

Abstract

This thesis is focused on finding the optimal tools for modelling of the overland flow and verification of its reliability and limits in an extreme relief of the Bohemian Switzerland. This paper focuses on the Open Source tools for modelling of the overland flow implemented in the geographic information system GRASS GIS. The region of the Bohemian Switzerland, especially of the same name national park, was chosen for two main reasons. The first is the fact that the range of reliefs' shapes of local sandstone rock areas is exceptionally varied. Extreme vertical segmentation, relief edges, changes of convex and concave shapes of relief, significant changes of profile, planar and tangential curvature and often extremely narrow and deep valleys are extremely difficult from the point of view of overland flow modelling. The second reason for the focus on the above mentioned field is the fact that for the given area there is available an exceptional quality digital elevation model (DEM) from the GeNeSis project – „Geoinformationsnetzwerke für die grenzüberschreitende Nationalparkregion Sächsisch – Böhmisches Schweiz“. This DEM financed from the operational program EU Interreg IIIA Cross-Border Cooperation was carried out by the Technical University Dresden and is characterized by high density of scanning by LIDAR with 1 point per 1 sqm.

The paper concerns with comparison of various algorithms for determination of flow direction (FD) and subsequently a calculation of flow accumulation (FA) that are implemented in the system GRASS GIS (and in various forms also in other GIS, such as SAGA GIS or selected extensions into ArcGIS). On six different catchments we calculated the rasters of values of flow accumulation that were evaluated from the point of view of ability to maintain a disconnected flow track and determine correctly the flow directions in the difficult relief. They were further compared with the results of the established distributed rainfall-runoff model MIKE SHE and Open Source rainfall-runoff model SIMWE (implemented in the system GRASS GIS through the module *r.sim.water*). By using such algorithm (implemented in the module *r.terraflo*) we analyzed 33 catchments from the area of Bohemian and Saxon Switzerland with the total area of ca 107 sqkm. For all these catchments we carried out basic systematic analyses, evaluation of the main morphometric parameters and mutual relations of these values with the values of accumulation and height of the overland flow were investigated.

The results showed high efficiency and reliability of the examined tools in the field of localization of the places endangered by extreme manifestations of the overland flow (and generally by planar distribution of overland flow), and unsubstitutable role of the full rainfall-runoff models in the field of quantifying of the overland flow. Especially the analysis of the relation between the main morphometric parameters of the examined catchments and characteristics of the overland flow indicated the suitable directions of further development of the tools for overland flow modelling. According to the author, main directions of further development should lead especially to the

change from 2D modelling (2D rasters) to the real 3D surface modelling and to the support of DEM with extremely high resolution.

The contribution of the provably reliable and undemanding tools for overland flow modelling is in easy detection of places endangered by extreme manifestation of overland flow (flash-floods, fluvial erosion, etc.), a supplementary source of information for hydrologic modelling, etc.

Key words: overland flow modelling, GRASS GIS, extreme relief, MIKE SHE, Bohemian Switzerland