MAPPING OF EROSION REGULATION ECOSYSTEM SERVICES

Boris Markov, Stoyan Nedkov

National Institute of Geophysics, Geodesy and Geography

Introduction

Ecosystem services are the benefits people obtain from ecosystems. They are can be *provisioning services* such as food, water, timber, and fibre; *regulating services* that affect climate, floods, disease, waste, and water quality; *cultural services* that provide recreational, aesthetic, and spiritual benefits. The human society, while buffered against environmental changes by culture and technology, is fundamentally dependent on the flow of ecosystem services. Regulating Services are the benefits obtained from the regulation of ecosystem processes (**MA, 2005**). Soils provide many ecosystem services required to support human well-being. Soil erosion is one of the major and most widespread forms of soil degradation. Erosion and sedimentation are natural processes that contribute to healthy and functioning ecosystems. Acceleration of these processes, has severe consequences. The major impacts are on the topsoil layer destroying the capability of the soil to provide economic or environmental services. By removing the most fertile topsoil, erosion reduces soil productivity and increases the risk of flooding. Erosion regulation is the ability of the ecosystems to prevent and mitigate soil erosion(**Burkhard, 2010**). In this study we investigated the capacity of the ecosystems to regulate soil erosion in the study area.

Objectives

- To analyze factors that affect soil erosion and their relation to ES supply
- To choose appropriate method for mapping erosion regulation ecosystem services
- Highlight the areas with high erosion regulation capacity

Study area

Location: The Bulgarian part of the catchment of Strumeshnica river is located in the most southwest part of Bulgaria with an area of about 440 km^2. It is located between *41*°31" and *41*°52" n.l. and *22*°91" and *23*°29" e.l., while it entirely is within the municipality of Petrich and the region of Blagoewgrad (fig. 1).
Geology and geomorphology: The study area has parallel direction and includes three morphographic units. To the north is Ograzhden mountain which rises up to 1600 m. To the south is Belasitsa mountain, which has typical horst structure and reaches 2000 m. Between them is the graben of Strueshnitsa valley build by sedimentary rocks.
Climate: The climate is transitional between temperate continental and Mediterranean characterized by dry summer and wet winter. The low parts has relatively high annual temperatures 13.5 ^{o}C), low annual temperature amplitude and positive temperatures during the coldest month (January).
Hydrology: Strumeshnitsa river originates from the Plachkovica mountain in the Republic of Macedonia and flows into the Struma river. It has a total length of 114 km, of which 81 km in the Republic of Macedonia and 33 km in Bulgaria
Soils: The soils in the study area are represented by three main soil types – Cambisols (CM), Fluvisols (FL) and Luvisols (LV).
Vegetation: The study mountain part of the study area is mostly covered by forests, represented mainly by oak in the lower part and beech in higher altitudes.

