Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

MIS03-04 会場:101B 時間:5 月 25 日 09:45-10:00

Treeline dynamics under the climate changes in the Russian Altai Mountains
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This research is a part of a big project of the Saint-Petersburg State University (SPbSU) - The Northern Eurasia mountain geosystems under the global climate changes and the transformation of the nature management regimes. The mountain regions, and particularly the Altai Mountains, are of specific interest due to the relatively low anthropogenic load and great sensitivity of the mountain landscapes. The current research is a continuation of the long-term field expeditions and theoretical researches of the SPbSU in the Altai-Sayan Mountains. The Department of Geography and Geoecology of the SPbSU has been organizing annual field expeditions to this mountain system during the last 20 years.

The regional climate changes are presented against the background of global climate change including the atmospheric circulation epochs. The uniqueness of the Altai landscapes lies in a great variety as the mountains are higher than 4 km and located on the zonal border between steppes and semi-deserts and between continental and sharply continental climates. The purpose of the research was to reveal space-time features of regional climate changes and the reaction of treeline position to these changes.

The 1940-2004 time series of the seasonal air temperature and precipitation from 14 weather stations from 300 to 2600 m a.s.l. were statistically analyzed applying regression, correlation, spectral and cluster analyses. The analysis of climate change spatial patterns in the region was made. To extend the time series over the past 350-400 years, mean summer temperature and precipitation were reconstructed applying dendroclimatological methods and using the WSL Dendro data base and core samples and tree line position estimates received during the field expeditions.

Comparing to the Northern Hemisphere the tendency of temperature increase in the second half of the 20th century over the Altai has been observed generally earlier, since 1950s. The most intense temperature increase during the last 20-30 years is specific to the most arid part of the region - South-Eastern Altai. Maximum warming rate in the last quarter of the 20th century is typical to winter in the Altai (0,85 degrees Celsius/10 years) as well as the entire Northern Hemisphere. Synchronous changes in the Altai and the entire Northern Hemisphere are observed in all seasons only in 1975-2004 years. At the turn of the XX-XXI centuries warming rates slow down in the region while the temperature level is still high.

The dendrochronological reconstruction showed that mean summer temperature increased from the end of the LIA to its maximum in the 1990s by approximately 2 degrees Celsius, to the average for the period 1986-2004 yrs ? about 1,3 degrees Celsius. Finally the climatic conditionality of the altitudinal belt spatial distribution, treeline and glaciers dynamics were estimated. In the Altai almost the full range of the temperate zone altitudinal belts is presented - from desert steppe to glacial-nival. Vertical hydrothermal gradients were employed to characterize each altitudinal belt by the climatic area of distribution (mean summer temperature and annual precipitation ranges). As treeline against the other belt borders strongly limited by summer temperature (7.5-9 degrees Celsius) its eventual dynamics were estimated and treeline position at different stages of warming was reconstructed. Theoretical evaluation shows that mean summer temperature increase of 1.3 degrees Celsius from the end of the LIA (1860-1880 yrs) to the period of 1986-2004 yrs causes treeline to rise maximum by 180-280 m in different localities of the Altai Mountains.

The results of the research are used for the development of the mountain landscapes dynamics prediction, the strategy of the mountain regions sustainable development and the estimation of the natural resources potential of the mountain landscapes.

キーワード: treeline dynamics, regional climate change, the Altai Mountains
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