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

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Introduction

Development of the PESHMELBA model (Rouzies et al. 2019) to simulate pesticide transfers and fate on small agricultural catchments

✓ Simulations of heterogenous landscapes (plots, vegetative filter zones, hedges, ditches and rivers)

✓ Modular structure to explore landscape management scenarios (decision-making tool)

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**How to reduce uncertainties on PESHMELBA outputs?**

⇒ Development of a data assimilation framework to integrate different data sources

Case study

Virtual simplified catchment inspired from La Morcille catchment (Beaujolais region, France)
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Data sources (virtual) available:

- ✓ Surface moisture images (radar)
  - 6 days
  - 12 days
  - 18 days
  - 24 days

- ✓ Ponctual vertical moisture profiles (EMI)

- ✓ Pesticide concentrations in the river
Comparison of DA methods

Assimilation of surface moisture images to correct vertical moisture profiles (freq=6 days) and comparison of 3 DA methods:

- **a) Ensemble Kalman Filter**
- **b) Ensemble Smoother-Multiple DA**
- **c) iterative Ensemble Kalman Smoother**
Comparison of DA methods

Assimilation of surface moisture images to correct vertical moisture profiles (freq=6 days) and comparison of 3 DA methods:

The b) ES-MDA best improves surface moisture estimates but no strong effect of DA to correct deeper moisture.
Multi-source assimilation

DA based on b) ES-MDA + Integration of other sources of data

Surface moisture from radar + moisture profile

Catchment-averaged CRPSS score (the closer to 1, the better DA performs) on outlet pest concentration ⇒ inclusion of pesticide observation necessary to improve simulation of pest concentration.
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...but no effect to improve simulation of pest. concentration at the outlet
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⇒ inclusion of pesticide observation necessary to improve simulation of pest. concentration at the outlet
Conclusion

✓ DA framework set for pesticide transfer model PESHMELBA
✓ Ensemble Smoother with Multiple Data Assimilation identified as most efficient method for this case study
✓ Correction from a compartment hard to propagate to other compartments: ⇒ need for various data sources
⇒ Paves the way for future applications of DA at the scale of a real catchment

Thank you!

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