Modelling the runoff from snowpack in the forest and in open areas

Abstract

Spring floods are closely related to the issue of snow. It is very important to study the process of snow accumulation and snowmelt in mountainous areas, where the monitoring of the snow water equivalent throughout the winter season is carried out. Snow water equivalent indicates the amount of water bounded in the snow, and therefore it represents a potential danger during snow-melt.

The thesis is dealing with snowmelt processes and particularly with the impact of vegetation on the runoff process during snowmelt. The lumped rainfall-runoff model HEC-HMS was used for the modelling. Modelling of snowmelt runoff was carried out by means of degree-day method. The model was applied on the Zlatý Brook catchment in the Ore Mountains. The degree-day method is very sophisticated method and takes into account the snowmelt dynamics during precipitation and snowmelt in the period without any precipitation. The method takes into account the effect of heat emitted by the Earth's surface. The method tries to capture the overall energy balance of snowpack by means of air temperature.

The model simulated the evolution of snow water equivalent and discharge in the winter 2009/2010. Simulated discharges were compared with observed ones. After model calibration a simulation was carried out, which followed up a vegetation impact on the runoff process. Degree-day factor for the forested catchment was set to 2.05 mm. $°C^{-1}.d^{-1}$.Degree-dayfactor for complete afforested catchment was set to 6 mm. $°C^{-1}.d^{-1}$.

The results show the influence of the vegetation on runoff process during snowmelt, which has been demonstrated on simulated hydrographs. Runoff volume from the forested basin was about 25% lower than in open areas. Peak flow was about 84% higher in open areas than in forest. Hypothetical peak flow from the afforested catchment (open areas only) was about 53% higher then the observed peak flow.

Key words: HEC-HMS, modelling, snow accumulation, snowmelt, degree-day model, Zlatý potok