Interactive comment on "The impact of land surface temperature on soil moisture anomaly detection from passive microwave observations" by R. M. Parinussa et al.

Anonymous Referee #2
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Firstly, the authors of the manuscript would like to thank the anonymous reviewer for their helpful comments. Secondly, this document is structured similar to the reviewer's document as presented online in HESSD. Each reviewer's comment (*italic*) is followed by the author's response.

This is a well-written paper of interest for HESS readers, it addresses an important issue regarding the retrieval of soil moisture from remote sensing. Surface temperature estimates are, among others parameters, required for the retrieval of soil moisture from remote sensing. While previous satellites such as AMSR-E and Windsat are able to provide Ka-Band measurements allowing an estimation of surface temperature, the SMOS spatial mission as well as the upcoming SMAP mission lack this information. As a matter of fact, surface temperature estimate has to come from ancillary sources such as reanalysis. The paper is well structured and clear. The title clearly describes the contents of the paper. The abstract provides a concise and complete summary, the reference list is appropriate but could be enlarged. The language is fluent and precise. The results are generally sound and well supported with figures. My recommendation is mainly for reinforcing the clarity of the paper as a lot of information are provided to the reader. A number of comments/suggestions that the authors could consider follow below:

P.6684, L.14-15 ; *"Because of this, ancillary – and potentially less accurate – sources of surface temperature information [...]". I found arguable that K-band based surface temperature retrievals are "less accurate" than re-analyses. Please, consider adding more informations on this subject.*

The authors agree on the reviewers comment that the quality of the different land surface temperature products is arguable – which is why we describe re-analysis data as only 'potentially' less accurate. In truth, the relative impact of re-analysis versus Ka-band on soil moisture retrievals is currently unknown and this open question is a large part of the motivation for our paper. Will believe this uncertainty is adequate described in the manuscript's introduction.

P.6685, L.10-13 ; *"Most recently [...] (Kerr et al., 2001)." Please update with either Kerr 2007 or Kerr et al., 2010.*
Kerr, Y. (2007): Soil moisture from space: where are we?, Hydrogeol. J., 15(1), 117–120. Kerr, Y.H., Waldteufel, P., Wigneron, J.-P., Delwart, S., Cabot, F., Boutin, J., Escorihuela, M.-J., Font, J., Reul, N., Gruhier, C., Juglea, S.E., Drinkwater, M.R., Hahne, A., MartiÌA¸n-Neira, M. & Mecklenburg, S., (2010). The SMOS Mission: New Tool for Monitoring Key Elements of the GlobalWater Cycle. Proceedings of the IEEE, 98 (5), 666 - 687.

The reference Kerr et al. (2001) was updated with Kerr et al. (2010)

P.6685, L.20 ; *Please consider adding reference from Schmugge, 1983.*
Schmugge, T. J. (1983). Remote sensing of soil moisture: recent advances, IEEE T. Geosci. Remote Sens., GE21, 145–146.

Reviewer's suggestion was followed.

P.6687, L.21 ; *Do you mean that they are based on the use of unbiased data?*

The text was adapted in an attempt to clarify this section and reads as follows:

'The skill to capture a high degree of temporal variability of soil moisture was the main driver to select LPRM soil moisture retrievals for this study. For the majority of the applications and/or data assimilation techniques that use remotely sensed soil moisture data the temporal correlation coefficient is arguably the most important indicator of utility. Especially for data assimilation it is a prerequisite to minimize systematic differences (Reichle and Koster, 2004), often by removing the climatology and scaling the anomalies to match the models climatology (e.g. by cumulative distribution function (CDF)-matching).'

P.6687, L.27 ; *"[...] by a lack of ground-based observation networks [...] (Scipal et al., 2008)." I agree with the spatial density issue, however since 2008 big efforts were made to provide ground-based observations (ISMN, http://www.ipf.tuwien.ac.at/insitu/, NCRS-SCAN,http://www.wcc.nrcs.usda.gov/scan/), I think it is of interest to notify it as several studies already showed that point scale data are able to monitor coarse scale soil moisture product.*

The authors agree that it is of general interest to inform the reader about the efforts put into the recent progress for getting ground-based observations more readily available. The text was adapted and looks as follows:

'Large-scale validation/verification of surface soil moisture retrievals is generally hampered by a lack of ground-based observation networks with sufficient spatial density to be accurately up-scaled to the resolution of satellite-based soil moisture retrievals (Scipal et al., 2008). Recently, ground-based observations have been made more readily available (http://www.ipf.tuwien.ac.at/insitu/ and http://www.wcc.nrcs.usda.gov/scan/), enhancing the evaluation of remotely sensed soil moisture using ground-based observations over a wide range of land cover types (e.g. Brocca et al., 2011; Parinussa et al., 2011). Nonetheless, global scale applications increasingly require global scale estimates of the skill of soil moisture data that isolated monitoring networks cannot provide.'

