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δ^{13}C and δ^{18}O in Siberian tree rings as indicators of environmental changes in the Eurasian north

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According to the Intergovernmental Panel on Climate Change report (IPCC 2007) some aspects of the current climate change are not unusual, but others are. Therefore we need to look into the past for revealing "unusual" (extremely warm or cold) climatic changes. The application of long-term tree-ring chronologies in paleoclimate reconstructions helps us to evaluate climatic and environmental changes in the past and to estimate the magnitude of the recent warming.

The application of the stable isotope analysis to classical dendrochronology is steadily increasing because stable isotopes provide complementary information about climatic variabilities, which is not available with tree ring width alone. In northern latitude forests, stable isotopes may yield insight into precipitation variability, while tree-ring width and density are more sensitive to temperature changes. Using stable isotopes is therefore very helpful in improving our understanding of the forest response to environmental changes.

The tree-ring width and stable isotope (δ^{13}C, δ^{18}O) analyses were carried out for Siberian tree ring chronologies from northeastern Yakutia (70N-148E) and eastern Taimyr (71N-102E). The results showed extremely warm AD 900-1100, AD 1950-2006 and extremely cold AD 516-560, AD 1600-1650, AD 1800-1850 periods during the late Holocene. Isotope analyses reveal new supplementary signals about the moisture regime, in particular a correlation to July precipitation was found for the calibration period. We detected a strong relationship between the oxygen isotope ratio of tree rings and Greenland ice core chronologies [Meese et al. 1994] for the Medieval and recent periods, which indicate similarities in the nature of low-frequency temperature variability in these two regions. Further, we found that trees from the vast Subarctic Eurasia zone (eastern Taimyr and northeastern Yakutia) showed a decrease in the tree radial growth, δ^{13}C, δ^{18}O in whole wood and cellulose after major volcanic eruptions (stratovolcano), that indicate a temperature decrease (up to 4°C) due reduced incoming solar radiation, which is thought to be due to higher stomatal conductance caused by a decrease in VPD but lower photosynthetic capacity, due to significantly lower temperatures.