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Taking the temperature of living rivers: on new ways to explore water source and connectivity

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At present, our conceptual understanding of catchment-scale water mixing, source apportionment and hydrological connectivity suffers from measurement limitations. While significant progress is being made in related areas of physical hydrological science with new wireless sensor arrays, new geophysical approaches, new fibre optic approaches, few advances have been made in recent years in water quality approaches using new or different water tracer techniques.

Our recent work in the Attert watershed (Luxembourg, Europe) has shown how a new hydrologic tracer technique, employing drift diatoms, offers great potential for tracing spatial sources and detecting on/off initiation of surface runoff during precipitation events. Diatoms sampled in the stream during runoff events appear to have the ability to record their geographic origins (in terms of hydrological response units – HRUs) at the watershed scale. More specifically, the drift diatoms have the potential for providing information on surface runoff processes that could extend considerably the insights given by existing isotope and geochemical tracers.

In the same context, the potential for infrared thermography is investigated for a better targeting of diatom sampling spots in key areas of the various hydrological response units of the experimental catchments under investigation. This new, affordable remote sensing technology, produces high-resolution thermal imagery of saturated areas. These images offer great potential for identifying, characterizing and classifying surface runoff. Additional information gained through this technology will consist in the timing and duration of hydrologic mechanisms contributing to surface runoff (i.e. infiltration excess overland flow and saturation excess overland flow).

Applied in conjunction with diatoms, geochemical and isotopic tracers, infrared thermography will contribute to calibrate and test the complementarity of multiple tracer approaches to de-convolute the stream hydrograph during storm events. Overall, the first successful application of these techniques in the Attert watershed (Luxembourg) demonstrated their potential for a new and idependent perspective on runoff generation processes in experimental hydrology and might help to substantially advance our process knowledge in combination with traditional tracer measurements.