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Uncertainty propagation in hydrological forecasting using ensemble rainfall forecasts

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Abstract Rainfall forecasts provided by Numerical Weather Prediction (NWP) models are affected by different sources of uncertainty, as the models aim to simulate a chaotic non-linear system that is highly sensitive to small changes in the initial conditions. Therefore, there is a need to move towards an operational probabilistic approach and this is often based upon the concept of ensemble forecasts. This paper attempts to assess the feasibility of the use of high-resolution precipitation ensemble forecasts as a direct input to hydrological models used in operational real-time flood forecasting and warning systems. The mesoscale model MM5 was utilised to run 48-hour lead-time forecasts. The MM5 model, like all mesoscale models, requires conditioning by initial and boundary conditions taken from a global model that generally operates at coarse spatial and temporal resolutions. On this occasion these were obtained from ECMWF (European Centre for Medium-Range Forecast), which also provides the perturbed ensemble forecasts. The MM5 model was set up using a four-nested domain configuration with the smallest domain having a 2-km grid resolution. The domains dynamically downscale and were centred on the southeast of England, in the Upper Medway Catchment. An established rainfall–runoff model, the Probability Distributed Model (PDM), has initially been implemented: this receives ensembles of forecasted rainfall generated by the MM5 model in order to predict the runoff generation at the catchment outlet 48 hours ahead. This paper presents an initial assessment of the probabilistic forecasts produced using a coupled-modelling approach and contributes to the development of Hydroinformatics in the context of Operational Hydrology.

Key words probabilistic forecasts; ensembles; high-resolution NWP; coupled models