Hydrology and Earth System Sciences Discussions

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Interactive comment on "Simultaneous estimation of land surface scheme states and parameters using the ensemble Kalman filter: idealized twin experiments" *by* S. Nie et al.

Anonymous Referee #3

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The stated contribution is in demonstrating that constraining the parameters to be estimated in a simultaneous parameter estimation/data assimilation scheme will improve the otherwise poor performance. The authors tie the parameters together via constraints based on pedotransfer functions (relationships linking soil sand and clay fractions to soil hydraulic parameter values). I think of this as a relatively mild contribution for the reasons stated below. I would not recommend publishing unless the five points can adequately be addressed:

1) Rather than introduce the constraints, why not simply use sand and clay fractions as the parameters to be estimated? Sand and clay, via the pedotransfer functions used

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(those of Cosby et al.), fully define the four hydraulic parameters. The authors instead stick with the four parameters and constrain them with the relationships developed from the pedotransfer function relationships. Had they simply used sand and clay as the two variables included in their framework, the same outcomes would be achieved by my read of their paper. If so, the conclusion would be that the simultaneous parameter estimation/data assimilation is more likely to be successful with two parameters than four, which is not a significant contribution to parameter estimation/data assimilation methodology. The authors should address this point.

2) Pedotranfer functions also have errors and such errors are not incorporated in the analysis. In this sense, the parameter values are overconstrained. They could have incorporated such errors into the framework. This would address in part the concerns from my first point.

3) The problems with the batch methods are overstated. P. 1436, ln 6: "(ii) it only addresses parameter error while errors from initial conditions and atmospheric forcing data are ignored." This is not the case. It may be true that "as commonly practiced, errors from initial conditions and forcing data are ignored." But it is not an inherent limitation of batch methods. Vrugt et al. (2005) is such an example of a batch method that does consider such errors. This is important because the parameter estimation procedure in batch methods is infinitely more robust than that inherent in the simultaneous parameter estimation/data assimilation approach, which relies essentially on a random walk-like search (which is why it scales poorly with the number of parameters to be estimated.) The only real reason to use a simultaneous approach, it seems to me, then is their point (i), that observations can be incorporated continually. This may have some benefit in operational systems in which it may be burdensome to routinely carry out a batch analysis.

4) In the next paragraph (p. 1436), Vrugt et al. (2005) is erroneously cited as an example of a simultaneous state-parameter estimation approach. In a paper claiming a methodological contribution, this is a significant misread of the literature. Vrugt et al.

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(2005) is a batch procedure.

5) The constraint formulation in this case is relatively straightforward due to the simplicity of the Cosby relationships, all of which have a linear function in one variable (conductivity as linear function of sand fraction). It would not be as easy given more complex pedotransfer function relationships. And it still seems far easier to define the parameters, in this case, sand and clay fraction, as the parameters to be estimated rather than back out the constraints.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 1433, 2011.

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