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Setting up a groundwater recharge model for an arid karst system using time lapse camera data

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Groundwater is the principal water resource in most dryland areas. Therefore, its replenishment rate is of great importance for water management. The amount of groundwater recharge depends on the climatic conditions, but also on the geological conditions, soil properties and vegetation.
In dryland areas, outcrops of karst aquifers often receive enhanced recharge rates compared to other geological settings. Especially in areas with exposed karst features like sinkholes or open shafts rainfall accumulates in channels and discharges directly into the aquifer. Using the example of the As Sulb plateau in Saudi Arabia this study introduces a cost-effective and robust method for recharge monitoring and modelling in karst outcrops. The measurement of discharge of a small catchment (4.0 x 104 m2) into a sinkhole, and hence the direct recharge into the aquifer, was carried out with a time lapse camera observing a v-notch weir. During the monitoring period of two rainy seasons (autumn 2012 to spring 2014) four recharge events were recorded. Afterwards, recharge data as well as proxy data about the drying of the sediment cover are used to set up a conceptual water balance model. This model was run for 17 years (1971 to 1986 and 2012 to 2014). Simulation results show highly variable seasonal recharge-precipitation-ratios, which underlines the nonlinearity between recharge and precipitation in dryland areas. Besides the amount of precipitation this ratio is strongly influenced by the interannual distribution of rainfall events.