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Hydrology and Earth System Sciences Discussions

Interactive comment on "Spatial horizontal correlation characteristics in the land data assimilation of soil moisture and surface temperature" *by* X. Han et al.

X. Han et al.

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Response to editor comments on "Spatial Horizontal Correlation Characteristics in the Land Data Assimilation of Soil Moisture and Surface Temperature"

Dear editor Liu,

Thanks for your comments and recommendations to help us re-designing the experiment. We will follow the suggestions of the two anonymous reviewers to improve the representation of this work. The experiment has been re-designed and the research period has been extended. Please find below our responses (in blue):

Major Comments:

Comment: The entire experiment design could be improved and simplified. Since the purpose is to investigate the value of incorporating spatial correlation in LETKF for estimating soil moisture/temperature for both covered and uncovered grid cells, one could simply compare the open-loop CLM ensembles to the results from LETKF for the entire domain with different levels of observation selection. In this case, using only one observation for those cells with 'direct' observations is equivalent to the common assimilation strategy of ignoring spatial correlation. The current design involving strategy-1,-2, and 3 seems to be a bit confusing and unnecessarily complicated.

Response: Thanks for your suggestion. We will reduce the results and focus on the comparison of different observation selection schemes. If we only use one observation during assimilation, the spatial correlation is also needed for the uncovered grid cells. This is different from the common assimilation strategy in which we do not use any observation for the uncovered grid cells. We will analyze two different cases: (1) only the covered grid cells are updated with one observation; (2) all the grid cells with one correlated observation (if it is available) are updated. We will improve the description to clarify this.

Comment: I would also suggest that the authors make a distinction between grid cells that are covered with observations and those that are not when calculating the statistics. Currently all grid cells are lumped together, making it difficult to understand the net benefit from using spatial correlation in the assimilation procedure for either covered or uncovered grid cells. One would expect that incorporating spatial correlation can have a larger impact on the estimation for uncovered cells than for covered cells; this however needs to be tested / confirmed by making a distinction between the two types of cells as described above.

Response: Thanks for your advice. We will separate the analysis on covered grid cells and uncovered grid cells to make it clear.

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Comment: When discussing the improvement from data assimilation, only mentioning the relative percentage improvement in RMSE and NSE without referring to the absolute values of these metrics is not that meaningful, as the first reviewer also pointed out.

Response: Thanks. We will use the absolute values instead and add discussion concerning the statistical significance of the results.

Comment: The study uses a cloud mask from Feb. 2008 that has an observational coverage of 72%, while in some cases the observation coverage could be way below 72%. Hence other cases with different degrees of observational coverage (e.g., 50%, 25%) should also be investigated to determine the minimal level of coverage necessary for the spatial correlation assimilation approach to have a meaningful impact.

Response: Thanks for your suggestion. We could add the results of different degrees of coverage in the revision with different masks to validate the suitability of the proposed methods, but we think that there will not be a minimal level of coverage for this approach. If the observational coverage degree is very low, then less model grid cells will be updated with their neighboring observations because there are not enough correlated observations for most of the model grid cells. Therefore, the degree of observation coverage only has an impact on how many grid cells will be updated with help of the correlated observations. The reduction of the observational coverage will result in a poorer analysis performance because of the reduction of observations. But this reduction is not related to the proposed approach of this study. We will add two other cases with small observational coverage in the revision.

Comment: How the model parameters for the four statistical models were determined, and what dataset the fitting was based on need to be clarified in the manuscript.

Response: These model parameters were determined based on the observation data used in the data assimilation. We fitted the model for each observation and got the model parameters with the geoR package. We will clarify this in the revised version of

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the paper.

Minor Comments:

Comment: P18, L379: for the calculation of RMSE, the number of grid cells N should also be included.

Response: We will change it.

Comment: P19, L402-404: Please rephrase this sentence by discussing RMSE and NSE separately for clarity and easier comprehension.

Response: Thanks. We will improve it.

Comment: Figure 6, caption: do you mean "the ensemble mean of soil moisture" here?

Response: Because we did not run the CLM in ensemble mode during the experiment, the soil moisture is the CLM result and not the ensemble mean. In the revision, we will run the CLM in ensemble mode and will get the ensemble mean.

Comment: Figure 6(a) is not mentioned in the text.

Response: Sorry for this mistake. We will correct this.

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