Geophysical Research Abstracts
Vol. 12, EGU2010-14219-1, 2010
EGU General Assembly 2010

Stable C and O Isotopes from Tree Rings Reveal Changes in the Carbon Water Relations Along a Siberian North South Transect in the Last 150 Years

Rolf TW Siegwolf (1), Olga V Sidorova (1,2), Matthais Saurer (1), Alexander Kirdyanov (2), Anastasia A Knorre (2), and Eugene A Vaganov2 (3)

(1) Paul Scherrer Institut, Lab of Atmospheric Chemistry, Villigen, Switzerland (rolf.siegwolf@psi.ch, +41 56 310 4525), (2) V.N. Sukachev Institute of Forest SB RAS, Akademgorodok, Krasnoyarsk 660036, Russia, (akird@forest.akadem.ru; aknorre@ksc.krasn.ru), (3) Siberian Federal University, 660041 Krasnoyarsk, Svobodnii 79, Russia (eavaganov@forest.akadem.ru)

The increasing industrialization in the last 150 years resulted an increasing atmospheric CO_2 concentration (c_a) from ca. 260 to 385 ppm as a result of the growing use of fossil fuels. Besides the greenhouse effect elevated CO_2 affects also the vegetation, as plants respond instantaneously with an increased photosynthetic rate, and a reduction in stomatal conductance. This results in a lower c_i/c_aratio (c_i is the leaf intercellular CO_2 concentration), which is reflected in a reduced ^{13}C fractionation during photosynthesis. Accordingly the intrinsic water use efficiency (WUE_i) will be altered. However, with increasing duration of exposure to elevated CO_2 plants will acclimatize, i.e. down regulate the photosynthetic capacity to some degree. The degree of the long-term response to changes in CO_2 varies largely between plants growing under different growth conditions, such as climate water availability, nutrient supply and between different species.

In this presentation we show C and O isotope data from tree rings for the last 150 years, reflecting the changes in the carbon water relations (WUE_i) from central Siberia (Russia) along a north south transect of ca. 2400 km. It will be shown that changes in the environment either increase or reduce the effect of elevated CO_2 on trees, growing in the highly sensitive Siberian ecosystem. The combination of the C and O isotope fractionation values in a conceptual model (Scheidegger *et al*., 2000; Saurer and Siegwolf, 2007) allows the link of gas exchange mechanisms with $\delta^{13}C$ and $\delta^{18}O$ data. With this conceptual approach we can distinguish whether trees respond to elevating CO_2 and environmental changes with an increase in the photosynthetic rate or with changes in the stomatal conductance or both. The understanding of the physiological response patterns of trees to elevated CO_2 allows an improved interpretation of climate data for the last 150 years.

Matthias Saurer, Rolf T.W. Siegwolf, 2007. Human impacts on tree ring growth reconstructed from stable isotopes. In: Stable Isotopes as Indicators of Ecological Change. Todd E. Dawson, R.T.W. Siegwolf. (Eds.), Terrestrial Ecology Series, Elsevier; Amsterdam, Boston, pp. 49-62.

Scheidegger Y., M. Saurer, M. Bahn and Siegwolf RTW, (2000). Linking stable oxygen and carbon isotopes with stomatal conductance and photosynthetic capacity: a conceptual model. Oecologia, 125 (3): 350-357.