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High-frequency river chemistry unveils the inner workings of concentration-discharge relationships during flood events

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Shifts in water fluxes through the Critical Zone exert a major control on stream solute export, but the exact nature of this control is still obscure, especially at the scale of relatively short flood events. To address this question, here we take advantage of a new high-frequency, flood event stream concentration–discharge (C-Q) dataset. Stream dissolved concentration of major species were recorded every 40 minutes over five major flood events in 2015/2016 recorded in a French agricultural watershed using device called the "River Lab". We focus our attention on the flood recession periods to highlight how C-Q relationships are controlled by hydrological processes within the catchment rather than by the dynamics of the rain event.

We show that for C-Q relationships resulting from data acquisition over multi-year time scales and including several flood events, lumping all trends together potentially result in biases in characteristic parameters (such as exponents of a power-law fit), that are strongly dictated by data from the recession periods of the most intense floods alone.

In order to evaluate the role of mixing of pre-existing water and solute pools in the catchment, we apply to solute fluxes an approach previously developed in catchment hydrology linking water storage and stream flow. This approach, which considers that hydrological processes prevail over chemical interactions during the short time spans of flood events, allows us to reproduce at first order a large diversity of shapes of recession C-Q relationships.