

Authors' Response to Referee #2

UV-Indien Network ground-based measurements: comparisons with satellite and model estimates of UV radiation over the Western Indian Ocean, **K. Lamy, T. Portafaix, Earth System Science Data, [essd-2021-55](#)**

Introduction

We thank the referee for the time and effort he has dedicated to provide us with valuable feedback. We are grateful to the reviewer for their insightful comments and their suggestions.

As mentioned in our response to Referee #1, we have prepared a new version of the manuscript that will be more in line with the objectives and scope of the ESSD and taking into account the comments and suggestions of both referees. This new version of the manuscript is part of our final response to the discussion. (Step 5 of the revision as described here:

https://www.earth-system-science-data.net/peer_review/interactive_review_process.html)

Before we start answering in detail, we would like to point out that we have taken into account the remarks of both referees on the slight discrepancy between the Aims and Scope of ESSD and some sections of the article. We also agree with the referees on the lack of information on site selection, site specificity or instrumental specificities. We are therefore preparing a new version of the manuscript that will include the suggestions and corrections made by the two referees. This new version will follow a structure close to that proposed by Referee #2. Thus, the emphasis of the paper will be shifted from the presentation of the data (Diurnal Cycle of UVR and Clouds) to the description of the instrumented sites, the instrumental characteristics (type of instrument, protocols, calibrations and uncertainties) and the creation of the data set (filtering method, post-processing).

We also hope that the restructuring and shifting of the focus of the paper has helped to realign the manuscript with the aims and scope of ESSD.

Below we provide detailed answers to the main questions raised by the Referee #2. We refer to this part as Part 1: Answer to the General Comments. Our responses to the specific comments are detailed in Part 2 of this document.

Part 1: Answer to the General Comments

General Comments of the Reviewer to the Author:

A useful manuscript detailing UV measurements in a part of the world that has, until now, had limited coverage. I expect it should find a suitable home somewhere, but as Reviewer #1 notes, it does appear to fall slightly outside the remit of EESD by a strict reading of the journals aims and scope. This could be addressed by a shift in emphasis to providing more details about the ground instruments and their capabilities and calibrations, and a summary of the resulting data, and less emphasis on the intercomparison to satellite datasets. However that specific point I leave for the editor.

Aside from the issue of whether the manuscript properly fits within EESD's remit, I think the manuscript would anyway be improved by this shift in emphasis and some restructuring. There would be much to be gained by adding details of the calibration procedures, more details on the sites and their localities, more details about what instruments are running when at each station, more details about the data processing. This would enable the reader to assess the quality of the resulting data, which is not really possible at present. The comparison to satellite data tells us more about the disparities between different satellite and model products than it does about the ground data — ground data usually being used to validate satellites, rather than the other way round. I found the two sections comparing ground based data to satellite data less helpful, perhaps because the thrust is that there are differences between the Bentham and the satellites due to their different footprints and processing techniques, but little effort to resolve these differences. As a result it tells us little about the Bentham and UVR data. More details and depth on the calibration procedure and instrument characterisation on the other hand would assist here. The conclusions are also heavily biased to interpreting the satellite aspect rather than the novel ground data.

In general I would recommend the authors restructure the paper. The introduction is mostly fine. Then perhaps something as follows:

- site selection (how were they chosen)
- site details (latitude, longitude, altitude, urban, rural, general surrounding habitat, other ancillary measurements e.g. SAOZ)
- instruments and which at which sites
- instrument maintenance protocols and frequencies, characterisations (cosine error, spectral responses), calibrations and data processing (include levels of data)
- data products and pathways (leading on from data processing)
- presentation of summary data: diurnal variation of UVR and CF at each site, monthly means / annual variation, depending on length of measurement period

I think most of this information will be available to the authors if it is not already in the manuscript, but, for example, putting all the information about calibrations together will help (at present it is spread between sections 2.1 and 3.1).

