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Hydrology and Earth System Sciences Discussions

Interactive comment on "A dual-pass data assimilation scheme for estimating surface energy fluxes with FY3A-VIRR land surface temperature" *by* T. R. Xu et al.

Anonymous Referee #1

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General Comments

The paper by Xu et al. proposes a new data assimilation approach applied to the CoLM land surface model. Remotely sensed Land Surface Temperature (LST) data from the Chinese meteorology satellite FY3A-VIRR are assimilated into the model. The modelled energy fluxes (and soil moisture) without and with the assimilation are compared and analysed. I believe the paper is well-written, well structure and clear. Moreover, the topic of the paper is of interest for the HESS readership as the improvement of modelling predictions through the assimilation of satellite data represents an important issue for scientific and operational applications.

However, this is not the first time I am reviewing the paper and I am disappointed that the authors did not address the main issue that was revealed, at least in my opinion, in the paper. In fact, it is clear from reading the paper that the assimilation provides a significant improvement in the estimation of surface energy fluxes and this is good. Unfortunately, it is not clear why these results were obtained. Specifically, the added-value of the assimilation of satellite derived LST data seems to be only related to a BIAS between modelled data and observations that is corrected through the assimilation (see page 3959, line 7: "The errors in surface energy ïňĆux predictions are mainly model biases (Figs. 3 and 4) and the dual-pass data assimilation can cut down model biases signiïňĄcantly (Table 4)").

As I already wrote in the previous review, a bias in the forecast model (or assimilated observations) invalidates key assumptions of (bias blind) data assimilation, leading to sub-optimal ïňĄlter performance (*Dee, 2005*). Data assimilation techniques are designed to correct random errors in the model and rely on the assumption of unbiased background and observations (*Barbu et al., 2012*).

Looking at Figure 3, it is clear that the model significantly overestimates observed LST and that satellite data are closer to the observations with respect to the model (if daily values were shown this overestimation would be clearer). Therefore, it is highly expected that any assimilation technique will provide an improvement in the modelled energy fluxes. Therefore, if the paper wants to propose a new data assimilation approach for improving predictions, I am not sure that improvements are related to the proposed technique. Moreover, it would be interesting to know why the BIAS exists. Is it due to the model parameterization? To the model structure? To input data? This issue should be addressed.

In summary, I believe that if the BIAS between modelled and observed LST data was removed, the improvements related to the assimilation will be much smaller. In my opinion, if the authors do not address this issue, the paper does not deserve to be published (as I already suggested).

Specific Comments

At page 3950, lines 14-20 the dual pass contributions for reducing the model BIAS are analysed. It is underlined that Pass 2 performs better than Pass 1. I believe that it can be due to the higher temporal density of the Pass 2 assimilation (daily) with respect to the Pass 1 (weekly). Can the authors elaborate better on this aspect?

References

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Dee, D.: Bias and data assimilation, Q. J. Roy. Meteorol. Soc., 131, 3323–3343, 2005.

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