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Investigation of groundwater recharge in arid environments using combined Geophysical and Isotopic techniques

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Understanding groundwater recharge is essential for the proper management of the scarce water resources of arid regions. However, obtaining reliable recharge estimates in such environments is made extremely complicated by the high evapotranspiration rates that by far exceed the little and erratic precipitation amounts resulting in very small water fluxes to percolate through immensely thick unsaturated zone (Philips, 1994; Scanlon et al. 1997).

The vadose zone water fluxes that constitute the generally assumed little amount of recharge are primarily controlled by hydraulic and thermal processes in the thick unsaturated zone as well as by the amount, intensity, and temporal distribution of precipitation. Thus, any effort aimed at deriving good recharge estimates requires an in-depth investigation of these variables (e.g Pfletschinger et al. 2011).

Sand dune areas and wadi floors in the hyper arid deserts of the Kingdom of Saudi Arabia were selected for this study as they are often considered as the typical locations for potential groundwater recharge in such settings. Direct-push technique using Geoprobe (7720DT) was used to retrieve undisturbed soil samples down to depths of about 15 m of the vadose zone. The drilled boreholes were used for the installation of specially designed flat-cable TDR sensors that provide continuous monitoring of the soil moisture fluctuations in high vertical resolution. In addition, a nest of temperature sensors were installed to obtain vertical temperature profiles in the unsaturated zone. GPR imaging and several infiltration tests were also performed.

We present data on the analyses of soil samples as well as on the observed water content distribution over time as determined by the TDR flat-band cables. Preliminary results from the sand dune areas show high penetration depths of water fluxes than would be suggested by field capacity computations and the infiltration front penetration depths shown by the installed TDR sensors.

Reference

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