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New insights into hydrological connectivity in the hillslope-riparian-stream system through the use of terrestrial diatoms

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Diatoms (Bacillariophyta), one of the most common and diverse algal groups (ca. 200000 species, $\sim$10-200 μm, unicellular, eukaryotic algae), have recently been used as novel, natural tracers to infer connectivity in the hillslope-riparian-stream system. In the schistous Weierbach catchment (0.45 km2, NW Luxembourg), terrestrial diatom abundance in the stream systematically increased with precipitation during several events, suggesting rapid connectivity between the soil surface and stream water. Nevertheless, a marginal contribution of overland flow to stream water was determined using end-member mixing analysis with geochemical and water isotope tracers. These contradictory results raised new questions regarding how terrestrial diatoms, living on the soil surface, reached the stream network. Taking into consideration that no diatoms were found in groundwater samples, we first hypothesised that flushing of the terrestrial diatoms may take place through networks of macropores in the shallow soils of the catchment. This hypothesis was tested by conducting laboratory percolation experiments with fluorescent diatoms (see contribution by Tauro et al. in session HS2.4) and results suggest that diatom flushing through the soil cores does not occur. A second hypothesis arose when performing simulated rainfall events to determine diatom population depletion. Simulated rainfall experiments showed that terrestrial diatom populations in the riparian zone deplete in response to rainfall. These field and laboratory experimental results suggest that terrestrial diatoms may reach the stream suspended in event water via – yet undocumented – surface or near-surface pathways. Surface saturated and subsurface mixing processes in the riparian zone are currently being investigated in the catchment using water isotope and geochemical tracers, infrared thermography and piezometers (see contribution by Frentress et al. in session HS2.4). Further research will focus on pathways that terrestrial diatoms located further from the stream network (i.e. hillslopes) use to reach the stream. Ultimately, we seek to combine these results from multi-tracer studies to develop an improved, holistic understanding of catchment behaviour.