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Investigating the seasonal origin of soil and xylem water in Italian mountain catchments

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Stable isotopes of hydrogen and oxygen are useful tracers for investigating the water sources exploited by plants for transpiration. Recent studies focused on the analysis of the temporal origin of soil and xylem water, and showed that many plant species, during the growing season, tend to take up water originating from winter rainfall events. However, the climate and biophysical factors controlling the temporal origin of soil and xylem water are still unclear. Given this background, this study aims to *i)* evaluate the seasonal origin of soil and xylem water by using the so-called Seasonal Origin Index (SOI), and *ii)* investigate the climate drivers and biophysical controls influencing the seasonal origin of xylem water.

For this, we used isotopic data in precipitation, soil and xylem water along an Italian climate and topographic transect, including four Alpine and pre-Alpine catchments (Dora del Nivolet, Grangia dell'Alpe, Matsch/Mazia, and Ressi) in northern Italy, and two Apennine catchments in central (Re della Pietra) and southern Italy (Gorga). Soil samples at different depths up to a maximum depth of 1 m and vegetation samples were collected fortnightly during the growing seasons in the period 2020-2022, whereas bulk precipitation was collected fortnightly or monthly throughout the year. Vegetation samples included lignified twigs or wooden cores from different tree species (i.e., beech, chestnut, and larch) as well as roots from shrub species typical of Alpine grasslands.

The dual-isotope plot evidenced a marked isotopic variability in water samples among the different sites, particularly for precipitation. Soil water reflected the seasonal variability observed in precipitation in all study sites, although the isotopic signal was affected by evaporative processes, particularly marked in the shallow soil layers. The isotopic composition of xylem water showed that in most study areas these samples had predominantly a spring and summer origin, except for soil and xylem water in the two Apennine catchments which had a strong winter (Re della Pietra) and summer origin (Gorga). So far, no clear relations between the average SOI for soil water and xylem water and climatic indicators (e.g., rainfall seasonal index) were detected. Further analyses will include other indicators which better characterize vegetation characteristics, soil properties, and terrain features.

Keywords

Xylem water, soil water, stable isotopes of hydrogen and oxygen, seasonal origin index