

Effect of warming on larch trees in the Asian southern border of the boreal forest, Mongolia and China in the 20th century.

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In recent decades air temperature (T_a) has been increasing steadily around the globe and it is reported that in the last 40 years T_a in Mongolia alone has increased by about 2.1 deg.C. The boreal region as a whole is expected to experience changes due to atmospheric drying, permafrost degradation, increases in the frequency of forest fires and other factors that will lead to a shift of the forest ecosystems northward. The southern border of the boreal forest distributes in northern Mongolia and northeast China, which as transition areas are more sensitive to changes. In a 500 km long south-north transect of larch forests extending in each of these two countries, larch forest sites were chosen (*Larix sibirica* in Mongolia and *Larix gmelini* in China). Studies until now have used only tree-ring analysis to determine past and recent climate in Mongolia and China. However, isotope analysis has not been coupled with this analysis to give a wider overview of the environmental changes taking place in these regions. Therefore in this study tree core samples were collected for tree-ring and carbon isotope analysis to be coupled with available meteorological data. These data indicate that in the last four decades, the northernmost site of the selected transect has experienced the largest increase in T_a , but nevertheless the annual T_a in the southernmost site remained several degrees higher. On the other hand precipitation shows a very slight increase in the central and northernmost sites while an insignificant decrease is observed in the southernmost site. Tree-ring analysis shows that for most of the 20th century tree ring growth had lower inter-annual variability until the beginning of the 1970's but from then on the annual variability has increased.

Unlike the results of the tree-ring analysis, the carbon isotope analysis revealed that until the 1970's the increases in the drying atmospheric conditions (higher temperature-no changes in rainfall) were not present but the steady increase in values from the 1980's clearly represented the drying effect, especially in the southernmost site. The differences in the carbon isotopic values reflect wetter conditions in the north than in the south but in general all sites are experiencing drier conditions than in previous decades. However the northern site showed more cyclic behavior with values increasing and decreasing in a decadal basis while the southern sites showed a steady increase from a mean value of -23.4 ‰ in the 1950's to a mean value of -21.0 ‰ in the first decade of the 21st century.