



Inter-annual variations of heavy precipitation events over European Russia

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A study of heavy precipitation events, i.e. extreme daily totals, over European part of Russia (EPR) is conducted. The term "heavy precipitation event" (HPE) and some characteristics of its long-term variability are proposed. HPE means daily precipitation sum exceeding the threshold determined as percentile 99.9 for the joint seasonal rain-days sample. Statistically significant positive trends in the annual HPE characteristics are found using daily rain gauge data from 107 stations over EPR. This related to the HPEs total number, the number of days with HPEs, the number of unique observation points with recorded HPE, and precipitation sum associated with HPEs. The obtained trends are tested for robustness to input data with the Monte Carlo method. Western (westward of 45°E) and northern regions (north of 60°N) of the area are identified as domains that predominantly determine the character of inter-annual variability within the whole data set. It is found that the formation of inter-annual variability of HPE in 1966-1990 took place against the background of positive trends in summer heavy precipitation events and, afterwards, against the background of increase in the number of winter events and increase in the number of days with HPE of high spatial connectivity. The latter means that HPEs were observed at several stations in the EPR simultaneously. Such spatially cohesive events occur mainly in autumn and winter. A significant tendency to decrease in the number of autumn days with HPE was also detected after 1990. An increase in the average number of HPE per day with HPE during 1991-2015 and positive trend in mean precipitation totals per day with HPE in 1966-2015 indicate the increase in the number of days with more than one heavy precipitation event over EPR.

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