Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09412, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09412
EGU General Assembly 2008

Using high-resolution numerical weather prediction models in flood forecasting: an extreme event case study

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Rainfall forecasts from Numerical Weather Prediction (NWP) models typically decrease in accuracy at higher lead-times. When these rainfalls are used to generate flood forecasts, the nature of this decrease in accuracy ultimately determines their utility for timely flood warning, especially during extreme events. One approach for improving accuracy is to increase the spatial resolution of the NWP model. This should provide better rainfall predictions through improved representation of orographic effects (the feeder-seeder mechanism) and, through their use with suitable hydrological models, more accurate flood forecasts. Recently, high-resolution configurations of the Met Office NWP model (the Unified Model) have been developed to run with a grid spacing of 4 or 1 km. The potential benefit of running such models, compared to the previous operational resolution of 12 km, is assessed using an extreme orographic rainfall event over northwest England that caused extensive flooding of Carlisle in January 2005. These NWP model rainfall forecasts were used as input to a lumped rainfall-runoff model (the Probability Distributed Model, PDM) to predict river flows at the outlets of two catchments important for flood warning. Nowcasts based on a combination of radar-extrapolated and NWP model forecasts, from the Met Office Nimrod system (only available out to 6 hours), were used as a baseline in the assessment. The results show the benefit of increased resolution in the NWP model, the benefit of coupling the high-resolution rainfall forecasts to hydrological models and the improvement in timeliness of flood warning that might have been possible.