EGU2020-7080
https://doi.org/10.5194/egusphere-egu2020-7080
EGU General Assembly 2020

Quantitative estimation of genetic components in the seasonal runoff of a small river by the graphoanalytic and isotopic method

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The processes of spring flood formation associated with intensive snow melting are becoming less and less predictable, and forecasts of such important characteristics as maximum discharge and water level do not fit into the allowable ranges of error. In some areas, a sharp decrease in river runoff was observed, followed by catastrophic floods, associated with the anomalous hydrometeorological conditions and an unfavorable combination of flow-forming factors. All this testifies to the change in runoff formation processes in regions with a significant share of snow-fed rivers. A new method of storing processing and visualizing of the information is developed to bridge the gap between point data on river runoff and globally distributed data on characteristics affecting the genetic components of runoff. The use of new model for separating runoff into genetic components was verified by isotope hydrograph separation.

Under unsteady climate conditions, the isotope signature of river water within a year and on a multi-year scale is an important indicator of the response of hydrological system to change (associated with different amounts of snow in the winter and different contributions of snow melting to the river and groundwater reservoir). Observations at the local site of the Protva River catchment on the European Plain showed that over 9 years (in 2009-2010 and in 2019), the groundwater component did not change its isotopic characteristics: δ18O = -12.3 ‰. The intra- and interannual fluctuations associated with different amounts of atmospheric precipitation entering the upper groundwater horizon practically did not shift oxygen isotope composition of water. In 2014, the weighted average annual value δ18O of the precipitation for Moscow was -12.1‰ (Chizhova et al., 2017). The δ18O value of precipitation in the summer months varies from -3 to -10 ‰. In Protva river runoff in mid-summer the contribution of precipitation is from 16 to 34% according to the isotope hydrograph separation. This work was supported by RSF project 19-77-10032.