Hydro-meteorological model simulations of extreme precipitation events in a small-size basin of Mallorca, Balearic Islands

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Within the framework of AMPHORE and PRECIOSO projects (EU/Interreg and Spain/MEC, respectively), devoted to the implementation and improvement of operational forecasts of floods in the Western Mediterranean area, a hydro-meteorological model study has been carried out for the Balearic Islands. The feasibility of discharge predictions driven by numerical weather forecasts for a small basin is assessed. Specifically, we analyse four intense precipitation episodes which affected Mallorca and caused floods of different magnitude over the Albufera river basin, a small-sized catchment (˜ 600 km2) with complex orography located in the north-eastern part of the island.

The HEC-HMS hydrological physical model has been implemented in the Albufera river basin using a semi-distributed and event-based scheme. The stream flow simulations are first driven using precipitation observations to assess the performance of the model over the selected catchment, and then using rainfall forecasts provided by the high-resolution (2.5 km) non-hydrostatic MM5 mesoscale model, in order to evaluate the reliability of the discharge predictions resulting from the one-way coupling. The lack of flow measurements in the basin poses great difficulties to the evaluation of the rain-gauge driven runoff simulations. Therefore, the runoff model has been run under the assumption that a best estimation of the hydrological model parameters, mainly related with the infiltration properties of the watershed, can be obtained from the high resolution observational campaign developed by the CORINE project.

The results show that high-resolution numerical weather forecasts in this complex orography area reproduce accurately most of the extreme precipitation events under study, allowing the issue of valuable discharge predictions despite the small size of the basin. In addition, an ensemble of microphysical, moist convection and boundary layer parameterizations in the MM5 simulations has been adopted. The performance of this ensemble system is assessed in terms of discharge predictions resulting from the one-way coupling with HEC-HMS, thus employing the hydrological model as a validation tool. The value of a multi-physical model ensemble as the one tested to convey the uncertainty of the discharge forecast is also discussed.