Climate change impacts on snow storages and spring runoff in the Vydra river basin

Abstract

As a result of increasing air temperature, the fraction of precipitation falling as snow decreases. This affects snow cover indicators including snow cover duration, snow cover extent and the amount of water that accumulates in snow cover during winter. These changes further propagate through local runoff process and alter winter and spring runoff.

The impacts of air temperature warming of $1℃$, $2℃$ and $3℃$ on the above-mentioned indicators were simulated using a conceptual catchment runoff model HBV-light. Multi-criteria calibration, based on functions describing the goodness of fit of simulated runoff and snow water equivalent (SWE) values was performed. The temperature change scenarios were derived using the delta-change method from reference dataset 1980-2014. The indicator changes were evaluated for 5 elevation belts of the catchment as well as for the catchment as a whole, so that the observed alternations of snow cover indicators could be related to the modelled alternations of runoff.

The changes in snow cover characteristics based on these simulations include a decrease of snowfall fraction, shortened snow season, decrease in average and maximal SWE values, and the shift of the average day of year of $\mathrm{SWE}_{\max}$ to an earlier period. An increase in the frequency of rain-on-snow (ROS) events was observed in certain periods during peak winter, although the average number of ROS events in a season is predicted to decrease. The frequency of frost days without snow cover will increase as well as the average length of an episode with such conditions. The average temperature of frost days without snow cover will also decrease. The effect of snowmelt on total runoff decreases in simulated scenarios as well as the average spring runoff maxima. The period of increased snowmelt generated runoffs shifts from late spring to early spring and winter.

Key words: climate change, snow storage, spring runoff, HBV-light