Author's Response: We agree with the reviewer on a necessary restructuring of the manuscript. This has been done and a new version of the manuscript is available. The new manuscript now focuses on the characterisation and choice of instrumented sites, the instruments (characteristics, calibrations, maintenance, data processing). The data presentation part has been lightened but is still present, it contains the comparison with other satellite estimates and UVI models, the ranges of variables of the datasets over the day or over the months of the year. We believe that this presentation of the data (section 4 of the new manuscript) provides the future user with key elements for understanding the ranges of values present in the dataset in order to be able to use the network data appropriately. This part therefore also plays its role of data quality assurance. We also hope that the restructuring and shifting of the focus of the paper has helped to realign the manuscript with the ams and scope of ESSD.

Part 2: Answer to the Specific Comments

Specific points of the Reviewer to the Author:

RC: II 1-2 Rephrase to make it clear that the spectroradiometer is a single instrument shared across the network, rather than each site having a spectroradiometer. Likewise for the all sky cameras that not all sites benefit from such an instrument.

AR: Corrected

RC: I 2 "Homogenously" is not quite correct, there are not an equal number in each country; perhaps "spatially" or "geographically" would be better. How these sites were selected would also be interesting to include.

AR: Corrected

RC: I 19 "increases more than 4". I presume this does not mean a factor of 4, but it should be made clearer to the reader.

AR: Corrected

RC: I 48 Insert comma after "radiation" and remove after "conditions"

AR: Corrected

RC: I 82 Region should not have a capital here

AR: Corrected because this sentence no longer appears in this form in the new version of the manuscript.

RC: II 92-95 This would be better changed to "all sites have operational UVR instruments (...), and four stations (...) have operational all sky cameras" or similar

AR: Corrected. This sentence no longer appears in the new version of the manuscript.

RC: I 96 Which model spectroradiometer?

AR: Bentham DTMc300. The Bentham model used is now correctly cited in the new version of the manuscript.

RC: I 97 How are the TOC and calibration measured simultaneously? Or do the authors mean that the calibration is dependent on TOC (and also SZA?) and applied after measurement? How was the calibration obtained? How often is it reassessed?

AR: We mean that the calibration is dependent on TOC and SZA and it is applied after measurements. More details on the calibration process can be found in the newer version of the manuscript in section 3.1.2.

RC: II 98-100 What is the calibration frequency so far? This is more important than an anticipated future 2 years cycle for the data presented. How is the cross-calibration carried out? How is the Bentham calibrated and what are the details of its calibration / traceability? Why was the Saint-Denis calibration method changed from the Davos one to the Bentham-derived one? How does this affect the data? Do the authors mean PMOD when they state "Davos"? If so, this should be stated more clearly and acknowledged.

AR: The UVS-E-T 150124 radiometer (installed in St-Denis) was installed in December 2016. It was recalibrated in Davos (PMOD/WRC) from 1 July to 1 August 2017. It was then compared to the Bentham in St-Denis from April to November 2019. This is not the case for the other instruments. The SUV-E radiometers were all compared to the Bentham in St-Denis before being installed at their respective sites. The other UVS-E-T radiometers (Anse Quitor, Antananarivo and Mahé) should have been repatriated to be recalibrated in Davos or at least in St-Denis with the Bentham, unfortunately logistical and financial constraints have slowed down this recalibration process.

Details have been added in the manuscript on the calibration of the radiometers against the Bentham (section 3.1.2) and on the calibration of the Bentham itself (section 3.1.1).

We did mean PMOD/WRC when we said Davos, clearer details and acknowledgements have been added in the manuscript in order to correctly cite this institute.

RC: I 101 What do the authors mean by mesh-size (graduations in TOC in the lookup table for calibration)? If so, how does this relate to the cost of the instrument?

AR: Corrected, this sentence was a typo and no longer appears in the new version of the manuscript.

RC: I 102 How much difference is there between OMI TOC and SAOZ TOC at the stations with both, and how much does this affect the UVR calibration?

AR: We have not experimented with doing the calibration twice with OMI and then SAOZ, comparing the differences on the UVI obtained. However, if we take for example the $f_n(\text{sza}, \text{ozone})$ function obtained by the PMOD/WRC calibration and if we estimate that the difference between the total ozone value measured by OMI and that of SAOZ at Moufia, is less than 1.3% (Tohir et al., 2018), this would induce a difference in calibrated UVI of less than 1% whatever the solar zenith angle.