P.6690, L.1-10 ; *It is not the first time you mention these differences, may they can be summarize in a table.*

Reviewer's suggestion was followed and specifications of AMSR-E and WindSat used in the soil moisture retrieval algorithm were summarized in Table 2.

P.6690, 2.2 *MERRA data, do you plan to use other data sets, analysis and re-analyses (NCEP, ECMWF)?*

The analyses presented in this manuscript could also be done using other LST sources. MERRA LST data are produced at an hourly interval, this high temporal availability was the main driver of using MERRA LST in this analysis. There are currently no plans to use NCEP or ECMWF data in this analysis however this could be done in the future and this manuscript can be used as a guide in doing such analysis.

P.6691, L.18-20 ; *"P gauge is based on the same satellite input data (TRMM 3B42) but includes a retrospective correction based on monthly rain gauge data and is therefore of higher quality than P sat" Do you have any evaluations references for this?*

Huffman et al. (2007) demonstrated the higher quality of P^{gauge} after the retrospective correction of P^{sat}, the text was adapted and looks as follows:

'P^{sat} is based on the real-time TRMM 3B42RT product calculated by combining passive microwave with microwave calibrated infrared satellite data derived from different sensors (Huffman et al, 2007). P^{gauge} is based on the same satellite input data (TRMM 3B42) but includes a retrospective correction based on monthly rain gauge data. Hufmann et al. (2007) demonstrated the substantially higher quality of P^{gauge} after the retrospective correction of P^{sat}.'

P.6692, Section 2.4, *Wagner et al, 1999 for the TU Wien soil moisture change detection algorithm, Draper et al., 2011 and Albergel et al., 2010 for examples of use/evaluation.*
Wagner, W., Lemoine, G. & Rott, H. (1999). A method for estimating soil moisture from ERS scatterometer and soil data, Remote Sens. Environ., 70, 191-207.
Draper, C., Mahfouf, J.-F., Calvet, J.-C., Martin, E. & Wagner, W. (2011). Assimilation of ASCAT near-surface soil moisture into the French SIM hydrological model, Hydrol. Earth Syst. Sci. Disc., 8, 5427-5464, doi:10.5194/hessd-8-5427-2011.
Albergel, C., Calvet, J.-C., de Rosnay, P., Balsamo, G., Wagner, W., Hasenauer, S., Naemi, V., Martin, E., Bazile, E., Bouyssel, F. & Mahfouf, J.-F. (2010). Cross-evaluation of modelled and remotely sensed surface soil moisture with in situ data in southwestern France, Hydrol. Earth Syst. Sci., 14, 2177-2191, doi:10.5194/hess-14-2177-2010.

Several references were added in Section 2.4 Scatterometer data, including Wagner et al. (1999), Figa-Saldana et al. (2002), Naemi et al. (2009), Albergel et al. (2010) and Brocca et al. (2011).

P.6694, L.10-13 ; *As it is a important sentence in this article I suggest to rephrase it (maybe 2 sentences) for a better comprehension (+ it is the same sentence P.6688).*

Reviewer's suggestion to explain this part (as well as the part on P.6688) in more detail was followed.

P.6694, L.16 ; *"satellite-base precipitation product (P sat)" Already defined, use P sat.*

Reviewer's suggestion was followed

P.6696, L.9-10; *"[...] are rescaled so that they have the same temporal standard deviation [...]" Which technique was use? please link with P.6700 L.1-2 "[...] processed to have the same temporal mean and standard deviation [...]".P.6698, section 3.2, Adding a table summarizing all the different scenario will help the reader.*

In response to questions about our rescaling procedure, we have completely rewritten this section of the manuscript. The revised text now references the re-scaling technique with Scipal et al. (2008) and Stofellen et al. (1998) which provide detailed information about appropriate re-scaling approaches which are for obtaining reliable error estimations using the TC verification technique. In this paper we followed the rescaling steps as described in these papers, leading to scaling factors (3) and (4).

$$\hat{\theta}^{*}_{API} = \hat{\theta}_{API} \cdot \left(\frac{\overline{\hat{\theta}_{ASCAT} \cdot \hat{\theta}_{LPRM}}}{\overline{\hat{\theta}_{LPRM} \cdot \hat{\theta}_{API}}} \right) \quad (3)$$

$$\hat{\theta}^{*}_{LPRM} = \hat{\theta}_{LPRM} \cdot \left(\frac{\overline{\hat{\theta}_{ASCAT} \cdot \hat{\theta}_{API}}}{\overline{\hat{\theta}_{API} \cdot \hat{\theta}_{LPRM}}} \right) \quad (4)$$

Also, the reviewer's suggestion to summarize the different LST scenarios in a table was followed, resulting in Table 3.

P.6699, L.8, *"root mean square error" already defined, use RMSE only.*

Reviewer's suggestion was followed

Figures 2 to 5, *please add legend on colour bar*

Reviewer's suggestion was followed