Geophysical Research Abstracts
Vol. 19, EGU2017-14073-1, 2017
EGU General Assembly 2017
© Author(s) 2017. CC Attribution 3.0 License.

Particular geoscientific perspectives on stable isotope analysis in the arboreal system

Gerhard Helle (1), Daniel Balting (1), Maren Pauly (1,2), Franziska Slotta (1,2)

(1) GFZ German Research Centre for Geosciences, Geoarchives, Potsdam, Germany (ghelle@gfz-potsdam.de), (2) Freie Universität Berlin, Department of Earth Sciences, Institute of Geological Sciences, Berlin, Germany

In geosciences stable isotopes of carbon, oxygen and hydrogen from the tree ring archive have been used for several decades to trace the course of past environmental and climatological fluctuations. In contrast to ice cores, the tree ring archive is of biological nature (like many other terrestrial archives), but provides the opportunity to establish site networks with very high resolution in space and time. Many of the basic physical mechanisms of isotope shifts are known, but biologically mediated processes may lead to isotope effects that are poorly understood. This implies that the many processes within the arboreal system leading to archived isotope ratios in wood material are governed by a multitude of environmental variables that are not only tied to the isotopic composition of atmospheric source values (precipitation, CO_2), but also to seasonally changing metabolic flux rates and pool sizes of photosynthates within the trees. Consequently, the extraction of climate and environmental information is particularly challenging and reconstructions are still of rather qualitative nature. Over the last 10 years or so, monitoring studies have been implemented to investigate stable isotope, climate and environmental signal transfer within the arboreal system to develop transfer or response functions that can translate the relevant isotope values extracted from tree rings into climate or other environmental variables. To what extent have these efforts lead to a better understanding that helps improving the meaningfulness of tree ring isotope signals? For example, do monitoring studies help deciphering the causes for age-related trends in tree ring stable isotope sequences that are published in a growing number of papers. Are existing monitoring studies going into detail enough or is it already too much effort for the outcome? Based on what we know already particularly in mesic habitats, tree ring stable isotopes are much better climate proxies than other tree ring parameters. However, millennial or multi-millennial high quality reconstructions from tree ring isotopes are still rare. This is because of i) methodological constraints related to mass spectrometric analyses and ii) the nature of tree-ring chronologies that are put together by many trees of various individual ages. In view of this: What is the state-of-the-art in high throughput tree ring stable isotope analyses? Is it necessary to advance existing methodologies further to conserve the annual time resolution provided by the tree-ring archive? Other terrestrial archives, like lake sediments and speleothems rarely provide annually resolved stable isotope data. Furthermore, certain tree species from tropical or sub-tropical regions cannot be dated properly by dendrochronology and hence demand specific stable isotope measuring strategies, etc.. Although the points raised here do specifically apply for the tree ring archive, some of them are important for all proxy archives of organic origin.