Modelling the response of stream chemistry to storm events – Reactive or passive transport?

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There already exists a wide range of reactive transport models predicitng and quantifying the influence of adsorption, dissolution and precipitation reactions on the dissolved phase in the Critical Zone [1-3]. However, only few directly address the incorporation of trace elements (*e.g.* Lithium) and the corresponding isotope fractionation which provide crucial information on processes that regulate dissolved solute concentrations, *i.e.* secondary mineral formation or uptake by vegetation. Here we present a simple set of equations based on a TST-rate law [4], considering the behaviour of trace elements and their possible isotope fractionation during precipitation and dissolution reactions to better constrain overall dissolved solute fluxes within watersheds and unreveil the underlying role of water mixing and chemical reactions for solute export-discharge relationships.

These set of reaction equations reflect several simplified aquifer geometries: a closed batch reactor configuration, and an open-flow through reactor with constant or time-varying water input, in order to simulate the effect of rain events on a catchment. To evaluate the differences in the predicitons made from this reaction model and those made from mixing models, model outputs are examined in terms of their concentration- and isotope ratio-discharge relationships. Evaluating the differences using statistical parameters points to a stronger response for reaction-induced concentration-discharge relationships than from those generated by mixing. Our model shows the potential of using simple theoretical predictions on the shape of concentration- and isotope ratio-discharge relationships as a diagnosis tool for the processes (in particular hydrological mixing *vs*. chemical reactions) underlying these relationships on the field, and therefore for the identification of the mechanisms controlling the coupling between hydrology and chemical weathering in the Critical Zone.

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