Author's Response for All the Comments

Dear Topic Editor and Referees:

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

According to the second round of comments and suggestions, we have tried our best to improve the revised manuscript essd-2020-353 (Generating Seamless Global Daily AMSR2 Soil Moisture (SGD-SM) Long-term Products for the Years 2013-2019). The modified words or sentences are marked as blue color in the revised manuscript. An item-by-item response follows.

Thanks very much for your time.

Best regards,

Qiang Zhang and all co-authors

Author's Response to the Comments of Referee #3 (RC3)

General comments:

Great thanks to the authors for their efforts in addressing the comment. This reviewer has three major comments for the author' further consideration, and suggests to accept this paper after minor revisions.

Response: We are particularly grateful to the reviewer for his/her careful reading and detailed suggestions once again! According to the reviewer's comments, we have tried our best to improve the previous revised manuscript. An item-by-item response to each major and minor constructive comment follows.

Major comments:

Q3.1: *Figure 1b shows no selected in-situ measurements at China and Russia for comparisons. As such, the reviewer is a bit less convinced by the quality of data at Asia, especially at the Tibetan Plateau where the fast changing atmospheric conditions complicate soil moisture retrieval and therefore the AMSR2 product. The author may check 'Zhang P, Zheng D, van der Velde R, Wen J, Zeng Y, Wang X, Wang Z, Chen J, Su Z. Status of the Tibetan Plateau observatory (Tibet-Obs) and a 10-year (2009–2019) surface soil moisture dataset. Earth System Science Data Discussions. 2020 Oct 16:1-34.' to see if these in-situ data can be applied for comparisons at this region. On the other hand, it seems that there are also in-situ soil moisture measurements at a national network of Chinese Automatic Soil Moisture Observation Stations (CASMOS) maintained by the Chinese Meteorological Administration (please see the information mentioned in https://hess.copernicus.org/preprints/hess-2020-407/), the author may also check the possibility of selecting some data to compensate comparisons. In case not lengthen the paper, comparisons can be attached as supplementary materials.*

Response: Thanks for this significant suggestion. Available in-situ measurements at China and Russia are rare for comparisons in ISMN. It is really a bit less convinced by the quality of data at Asia in previous validation. To overcome this issue, we have downloaded the Tibetan Plateau observatory (Tibet-Obs) soil moisture sites [1-2] between 2009 to 2019 at https://doi.org/10.4121/uuid:21220b23-ff36-4ca9-a08f-ccd53782e834. Then we selected the daily soil moisture sites (Maqu, Naqu, Ali and Shiquanhe networks, 0-5cm depth) in 2018 to validate the accuracy of our SGD-SM products in Tibet Plateau region. This surface SM dataset includes the original 15-min in situ measurements collected by multiple SM monitoring sites of the three networks. The comparison results are listed in the supplementary material. As shown in Table A, the reconstructed SGD-SM products also perform approximatively with the original AMSR2 products (Reconstructed (Original). R: 0.654 (0.657), RMSE: 0.097 (0.096), MAE: 0.083 (0.081).). This validation also demonstrates the availability of the proposed SGD-SM products at the Tibetan Plateau region, where exits the fast changing atmospheric conditions.

Table A. Comparisons between original and reconstructed soil moisture products in Tibetan Plateau via Tibetan Plateau observatory (Tibet-Obs) soil moisture sites.

Soil Moisture products	Evaluation index		
	R	RMSE	MAE
Original	0.657	0.096	0.081
Reconstructed	0.654	0.097	0.083

References:

[1] Zhang, P., Zheng, D., van der Velde, R., Wen, J., Zeng, Y., Wang, X., Wang, Z., Chen, J., and Su, Z.: Status of the Tibetan Plateau observatory (Tibet-Obs) and a 10-year (2009–2019) surface soil moisture dataset, Earth Syst. Sci. Data Discuss., in review, 2020.

[2] Qiu, J., Dong, J., Crow, W. T., Zhang, X., Reichle, R. H., and M. De Lannoy, G. J.: The added value of brightness temperature assimilation for the SMAP Level-4 surface and root-zone soil moisture analysis over mainland China, Hydrol. Earth Syst. Sci. Discuss., in review, 2020.