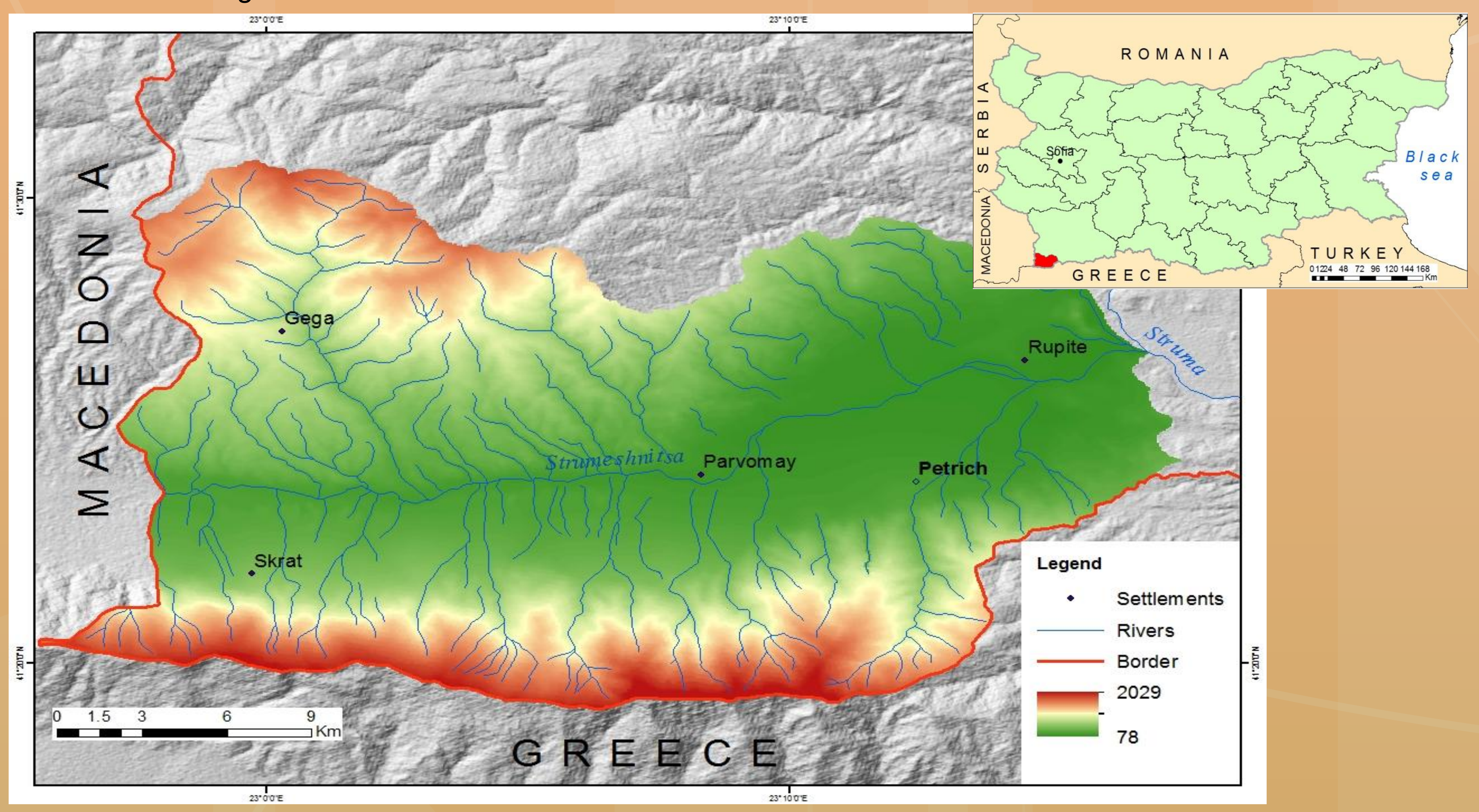

Figure 1. Study area Strumeshnitsa basin

Methods & Materials

To map the erosion regulation, as an ecosystem service we estimate Erosion regulation based on four USLE (Universal Soil Loss Equation) factors that affect the rate of erosion – soil erodibility (K-factor), topography factor (LS), crop management factor (C-factor).

K-factor: Erodibility defines the resistance of the soil to both detachment and transport.

LS-factor: The topography factor combines the slope length and slope steepness

C-factor: It is the ratio of soil loss from land cropped under specified conditions to the corresponding loss from clean-tilled, continuous fallow (Wischmeier and Smith, 1978).

ArcGIS 10.1 was used to calculate the factors and estimate the capacity of Erosion regulation ecosystem services. The conceptual scheme of the GIS based modelling is presented in Figure 2. It includes three main components each of them corresponding to the calculation of respective soil erosion factor. The initial data set includes 50m DEM generated from topographic maps, Landsat 5 satellite image taken on 15.07.2009 and Landsat 8 (Path 184, Row 31) from 17.12.2013 , and soil polygon data derived from soil map of Bulgarian at scale 1: 400000.
Each factor was calculated using particular procedure in order to generate layer representing the spatial distribution of the corresponding parameter. The capacities to supply erosion regulating ES were assessed on a relative scale ranging from 0 to 5 (following Burkhard 2010). The overall erosion regulation capacity of the area was defined by overlaying the three layers from the previous procedure.

