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High frequency sampling of stable water isotopes for assessing runoff generation processes in a mesoscale urbanized catchment

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Experimental hydrology critically relies on tracer techniques to decipher and uncover runoff generation processes. Although tracer measurements contributed significantly to a better understanding of catchment functioning, their potential is not yet fully exploited. The temporal resolution of tracer measurements is typically relatively coarse, and applications are confined to a few locations. Additionally, experimental hydrology has focused primarily on pristine catchments, and the influence of anthropogenic effects remains largely unexplored. High frequency sampling of multiple tracers may therefore substantially enhance our understanding of hydrological processes and the impact of anthropogenic effects and enable a better protection and management of water resources and water quality.

In this preliminary study we aim to assess runoff generation processes using geochemical and isotopic tracer techniques in the mesoscale Olewiger Bach catchment (24 km^2) that is located in the low mountain ranges of the city of Trier, southwest Germany. The catchment is mainly characterized by quartzite and Devonian schist, overlain by fluvial sediments. Mixed land use prevails in the southern part of the basin, while the northern lower reaches are mainly urbanized. Several waste water treatment plants, separate sewer and stormwater management systems are present in parts of the catchment and contribute to the discharge of the main river.

Tracer techniques employed in this ongoing study are twofold. A long term sampling of stable water isotopes (oxygen-18 and deuterium) was initiated in order to allow inferences about mean residence times of water in different catchment compartments, while event-based sampling using a multi-tracer approach was used to identify different runoff components and associated water pathways. Special attention is given to the observation of in-channel processes by assessing the dynamics of dissolved and particulate geochemical tracers and stable water isotopes during several controlled reservoir releases in the basin. The application of high resolution sampling of stable water isotopes employing a portable laser spectroscope is foreseen in this context.