Response to Reviewer Comments for “Daily satellite-based sunshine duration estimates over Brazil: Validation and inter-comparison”

Gava et al., 2023

Reviewer comments are written in black text below, and our responses are written in *blue* text.

Referee #1 comments:

This study evaluates two satellite-based data records of sunshine duration for the region of Brazil. The first product is a Meteosat-based climate data record by CM SAF, the other product is a GOES-based product by DISSM / INPE. Both datasets are compared against in-situ measurements from ground stations all over Brazil. The analyses is done for different climatic regions and seasons.

General comments

- Sunshine duration is an important parameter as there are long-time series of measurements and it is easy to communicate to the general public, as this parameter is well known and easy to understand. This study helps to estimate the quality of satellite-based sunshine duration and shows that satellite-based products can be a good complement to station-based data.
- The study is very well structured and written. It gives an excellent overview about the two different retrieval techniques used to derive sunshine duration from satellite. The applied approach is clearly explained and the results are easy to understand and well presented by meaningful figures. Results and figures support the conclusions in an adequate way.

We deeply appreciate the reviewer's valuable comments and suggestions, which helped us enhance the quality of the manuscript. We are glad for the reviewer’s mostly positive comments on our paper. We carefully considered each comment, and responded to each one down below.

Specific comments

- It might be good to include a paragraph describing some of the specific challenges, which have to be considered while comparing satellite-data to station-based data. For the

Meteosat-based product Brazil is right at the outer edge of the observed region, which comes along with larger uncertainties in the data due to different effects (parallax effect, larger footprint, different atmospheric effects, …). Thus, the observing geometry is different to a GOES-based product. How representative are station-based measurements for a grid point of 4 km by 4 km (or even larger for the CM SAF product at the edge of the Meteosat disc)?

We highly value this comment. We have included in the conclusions a sentence on the challenges of comparing satellite (area measurements) and station data (point measurements). We believe that the inclusion of this will help readers understand the underlying limitations of satellite pixel and station data comparison.

Added on Line 309:

"There are some challenges in comparing satellite-based products and station data. Satellite-derived observations are area measurements, and station records are point data; therefore, some representativeness error is expected due to the inherent differing spatial scale. Nevertheless, monthly bias discloses a fine agreement between SDU retrieved and observed. Both products present low bias for most of the country (between -1 and 1 h)."

Additionally, we acknowledge that despite the METEOSAT's observing geometry challenge over the analyzed region, CMSAF's product has fine agreement with ground data.

Added on Line 320:

"CMSAF's performance is remarkable, given that METEOSAT covers Brazil, particularly the EQ region, with a very high satellite viewing angle, which contributes to uncertainties on the observation due to different effects. In fact, the results indicate that the algorithm is robust and that its performance seems to be independent of the viewing angle."

- CM SAF released SARAH version 3.0 in May 2023. Especially with some improvements in underlying auxiliary data, such as water vapour and surface albedo, it is expected to perform better in the region of Brazil.

We are thankful to the referee for letting us know about this new version of SARAH. We have reviewed the algorithm theoretical basis document (ATBD) and the validation report of the new version of the dataset, and included some modifications to the dataset that might have positive impacts on CMSAF's SDU retrieval. Along with that, we included the shortened data acquisition time for the new GOES generation, which is expected to improve the DISSM's SDU estimates.

Added on Line 322:

Furthermore, it is important to highlight that both products are undergoing continuous development, thus improvements in their quality are expected. For instance, the new generation of GOES reduced the time gap between consecutive images from 30 minutes to 10 minutes; CMSAF has recently introduced an upgraded version of SARAH, which incorporates various enhancements in ancillary data, such as surface albedo, atmospheric aerosol, and water vapor profiles. These adjustments have the potential to decrease uncertainties in SDU measurements and further enhance the overall performance of these products.

Technical corrections

- line 206: ‘summer’ could be confusing for some readers, as we are on the southern hemisphere

Thank you for the comment. We agree that the terminology can be misleading, so we have changed “summer” to “austral summer” in line 207, as well as other similar occurrences in the text. Particularly for the sentence: “Semi-humid, marked by rainy summer and dry winter (Cavalcanti, 2009)” in line 206, we clarified the season period as: “Semi-humid, marked by rainy summer (December to February) and dry winter (June to August) (Cavalcanti, 2009)”.

- Fig. 8: I learned that it should be avoided, wherever possible, to use rainbow colour scales. Maybe you consider this at least for the next time.

Thank you for taking the time to share your comment; it has enlightened us to the problem of using rainbow-like color schemes. We previously chose this particular color scale to facilitate comparison with Fig. 9 of Porfírio et al., 2020. However, we researched the issue of using rainbow color scale, and concluded that, indeed, this choice might be a challenge to people with color vision disabilities, besides it can mislead the interpretation of the data. So we have regenerated Fig. 8 with a different color scheme, batlow (Crameri, 2018), which was developed to prevent visual distortion of the data and exclusion of readers with color vision deficiencies (Crameri et al., 2020). We appreciate this comment as it helps us be more inclusive.

Crameri, F.: Scientific colour maps, Zenodo, 10, 2018.

Crameri, F., Shephard, G. E., and Heron, P. J.: The misuse of colour in science communication, Nature communications, 11, 5444, 20

Porfirio, A., Ceballos, J. C., Britto, J., and Costa, S.: Evaluation of Global Solar Irradiance Estimates from GL1. 2 Satellite-Based Model over Brazil Using an Extended Radiometric Network, Remote Sens., 12, 1331, https://doi.org/10.3390/rs12081331, 2020.

Figure 8. Average Rmin obtained for each analyzed month in the period from October 2013 to October 2017 Darker (Lighter) colors correspond to low (high) reflectance values.