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Open Access Earth System Science Data Discussions

Interactive comment on "Gap-Free Global Annual Soil Moisture: 15 km Grids for 1991–2018" *by* Mario Guevara et al.

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OVERVIEW The study presented a gap-filled global soil moisture dataset based on the ESA CCI satellite soil moisture product. The dataset is characterized by a spatial resolution of 15 km. The new filled and downscaled dataset has been validated against in situ soil moisture and precipitation data through annual comparison as well as in terms of long-term trends during the period 1991-2018.

GENERAL COMMENTS

The paper is well written and clear and I found the topic of interest for the readership of Earth System Science Data. However, I have some comments and doubts that should be clarified before considering the paper for publication. My comments are listed below.

RESPONSE: We appreciate the recognition of the importance of this dataset and the research presented. Below we address the Reviewer's comments individually.

1) Please, add some details about the ESA CCI SM product. Did you use the combined dataset? I think version 4.5 (or 4.9, please check out throughout the manuscript) is the latest one;

RESPONSE: We used the combined dataset, Version 4.5. We will clarify this issue in the revised version of our manuscript.

We recognize that the ESA-CCI soil moisture product is constantly evolving and improving. At the same time, we want to outline how our proposed downscale method (which is part of the paper contributions) is applicable across different versions of the ESA-CCI product. As a matter of fact, our method has been tested on different versions of the ESA-CCI (i.e., 4.4 and 4.5) and we have observed consistency across versions for validation at the regional (Llamas et al., 2020) and global scale (see: https://essd.copernicus.org/preprints/essd-2020-264/#discussion).

2) It is unclear to me how you have selected the data gaps in the original CCI dataset. The ESA CCI SM product is a daily dataset, so the gaps should be present during the entire period? Did you estimate an annual mean of original CCI data? Did you find a reduction of gaps during the analysis period;

RESPONSE: We use all available observations for each pixel across each year to estimate an annual mean using the original CCI v4.5 data. There are areas in the world (mainly in the tropics or deserts) with gaps that are present throughout an entire year. In the manuscript, we point out that the number of temporal and spatial gaps for a given region can be different across the several years. The years with the larger number of missing values (i.e., data not available; NAs) are between years 2003 and 2006 (Figure R1). In the revised version of our manuscript we will include more information about how gaps were quantified and how gaps vary across years (Figure R1).

3) Bioclimatic features are not described at all;

RESPONSE: We will include a detailed description of bioclimatic features in the methods section (e.g., 2.1 Datasets of Prediction Factors) as part of the revised manuscript.

4) It is unclear to me how the comparison with ISMN has been carried out. You extracted the original and the downscaled ESA CCI SM products over the stations locations and then? Did you estimate an annual mean of observed SM and compared to the satellite data? Are the couples drawn in Figure 8 the results for each year (so, 28 points)? How these couples have been estimated?;

RESPONSE: First we computed annual means for each year in every available location of the ISNM dataset. Then, we extracted the annual mean for each year in every corresponding location from the datasets of ESA-CCI (v4.5) and our predictions. In other words, we compare annual means for each location available in the ISNM and the corresponding locations from the datasets of ESA-CCI (v4.5) and our predictions. Consequently, these comparisons are consistent in space (i.e., locations from the ISMN and corresponding pixels in the ESA-CCI (v4.5) and our predictions) and time. We will revise the methods section (e.g., 2.4 Validation against independent in situ data) to clarify this point.

5) The link to the downscaled product reported at line 907 is referred to the previous version of the dataset, please change it.

RESPONSE: We will update the link in the revised version. The correct link is: https://www.hydroshare.org/resource/9f981ae4e68b4f529cdd7a5c9013e27e/

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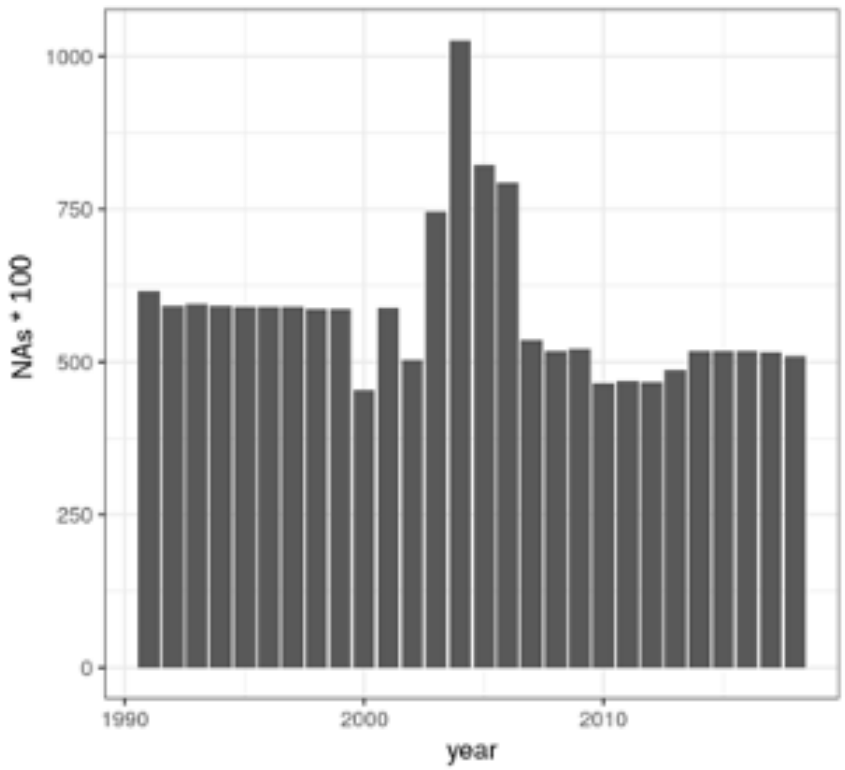

Fig. 1. Figure R1. Number of data gaps or not available values (NAs) *100 in the ESA-CCI v4.5 across years during the analyzed period.