The manuscript of Beck et al. evaluated the temporal dynamics of 18 state-of-the-art (quasi-)global near-surface soil moisture products. I this study very interesting and up-to-date. Overall, the paper is well organized and well written, and provides new insights about the advantages and disadvantages of different soil moisture products and on the merit of various technological and methodological innovations.

We thank Dr. Nelson for reviewing our manuscript and providing thoughtful comments.

However, the introduction is not well written and more discussion and comparison to recent studies should be provided. In my opinion, the paper deserves publication once the following points are addressed with some more details.

We appreciate the comment; we have re-read the introduction with this in mind and made some improvements.

line 4-12: Provide the reason why you would like to address these questions. I like your way to express your purposes of your study. However, it's not appropriate to pose so many questions here without giving any reason.

We agree and have added that these questions are *"frequently faced by researchers and end-users alike."* References and further background on each question is provided in the subsections discussing addressing the questions (Sections 3.1 to 3.9).

Section 2: Why these datasets are chosen out for comparison? What are main differ-ences among the products within each group (i.e., satellites, open-loop models, and models with DA)?

Good question. We have added the following to justify our product selection: "*We evaluated six products per category, which was sufficient to compare the performance among and within product categories and address the questions posed in the introduction. We only considered widely used products with (quasi-)global coverage and we attempted to keep the selection of products in each category as diverse as possible. For example, we considered products based on several major satellite missions used for global soil moisture mapping (AMSR2, ASCAT, SMAP, and SMOS), models of various type and complexity (with and without calibration), different sources of precipitation data (satellites, reanalyses, gauges, and combinations thereof), and various data merging and assimilation techniques (with different inputs).*"

The authors missed some recent publications on soil moisture evaluation. For example:

Chen, Y., & Yuan, H. (2020). Evaluation of nine sub-daily soil moisture model products over China using high-resolution in situ observations. Journal of Hydrology, 125054.https://doi.org/10.1016/j.jhydrol.2020.125054

Tavakol, A., Rahmani, V., Quiring, S. M., & Kumar, S. V. (2019). Evaluation analysis of NASA SMAP L3 and L4 and SPoRT-LIS soil moisture data in the United States. Remote Sensing of Environment, 229, 234-246. https://doi.org/10.1016/j.rse.2019.05.006

Add a review on these publications in introduction and more discussions with these papers in Section 4 will add much value to this manuscript.

Thanks for pointing us to these very interesting studies. We have added them to the introduction and to other relevant sections of the paper. Even though our paper has already well over 200 references, the body of literature on soil moisture estimation is so vast that it's easy to miss studies.

line 30: What are the sensor types? Are there all FDR sensors?

We have added the following text: *"The measurements were performed using various types of sensors, including time-domain reflectometry sensors, frequency-domain reflectometry sensors, capacitance sensors, and cosmic-ray neutron sensors, among others.*"

Add a map showing the observation length and the frequency of in-situ observation.

Please see Supplementary material Fig. S1 for a figure showing the observation length and the frequency of *in situ* observation.

Table 1: Add one column to describe the vertical layers for the soil moisture products. Since soil moisture data of model products or satellites are not representative at 5 cm, have you done some vertical interpolation?

The depths of the soil layers of the models are provided in the "Details" column. The penetration depth of microwave signals can differ significantly depending on the observation frequency and the land surface conditions, and therefore cannot be listed in the table. To improve the vertical representation of the satellite products, we used the SWI filter (see Section 2.1). We have added the following text to the revised manuscript

to discuss the vertical support of the models: *“The vertical support is physically consistent with in situ soil moisture measurements at 5-cm depth for most models. The average depth of the soil layer (i.e., half the depth of the lower boundary) is 2.5 cm for SMAPL4, 3.5 cm for ERA5 and ERA5-Land, 5 cm for GLEAM, 8.5 cm for HBV-ERA5, 6.6 cm for HBV-IMERG, 7.3 cm for HBV-MSWEP, and 15 cm for VIC-PGF (Table 1; Supplement Table S1). The soil layers of HBV may seem too deep, especially since they represent conceptual “buckets” that can be fully filled with water, in contrast to the soil layers of the other models which additionally consist of mineral and organic matter. However, the soil layer depths of HBV were calibrated (see Section 2.3) and are thus empirically consistent with in situ measurements at 5-cm depth.*”