Review of the paper:

"Multi-decadal analysis of root-zone soil moisture applying the exponential filter across CONUS"

by: Kenneth J. Tobin, Roberto Torres, Wade T. Crow, and Marvin E. Bennett

GENERAL COMMENTS

The paper applies the exponential filter to produce an estimate of root-zone soil moisture (RZSM) from four types of microwave-based, surface satellite soil moisture products, namely: the NASA LPRM AMSR-E product and 3 additional products obtained from the European Space Agency Climate Change Initiative (CCI), i.e., the CCI-Active, CCI-Passive and the CCI-Combined soil moisture products.

The estimates are compared against in situ observations derived from 4 different networks (AMR, SCAN, SNOTEL, USCRN) in Contiguous United STATES (CONUS) during 4 eras selected according AMSR-E data availability.

The recursive formulation of the exponential filter (Albergel et al. 2008) is used for the evaluation of the Soil Water Index. The calibration of the only parameter T is carried out in two ways: 1) by the minimization of the RMSE against in situ root zone soil moisture and 2) by using NDVI derived from MODIS as in Qiu et al. (2014).

The topic is of interest for the HESS readership and worth to be published. The paper is also well organized and contains interesting analyses and results. I particularly appreciate the use of the NDVI index for the filter calibration which I think should be more highlighted and more discussed in the paper. Despite this, I found some moderate issues that the authors should address prior the paper can be considered adequate for publication. My main comments are listed below:

1. The distinction among the different eras is done by considering AMSRE soil moisture product as a reference (pre-AMSRE, post-AMSRE etc…). Given the paper results, it is also clear that the gaps contained in the surface soil moisture data have an effect on the performance of the exponential filter (although this effect is limited for gaps < 2days). Based on that, I wonder if the rationale in the choice of the different eras should not take into consideration also the advent of the ASCAT sensor. Indeed, according to the paper of Dorigo et al. 2015 (Figure 5) it can be observed a significant increase in the data density after 2007, i.e., when the Advanced Scatterometer ASCAT has started to be operational. From the figure, we can also observe a significant reduction of the data density during 2001-2003, which might have an effect on the performance of the exponential filter (especially after the quality check, which might significantly reduce the data density).
2. It is not completely clear from the paper how the problem of gaps in the satellite soil moisture data is addressed within the application of the exponential filter. I suppose the authors use the exact time difference between two valid satellite observations, i.e., t_n-t_{n-1}. When this time difference is large (even weeks in northern CONUS), as it might happen during the winter season, is the filer re-started? Please add a brief discussion on that.
3. The quality of the figures is not appropriate and some captions are not self-explanatory. This makes difficult the interpretation of the results. I will list below specific comments on them.

4. The version of the specific CCI product is not mentioned. There are sensible changes between the different versions of the products with respect to the merging procedure and the sensors used (e.g. SMOS) that justify the inclusion of the product version in the manuscript.
5. At a point of the manuscript (line 256 pag 10) it reads: "The T_{Opt} and lagged r-values discussed are based on results that have a low absolute bias (± 10%)". Nothing is said before about any distinction between stations with low and high absolute bias and why this distinction is included in the results. Nor the authors provide the number and which of the stations show low and high absolute bias. I found this confusing. This issue of the bias is also confounding with the notation used at page 9 line 224 where SWI is defined as "rescaled SWI". Do the authors use any rescaling technique? If so, how it is related with the bias? Which rescaling technique has been used?

Based on the comment above I recommend the publication after **MODERATE REVISIONS**.

I will list below my specific comments in order of appearance in the manuscript also indicating their relevance.

PAGE	LINES	RELEVANCE	COMMENT
4	103-109	MINOR	Why not add a table of the selected eras. This would simply the reading.
5	136	MODERATE	Indicate the CCI version here. This is important.
9	227	MOD/MAJOR	"Days in which the minimum air temperature was less than 0 °C were removed from the SWI dataset." This is an important point. I think it is not completely correct to remove these values at this point (i.e., after the application of the filter). Indeed, given the recursive nature of the filter any surface observation characterized by a temperature lower than 0°C has a detrimental effect on future observations. Hence, this masking has to be carried out on the surface observations and not on the SWI.
10	245	MINOR	Here the authors uses "lag correlation", in section 3.3 simply "correlation" while in the figures "lagged correlation factor". Later lagged r-values. Please use a consistent notation.
10	256	MOD/MAJOR	"low absolute bias" (see point 5 of the main comments)
11	285	MODERATE	See previous point
12	310	MINOR	You may also cite this work (Massari et al. 2014) in which the authors used ERA-Interim root zone soil moisture within a simple hydrological model to infer the catchment wetness conditions before flood events. Massari, C., Brocca, L., Barbetta, S., Papathanasiou, C., Mimikou, M., & Moramarco, T. (2014). Using globally available soil moisture indicators for flood modelling in Mediterranean

			catchments. *Hydrology and Earth System Sciences*, *18*(2), 839–853. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84896859292&partnerID=40&md5=02d91d8522bb7c834f88e95a0266c9a3
13	328	MINOR	"NS<1" should it be NS<-1
Table2 caption		MINOR	Define n in the table
Figure 1		MODERATE	Improve the legend quality and provide explanation about grey areas.
Figure 10		MODERATE	Add letters to identify subfigures and add a legend.