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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 #2

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The paper evaluates the data assimilation efficiency of SMAP brightness temperature data by updating the root-zone soil moisture with CLSM (the Catchment Land Surface Model) model and an RTM model (radiative transfer modeling). The result of soil moisture filed delta_R increments then identifies substantial factors that control this data assimilation efficiency, such as precipitation error and SSM-RZSM coupling strength error. I appreciate the motivation of this paper, and its conclusion and inference are probably attractive to the L-band TB data assimilation community. However, I cannot agree on the methodology part of this paper, and I don't think the findings would help with the further development of RZSM DA improvements. My concerns are:

Majors: 1. Line 23 & Line 75-79, Line 144 & Line 152: how do the authors select these eight control factors? 2. Line 80, please show which part of the paper corresponds to each sentence. For instance, "Next, the in-situ measurements . . .", As I see, only figure 1 is about the in-situ measurements. 3. Still, Line 80-81, the soil moisture profile measurements from CMA networks can reach 100 cm. please refer to: Han Shuai, Shi Chunxiang, Jiang Lipeng, Zhang Tao, Liang Xiao, Jiang Zhiwei, Xu Bin, Li Xianfeng, Zhu Zhi, Lin Hongjin. The Simulation and Evaluation of Soil Moisture Based on CLDAS[J]. Journal of Applied Meteorological Science, 2017, 28(3): 369-378 I suggest the authors separate the sites that contain measurements with 100 cm and the rest in the analysis. 4. Section 2.2, the repetitiveness of in-situ soil moisture measurements is questionable. Line 128, the atmospheric elements such as air temperature, humidity, etc. of these stations cover different land-use types. When it comes to soil moisture, due to high spatial difference, the in –situ soil moisture profile measurements may vary a lot to the station outside. In standard, all these CMA stations should only have grassland or bare soil land types. Other land covers are impossible, and this affects precipitation, evaporation, draining, etc., as authors said in Line 144-146. The scale mismatch between CLSM outputs and in-situ measurement would exceed the accuracy indicates in the evaluation. 5. Line 161, Table 1 & Line 192, could we use the same LAI data? As well as the rainfall data. 6. Line 248, what is the DA efficiency? Line 309, it says "the efficiency of SMAP L4 DA (i.e., ΔR = RL4 - ROL)". The data efficiency is not that simple, indeed. Please refer to (Nearing et al. 2018) for the definition of data assimilation efficiency, or provide where this "the efficiency of SMAP L4 DA (i.e., ΔR = RL4 - ROL)" comes from in citations. Nearing, G., Yatheendradas, S., Crow, W., Zhan, X., Liu, J., & Chen, F. (2018). The Efficiency of Data Assimilation. Water Resources Research, 54, 6374-6392 7. Figure 1 & Section 3.1, one of the conclusions in this paper that RZSM is improved by assimilating brightness temperature. Figure 1 & Section 3.1 are the only evidence to support this view, which is vital to the following paragraphs. By any two datasets, the increased correlation coefficient is hard to address improvement. unRMSE, bias, and other characters shall also be accounted as SMAP evaluate

its soil moisture products. As in Line 52-54, "observations-minus-forecast residuals" may not be sufficient, but it doesn't mean it is unnecessary. Besides, Spearman's rank correlation coefficient is very loose in statistics. Pearson correlation can assess linear relationships hypothesized in ordinary DA filters. Line 133-134 is not solid for support the advantage of Spearman's and it should clarify what the outliers are.

Minors: 1. Line 1, please clarify what is the added value, is it a correlation coefficient or DA efficiency? The term "added value of .... soil moisture..." is misleading because the study is based on delta_R, not soil moisture increment. 2. Line 25, it should be "Spearman's rank correlation coefficient" instead of "Spearman rank correlation skill". Skill is more sophisticated. 3. Line 27, "the same percentage" is not clear 4. Line 172-174, a citation is needed. 5. Line 258, clarify what kind of anomalies it is

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