



## Changes in maximum and minimum runoff of Eurasian Arctic rivers during the climate change epoch

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The study is devoted to the analysis of daily time series of river runoff in the Arctic zone of Eurasia. Unique data on daily water discharges in the closing gauges of Arctic rivers were collected and processed in the package `grwat` (<https://cloud.r-project.org/web/packages/grwat/index.html>), which identifies genetic components of runoff. As a result, 53 runoff characteristics were obtained for each of the 25 rivers flowing into the Arctic Ocean and the contribution of snowmelt, rainfall, and groundwater components to the total runoff was analyzed. Particular attention was paid to extreme characteristics - maximum water discharges of spring freshet, rain events and minimum 1, 5, 10-averaged discharges during summer and winter.

The study of maximum water discharges has shown that, in general there are trends of decreasing annual maximums for both large and medium-sized Arctic rivers. This trend, however, is not yet statistically significant everywhere. The most intensive decrease in maximums localized in the Northern Dvina, Ob, and Yenisei rivers, for which flow regulation by reservoirs has a significant impact. For the Kolyma, Yana and Indigirka rivers, there are periods of increase in maximums and their decrease lasting 5-7 years, with a general tendency to increase during 1960-2001 up to 15-20%.

In contrast, the minimum discharges with different averaging intervals increases by 25-56 % everywhere; this trend is presumably related to the general climate warming, increased infiltration and the role of groundwater flow, and for the rivers in the eastern part of the Arctic zone - to the degradation of permafrost.

The study also included analysis of the runoff signature transformation in Arctic zone by every year, as well as on average for the modern and historical period. The typing methodology consisted in classifying hydrographs according to two main features: a) exceedance of maximum discharge relative to the average annual discharge b) the share of flood runoff volume in the total annual runoff. The analysis showed a noticeable increase in the frequency of occurrence of smoothed hydrographs on the rivers of the Arctic zone of the Asia-Pacific region, for some basins the number of such years increased by 1.5-2 times (Polui, Turukhan, Ob rivers).