Groundwater recharge and land surface/vadose zone hydrology - is there a connection?

Erwin Zehe (1) and Theresa Blume (2)

(1) Chair for Hydrology, Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany (e.zehe@bv.tum.de, +49-(0)89-28923172), (2) GFZ German Research Centre for Geosciences, Section 5.4 Hydrology

Groundwater recharge seems to be "the poor cousin" even in the field of soil hydrology. Soil structure and vegetation controls on runoff generation and especially vadose zone flow and transport are frequently addressed in scientific studies. While possible contamination of groundwater resources is often the motivation these studies, groundwater recharge and contaminant loads are often regarded as being equivalent to the lower boundary condition but rarely quantified in an explicit manner.

So where is the connection between surface and vadose zone hydrology and groundwater recharge? We understand in principle that the unsaturated zone acts as a non linear "low pass" filter for surface water, energy and mass flows across the soil surface; the spectrum of groundwater recharges is thus deemed to be shifted towards the red. We furthermore understand that the age of the water that recharges groundwater resources depends on the spectrum of flow velocities and the lengths of the flow paths in the vadose zone. However, it is not straight forward to translate these "common grounds" into quantitative terms for catchments of interest.

How do residence times and red shift in the vadose zone filter depend on vadose zone depth and properties, but especially on root zone depth and apparent preferential flow paths? How will changes in the precipitation and thus soil moisture regime affect residence times and red shift in the vadose zone filter Can we identify "hot spots" of groundwater recharge and how are they controlled by vegetation and transpiration? The proposed study will explore these questions for three headwater catchments in different hydro climatic conditions based on available long term tracer data and process based modelling.