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.

Anonymous Referee #3

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The manuscript describes and tests the application of an iterative exponential filter to estimate root-zone soil moisture from a time series of sporadic surface-zone soil moisture observations. The procedure is of interest due to the extremely shallow vertical support of remotely-sensed soil moisture retrievals expected from current and near-future microwave remote sensing missions. Overall, this is a well written paper described solid reserach on an interesting topic. However, I do have a couple of comments that should be considered prior to publication.

1) One omission in the analysis is the lack of discussion concerning potential seasonal

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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.

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 root-zone 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?

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 pre-dawn is that it likely represents the strongest vertical coupling of the surface to the sub-surface. 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 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.

Minor comments:

1) Abstract "automatic" -> "automated"

2) Abstract "retrieve the soil moisture" -> "retrieve soil moisture"

3) Section 2.3. "SIM was extended to the whole of continental France in 2002 in order to monitor the water resources" -> "SIM was extended to the whole of continental France in 2002 in order to monitor water resources"

3) Figure 6. Its very hard to see the difference between small and large dots here. Consider a different format.

4) Section 3. "undesired effects in the real data base due to local climatic incidences" It is unclear what is meant here. Clarify.

5) Section 4.1.2. "Betters results are obtained if the surface soil moisture observations are normalized yearly". Change to "Betters results are obtained if the surface soil moisture observations are normalized separately on a year by year basis"

6) Discussion "The two main factors impacting on the retrievals exists" to "The two main factors impacting on the retrieval are"

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