



Stable isotopes, the link between tree physiology tree ring width data as climate proxies

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Tree rings are a well-acknowledged archive for climate reconstructions. In the northern and temperate regions it is a matrix, which can be easily dated (one tree ring per year) and the determination of the tree ring width (TRW) and density (TRD) follows a well established protocol. The correlations between TRW and temperature are usually good and reliable. Stable isotopes complete the classical dendrochronology ideally, as they originate from the same sample formed in the year when the tree ring was built at the same location, thus representing an ideal synchronicity. The carbon isotope ratio provides information on the water availability and air humidity, while the oxygen isotope ratio was mostly used as a proxy for temperature. Newer studies have shown that the oxygen isotope ratio is also modulated by the stomatal conductance of the leaves. The oxygen isotope ratio is therefore an interesting indicator for plant water relations.

Since the last 30 - 40 years the correlations between the above mentioned proxies and climatic drivers decreased the more the reconstructions are carried out towards the present days. As the isotopes are strongly linked to physiological processes of the trees and the mathematical formulation for the isotope fractionation is well established and understood, we have a powerful instrument at hand, which allows a more detailed analysis of the signals, stored in whole wood and cellulose. However the potential of the isotopes has up to now been rarely fully exploited, as often the link between the isotope ratios and the environmental drivers was made with mere correlation analyses. For a better understanding of the signal variability in tree rings mechanistic approaches are needed. As the physiology of the fractionation processes in plants for ^{13}C and ^{18}O are well known and formulated in simple mathematical terms the basis is given for mechanistic evaluations and interpretations, a very promising way.

The physiological interpretation of environmental impacts will be discussed using stable isotopes and tree ring width with the focus on increasing drought and CO₂, on measured tree ring data.