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Using initial field campaigns for optimal placement of high resolution stable water isotope and water chemistry measurements

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Understanding hydrological processes and flow paths is of major importance for the management of catchment water resources. The power of stable isotopes as a tracer and to encoder environmental information provides the opportunity to assess hydrological flow paths, catchment residence times, landscape influences, and the origin of water resources in catchments. High resolution isotope sampling of multiple sources ensures detailed comprehension of hydrological and biogeochemical interactions within catchments. Technical advances over the last years have made it feasible to directly measure stable water isotope signatures of various sources online in a high temporal resolution during field campaigns. However, measuring long time series in a high temporal resolutions are still costly and can only be performed at few places in a study area. The identification of locations where measurements should be implemented is still challenging.

Our study is conducted in the developed landscape of the Schwingbach catchment located in central Germany. A reconnaissance assessment of the spatial distribution of runoff generating areas was performed in a short time frame prior to the selection of the final sampling site. We used a combination of:

- water quality snapshot sampling to identify spatial differences and potential hot spots,
- event-based hydrograph separation to differentiate possible flow paths,
- consecutive runoff measurements by salt dilution to identify gaining and loosing reaches,
- field reconnaissance mapping of potentially variable source areas in the riparian zone,
- infrared imagery of stream surface temperatures to locate potential concentrated groundwater discharge to the stream, and
- groundwater table mapping to identify sites where different dominant processes (e.g., groundwater flow, groundwater-surface water interactions and runoff generation) can be expected.

First results indicated that precipitation and stream water are significantly different in isotopic composition and groundwater is not reactive to the annual precipitation cycle. Consecutive runoff measurements revealed bidirectional water exchange between stream and groundwater where influent and effluent conditions occur at different stream sections during baseflow conditions. Moreover, stream water quality responds to land use with significant variation of nitrate concentration due to agricultural land use.

The a priori assessment of information from various sources and methods will allow us to guide the placement of high resolution stable water isotope and water chemistry measurements. We will report on the merits and drawbacks of each approach. Results will be used to select up to 12 sampling sites for a novel self-sufficient measurement system and guide the method selection for other researchers facing a similar challenge.