References :

Tohir, A. M., Portafaix, T., Sivakumar, V., Bencherif, H., Pazmiño, A., and Bègue, N.: Variability and trend in ozone over the southern tropics and subtropics, *Ann. Geophys.*, 36, 381–404, <https://doi.org/10.5194/angeo-36-381-2018>, 2018.

RC: I 105 It would be useful to know what level 0 and level 1 data is as well.

AR: Details have been added on data processing and the notion of levels (although used internally in our data processing chain) no longer appears in the manuscript. (Section 3.1.3)

RC: I 107 It would be useful to provide at least brief details of the cloud segmentation algorithm and any known issues or bias in addition to the citation to assist the reader.

AR: Details have been added on the cloud segmentation algorithm (section 3.1.1 in the new version of the manuscript).

RC: I 96-197 Using the abbreviations AD and RD makes reading the following section much harder. Suggest they be removed and spelt out.

AR: As suggested, we have removed the abbreviations AD and RD.

RC: I 208 Remove space before period.

AR: Corrected

RC: I 211 BENTHAM should not be fully capitalised here

AR: Corrected

RC: II 231-234 This detail should be left for the figure caption.

AR: Corrected

RC: I 241 Absolute and Relative Differences should not be capitalised

AR: Corrected

RC: II 248-249 Yes UVI-RADIO and UVI-BENTHAM should be aligned, but as the authors are presenting the data, and the quality of the data depends on the quality of the calibration, how well this has been transferred between the two instruments would be very interesting to include.

AR: Details have been added about the calibration of the UVS-E-T located at St-Denis against the Bentham. These details are in section 3.1.2.

RC: I 252 M-RD: these designations make reading the text harder

AR: We understand the reviewer's point about abbreviations. However, we have chosen to keep abbreviations for these terms as they were very present in this section. We feel that writing these terms out in full would also make them more cumbersome to read, so we have changed M-RD and M-AD to Mean-RD and Mean-AD and med-RD and med-AD to Median-RD and Median-AD for more clarity and less clutter.

RC: I 289 Likely smaller than 100km as well, but including some details of the sites' local environment would complement this point

AR: The environmental conditions have been described in Table 1 and in section 2.2 of the new manuscript.

RC: I 300 How long is the measurement period? Please provide details.

AR: The measurement period used to make these monthly averages (formerly climatology) is the same as for Figure 5: Anse Quitor (start of measurements (2017) to 06/2020), Antananarivo and St-Denis (start of measurements (2016) to 12/2020) and Mahé (start of measurements (2017 to 11/2020). These details have been added in the manuscript.

RC: I 317 Enhancement suggests a ratio (or factor), but as before do the authors mean a difference of 2 to 3?

AR: We were talking about an absolute increase in UVI of 2 to 3 units. This is now made explicit in the manuscript.

RC: I 328 How long is the data set being discussed?

AR: It depends on the station, the periods of the radiometers of each station are now shown in figure 2 of the new version of the article. The length of the data sets discussed here are about 4 years for St-Denis and Antananarivo, about 3.5 years for Anse Quitor and about 3 years for Mahé.

RC: I 369 Rearrange sentence so does not start with "10 am"

AR: Corrected

RC: II 380-390 This information would be better in a "data availability" section

AR: We are not sure we understand this comment because lines 380-390 were in the "Data availability" section.

RC: Fig 1: It would be useful to distinguish the stations, perhaps by colour, according to the instruments that monitor at each site.

AR: The map has been updated to show the presence or absence of a Bentham spectroradiometer, camera or radiometer.

RC: Fig 2: This mainly shows satellite timelines. It would be better to show the timelines of the UVR instruments which give most of the geographic coverage and the all sky cameras which are the focus of the manuscript

AR: Both figure are now present in the manuscript. Timeline of UV-Indien instrument are among the main figure. Timeline of satellite, models and Bentham and radiometer at St-Denis are in appendix.

RC: Fig 5: Is this UVR data or Bentham data?

AR: This is UVR data.

RC: Fig 6: I am not sure whether the length of the data series is sufficient to call these "climatologies"

AR: As stated in the text (l328 in the old version of the manuscript), we agree with the Reviewer on this point. The measurement periods are not long enough to be considered as climatologies. We have therefore renamed them "monthly averages" in the new version of the manuscript.
