

Studying scale effects in streamflow response in glacierized Baksan river catchment in the North Caucasus using natural stable isotopes.

Ekaterina Rets¹, Victoria Khomiakova², Ekaterina Kornilova³, Alexey Ekaykin², Anna Kozachek², Vladimir Mikhailenko⁴

¹ Institute of Geophysics, Polish Academy of Sciences, Warszawa, 01-452, Poland

² Antarctic Research Institute, Climate and Environmental Research Laboratory, St. Petersburg, 199397, Russia

³ Water Problems Institute, Russian Academy of Sciences, Moscow, 119333, Russia

⁴ Institute of Geography, Russian Academy of Sciences, Moscow, 119017, Russia

Based on the results of series of sampling for stable isotopes O18 and D in 5 sections from the upper reaches to the lower reaches of the glacierized Baksan River in North Caucasus first estimates of melt runoff share in the Baksan river runoff were obtained and its transformation from the alpine headwaters to lowlands. A total of 6 sampling series were carried out during June-September in 2020 and 5 series in 2021. To study the scale effects of streamflow response the watersheds of different sizes were chosen from 8.7 km² with 30% glaciation (Djankuat gauge) to almost 3000 km² with 7% glaciation (Islamey gauge). Sample processing was carried out using a Picarro L2140-i laser analyzer. To separate the Baksan river hydrograph into melt and rain runoff a simple two-component balance approach was used. The long-term observations in the Djankuat research catchment were used to estimate the typical value of dO18 in the glacier/firm melt waters. As a great spatial variance is usually characteristic of the O18 concentration in melting seasonal snow here we estimate the probable range of dO18 values using the Azau glaciological station data on fresh precipitation sampling during winter period and the results of sampling the old melting snow in the snowpits on the Djankuat glacier as hypothetically “minimum” and “maximum” borders of this range. The Azau glaciological station and Djankuat research catchment data on fresh precipitation sampling was used to define O18 concentration in liquid precipitation for each event.

On days with relatively dry weather between significant rain events the share of the melt component of the runoff is constantly high and doesn't depend much on the glaciation ratio. It ranges from 60–100% (“minimum–“maximum” estimates), in basins with 16–30% glaciation to 60–90%, in the lower reaches with 11–7% glaciation. The picture changes dramatically on precipitation events: the share of melt water runoff decreases sharply with an increase in the non-glaciated part of the catchment area. On the 24th of August, 2020, after a significant rainfall on August 21–22 (30–53 mm in two days according to data from different weather stations in the basin), the share of liquid precipitation in the runoff of the Baksan River in the Zhankhoteko gauge (F=1794 km², Gl. Ratio =11%) rose to 64%, in the Islamey gauge (F=2941 km², Gl. Ratio =7%) – up to 77%. At the same time, a heterogeneous pattern was observed in the upper reaches due to the spatial heterogeneity of precipitation. The rain flood has already mostly passed by the 24th of August at the Djankuat gauge, so the share of rainwater was only 20% while in the Elbrus gauge the retention continued - the share of rainwater was 31%.

The melt component of the runoff is found to be overwhelming source of the Baksan River runoff during most of the summer period. The expected decrease in glacial and high-mountain snow runoff during in course of degradation of glaciation may have a critical impact on the quality and availability of water resources in the North Caucasus region in July and August, especially during droughts.

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