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Selected Micropollutants as Indicators in a Karst Catchment

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High flow dynamics and variations in water quality are typical for karst springs and reflect the complex interaction of different flow and storage components within a karst system. Event-based monitoring of mobile micropollutants in spring water combined with information on their input is used (1) to quantify the impact of certain contamination scenarios on spring water quality and (2) to gain additional information on the intrinsic characteristics of a karst system.

We employ the artificial sweeteners acesulfame and cyclamate as source specific indicators for sewage along with the herbicides atrazine and isoproturon for agriculture.

The study site is the 45 km^2 rural catchment of the perennial karst spring Gallusquelle in SW-Germany (mean discharge: 0.5 m^3/s). Overflow events of a stormwater detention basin (SDB, combined sewer system) are known to impact water quality. Most of the sewer system is situated in the SW of the catchment. Most agricultural land is found in the NE. Neither atrazine nor significant amounts of isoproturon were detected in wastewater. Concentrations and mass fluxes of acesulfame and cyclamate in wastewater were determined.

The combined evaluation of the persistent compound acesulfame with the rather degradable cyclamate allows for the distinction of long and short transit times and thus slow and fast flow components. The same applies for atrazine (persistent) and isoproturon (degradable). In Germany, acesulfame was licensed in 1990, atrazine was banned shortly after, in 1991.

During low flow conditions only atrazine (max. 4 ng/L) and acesulfame (max. 20 ng/L) were detected in spring water. After a recharge event without SDB overflow concentrations as well as mass fluxes of both compounds decreased, reflecting an increasing portion of event water in spring discharge. A breakthrough of isoproturon (max. 9 ng/L) indicated the arrival of water from croplands. After a recharge event accompanied by a SDB overflow cyclamate was detected at max. 28 ng/L. Simultaneously, acesulfame concentrations show superposition of background dilution (old component) and a breakthrough (fresh component, max. 22 ng/L). 1-D-transport-modelling of the cyclamate breakthrough revealed results that are in good agreement with the results of other studies. Analyses of micropollutants might become very sensitive tools in karst hydrogeology where natural background concentrations and signal dampening are limiting factors for conventional investigation methods.