Genetic analysis of seasonal runoff based on automatic techniques of hydrometeorological data processing

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Detection of the rivers' feeding type is a complex and multifactor task. Such partitioning should be based, on the one hand, on the genesis of the feeding water, on the other hand, on its physical path. At the same time it should consider relationship of the feeding type with corresponding phase of the water regime. Due to the above difficulties and complexity of the approach, there are many different variants of separation of flow hydrograph for feeding types. The most common method is extraction of so called basic component which in one way or another reflects groundwater feeding of the river. In this case, the selection most often is based on the principle of local minima or graphic separation of this component. However, in this case neither origin of the water nor corresponding phase of water regime is considered.

In this paper, the authors offer a method of complex automated analysis of genetic components of the river's feeding together with the separation of specific phases of the water regime. The objects of the study are medium and large rivers of European Russia having a pronounced spring flood, formed due to melt water, and summer-autumn and winter low water which is periodically interrupted by rain or thaw flooding. The method is based on genetic separation of hydrograph proposed in 1960s years by B. I. Kudelin. This technique is considered for large rivers having hydraulic connection with groundwater horizons during flood. For better detection of floods genesis the analysis involves reanalysis data on temperature and precipitation. Separation is based on the following fundamental graphic-analytical principles:

• Ground feeding during the passage of flood peak tends to zero
• Beginning of the flood is determined as the exceeding of critical value of low water discharge
• Flood periods are determined on the basis of exceeding the critical low-water discharge; they relate to thaw in case of above-zero temperatures
• During thaw and rain floods, ground feeding is determined using interpolation of values before and after the flood
• Floods during the rise and fall of high water are determined using depletion curves plotting
• Groundwater component of runoff is divided into dynamic and static parts.

The algorithm of subdivision described was formalized in the form of a program code in Fortran, with the connection of additional modules of R-Studio. The use of two languages allows, on the one hand, to speed up the processing of a large array of daily water discharges, on the other hand, to facilitate visualization and interpretation of results. The algorithm includes the selection of 15 calibration parameters describing the characteristics of each watershed.

Verification and calibration of the program was carried out for 20 rivers of European Russia. According to calculations, there is a significant increase in the groundwater flow component in the most part of watershed and an increase in the role of flooding as the phase of the water regime as a whole.