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Characterising water sources in glacierized catchments in the northern Tien Shan using stable isotopes

Zarina Saidaliyeva¹, Maria Shahgedanova¹, Andrew Wade¹, Vadim Yapiyev¹, Vassiliy Kapitsa², Nikolay Kasatkin², and Igor Severskiy²

¹The University of Reading, Department of Geography and Environmental Science, United Kingdom of Great Britain and Northern Ireland (z.saidaliyeva@pgr.reading.ac.uk)

²Institute of Geography, Almaty, Kazakhstan

The Kishi and Ulken Almaty rivers drain glacierized catchments in the northern Tien Shan, Kazakhstan. Both rivers supply water for the Almaty agglomeration with population around 2.5 million. Changes in discharge of these [and many other regional] rivers are affected by changes in all components of the cryosphere (seasonal snow, glacier ice, ground ice) as well as precipitation and ground water. Uncertainties of projections of water availability in the context of the observed climatic warming are an important economic and politic issue in this region. Knowledge of the extent, to which discharge of these rivers depends on different sources of nourishment, is important for the formulation of regional adaptation strategies and policies.

A comprehensive data set on concentrations of daily values of stable isotopes of oxygen and hydrogen, temperature, precipitation, and discharge was collected in both catchments in 2017 and 2018 in order to characterize contribution of different sources of water to total discharge. There is a clear correlation between isotopic concentrations in stream water with temperature, precipitation and discharge enabling separation between contributions of ground water ($\delta^2\text{H}=-78.25\text{‰}$; $\delta^{18}\text{O}=-11.80\text{‰}$), snow melt ($\delta^2\text{H}=-84.56\text{‰}$; $\delta^{18}\text{O}=-13.20\text{‰}$), and glacial melt ($\delta^2\text{H}=-78.97\text{‰}$; $\delta^{18}\text{O}=-12.41\text{‰}$). Analysis of isotopic signatures of sources of water shows separation between seasonal snow, glacier ice, rock glaciers and permafrost.

Following these preliminary results, the sampling programme has been extended in 2019 to the Ulken Almaty and Kishi Almaty (Kazakhstan), Ala-Archa and Chon Kyzyl-Cuu (Kyrgyzstan), Chirchik (Uzbekistan), Varzob-Kofarnihon (Tajikistan) catchments in 2019-2020 enabling the development of the most comprehensive data set on water isotopes in Central Asia.