Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., author comment AC1
https://doi.org/10.5194/acp-2022-481-AC1, 2023

Reply on RC1

Jay Herman et al.

Author comment on "Measurement Report: Observed Increase in Southern Hemisphere Reflected Energy from Clouds During December 2020 and 2021" by Jay Herman et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-481-AC1, 2023

I have made many changes, marked in green, in the text as shown in the supplement file both from referee comments and from re-reading the paper myself. I have also revised the figures in response to referee comments.

General comments:

- Overall motivation: From the paper I remain unconvinced that December 2020 and 2021 had interesting anomalies that really need explaining. It would be helpful to show that the differences seen in those months are large compared to interannual variability in general (e.g., as measured by the interannual standard deviation of previous years).

I have included error bars based on the standard deviations of previous years.

The introduction and concluding paragraph frame the study as primarily motivated by the question of whether angular dependencies are substantially affecting EPIC measurements. I did not pick up on this motivation from the abstract or title of the paper.

The authors also claim they correct the EPIC data for changes in orbit in 2020 and 2021, although they do not describe how this is done. If they are able to correct for the orbit changes, then what added benefit is the analysis shown? Or is the analysis supposed to be a confirmation that the corrections indeed work and the differences seen after correction are due to cloud changes?

After corrections for the change in viewable area when the viewing angles are large (near 180 degrees), the differences are still present.

- General sloppiness: Overall I found the paper incredibly hard to follow. I believe a large portion of this could be fixed by better organization and explanation on the part of the authors. The use of equations is particularly galling, with 9 equations stacked in a row with minimal explanation at one point and a tenth equation placed within a figure caption. There are also a large number of typos and grammar mistakes.

The equations are now separated by text

Hopefully, I have improved this aspect.

Specific comments:

Lines 21-22: Isn't there an effect of eccentricity here too, as the Earth is closer to the Sun in December? **Yes, the earth-sun distance is included**

Lines 88-89: I don't believe the fact that increased reflection was observed in 2020 and 2021 has been introduced. It might be good to show that here and give a sense of how large the anomalies are relative to other years. **Later figures show that explicitly**

Lines 115-116: What is the correction? As mentioned above, this seems fundamental to the paper's motivation.

This is followed by a correction for the increased viewable area caused by the satellite's orbit getting close to the Earth-Sun line in 2020-2021.

Added to the text

Equations 1-9: The equations could definitely be explained better. Maybe interspersing them within the text instead of just listing them all at once would be an improvement?

Done

Eq. 5: L_{ER} is not defined. Should B be B_l? **Fixed**

Line 127: "and" should be "an"? **Fixed**

Figure 1: Why is data from 2019 excluded? Could you please explain the data gap.

The satellite pointing system (gyroscope + momentum wheels) failed in 2019 and were replaced by the star tracker, external propulsion jets, and new software, which took almost a year to develop, test, and deploy. See the caption in Fig. 1

Line 153: Isn't this Figure 4? **Fixed**

Line 176: Could you explain how Figure 3 supports this?

It should have been (Fig. 4 and its magnified version in Appendix Fig. A1)

Figures 4-8, 10-11: What is the y-axis showing? Are you reporting the amount of sunlight reflected in a given latitude band divided by the entire amount of sunlight received by the Earth? So the sum of everything should be ~30%?

Looking at Fig. 1 the global percent reflected of incident energy varies from 24% to 38% depending on the month of the year. The global reflected energy is dominated by the SH summer (December-January). In the following figures (4-8) and (10-11) the y-axis is the percent of total energy on the illuminated Earth disk.

The annual average is P_{SE} = 29.2% of the incident solar energy including the surface contribution (Lines 118 to 120)

The 29.2% was stated in the original text, but the above has been added.

Figure 5 bottom right panel: What does a negative value for percent of sunlight reflected mean?

The original data are not negative (grey circles). The negative values are an artifact of the averaging technique I used, Loess(325pts). When I use Adjacent Averaging AA(325 pts) the values are not negative. The 60S-70S figure now uses AA.

Figure 5 legend: The red line should be labeled 2016-2017, not 2017-2017. The blue line should be labeled 2018-2019, not 2018-2919. **Fixed. I apologize for the unnoticed typos.**

Line 176: There is no justification for this being an Appendix with only one sentence and one figure. Why not just bring it into the main text?

I could put the figure in the main text, but the Appendix figure is the same as the one in the main text but with the time scale magnified. It has no additional information except the summer small SEV effect is easier to see.

Figure 6: Maybe put error bars of 1 standard deviation around the 2015-2018 values to show if the December 2020 values are really that extreme?

Error bars have been added

Figure 6/Eq. 10: Are you defining an equation inside of a figure caption? Please define the equation within the main text.

The equation was not in the Figure Caption. Some text has been added in front of Eq 10.

Line 202: How does Figure 2 support this?

Figure 2 does not support this. However, the explanation of the minimum over Africa supports Figure 2. Reflectivity at 388 nm is mostly from clouds with the background land having low reflectivity (less than 4% except for a small desert in Libya). Africa usually has almost no cloud cover per km^2 compared to other regions, both land and oceans. Therefore, the 388 nm reflectivity is a minimum over Africa. In addition, the files are time stamped and can be matched with visible wavelength images such as the one shown below. Northern Africa is almost cloud-free. A sentence and reference have been added to this effect.

Africa has little cloud cover per km^2 compared to other regions (e.g., https://epic.gsfc.nasa.gov/?date=2022-06-09) and the land surfaces are dark (LER < 0.05) at 388 nm (Herman et al., 2018b).

Herman, Jay, Guoyong Wen, Alexander Marshak, Karin Blank, Liang Huang, Alexander Cede, Nader Abuhassan, Matthew Kowalewski' Reduction in Earth Reflected Radiance during the Eclipse of 21 August 2017, Atmos. Meas. Tech., 11, 4373–4388, https://doi.org/10.5194/amt-11-4373-2018. 2018b.

Visible wavelengths showing almost cloud-free Noarthern Africa

Please also note the supplement to this comment:
https://acp.copernicus.org/preprints/acp-2022-481/acp-2022-481-AC1-supplement.zip