Response to the Comments of Referee #1

Dear Referee #1:

We are particularly grateful for your careful reading, and for giving us many constructive comments of this work!

According to the comments and suggestions, we have tried our best to improve the previous manuscript ESSD-2022-80 (SGD-SM 2.0: An Improved Seamless Global Daily Soil Moisture Long-term Dataset From 2002 to 2022). An item-by-item response follows.

Once again, we are particularly grateful for your careful reading and constructive comments. Thanks very much for your time.

Best regards,

Qiang Zhang

General comments:

This paper develops SGD-SM 2.0 framework for reconstruction of seamless global daily soil moisture dataset from 2002 to 2022, based on the development of the LSTM-CNN method. The method fuses the global daily precipitation products and is able to consider sudden extreme weather condition. Generally, the topic is interesting, the method makes sense and the results are supportive. Some minor comments before positive publication are as follows.

Response: We are particularly grateful to the reviewer for his/her detailed suggestions! According to the comments, we have tried our best to improve the previous manuscript. An item-by-item response to each constructive comment follows.

Major comments:

Q1.1: ***Please provide the parameters and descriptions of AMSR-E, AMSR2, and WindSat to demonstrate the rationality of using three heterogeneous sensors.***

Response: Thanks for this suggestion. The parameters and descriptions of AMSR-E, AMSR2, and WindSat are provided below:

AMSR-E/2 and WindSat global daily soil moisture products are utilized from 2002 to 2022. These three sensors are onboarded at Aqua satellite, GCOM-W1 and Coriolis satellite, respectively (Nepal et al., 2021). AMSR-E, AMSR2 and WindSat are all passive sensors for soil moisture retrieving. The spatial resolution is all 0.25° grid (about 25km) in these products, as depicted in Fig. 1(a)-(c). The retrieving model adopts the land parameter retrieval model (LPRM) for AMSR-E, WindSat, and AMSR2 products (McColl et al., 2017). We select the descending orbit (night-time), and 6.9 GHz band for all these soil moisture products.

Q1.2: ***The original SM data acquired from AMSR-E, AMSR2, and WindSat sensors were used to generate the seamless soil moisture dataset. As we know, although the frequency band of both AMSR-E/2 and WindSat have the same frequency band to retrieve the soil moisture, the GHz of WindSat sensor is different from that of AMSR-E/2. Is there a big difference in accuracy between 2011.10.5 to 2012.07.02 (i.e., using WindSat) and other periods (i.e., using AMSR-E/2)?***

Response: Thanks for this meaningful question. As the reviewer stated, although the frequency band of both AMSR-E/2 and WindSat have the same frequency band to retrieve the soil moisture, the GHz of WindSat sensor is different from that of AMSR-E/2. Between 2011.10.5 to 2012.07.02, both the original SM data acquired from AMSR-E and WindSat is existing. The main difference between WindSat and AMSR-E is the global daily land coverage rate. The average land coverage rate of WindSat is just 34%, compared with AMSR-E (about 50%). In other word, AMSR-E outperforms on global reconstruction accuracy than WindSat on SGD-SM 2.0, due to the quantity of valid information.

Q1.3: ***Section 4.3 only exhibits the dynamic change of the SGD-SM 2.0 dataset. Perhaps, the advantages of version 2.0 can be demonstrated by introducing version 1.0 as the reference in this section. Moreover, this revised description is different from Section 5.2 (the time series in the precipitation area).***

Response: Thanks for this issue. In Section 4.3, we exhibit both the dynamic change of original and reconstructed soil moisture (SGD-SM 2.0) value. The main purpose is to reveal the typical time-series continuity in this time-series validation. In Section 5.2, we provide the time-series comparisons between SGD-SM 1.0 and 2.0 products with time-series precipitation data. The main purpose is to compare the difference of SGD-SM 1.0 and 2.0, especially for the sudden daily

precipitation weather. Though this comparison in Section 5.2, the advantage of SGD-SM 2.0 could be better reflected via daily precipitation data assimilation and LSTM-CNN model. Therefore, we arrange two different time-series validation sections to demonstrate the advantage and availability of SGD-SM 2.0.

Q1.4: ***Please provide the website for collection of in-situ data, if the data are public.***

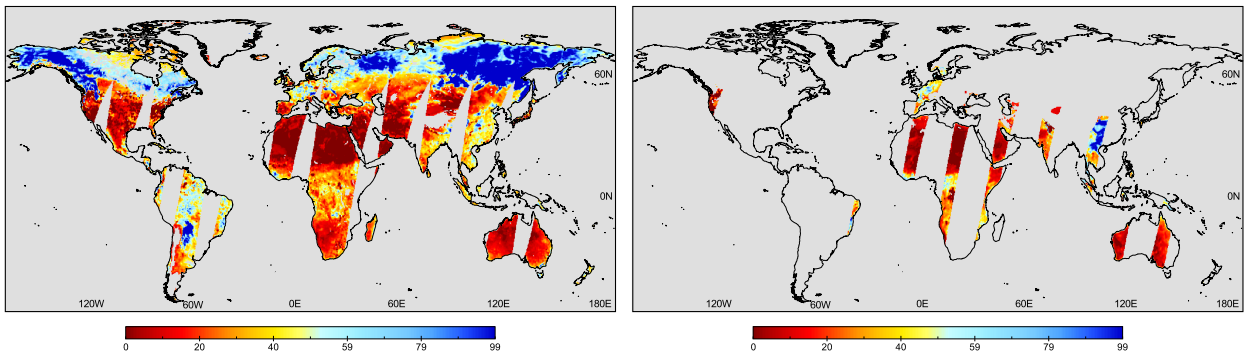
Response: Thanks for this comment. We have supplemented the website for collection of in-situ data in the revised manuscript. These in-situ soil moisture data are public and could be downloaded at https://ismn.geo.tuwien.ac.at/en/.

Q1.5: ***Why the partial CNN and mask updating were used to reconstruct the missing regions?***

Response: Thanks for mentioning this query. For partial CNN, it can effectively acquire the spatial information within valid regions, and eliminate the invalid information within gap or soil moisture missing regions. For mask updating, if the partial convolution can generate at least one valid value of the output result, we need mark this location as valid value in the new masks. We have supplemented these explanations in Section 3.1.

Q1.6: ***What is the relation between the two sub figures in Fig. 1?***

Response: Thanks for this question. In Fig. 1, two sub captions of original soil moisture products of AMSR-E and WindSat are incorrect. We have revised this mistake in current version.



(a) Original SM products of AMSR-E in 2009.6.1 (b) Original SM products of WindSat in 2012.1.9

Fig. 1. Daily soil moisture products of AMSR-E and WindSat.

Q1.7: ***Please consider including more up-to-date references on gap filling, such as [Remote sensing image gap filling based on spatial-spectral random forests. Science of Remote Sensing, 2022, 5: 100048].***

Response: Thanks for this comment. We have cited this reference [Remote sensing image gap filling based on spatial-spectral random forests. Science of Remote Sensing, 2022, 5: 100048] in the revised manuscript.

Q1.8: ***Check the caption of Fig. 6.***

Response: Thanks for this suggestion. In Fig. 6, the "Original SM and proposed SGD-SM 2.0 results in 10, 20, and 30 September 2002.4" has be recorrected as "Original SM and proposed SGD-SM 2.0 results in 10, 20, and 30 September 2002".