OROGRAPHY ANALYSIS BY COMPLEX PATTERNS OF SPATIAL ANALYSIS

Joldis (Badescu) Rodica, M. Dirja, G. Badescu, Adela Hoble
University of Agricultural Sciences and Veterinary Medicine, Mănăștur Street 3-5, Cluj – Napoca, Romania

Abstract. Water flow rate is influenced by slope and thickness of the water running down the slope. Water erosion process which is triggered as follows: precipitation that fell on the soil surface are absorbed by the absorption capacity of the soil volume exceeded rainfall quantity, water will accumulate in micro-depressions. If rainfall continues to fall, stretches of water formed unite and form a continuous film of water begins to flow as rills or streams. Soil erosion is caused mainly by: relief, climate (air temperature, wind, rainfall, atmospheric pressure, humidity, duration sun radiation, cloud cover, weather phenomena), soil, rock soil formation, vegetation and land use. Creating GIS spatial analysis model required the following steps: creating the database, appropriate spatial modeling, model validation to quantify the risk.

Keywords: morphometry, altitude, geodeclivity, landscape energy.

INTRODUCTION

Water flow rate is influenced by slope and thickness of the water running down the slope. Water erosion process which is triggered as follows: precipitation that fell on the soil surface are absorbed by the absorption capacity of the soil volume is exceeded rainfall, water will accumulate in micro-depressions. If rainfall continues to fall, stretches of water formed unite and form a continuous pellicle of water begins to flow as rills or streams.

Raindrops can cause shoving soil permeability effect is decreasing. Spreading the particles of soil can be held at a distance of 1 – 1.5 m and a height of 60-80 cm. Transport of material occurs on sloping land where there is a ground shift downstream. Material transport takes place and where flat land. Research conducted shows that on land that has a slope of 10% is transported downstream due to water drops, three times more material than upstream.

Any territory is significant elements involved in the emergence and evolution of triggering landslides considered that if each parameter is calculated quantitative morphometric analysis and is integrated all parameters based on complex patterns of spatial analysis, can lead to a real appreciation of the likelihood of landslides.

Parameter qualitative spatial analysis of morphometric characteristics of the landscape is defined by the orientation of the inclined surfaces or slope orientation. Slope orientation geomorphological processes participating in the development of slope due to climatic factors are not evenly dispersed on the surface of land: solar radiation, sunlight, rainfall and temperatures. This parameter causes the differences of exposure to the sun.

In the spatial orientation of the slopes has a special significance because it influences the location and layout of residential areas, land use categories and determining the suitability of crops reported, etc.

Slope orientation with their geodeclivity regimes produce different caloric influencing soil moisture and causing quantitative and qualitative reproductions.
geomorphological processes and vegetation, etc. Since the slopes have different shapes (concave, convex, mixed), it was noted that this parameter combined with geodeclivity, which are felt disrupt the diurnal amplitude of air temperature and substrate, and the values are lower convex surfaces versus values concave surfaces.

Databases using GIS spatial analysis methodology are given vector, raster data, attribute data and derived (hypsometry, slope, slope aspect, drainage density, drainage depth, slope orientation). Methods for preparation of maps based on a universal coordinate system (cartographic projection and coordinate system), have potentiality to interpolate correction layers and provide opportunities where changes occur in the study area.

Determination of the likelihood of landslides, according to the method proposed by Petrea Dănuţ et al (2014), is based on a system of two equations: the equation for calculating the probability coefficient specific to the extension of the range of probability (1) and the equation calculating the range of the probability coefficient (2).

\[
\frac{(x \times y)}{100} = z; \quad (1)
\]

\[
x = v_{p_{\text{max}}} - v_{p_{\text{min}}}; \quad (2)
\]

where:
- \( x \) - the value range of probability;
- \( y \) - the range of spatial extent, expressed as a percentage;
- \( z \) - the coefficient of probability depending on the area;
- \( v_{p_{\text{max}}} \) - maximum probability interval;
- \( v_{p_{\text{min}}} \) - the minimum value of probability interval.

\[
v_{p} = a + z; \quad (3)
\]

where:
- \( v_{p} \) - probability value;
- \( a \) - base value of the range of probability;
- \( z \) - the coefficient of probability depending on the area.

According to equations (1), (2) and (3) was determined the value of the probability for each interval of morphometric parameters that are considered necessary to assess the probability of landslides.

**MATERIAL AND METHOD**

Ciurila village is located 20 km from Cluj-Napoca, Hill Feleacului - Hășdate depression in the river basin Hășdate. It covers an area of 72.22 km², is located at an altitude of 562 m and intersected by the parallel of 46° 39' 03'' North and longitude 23° 32' 54" East. Within this joint part following locations: Ciurila, Salice, Săliște Prunis, Sutu Pădureni, bottom tabs and tabs on top.

Săvădisla village is located about 22 km southwest of Cluj-Napoca, the Apuseni Mountains, the landscape is made up of depressions. It covers an area of 52.11 km², is located at an altitude of 492 m and intersected by the parallel of 46° 40' 25'' North and longitude 23° 27' 21'' East. From this common, the following localities: Săvădisla, steward, Vlachs Vălișoara, Finişel, Hășdate, Lita and Liteni.

