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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Comparison of UV irradiances from Aura/Ozone Monitoring Instrument (OMI) with Brewer measurements at El Arenosillo (Spain) – Part 1: Analysis of parameter influence" *by* M. Antón et al.

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Items-by-items response to Reviewer #1

(* Reviewer comment, ++ Our response)

* Pitfall 1. Brewer instrument does not measure the whole UV spectrum. So, to get a UVER number a "correction" has to be applied to the brewer scan. This correction should be described in detail, and an estimation of the errors (both systematic and random) associated with this correction should be given. Of course, a reference to a

published manuscript (where all this is formation is detailed) will suffice.

++ Effectively, the spectral range of the Brewer spectrophotometer measurements must be expanded from 363 nm (actual limit of its measurements) up to 400 nm, which is the upper limit of the CIE standard spectrum which is the reference spectrum to obtain UVER data (McKinlay and Diffey, 1987). This correction is performed by the software developed by Martin Stanek at the Solar and Ozone Observatory of the Czech Hydrometeorological Institute (Stanek 2007). The UVER data derived from interval 280-363 nm represents around 95% of the UVER data for whole range 280-400 nm. So, the error associated with the expansion is very limited. An empirical correction of this error can be found in the work of Vilaplana et al. (2006). According the reviewer's suggestion, we have added this following discussion in Section 3: "In order to obtain UVER data from the Brewer spectrophotometer, its measurements' range has to be expanded from 363 nm (actual limit of the measurements of this instrument) up to 400 nm (upper limit of the CIE standard spectrum). This correction is performed by the software developed by Martin Stanek at the Solar and Ozone Observatory of the Czech Hydrometeorological Institute (Stanek 2007). An empirical correction of this error can be found in the work of Vilaplana et al. (2006)."

The following two references have been added to the reference's list:

Stanek, M. 2007. "Total Ozone and UV Radiation Monitoring Software." Available at http://www.o3soft.eu/.

Vilaplana JM, Cachorro VE, Sorribas M, Luccini E, de Frutos AM, Berjón A, de la Moreno B: Modified calibration procedures for a yankee environmental system UVB-1 biometer based on spectral measurements with a brewer spectrophotometer. Photochemistry and Photobiology 82, 508–514, 2006.

* Pitfall 2. There is a difference in bandwidth between OMI (0.45 nm) and the Brewer (0.6 nm). Again an analysis of the systematic and random errors is in place.

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++ The OMI instrument uses a triangular slit function with full width half maximum (FWHM) of 0.55 nm in the UV region instead of 0.45 nm. This mistake has been corrected in the text. So, the bandwidth of OMI (0.55 nm) and Brewer (0.6 nm) instruments are very similar. Therefore, the error in OMI-Brewer comparison related to this difference is not significant.

* Pitfall 3. The OMUVB products contain a large number of UV dataset, many of which are not suitable for this study. The authors should specify EXACTLY which OMUVB datasets have been used (e.g. OPErythemalDoseRate, LambertianEquivalentReïnËĞ C′ ectivity, OPIrradiance305,.....).

++ We have used the following UV datasets: OPEDRate (Overpass Erythemal Dose Rate), and OPIrd305, OPIrd310, OPIrd324 (Overpass Irradiance at 305 nm, 310 nm and 324 nm, respectively). In addition, we have used the LambEquRef (Lambertian Equivalent Reflectivity at 360 nm) for cloud characterization. In order to clarify this subject, we have added the following comments in Section 2: "In this study, the following OMUVB products are used: OPEDRate (Overpass Erythemal Dose Rate), and OPIrd305, OPIrd310, OPIrd324 (Overpass Irradiance at 305 nm, 310 nm and 324 nm, respectively). In addition, OMUVB dataset contains LambEquRef (Lambertian Equivalent Reflectivity at 360 nm) which is used for cloud characterization."

Minor issues and questions

* P6799 L3 from Ozone Monitoring Instrument.... -> from the Ozone Monitoring Instrument"

++ This minor error has been corrected.

* P6799 L6 Why call it a Brewer spectroradiometer" when the manufacturer calls it a "Brewer spectrophotometer"?

++ Spectroradiometer and spectrophotometer are synonymous words. Nevertheless, it is truth that the manufacturer calls it "Brewer spectrophotometer". Thus, we have

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replaced “spectroradiometer” by “spectrophotometer” in the text.

* P6799 L20 “...is clearly documented as due to...” This is an exaggeration. This paper shows that aerosol extinction plays an important role, but it does also shows there is more than aerosol extinction.

++ We agree with this comment. Thus, we have replaced “. . .is clearly documented as due to. . .” by “. . .is partially due to. . .”

