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Ensemble strategies better targeted to relevant sources of uncertainty for flash-flood forecasting: the 12 October 2007 case study over the Serpis river basin, eastern Spain.

Arnau Amengual (1), Giovanni Ravazzani (2), Diego Carrió (1), and Víctor Homar (1)

(1) Grup de Meteorologia, Departament de Física, Universitat de les Illes Balears, Palma, Mallorca, Spain (arnau.amengual@uib.es), (2) Gruppo di Idrologia Fisica, Dipartimento di Ingegneria Civile e Ambientale, Politecnico di Milano, Milano, Italy

On 12 October 2007, several flash-floods affected the Valencia region, eastern Spain, with devastating impacts in terms of human, social and economic losses. An enhanced modeling and forecasting of these extremes, which can provide a tangible basis for flood early warning procedures and mitigation measures over the Mediterranean, is one of the fundamental motivations of the international HyMeX programme. The predictability bounds set by multiple sources of uncertainty, and specially by convectively scale precipitation systems, require the explicit representation of these in hydrometeorological forecasting systems. Short-range ensemble prediction systems (EPSs) provide the optimal framework to generate quantitative discharge forecasts and cope with the different sources of external-scale uncertainties. We examine the performance of three distinct hydrological EPSs (HEPSs) for the small-size Serpis river basin as a support tool for early mitigation strategies. To this end, the FEST-WB model has been driven by ground stations to examine the hydrological response of this semi-arid catchment. The use of a multi-site calibration approach for the FEST-WB parameters is necessary to better cope with the high non-linearities emerging from the rainfall-runoff transformation and heterogeneities in basin response. Doing so, the hydrological model reproduces reasonably well the hydrological response to intense precipitations and, in particular, to the 12 October 2007 flash-flood. Next, the WRF model has been used to build two EPSs accounting for (i) uncertainties in the initial and lateral boundary conditions (IC/LBCs), and (ii) physical parameterizations. We have also designed an ensemble Kalman Filter (EnKF) to test the ability of ensemble data assimilation methods to represent key mesoscale uncertainties from both IC and sub-scale processes. Results indicate that to encompass inaccuracies arising from the WRF physical schemes is the most suitable forecasting strategy for this particular flash-flood. The EnKF strategy improves the performance of the perturbed IC/LBCs ensemble, but without outperforming the multiphysics approach. That is, deep convection strongly anchored by local orography is extremely sensitive to errors in the moist processes. Ensemble strategies better targeted to relevant sources of uncertainty shall be used before these natural hazards, given the elevated running costs of high-resolution HEPSs required for operational purposes.