Q3.2: *In Line 250, the author mentioned that 125 soil moisture stations (0-10cm) were used. Since AMSR2 are C-band (wavelength ~5 cm) sensors, meaning low penetration depth, even for SMAP L-band (wavelength ~21 cm), it can only detect changes of soil moisture in the top 0-5 cm (see F. T. Ulaby, R. K. Moore, and A. K. Fung, Microwave Remote Sensing, Active and Passive, Vol. III: From Theory to Applications. Norwood, MA: Artech House, 1986). The reviewer wonders why the author did not use 0-5 cm soil moisture measurements for comparisons. Unless the author provides the rationality, otherwise the review would suggest to use soil moisture measured at 0-5 cm for comparisons.*

Response: Thanks for this comment. As the reviewer stated, 0-5cm soil moisture values are more relevant with the AMSR2 soil moisture products. Therefore, we just employ the 0-5cm sites (113 stations after selecting) for comparisons. The updated in-situ validation between original and reconstructed soil moisture products by 0-5cm sites is listed in Table 1 as follow. Overall, the accuracy of reconstructed products is generally accorded with the original products. The differences of these indexes are minor between the original and reconstructed results in Table 1.

Table 1. Comparisons between original and reconstructed soil moisture products

Soil Moisture products	Evaluation index		
	R	RMSE	MAE
Original	0.689	0.093	0.077
Reconstructed	0.685	0.097	0.079

Q3.3: *The review also suggests to make the code of the 3-D CCN network model available with the published paper.*

Response: Thanks for this suggestion. We have publicly released our SGD-SM model and codes

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at https://github.com/qzhang95/SGD-SM (Language: Python 3.7.4; Flatform: Pytorch 1.7.1). This explanation has been supplemented in the updated version.

Minor comments:

Q3.4: *Please the author may complete the title as "Generating Seamless Global Daily AMSR2 Soil Moisture (SGD-SM) Long-term Products for the Years 2013-2019".*

Response: Thanks for this comment. We have completed the title as "Generating Seamless Global Daily AMSR2 Soil Moisture (SGD-SM) Long-term Products for the Years 2013-2019".

Q3.5: *In Line 19, please give the full name when it (i.e., EOS) is first mentioned.*

Response: Thanks for this issue. We have given the full name when it is first mentioned, such as Earth Observing System (EOS) in the whole manuscript.

Q3.6: *In Line 22, please add 'see Figure 1a.' for clarity in 'about 30%~80% missing ratio in AMSR2)'.*

Response: Many thanks for this helpful suggestion! We have added 'see Fig. 1(a)' for clarity in 'about 30%~80% missing ratio in AMSR2' in this sentence.

Q3.7: *In Line 143, please add 'detailed technique descriptions of the network implementation are provided in the supplementary materials' to guide the audience to see the supplementary.*

Response: Thanks for this comment. We have added 'Detailed technique descriptions of the network implementation are provided in the supplementary material', to guide the reader to read the supplementary file.

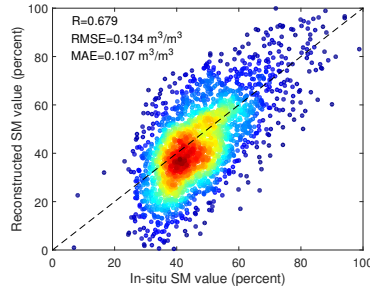**Q3.8:** *In Line 221, please delete 'It should be highlighted that'.*

Response: Thanks for this issue. We have deleted 'It should be highlighted that...' in this sentence.

