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Soil - the critical switch of water pathways

Hans-Joerg Vogel, Ulrich Weller, and Ute Wollschläger
Helmholtz Center for Environmental Research - UFZ, Soil Physics, Halle, Germany (hjvogel@ufz.de)

Generally, the port of entry for water into terrestrial systems is the soil surface. The subsequent flow path of any water molecule towards productive transpiration, nonproductive evaporation, seepage to groundwater or surface runoff is decided within the upper decimeters of soil. Moreover, a substantial fraction of 70% of the Earth's freshwater resources is used by agriculture. Thus, let's say soil is relevant.

The dynamics of water within the unsaturated soil is mostly vertical, since the gradients in the gravitational field of the Earth are typically pointing either upwards or downwards. Thus a relevant scale for modeling soil water dynamics is the vertical profile across different soil layers having different hydraulic properties.

Based on these considerations and having in mind the management of water resources some crucial questions pop up: i) To what detail do we need to know the basic soil hydraulic properties (i.e. water retention characteristic and unsaturated hydraulic conductivity function)? ii) How useful are sophisticated lab measurement to predict what is happening in the field? How to handle the highly non-linear change in flow paths as a function of the hydraulic state and its history? These questions are addressed based on the evidence of field measurements. Then, another crucial question is how to connect soil hydrology to the larger scales which, depending on the context, might be relevant as well.