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Occasional floods on the Russian Plain: types, frequency and conditions for the origin in the face of changing climate

Maria Kireeva¹, Ekaterina Rets², Frolova Natalia¹, and Gorbarenko Artem¹

¹Lomonosov Moscow State University, Hydrology, Moscow, Russian Federation (kireeva_mb@mail.ru)

²Water Problem Institute, Russian Academy of Science, Moscow, Russian Federation

In the last decade, floods on the rivers of Russia have become one of the most terrifying natural disasters. Among the catastrophic events, historical flood in Krymsk (2012), Amur River basin (2013), Veliky Ustyug (2016), floods in the Voronezh and Volgograd Region (2018) and Irkutsk and Novgorod Region (2019) can be called.

Floods on the rivers of the Russian Plain are divided into three main genetic types: rain, snowmelt and mixed. There is also a classification by seasons in which they can be observed. The seasonality of the flood peaks passage depends on the geographic location of the catchment and its local features. For most of the rivers of Central Russia, it was traditionally believed that occasional floods are mainly observed in the summer-autumn low flow period. In the summer, they are most often associated with intensive rainfall, and in the fall, with prolonged and drizzling rains. The influence of climate change on the processes of runoff formation has led to a transformation of the conditions for the occurrence of flood peaks and the need to rethink traditional ideas.

In this work, we analyzed the daily discharge time-series and highlighted flood peaks at 60 hydrological stations located in different natural zones of the European territory of Russia. Occasional flood peaks were divided into 5 classes, taking into account the time of their formation and genesis: a) thaw peaks during the winter low flow period, b) mixed peaks during the winter low flow period, c) mixed peaks during the rise of the main seasonal (snowmelt) wave, d) rain peaks during the decline of the main seasonal (snowmelt) wave, e) rain peaks during the summer-autumn low flow period.

The total number of peaks, the maximum peak discharge and its unit discharge rate, the beginning, end and duration of the flood peak, the total runoff volume of the flood, the relative stability of the low-flow period were estimated.

On average, the number of flood peaks in the rivers of the study area varies from 1 to 8 events per year. The greatest number of flood peaks is characteristic of the foothills of the Caucasus and the rivers of the Kola Peninsula, as well as the most western regions - the upper reaches of the Seversky Donets, Dnieper, and Western Dvina. The maximum unit discharges of rain floods on average is from 5 to 50 and more and thaw from 2 to 20 l/s*km². The spatial pattern shows that higher unit discharges are typical for the windward western slopes of the hills, and relatively low

ones are observed on the leeward, eastern slopes. In general, unit discharge rates increase from southwest to east, northeast.

In recent decades, the seasonality of flood peaks has changed significantly, they began to be observed in almost any period of the year, the number of events in the pre-flood period increased, as well as in the autumn period, at the time of transition to negative air temperatures.

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