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Short period forecasting of catchment-scale precipitation. Part II: a water-balance storm model for short-term rainfall and flood forecasting

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Abstract. A simple two-dimensional rainfall model, based on advection and conservation of mass in a vertical cloud column, is investigated for use in short-term rainfall and flood forecasting at the catchment scale under UK conditions. The model is capable of assimilating weather radar, satellite infra-red and surface weather observations, together with forecasts from a mesoscale numerical weather prediction model, to obtain frequently updated forecasts of rainfall fields. Such data assimilation helps compensate for the simplified model dynamics and, taken together, provides a practical real-time forecasting scheme for catchment scale applications. Various ways are explored for using information from a numerical weather prediction model (16.8 km grid) within the higher resolution model (5 km grid). A number of model variants is considered, ranging from simple persistence and advection methods used as a baseline, to different forms of the dynamic rainfall model. Model performance is assessed using data from the Wardon Hill radar in Dorset for two convective events, on 10 June 1993 and 16 July 1995, when thunderstorms occurred over southern Britain. The results show that (i) a simple advection-type forecast may be improved upon by using multiscan radar data in place of data from the lowest scan, and (ii) advected, steady-state predictions from the dynamic model, using "inferred updraughts", provides the best performance overall. Updraught velocity is inferred at the forecast origin from the last two radar fields, using the mass-balance equation and associated data and is held constant over the forecast period. This inference model proves superior to the buoyancy parameterisation of updraught employed in the original formulation. A selection of the different rainfall forecasts is used as input to a catchment flow forecasting model, the IH PDM (Probability Distributed Moisture) model, to assess their effect on flow forecast accuracy for the 135 km^2 Brue catchment in Somerset.

Keywords: rainfall forecasting, flood forecasting, weather radar, satellite, storm model

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