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Do changes in climatic norms influence on runoff variability? Data-based and model-based results.

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In the field of terrestrial hydrology, hydrological consequences of climate change are studied mainly in terms of changes in mean values of river runoff (runoff characteristics averaged over a long period of time). At the same time, climate change is manifested not only and not so much in changing the norms of the runoff characteristics, but in increasing their variability, which, in turn, can lead to an increase in the frequency and magnitude of extreme hydrological events.

The presentation consists of 2 parts. First, modern tendencies of changes in variability indicators (standard deviation and coefficient of variation) of the annual and maximum river runoff, estimated on the basis of observations in 61 watersheds of European Russia, are considered. It is shown that negatively directed trends in the variability indicators of the annual and maximum runoff predominate in the basins under consideration. For small catchments (with an area of less than 10,000 km2), the variability indicators turned to be sensitive to changes in the morphometric characteristics (area, slope, etc.) of the basin. The effect of changes in climatic norms on the variation of maximum and annual runoff for the period of observations proved to be statistically insignificant.

In the second part of the presentation, sensitivity of river runoff variations to changes in climatic parameters is analyzed on the basis of numerical experiments with hydrological models for the two great rivers: Lena and Amur. Being driven by the data of meteorological reanalysis, the regional hydrological models demonstrate good performance in reproducing the long-term historical streamflow data recorded in both basins. A delta-change approach is applied for construction from the observation data the synthetic series of meteorological data. These series are used as the inputs into the hydrological models whose responses may be interpreted in terms of sensitivity of the basins' water regime to the pre-determined changes of climatic norms. The elasticity (sensitivity) indicators showing changes of the variability indicators (standard deviation and coefficient of variation of mean annual and maximum annual flow) to small changes in climatic norms are determined from the simulated responses. As a result, for the two large basins located in different climatic conditions, the effect of changes in the variability indicators with the change in the climatic norm of precipitation and air temperature is revealed. In other words, possible changes in climatic norms affect not only mean values of the annual and maximum flow rates, but also the variations in runoff. This finding can be explained by the nonlinear response of the hydrological systems of large river basins to possible climate changes.