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Discussions

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Interactive comment on "The added value of brightness temperature assimilation for the SMAP Level-4 surface and root-zone soil moisture analysis over mainland China" *by* Jianxiu Qiu et al.

Anonymous Referee #1

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The author assesses the performance of the surface and root-zone soil moisture (SSM and RZSM) estimates by SMAP Level-4 DA system using an open loop (OL) simulations and two years in situ profile soil moisture observations at 2474 sites over mainland China. The anomaly Spearman's rank rather than Pearson correlation coefficient is calculated for comparisons and evaluations. In the following, to evaluate the efficiency of SMAP L4 DA system, the author chooses eight factors and uses methods of random forest regression and box plot comparisons to do the attribution analysis. Results show the improvement of SSM and RZSM estimates through the increased anomaly with in situ measurements, compared to OL based results. Three factors namely the standard deviation of the observation-minus-forecast Tb residuals, errors in precipitation forcing

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data and microwave soil roughness parameter H are found dominantly affecting the efficiency for SSM and RZSM estimates by SMAP Level-4 DA system. Furthermore, the SSM-RZSM coupling strength characterizing the surface to subsurface physics in CLSM is evaluated based on in situ measurements and OL and DA estimates.

Although it is enough to understand what 'went on', the scientific and English language is imprecise in various places as well as some cited information. I have given some examples below and labeled some in the attachment, but the authors should go throughout the entire manuscript carefully, and check that the descriptions and citations are as exact as possible. On the other hand, the author often uses different tenses in a paragraph even in one sentence, making presentations a bit messy. Additionally, too many brackets are used to present information. Please do the appropriate revisions, as a reader, I tend to get accurate information rather than having a hesitation on whether I shall ignore/keep the information, and thereby guess how does each step be carried on and may lose interest. I am sorry. I would say, maybe some main contents are ignored by the reviewer because of the weak presentation.

Major and minor comments are listed in blow and others please find in the attachment.

Major comments:

In line 77, Please specify key CLSM parameters and give the reason why you choose these parameters?

In line 105, please clarify whether the OL run is conducted in this study? In line 29, I am sorry I cannot understand, what does "error in Tb observation space" mean? Please also explicitly clarify Tb error. In line 108-111, please clarify/specify "microwave soil roughness parameters, a vegetation structure parameter, and the microwave scattering albedo". "Soil roughness parameters" are used throughout the paper but without explaining what they are. Does it refer to both h and N, or s and L, or others? Additionally, please keep the cited information correct (equation A1 instead of B1). Please carefully check throughout the manuscript.

In line 120, LH and SH are mentioned. LH error is seen, please if possible, give the reason why SH error is disregarded.

In line 127, if possible, please give the figure plotting the distribution of CASMOS as new Fig. 1.

In line 133-134, I cannot be convinced by the described reason about the use of Spearman correlation rather than Pearson correlation. Could you explain more? Wikipedia says that the Spearman correlation concerns the rank and Pearson correlation the mean. Do you calculate Pearson correlation based results? Please give the definition of outliers excluded in this study. In line 144-147, please clarify why these five control factors are chosen, and why the difference in clay fraction across the vertical can be used to quantify vertical variability in soil properties.

In Table 1, please clarify why different LAI products are used? What is the relationship between these two LAI datasets? Why does SMAP L4 LAI be used for LSM rather than RTM, which simulates Tb that is used for comparisons to SMAP Tb.

In line 153, why is there a joint error in SMAP Tb observations and RTM Tb simulations? Sorry if I misunderstood something, what does "joint" mean? How do you quantify this joint error and what is the rationality behind?

In line 154, "the magnitude of LAI (as a proxy for the vegetation optical depth at microwave frequencies, which modulates the sensitivity of the observed Tb to SSM conditions)". The description is inaccurate. LAI should be as a proxy for the estimation of vegetation optical depth. Please clarify how vegetation optical depth modulates the sensitivity of the observed Tb to SSM conditions, it is hard to make the audience understand who does not be familiar with the zero-order RTM.

