



Quantification of groundwater recharge through application of pilot techniques in the unsaturated zone.

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Accurate determination of groundwater recharge is a key issue for the “smart mining” of groundwater resources. Groundwater recharge estimation techniques depend on the investigated hydrologic zone, and therefore main approaches are based on (a) unsaturated zone, (b) saturated zone and (c) surface water studies. This research contributes to the determination of groundwater recharge by investigating the infiltration of groundwater through the unsaturated zone. The investigations are conducted through the application of a combination of different pilot field as well as lab techniques. The field techniques include the installation of specially designed Time Domain Reflectometry (TDR) sensors, at different depths within the unsaturated zone for in-situ and continuous measurements of the volumetric pore water content. Additionally, the extraction of pore water -for analysis of its isotopic composition- from multilevel undisturbed soil samples through significant depths within the unsaturated zone column, enables the dating of the groundwater age through the determination of its isotopic composition. The in-situ investigation of the unsaturated zone is complemented by the determination of high resolution temperature profiles.

The installation of the pilot TDR sensors is achieved by using direct push methods at significant depths within the unsaturated zone, providing continuous readings of the soil moisture content. The direct push methods are also ideal for multilevel sampling of undisturbed -without using any drilling fluids which affect the isotopic composition of the containing pore water- soil and consequent extraction of the included pore water for further isotopic determination.

The pore water is extracted by applying the method of azeotropic distillation; a method which has the least isotopic fractionation effects on groundwater samples. The determination of different isotopic signals such as ^{18}O , ^2H , ^3H , and ^{36}Cl , aims to the investigation of groundwater transit times as well as preferential flow paths through the unsaturated zone.

The synthesis of all the aforementioned methods, is expected to result to the accurate quantification of groundwater recharge in space and time through the unsaturated zone.

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