Estimate of possible hydrological regime change of Tsimlyansk reservoir in conditions of the climat warming

Grechushnikova Maria

The work purpose is to estimate probable changes of the hydrological regime of the Tsimlyansk Reservoir – first in their Don cascade. The number of predictive studies of climatic, hydrothermal and water resource changes at the Geographical Faculty of MSU in case of further warming on the East European Plain in the XXI century is the basis of our study. Data results of climate modeling for the scenario IPCC A2 (the most "rigid" option) served as basic for the assessment of the possible change of river flow. The universal two-dimensional box hydrological model of a reservoir is developed and verified (GRM-MSU).

According to this forecast based on a row of models of the atmosphere general circulation for the central part of the European plain, essential decrease of river flow to the south from 54-55o NL is expected, and the tendency of the decrease of the river flow to the south of the plain at the end of the XXI century will exceed.

Multiple predictive model calculations show that at possible warming of the climate in the second half of the XXI century and the reduction of inflow of water to the Tsimlyansk Reservoir changes will be mostly observed in the reduction of its net volume and water cycle. Duration of ice period will be reduced. Since March the vegetative and navigation season in some years can last till January. The considerable increase in water temperature during the summer period shouldn't be expected. It will be within limits of 2-3oC and not more because of significant increase in heat losses at evaporation and the increasing effective water radiation

In case of water inflow and its reduction approximately by two times, the reservoir flowage will decrease by 1,5 times. If the inflow decreases by 4 times, the flowage will be slowed down by 3,5 times. In case of adverse warming of the climate water expenses downstream, which take place from April till the end of June for the flooding of the spawning areas of Don mouth, should be reduced by two times that will lead to the decrease in water level in the reservoir by 0,5-1 m lower than the mark of the level of the minimum volume (31 m). It is adverse for the hydroelectric power station work during the whole autumn and winter.

Model calculations of thermal balance components showed that the greater increase of heat loss for evaporation (up to 1,5 times) in predictive scenarios will occur during summer and autumn, and also in March because of early cleaning of the reservoir from the ice cover. At the same time heat loss with an effective radiation will increase by 2-3 times during the spring and summer period and in autumn by 1,5 times. Such a big increase in heat losses during the period of open water prevents the overheat of water mass in the conditions of expected warming of the climate. In water equivalent the increase in losses with evaporation will make up in average from 10% to 20% in a year. At the lower level of water (32 m and below) and the reduced water surface the additional decrease of level owing to the increase of evaporation will make up from only 20 to 30 cm.

Additional studies showed that at the interaction of the Tsimlyansk reservoir with the atmosphere there can appear a certain critical condition in the change of the intensification of this interaction, namely the

increase of evaporation at water level in the vicinity of 32 m that is connected with the features of a bathymetry (at water level change from 33 m to 31 m, at different velocity of wind volume of evaporated water considerably increases at first to the level of 32 m, and then decreases). The decrease of the intensity of evaporation at the decrease in level of a reservoir from 32 m to 31 m can cause the corresponding decrease in gas exchange that can worsen the ecological condition of a water body. The standing of the level near at mark of 32 m is unprofitable because of the increase of water losses at future inflow reduction from the point of view of water consumption.

. Water mineralization during the spring period will increase in the upper courses, and in summer-autumn low inflow period in the dam area as well. The increase in losses of evaporated water is one of the factors of mineralization increase in a reservoir in a steppe zone, along with the increase in a share of feeding of tributaries by ground waters at the reduction of flood volume. Calculation by GRM-MSU model for real conditions shows the increase of water mineralization for the period of open water by 15% that coordinates quiet well with the balance assessment. Predictive calculation for forecast scenario showed probable increase in the sum of ions in water mass by 18-20%. Mineralization increase by autumn from 420 to 470 mg/l (and consequently hardness of water) in the dam area is adverse for water management of the Rostov nuclear power plant.