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Combination of geochemical and hydrobiological tracers for the analysis of runoff generating processes in a lowland catchment

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Since lowlands are characterised by flat topography and low hydraulic gradients, groundwater inflow has a large influence to streamflow generation in such catchments. In catchments with intense agricultural land use, artificial drainages are often another major contributor to streamflow. They shorten the soil passage and thus change the matter retention potential as well as runoff dynamics of a catchment. Contribution of surface runoff to streamflow is usually less important in volume. However, due to high concentrations of agrochemicals, surface runoff can constitute an important entry pathway into water bodies, especially if strong precipitation events coincide with fertilizer or pesticide application.

The DFG funded project "Separating surface runoff from tile drainage flow in agricultural lowland catchments based on diatoms to improve modelled runoff components and phosphorous transport" investigates prevalent processes in this context in a 50 km^2 lowland catchment (Kielstau, Schleswig-Holstein, Germany) with the goal of improving existing models. End Member Mixing Analysis (EMMA) is used in the project to determine the relative importance of groundwater, tile drainage and surface runoff to streamflow at daily time steps. It became apparent that geochemical tracers are suitable for distinguishing surface runoff, but are weak for the separation of tile drainage and groundwater influence. We attribute this to the strong and complex interaction between soil water and shallow groundwater tables in the catchment.

Recent studies (e.g. Pfister et al. 2011, Tauro et al. 2013) show the potential of diatoms as indicators for hydrological processes. Since we found diatoms to be suitable for the separation of tile drainage and stream samples (Wu et al., unpublished data) in our catchment, we are able to include diatom derived indices (e.g. density, species moisture indices, diversity indices) as traces in EMMA. Our results show that the inclusion of diatom data in the EMMA dataset improves the ability to distinguish tile drainage, groundwater and surface runoff influence to streamflow in our agriculturally dominated lowland catchment.

Keywords: tile drainage, surface runoff, groundwater, hydrograph separation, EMMA, dia-toms, water quality, lowland catchments

References:
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