

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

Anonymous Referee #2

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Summary and key findings of the study

This study investigate the performances of soil moisture observations into a two levels of complexity of land surface models. The main scopes of the paper were to 1) evaluate open-loop simulations of the two models (a 2-layer LSM Vs. a multi-layer LSM); 2) evaluate performances of soil moisture observations assimilation into the two models; 3) test sensitivity of the assimilation scheme when assimilating observations to deeper layers (or when introducing correlation among layers); when observations were a-priori bias-corrected, or when poor precipitation forcing were available. The most important finding of the paper is that multi-layer models should be used along with soil moisture assimilation to provide better estimates of surface and root zone soil moisture. A multilayer model allows for inclusion of correlations among layers which as mentioned in

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the present work motivates further research on the topics on how evolution of background model covariances could be further investigate to improve the analysis results throughout multiple soil layers.

General comments:

The paper addresses some of the most relevant questions for HESS readers. The development of new satellite to observe soil moisture makes this research key to better understand what optimal assimilation setups can provide the most accurate estimation of soil moisture dynamics. The manuscript is well written. Ideas and scopes of the paper are clearly presented, methods are well described, results and discussion are systematically addressing the specific questions of the study. Overall English language is fluent, precise, and technically sounded. The abstract provides a concise and complete summary of the experiments developed in the paper along with a clear statement of the main findings of the study.

Specific Comments:

1) I was under the impression that CDF correction was included already in the reference tests, I only found later in the text that "CDF matching year per year is computed in the experiment DF-CDF but not in the DF-REF". In general and to my knowledge CDF matching should be considered a priori assimilation in order to improve the overall analysis results, e.g. it seems that CDF should be considered already as part of the references cases. Can the authors explicitly state what is the main rationale for not including it in their reference tests?

2) Are the parameters/initial conditions of the 2L and DF models consistent among each other? Is it possible to add a table including the main parameters/initial conditions or state any other possible differences between the two models beside the layer structure?

Technical corrections: It may be easier to include the terms “w_1” and “w_tot” (as per

result section 3.2.1) in the caption of Figure 4 to be more consistent between text and figures.

In Figure 5 there is a reference to “OL-FR” and “EXP-FR” does “FR” refer to “Force-Restore”? I could not find this defined in the text, maybe consistently use either “2L” or “FR”?

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