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Interactive Comment

Interactive comment on "Uncertainty analysis of hydrological ensemble forecasts in a distributed model utilising short-range rainfall prediction" *by* I. D. Cluckie et al.

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The authors use a distributed hydrological model (gridded, 500km) resolution to create ensemble forecasts resulting from ensemble QPF from a high resolution numerical weather prediction model. An example is presented for the 135 km2 Brue catchent in South Western England, UK. Short range QPF ensembles (51 members) were generated for a 24hr period during each of 2 example events using a nested application of the MM5 model to dynamically downscale ECMWF ensemble forecasts to a 2km resolution.

It was found that the direct application of the raw ensemble QPF from MM5 resulted in a severe underestimation of the observed flow with the observed flow being outside the spread of the hydrological ensembles for both example events. A dense rain gauge network was used to estimate the true space-time variability of the rainfall patterns for the example events. In both cases it was found that the raw ensemble QPF underestimated the area-averaged gauge analysis.

Some interesting diagnostic studies to explain this result are presented. These studies involved modifying the QPF ensemble members by (a) transposing them in space to find a neighboring area having a 24hr spatial pattern most highly correlated with the gauged-analysis spatial pattern and (b) re-scaling both the transposed and untransposed the MM5 QPF ensemble members using the ratio of the 24hr spatially averaged ensemble mean to the corresponding gauge value to remove bias.

The idea of spatially transposing the forecast members is an interesting one to consider because atmospheric model forecasts often look like observed events but not in the same place as observed. Also, dynamic downscaling may have better potential to preserve spatial structure of events than statistical downscaling. But it is not clear from the results in this study that the spatial adjustments were very important in diagnosing the results. I think the stated conclusion "ensemble rainfall inputs [need to be]Ěproperly shifted to match the rainfall pattern" is not strongly supported by the information presented in the paper.

The biased-adjusted ensemble QPF forecasts gave better hydrologic ensembles than the unadjusted ensemble QPF forecasts, and the medians of the ensemble flow forecasts were more comparable to the model-simulated hydrograph based on the gauge-data. There were some timing problems in all members of the QPF ensembles for one of the test events and the pattern transposition strategy seemed to help compensate for this in a limited way.

Uncertainty in the hydrological model was not investigated but was acknowledged to be potentially an important contributed to uncertainty in the flow forecasts.

Neither the bias adjustment nor the pattern transposition strategies used for diagnostic purposes in this study could be used operationally in the same way they were used here. I think this study points to the need for a significant archive of atmospheric ensemble forecasts and corresponding observations analyses so that reliable adjustment procedures can be developed, tested and used to make hydrological re-forecasts with large enough sample sizes to produce reliable verification statistics.

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