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Experimental measurement and modeling of snow accumulation and snowmelt in a mountain microcatchment

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Fieldwork is a very useful source of data in all geosciences. This naturally applies also to the snow hydrology. Snow accumulation and snowmelt are spatially very heterogeneous especially in non-forested, mountain environments. Direct field measurements provide the most accurate information about it. Quantification and understanding of processes, that cause these spatial differences are crucial in prediction and modelling of runoff volumes in spring snowmelt period.

This study presents possibilities of detailed measurement and modeling of snow cover characteristics in a mountain experimental microcatchment located in northern part of Slovakia in Western Tatra mountains. Catchment area is 0.059 km2 and mean altitude is 1500 m a.s.l. Measurement network consists of 27 snow poles, 3 small snow lysimeters, discharge measurement device and standard automatic weather station. Snow depth and snow water equivalent (SWE) were measured twice a month near the snow poles. These measurements were used to estimate spatial differences in accumulation of SWE. Snowmelt outflow was measured by small snow lysimeters.

Measurements were performed in winter 2014/2015. Snow water equivalent variability was very high in such a small area. Differences between particular measuring points reached 600 mm in time of maximum SWE. The results indicated good performance of a snow lysimeter in case of snowmelt timing identification. Increase of snowmelt measured by the snow lysimeter had the same timing as increase in discharge at catchment's outlet and the same timing as the increase in air temperature above the freezing point. Measured data were afterwards used in distributed rainfall-runoff model MIKE-SHE. Several methods were used for spatial distribution of precipitation and snow water equivalent. The model was able to simulate snow water equivalent and snowmelt timing in daily step reasonably well. Simulated discharges were slightly overestimated in later spring.