In line 156-160, please make expressions precise. You give "e.g.," may I ask what else do you use, please list every item as accurate as possible, as such, readers and the author are on the same page. In line 160, I fully doubt "because increased LAI

is associated with decreased soil moisture information content in microwave observations", is it true? How do you explain, for example, when vegetation is mature, the soil experiences drying and wetting processes? Please make expressions accurate.

In line 204-205, please clarify the reason.

In line 210, why the anomaly SSM and RZSM are not used for Eq. 1, because in previous it is mentioned that anomaly Spearman's rank correlation is calculated with in-situ observations.

In line 214, "Cases with negative CP do not exist." I have litter doubt whether the in situ measurements will show that α is greater than 2.0, then CP can be negative? Please confirm this.

In line 227, please explicitly clarify "error" in FLUXCOM LE. Does this error refer to the uncertainties mentioned in line 186?

In line 235, please clarify "three independent sources (x, y and z)", does it refer to geographic location or one of the variables mentioned in your study? Please also explicitly explain two instrumental variables I and J. I did not see the time information mentioned in Eq. 2. Please is "(I and J, i.e., It = αxPt-1 + Bx + εxt-1, Jt = αyPt-1 + By + εyt-1)" important in the calculation, if so, please list it as an independent equation. Please clarify $\varepsilon\_(xt-1)$ or do you mean $\varepsilon\_(x,t-1)$? Additionally, too much information is listed in brackets, shall readers ignore/keep this information? Please do revisions.

In line 255, "based on the output of RF", as a reviewer, I do not know more about RF, what are inputs for RF? I think the introduction of RF is too general and not informative. Please do revisions. Taking this paragraph as a case, past and present tenses are mixed used. Please do revisions.

In Fig. 1a-d, what is the maximum value for R? Can it reach 0.9? If not, please adjust the scalar. Please rewrote the caption of Fig.1.

In line 261, "an increasing trend of SSM estimation skill moving from northwest to

southeast China", if possible, please write a short sentence to explain the reason.

In line 280-281," Errors in the CLSM precipitation forcing are relatively higher in northern and northwestern areas of China (Fig. 2a), where the gauge density is generally more sparse than southern China." I agree with this point. But I am sorry if I misunderstood. The magnitude of precipitation on the northwestern part may be smaller than on the southern part, as such, there is a possibility that errors may present a reverse trend, is this a case? Please confirm.

Figure 2g, please revise the title as "soil roughness parameter *". In Fig. 2h, the maximum value of LAI is 2.0 m2/m2, please confirm. Fig. 2f, please revise the title as "the standard deviation of O-F Tb residuals". I think the meaning of "O-F Tb residuals" is different from Tb error itself.

In line 297-298, "The 2017-2018 mean of soil roughness and the 2017-2018 mean LAI show higher values in southwest and southeast China (Fig. 2g-h)." The sentence is not informative. Please revise.

In line 335-336, OL run does not implement DA, why "Tb error (microwave soil roughness)" are involved. Please clarify. I am sorry if I misunderstood something.

In line 389, "OL does get worse with increasing roughness, there is more room for improvement as the roughness increases", please clarify whether the increase of roughness is physically reasonable.

In line 441, "it is unclear whether or not the observed SSM-RZSM coupling strength biases are real in an absolute sense – or simply reflect inconsistencies in the depth of modelled versus observed SSM and RZSM time series". I am sorry, I am confused whether the coupling strength based on in situ measurements can represent the real?

In Conclusions, the second and fourth paragraphs have duplicate content. Please do revisions.

In line 451-452, "the partitioning of the available energy into latent and sensible heat

(LE error) and the microwave radiative transfer modeling (Tb error)." is not informative.

Minor comments:

Please give the full name for abbreviations when they appear for the first time. The examples are SPOT VGT and EASE. Please carefully check throughout the manuscript.

In line 216, SMAP L4 CP estimates (CPOL), please confirm. You mentioned SMAP L4 is the assimilation experiment.

Please confirm the use of RTM-related, R-values, and so on throughout the whole paper, as well as the use of "their" and "our".

Please also note the supplement to this comment:
https://hess.copernicus.org/preprints/hess-2020-407/hess-2020-407-RC1-supplement.pdf

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2020-407, 2020.