Water Isotopes and Climate Workshop Abstract

Title: Numerical modeling of stable water isotope signatures for investigations in ecohydrologic separations

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Water isotope signatures have been used as environmental tracers across hydrologic disciplines to trace precipitation as it traverses from the atmosphere through the land surface and into stream channels. In hydrologic models, soil reservoirs are often assumed to be well mixed and precipitation entering the bulk soil matrix is integrated into soil moisture with can then be discharged to the stream. However, recent work has shown evidence of ecohydrologic separations (i.e. compartmentalization of space and time) between root water and stream water, indicating distinct soil water pools within the bulk soil matrix. This separation has been explained by the presence of mobile and immobile regions within the soil column that are reflections of the temporal variation in the isotopic composition of precipitation events. The objective of this study was to test this hypothesis using the soil hydrologic model Hydrus-1D by incorporating stable water isotope (δ^2H and $\delta^{18}O$) time series datasets of precipitation, soil moisture, and stream discharge from Watershed 10 at the H.J. Andrews Experimental Forest. The Hydrus-1D dual porosity function enables partitioning of the soil column into different mobile and immobile regions each with their own respective set of soil hydraulic parameters. Precipitation events are 'tagged' and isotope signatures are modeled in time and space within the mobile and immobile soil regions distinctly. An ensemble of modeled potential hydrologic partitions is compared with observed isotope signatures, and suggests evidence for mobile immobile fractions arising from ecohydrologic separations in soils. The results provide evidence for the value of hydrologic signatures in modeling and the interpretation of subsurface transport mechanisms. Broader implications of this work relate to understanding contaminant and solute movement through environmental systems.