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A hydrometeorological forecasting approach for basins with complex flow regime

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The combined use of weather forecasting models and hydrological models in flood risk estimations is an established technique, with several successful applications worldwide. However, most known hydrometeorological forecasting systems have been established in large rivers with perpetual flow. Experience from small- and medium-scale basins, which are often affected by flash floods, is very limited. In this work we investigate the perspectives of hydrometeorological forecasting, by emphasizing two issues: (a) which modelling approach can credibly represent the complex dynamics of basins with highly variable runoff (intermittent or ephemeral); and (b) which transformation of point-precipitation forecasts provides the most reliable estimations of spatially aggregated data, to be used as inputs to semi-distributed hydrological models. Using as case studies the Sarantapotamos river basin, in Eastern Greece (145 km^2), and the Nedontas river basin, in SW Peloponnese (120 km^2), we demonstrate the advantages of continuous simulation through the HYDROGEIOS model. This employs conjunctive modelling of surface and groundwater flows and their interactions (percolation, infiltration, underground losses), which are key processes in river basins characterized by significantly variability of runoff. The model was calibrated against hourly flow data at two and three hydrometric stations, respectively, for a 3-year period (2011-2014). Next we attempted to reproduce the most intense flood events of that period, by substituting observed rainfall by forecast scenarios. In this respect, we used consecutive point forecasts of a 6-hour lead time, provided by the numerical weather prediction model WRF (Advanced Research version), dynamically downscaled from the $\sim 1^{\circ}$ forecast of GSF–NCEP/NOAA successively first to $\sim$18 km, then to $\sim$6 km and ultimately at the horizontal grid resolution of 2x2 km^2. We examined alternative spatial integration approaches, using as reference the rainfall stations over the two basins. By combining consecutive rainfall forecasts at the sub-basin scale (a kind of ensemble prediction), we run the model in forecast mode to generate trajectories of flow predictions and associated uncertainty bounds.