Geophysical Research Abstracts
Vol. 16, EGU2014-1700, 2014
EGU General Assembly 2014

Using artificial sweeteners to identify contamination sources and infiltration zones in a coupled river-aquifer system

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In shallow or unconfined aquifers the infiltration of contaminated river water might be a major threat to groundwater quality. Thus, the identification of possible contamination sources in coupled surface- and groundwater systems is of paramount importance to ensure water quality. Micropollutants like artificial sweeteners are promising markers for domestic waste water in natural water bodies. Compounds, such as artificial sweeteners, might enter the aquatic environment via discharge of waste water treatment plants, leaky sewer systems or septic tanks and are ubiquitously found in waste water receiving waters.
The hereby presented field study aims at the (1) identification of contamination sources and (2) delineation of infiltration zones in a connected river-aquifer system. River bank filtrate in the groundwater body was assessed qualitatively and quantitatively using a combined approach of hydrochemical analysis and artificial sweeteners (acesulfame ACE) as waste water markers.
The investigated aquifer lies within a mesoscale alpine head water catchment and is used for drinking water production. It is hypothesized that a large proportion of the groundwater flux originates from bank filtrate of a nearby losing stream. Water sampling campaigns in March and July 2012 confirmed the occurrence of artificial sweeteners at the investigated site. The municipal waste water treatment plant was identified as point-source for ACE in the river network. In the aquifer ACE was present in more than 80% of the monitoring wells.
In addition, water samples were classified according to their hydrochemical composition, identifying two predominant types of water in the aquifer: (1) groundwater influenced by bank filtrate and (2) groundwater originating from local recharge. In combination with ACE concentrations a third type of water could be discriminated: (3) groundwater influence by bank filtrate but infiltrated prior to the waste water treatment plant. Moreover, the presence of ACE at elevated concentrations in aquifer zones dominated by local recharge indicated another point-source of domestic waste water.
The combined analysis of ACE and conventional hydrochemical data proved to be useful to identify different sources of waste water. It is shown that the combination of physicochemical parameters and artificial sweeteners allow for a clear delineation of infiltration areas in the investigated aquifer system.