessary to conduct topographic surveys of the torrential organisms and of other objectives which are affected by their action. On transversal and longitudinal based profiles, there can be designed appropriate constructive elements for each situation.

In addition, there can be distinguished the sloped areas, for their rational use, for restoring the herbaceous carpet, by seeding lawns and by planting trees or there can be emphasized the areas in which is necessary the protection of the slope with coast fences, etc.

At the same time, the existing morphometric conditions can be studied in order to find optimal solutions for the restoration of the forest roads and the access road to the dispersion basket.

5. References

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