C-Q relationships viewed by high frequency temporal moniroring of rivers.

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Stream concentration–discharge relationships (*C-Q*) have been used as a tool to track the coupling between water flow and chemical reactions in the Critical Zone. We present a new *C-Q* data series recorded at very high frequency (one measurement every 40 minutes) over one year in a French agricultural watershed underlain by carbonates, the Orgeval Critical Zone Observatory (OZCAR Research Infrastructure). This exploration was made possible using a "lab-in-the-field" prototype called RiverLab that performs the analysis of all major dissolved species (Na^+, Mg^{2+}, Ca^{2+}, Cl^-, SO_4^{2-}, K^+, and NO_3^-) using ion chromatographs, through continuous sampling and filtration of the river water [1]. The data generated open a new avenue of research by highlighting processes that we would not have seen with at a lower time resolution. In particular, they offer a new approach of the C-Q relationship problem. We will present the C-Q relationships generated using these high frequency data, in particular for 5 winter and spring flood events of variable intensities. The overarching message is that C-Q relationships are actually hysteresis loops and that each flood is different, depending upon the history of the floods.

Assuming that the catchment can be seen as a non-linear hydrochemical, dynamical system, and that the two relevant catchment-scale metrics that characterize water and solute release are not concentration (*C*) and discharge (*Q*), but rather elemental flux (*F*) and discharge (*Q*), we were able to reproduce at first order the diversity of shapes of observed recession *C-Q* relationships.

[1] Floury, P., (2016). The potamochemical symphony: New progress in the high-frequency acquisition of stream chemical data. *Hydrology and Earth System Sciences*, *21*(12), 6153-6165.

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