Hydrol. Earth Syst. Sci. Discuss., 9, C3963–C3969, 2012
www.hydrol-earth-syst-sci-discuss.net/9/C3963/2012/

Hydrology and Earth System Sciences Discussions

Interactive comment on "A data based mechanistic real-time flood forecasting module for NFFS FEWS" *by* D. Leedal et al.

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Received and published: 24 August 2012

Response to Reviewer 2

Thank you for the review of this article. We appreciate the comments and are sorry you do not feel the article is appropriate for publication in HESS. However, we have taken your comments very seriously and instigated a major re-write and reconfiguration and hope we can convince you that the proposed new version will meet your approval. We think many of the issues you have identified are correct and we will attempt to address these here or describe the mechanism by which they will be addressed in the proposed new version.

Too large uncertainty range

In the response to reviewer 1 we have included a description of the parameterization process and also identified an error in the method used to generate the figures that is partly responsible for the large error bounds at the short forecast lead times. This has been corrected. However, we would also point out that for the longer lead time forecasts the uncertainty estimation is quite realistic. This is the +- 2 standard deviation range (approx. 5th and 95th percentile range). The type of uncertainty range presented is not limited to the DBM modelling approach. During the January 2005 flood event, the EA ISIS model underestimated the flood peak by around 1m and 450m^3s^{-1} (Spencer et al. 2006). We agree that this makes decision making difficult but it does give a more realistic indication of the true uncertainties that operations staff have to deal with. However, as stated above we feel we have been too conservative with the uncertainty bounds and following a correction and the calculation of the uncertainty estimate based on parameter optimization at the lead time specified in the figure rather than the maximum lead time available we have re-plotted the figure and included those here. Please notice we have also implemented the axis scaling you suggested and removed the small peak artifact that was a result of a missing value in the observation series that had not been correctly interpolated - we appreciate you bringing this to our attention.

Address to main criticism - paper structure etc.

We agree the DBM method is not new; however, during the 30 or so years since its first appearance it has been in a constant state of development, refinement and diversification. There is no one definitive implementation; often, as is the case here, each application includes a number of subtle and new features designed to address the particular challenges of the chosen catchment system. In the Eden for example the model is specifically designed to cover a large spatial range in-order to link together flow contribution from the main Eden channel as well as the Caldew, Petteril and Irthing sub-catchments. In this way it is hoped that the forecast will be more robust

should a spatially distinct intense rainfall cell develop in a future storm scenario (this was the case in 2005 where a large contribution to the flood came late in the event from storm cells in the NE corner of the Irthing catchment (Archer et al. 2006)). Also this is the first time the DBM method has been applied to the Eden catchment so the results from this case study are a new contribution to the field. Further, this is the first time the DBM modelling method has been taken from the research field and entirely re-implemented for inclusion in an operational flood forecasting framework. The approach has since been applied on a section of the Severn catchment which is currently in preparation for submission by Smith et al. Therefore the Eden case study is the first of two such studies so far. As such, we feel the paper *does* provide a considerable amount of new research and data. Please also bear in mind the paper is written for inclusion in a special issue on data assimilation for operational hydrologic forecasting and water resource management. One of the key developments of the DBM approach is its fundamental inclusion of a data assimilation scheme via an adapted Kalman Filter mechanism. As such it would seem a pity not to communicate this research to an audience with such a clear interest in these methods.

...having said that

We entirely take your point about the structure and lack of earth system science content of the article. We have decided to reformat the article for the proposed new version such that the technical description of the DBM method is moved to an appendix. This will then free up room for a more extended treatment of the Eden case study including a more detailed catchment description with better emphasis on issues pertinent to Hydrology and Earth Systems Science. One aspect of the Eden case study that is important and has not so far been emphasized is that the DBM model provides a semi-distributed forecast i.e., a forecast is available at each of the gauge sites within the model domain (Great Corby, Greenholme, Harraby Green, Denton Holme, Linstock, and Sheepmount). More emphasis will be placed on this spatial element in the proposed updated manuscript along with the descriptors relevant to the hydrology, hy-

drogeology and meteorology within the catchment. An additional figure will be included showing forecast at the Linstock site (included in this comment along with the updated Figures 5 and 6).

New title

To reflect the changes you suggest, and the adjustments to the format we have outlined here, we have specified a new title for the paper: “Application of Data Based Mechanistic Modelling for flood forecasting at Multiple Locations in the Eden Catchment in the National Flood Forecasting System (England and Wales)”

Typos etc.

Thank you for identifying the typos and mistakes in the article. We will correct these in the proposed new version.

In summary

Thank you once again for your useful comments. We hope the significant changes we propose to make will allow us to submit a revised manuscript that will convince you of the articles worth.

References

Spencer P., Boswell D., Davison I., Lukey B. (2006). Flood forecasting using real time hydraulic and other models: lessons from the Carlisle flood in January 2005. Defra Conference, York, 2006.

Archer DR, Leesch F, Harwood K. (2007). Learning from the extreme River Tyne flood in January 2005. Water and Environment Journal 21: 133–141.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 7271, 2012.

