

Review of paper: “Advancing land surface model development with satellite-based Earth observations”

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## General

This paper aims at validating the ECMWF surface model both coupled and uncoupled to the atmospheric model. The validation approach is rather complex, using several sources of satellite data. Ensemble technique is used with 6 parameters listed in Table 2 perturbed. The validation is both quantitative (for LST in Fig. 1) and qualitative to infer links between various parameters on the performance (Figs. 3-5). While the approach is interesting for the simultaneous examination of various causes of uncertainty, there is no clear path forward, notably to improve LST. It is commented that improving one LST may lead to deteriorating other aspects such as hydrology. It is implied that calibration of parameters will be best accomplished by simultaneously optimizing these. But how? The paper could be published after improving the flow of the arguments, and addressing points listed below.

## Specific points

- Physical insight would be appreciated on LST results. Large range bias in southern Africa, for instance could be due to various factors. Which ones? Could it be for instance due to differences in surface emissivity used in retrievals versus that used in the model?
- Justify the need to run 45-day forecasts to infer the performance of a surface model. Seems quite long.
- The multiplicative factor  $s$  in section 2.2.3
- : 0.25-4.0 applied to selected parameters appear arbitrary. These should be based on assumed uncertainty.
- Similarly, why do you need a validation over many years to get Fig. 1? To do that, you presumably need initial ECMWF analysis which are based on different versions of the ECMWF model, which used different input data (notably satellite datasets).
- It seems that validation in coupled mode starts with an ECMWF analysis at each forecast, without actually cycling. Normally validation is done in an analysis cycle, which is quite demanding in terms of computer resources, but needed before implementing.
- Clarify the nature of the 25 parameter sets. How to do establish the “best parameter sets”.