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Insights into streamflow generation mechanisms using high-frequency analysis of isotopes and water quality in streamflow and precipitation

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In the pre-Alpine Alptal catchment in central Switzerland, snowmelt and rainfall events cause rapid changes not only in hydrological conditions, but also in water quality. A flood forecasting model for such a mountainous catchment thus requires process understanding that is informed by high-frequency monitoring of hydrological and hydrochemical parameters. Therefore, we installed a high-frequency sampling and analysis system near the outlet of the 0.7 km^2 Erlenbach catchment, a headwater tributary of the Alp river.

We measured stable water isotopes ($\delta^{18}O$, $\delta^{2}H$) in precipitation and streamwater using Picarro, Inc.'s (Santa Clara, CA, USA) newly developed Continuous Water Sampler Module (CWS) coupled to their L2130-i Cavity Ring-Down Spectrometer, at 30 min temporal resolution. Water quality was monitored with a dual-channel ion chomatograph (Metrohm AG, Herisau, Switzerland) for analysis of major cations and anions, as well as with a UV-Vis spectroscopy system and electrochemical probes (s::can Messtechnik GmbH, Vienna, Austria) for characterization of nutrients and basic water quality parameters. For quantification of trace elements and metals, we collected additional water samples for subsequent ICP-MS analysis in the laboratory.

To illustrate the applicability of our newly developed automated analysis and sampling system under field conditions, we will present initial results from the 2016 fall and winter seasons at the Erlenbach catchment. During this period, river discharge was mainly fed by groundwater, as well as intermittent snowmelt and rain-on-snow events. Our high-frequency data set, along with spatially distributed sampling of snowmelt, enables a detailed analysis of source areas, flow pathways and biogeochemical processes that control chemical dynamics in streamflow and the discharge regime.