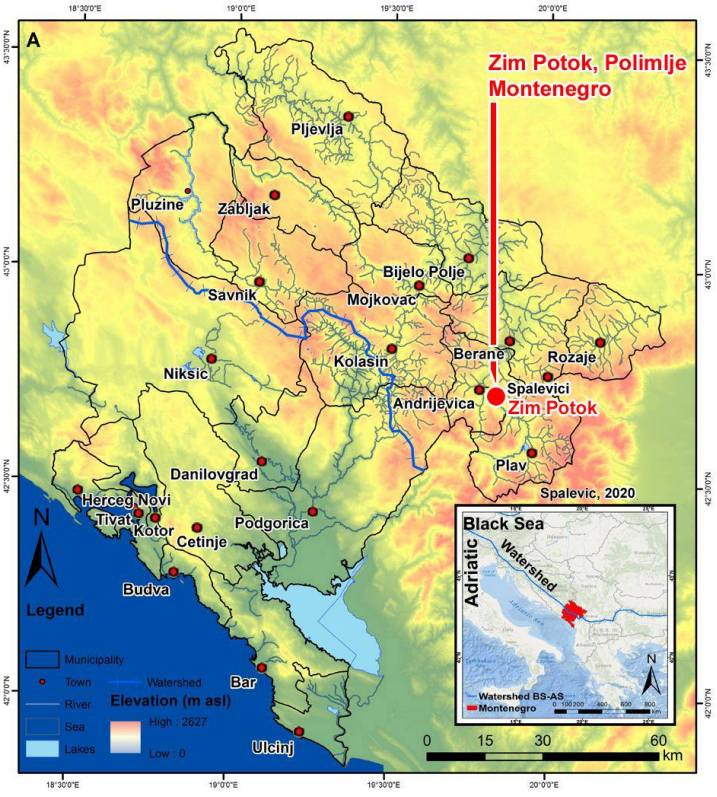
Environmental modelling and computer-graphic simulation for the analysis of physical-geographical characteristics of watersheds: Case study Zim Potok, Montenegro

Amela Drljan, University of Montenegro, Faculty of Philosophy, Geography, Niksic, Montenegro; ameladrljan@gmail.com
Velibor SPALEVIC, Goran BAROVIC, Dusko VUJACIC, Veljko MARTINOVIC, Veljko SINANOVIC, Zeinab HAZBAVI, Abdulvahed KHALEDI DARVISHAN

Global change refers to planetary-scale changes of the land, oceans, atmosphere, the planet's natural cycles and processes. These constituent parts of the Earth systems influence one another and now includes human society, so global change also refers to large-scale changes in society and the subsequent effects on the environment. This situation of environmental degradation should be stopped without further delays, with thinking and planning globally, but dealing locally. Every, even minor positive initiatives, we should count as worthwhile contribution to protecting natural resources from the degradation. Therefore, we need innovative theoretical and practical scientific approaches. The urgency of the problem poses a challenge to environmentally oriented informatics. Important methods and tools are modelling and simulation: a problem solving method where problems are solved not by experimentation with real world systems but by experiments using models of real world objects. This paper gives a short report on environmental modelling and computer-graphic simulation for the analysis of the physical-geographical characteristics of watersheds with the idea to offer guidelines for the protection on soil erosion process to this Region, but also worldwide, where possible to apply.

The value of Z coefficient was calculated on 0,243 in the previous research what indicates that the river basin in that time belongs to the 4th destruction category (of five). The strength of the erosion process was weak, and according to the erosion type, it was surface erosion. The present erosional condition is different with the research from 2010, where the value of Z coefficient is 0,429; 3rd destruction category, with the medium strength of erosion process and surface erosion within the basin. Production of erosion material in the river basin, Wyear, was 2000 m3 year-1, while for 2020 it was 4600 m3 year-1. The net soil loss for the studied river basin was 630 m^3 per year, 140 m^3 per square kilometre per year (2010); 1400 m^3 per year, 330 m^3 per square kilometre per year for 2020. According to both calculations (2010-20) there is a possibility for large flood waves to appear in the studied basin.
Comparing the previous and current calculations results, the soil erosion intensity increased significantly during the last decade.

From global to local, we offered to present soil erosion modelling approach in one small watershed in the North Montenegro: Zim Potok from the Polimlje Region. Application of some models for calculation of soil erosion intensity, earlier developed in Yugoslavia, afterwards in Montenegro will be discussed in this study: Erosion Potential Method (Gavrilovic 1988); River Basin Model (Spalevic, 1999, Spalevic et al, 2000); Surface and Distance Model (Spalevic, 1999); IntErO and WIntErO models (Spalevic, 2001). Requirements and approaches to the software tools for model description and simulation systems will be presented. The present research is based on the previous available data imported from the IntErO model (Spalevic, 2011) to the new WIntErO model, amending some specific inputs related to the land use that have changed in the last decade, what allowed the calculation of the soil erosion and runoff of the studied region.



This result related to the stated increase could be accepted with strong reservations, because of the different teams processing approaches and estimations of the inputs on land use taken from the field, but also calculated from the maps. For this new calculation (2020) we didn't use validation of the model applied for the studied period, like we did it for the previous (2010), with applying bathymetry in the studied region (2010). However, the experience with using of the new WintErO model and the previous research experiences gained with the River Basins and IntErO models, all the models may be recommended for soil erosion modelling in the river basins similar to the studied watershed. New initiatives may be expected in relation to the WintErO model. Sustainable Integrated Watershed Management (SIWM) paradigm is becoming more important in terms of managing and protecting natural resources. The biggest problem is that the state organization and structure of the legislation are not appropriate for SIWM paradigm (Göl et al, 2017). There are incompatibilities in the shareholders' expectations and requests that make development of such approaches more complex. After these initial steps with establishing database and testing the use of models, further studies in this region should also investigate the administrative, legal, economic and ecological problems in terms of Sustainable Integrated Watershed Management, and establishment of the more detailed database, using the presented models as a good support to the decision making in relation to the subject analyses.