* P8603 L12 The estimated accuracy of the Brewer UVER is 5%. Is it possible to indicate if this error is “systematic” (meaning likely to be the same in all the measurements) or is there a pseudo random component (e.g. errors change from calibration to calibration)?

++ The estimated accuracy of the Brewer UVER is less than 5%. This is a systematic uncertainty of the Brewer. In the International Brewer calibration campaign at El Arenosillo, September 2009, the Brewer/QASUME diurnal variability estimated for 17 Brewer where from 1% to 4% including the wavelength shift and temperature dependence.

* P6803 L28 El Arenosillo is on the coast. Please indicate this. (This could be relevant if there is a persistent cloud-cover gradient over the station)

++ According the reviewer’s suggestion, we have added the following sentence in Section 2: “It is located in the Gulf of Cadiz near the coast in Mazagón, Huelva, Spain”

* P6804 L11 Am I correct to assume that only one OMI pixel per day has been used, even if there are two orbits over El Arenosillo? If so, which one has been used?

++ Effectively, only one OMI pixel per day has been used in this work. For each day of Brewer observations the single OMI ground pixel most closely collocated with El Arenosillo station is selected as the best match. In order to clarify this subject, we have added the following statement in Section 3: “For each day of Brewer observations the single OMI ground pixel most closely collocated with El Arenosillo station is selected

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as the best match”

* P6804 L13 I am confused about the time window mentioned here. Did you use the Brewer UV-scan closest in time to the OMI overpass (then why is the window relevant?), or did you average the Brewer data in this window?

++ Yes, we use the Brewer UV-scan closest in time to the OMI overpass. It is truth that the time window is not relevant. So, we have replaced in Section 3 “In addition, in this comparison we used the Brewer data between 12:30 and 14:30 local solar time close to the OMI overpass time at ∼13:45.” by:

“In addition, in this comparison we used the Brewer UV-scan closest in time to the OMI overpass at ∼13:45.”

* P6804 L22 Fortunately you have an instrument to measure AOD at all relevant wavelengths. It is called a “Brewer spectrophotometer” (I think).

++ Certainly it seems, but during the last years we have been trying to get AOD values by our Brewer spectrophotometer for operational purpose, but unfortunately we can show to the reviewer that the results were not correct. We think that the problem is basically due to that fact that the obtained calibration constants are not sufficient good for aerosol retrieval (at least in our case). Certainly we know that AOD may be determined by Brewer and in this sense we have published two papers (Groebner et al., 2001, GRL Vol 28, pag. 1691; Cachorro et al., 2009; JTECH Vol 26, pag. 1558; See also references herein). However we have not reached good values for a long period. This is also explained in the second companion paper (Cachorro et al., 20101, ACP) and how we obtained AOD at UV wavelengths derived by CIMEL sunphotometer (also explained in the question P6804 L23).

As an example, please see in the supplement file one figure (two plots) with the evolution of the AOD values obtained with the Brewer instrument and two Cimel, one (#341) of them has 340 and 380 nm channels and the other one without UV wavelengths

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(#45). The period shown is after a calibration campaign corresponding to the "Regional Brewer Calibration Center for Europe (RBCC-E) intercomparison for Brewers" in 2005 at El Arenosillo.

* P6804 L23 "being the shortest channel" is not clear. I assume you refer to "the channel that observes light with the shortest wavelength".

++ We have replaced in Section 3 "being the shortest channel used for the analysis was centered at 440 nm" by: "being the channel that observes light with the shortest wavelength"

* P6804 L23 The CIMEL measures both AOD 440 and alpha. It is conceivable that you estimate from this an AOD 305, AOD 310, AOD 324 etc. You chose not to do so. Why not?

++ Certainly we can do this procedure as it is explained in the already mentioned companion paper focused on the aerosols effects over OMI irradiances. As we explain in this paper, "AOD values at 440 nm and the alpha parameters have been used to extrapolate the AOD to UV wavelengths. This approach has been validated using the measurements of AOD values at 340 nm. In this sense, Figure 1a (in the companion paper) shows a good agreement between the measured and calculated values at 340 nm". Please see the companion paper for this issue.

* P6804 L13/L26 Is "local solar time" the same as "true solar time"? I think the phrase is simply "solar time", not to be confused with "local mean time".

++ Yes, the local solar time is the true solar time. According the reviewer's suggestion, we have used "solar time".

* P6805 L13/L14 Could you please consider using "OMUVB" rather than "OMI" when you refer to the OMI UV products?

++ According the reviewer's suggestion, we have replaced "OMI UV products" by "OMUVB products".

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* P6806 L22 When I look at figure 2, I see MBE values of 14, 13, 12, 9, 11% for LER<30%. The values quoted in the text are different (5-13%).

++ Thank you for the warning. The right range is 5-15% for LER<30. So, the error has been corrected in the text.

