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δ^2H, δ^{13}C and δ^{18}O isotopes in oak trees. Relationship between earlywood and latewood.

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We measured the δ^{18}O, δ^{13}C as well as δ^2H isotopic compositions both in earlywood and latewood from an oak forest (Quercus sp.), situated in the Swiss "Mittelland", by an Isotope Ratio Mass Spectrometer (IRMS) linked to a Thermo Chemical Elemental Analyzer TC/EA (Leuenberger and Filot, 2007; McCarroll and Loader N.J., 2004).

A comparison of isotope compositions between early- and latewood can help us to investigate and understand the processes of plant metabolism in more detail. The fact that we found excellent correlations between current early- and latewood (r^2= 55 %) ($p<0.0001$) and between current earlywood and previous latewood (r^2= 68 %) ($p<0.0001$) for carbon isotopes strengthens the common knowledge that atmospheric CO_2 acts as the major carbon source and that there is hardly any carbon exchange within the tree reserves. This was found to be different for both the hydrogen (this study) and oxygen isotopes (Waterhouse, 2013; this study) – low correlations for early- and latewood (r^2 = 0-8 %), but stronger correlations between earlywoods of several years back and forward in time (r^2 = 23-30%) –, documenting that tree reserves (starch, glucose) carry a long term common signal for those isotope species. In addition, the absent correlation between current latewood and latewoods of several years forward and back in time (r^2 = 0-5 %) manifest the higher variability of direct assimilates during the latewood period (Borella et al., 1998; Helle and Schleser, 2004). Based on these observations isotope incorporation models need to be revised taking into account the re-allocation of reserves from the roots (starch) to the twigs and stem glucose in winter that is further been used for leaf formation. Extensions of already existing models (Roden, 2000) are presently undertaken, within the iTREE project funded by the Swiss National Science Foundation. We distinguish glucose, starch and cellulose in the leaf, stem and root compartments. The cellulose production takes places during June to August whereas the reserves (glucose and starch) are built from August to October. Yet the model allows to explain only a quarter of the observed carbon isotope variability.

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