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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.

T. R. Xu et al.

xutr@bnu.edu.cn

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We thank the anonymous reviewer and editor very much for your valuable comments on our paper. Our responses to referee #2 are as follows:

General Comments: The main issues that were raised regarding the first submission have not yet been addressed. Hence, I recommend that the paper be rejected. Specific major issues are listed below. There are also minor issues that I have not listed here, since many of these were mentioned in previous reviews.

Lack of originality: This study does not make a significant new contribution, given its

similarity to Xu et al., 2011b. The main difference between this study and the previous one is in the timing of the parameter update, and yet these parameters do not change much once spun up (also the parameters do not seem to influence the reported statistics, according to Figure 10). Hence the change in the timing of the parameter updating is expected to have little effect on the assimilation output. The paper does not include any discussion of how this study differs from previous studies by the same authors, nor any justification of why the methods were changed from previous studies (I suspect some of the discussion of the previous studies has actually been removed in the latest submission?).

Treatment of bias: The idea behind dual pass filters such as this one is to correct the model-observation bias by updating the model parameters, and then correct the remaining *random* error through data assimilation. As stated in previous reviews, it must be ensured that the assimilated observations are not biased relative to the parameter-updated model. Then the reduction in random errors from the model state update should be demonstrated. However, Figure 10 shows that the model parameter update has very little impact on the model bias, while the (bias blind) assimilation decreases the biases. The scheme is not then working as intended at all. From the statistics presented it is also not clear whether there is any improvement in the model forecasts, other than the improvement in the biases. While the correlations are presented, the improvements in correlation are likely due to changes in the diurnal cycle associated with the changes in the bias (see Fig 3).

Response: Thanks for your suggestion, and your comments are very meaningful and helpful for our manuscript.

This manuscript is different with Xu (2011b) actually. In this paper, we have added some new materials such as, all the sites are located in China data and some data are from WATER (Li et al., 2009), the validation data from eddy covariance and large aperture scintillometer system, the first time use of the FY3A-VIRR land surface temperature, the dual-pass data assimilation technique, etc. In Xu (2011b), the model states and parameters are simultaneously optimized by using GOES data, and model states are retrieved and model parameters are calibrated at the same time. However, the model states and parameters vary at different temporal scales, it's more reasonable to optimize the model states and parameters with two loops than optimize them simultaneously. That's why we develop the dual-pass data assimilation technique. Pass 1 of the dual-pass data assimilation scheme optimize vegetation parameters at the weekly temporal scales which like a procedure to calibrate the model parameters, and pass 2 optimize soil moisture at the daily scale. In this study, we optimize the model states and parameters separately using a dual-pass data assimilation technique at the different temporal scales. For the performance of the two schemes, Xu et al. (2011b) and this study can improve significant turbulent flux simulations. Since with the same assimilated data, the performance of these two schemes is similar, the results were not shown in this paper.

In this study, we assimilate FY3A LST data for the first time into a land surface model to improve model predictions. As a new generation of polar orbiting meteorological satellite, the FY-3 series consists of two experimental (FY-3A/B) and at least four operational satellites (FY-3C/D/E/F). The FY-3 series is expected to have a service life until 2020. FY-3A/B is a research and development satellite, and FY-3C/D/E/F is operational satellite. The primary missions of the FY-3 are: global sounding of three-dimensional thermal and moisture structures of the earth's atmosphere, measuring cloud properties, and other key parameters, such as precipitation, ozone, etc., to support global numerical weather prediction and environmental services; global imaging of the Earth's surfaces to monitor large-scale meteorological and/or hydrological disasters and the biosphere environment; establishing long-term environmental datasets with important geophysical parameters for climate monitoring, global prediction, and Earth science research; collecting and retransmitting data by data collection platforms.

FY-3 series satellites will provide data sources globally for tens of years. FY-3 land surface temperature data will become a new data source for global water and energy

balance research. Thus, the assimilation of FY-3 data is very interesting and meaningful work.

The underestimate of soil porosity at Arou site caused the underestimation of soil moisture. With lower soil moisture, the optimization of vegetation parameters did not perform well. We will recalculate the results with ground-measured soil parameters. we will give the statistics of improvements using pass 1 (bias correction) and the dual-pass scheme.

Since data assimilation technique is bias blind, model biases is an important issue in data assimilation (Figures 3-4). We developed the dual-pass data assimilation technique to cut down the biases nearly zero (Fig. 10). Pass 2 performs better than pass 1, which means soil moisture is more important than vegetation parameters in surface energy flux predictions on the experiment sites. However, bias correction is important for data assimilation systems. If the model bias was not corrected, the results will be sub-optimal. Thus, data assimilation system that can correct model biases should be designed (De Lannoy et al., 2007), and the study on bias correction should be enhanced.

De Lannoy, G.J.M., Reichle, R.H., Houser, P.R., Pauwels, V.R.N., Verhoest, N.E.C. (2007). Correcting for forecast bias in soil moisture assimilation with the ensemble Kalman filter. Water Resources Research, 43, W09410, doi:10.1029/2006WR00544.

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