Dynamics and forecasting of the Central Asian glaciation and its impact to the projected annual water resources

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Data on long-term changes in glacier size are necessary for analysis between climate and regime of glaciers, modeling and forecasting runoff in river basins of Asia. The paper provides first information on changes of glacier parameters in Central Asia for four time slices during 1961-2000 period and in the future by 2020. The method of obtaining data includes the following components. a) Adjusting of the not simultaneous data on total area F and volume V of glaciers to the selected common time slices; (b) Determination of F and V outside the empirical time range. The following conclusions were obtained [4]. 1. New data on long-term variability of glaciers during 1961-2000 should be considered as quite reliable, because the percentage of results based on the use of large-scale topographic maps, aerial-photo survey and remote sensing of glaciers, reached by years: 1961 - 100%, 1980 - 100%, 2000 - 74%. 2. Spatial shrinkage of glaciers in the Aral Sea Basin during 1961-2000 varies from 14.2 % till 51.9 %. Reducing of total glaciation size consist of change in area of individual objects having different sign of increment. These data are well coordinated with similar information in the mountainous regions of Asia and Europe. 3. Glacier surges did not significantly effect on the evolution of glaciers in the scale of major river basin. As a result of deglaciation in 1935-1994, glacial runoff in 1965-1994 decreased by 25.3% over the previous thirty years. Despite significant changes in the hydrological regime of glaciation, the total seasonal flow of the rivers Vakhsh and Panj in average for 1935-1964 and 1965-1994 remained almost constant. Different methods were used to estimate by 2020 the annual values of water resources in river basins, and also area and volume of glaciers there. In the first case they were; (a) linear independently tested equations W=f(P,T), where P and T – are correspondingly annual precipitation and summer air temperature at the most informative meteorological stations [7] or in the selected grids from Data Bases on Climate (e.g., CRU, Aphrodite, GPCC [1, 3, 5, 6 9]) of high resolution; (b) extrapolation of previous long term data, using linear recurrent formula, received by means of Caterpillar SSA method [2]. The source of future values of P and T is WorldClim Data at different scenarios of emissions [3, 8]. The expected values of the glacier area and volume in 2020 were received by using the equation for the corresponding trends during 1961-2000. The methods have used in our research to calculate the annual amount of precipitation, evaporation, glacier runoff, and dynamic water reserves are sufficiently reliable and suitable for other basins in the Central Asia with a similar type of runoff formation, as these methods provide quality of calculated river runoff, which comparable with its measurements.

Application of generalized parameters for groups of glaciers have improved spatial extrapolation the climatic factors of runoff and have provided possibility to compare parameters of hydrological regime of glaciers in different river basins.

The method suggested in the present paper on regionalization of glacier populations, and examples of their application in the Asian river basins reveals new possibilities for the objective description of spatial distribution the areal-altitudinal parameters of glaciers, and for using this information in statistically substantiated glaciological and hydrological models and computations.

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