

We sincerely thank the editor and reviewers for taking the time to review our manuscript and providing constructive feedback to improve our manuscript. We have revised the manuscript accordingly by following the reviewers' suggestion. Below shown are the original comments from reviewers in black and our corresponding responses in blue.

Comments by RC1:

This paper deals with the validation of the UV irradiance retrieved from OMI against ground-based measurements at 31 sites in the US. It is a well written study which with the following corrections it could be published in the Atmospheric Chemistry and Physics journal.

My most serious comment has to do with the collocation logic of satellite and ground- based measurements in terms of atmospheric conditions persistence. I do not see the point at comparing 31 ground stations with satellite retrievals and making such a big assumption. The comparison at local noon seems to not follow scientific criteria because the transferability of the sensitive UV irradiance at different time positions undermines fundamental assumptions, but, at the same time, has an interpretation oriented to usefulness and applicability as at local noon the impact of UV irradiance on human health is major, so I believe that the whole effort is worthwhile. To my understanding there are no alternative ways to compare these datasets at local noon but it is highly recommended to include a description on the error percentages that were added by each one of the atmospheric parameters that has impact the UV irradiance. As a result, my suggestion to the authors is to include an analytical and quantified list of the atmospheric parameters that affects this time transferability of UV irradiance observations and discuss the magnitude of these impacts.

Response: We are very thankful for the reviewer's overall comments on the manuscript and the suggestions to help us improve the manuscript. Regarding the suggestion to provide an analytical and quantified list of the atmospheric parameters that affects this time transferability of UV irradiance observations and their respective impacts, we understand that it is important to quantify the individual effect. However, it is difficult to quantify the impact from each atmosphere parameter due to the following reasons. The erythemally weighted irradiance covers the range from 300 to 400 nm, for which using this weighted irradiance information alone would not be able to attribute the bias to a specific cause such as changes in ozone or aerosols. Additional information such as the comparison of OMI spectral irradiance with ground measurements would be helpful in revealing the cause, which is beyond the scope of our current study. Nevertheless, in our current work, we provide the overall combined effects from different parameters, and we also further outlined and studied possible factors (such as cloud, aerosols, and ozone). Unfortunately, the measurements of these factors from space also have their uncertainties. In addition, we added some discussion on the limitation of our current work in this perspective in Sect. 5 (Conclusion and Discussion). Furthermore, clarification is made regarding the inter-comparison between OMI and ground-based observations at local solar noon; especially we now use the local solar zenith angle (instead of local hour) to define the local noon time that is consistent with the OMI algorithm itself. The results are improved and figures are updated.

Overall, the main part of the paper is the long-term evaluation of the OMI product to reveal if there is any systematic bias and trend in its surface UV product, and if the polar-orbiting satellite with once-per-day sampling is sufficient to describe the climatology of surface EDR, especially daily maxima of EDR that is of high interest for studying the

impact of UV exposure on the health of biosphere and human. To some extent, this work is in analogy with the trend analysis of surface temperature first before we can figure out the causes for the trend (if there is any). For the bulk part, we didn't find any significant and coherent trend in surface UV, O₃, aerosols, and clouds from OMI.

On page 13, line 387, the trend analysis needs to be performed with reliable monthly averages, so filter the data as to represent mean values with minimum missing data (e.g. at least 20 days of data permonth).

Response: We have followed the reviewer's suggestion to calculate the monthly average only for months with at least 20 days of data available.

I recommend also the authors to renew the reference list throughout the paper with updated and more recent results.

Response: We agree with the reviewer. We have added a few newer references when appropriate to make our work more relevant.

At line 20 of the Abstract maybe the authors want to say "variability" instead of "viability"?

Response: Corrected

At line 187 change the last letter of the word "room" with "t".

Response: Corrected.

The RMSD is the same magnitude as the RMSE, so for the normalized RMSD use NRMSE or change the RMSE to RMSD as to not confuse the reader.

Response: Thanks for the suggestion and we have updated this in the manuscript (Eq. (4)).

At line 380 what is the AAOD? Add a description before using any abbreviation.

Response: We have described the AAOD in the earlier Sect. 2.1 and we apologize for the many abbreviation and acronyms used in the current manuscript. We have modified Table 2 to better organize the abbreviation we have used in the current manuscript.

At line 425 What are the "TEMPO and GEMS"? Add a nomenclature and abbreviation table for the whole document.

Response: Corrected.

In Figure 5 change the x axis from 0 to 400.

Response: Corrected.

In Figures 6 and 15 add grid lines.

Response: Corrected.

In Figure 8 change the x axis borders from 0.0 to 2.5 (now its until 3.0). Add also some in plot statistics (e.g. median or mean) and discuss in detail the form of the different distributions of plots a and b.

Response: Thanks for the suggestion. We have replotted the figure and discussed the figure in more details in the text.

In Figure 10 add horizontal grid lines.

Response: Corrected.

Finally, in Figure 11 place plot b below plot a and increase the aspect ratio as to cover the whole width. Then, at x axis place the SZA steps every 4-5 degrees as to describe better these interesting plots.

Response: Thank you for the suggestion and we have replotted the figure based on the suggestion.

The overall analysis merits publication and is able to forward the use of Earth Observation techniques in order to measure or estimate with high accuracy the UV irradiance levels. I strongly believe that after the above revisions the paper could be published in the Atmospheric Chemistry and Physics journal.

We thank the reviewer again for the positive feedback.