Florești village is situated about 10 km from the city of Cluj-Napoca, on the right bank of the river Somes Mic at the junction of the Apuseni and Transylvanian Plateau. It covers an area of 6,092 hectares, is located at an altitude of 500-600 meters and intersected by the parallel of 46° 44' 52'' North and longitude 23° 29' 27'' East. Within this joint part following locations: Floresti Luna de Sus and Tauti.
Calculation of the probability of slope orientation parameter
For low probability
\[
(0.1 \times 1.88) / 100 = 0.002
\]
\[0 + 0.002 = 0.002\]
For the average probability
\[
(0.20 \times 31.93) / 100 = 0.064
\]
\[0.10 + 0.064 = 0.164\]
For medium - high probability
\[
(0.19 \times 24.72) / 100 = 0.047
\]
\[0.31 + 0.047 = 0.357\]
For high probability
\[
(0.29 \times 21.17) / 100 = 0.061
\]
\[0.51 + 0.061 = 0.571\]
For very high probability
\[
(0.20 \times 20.30) / 100 = 0.041
\]
\[0.80 + 0.041 = 0.841\]

Calculation of the parameter likelihood gradient
For low probability
\[
(0.1 \times 29.94) / 100 = 0.030
\]
\[0 + 0.030 = 0.030\]
For the average probability
\[
(0.20 \times 58.55) / 100 = 0.117
\]
\[0.10 + 0.117 = 0.217\]
For medium- high probability
\[
(0.19 \times 10.42) / 100 = 0.020
\]
\[0.31 + 0.020 = 0.330\]
For high probability
\[
(0.29 \times 0.81) / 100 = 0.002
\]
\[0.51 + 0.002 = 0.512\]
For very high probability
\[
(0.20 \times 0.28) / 100 = 0.001
\]
\[0.80 + 0.001 = 0.801\]

One of the research methodology was adopted by Decision no. 447/2003 issued by the Government relating to the drafting and content of risk maps naturally to landslides, but not sufficiently complete. This methodology, in some cases, obtain conclusive results, although the opinion of experts is that the methodology is very effective, because the sign variables (lithology, climate and hydrogeological) relates a certain subjectivity, both derived from various types of applications and the scales of maps and also the information ordering, related areas investigated.

Methodology to quantify the likelihood of landslides value proposed in the Government Decision 447/2003 refers to the qualitative and quantitative analysis of landslides for each probability interval. Considering compliance methodology for the drafting and content of risk maps naturally to landslides, but considering that this is based on variables that are difficult to calculate and have a spatial continuity (lithology,
hydrogeology, seismicity), Petrea Dănuț et al. (2014) found it possible to validate the model with some morphological and morphometric unitary, derived from DEM.

**RESULTS AND DISCUSSION**

The spatial analysis we developed using several database structures, based on the morphometric primary database (obtained by vectorization of contour maps 1:25000), database modeling (DEM, drainage density, potential index infiltration of water transport capacity index, the coefficient of probability) and databases derived (inclination, slope aspect, drainage density, plan curvature, profile curvature and depth hypsometry fragmentation). Estimating the likelihood of landslides are important issues in spatial planning, in terms of efficient use of land. In this regard were issued several research methods, but falling short of the consensus.

By reclassification was done a raster grid database, which indicates that the highest rate corresponds to the average probability, that is 31.93%, which is 77.63 km², followed by 24.72% for the percentage probability medium-high, which is 60.11 km², 21.17% for high probability, ie 51.47 km² and 20.30% for high probability, ie 49.37 km². It can be seen that the areas that have low probability is very low, 4.57 km², ie 1.88% of the study area (Fig. 1).

![Fig. 1. Reclassification by a raster grid database](image)

<table>
<thead>
<tr>
<th>Value</th>
<th>Probability</th>
<th>Interval</th>
<th>Probability value</th>
<th>Surface (km²)</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.1</td>
<td>low</td>
<td>PLAN</td>
<td>0.002</td>
<td>4.57</td>
<td>1.88</td>
</tr>
<tr>
<td>0.1 - 0.3</td>
<td>medium</td>
<td>N, NE</td>
<td>0.164</td>
<td>77.63</td>
<td>31.93</td>
</tr>
<tr>
<td>0.31 - 0.5</td>
<td>medium-high</td>
<td>E, NV</td>
<td>0.357</td>
<td>60.11</td>
<td>24.72</td>
</tr>
<tr>
<td>0.51 - 0.8</td>
<td>high</td>
<td>SE, S</td>
<td>0.571</td>
<td>51.47</td>
<td>21.17</td>
</tr>
<tr>
<td>&gt; 0.8</td>
<td>very high</td>
<td>SV, V</td>
<td>0.841</td>
<td>49.37</td>
<td>20.30</td>
</tr>
</tbody>
</table>

*Table. 1. Values and probability classes (slope orientation)*
CONCLUSIONS

Quantitative analysis of specific probability values of the slope parameter determined in the entire complex research shows that between spatial extent, the probability is reduced to 72.79 km² (29.94% of the whole area of study), followed by average probability of 142.37 km² (58.55%). Average probability intervals - great, great and great territorial expansion were reduced by 25.34 km² (10.42%), 1.96 km² (0.81%) and 0.69 km² (0.28%), which shows a good stability of the slopes in the area studied.
REFERENCES


30. Ştefan, O., Bădescu, G., Rădulescu, G.M., 2010 - Considerations on the possibilities of monitoring the convergence of underground mining works by ordinary topographic methods, 14th International Conference on Modern Technologies, Quality and Innovation (ModTech 2010), Slănic-Moldova, România MODTECH 2010: NEW FACE OF TMCR, Proceedings Pages: 571-574, Slănic Moldova, România.