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Coupled modelling of daily stream concentrations of carbon, nitrogen and phosphorus in a small agricultural watershed

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Hillslope, groundwater, near- and in-stream interactions are key processes to understand in order to reduce the impact of agriculture on natural ecosystem. Indeed, hydrologic connectivity controls the fate of the nutrients within a catchment. The dynamics of nutrients (Nitrates NO_3 and Phosphates PO_4) and dissolved organic carbon (DOC) at the outlet are the product of past agricultural practices and local climate conditions. DOC, NO_3 and PO_4 are usually studied and modelled separately and originate from wetlands, groundwater and surface flows respectively. The simultaneous modelling of these elements is an opportunity to better understand the hydrologic connectivity because of their specific spatial origin, reactivity and mobilization processes. We developed a parsimonious rainfall-runoff model coupled with solutes reactivity and transport module in an agricultural research catchment (Kervidy-Naizin, 5km²). We used a three boxes lumped model (soil, groundwater and wetland) and StorAge-Selection function (SAS-function), agricultural surplus and daily climatic variables (precipitations, temperature, evapotranspiration) in order to simulate the daily discharge and stream concentrations at the outlet. Model tests confirmed that adding constraints such as solutes concentrations to a hydrological model helped to avoid unlikely sets of parameters. Simulations also showed that air temperature and agricultural practices are the major drivers of the supply of elements available within the catchment by controlling their biogeochemical reactivity; and that water table levels and precipitations are the major drivers of the variability of the concentrations in the stream by controlling the hydrological connectivity and the mixing between sources areas.