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Linking root extraction depths and plant contribution to evapotranspiration using isotopes of water in controlled conditions

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Analysis of the heavy stable isotopic ratios of water (^{18}O and ^{2}H) in the soil can allow determining its history since the last rainfall event: whether it has just infiltrated, re-evaporated from the soil or been extracted by the plants.

By using the natural abundance in ^{18}O and ^{2}H of the atmospheric water vapour, and when making specific hypothesis, it is possible to identify and quantify its different sources (vegetation and soil at different scales) and realise a partition of evapotranspiration fluxes into plant transpiration and soil evaporation.

The study of all the interactions at the field scale is still very difficult due to the large number of controlling variables describing climate, vegetation and soil characteristics. A monolith experiment (including soil and growing plant) was carried out in a reactor called RUBIC (Reactor Used for Continental Isotopic Biogeochemistry, Bariac et al., 1991). Controlled conditions allowed a monitoring and regulation of climatic parameters (net radiation, air temperature, vapour pressure deficit, CO_2 partial pressure, and wind speed). It was also necessary to fix soil (structure, texture, and water content) and vegetation (specie and seeding density) parameters.

The collected data allow us to improve our understanding of the partition of evapotranspiration into soil evaporation and plant transpiration. Furthermore, the isotopic

ratios of evapotranspiration, under these controlled conditions, give us information regarding the depth of water extracted by the roots when comparing the values to the soil water isotopic profile.