Response to the Reviewers' Comments

Concerning manuscript amt-2017-210, *"The TROPOMI surface UV algorithm"* by Anders V. Lindfors et al.

We have received the comments on our manuscript by two reviewers. We thank the reviewers for their constructive comments. We have considered these comments in regards of our revised manuscript. Below, we detail the comments by the reviewers together with our response to them.

Reviewer #2

Reviewer #2 indicates in a general remark that our paper describes the basis of an algorithm that will produce data important for continued monitoring of the surface UV radiation conditions.

Comment #1: *P 1, L6-7. There are several occasions throughout this paper beginning here with 'OMI' and 'AC SAF' when the spelled out name of an acronym is given in parentheses following the acronym. The proper format is to provide the spelled out name first followed by the acronym in parentheses.*

Reply: Corrected as suggested. On rare occasions, when an acronym had already been defined but we wanted to remind the reader of its meaning, we still use the spelled out description in parentheses (e.g., P6, L3: "found an average CMF (Cloud Modification Factor) of 0.4")

Comment #2: *P1, L24. Please provide references for each of these statements: ' increased during the last decades of the 20th century', 'strongest place in the high latitudes of the south- ern hemisphere', 'Artic and mid-latitudes in both hemispheres have experienced UV increases'.*

Reply: UNEP 2011 is the reference for all those statements. The text has been revised to make this clear to the reader.

Comment #3: *P2, L18. It is also important to note that the TROPOMI is a backscatter instrument and that total column ozone observations are limited to the sun-lite portions of the earth. Of course where there is no sun light there is no UV at the surface.*

Reply: The paragraph in question has been modified to reflect the point made by the reviewer. Furthermore, since the S5P satellite has now already been launched, the text was updated to reflect this fact, with the launch date included.

Comment #4: *P3, L26. Add 'respectively' to the references as they match the European and North American regions.*

Reply: During the revision process, an additional geostationary satellite UV algorithm came up, and we decided to refer also to that algorithm. Thus the citation at the end of the sentence is now to three papers, and therefore adding 'respectively' does not seem appropriate.

Comment #5: *P4, L14. Somewhere in the 'Heritage' section it should be noted what the Equator crossing times were for the previous surface UV observing satellites. This is important to know at what time the actual observations were made when combining data sets.*

Reply: We added information on TOMS, OMI and TROPOMI equator crossing times to the revised manuscript (P4, L19-20 in revised manuscript).

Comment #6: *P6, L12. The effect of enhanced UV at the surface depends upon the integration time (dosage) instantaneous increases as noted have been observed, but these are not sustained over longer time integrations (minutes to hour).*

Reply: Text changed to reflect this.

Comment #7: *P7, L11. An additional piece of information would be that this effect is in the order of 3% and that the earth is closest the sun in early January and furthest in July.*

Reply: We added this information to the revised manuscript.

Comment #8: *P11, L16. Where or how is the aerosol absorption optical depth determined?*

Reply: Determination of the aerosol absorption optical depth is described in the papers referred to (Arola et al., 2005; Krotkov et al., 2005). Arola et al. used an inversion algorithm based on spectral Brewer measurements, while Krotkov et al. used an inversion algorithm based on measurements of a UV-multifilter rotating shadowband radiometer (UV-MFRSR).

Comment #9: *Why is the aerosol correction applied after the erythemal and vitamin-D values are determined? Why can't the aerosol corrected UV irradiances be used to compute the erythemal and vitamin-D values?*

Reply: This has to do with the design of the algorithm. As the aerosol correction is applied as a post-correction step, in line with the studies in the literature suggesting to use this correction (Krotkov et al., 2005; Arola et al., 2005), it also means that it would be technically difficult to include the aerosol correction spectrally into the UV look-up-table before the weighted dose rates are introduced. Therefore, we have chosen to correct the erythemal and vitamin-D weighted UV dose rates according to the same scheme as used for the irradiances at single wavelengths.

Comment #10: *P12, L15. How many scan positions are there in each swath?*

Reply: The TROPOMI swath consists of 450 across-track pixels, we added this to the revised manuscript. We would like to further point out that TROPOMI is not a scanning instrument. The whole swath is measured at once using CCD detectors.

Comment #11: *P12, L32. The relationship is easy to state: UVI = 0.4 *Erythemal Dose Rate (W/sq m).*

Reply: We have added the information how to calculate the UV Index in the revised manuscript. Note, however, that the relationship is: UVI = 40 * erythemal_dose_rate [W/m2] (see WHO, 2002).

Comment #12: *P13, L5. There is a small crescent shaped area just south of the Black Sea of high reflectance. There are mountains there. Is the high reflectance due to snow, clouds or both? This area translates into lower UV values.*

Reply: This is indeed an interesting feature. Meteorological satellite data from Meteosat/SEVIRI show clouds over this region for the time corresponding to the data presented in the figure. We added a sentence on this in the revised manuscript.

Comment #13: *P13, L6. Not to add too many more plots, but it would be nice to see observations from Jokioinen and Sodankyla on entirely clear days to show that the observations do lay on top of the green curve. Figure 5 is useful to show the potential error in computing the daily dosage from one overpass per day. However, since the overpass time and solar noon at most points along the orbit are within ±2 hours the error from overpass time to solar noon should be smaller unless rapid cloud conditions do occur.*

Reply: We are restricted to the test data sets available from the TROPOMI working group. From those data, we could not find a suitable cloud-free day for FMI's UV stations. However, in order to elaborate on the point made by the reviewer, we added some text to a sentence already in the manuscript, elaborating on the agreement in Jokioinen during the cloud-free early morning and late afternoon hours ("The very morning and late afternoon hours in Jokioinen also appear cloud-free, with good agreement between the TROPOMI clear-sky UVI and that measured by the Brewer").

Comment #14: *P15, L12. Instead of telling the reader later in the paragraph that the errors were assessed at high latitudes, add that piece of information in the beginning sentence.*

Reply: Added high-latitude to the beginning as suggested.

Comment #15: *P15, L 27. This phrase does not make sense: 'continues to present date thanks on the OMI UV record'.*

Reply: Sentence changed to 'continues to present data thanks *to* the OMI UV record'.