A multilayer transport model of soil water isotopologues in the root zone: applications for the simulation of 18O/16O signals from wood cellulose and soil CO2 efflux

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The oxygen isotope composition of soil CO_2 efflux is strongly affected by the vertical profiles of soil moisture content and oxygen isotope ratio. This is even more so the case because recent studies showed that, due to high levels carbonic anhydrase activity by soil micro-organisms, CO_2 hydration is strongly enhanced at the surface of vegetated soils where the isotope ratio of soil water changes rapidly with depth. Similarly, because fine roots are mostly located at the soil surface, these vertical gradients in the isotopic composition of soil moisture should also affect the composition of cambial water and thence of wood cellulose. In this paper, we present a new multilayer transport model of energy and soil water isotopologues in the root zone and, using a 10-year dataset, explore to what extent the oxygen isotope compositions of soil CO_2 efflux and wood cellulose are affected by strong vertical gradients of soil water isotope ratios at the soil surface, for different levels of soil CA activity and drought intensity.