Hydrology and Earth System Sciences Discussions

Interactive comment on "Using a spatio-temporal dynamic state-space model with the EM algorithm to patch gaps in daily riverflow series, with examples from the Volta Basin, West Africa" *by* B. A. Amisigo and N. C. van de Giesen

Anonymous Referee #1

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This paper uses spatio-temporal dynamic models, with Kalman-Smoother based state estimation and E-M algorithm based parameter estimation in the context of the problem of filling in gaps in daily river runoff series. By using spatial and temporal information, one should obtain better predictions for these gaps. The spatio-temporal dynamical model is ideal in this context, given the dynamic nature of the runoff process. The authors do a good job of describing the methodology, although perhaps a bit more technical than this audience would expect. I do have several concerns related to the methodology and analysis.

Major Comments:

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(1) In recent years, the environmental statistics literature has produced many spatio-temporal dynamical model analyses from the fully-Bayesian context. The Kalman filter approach presented here can be thought of as an empirical Bayesian analysis. The authors should discuss why they feel it is not necessary to perform the fully Bayesian analysis.

(2) Related to question (1), the authors do not discuss how they might obtain uncertainty estimates for their E-M algorithm-based parameter estimates. This seems like a critical oversight.

(3) In the Xu and Wikle (2004) reference, it seems that the motivation for the use of parameter matrix constraints (rather than unconstrained estimates) is due to the high-dimensionality one often finds in spatio-temporal data sets of environmental processes. In the current application, dimensionality does not seem to be an issue (hence the unconstrained estimation of the matrix F). In this case, what is the motivation behind the contstraints on the measurement error covariance matrix (R) and the process noise matrix (Q)? Why not just use the unconstrained estimates if you can?

(4) The paper seems to de-emphasize the application at the expense or the methodology. The application and results should be the emphasis.

Minor Comments:

What norm are you considering for the convergence tests (12a, 12b)?

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