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Hydrology and Earth System Sciences Discussions

Interactive comment on "From near-surface to root-zone soil moisture using an exponential filter: an assessment of the method based on in-situ observations and model simulations" *by* C. Albergel et al.

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The authors thank the anonymous referee #3 for his review of the manuscript and for his comments. For an easier comprehension, general comments of the referee are also reported (3.XX).

3.1 [One omission in the analysis is the lack of discussion concerning potential seasonal impacts on the estimation of optimal T. Strong root-zone soil moisture seasonality (due primarily to seasonal ET variations?) is observed at all the study sites. Therefore it is reasonable to assume that seasonal variations exist in the coupling of the surface and root-zone (due to wet versus dry seasonal conditions) and the persistence of root-zone soil moisture anomalies (both factors that should explicitly impact optimal T). However, the theoretical basis (in (1) and (2)) of the approach explicitly neglects ET (let alone its seasonality) and the entire analysis is based on fitting a single optimal T to all seasons. In particular, the seasonal structure of errors in Figure 6 (too dry in winter, too wet in summer) seems to indicate the neglect of seasonal variation in T. The multi-year time series of observations at the SMOSREX site is a very good site these examine seasonal effects at. At the very least, the revised manuscript should contain a discussion of potential seasonal variations in optimal T. Ideally, it would also look at the potential for addressing errors in Figure 6 by fitting a different T to winter and summer periods.]

Response 3.1

A possible seasonal impact on the T parameter for the 7 year period of SMOSREX was investigated. Instead of applying the filter with T=6d to the whole 7-year period, the filter was applied season by season (winter, spring, summer, autumn, with T values optimised for each season pooled over the 7-year period, of 2d, 3d, 4d, 6d, respectively). The seasonal SWI values where then aggregated and compared to the scaled observations at 30cm. The obtained N value (0.717) is lower than for the standard method (0.858).

3.2 [A reasonable baseline comparison for Nash-Sutcliffe N associated with root-zone predictions from the exponential filter are analogous N values associated with simply using unaltered surface zone observations (and a persistence model) to estimate rootzone soil moisture. My understanding is that this would correspond to exponential results for the case of T=0. In Figure 5, some of the sites exhibit high N (e.g. the SFL site) simply because they start out with a high N at T=0. While other sites smaller a lower peak N (at optimal T) but a larger increase relative to N at T=0 (e.g. the URG site). If the purpose of the paper is to describe the value of an exponential filter, rather that a simple assumption of perfectly correlated variations with depth that would results in high N at T=0, than some discussion about the differences between these two cases seems important. The exponential method appears particularly valuable at the URG site, despite the fact that the overall N at peak T is low relative to other sites. Might the difference between N at peak T and T=0 correlate with environmental variables like soil texture in a way that that just the peak N might not? Also, would mapping the difference between N at T=0 and peak T for continental France (as in Figure 7) lead to any interesting insights?]

Response 3.2

Assessing the exponential filter for T=0 at SMOSMANIA stations and SMOSREX is tantamount to comparing unaltered scaled surface soil moisture (at 5cm) with the scaled root-zone soil moisture (at 30cm). The comparison of the two time series shows high correlations ($r2>0.5$) for 10 stations (including SMOSREX). Three stations (LHS, MTM, LZC) present lower correlation levels. It is interesting to note that for these stations, the filter score N (Table 2) is rather low, also. This is not a general rule: although the filter score N is low for SBR, the 5cm vs 30cm correlation is high (r2=0.656). Regarding the correlation simulated by ISBA between the surface soil moisture and deeper layers, a number of factors (soil texture, vegetation coverage, time) were investigated by Calvet and Noilhan (2000). A decoupling between the 2 layers may occur for low vegetation coverage (favouring direct soil evaporation). The decoupling is more pronounced before dusk, and for sandy soils. As the SMOSMANIA and SMOSREX stations are densely covered by grass, the decoupling may be limited by the presence of vegetation.

3.3 [The analyst focuses on 6 am observations. This is an understandable choice given SMOS mission design. However, optimal retrieval time is still an open issue for future missions like NASA SMAP. As pointed out by the authors, one justification for predawn is that it likely represents the strongest vertical coupling of the surface to the subsurface. However, there are also complicating effects like dew storage on the canopy to consider. It would be interesting to see how the authors results varied with assumed

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retrieval time. You would expect the best performance at pre-dawn but a quantitative estimate of how much worse results at later times become might help future missions weigh the relative advantages and disadvantages of pre-dawn overpass times.]

Response 3.3

The in-situ data used in this study are not affected by dew, as they are taken below the ground. Therefore, this effect cannot be investigated here. We have repeated the exponential filtering for other times of day. No significant diurnal cycle was found on the performance of the filter, for either SMOSMANIA or SMOSREX.

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