Geophysical Research Abstracts
Vol. 19, EGU2017-10032, 2017
EGU General Assembly 2017

Impacts of climate change on river discharge in the northern Tien Shan: Results from the long-term observations and modelling

Maria Shahgedanova (1), Muhammad Afzal (1), Zamira Usmanova (2), Vasilii Kapitsa (2), Elisabeth Mayr (3), Wilfried Hagg (3), Igor Severskiy (2), and Dauren Zhumabayev (4)

(1) University of Reading, Geography and Environmental Science, Reading, United Kingdom (m.afzal@reading.ac.uk), (2) Institute of Geography, Almaty, Kazakhstan, (3) Lugwig Maximilians University, Munich, Germany, (4) Nazarbayev University, Astana, Kazakhstan

The study presents results of investigation of the observed and projected changes in discharge of seven snow- and glacier-nourished rivers of the northern Tien Shan (south-eastern Kazakhstan). The observed trends were assessed using the long-term (40-60 years) homogeneous daily records of discharge from the gauging stations located in the mountains and unaffected by human activities including water abstraction. Positive trends in discharge were registered at most sites between the 1950s and 2010s with the strongest increase in summer and autumn particularly in 2000-2010s in line with the positive temperature trends. The observed increase was most prominent in the catchments with a higher proportion of glacierized area. At the Ulken Almatinka and Kishi Almatinka rivers, where 16% and 12% of the catchment areas are glacierized, positive trends in summer and autumn discharge exceeded 1% per year. The strongest increase was observed in September indicating that melting period extends in the early autumn. In September-November, the number of days with extreme discharge values, defined as daily values exceeding 95th percentile (calculated for each meteorological season), increased at all rivers.

Future changes in discharge were modelled using HBV-ETH hydrological model and four climate change scenarios derived using regional climate model PRECIS with 25 km spatial resolution driven by HadGEM GCM for RCP 2.6 and RCP 8.5 scenarios and HadCM3Q0 and ECHAM5 GCM for A1B scenario. A range of glacier change scenarios was considered. All climate experiments project increase in temperature with the strongest warming projected by the HadGEM-driven simulation for RCP 8.5 scenario and HadCM3Q0-driven simulation for A1B scenario. The projected changes in precipitation varied between models and seasons, however, most experiments did not show significant trends in precipitation within the studied catchments. The exception is a simulation driven by HadGEM GCM for 8.5 RCP scenario which projects summer drying.

All simulations project that in the 2020s, discharge will remain close to its baseline (1990-2005) values suggesting that peak flow has been reached in the northern Tien Shan. Significant decrease in discharge is projected for the post 2030s period for June-September. The strongest changes are expected in July and August when discharge values are projected to decrease by 25-38% in 2030-2060 and decline further to up 50% of the baseline values in 2060-2099.