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Hydrology and Earth System Sciences Discussions

Interactive comment on "Hydrologic system complexity and nonlinear dynamic concepts for a catchment classification framework" *by* B. Sivakumar and V. P. Singh

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This well written paper by Sivakumar and Singh proposes a catchment classification system based on complexity of observed catchment responses such as stream flow records. Complexity is hypothesised to be correlated to the number of dominant processes producing the observed catchment response. They propose three steps to develop such a framework.

General comments:

1. As pointed out by the authors, this framework could be very useful and is certainly

needed. However, Sivakumar et al. have previously published discussion papers with a similar focus. The third step in their proposal, namely the verification of the framework, i.e. to relate different levels of complexity to catchment properties and processes, is probably a very important one. This step would also test the underlying assumption of this framework, i.e. complexity in observed catchment response is related to the number of contributing processes. It would be an innovative aspect of this paper that was not previously published. The third step in their proposal could readily be demonstrated by applying models of different complexity to e.g. the Missisipi and Kentucky river flow records presented in their paper. Adequate models will produce streamflow simulations that have a similar complexity as observed ones. Note that criteria such as Nash-Sutcliffe efficiency or Root mean square error may not be sufficient here.

2. Study by Jakeman and Hornberger (1993) shows that for a range of scales and climatic conditions, a model with two storages in parallel representing a slow and a quick run-off component were sufficient to reproduce observed stream flow from rainfall. In the context of the proposed framework, it may therefore be expected that most of the catchments would fall into one single category of complexity.

3. For the example presented (Figures 1 and 2), correlation dimension seems to be related to autoregression at short time scales. Phase space diagram reveals higher autocorrelation of streamflow for Mississippi than for Kentucky river at lag of one day. This, however, is also obvious from autocorrelation function. Consequently also correlation dimension is higher for Mississippi than for Kentucky river.

4. Complexity of observed discharge probably also depends on the temporal scale of observation. Hourly time series have different complexity compared to daily data. Different model purposes require different time scales.

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