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Comparison between genetic programming and an ensemble Kalman filter as data assimilation techniques for probabilistic flood forecasting

L. Mediero, L. Garrote, A. Requena, and A. Chávez
Department of Hydraulic and Energy Engineering, Technical University of Madrid, Madrid, Spain (luis.mediero@upm.es)

Flood events are among the natural disasters that cause most economic and social damages in Europe. Information and Communication Technology (ICT) developments in last years have enabled hydrometeorological observations available in real-time. High performance computing promises the improvement of real-time flood forecasting systems and makes the use of post processing techniques easier. This is the case of data assimilation techniques, which are used to develop an adaptive forecast model. In this paper, a real-time framework for probabilistic flood forecasting is presented and two data assimilation techniques are compared. The first data assimilation technique uses genetic programming to adapt the model to the observations as new information is available, updating the estimation of the probability distribution of the model parameters. The second data assimilation technique uses an ensemble Kalman filter to quantify errors in both hydrologic model and observations, updating estimates of system states. Both forecast models take the result of the hydrologic model calibration as a starting point and adapts the individuals of this first population to the new observations in each operation time step.
Data assimilation techniques have great potential when are used in hydrological distributed models. The distributed RIBS (Real-time Interactive Basin Simulator) rainfall-runoff model was selected to simulate the hydrological process in the basin. The RIBS model is deterministic, but it is run in a probabilistic way through Monte Carlo simulations over the probability distribution functions that best characterise the most relevant model parameters, which were identified by a probabilistic multi-objective calibration developed in a previous work. The Manzanares River basin was selected as a case study. Data assimilation processes are computationally intensive. Therefore, they are well suited to test the applicability of the potential of the Grid technology to hydrometeorological research.