The application of two physically-based erosion models in small catchments: a case study of the Myjava Hill Land, Slovakia

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ABSTRACT

The goal of this study is the application of two physically-based erosion models, i.e., EROSION-2D and EROSION-3D, in small Slovak catchments. These two models are event-based and calculate potential soil water erosion during actual measured rainfall events on agricultural land (Schmidt, 1996). Both models are predominantly based on physical principles and simulate surface runoff, the erosion or deposition of material, and the detachment of soil particles for single event. They and provide good tools to simulate and quantify soil erosion, but have not been established for use in Slovak basins yet. The soil system of Erosion 3D is based on the fourth edition of the soil classification of "Bodenkundliche Kartieranleitung" ("KA 4", AG Boden, 1994). Because of different soil classifications, first step required the creation of an overplot of the KA 4 textural system with the USDA textural system used in Slovakia. The model requires three input parameters, i.e., the relief, precipitation and soil. The first two parameters are relatively easy to obtain by taking advantage of a precise DEM with a 10 x 10 m resolution, and the precipitation data sets of a selected rainfall event, which was measured at the Myjava meteorological station. However, the soil input parameters are more complicated, and that is why we focused on the creation of soil input data sets for Slovak conditions including the establishment of a Parameter catalogue for every soil input parameter. The catalogue has been configured on the bases of an overplotted textural triangle.

The erosion models were applied to two small catchments (0.3 km^2 and 6.3 km^2), which are situated in the Myjava Hill Land in the western part of Slovakia, which is known for its quick runoff response and related erosion processes. The calculations were performed for three storm rainfall events and eight initial soil moisture scenarios, which were established by terrain measurements. Fallow, silage corn and winter wheat were chosen as the land cover types, in order to estimate the variability of the soil erosion processes between the different field management practices.

The results point to differences between the EROSION-2D and EROSION-3D models, which had been expected. However, the differences in the values of the resulting parameters are relatively much greater, especially in the case of the different land cover types. On the other hand, the effect of variable initial soil moisture on all the calculated results is the same in both models. It was presented by an obvious trend, which is described by a polynomial function with a high degree of correlation. In light of the storm rainfall events, the results show that the intensity of rainfall can be more important than the total amount of precipitation. Finally, we are able to say that we successfully set the models´ input parameters for Slovak conditions

(mainly the soil conditions), and both models are useful tools for estimating the soil erosion processes in the Myjava Hill Land. Of course, it is necessary to confront our results not only with other possible erosion models (empirical or physical), but also with actual in situ measured data and apply these tools in other catchments in Slovakia with different physical-geographic conditions.