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Rainfall forecasting using the Numerical Weather Model WRF and assimilated weather radar data

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Accurate prediction of the rainfall (a principal driver of flooding) is required in real-time flood forecasting systems in order to enlarge the forecast lead time. An invistagation of radar data assimilation into the Weather Research and Forecasting (WRF) model is investigated using different storm events types for real-time rainfall prediction. The 3DVAR (the three dimensional variational data assimilation system) is a novel approach for data assimilation in NWP models, the development of which originated from the predecessor of WRF model (the MM5). Its impact in improving the performance of the NWP model has been demonstrated to be positive in some previous studies. The Brue catchment is chosen as a study catchment in this research, which is located in the southwest England and has been continuously scanned by a Doppler and two C-band weather radars during the HYREX project (HYdrological Radar EXperiment, 1993-1997).

A number of storm events with high rainfall intensities are selected from the Brue catchment and categorized into four types according to the temporal and spatial distributions of the observed data. Real-time weather simulations generated from the ECMWF (European Centre for Medium-range Weather Forecasts) were used with different lead in time of 3, 6, 9 and 12 hours. This data was downscaled and interpolated using the WRF model with four nested domains (27, 9, 3 and 1 km grid spacing). During this process, the radar reflectivity data from one of the C-band radars at the Wardon Hill are assimilated into the WRF model by using the 3DVAR system. The performance of the 3DVAR in assimilating radar data for real-time rainfall predictions using the WRF model has been proven to be promising, and the results are compared with different forecast lead times and for the four types of storm events with various climatic characteristics.