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Changes in the growth-climate relationship of larch trees in eastern Siberian taiga over the past 100 years

TEI, Shunsuke[1*], SUGIMOTO, Atsuko[2], YONENOBU, Hitoshi[3], Trofim C. Maximov[4]

[1]Graduate School of Environmental Science, Hokkido University, [2]Faculty of Environmental Earth Science, Hokkaido University, [3]Graduate School of Education, Naruto University of Education, [4]Institute for Biological Problems of Cryolithozone SB RAS.

Dendrochronological studies in high-latitude region focused on the positive growth of trees to warmth (D'Arrigo and Jacoby, 1993). From these results, it had been expected that warming would lead to more tree growth, better survival of individuals and ultimately expansion of trees in tundra. However, from middle of 20th century positive sensitivity of trees growing in northern high-latitude to temperature has declined (Briffa et al., 1998) and temperature induced drought stress may limit radial growth of trees (Barber et al., 2000). That is, trees growing in high-latitude region like as east Siberian taiga are on water stress and moisture condition is likely to be limiting factor for tree growth (Kagawa et al., 2003). Here, we report an analysis of tree ring and climate data including soil moisture reconstructed form delta-13C of tree ring to explore the tree growth-climate relationship and a change in this relationship over the past 100 years in eastern Siberia.

Larch trees (Larix cajanderi) collected in Yakutsk (62N, 129E) were used for the analyses of tree ring width and its carbon isotope ratio. The samples were crossdated with ITRDB's (International Tree-Ring Data Bank) ring-width records in eastern Siberia. Soil moisture for the past 100 years was reconstructed form the delta-13C of tree ring (Tei et al., in preparation). Reconstructed soil moisture from the delta-13C of tree ring was compared with the regional climate record (precipitation), the amount of water input into the soil and a calculated results by one dimensional land surface model (2LM), and seems to be reasonable.

Tree ring width showed positive and negative correlation with soil moisture reconstructed form delta-13C of tree ring ($r=0.56$, $P<0.001$) and July-August temperature ($r=-0.20$, $P<0.05$) in previous year over the past 100 years, respectively. However, these correlations were not stable and the correlation coefficients changed over time. Moving-interval correlation analysis, using 31 years window showed that the relationship between tree growth and late summer soil moisture and temperature in previous year became gradually stronger. These results show that water stress during the late summer in the previous year caused a reduction of tree growth.

In this presentation, we will also show the tree ring width and delta-13C chronology of dead trees and compare with that of living trees to explore the records of stress which larch trees in high-latitude region had experienced.

Keywords: eastern Siberia, tree ring, carbon isotope, soil moisture