Atmospheric Chemistry and Physics Discussions

Interactive comment on "Total ozone retrieval from GOME UV spectral data using the weighting function DOAS approach" *by* M. Coldewey-Egbers et al.

Anonymous Referee #2

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Review of Coldewey-Egbers et al. "Total ozone retrieval from GOME UV spectral data using the weighting function DOAS approach", manuscript ACPD-2004-0108

General comments

This paper describes a new approach to total ozone retrieval from space nadir observations and its application to the Global Ozone Monitoring Experiment (GOME). The evaluation scheme, called weighting function DOAS (WFDOAS), was first developed by the same team for trace gases retrieval in the near-infrared region. In this paper it is extended to total ozone retrieval in the UV Huggins bands. Formally the WFDOAS approach can be seen an extension of the standard DOAS technique where the fitting of sun-normalised radiances to absorption cross-sections (according to Lambert-Beer

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law) is replaced by a fitting to ozone weighting functions derived from radiative transfer calculations in a realistic multiple-scattering and pseudo-spherical atmosphere. The strength of the method is to allow direct derivation of vertical columns accounting for the slant path wavelength modulation that is neglected in the standard DOAS approach. The drawback is that different appropriate weighting functions must be used for each retrieved pixel (depending on observation geometry, ozone column, etc). Computational efficiency can still be maintained however through use of large look-up tables of pre-calculated spectral weighting functions sorted as a function of relevant parameters.

The present paper focuses on a description of the new algorithm and a discussion of its error budget. Although validation issues are presented in a companion paper, convincing arguments are given that the new method is accurate and represents a step forward with respect to total ozone retrieval in the UV region. Overall the paper is well written. The text is generally concise and well organised. The figures are clearly drawn and properly commented. Therefore this paper will certainly be acceptable for publication in Atmospheric Chemistry and Physics Discussion after the following comments are addressed by the authors. Hopefully these comments can be addressed by some improvements to the paper, rather than only response.

Specific comments

Pg. 4919. In the description of the algorithm (section 2) the fit for a scalar temperature shift parameter (delta T) is introduced, which accounts for the temperature dependence of the ozone absorption in the Huggins bands. This parameter actually represents a shift of the entire temperature profile, which obviously may not be physically realistic. Good argument(s) should be given here by the authors to convince the reader that this does not represent an issue in terms of ozone retrieval accuracy.

Pg. 4920. I understand from the text that a pseudo-spherical approximation has been used throughout for the radiative transfer calculations. Although this approximation is certainly valid for most GOME observational conditions, it is not the case for the special

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Polar Viewing Mode of GOME where large off-nadir viewing angles are used. Please mention that this mode is excluded from your analysis.

Pg. 4921, line 2. The wavelength interval selected for processing seems to have been carefully adjusted (326.8 – 335.0 nm), however I could not find any discussion about the criterion used for this selection. Best residuals? Minimum correlation between absorbers? Minimum temperature dependency? Please comment further on this issue.

Pg. 4921, lines 15-20. The choice of appropriate ozone profile climatology is a key aspect of the ozone algorithm. Reading through the text, I understand that a combination of TOMS version 8 (for the troposphere) and of TOMS version 7 (for the stratosphere) has been used. It is stated that the TOMS version 7 climatology provides a better representation of the stratospheric variability (than TOMS version 8?). Surely this cannot be true, since the latest TOMS climatology (version 8) has been designed precisely to improve this representativeness at all altitudes and not only in the troposphere.

Pg. 4922, line 20. Fractional cloud weighting is used for the calculation of the effective height. In the independent pixel approximation, it is nowadays usual to apply a combined fractional cloud and radiance intensity (since cloud albedo is generally much higher than surface albedo in the UV). Please could you comment on the reason for using a different approach here?

Pg. 4923, line 4. It is mentioned that the radiance at 377.6 nm (which is used for albedo retrieval) can be "easily" corrected for the Ring effect. Please could you comment on how is the correction applied (even if this is a minor correction).

Pg. 4924, lines 1-3. This sentence is unclear. I suppose it means that nearest neighbour Ring spectra are taken in a table sorted as a function of albedo, altitude, latitude, etc. As stated in the text, the reader might understand that Ring spectra do not depend on these parameters.

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Pg. 4928, line 10. It is unclear whether SCIATRAN calculations are set up with some generic assumption on aerosol or if aerosols are simply excluded from the calculations. In the discussion about the impact of reflective aerosols on the retrieved effective albedo, you might also mention the fact that the FRESCO cloud algorithm is also sensitive to reflective aerosols, so cloud fraction and cloud top height also implicitly accounts for the net effect of reflecting aerosols.

Pg. 4930, lines 8-15. Why not showing Figure 8 and the accompanying discussion already in section 5 (case studies). I think this would strengthen this section by providing more quantitative results.

Minor points, typos

Pg. 4920, line 8. The sentence starting by "Altitude of the boundary...", might be rephrased as follows: "The altitude of the lower boundary of the atmosphere varies between 0 and 12 km"

Pg. 4920, line 27. In the sentence "... the GOME solar spectrum in non linearly fitted..", change "in" by "is"

Pg. 4930, line 7. Replace "show" by "shows", and "form" by "from"

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 4915, 2004.