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Combining water and pesticide data with coupled surface/subsurface hydrological modeling to reduce its uncertainty.

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In small agricultural catchments over Europe, intensive use of pesticides leads to widespread contamination of rivers and groundwater, largely due to hydraulic transfers of these reactive solutes from plots to rivers. These transfers must be better understood and described in the watershed in order to be able to propose best management practices adapted to the catchment and to reduce its contamination. The physically based model CATHY simulates interactions between surface and subsurface hydrology and reactive solute transport. However, the high sensitivity of pesticide transfers to spatially heterogeneous soil properties induces uncertainty that should be quantified and reduced. In situ data on pesticides in a catchment are usually rare and not continuous in time and space. Likewise, satellite imagery can provide spatial observations of hydrologic variables but not generally of pesticide fluxes and concentrations, and at limited scale and time frequency. The objective of this work is to combine these 3 types of information (model, in situ data, images) and their associated errors with data assimilation methods, in order to reduce pesticide and hydrological variable uncertainties. The sensitivity to spatial density and temporal frequency of the data will be evaluated, as well as the coupled data assimilation efficiency, i.e., the effect of assimilating hydrological data on pesticide-related variables. The methods will be developed using a Python package, and compared/evaluated on twin experiments using virtual data that are however generated over a real vineyard catchment, in Beaujolais, France, in order to ensure realism of the experiments, data, and associated errors.