

Change of river flow due to degradation of glaciers

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Recent climate changes and temperature increases on our planet has led to degradation of glaciers within mountain river basins. In this context, the need arises to study changes in water resources of Balkhash lake basin - one of the regions of the Republic of Kazakhstan - during and after glacier degradation. In this region, according to Mynzhilki weather station (3,017 m), the average annual air temperature during that period increased by 1.1 °C as compared to the previous period (1879-1955), whereas average for the summer by 0.8 °C. In the second half of the 20th century - early 21st century the degradation of glaciers significantly increased due to rising air temperatures, which caused some increase in mountain river flows [1]. Glaciological observations and studies, as well as estimations showed that over 50 years (1956 - 2005) the glacial area in Balkhash Lake decreased by 1,498 km² (36.9%), while water storage in glaciers by 98.6 km³ (42.3%). Similarly, the glacial area and water storage in glacier systems in the Ili River basin decreased by 1,254 km² (36.6%) and 85.5 km³ (41.6%), respectively.

In the last decades of the 21st century, when, according to forecasts, glaciers in mountain river basins almost completely will disappear, inflow into rivers from melting glaciers will stop. The losses in runoff formation on the surface (free from the glaciers) of catchments will increase by 50-55%, i.e. up to values specific to highlands in the absence of glaciation. This will reduce water resources in Balkhash Lake basin by 12% or 2-2.5 km³ per year compared with glacial conditions, including in the territory of Kazakhstan by 0.8 km³ per year [2]. The degradation of mountain glaciers will cause significant changes in rivers' water regime: inter-annual variability and annual distribution will increase. Flow will increase by 12-20% during wet years and will decrease by 33-38% during dry years as compared with its average values. Annual distribution of flow also changes significantly. The flow of summer period (July-September) will decline by about two-fold, while that of spring-summer period (May-July) will about to double, and only slight changes will be observed in fall-winter flow.

As a result of studies, for the first time, researchers have managed to assess changes in runoff characteristics resulting from degradation of mountain glaciers and quantify them. These changes may significantly complicate agricultural activity in irrigated areas and create considerable tension with the use of surface water resources of Balkhash Lake. The work has been performed under the program - "Resource Assessment and Forecast of Natural Water Use in Kazakhstan under Conditions of Anthropogenic and Climate-Driven Changes".

References

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