

***Interactive comment on “Integrating ASCAT surface soil moisture and GEOV1 leaf area index into the SURFEX modelling platform: a land data assimilation application over France” by
A. L. Barbu et al.***

Anonymous Referee #2

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Dear Authors/ HESS-Editor,

I have read with interest the paper by Barbu et al. 2013 submitted to HESSD. I feel the paper was indeed well written, addressing relevant scientific challenges of assimilating observations of different sources into a land surface model and using state-of-the-art data assimilation techniques such as the Extended Kalman Filter, although in a simplified version (i.e. without background covariance matrix evolution).

The Leaf Area Index (LAI) and the Surface Soil Moisture (SSM) produced by two dif-

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ferent satellite data retrievals were ingested into the Land Data Assimilation System (LDAS) to correct the entire water energy and carbon balance via analysis increments applied to the Land Surface Model (LSM) prognostic variables (in particular the LAI and the root-zone soil moisture).

The results are well presented and the figures are of good quality (just a technical remark on Fig. 10-12 below). The limitation in the LSM (errors in simulating LAI seasonality and lack of vertical resolution in simulating the soil moisture) are highlighted as well as the limitation in the LDAS (the CDF matching procedure being applied to SSM only) but are not preventing interesting and relevant results to be presented, on the contrary they enhance the validity by drawing the perimeter of applications.

The impact of the LDAS is shown on the different compartment of the land surface energy&water balance and on the land carbon. The method is innovative as it propose also a multi-patch aggregation/disaggregation that can distribute the analysis increments. Its application to newly available datasets such as the GEOV1 and the ASCAT-SWI001 produced in the Geoland2 projects are also of great interest to the community. The methodology and statistical analysis produced are excellent.

While recommending acceptance in HESS I suggest the authors to consider the following minor comments:

1) Why not mentioning at all the Ensemble DA techniques and Ensemble applications of the current study? There is large evidence in literature and also in operational applications that the Numerical Weather Prediction, dealing with chaotic complex systems, is best addressed by systems that generates an ensemble of states, therefore enabling to account for uncertainties in the modelling (ancillary, parameters and parameterisations) and observations (systematic and random errors) in the predictions. I believe that adding a few sentences and relevant publications with comments on the possible extension of the present study to EnKF or Particle Filters might be beneficial.

2) The patch-aggregation observation operator is a necessity for the application of a

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simplified EKF to complex multi-patch LSMs such as in SURFEX platform. However the multi-patch aggregated grib-boxes could contemplate cases where inner grid inconsistencies are present (e.g. a field being harvested while another kept growing, or similarly for soil moisture, a field being irrigated next to a field that kept drying out), this information cannot be disentangled from the grid-wise satellite data but an estimation of such an effect can be obtained in a simulated experiment. Has this being tried? Obviously inner-grid inconsistency are very likely attributed to human intervention. How big a limitation of the validity of this method can come from such cases? Is it worth mentioning this as a limitation of current observational and/or products resolution? I would invite the authors to consider those questions.

3) It is a pity that no river discharge data is being used to further validate and to convince the reader that the LDAS is indeed improving the water partitioning between evapotranspiration, soil storage and soil drainage. It is true that the soil moisture in-situ validation provide such a supplement, but this lacks the regional-scale validity that considering French major rivers would have provided (after all the results are presented on the whole of France and SMOSMANIA represent only a transect in the southern part). I hope this can be considered in future studies and if so be explicitly mentioned in the concluding sentences.

4) Figure 10-12 adopt shadows of greens and reds colours that made difficult to appreciate the quantitative aspects of the maps shown. When colours figures are adopted why not using a legend that would enable appreciating also the values, using different colours?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 9057, 2013.

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