



Tree Growth Responses to Climate Change at the Upper Treeline in the Mountains of Western Tuva

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The response of forest to climate change is most pronounced at higher elevations due to the limitation of growth by temperature and precipitation. Modern instrumental measurements show temperature increase during the 20th century that causes rising of upper boundary of forests in the mountain regions. Climate-driven upward tree migration in the region of Altai-Sayan Mountains has been demonstrated in a number of investigations. The purpose of this research was an analysis of the impact of main climatic factors on tree growth and current treeline dynamics under the climate changes in the mountains of Western Tuva. Tree-ring width chronologies were built based on larch samples (*Larix sibirica*) of living trees from the upper treeline, the chronologies were compared, their statistics were estimated, and correlation with temperatures and precipitations were analyzed. Tree growth is dominated by two major factors – moisture supply and summer temperatures. It is generally hypothesized that tree growth at the lower treeline is precipitation limited while at the upper treeline is normally controlled by temperature. However in the upper forest belt temperature can influence tree growth negatively as well as positively. Correlations between chronologies and climatic factors revealed different climatic influences on radial growth along a north-south gradient in the study area. Within northern wetter areas tree ring width correlates positively with summer temperatures and negatively with precipitation, so temperature increase leads to rise of upper treeline. Within southern drier areas tree ring width correlates positively with precipitation and negatively with rising summer temperatures. The analysis showed that in this case the tree growth is determined by combination of optimal temperature and maximum precipitation. The results provide evidence of critical importance of temperature and precipitation in the upper forest belt and will be used in subsequent analysis of temporal and spatial forest dynamics within the upper mountain forest belt of Altai-Sayan Mountains.