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On the assimilation of SWOT type data into 2D shallow-water models

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In river hydraulics, assimilation of water level measurements at gauging stations is well controlled, while assimilation of images is still delicate. In the present talk, we address the richness of satellite mapped information to constrain a 2D shallow-water model, but also related difficulties. 2D shallow models may be necessary for small scale modelling in particular for low-water and flood plain flows. Since in both cases, the dynamics of the wet-dry front is essential, one has to elaborate robust and accurate solvers. In this contribution we introduce robust second order, stable finite volume scheme [CoMaMoViDaLa]. Comparisons of real like tests cases with more classical solvers highlight the importance of an accurate flood plain modelling. A preliminary inverse study is presented in a flood plain flow case, [LaMo] [HoLaMoPu]. As a first step, a 0th order data processing model improves observation operator and produces more reliable water level derived from rough measurements [PuRa]. Then, both model and flow behaviours can be better understood thanks to variational sensitivities based on a gradient computation and adjoint equations. It can reveal several difficulties that a model designer has to tackle. Next, a 4D-Var data assimilation algorithm used with spatialized data leads to improved model calibration and potentially leads to identify river discharges. All the algorithms are implemented into DassFlow software (Fortran, MPI, adjoint) [Da]. All these results and experiments (accurate wet-dry front dynamics, sensitivities analysis, identification of discharges and calibration of model) are currently performed in view to use data from the future SWOT mission.

[CoMaMoViDaLa] F. Couderc, R. Madec, J. Monnier, J.-P. Vila, D. Dartus, K. Larnier. “Sensitivity analysis and variational data assimilation for geophysical shallow water flows”. Submitted.

[Da] DassFlow - Data Assimilation for Free Surface Flows. Computational software

http://www-gmm.insa-toulouse.fr/∼monnier/DassFlow/

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[RoDa] H. Roux, D. Dartus. “Use of Parameter Optimization to Estimate a Flood Wave: Potential Applications to Remote Sensing of Rivers”. J. Hydrology (2006).