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Evaluating the changing discharge behaviour of a karst spring (Hammerbach, Austria)

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The Hammerbach spring (Austria) receives concentrated allogenic recharge from the sinking stream Lurbach in addition to the (diffuse) autogenic recharge from the Tanneben karst plateau. The variability of the hydrograph of this spring appears to be damped since a flood event in August 2005. In order to assess whether the changed discharge behaviour is caused by changing recharge conditions or by changes within the karst system itself, master recession curves were constructed for the time periods before and after the flood in August 2005. The resulting master recession curves suggest that the recession behaviour has strongly changed since August 2005: The recession is much slower and thus baseflow remains higher than in the years before. Since the hydrograph recession is believed to be controlled by the karst aquifer itself rather than by the recharge conditions, this finding suggests that changes have occurred within the karst system, most likely within the conduit system (e.g. sediment aggradations constricting a conduit pathway). To further confirm this hypothesis and to improve our understanding of the potential changes within the karst system a lumped conceptual rainfall-runoff model was employed. The spring hydrograph was split in several time periods and the model was calibrated for different time periods and validated on the other time periods. The results clearly indicate that the damped discharge behaviour observed after the major flood event in August 2005 cannot be simulated appropriately using the parameter sets of the other periods and vice versa. In contrast, the drought period in the year 2003 is reasonably simulated using the parameter sets of the other calibration periods aside from the parameter set of the period of damped behaviour. This supports the idea that changing recharge is not the main cause driving the damped behaviour of the years following the major flood event in August 2005. The calibrated value of the exchange parameter, which represents flow to or from neighbouring catchments in this rainfall-runoff model, indicates an increased flow diversion to other catchments after this major flood event. This may be related to an increase in the overflow to the nearby Schmelzbach spring, which is known to occur at high water conditions (see Wagner et al., Geophysical Research Abstracts, Vol. 13, EGU2011-7962, 2011). Thus, the findings from the conceptual hydrological modelling provide additional insight into the mechanisms that may have caused the observed changes in the discharge behaviour.