

Interactive comment on “Assimilation of surface soil moisture into a multilayer soil model: design and evaluation at local scale” by M. Parrens et al.

M. Parrens et al.

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The authors thank the anonymous reviewer #1 for his/her review of the manuscript and for the fruitful comments.

1. [The application of the ISBA-DF model is only briefly described. I expect that a number of parameters should be set for the simulation of the different processes simulated by the model. However, no mention to the value of these parameters and how they are obtained is given. At the beginning, I expected that the ISBA models (2L and DF) were calibrated against in situ observations at the SMOSREX site, but this should be not the case. I expect that the model parameters are all fixed a priori based on soil texture and vegetation. Isn't it? Can the authors give more details on these aspects?]

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RESPONSE 1

The models were not calibrated, except for the field capacity value in ISBA-2L. In the case of ISBA-2L, the average of the observed soil texture profile is used (i.e. 20.0 % of clay and 45.3 % of sand). The field capacity parameter is set to 0.30 m³m⁻³ in accordance to the measurements. In the case of ISBA-DF, the measured profiles of soil texture (Fig. 1) and soil density are prescribed to the model. The value of the field capacity parameter is not prescribed in ISBA-DF.

2. [I believe that the rationale for the application of the bias correction (i.e., the CDF matching) should be detailed better. Usually, the bias correction is done for assimilating satellite observations into a model that simulates ground data. In fact, the assimilation impact is evaluated in terms of the simulation of ground data. In this study, ground observations are bias corrected and, then, assimilated for simulating the same ground observations. Therefore, I expect that a bias correction should not be made (likely the model parameters should be corrected). However, I believe the authors have in mind the ISBA-DF application at a regional and global scale with the assimilation of satellite data and with the model parameters fixed a priori. In this case the bias-correction is strictly needed. Can the authors give more explanations for their choice to apply the bias-correction for this specific case study?]

RESPONSE 2

This study is a first step towards the assimilation of satellite data in ISBA-DF at regional and/or global scales. The methodology described in this paper could be used in future satellite data assimilation studies as the models were not calibrated for this site (a priori parameters are used, except for field capacity in the case of ISBA-2L). In such a context, systematic errors between the observations and the model have to be reduced. In situ observations are assimilated and as explained in section 3.1, systematic errors between in situ observations and model values are actually observed. The CDF-matching technique is used to reduce systematic errors.

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3. [I would also suggest showing the results in terms of soil moisture anomalies (with respect to a long-term mean value or by considering an N-day sliding window). By removing the seasonal cycle, it can give further insights on the assimilation impact and on the experiment that better reproduces root-zone soil moisture observations.]

RESPONSE 3

Yes, computing a scaled anomaly correlation score (R_{ano}) is very useful for assessing the day-to-day variability of w_1 , as shown in past studies (e.g. Albergel et al., 2009). For the six experiments, and both open-loop and analysis simulations, R_{ano} values were derived from soil moisture anomalies with a five week moving window. It is found that the analysis slightly improves R_{ano} in the case of ISBA-DF (0.62 against 0.60) and has no impact on this score in the case of ISBA-2L (0.46 for both open-loop and analysis simulations). These results will be included in Table 2.

REFERENCE:

Albergel, C., Rüdiger, C., Carrer, D., Calvet, J.-C., Fritz, N., Naeimi, V., Bartalis, Z., and Hasenauer, S.: An evaluation of ASCAT surface soil moisture products with in-situ observations in Southwestern France, *Hydrol. Earth Syst. Sci.*, 13, 115–124, doi:10.5194/hess-13-115-2009, 2009.

4. [Sometimes I found that the number or the sentences reported in the text are not in accordance with those reported in Table 2 and Figure 5. For instance, at page 9568, lines 1-3 it reads that the assimilation increases the correlation coefficient and decreases the RMSE. However, if I am not wrong, from Figure 5 the assimilation provides an increase of the RMSE, not a decrease. Similarly, at page 9658, lines 23-24 it reads that the assimilation provides a decrease of 20% and 25% of the RMSE (for the w_1 simulation) for the open loop and the analysis. However, I obtain different values, i.e., $(0.055-0.066)/0.066=-17\%$ and $(0.032-0.052)/0.052=-38\%$. See also numbers at page 9663, lines 19-20. Therefore, I suggest carefully checking all the number reported in the text (or in the Table/Figure). Moreover, I suggest not reporting a lot of numbers in

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the text that makes the paper hard to read.]

RESPONSE 4

Yes. All the numbers reported in the text have been checked and will be corrected when necessary. Sometimes, numbers will be deleted to improve the readability of the paper.

5. [P9647, L26-27: I suggest mentioning here the very recent and interesting paper by Pipunic et al. (2013) that performed a similar experiment in Australia.]

RESPONSE 5

Yes. The reference to Pipunic et al. will be added in the revised version of the manuscript.

REFERENCE:

Pipunic, R.C., Walker, J.P., Western, A.W., Trudinger, C.M. (2013). Assimilation of multiple data types for improved heat flux prediction: A one-dimensional field study. *Remote Sensing of Environment*, 136, 315-329, doi:10.1016/j.rse.2013.05.015.

6. [P9649, L18-24: I suggest specifying here, among the paper objectives (and also in the Abstract), that you are going to assimilate surface soil moisture observations obtained from ground data (at the beginning I supposed you are using satellite data).]

RESPONSE 6

Yes, this will be done.

7. [P9649, L21: IBSA-2L, spelling error.]

RESPONSE 7

The sentence will be revised accordingly

8. [P9659, L26-29: It reads that in dry periods "the information provided at the surface

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does not penetrate very deeply into the soil". Then, that in summer the maximum values of the Jacobian and Kalman gain are obtained. This seems to me counterintuitive.]

RESPONSE 8

During dry periods, the information from the surface does not penetrate very deeply into the soil (less than during wet periods). However, the information from the surface affects the top layers of the soil (1-15 cm) more intensely than during wet periods. The Jacobian values (Fig. 9) show a decoupling of surface layers from deeper layers during dry periods, in relation to lower values of the hydraulic conductivity.

9. [P9664, L9: I would change "flexible" with "suitable".]

RESPONSE 9

The sentence will be revised accordingly.

10. [P9665, L3: It reads that in the ISBA-2L model the impact of the data assimilation is stronger for the first layer. Actually, the mean Jacobian value is higher for the second layer than for the first layer also in the 2L model (see P9658, L12). Please check.]

RESPONSE 10

Yes, this sentence is not clear. The reference to ISBA-2L is not useful and the sentence can be reworded as follows:

In the case of ISBA-DF, small Jacobian values are obtained for the top soil layer. Due to the small size of the w1 reservoir (1 cm), the dynamics of the first layer is driven by the atmospheric forcing to a large extent.

11. [Figure 5: This figure is hard to read and also the symbols given in the legend are not consistent with the text. I would suggest reporting the results of this figure in a table as in Table 2. By doing this, the reading of the results should be clearer (at least for me).]

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RESPONSE 11

Yes. The legends of Figure 5 will be changed to be consistent with the text.

12. [Figure 13: In the caption the meaning of the x- and y-axis is inverted.]

RESPONSE 12

Yes. The caption of Figure 13 will be revised accordingly.

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