Atmos. Chem. Phys. Discuss., 7, S1488–S1493, 2007
www.atmos-chem-phys-discuss.net/7/S1488/2007/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Towards closure between measured and modelled UV under clear skies at four diverse sites" *by* J. Badosa et al.

J. Badosa et al.

Received and published: 2 May 2007

(– Referee comment ++ Our response)

–The manuscript presents a comparison of UV-Index values determined from clear sky spectral UV measurements and from model calculations at 4 diverse sites. The extensive set of measurements is compared with different approaches for the input parameters of a radiative transfer model. The results and the discussions do not show principally new aspects, but they show very detailed and in depth the problems and uncertainties of both approaches, measurements and modelling. The manuscript is well organised. In the abstract the significant results are mentioned, tables and figures are generally informative and clear, and the list of references is adequate.

++Thank you very much for these constructive comments.

–Some small points should be addressed by the authors prior to publication:

–p1512/16-25: I think such a detailed list of content is not necessary.

++We agree that this is a long paragraph but we believe that it is useful to inform the reader about the contents and the organization of the paper. This orientation is beneficial because the paper very succinctly covers a wide range of case studies.

–p1514/9, Tab3: When the uncertainties of the measurements are discussed, it should be stated if all uncertainties refer to a coverage factor of k=1 or k=2 (1 sigma or two sigma level).

++They cover K=2 (it is now stated in Table 3).

–p1518/21-22: wrong sequence of words: 'is used'

++Correction applied. Thank you!

–p1519/9-14: what are the highest SZA, where TOZs can be used reliably without a systematic error?

++As in the study by Houët and Brogniez (2004), we also use the Stamnes method up to 80 degrees of SZA, with may produce an error within +/- 3% (stated in Table 6).

–p1526/10-20: I think, this discussion of diurnal variations of ozone and AOD should be more systematic, to show better the effects: After discussing the standard case (D2), which is wrong by both assumptions (high SSA and constant ozone), the discussion of D6 (no aerosol, constant ozone) does not provide a significant contribution, because it is also wrong by both parameters (AOD and ozone), thus it can be deleted to increase clarity. When comparing D8 (low SSA, constant ozone) with D2, then not the effect of ozone variations is seen, but the effect of lower SSA. The effect of changing ozone becomes clearly visible in comparing D8 (low SSA, constant ozone) with D9 (low SSA, variable ozone) or D2 (high SSA, constant ozone) with D3 (high SSA, variable ozone). Both of these comparisons show the same, therefore, again for increasing clarity, D3

ACPD

7, S1488–S1493, 2007

is not necessary and can be deleted.

++It is true that there are five plots in one, which makes Figure 10 more complex. It is correct that to show that the best agreements are found when considering the TOZ daily variation and the aerosols with SSA=0,7, we could have deleted D3 and D6. However, we believe that it makes sense to show the other cases in our paper, as they have interest from the modelling point of view. We believe that the extra cases serve as useful tests of the sensitivity to the model input parameters.

–However, when discussing diurnal variations of UV as a consequence of diurnal variations of ozone, it should be kept in mind that the ozone value was determined from the UV measurements and not independently. For example, if a wrong ozone profile is assumed, this would result in a diurnal effect on UV (see Fig. 4). But the method of ozone retrieval from the UV measurements would give a variation in ozone, which perfectly describes the UV measurements, but which nevertheless would be wrong. Furthermore it should be mentioned that for detailed analyses of the reasons for a difference between modelling and measurements it would be advisable to use the complete spectral data (instead of a weighted integral), then ozone-related effects could be clearly separated from aerosol-related effects.

++For Figure 10, we now remind the reader explicitly in the paper that one has to keep in mind that ozone from Stamnes method is not independent from the UV measurements and that there is some degree of circularity and also that spectral analyses would clarify the presented analyses:

++“Recall that TOZ$_{S}) values are not fully independent of the UVI measurements, so they are in some degree affected by the circularity issue, as discussed through Fig. 7. Also, a better understanding about the effects of changing aerosol and TOZ characteristics on the UV irradiances would be obtained from detailed spectral analyses.”

–p1529/26: ’the broadest possible range of ancillary data’ might be exaggerated, because from the paper it becomes clear that the SSA would be an additional important

ACPD
7, S1488–S1493, 2007

information, which is also possible to measure, but is not available in the present data set.

