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Hydrology and Earth System Sciences Discussions

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

I. D. Cluckie et al.

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While we thank the anonymous referee for the comments, we strongly feel it is necessary to clarify some fundamental misunderstandings used as the basis in the judgements made in the comments.

> . . . It is unfortunate that a relatively very small catchment has been chosen to address this issue. The typical resolution of ensemble systems is much coarser- in this case the ECMWF EPS has been used with a spatial resolution of roughly 80x80 km. Thus already 1 pixel covering 6400 km2 - as compared to the catchment size of 135 km2. I am not sure if with all sorts of

downscaling techniques you'll get somewhere, since the origin of the data is still the EPS resolution.

The resolution of the rainfall forecast used in the study is 2 km, certainly NOT 80 km, although the mesoscale scale model does take data sets from ECMWF that has the resolution of 80 km. The discussion of how the weather model works will go well beyond of the scope of the discussion, however, the simple assertion made by the referee apparently is questionable if not completely wrong. It should be mentioned the high resolution of rainfall forecast is achieved in a dynamical way rather than working directly upon the rainfall field produced by the ECMWF with 80 km resolution.

> . . . The authors do state that the methodology they propose and discuss is not suitable in >a forecasting mode. This is in my opinion exactly the added value application domain of ensemble prediction: possible expected weather patterns. So it could be argued, if the solution proposed in this publication has useful practical applications.

The purpose of the study attempts to look at the how uncertain the coupled meteorological-hydrological forecast would be with the help of ensemble weather forecasts which are supposed to be able to represent the uncertainties in NWP-based QPF. Again, there are some applications already which utilise the NWP-based QPF as the inputs, not limited by the weather patterns as suggested by the referee. Although the method proposed in the study did not intend to be used in a real time environment, it is still of use in designing some operational schema for utilising QPF in flood forecasting, if the persistence of location/timing errors are apparent (actually we do find such behaviour in another study).

> . . . Given the above, it is quite obvious that a gauge-calibrated hydrological model will underpredict discharge using weather ensembles as they are

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> produced, and indeed some sort of procedure is needed. Like discussed above, I am not sure if the solution suggested here is a practical way forward.

Indeed, the flow forecast based on QPF inputs can either under-predict (as the examples in the paper) or over-predict (we have observed as well as other researchers' findings, see reference of the paper). It is inevitable to have those differences as the raingauge-calibrated hydrological model takes QPF as inputs. Again, the purpose of the study is try to reveal the uncertain behaviour of those hydrological application with QPF input. The usefulness of this sort of systems has been argued by various researchers and we are not going to argue about that again here.

> . . . Ideally, EPS-based discharge forecasts should be compared to and run with a calibrated hydrological model forced by data of the similar nature, so some sort of EPS climatology.

We are not clear about the "EPS of climatology" and how this kind of climatology can be produced. However, we think that the ideal EPS-based flow forecasts should be able to represent the possible outcomes (the flow) of the possible atmospheric states. As to the possible atmospheric states, it is exactly what the EPS-based weather predictions try to reveal, and this is why we used EPS results from ECMWF to produce the ensemble forecasts.

There could be other ways to simulate the plausible weather states, but as far as we know, the ensemble weather forecasting (as we used to produce QPF) remains as the first choice. Yes, we agree that there are problems associated with this coupled environment, for example the model errors (apart from the 'real' uncertainty due to initial/boundary conditions) in the weather models and the scale gap between the rainfall forecast and the original raingauge observations but we don't think they are the reasons to ignore the possibility to integrate the rainfall forecast into flood forecasting.

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