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Rainfall-runoff model HEC-HMS in a small inhomogeneous basin

Iva Ponížilová (1), Jan Unucka (2), and Veronika Říhová (3)

(1) Czech Hydrometeorological Institute, Ústí nad Labem, Czech Republic, (2) VŠB -TU Ostrava, Ostrava, (3) Czech Hydrometeorological Institute, Ostrava - Poruba, Czech Republic

The contribution focuses on the applicability of the hydrologic rainfall-runoff model HEC-HMS to verify the effect of inhomogeneities of the basin surface. The simulation of an extreme rainfall-runoff episode using the HEC-HMS model should prove the influence of basin inhomogeneity on the speed and volume of runoff and the potential of watersheds on runoff mitigation. The area of interest is situated in North Bohemia, Czech Republic.
Inhomogeneity of the Robecsky stream basin is caused by different physical-geographic conditions in the basin of the main reaches of the Robecsky stream and its major left tributary which is the Bobri stream. Before their confluence, both streams have a comparable catchment area of about 130 km2. Significant differences are manifested in average altitude of the basin, basin shape, basin slope, time of concentration and the proportion of forest areas. The Bobri stream shows more extreme runoff characteristics in combination with a smaller area of forestation.
Another important factor affecting runoff from the basin is the proportion of watersheds that accumulate water in the landscape and cause runoff mitigation and slowdown.
To illustrate the influence of watersheds Machovo Lake on the Robecsky stream and Holansky pond on the Bobri stream were selected. Machovo Lake is the third largest watershed in the territory of the Czech Republic. Holansky pond is the largest of the system of Holansky ponds. The Robecsky stream has the lowest runoff coefficient from the entire Ploucnice basin. The lakes surface-drainage area ratio is approximately 1.7% of the total catchment area of the Robecsky stream.
The rainfall-runoff model HEC-HMS was utilized for the analysis and to determine the volume of runoff the method of CN curves was used that depends on hydrological properties of soils.
For schematisation of extreme runoff conditions of the basin the precipitation period from 6th to 8th August 2010 was selected. Extremeness of peak flows of the Ploucnice river and its tributaries corresponded to a 50- to 100-year recurrence period.
The simulation showed the impact of inhomogeneity in the catchment of the Robecsky stream, especially in the runoff volume, which was more significant in the catchment of the Bobri stream. The peak flow in the Robecsky stream achieved 8.9 m3.s-1 in the simulation. The peak flow in the Bobri stream was 16.1 m3.s-1. For both parts of the examined catchment area, the HEC-HMS model suggests virtually the same time of the onset of the flood wave.
The Robecsky stream is also influenced by the watersheds of Machovo Lake and Holansky pond which largely accumulate the flow in the catchment area. According to the model outputs the flow rate will be reduced by 21.8 m3.s-1 for Machovo Lake and by 27.8 m3.s-1 for Holansky pond. Their importance lies in runoff slowing and peak flow transformation. To some extent, they regulate runoff from the catchment area.
Model HEC-HMS confirmed that the basin inhomogeneity has detectable influence on runoff. It also reflected the transformation of the flood wave in the watersheds.