

Interdisciplinary study of the mountain geosystems in the Altay-Sayan region

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The results of several projects funded by Russian geographical society and RFBR are presented. The main objective of this regional research is to reveal current state and changes of mountain geosystems mainly under the influence of natural factors as well as socio-economic factors during the last several decades.

Study region is partly located in the Dry Latitudinal Belt of Northern Eurasia and includes several key sites in the Russian, Mongolian and Kazakhstan Altai, in the Tuva Mountains and the Western Sayan Mountains. These mountain systems are the watershed between the Arctic Ocean basin (upper parts of Yenisei and Ob river basins) and Inner Asia closed drainage area (Great Lake Depression).

Complex geographical field work was conducted during last several years including glaciological, hydrometeorological, hydrochemical, dendrochronological measurements as well as interviewing. Analysis of weather stations' data, remote sensing data acquired from satellites, various map documents and statistical data also was made.

There is positive mean annual air temperature trend in the region during the last several decades (0.2-0.6 degrees Celsius/10ys). But at the same time in recent years the warming trend is weakening in some areas. As for precipitation there is no any statistically significant trend. Such combination of climatic parameters in some areas, for example in the Khovd river basin in Great Lake Depression plays a critical role and we see a tendency to aridization. These facts are well confirmed by dendrochronological streamflow and temperature reconstructions for a longer period.

Dendrochronological analysis results in four regional ring-width chronologies, the longest one is since 1463. Chronologies demonstrate similar year-by-year and long-term variability and contain 10-14 and 29-33-yr cycles. The tree-ring growth is limited mostly by June-July air temperature ($R=0.5-0.7$). At the same time, chronologies are sensitive to the variability of circulation, hydrological, and glaciological parameters. Strong signal of nature factors permit to use these regional tree-ring chronologies for reconstructions of hydrometeorological parameters.

The water discharge formation in the upper parts of river basins in this region is associated mainly with glaciers. Glacier area and tongue regression was fixed mainly under temperature influence. Large glaciers such as Kozlov and Potanin were retreating at an average rate of 28-34 m/year during last years. At the same time there are some synchronous and non-synchronous changes of glacier retreat rate in different key sites associated basically with location, aspect of a slope, morphological and geomorphological patterns.

Hydrochemical TDS (Total Dissolved Solids) measurements show the dependence on source of nourishment and usually TDS changes from 0-7 ppm in the high-mountain headwaters near glaciers to 65-90 ppm along the river towards the mouth. The water type usually is hydrocarbonate-calcium or hydrocarbonate-magnesian.

Our research also has an applied aspect. We made an independent scientific expertise consisting in assessment of the natural conditions during the realization of large transport projects in the Siberian region, for example construction of the Elegest-Kyzyl-Kuragino railway line along the mountainous territory. Analysis of such parameters as extreme values of air temperature and precipitation, strong winds, snow cover thickness, avalanche danger and others makes it possible to assess the potential natural risks during the construction and further operation of the transportation systems.

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