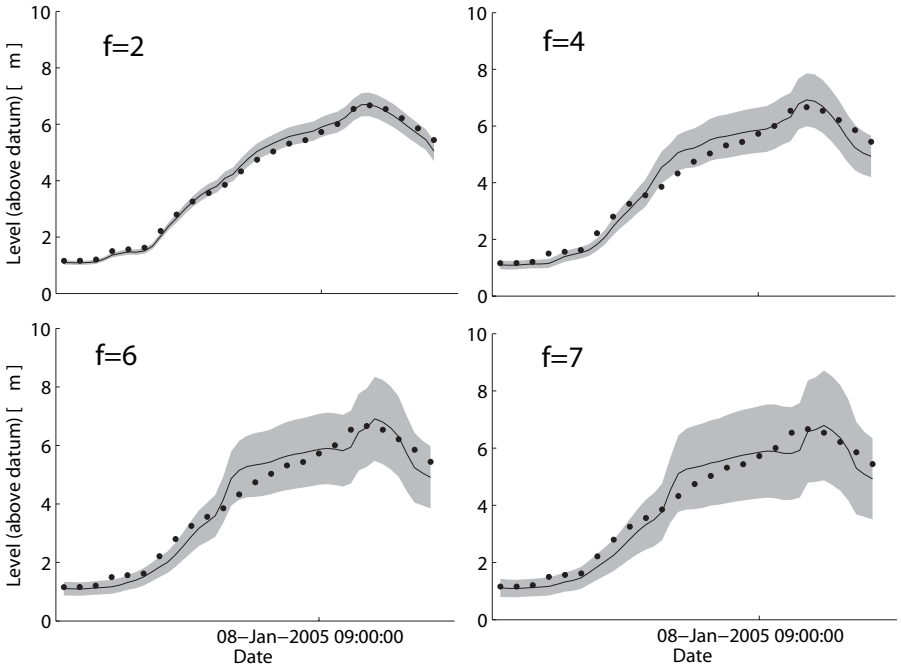

Fig. 1. (New Figure 5) Caption same as original

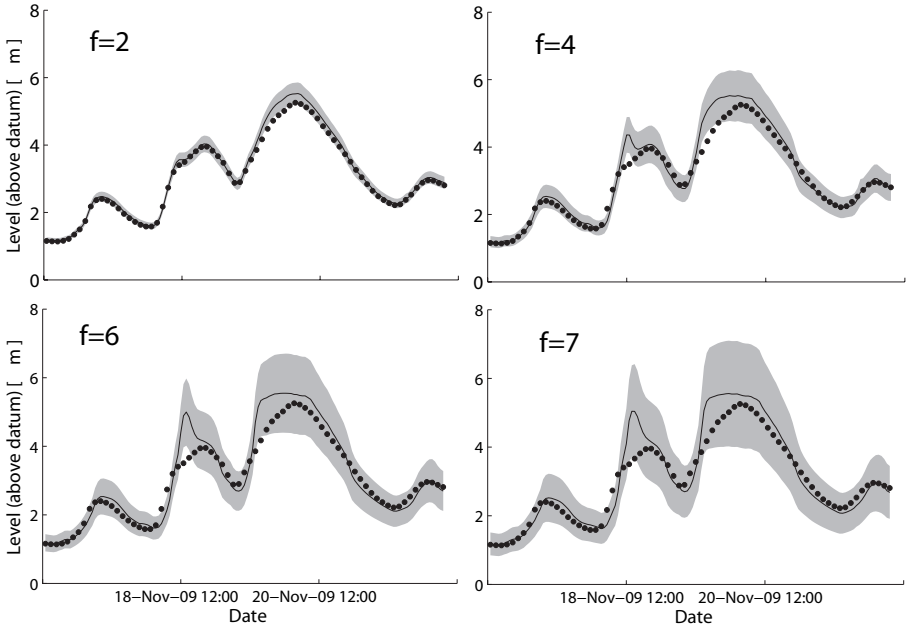

Fig. 2. (New Figure 6) Caption same as original

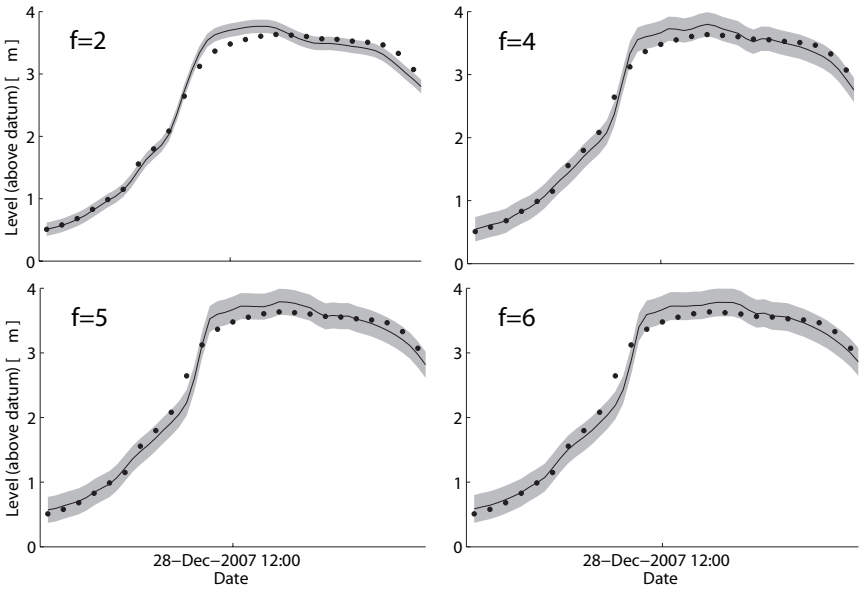

Fig. 3. (New forecasting figure) Emphasizes semi-distributed nature of the forecasting model by showing results for a location other than Sheepmount, in this case Linstock.