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Throughfall isotopic composition effects on ecohydrological analyses: moving beyond solving canopy interception puzzles

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Canopy interception changes the isotopic composition of precipitation. However, it is difficult to predict or explain the seemingly idiosyncratic variations in throughfall and stemflow isotopes. This is problematic because these variations are hypothetically important for the interpretation of stable isotopes in studies of soil-plant interactions. Quantifying how sensitive ecohydrological isotope applications are to canopy interception effects also requires understanding how isotopic signals propagate through soils or plants. The isotopic variability caused by canopy interception may be inconsequential, depending on how infiltrating waters mix with stored waters. Thus, it is worthwhile to consider soil water's sensitivity to precipitation inputs prior to the isotopic-puzzle-solving exercise of characterizing canopy-interception effects. Here, I examine whether we need to characterize the isotopic effects of canopy interception for accurate use of isotopes in soil-plant interaction studies. Results from a spatially intensive field study (140 measurement points in 1 ha) showed weak correlation between spatial patterns of soil water and spatial patterns of throughfall isotopes. These data illustrate that variations in soil water isotopic composition are largely controlled by other processes. Another dataset of soil- and plant- water isotopes, collected in 190 sites across Switzerland, suggests that soils contain precipitation from a span of many previous months. The long integration times of water in soils provide context for interpreting the patterns of throughfall isotope heterogeneity, as described in many past studies. This analysis reveals circumstances where canopy-interception effects would significantly bias ecohydrological stable isotope applications. However, the long integration times of soil water likely negate many of the effects that interception has on isotopes.