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Shift of extreme spring streamflow on the Belorussian rivers and its association with changes of cyclonic activity over Eastern Europe

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The intra-annual distribution of precipitation is the most variable component of the water resources of Belarus. This distribution is controlled by extratropical cyclones from the Atlantic Ocean and Mediterranean that bring most of precipitation to the nation. That's why the aim of our study was to quantify major characteristics of these cyclones and to estimate effects of their passing through the Belorussian territory on regional water budget including floods and low water conditions.
We documented the long-term fluctuations of streamflow and occurrence of extreme phenomena on the rivers of Belarus during the post-World War II period. It was established that annual water budget of the nation vary from year to year without systematic tendencies. At the same time, analysis of intra-annual distribution of streamflow reveals significant changes since the 1970s: increase of winter and decrease of spring runoff. As a result, the frequency of extreme spring floods has decreased. These changes in water regime are associated with climatic anomalies caused by large-scale alterations in atmospheric circulation, specifically in trajectories of cyclones. As a manifestation of these circulation changes, we observe increase of the surface air temperatures, more frequent cold season thaws, redistribution of seasonal precipitation totals, and decrease of the fraction of frozen precipitation in the shoulder seasons.
Analysis of cyclonic activity over Belarus during the past 60 years in the cold season (December through February) shows the largest number of cyclones in 1950-1970. During this period, the largest number of spring floods caused by snowmelt on the rivers of Belarus was reported. Since 1970, we observe a decrease in the total number of cyclones but also an increasing strength (deepening) of the remaining cyclones in the cold season. That has led to some precipitation increase. During the last four decades, more frequent zonal air movement in the atmosphere and substantial surface air temperature increase in the winter season provoked the prevalence of winter thaw conditions. The thaws interfered with accumulation of snowpack before the beginning of spring snowmelt and promoted decrease in the number of spring floods on the rivers of Belarus.