Geophysical Research Abstracts
Vol. 19, EGU2017-7751, 2017
EGU General Assembly 2017

Changes of seasonal snowpack and their impacts on summer low flows

Michal Jenicek (1), Jan Seibert (2,3), and Maria Staudinger (2)

(1) Charles University, Faculty of Science, Department of Physical Geography and Geoecology, Prague, Czech Republic (michal.jenicek@natur.cuni.cz), (2) University of Zurich, Department of Geography, Zurich, Switzerland, (3) Uppsala University, Department of Earth Sciences, Uppsala, Sweden

Snow is an important component of the water cycle in mountain regions and substantially influences groundwater recharge and runoff during spring. For the future, it is expected that during the cold season more precipitation will fall as rain due to the increase in air temperature and, thus, snowfall fraction will decrease. As a consequence, snow storage will decrease, which might cause reductions in spring and summer minimum discharges. The main objectives of this study were 1) to simulate the effect of changes in maximum annual snow water equivalent (SWE) on low flows during the warm seasons and 2) to relate drought sensitivity to the simulated snow storage changes in study catchments. The Swiss Climate Change Scenarios 2011 data set (CH2011) was used to simulate the impact of future changes in air temperature and precipitation on catchment runoff in 15 alpine and pre-alpine catchments in Switzerland. The CH2011 data set provides daily estimates of changes in air temperature and precipitation relative to the reference period 1980-2009 for three scenario periods (2020-2049, 2045-2074 and 2070-2099) and the A1B emission scenario. To quantify the impact of predicted climate changes on snow storage and streamflow we set up several model experiments using the hydrological model HBV-light. The model performance was evaluated using observed daily runoff and SWE. The simulations enabled to analyze the effect of snow storage on low flows separated from other water balance components.

The results showed a strong decrease in snow storage for the three scenario periods as expected. The largest decrease in maximum annual SWE was predicted for elevations from 1500 to 2500 m a.s.l. with a decrease by 50% in the scenario period 2070-2099 compared to the reference period. This resulted in earlier melt-out and thus in decrease in low flows in late spring and early summer. Snow storage was significantly correlated to low flows until August in catchments with mean elevation higher than 2000 m a.s.l. for the reference period. However, snow storage was correlated only to low flows until June or July in the study catchments for the scenario period 2070-2099. For catchments with a mean elevation less than 1500 m a.s.l., the correlation between snow and low flows was significant until June for the reference period and until May for the scenario period 2070-2099. A significant decrease in minimum runoff from May to August was simulated for all scenario periods compared to the reference period. The absolute decrease in minimum runoff for all scenario periods was larger in years with above-average maximum SWE compared to years with below-average maximum SWE. This might indicate that the decrease in minimum runoff in spring and summer is caused mainly by the decrease in maximum annual SWE. This was also indicated by the HBV-light simulations showing a strong decrease in runoff volume originating from snowmelt during late spring and early summer.