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A European network analysis of oxygen isotopes in tree-rings: Concept and first results

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Oxygen isotopes in tree rings are seen as a powerful tool for the reconstruction of past atmospheric conditions such as the isotopic composition of precipitation, air temperature, precipitation amount, relative air humidity, or even atmospheric circulation patterns. There exist, however, still uncertainties regarding the spatial and temporal stability of the climate signal. These uncertainties arise from the complex interplay between signals carried in the source water taken up by the roots and those produced by evaporative enrichment and (post-) photosynthetic processes at the leaf level and during downstream metabolism. Besides highly resolved physiological process studies, large data sets of broad ecological, spatial and temporal range are requested to get the best estimate under which environmental conditions the climatic signal in tree-ring δ^{18}O is maximized.
Here we present the currently largest and best replicated tree-ring δ^{18}O network with 35 European sites ranging from Fennoscandia to the Mediterranean region. Tree-ring δ^{18}O chronologies from four genera (Quercus, Abies, Cedrus, Pinus) were included in the analysis. The sampling design considered both, ecologically extreme sites at the northern and alpine treeline with temperature mainly controlling tree growth, but also temperate sites where mixed climate signals are recorded in 'traditional' growth parameters (ring width and maximum late wood density). All chronologies are annually resolved and fully cover the 20th century, seventeen chronologies reach 350 years back in time and at least eight chronologies cover the last 1000 years. We will discuss results from (i) signal strength analyses within the networks, (ii) spatial network analyses and (iii) calibration of isotopic parameters with climatic variables such as temperature, precipitation and drought, but also with indicators of atmospheric circulation patterns. We will detail common variance within European sub-regions and emphasise the reconstruction potential of annually resolved δ^{18}O from tree rings with a special focus on variation in European air mass trajectories.