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## ***Interactive comment on “Comparison of OMI ozone and UV irradiance data with ground-based measurements at two French sites” by V. Buchard et al.***

**V. Buchard et al.**

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Answers to referee #2 comments received and published on 10 April 2008, on the manuscript:

"Comparison of OMI ozone and UV irradiance data with ground-based measurements at two French sites."

General comments :

This well-written paper presents a comparison between OMI (TOMS-like and DOAS-like) estimated total ozone content (TOC) and the value retrieved from two Jobin Yvon spectroradiometers at two French sites. Spectral irradiance and erythemal doses/dose

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rates estimated from the satellite spectrometer and those measured by the spectroradiometers are also compared. Moreover, the authors analyse the effect of aerosols, clouds, snow and solar zenith angle. Validating satellite estimates is an extremely important task, because satellite products get more and more used and their accuracy is reaching that of well-calibrated precision instruments (Brewer and Dobson photometers, for ozone products).

- I think that the main restriction of the study is the uncertainty of the ozone values retrieved from the spectroradiometers. The authors say that the algorithm has an uncertainty about 3% on clear sky and 7% on cloudy days (daily averages). These uncertainties are rather higher than the expected mean relative differences between OMI and ground-based instruments and than well-calibrated spectrophotometers accuracy, about 1-2% (e.g. Balis et al. 2007, Validation of Ozone Monitoring Instrument total ozone column measurements using Brewer and Dobson spectrophotometer ground-based observations, J. Geophys. Res., 112). Regarding ozone data, I'm wondering if this represents a "validation" study (p. 4310 l. 6) or just a comparison between satellite and ground estimates.

Reply: In case of clear sky days, the averaged uncertainty on the ozone retrieved from the spectroradiometer data is about 3%. On cloudy days, the performance depends on the cloudiness: for example for cloudiness lower than 4 octas, the averaged uncertainty is about 4%, when cloudiness is larger than 4 octas, the averaged uncertainty is about 7% (Brogniez et al., 2005).

In their paper, Balis et al., 2007 (section 2) state that: "A well maintained and calibrated Dobson spectrophotometer measures the ozone column with an estimated accuracy of 1% for direct sun observations and 2-3% for zenith sky or zenith cloud observations."

Few lines further they add: "These values might be a bit too optimistic." After reading Basher (1982), we agree with this last comment.

So we think that the uncertainty we have on clear sky days is of the order of the uncer-

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tainty from direct sun observations with Dobson and Brewer.

Concerning cloudy days, we cannot compare the uncertainty of our retrieval to that from Dobson and Brewer because the meteorological conditions are not comparable.

Nevertheless, we agree that in any case it is a comparison rather than a validation. So, according to the reviewer comment, the sentence (p4310, l5-7) "the main objective of this work is to validate OMI data with ground-based measurements in order to use OMI products for scientific studies" has been changed by "the main objective of this work is to compare OMI data with ground-based measurements in order to use OMI products for scientific studies."

At Villeneuve d'Ascq, the RMS that we obtain with OMI-TOMS is 1.9% on clear sky and 3.2% for all sky conditions. In Balis et al, it is the mean value of relative differences averaged over different sites that is equal to 1%, not a RMS. Figure 1 of their paper shows that this average relative difference is variable depending on the latitude.

- Introduction (p. 4311): maybe it could be interesting to cite similar papers already published in the scientific literature (e.g. Balis et al. 2007) along with the results;

Reply: According to the reviewer suggestion, in section 3.1 (ozone comparisons), the reference Balis et al. 2007 has been added in the new manuscript with a comment on their results.

- p. 4312 l. 11: is the total ozone content retrieved from the global irradiance spectrum, as said here, or from global-diffuse (=direct) spectrum, as written in a recent paper by the same authors (C. Brogniez, V. Buchard, and F. Auriol, Validation of UV- visible aerosol optical thickness retrieved from spectroradiometer measurements, Atmos. Chem. Phys. Discuss., 8, 3895-3919, 2008)? This is extremely important, because "all ground-based remote sensing applications which take advantage of measuring scattered radiation in order to infer atmospheric trace gas abundances [...] are subject to large errors, when neglecting the influence of cloud scattering on the derived data" (B.

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Mayer, A. Kylling, S. Madronich, G. Seckmeyer, Enhanced absorption of UV radiation due to multiple scattering in clouds: Experimental evidence and theoretical explanation, JGR-Atmospheres 98JD02676 Vol. 103 , No. D23 , p. 31,241). This subject, if it is the case, should be pointed out.

Reply: The total ozone is retrieved from the global irradiance spectrum as it is written in the paper. In the other paper, it is the aerosol optical depth that is retrieved from global-diffuse (=direct).

- Moreover, how is the LUT structured (p. 4312 l. 15)? Which variables are taken into account (sza, TOC, ..., cloudiness?)? How was the algorithm validated?

Reply: The LUTs are built using a Radiative Transfer Code (DISORT) for various total ozone columns and solar zenith angles. Aerosols, temperature, pressure, ground albedo and site altitude are taken into account to calculate the LUTs. Some sensitivity tests were performed in order to find the validity range of the LUTs, the number of LUTs needed and a comparison was conducted with TOMS ozone data (Houët and Brogniez, 2004)

- p. 4312 l. 7-9: how often is the broadband radiometer calibrated? which is the relative difference of the measurements between the Yankee radiometer and the spectroradiometers? is a calibration matrix (TOC, solar zenith angle) used in the data processing?

Reply: Yes, we use a calibration matrix in the data processing. The instrument was calibrated at JRC (Ispra) in January 2003 and was calibrated at PMOD (Davos) in August 2006.

The mean relative difference between the measurements of the radiometer and of the spectroradiometer is indeed larger than that obtain with measurements performed in 2003. We don't understand currently the reason of that. It is still under study so we have preferred to remove the comparison between the OMI-EDR and the radiometer-

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EDR in the paper.

- p. 4316 I. 2-4: how are the data flagged as cloudy, clear sky and snow covered? Have you considered the COD from OMI, as in the EDR and EDD analysis?

Reply: The data are flagged as cloudy and clear sky using two information: the COD from OMI (as in the EDR and EDD analysis) and meteorological conditions from a weather station close to Briançon. These conditions include also the flag snow covered. In Villeneuve d'Ascq, we use in addition the variability of the broadband radiometer measurements. Following the reviewer comment, we think that this kind of information is useful, so we have added it in the paper.

- sect. 3.1: do the authors can explain why the ozone comparison shows a mean relative difference in Briançon higher (absolute value) than that in VdA?

Reply: We have searched for an explanation of this bias but we have found any.

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Interactive comment on Atmos. Chem. Phys. Discuss., 8, 4309, 2008.

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