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How to reduce uncertainties in a coupled and spatialized water quality model using data assimilation?

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Intensive use of pesticides in agricultural catchments leads to a widespread contamination of rivers and groundwater. Pesticides applied on fields are transferred at surface and subsurface to waterbodies, resulting from the interaction of various physical processes. They are also highly influenced by landscape elements that can accelerate or slow down and dissipate water and contaminant flows. The PESHMELBA model has been developed to simulate pesticide fate on small agricultural catchments and to represent the landscape elements in an explicit way. It is characterized by a process-oriented approach and a modular structure that couples different models.

In the long run, we aim at setting up and comparing different landscape organization scenarios for decision-making support. However, before considering such operationnal use of PESHMELBA, uncertainties must be quantified and reduced. Additionally, the model is physically-based, fully-spatialized which leads to a large set of parameters that must be carefully estimated. To tackle both objectives, we set up a data assimilation framework based on satellite images and *in situ* data and we evaluate the potential of Ensemble Smoother for joint variable-parameter assimilation. Assimilating surface moisture images allows for direct correction of variables and parameters on the top part of the soil. However, due to the PESHMELBA structure based on a dynamic parallel code coupler (OpenPALM), the impact of such correction on other compartments and other physical processes has to be finely assessed.

In this preliminary study, a fairly simple virtual hillslope inspired from a realistic catchment is set up and data assimilation is performed on twin experiments, *i.e.*, using virtual surface moisture images. The potential of such technique for improving the global performances of the model is scrutinized and the sensitivity to the assimilation framework (ensemble size, frequency of observations, errors, etc.) is assessed. Valuable information on the coupling functioning are obtained allowing for anticipating performances in a real case. Identified limitations of surface moisture assimilation also give precious indications about existing gaps and pave the way for multi-source data assimilation.