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Modelling coupled weathering and hydrological processes at the catchment scale in the Vosges Mountains

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The natural chemical composition of stream waters and soil solutions is the product of a complex combination of climate, vegetation and lithology. Stream water chemistry and its seasonality critically depends on the transfer of water through a set of surface and sub-surface reservoirs with different residence times. Water pH and hence chemical weathering is also conditioned by the soil CO2 pressure, which depends on the biological activity and the CO2 diffusivity in the surface soil horizons. We use the ASPECTS model (Rasse et al., 2001), which describes the water and carbon cycles in forest ecosystems. In this model, the soil is divided into a series of layers, in which the amount and fluxes of water and CO2 pressure are calculated. This model has been extended with a two external reservoir system to represent the influence of the aquifer and catchment saturated zone, and coupled with the WiTCh numerical model (Goddéris et al., in press) of chemical weathering in soil horizons and underlying bedrocks. Data from the Strengbach, the Longfoigneux and Wassongoutte granitic watershed (Vosges), and the 'Grands Escaliers' sandstone watershed (Vosges), were used to calibrate the model and determine the model sensitivity to mineral composition and texture of the soils and bedrocks, and to specify the size of aquifers and basin general configuration. Simulations were also performed using different meteorological inputs over several years to determine model sensitivity to climate and extreme events, and their influence on the seasonal variations in water chemistry.