Data Assimilation & Local Zoom for Shallow-Water Models

***J. Monnier[1], J. Marin[1]**

[1] University of Grenoble (Grenoble INP & INRIA)
Lab. LJK, France.
Jerome.Monnier@imag.fr
www-ljk.imag.fr/membres/Jerome.Monnier/

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ABSTRACT

Let us illustrate our method in a river hydraulics context. Classical network river models are based on global-net 1D St-Venant equations. In other respect, standard observations are available only in very small quantities in the main channel (water level measurements at very few gauging stations), while remote-sensed data such as satellite images are punctual in time but spatially distributed (eg snapshot of a flood extension). In order to take advantage of spatially distributed data and/or local data available outside the main channel, we elaborate a method which superposes locally a 2D shallow-water model (the local zoom model) over the 1D global shallow-water model. The superposition (coupling 1D-2D) is done using an optimal control approach. This implies the continuity at interfaces in a weak sense, and this allows to assimilate simultaneously the 2D local data into the 1D global-net model (using a variational data assimilation method, 4D-var). Thus, after convergence of the optimization process, one obtain the local zoom model coupled with the global model, *and* the local data assimilated into the global model (which allows the identification of inflow discharge and/or physical parameters for example). In other words, the local zoom model makes local data come back up to the global model.

This method is implemented into our software DassFlow [3]. Numerical results done in a toy configuration show the efficiency of the method. Given data available outside the main channel only (ie not represented by the global model), one manage to calibrate the global model using the present superposition principle. Different versions of the algorithm (based on an optimal control process) are discussed.

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