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Closing the gap between flood wave forecasting and damage prediction in support to decision.

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Effectiveness of flood early warning systgems depends significantly on the timing of the alert, which is in turn related to a rapid decision process. Endowing streamflow forecasts with a quantitative evaluation of their uncertainty and an estimate of the corresponding expected damage may facilitate, and hence expedite, such process.
This work present a flood forecasting system that can provide this additional information by combining a distributed hydrologic model with data assimilation and damage curves. The employed assimilation procedure (Ercolani and Castelli, 2017) adopts a mixed variational-Monte Carlo approach to update efficiently initial river flow, soil moisture, and a parameter related to infiltration in a hydrologic model that is part of the operational forecasting chain of Tuscany Region, Central Italy. The uncertainty of streamflow forecasts is assessed by computing the Hessian of the cost function minimized during the variational procedure. In respect to open loop simulations (i.e. runs that do not exploit discharge observations through data assimilation), such approach has the double benefit of improving forecasting accuracy and providing the corresponding confidence interval. Eventually, such estimates are coupled with flood damage curves (Arrighi et al., 2013), resulting into forecasts of damage probability that provide additional support to the early warning decision process.
The potentialities of this enhanced forecasting system are shown by applying it to real rainfall events that generated high flows in the Arno river network. Arno is the main river of Tuscany Region (about 240 km length and a basin extending over nearly 8300 km2), and, in addition, flood early warning is a relevant concern in this area, since Arno's mainstream passes through major Tuscan cities, as Florence and Pisa, that has been subject to floods (e.g. flood of November 1966). In the test cases, the information available for the decision process from the current operational setting (i.e. the hydrologic model alone) is compared with that provided by the enhanced system (i.e. the hydrologic model combined with data assimilation and damage curves), and the advantages are discussed.

REFERENCES

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