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# On the value of terrestrial diatoms as a tracer for fast flow path connectivity of source areas in a nested catchment setup

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Hydrological connectivity between different landscape units and flow paths to the stream has gained much attention in hydrological science. Much of recent work focused on threshold sequencing of spatial sources in upland forested watersheds, on hydrological connectivity and its spatial patterns of in the hillslope-riparian-stream (HRS) continuum. Hydrological connectivity is often strongly non-linear and controls runoff response and stream chemistry. Tracer applications are often limited in scale or by the number of available tracer. Due to these limitations fast flow path connectivity in the HRS continuum is still difficult to decipher. Recently diatoms, one of the most common and diverse algal groups that can be easily transported by flowing water due to their small size ($\sim$10 to 200 $\mu$m), were used to detect the onset and cessation of surface runoff to small headwater streams and constrain isotopic and hydro-chemical hydrograph separation methods. Here we hypothesize that diatoms can be a valuable tool to determine fast flow path connectivity between their habitat and the stream over various scaled catchments. This can support and constrain hydrometric and other tracer methods and increase understanding of runoff generation processes. In this study we used seven nested sub-catchments (0.47 sqkm to 250 sqkm) with clean and mixed geologies and landuse types within the Attert River catchment to test our hypothesis.
In a first step, we categorized the prevailing diatom communities based on their habitat in the HRS continuum. Second, we installed automatic samplers at every catchment outlet and sampled a storm event for diatom communities. The documented changes in diatom assemblages during flood hydrographs serve as a proxy of increased connectivity of fast flow paths at all investigated spatial scales. Diatoms proved to be a valuable scale independent tracer to detect fast flow path connectivity in the HRS system. We found more than 40 different species living outside the stream environment that can be used as natural tracer to indicate connectivity from their habitat to the stream. Further, diatoms can indicate temporal variability of contributions from different physiographic units to runoff in meso-scale catchments.