Dissolved Organic Carbon export from a headwater catchment: high-frequency monitoring and high-end modelling in order to reveal source area and transport dynamics in the field.

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Dissolved organic carbon (DOC) in surface waters used for drinking water is expensive to remove. The riparian zone of headwaters is the dominant source zone of DOC in temperate climates, where hydrological connectivity is defining potential DOC export loads and their temporal patterns. Thus, the spatiotemporal pattern of DOC source areas is driven by soil moisture dynamics, rainfall rate, and the hydromorphological set-up of the riparian zone. These factors determine the paths of overland and lateral subsurface flow that unlock localized DOC source areas and carry the released DOC to the stream.

In order to better understand the mechanisms and variability of DOC release we selected a 2.58 km^2 headwater catchment in the Harz mountains (Germany) and intensively monitored DOC quality in the stream water during runoff events in several seasons whilst monitoring groundwater levels and DOC quality in a 3600 m^2 extensively monitored plot with a network of 25 piezometers. A detailed Digital Elevation Model was obtained from drone-based altimetry. We used the data to set up the integrated hydrological model Hydrogeosphere for the riparian zone of this catchment because it has the capability to simulate detailed saturated-unsaturated subsurface flow combined with overland flow, taking into account the details of the surface topography.

Fingerprints from DOC quality from instream samples were taken over the course of typical rainfall-runoff events in different seasons and compared to riparian groundwater samples utilizing a detailed characterization of DOC species based on high resolution mass-spectrometry (FT-ICR-MS). We used similarities in DOC fingerprints for stream and groundwater to relate DOC export events to specific source locations.

The interaction of intensive monitoring and advanced modelling in order to characterize the driving factors of the spatiotemporal dynamics of DOC source zones in headwater catchments will advance our understanding of DOC release to streams and creates knowledge, which can be used for DOC- export models.