Geophysical Research Abstracts
Vol. 17, EGU2015-10057-4, 2015
EGU General Assembly 2015

Early to Mid-Holocene climate variability from multi-millennial tree ring isotope records

Malin Michelle Ziehmer (1,2), Kurt Nicolussi (3), Christian Schlüchter (2,4), Markus Leuenberger (1,2)

(1) Climate and Environmental Physics, Physics Institute, University of Bern, Bern, Switzerland (ziehmer@climate.unibe.ch), (2) Oeschger Centre for Climate Change Research, University of Bern, Bern, Switzerland, (3) Alpine Tree-Ring Group, Institute of Geography, University of Innsbruck, Innsbruck, Austria, (4) Quaternary Geology, Institute of Geological Sciences, University of Bern, Bern, Switzerland

The evolution of Holocene climate and its variability in the Alps has been principally investigated by analyzing low-frequency archives. The environment of the Alps is known to react sensitively to changes in environmental conditions such as variations of precipitation and temperature, which can be observed in the current retreat of glaciers as a result of global warming in the course of global climate change. The mentioned low- frequency records such as glacier and tree line fluctuations reveal an evolution of Holocene climate from a generally warm Early and Mid to a relatively cool Late Holocene, whereas the rare high resolution records often do not indicate such a general long-term trend. The causes and mechanisms behind are not fully understood yet.

Recent finds of wood remains of long-lived trees in Alpine glacier forefields changed the concept of Holocene glacier variability and therefore, the present understanding of Holocene climate dynamics as they prove that glaciers in the Alps were usually relatively small and short in their extension during the Early and Mid-Holocene (Joerin et al., 2008; Nicolussi, Schlüchter, 2012). Those findings of wood remains further prove that the natural variability of postglacial climate is still not sufficiently known. However; such knowledge is essential for climate model input and the ability to disentangle natural from anthropogenic influences on the Earth's climate.

The aim of our study is to establish highly resolved isotope records from calendar-dated wood remains covering the past 9000 years. Samples are collected in glacier forefields in the Alps, thereby covering a large SW- NE transect. Wood samples are separated into 5-year tree ring blocks from which cellulose is extracted and is crushed by ultrasonic homogenization (Boettger et al., 2007; Laumer et al., 2009). As the amount of samples (>7000 samples to cover the whole Holocene) is immense, the improved preparation procedure shortens the time for each single sample to a minimum. Stable isotopes of carbon, oxygen and hydrogen are simultaneously measured using a recently developed method by Loader et al. (2015). Measured stable isotope records, containing of a sample replication of at least 4 samples per 5-year tree ring block, allow to establish stable isotope chronologies over the time span of the Holocene.

A special focus is set here on the Early to Mid-Holocene climate variability covering a time period from approximately 9000 to 6000 years BP, which opens the opportunity to analyze minima and optima periods, but also to investigate abrupt climatic changes which are most prominent in the Early and Mid-Holocene such as the well documented 8.2 ka event. The new highly resolved isotope records (C, O, H), which are combined in a multi-proxy approach with the tree ring width and the maximum latewood density of analyzed wood enable a high-resolution reconstruction of environmental conditions and of the natural variability of the Early and Mid-Holocene.

References:

Boettger, T., et al. Anal. Chem., 2007, 79: 4603-4612

Joerin, U.E., et al. QSR, 2008, 27: 337-350

Laumer, W., et al. Rapid Commun. Mass Spectrom., 2009, 23: 1934–1940

Loader, N.J., et al. Anal. Chem., 2015, 87: 376-380

Nicolussi, K., C. Schlüchter. Geology, 2012, 40: 819-822