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Hydrology and Earth System Sciences Discussions

Interactive comment on "River flow forecasting with Artificial Neural Networks using satellite observed precipitation pre-processed with flow length and travel time information: case study of the Ganges river basin" *by* M. K. Akhtar et al.

Anonymous Referee #2

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The paper presented an interesting approach to combine satellite rainfall measurement and SRTM-derived time delays into a time series of lagged rainfall, which was used together with present and 1-day before discharge time series as input to an artificial neural network model. The authors concluded that their ANN model was able to forecast discharge 3-days ahead with acceptable accuracy, however, they also noted the facts that within the 3-day horizon the contribution of the pre-processed rainfall input was hardly seen, instead the contribution was mainly from present and past discharge,

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which introduced an apparent phase shift in the prediction.

The main innovation of the paper is the pre-processing of satellite rainfall data with time-delays derived from DEM analysis. The lagged precipitation in principle should be better correlated with discharge and thus could be a better candidate as input to the ANN. If one keeps in mind that there is a clear analogy between the ANN weights and parameters of traditional modelling approaches, although the ANN is commonly referred to as a "black box", it has to in some way mimic the dynamic of the rainfall-runoff processes. The physical implication of the lagged precipitation is however strange from a traditional hydrological point of view: it is equivalent to route the rainfall directly to the outlet without taking into account a number of storages and lost on the way. A discussion about the physical meaning of their lagged rainfall would be appreciated. A valuable benchmark could be for example a multiple regression, as the author mentioned that there was a very high auto-correlation of discharge, it would be interesting to see to what extent the accuracy of the forecast is dependent on this auto-correlation.

The methods were well documented but with some details need to be clarified. For example, it was not mentioned how overland flow and channel flow velocity were derived; cross-validation result was presented without mentioning what it is. Those performance measures were mentioned but without explanation, for example, what is a normalized root mean square error? It is better to define it with an equation to avoid any misunderstanding. The treatment of low flows was unclear: were the low flows also included in the calculation of performance statistics? There is no explicit explanation why slope was not included when calculating travel time, and why there was 25 rainfall time series.

The ANN was the main method used in the paper but it was introduced very briefly, some more insight and some discussion about its relation with other hydrological models would be useful for many readers. For example, it is hard to relate figure 1 to hydrological concepts, without some explanation both in the main text and in the figure caption.

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It was not clear how the lagged rainfall time series was constructed, was the rainfall weighted by the area of each cluster?

It would also be better if the authors could improve on small details, for example, the area of the basin was not provided, and more importantly the map of original and processed precipitation were not provided, small things like missing reference to SRTM, and in figure 4b for example it is hard to distinguish between 2 black lines, etc. There were many such problems.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 3385, 2009.