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ON THE METHODOLOGY FOR ASSESSING CHANGES IN THE HYDROLOGICAL REGIME OF MOUNTAIN RIVERS BASED ON CLIMATE SCENARIOS

Abstract: In this paper, the questions of the formation of the runoff of mountain rivers in Uzbekistan and adjacent territories in the context of climate change are considered. A methodology for studying the hydrological regime of water bodies - rivers, lakes, snow cover and glaciers based on the application of various scenarios of global climate change is outlined.

Key words: river, river basin, hydrological regime, atmospheric precipitation, air temperature, climate change, impact assessment.

The study of the impact of climate change on the natural resource potential of any country and their consequences is one of the most important scientific and practical state tasks. In recent years, in Uzbekistan, within the framework of the State Scientific and Technical Program, a large amount of research has been carried out aimed at assessing climate change and its consequences, such as changes in water, agro-climatic resources, snow cover, glaciation, glacial runoff and others (Glazyrin, 1991; Chub, 2000; Chub 2007; Khikmatov et al. 2020).

Against the background of high natural climate variability in Central Asia in general and, in particular, Uzbekistan, there is a reaction to ongoing global climate changes. As is known (Ososkova et al., 2005), climate change occurs under the influence of both natural climate-forming factors and anthropogenic factors on a global and regional scale.

Studies of the dynamics of the modern climate in Central Asia have shown

that against the background of high natural climate variability, the region also has a certain reaction to recent global climate changes. For example, for 100 years, the average annual air temperature in Tashkent has increased by 1.2 0C. Precipitation is characterized by alternating periods of excess and deficit (Chub, 2007).

At the Central Asian Research Hydrometeorological Institute (Scientific Research Hydrometeorological Institute, SANIGMI) (now the Scientific Research Hydrometeorological Institute, NIGMI Uzhydromet), studies of the current climate and its changes were carried out in parallel in two directions: the first - by the methods of dynamic climatology and, the second - with by determining statistically significant changes, both directional and periodic.

The degree of impact of probable climate changes on the regime of rivers, lakes, snow cover and glaciers in the region, according to these scenarios, has already been assessed using fairly reliable mathematical models of runoff formation developed by Yu.M. Denisov, G.E. Glazyrin, V.G. Konovalov , L.N. Borovikova, B.K. Tsarev, A.S. Shchetinnikov, V.E. Chub and others (Chub, 2000; Khikmatov et al. 2020).

In the 90s of the last century, when assessing changes in the water resources of rivers, lakes, the Aral Sea, glaciers and snow cover, with possible long-term climate changes, L.N. Borovikova, G.E. Glazyrin, B.K. Tsarev, N. E. Gorelkin, A. S. Shchetinnikov, M. G. Glazyrina, G. N. Trofimov and others adopted the following combinations of changes in air temperature and precipitation: temperature - 0, +1, +2 and +3o; atmospheric precipitation: -20, -10, +10, +20, -50 and +50% (Chub, 2007; Khikmatov et al., 2020). Similar combinations of changes in air temperature and atmospheric precipitation can also be taken to assess changes in the hydrological regime and water resources of the rivers of Uzbekistan and adjacent territories due to changes in climatic conditions in their basins.

At present, the world literature provides detailed descriptions of climate scenarios developed by foreign scientists and specialists. For example, today there are the following models of global climate change: GFDL - created in the Geophysical Laboratory of Fluid Dynamics - Model of the Geophysical Fluid

Dynamics Laboratory (USA); GISS - at the Goddard Institute for Space Research - Model of the Goddard Institute for Space Sciences (USA); UKMO - in the United Kingdom Meteorological Agency - Model of the United Queen Meteorologikal Office (England); SSCM - at the Canadian Climate Center - Model of the Canadian Climate Center (Canada). In carrying out this work, we used the results of the interpretation of these scenarios of global climate change for the conditions of Uzbekistan and adjacent territories from 2015 to 2030, developed by scientists from NIGMI Uzhydromet (Fig. 1).

