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Advancing in the estimation of effective recharge and its propagation in karst aquifers by combining soil moisture observations and the natural responses of springs. An example from Southern Spain.

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Improving our comprehension of infiltration processes in karst systems is crucial for a better adaptation to the global change regarding water resources availability and management. In this work, the effective recharge under different meteorological conditions and its transfer along the vertically distributed compartments of a geologically complex karst aquifer in southern Spain have been evaluated. Continuous records of soil moisture and temperature values (at 5 and 10 cm depth and the soil-rock transition -average depth of 28 cm-) have been combined with hourly hydrodynamic and hydrothermal responses recorded at two springs with a marked influence of the unsaturated zone (UZ) and the saturated zone (SZ), respectively.

Most rainfalls generate soil moisture signal in the shallowest probes. However, a mean increase of soil water content of 10.5% in summer (from background values of 2.5%) and 6.1% in autumn-winter (from 9.6%) at the soil-rock interface were needed to produce hydrodynamic responses in the system: first in the spring related to the UZ, with a time delay of 4-9 hours after moisture peaks, and then (14-18 hours) in the spring draining the SZ, but only during autumn-winter recharge events. In addition, recharge caused decreases (up to 0.9°C) in the temperature of the water drained by the first spring, while lagged rises (up to 0.6°C) occurred in the second outlet.

Transmission of the input signal would be favoured by stronger karstification, but the presence of inter-bedded detrital formations in the lithological sequence of the aquifer (partially confined in the SE border) filter and buffer groundwater flows before being drained by the spring related to the SZ. These findings will help to assess thresholds for effective infiltration and to predict groundwater recharge in karst aquifers under different climate change scenarios.