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Diatoms as a tracer of hydrological connectivity: the Oak Creek case study (Oregon, USA)

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The vast heterogeneity and complexity of rainfall-runoff transformation processes expresses itself in a multitude of water sources and flowpaths – ultimately resulting in the well-known intricacy of hydrological connectivity.
Pioneering work of Pfister et al. (2009) conducted in the Weierbach catchment (0.45 km2, NW Luxembourg, semi-oceanic climate) demonstrated the potential for diatoms (unicellular, eukaryotic algae) to be used as a tracer of hydrological connectivity. Diatoms originating from terrestrial habitats had been shown to be systematically flushed from the riparian areas into the stream during storm events.
Here, we present a study conducted in the Oak Creek(0.17 km2, Oregon, Mediterranean climate), characterised by a large riparian area. Our first working hypothesis (H1) stipulates that diatoms are an ubiquitous tracer of fast hydrological flowpaths. The second hypothesis (H2) states that the riparian area is the major reservoir of terrestrial diatoms that contributes to the flushing process during rainfall events.
A winter rainfall-runoff event was monitored in March 2012. Diatom samples were collected from soil, moss, epipelon and streamwater in order to characterise the communities along the hillslope-riparian-stream (HRS) continuum. Diatoms in each sample were also assigned to different wetness categories (according to Van Dam et al., 1994). The catchment was instrumented with an ISCO automatic streamwater sampler and the samples were analysed for conductivity, 18O, 2H, chemical elements and presence/abundance of diatoms belonging to different wetness categories.
Our results show that the percentage of diatom species originating from habitats located outside of the stream evolves along the rising and falling limbs of the hydrograph. This observation confirms the event-related flushing of diatoms from terrestrial habitats to the stream and, consequently, the potential for diatoms to be used for the detection of hydrological connectivity in the hillslope-riparian-stream continuum (H1). Moreover, almost no strictly terrestrial diatoms were found in the stream during the event, indicating the majority of the diatoms (identified as aerophytic) being exported from the riparian area (H2).