

Dear Dr. Stelios Kazadzis,

Thank you very much for the comments on the manuscript “Trends in observed surface solar radiation and their causes in Brazil in the first two decades of the 21st century”. We are again thankful for your time and constructive suggestions to improve the quality of the manuscript. We tried to take all your suggestions into consideration. The changes are highlighted in the manuscript.

Here is a point by point response to the editor’s comments.

Color code:

Red: Editor’s comment.

Black: authors’ response.

Comment from the editor

The authors have replied in a large number of comments raised by the three referees.

In my opinion is very difficult to accurately assess the role of different factors affecting the SSR.

In the particular study the first issue was to simulate all sky and cloudless sky time series. Temporal aspects play here a very important role on the day by day or month by month calculation of SSR for all and cloudless conditions.

In addition, cloud fraction provides an indication of changes in the solar transmission due to clouds but as the reviewers mention, there are also other cloud properties involved, especially when studying such a large area.

For cloudless cases aerosol play the most important role and it would help to discuss a clear distinction on biomass burning (mostly Amazon related) aerosol changes and anthropogenic/urban changes.

Finally, is not always clear what is the equivalent effect in SSR of a certain per cent change of cloudiness compared with the one based on AOD.

To this aspect, we estimated the Cloud Cover Radiative Effect (CCRE), introduced on section 2.1 and displayed for every composite on table 1. This variable estimates the change in SSR resulting from the observed change in cloud cover.

These three aspects cloudiness – anthropogenic/urban aerosols – biomass burning aerosols, I would try to discuss a bit more clearly in the conclusions.

So in general I think it should be clear that authors:

- Showed what is really happening on SSR in different regions in Brazil based on ground-based measurements
- They used state of the art methods with a number of assumptions that need both objective “limitations” but also subjective ones based on the data and the physics that need to be explained.

- Provided an assessment in some cases with lower and some cases with larger uncertainty, on the causes of SSR changes.

A different approach would be a station-by-station analysis together with radiative transfer modelling to individually assess these results. However, in the current approach a spatial large scale “picture” of SSR and possible effect is provided. And also authors decided to treat each station in exactly the same way concerning the data and methods used for the analysis.

So my recommendation is to try to discuss all the above in the conclusions of the work.

In addition, I would say that there is room for future work especially on quantifying each of the factors causing SSR changes. But in this phase the work can be published with minor revisions mentioned in this document.

We thank the editor for the clear and constructive feedback. We did various minor changes in the conclusion section (all highlighted in the manuscript) to try to address the suggestions. We state more clearly that there is room for further work in the topic. We also try to be more explicit when referring to anthropogenic/urban or biomass burning aerosols. We also mention now explicitly the quality control of the data, which was discussed in more details in section 2.

Concerning technical comments

I would agree that fig. 5 and 7 should mention (not only in the caption) : Lat, lon, and e.g. “AAOD change per decade and %AAOD change per decade” in the axis figures so it is easy for the reader.

We included “AOD per decade” and “AAOD per decade” in the figures, following exactly the suggestion.

Based on comment of reviewer 2 on related literature

I would suggest to try to include more recent papers e.g. Europe

Natsis, A.; Bais, A.; Meleti, C. Trends from 30-Year Observations of Downward Solar Irradiance in Thessaloniki, Greece. *Appl. Sci.* 2024, 14, 252. <https://doi.org/10.3390/app14010252>

Kazadzis, S., Founda, D., Psiloglou, B. E., Kambezidis, H., Mihalopoulos, N., Sanchez-Lorenzo, A., Meleti, C., Raptis, P. I., Pierros, F., and Nabat, P.: Long-term series and trends in surface solar radiation in Athens, Greece, *Atmos. Chem. Phys.*, 18, 2395–2411, <https://doi.org/10.5194/acp-18-2395-2018>, 2018.

These are recent and quite long time measurements.

Also

Schwarz, M.; Folini, D.; Yang, S.; Allan, R.P.; Wild, M. Changes in atmospheric shortwave absorption as important driver of dimming and brightening. *Nat. Geosci.* 2020, 13, 110–115.

And an older one but still important

Xia, X.; Chen, H.; Li, Z.; Wang, P.; Wang, J. Significant reduction of surface solar irradiance induced by aerosols in a suburban region in northeastern China. *J. Geophys. Res. Atmos.* 2007, 112, 1–9.

We thank the editor for the paper suggestions, especially for the Schwarz et al. (2020). This is a very important reference in the context of the present study, and it is a known paper, but somehow it was not included in the previous versions of the manuscript. This and all the other suggested papers are now included in the new version of the manuscript.

Also about the comment:

“Lines 70-84: it is necessary to add more information about the steps to move from the hourly values to the annual values in order to prove the robustness of the applied method. If any you can also add a reference of another paper where this method has been applied.”

I would agree that this is a very important issue and in addition to the citations to other works (e.g. Manara et al) a dedicated small paragraph with more details should be added. This would help a lot the reader to assess the presented results.

In the new version of the manuscript we separated one paragraph only describing the procedure from hourly to annual values. We included some additional information from the previous version and now any reader should have enough information to reproduce every step of the procedure we used in the present study.