Spatially-distributed isotopic and water quality sampling to conceptualize the runoff generation in large-scale, humid tropical catchments.

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(Poster HS2.1.9)

The scientific evidence base for understanding how rainfall is generated and partitioned into different hydrological processes in Costa Rica and the wider humid tropics is limited due to the scarcity of basic hydrological data. This makes it difficult to conceptualize the dominant runoff generation processes and severely hinders our ability to track water source dynamics. Stable isotope tracers play a crucial role to help generate low-cost additional information on hydrological water sources, fluxes and flow paths. With this background, a spatially distributed isotope monitoring in combination with basic water quality indicators is essential to strengthen hydrological analysis and to provide insights into the runoff generation processes that might facilitate conceptualization of suitable hydrological models.

A spatially-distributed isotope monitoring was established in the San Carlos River catchment (2632km2), in the north-east of Costa Rica covering an elevation range between 0 and 2,320masl. Monthly isotope sampling started in June 2018 with sample collection in 45 rivers that also cover longitudinal profiles of the most important water bodies. These surveys are supported by daily rainfall sampling for isotope analysis at one headwater site together with three historical isotope records of stations across the catchment. Further to the isotope monitoring, we collect pH, electrical conductivity, water temperature and the redox potential at all sites. Longer-term daily discharge data is available at three nested sites (3.2, 154 and 1600 km2) and complemented by 11 two-year daily historic records throughout the catchment.

A preliminary picture of the isotope hydrology of the San Carlos River showed a Local Meteoric Water Line (LMWL, $\delta^{2}H = 7.4 \times 10^{8}O + 8.8$, $R^2=0.93$) with slope of 7.4 close to that of the Global Meteoric Water Line (GMWL, slope=8). Monthly surface water isoscapes of $\delta^{2}H$ samples presented spatial variations from 1.5% to -34%. Temporal variations indicated a direct relationship to climate as the catchment is influenced by the Caribbean (enriched signatures) trade winds and to a lesser degree from Pacific (depleted signatures) precipitation. The water quality indicators showed a wide range of rivers influenced by volcanic and sedimentary geology, as well as some influence of geothermal waters.

The generated information is potentially useful to spatially evaluate a tracer-aided hydrological model in our rather data-scarce humid tropical catchment and to test if high-spatial resolution at lower-temporal sampling frequency of isotope data is able to reduce parameter uncertainty providing more robust simulations.