INFLUENCE OF THE CLIMATE WARMING ON RAINFALL FLOODS OF THE RIVERS OF THE WESTERN DVINA BASIN WITHIN BELARUS

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Noticeable changes of hydrological regime of the rivers are observed in last decades, caused by the consequences of global climate warming, occurring against anthropogenic influences. These changes have also transformed rainfall floods runoff.

The purpose of the present research is the long-term examination of fluctuations and a quantitative estimation of change of the rainfall floods water maximum discharges on the rivers of Western Dvina basin. At that long-term records of the maximum water discharges supervision of rainfall floods of the rivers of Western Dvina basins within Belarus were considered for the period from the beginning of instrumental observations to year 2005.

Hydrological regime of the Western Dvina river is featured by high spring high water, low summer-autumnal and winter low water, periodically interrupted by high waters, which can be formed during all seasons of the year. Approximately 50 % of the Western Dvina annual runoff is formed during a spring high water. Rainfall floods provide 20 %; on a subsurface runoff it is about 30 %. However such distribution is an average and can essentially fluctuate in years. The overland runoffs are increasing during rainfall floods. So, average value of the maximum overland runoff of rainfall floods of the 5 % probability on the rivers of the Western Dvina basin equals to 40–45 $l/(s \cdot km^2)$.

The analysis of observations over the maximum water discharges of rainfall floods from the long-term period was carried out to reveal the regularities of rainfall floods runoff fluctuations. The longest observations period for rainfall floods runoff is available on the Western Dvina river – Vitebsk city (since 1877). The observations duration is much less on inflows. Supervision is carried out on some of them from the end of 1920th years, while on others – from the middle of 1940th. The largest values of the maximum discharges of water of rainfall floods are noticed on the Western Dvina river – Vitebsk in first decades of XX century (1908, 1917) with 1 % probability thus less than the exceedance probability. The amplitude of fluctuations of the maximum discharges of water has considerably decreased starting from 60th years of XX century, and values of discharges are essentially less, than in a first half of XX century.

From inflows of Western Dvina the longest observation series for the water regime is available on Polota, Nacha, Ulla, and Drissa rivers, the supervision

duration there is about 80 years. The highest rainfall floods on inflows are noticed in 1952, 1962, 1978, 1987, and 1994 years. There is also a decrease of the maximum discharges of water of rainfall floods in a second half of XX century in comparison with a first half; the period from the middle of 1960th to the middle of 1970th should be especially noted.

Rainfall flood is a local phenomenon, and its size depends on a combination of many factors. Therefore on small rivers the greatest rainfall floods often are marked in different years. Besides, the intensive deposits causing rainfall floods on the rivers, are seldom covering the whole reservoir.

The basin of Western Dvina is characterized by rather high density of a river network, substantial inclines, prevalence of aquitard loamy soils, etc. Thereof during rains there is a fast water running off on slopes at small losses of water on seepage. So rainfall floods are developing quickly enough, the maximum is kept not for a long time, followed by fast recession. Hydrographers of rainfall floods are characterised by a considerable steepness as on lifting so on recession. Their height can reach 1–1,7 m and more (to 4–7) upon the level of dry weather period. In a northwest part of Western Dvina basin where the rivers Polota, Nacha, Drissa are forming their drain, the drain has considerable over adjustment due to raised lakes, marshiness and wood. Here rainfall floods are more long and spread, than on other rivers.

For a quantitative estimation of changes of maximum rainfall floods runoff the period of supervision is divided into 2 intervals: the first one from the beginning of supervision to the year 1985 (the beginning of climate warming), the second one from 1986 to 2005. Average values of the maximum discharges of rainfall floods water had been defined for each of the periods. If duration of observation was less than 15 years at least for one of the periods, these rivers were not considered.

After culling there were 20 rivers-alignments for which change values of maximum rainfall floods runoff were determined, have been presented in the form of the change factor of a runoff: $k_i=(Q_{av2}-Q_{av1})/Q_0$, where Q_{av1} and Q_{av2} are average values of the maximum discharges of water of rainfall floods for the periods until 1985 and 1986–2005, accordingly, Q_0 is maximum rainfall floods runoff average value for all period of the instrumental observation. Change factors of a runoff have been mapped with use of coordinates of the centres of gravity of reservoirs of the investigated rivers.

It is revealed, that on the rivers of Western Dvina basin within Belarus some transformation rainfall floods runoff took place in 1986–2005 in comparison with the period until 1985, with speed varied on territories. As a whole for a Western Dvina basin there is decrease of the maximum discharges of rainfall floods water in time of the climate warming. And on left-bank inflows of Western Dvina there are largest decrease within 25–35 and more percent. On right-bank inflows transformation value of maximum rainfall floods runoff is substantially lower (5–15 %). And on the Nishcha and Drissa rivers the increase within 10–15 % is noticed. This situation is caused first of all by natural factors, and less by anthropogenic ones.

Thus, on the rivers of Western Dvina basin within Belarus the value decrease of the maximum discharges of water of rainfall floods is noticed in climate warming in comparison with the period until year 1985.