Q3.9: *Please explain 'COSMOS' in Figure 7 and give the WGS84 geographical latitude and longitude for these sites shown in the figure title.*
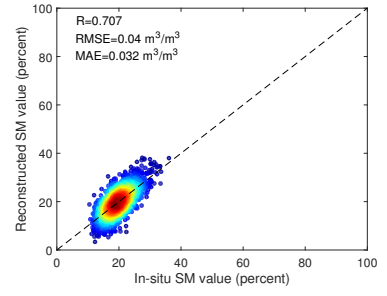
Response: Thanks for this comment. We have supplemented the explanation of 'COSMOS' in Figure 7 as 'COsmic-ray Soil Moisture Observing System (COSMOS)'. Besides, the WGS84 geographical latitude and longitude for these sites in Figure 7 are given in each sub-figure's title, respectively.
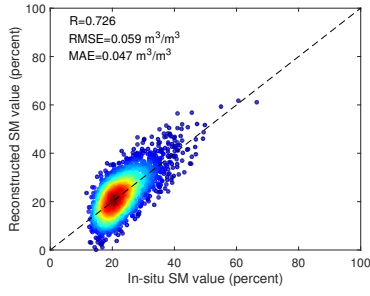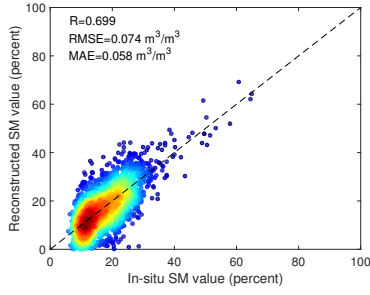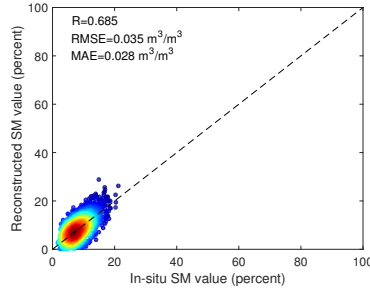
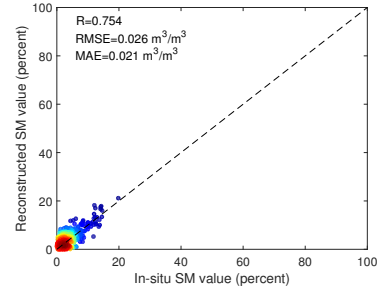(a) C-026 (40.0062°N, 88.2904°W) (b) C-055 (0.2825°N, 36.8669°E) (c) C-098 (44.5711°N, 11.5321°E)
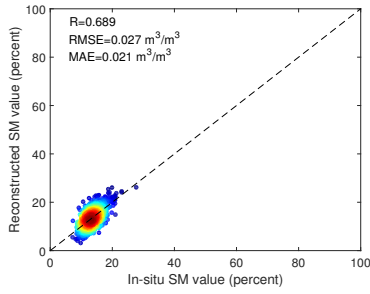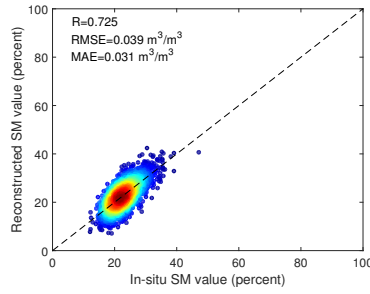
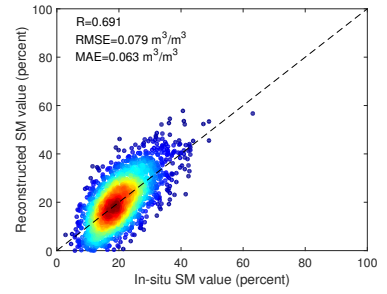(d) C-044 (21.6176°S, 47.6325°W) (e) C-033 (37.0310°N, 119.2564°W) (f) C-076 (14.1592°S, 131.3881°E)

(g) C-087 (48.1411°N, 15.1702°E) (h) C-048 (48.3077°N, 105.1019°W) (i) C-012 (19.7650°N, 155.4234°W)

Figure 7. Scatters of the in-situ/reconstructed soil moisture values within selected COsmic-ray Soil Moisture Observing System (COSMOS) stations

Author's Response to the Comments of Referee #4 (RC4)

General comments:

> *The authors have significantly improved the manuscript and addressed the points raised by my comments. I am still wary about the comment, that they may only publish their processing scripts/Pytorch model AFTER possible acceptance. I guess it is a trust issue. However, the preprint is public under discussion, thus, the precedent of their work is claimed. It does not improve the credibility to expect that they might publish the codes or not. No reasoning is given as, why they would withhold the codes.*
>
> *Nonetheless, while a lot of text was added and/or edited, the overall language quality still needs to be improved, e.g. such "The error of soil moisture for each frequency were also given in AMSR2 products." -> the errors were given | the error was given ... etc.*

Response: We are particularly grateful to the reviewer for his/her careful reading and detailed suggestions! According to the comments, we have tried our best to improve the previous revised manuscript.

For the codes issue of this work, we have publicly released our SGD-SM model and codes at https://github.com/qzhang95/SGD-SM (Language: Python 3.7.4; Flatform: Pytorch 1.7.1). This explanation has been supplemented in the updated version.

For the language quality, we have revised the whole manuscript sentence-by-sentence. Some grammar mistakes have also been corrected in this work, such as "the error were given..." to "the error was given".