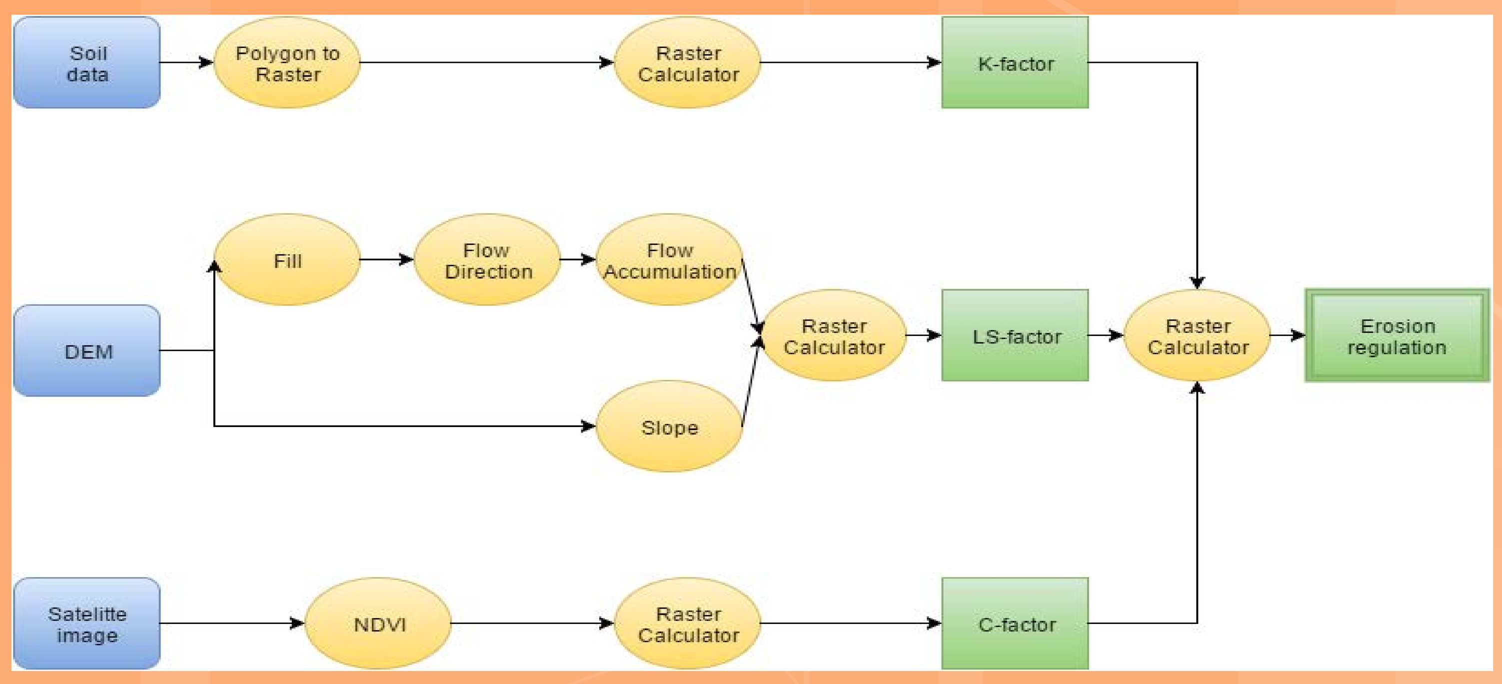

Figure 2. GIS algorithm for calculation of erosion ragulation

Results

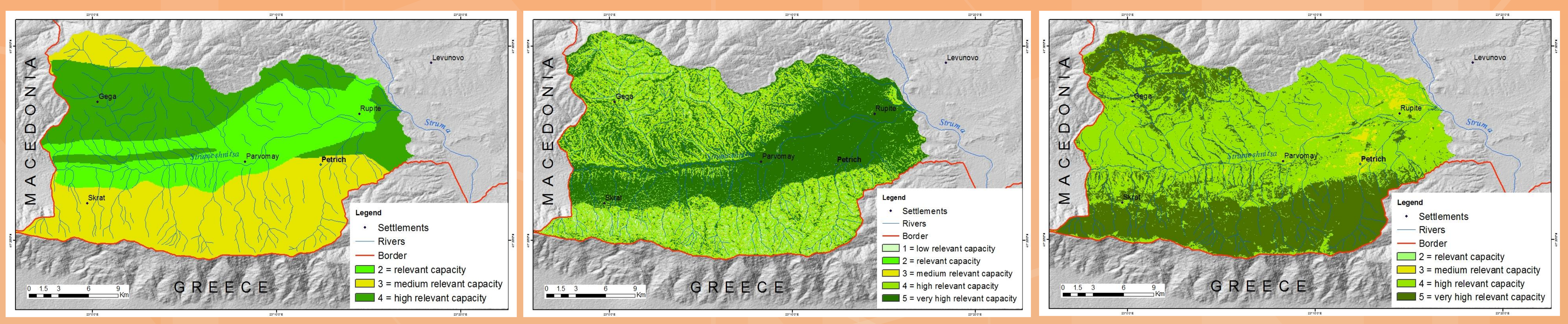

Figure 3. K, LS, C-factors erosion regulation capacity

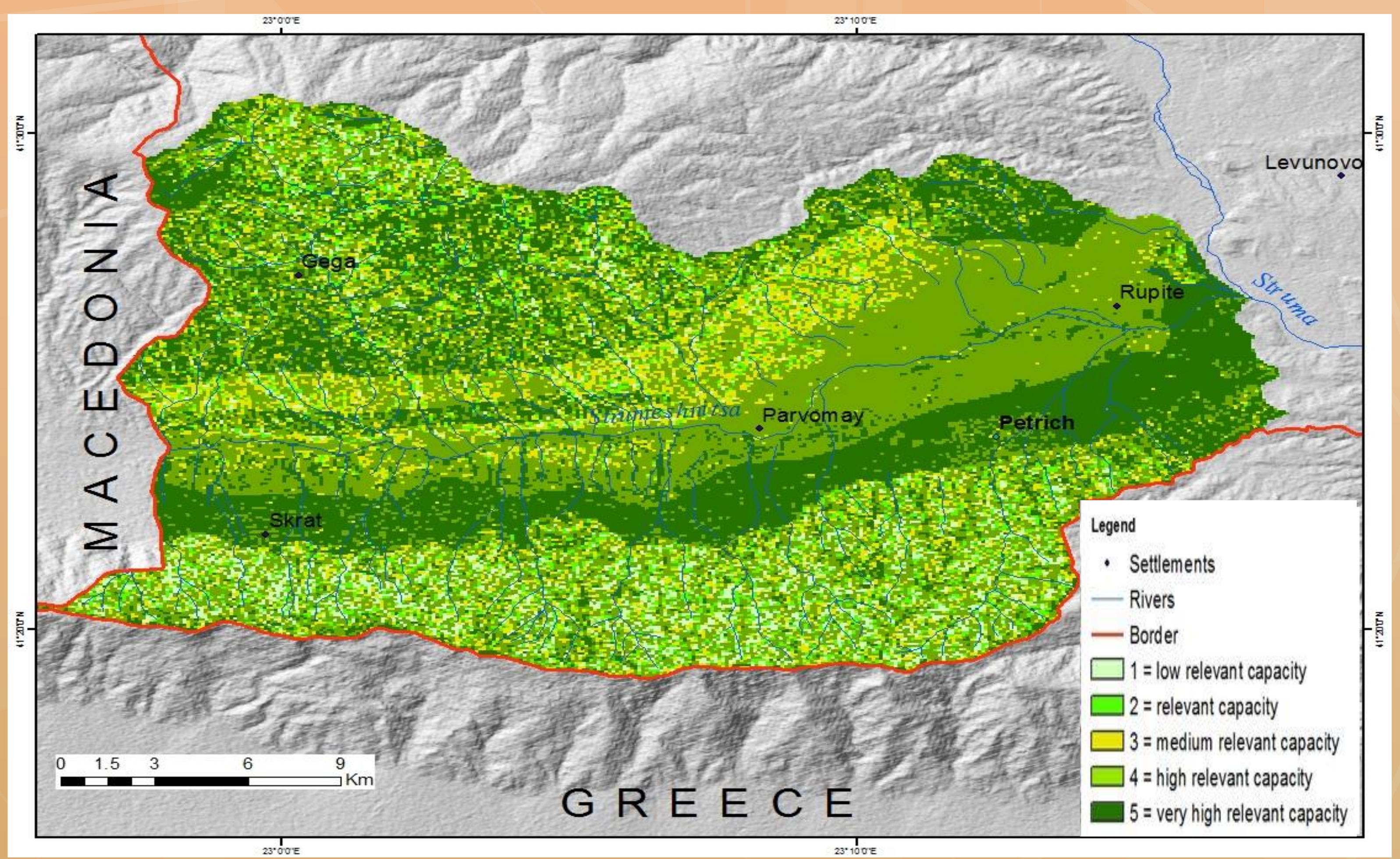

Figure 4. Erosion regulation ecosystem services

Maps were produced for K, LS and C-factors and estimated the capacity of erosion regulation for these factors. The capacity of erosion regulation was valued in the scale from 1 (low relevant capacity) to 5 (very high relevant capacity). All the maps were integrated to generate erosion regulation map to find out spatial distribution of this ecosystem service within GIS environment. The values of this ecosystem service ranges from 2 to 4.75.

Conclusion

The study shows that GIS and remote sensing provide a useful tool for mapping ecosystem services in a large scale. The model can be used as appropriate tool in understanding of the potential of ecosystem services to regulate the erosion processes. This method could be used for large scale models to visualize which ecosystems has low or high erosion regulation capacity. The results can be used to target key areas for various management practices.

References

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