* P6807 L13 Why haven't you used both OMI-LER and AERONET cloud-screening to select cloud-free days? in the interest of clarity.

++ We agree that the selection of cloud-free days using OMI LER data presents an inherent uncertainty. However, AERONET cloud-screening derived from the Cimel cannot be considered as a local observation of the cloudiness over El Arenosillo because we can not define a physical quantity or value to evaluate the cloudiness. The information was used to remove days with clouds and set up the file of cloud-free data. Therefore, the LER value derived from OMI is the unique available source of cloud information in our station of study.

* P6807 L25 "The statistical parameters show that agreement is excellent for all OMI products". If you change OMI to OMUVB (see above) this claim becomes more reasonable.

++ According the reviewer's suggestion, we have replaced "OMI" by "OMUVB".

* P6808 L15-16 We are discussing here the 1.31% difference in OMI (to use yet another acronym: OMTO3) and Brewer ozone data. This is close to the noise in the Brewer and the representativeness error in OMTO3. So a low correlation with UV biases is not surprising. I think the real argument is that a 1.31% difference in ozone cannot explain 13% bias in UV.

++ We agree that 1.31% difference between OMI and Brewer total ozone data cannot explain 13% bias in UV between both instruments. In order to clarify this subject, we have replaced:

"The slight underestimation of TOC values from OMI algorithm could potentially explain

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the overestimation found for the OMUVB products (especially for the shortest wavelengths), since the OMUVB algorithm uses the TOC values from OMI-TOMS as input. However, lack of correlation between OMI-Brewer TOC and UV differences implies that uncertainties in TOC can not explain the observed biases in UV. ”

by the following sentences:

“A notable underestimation of TOC values from OMI algorithm could potentially explain the overestimation found for the OMUVB products (especially for the shortest wavelengths), since the OMUVB algorithm uses the TOC values from OMI-TOMS as input. Nevertheless, it is clear that the small TOC underestimation found in this work (1.31%) cannot explain 13% bias in UV data.”

* P6808 Last paragraph. AOD, AAOD, extinction AOD. Please help the reader a bit. Do these acronyms refer to physical quantities, satellite products, or something altogether different?

++ The acronyms are always accompanied by the complete name of the physical aerosol magnitude or defined previously in the text. They are well known in the aerosol community and hence they are used currently in the papers. Nevertheless, we have removed “extinction AOD”, because this term is not correct, we can say “extinction” or “AOD” but not both together.

* P6809 L4 Please consider removing the word “second”.

++ We have removed this word.

* P6809 L20-22 I think it says here: “if we accept and compensate for the bias, look how nice the UV measurements are”. Fine. But it could be interpreted as “when there are no clouds and no aerosols, the bias disappears”. Wrong. Please formulate a bit more carefully.

++ According the reviewer’s suggestion, in order to clarify this issue, we have replaced:

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"These results indicate that the differences between OMI and ground-based Brewer UV measurements are reduced to the measurements uncertainties (∼5%) when the aerosol and cloud effects are removed."

by the following comments:

"These results indicate that the overestimation found in the OMUVB products is clearly reduced for cloud-free and aerosol-free sky conditions."

* P6810 L17 "according to the aerosol climatology in our area". I am not sure what this refers to. When I ignore this phrase the paper continues to make sense.

++ Please do not ignore this subject because we give in the references important information about the characteristics ("climatology" based on 6 year of data 2000-2005) of aerosols in our area of study, which are relevant for the aerosol analysis in this paper.

* P6810 L26 "the aerosol influence over the Brewer spectral measurements". This suggests the Brewer measurements are wrong! Please rephrase.

++ Sorry for the mistake. We have replaced that sentence by the following: "This wavelength dependence of OMI-Brewer bias for moderate-high aerosol load may be partially attributed to the aerosol influence over the OMUVB products."

* P6811 L18 The dependence of the UV bias on AOD is quite different. Wheis is quoted as 1.05 to 1.35; figure 3r shows roughly 1.12 to 1.20. "agree" is too strong a word.

++ We agree with the comment. So, we have replaced "agree" by "are in concordance"

* P6813 L12 Where do the values 8% and 14% come from? Table 2 quotes 12.27, 13.01, 10.87, 18.22. Figure 2 shows all kinds of values but I don't see 8%. Figure 3 shows values between 10 and 20 %.

++ These values come from Table 2, for dataset #1 "all sky conditions", which quotes 12.27, 14.24, 10.64, and 8.69 for UVER, UV 305, UV 310 and UV 324, respectively. In order to clarify this subject, we have replaced "OMI surface UV data" by "OMUVB

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products".

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/10/C3084/2010/acpd-10-C3084-2010-supplement.pdf

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Interactive comment on Atmos. Chem. Phys. Discuss., 10, 6797, 2010.