Automatic hydrograph separation approach provides possibility to look at less-studied characteristics of water regime

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The study presents an approach to automatic river hydrograph separation and analysis implemented in GrWat open source package for R programming language. In the proposed scheme of hydrograph separation, river hydrograph is separated into base and quick flow. For plain rivers quick flow is further separated into seasonal snowmelt flood quick flow; rain quick flow and thaw quick flow. For mountainous rivers seasonal snowmelt flood quick flow component is divided into "basic snowmelt flood" component and overlapping rain floods. Base and quick runoff is separated by a critical gradient. Flash-floods are separated from the seasonal snowmelt wave by critical values of air temperature and precipitation on the event for the plain rivers and using a critical gradient concept for mountainous rivers. More than 30 characteristics of river runoff regime are calculated for each water resource year: characteristics of annual and seasonal runoff, contribution of each genetic component, characteristics of maximum runoff, n-day minimum discharges and dates when they are observed. Additionally, more than 50 characteristics of each flash-flood are calculated: characteristics of shape, volume, timing of flash-floods, the values of meteorological parameters that bring about different types of floods. The presented approach to automatic river hydrograph separation and analysis was tested on 45 plain rivers in the European part of Russia in different climatic zones and on 10 mountainous rivers in the North Caucasus. The result of application provides a possibility for analyzing previously unstudied characteristics of river runoff regime and its climate-related transformation on the European part of Russia.

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