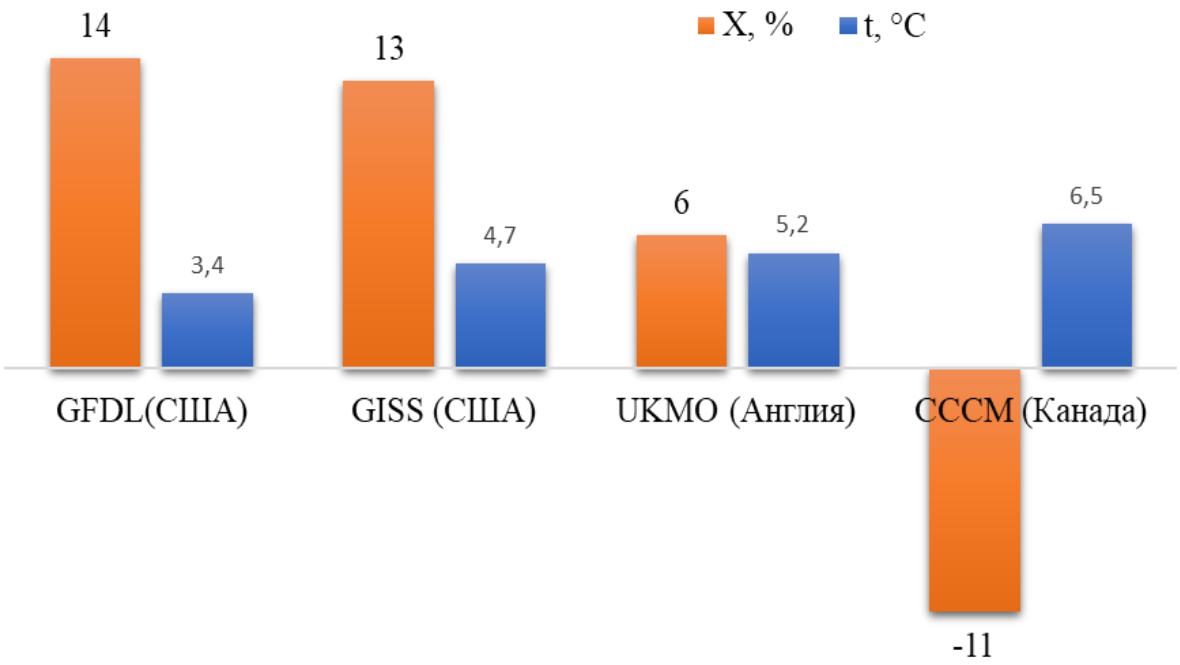

Fig. 1. Values of changes in air temperature (t) and atmospheric precipitation (X) according to global climate change models (Chub, 2000; Chub, 2007)

As can be seen from Figure 1, the SSSM model gives the greatest aridization of climatic conditions, the zone of formation of the flow of rivers in Uzbekistan and adjacent territories (average annual temperature increase by 6.5 0C, decrease in annual precipitation by 11%). An unfavorable situation may also arise if climate change develops according to the UKMO model, when the air temperature may increase by 5.2 0C, and the annual precipitation will increase by 6%. According to the GFDL and GISS scenarios, the average annual temperature in the formation zone will increase by 3–40C, and the average annual precipitation will increase by 10–15%.

The results of the studies carried out by us once again confirmed the climatic conditionality of the formation of runoff in the rivers of Uzbekistan and adjacent territories. The obtained dependencies on the example of r. Kashkadarya makes it possible to predict changes in the water content of rivers due to climate change. In this case, scenarios of possible climate change will be considered given. The degree of impact of likely climate change, i.e. climatic indicators - atmospheric precipitation of different seasons and air temperature of the warm period on the water content of rivers can be assessed using nomograms, an example of which was developed in our previous studies [Frolova et al., 2019; Khikmatov et al., 2020].

In the subsequent stages of research within this direction, i.e. assessments of changes in the water content of rivers will be made taking into account only climatic influences, since the zones of formation of the flow of the studied rivers are mainly located in mountainous areas and are not strongly influenced by non-climatic factors. In general, when assessing changes in the hydrological regime and water resources of the rivers of Uzbekistan and adjacent territories in connection with climate change, the above scenarios interpreted by scientists from NIGMI Uzhydromet for the study area will be used.

In conclusion, it should be noted that the work shows the expected climatic changes in the mountain river basins of Uzbekistan and adjacent territories. This was largely reflected in the main runoff-forming factors of mountain basins, such as the air temperature of the warm half of the year and atmospheric precipitation. The mode of intra-annual and territorial distribution of atmospheric precipitation, one of the ozone sources of feeding the rivers of the study area, has also changed.

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