EGU22-10384
https://doi.org/10.5194/egusphere-egu22-10384
EGU General Assembly 2022

Which data assimilation method and data source for a multi-compartment hydrology/water quality model? Application on the PESHMELBA model in a small agricultural catchment

Emilie Rouzies[1], Claire Lauvernet[1], and Arthur Vidard[2]
[1]INRAE, Riverly, Villeurbanne Cedex, France (emilie.rouzies@inrae.fr)
[2]Univ. Grenoble-Alpes, Inria, CNRS, Grenoble-INP, LJK, 38000 Grenoble, France

Assessing pesticide transfers and fate in agricultural catchments is a major challenge to protect water ressources and aquatic organisms. To do so, physically-based, spatialized hydrological models are useful tools as they can be used to set up relevant mitigation strategies. The PESHMELBA model (Rouzies et al. 2019) is one such model that focuses on accurately simulating water and pesticide transfers both in the surface and the subsurface compartments of the soil. This model also aims at explicitely integrating and assessing the impact of landscape structures such as hedges, vegetative filter strips or ditches on transfers. To do so, the PESHMELBA model is characterized by a highly modular structure that relies on various code units standing for different physical processes in the different soil compartments. Such code units are thus coupled in a dedicated framework to reach a complete representation of the catchment with interacting processes. The resulting structure is quite complex and leads to significant difficulties to quantify and reduce the uncertainties associated to the simulation outputs.

In this study, we aim at setting a relevant data assimilation framework to reduce the uncertainty into the PESHMELBA coupled surface / subsurface water flow and reactive solute transport model. To do so, we test several data assimilation methods on hydrological and pesticide variables describing the catchment behavior. At first, these methods are implemented by combining the PESHMELBA model and surface moisture satellite images, at the small catchment scale. Different filtering and smoothing stochastic assimilation methods are explored: the Ensemble Kalman Filter, the Ensemble Smoother with Multiple Data Assimilation and the iterative Ensemble Kalman Smoother. Their abilities to retrieve moisture and pesticide concentration in the observed surface compartment but also in the deeper soil, that is not observed, are assessed. Furthermore, the conducted experiments also aim at retrieving some input parameters that characterize such different soil compartments.

Preliminary results on this part show that all tested methods only succeed in retrieving surface moisture. The Ensemble Smoother is shown to particulary outperform the other methods as it fully integrates the system dynamics. However, its performances are much more limited to retrieve moisture and input parameters in the deeper compartment due to poor correlations between the surface and the subsurface compartments. To overcome such limitation, other

sources of data are gradually integrated in the DA framework. The process is proven successfull and we explore how the corrections from the DA process can propagate to other compartments such as the river streamflow and pesticide related variables .