++The sentence has been changed for “incorporating a broad range of ancillary data”.

–p1530/6: I do not understand the argument that ’polluted sites are good to test the model’: if at a polluted site the necessary ancillary input information are available, then the model would give satisfying results. If not, then the measurements might be used to derive aerosol parameters to get agreement between model calculations and measurements, but this I would not call ’test the model’.

++The sentence has been changed for “we conclude that polluted sites are good to test the modelling approach“ which we believe is more precise in meaning what we wanted to express. Note that the sense of the sentence is that, for the same level of accuracy in the measurements, when a disagreement is found in the measurement-model comparison, the source of the disagreement is more probably related with the input data (aerosol information) in polluted sites, while it might be related with measurement issues in very “clean” sites.

–p1530/10-15: When the fact is discussed that for Melbourne the agreement between model calculations and measurements is outside the given uncertainties of both approaches, it is never clearly said that there might be a more serious problem with the UV measurements. May be this is indicated a bit when the authors state that Melbourne is the ‘only non-DACC site’ - do they mean that there the quality is less and therefore the estimation of uncertainty is not valid?

++It must be remembered that although we have measurements of aerosol optical depths, in no cases are these within the UVB region. Because even small changes in ozone cause large changes in UVB radiation, reliable measurements of AOD in the UVB are really only possible at very polluted places. Here we have estimated the aerosol optical depth by extrapolating back from AOD measurements at longer wavelengths. However, it is possible that organic aerosols, such as those present

ACPD

7, S1488–S1493, 2007

over cities, may absorb preferentially in the UVB region (see Perkampus, 1992), which would lead to an error in our extrapolation. This, possibly in combination with resulting reduction in single scattering albedo at these UVB wavelengths, may lead to larger aerosol effects than are presently calculated by the model.

++It is true that at the Melbourne site, the calibration is one stage further appart from NIST standard lamps than at the other sites. However, results with multiple lamps and with other spectrometer (one from NIWA and one from ARPANSA) indicate that the UV measurements are reliable. The ARPANSA comparison was shown at the UV workshop, (Gies et al., 2006) where the discrepancy between NIWA and ARPANSA was similar to the discrepancies seen between these two groups (McKenzie et al, 1993; Seckmeyer et al, 1995).

++Therefore, as we state in the conclusions of the paper, the reasons for the differences are still not resolved at this site and "Better knowledge of aerosol properties in the UVB region is needed at this site to fully resolve this discrepancy".

++Gies, P., S. Henderson, J. Javorniczky, C. Roy, and D. Anderson, Inter-comparison of solar spectral irradiance measurements in Melbourne, in UV radiation and its effects: an update 2006, pp. 80-81, Royal Society of New Zealand, 2006. See http://www.niwascience.co.nz/rc/atmos/uvconference/2006/Gies_2.pdf

++McKenzie, R.L., M. Kotkamp, G. Seckmeyer, R. Erb, C.R. Roy, H.P. Gies, and S.J. Toomey, First southern hemisphere intercomparison of measured solar UV spectra, Geophysical Research Letters, 20 (20), 2223-2226, 1993.

++Perkampus, H.-H., UV-VIS Atlas of Organic Compounds, Weinheim, New York, 1992.

++Seckmeyer, G., B. Mayer, G. Bernhard, R.L. McKenzie, P.V. Johnston, M. Kotkamp, C.R. Booth, T. Lucas, T. Mestechkina, C.R. Roy, H.P. Gies, and D. Tomlinson, Geographical differences in the UV measured by intercompared spectroradiometers, Geo-

ACPD

7, S1488–S1493, 2007

physical Research Letters, 22 (14), 1889-1892, 1995.

–p1531/4-5: this estimation of a 5% effect is only true for the data used in this study, in general ozone variations and the corresponding UV variations can be significantly higher.

++The sentence has been changed as follows: “For the data used in this paper we have found that the daily change in TOZ, if not taken into account through considering one value for the whole day, can introduce an additional uncertainty of about 5{\%} in UVI.”

–References: the 6 references of McKenzie et al. should be sorted according to the date of publication.

++Done.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 1507, 2007.