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Atmospheric Measurement Techniques Discussions

Interactive comment on "A new method for the simulation of the Ring effect in observations of scattered sun light" *by* T. Wagner et al.

Anonymous Referee #1

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General comments

The paper fits within the scope of AMT. The paper presents the first (to my knowledge) simulation of 3D cloud effects on the Ring effect using an implementation within a Monte Carlo model. The authors give an example of cloud shadowing that might be observed in the spectrum of a satellite instrument via the Ring effect. The model compares well with two other published models of the Ring effect, providing confidence in its implementation.

An efficient method for computing the Ring effect within a limited wavelength band is also presented. The full rotational Raman scattering scattering calculation is done at a single wavelength and a resolution-independent scaling is used for the other wave-

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lengths. The coefficients from a DOAS-type fit may then be physically interpreted.

Specific Comments

The 3D cloud Ring-effect simulation is a new result and is important for understanding potential errors in UV/VIS cloud retrieval algorithms. I feel that it deserves more emphasis in the abstract and could be the focal point of the paper. This application of the Monte Carlo code appears to be disconnected from the fast computation part of the paper that comes before it. The 3D simulation is accomplished at a single wavelength and has more to do with assets of the Monte Carlo code than the detailed implementation of the Ring effect calculation for a DOAS analysis. This leads to questions about the organization and content of the paper.

The authors have chosen to emphasize the fast implementation of the Ring effect calculation. It is given as a general approach with a specific implementation that makes use of a Monte Carlo code. I find this part to be more of a technical implementation issue rather than a new concept as similar approaches have been previously implemented (see comments below). Therefore, I suggest a reorganization of the paper.

The description of the Ring effect implementation in the Monte Carlo code, comparisons with other codes, and 3D simulation could be a paper in itself. The fast calculation portion of the paper could be given as a particular implementation/application of the Monte-Carlo code (one that could be applied with other codes as well).

The title could be more descriptive. For example, instead of simply "A new method" it could highlight the 3D aspects of the model.

The first paragraph is very long and could be broken up at line 15 where the discussion of cloud effects comes in. In the last sentence, I am unsure of what the limitations are in measuring the Ring effect. I would suggest either elaborating here (separate paragraph) or removing this sentence (can also explain the details later).

In the 2nd paragraph: In reference other radiative transfer models of the Ring effect,

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the following should be included: Spurr, R.J.D., de Haan, J., van Oss, R., Vasilkov, A.P.: Discrete ordinate radiative transfer in a stratified medium with first order rotational Raman scattering, J. Quat. Spectrosc. Radiat. Transfer, 109, No. 3, pp. 404-425, 2008.

Here it is stated that Monte Carlo models are particularly well suited for the type of approach outlined. While this is certainly true, the approach can be similarly implemented with the other radiative transfer models referred to (e.g. Vountas et al or Spurr et al). Is there any particular advantage of the Monte Carlo model other than that it is well suited for 3D simulations? Do you have any idea how the Monte Carlo code compares to the others in terms of speed?

On p. 95: It should be noted that a similar form was derived by Joiner et al 1995: one term dependent on the solar spectrum and the other on the amount of scattering (independent of resolution).

p. 95, paragraph devoted to discussion on various options of solar spectra to use: It should be noted that Joiner et al. 1995 contained a similar discussion and that Liu et al. 2005 (reference below should be included) compared fits using high resolution solar spectra vs measured spectra (the latter giving a significantly better fit).

Liu, X., K. Chance, C.E. Sioris, R.J.D. Spurr, T.P. Kurosu, R.V. Martin, M.J. Newchurch, Ozone Profile and Tropospheric Ozone Retrieval from Global Ozone Monitoring Experiment (GOME): Algorithm Description and Validation, J. Geophys. Res., 110(D20), D20307, 10.1029/2005 JD006240, 2005.

An approach similar to the one outlined on p. 95-96 has already been implemented in the OMI Raman cloud pressure retrieval algorithm of Joiner and Vasilkov 2006 (though it was not described in as much detail). Their approach was based on table lookup rather than on-line RT, but it is the same basic idea - that the resolution-dependent part of the Ring effect can be decoupled from the resolution-independent part and that the resolution-dependent part can be scaled by the resolution-independent part.

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p. 102, line 19: Please include Liu et al. 2005 reference here as they also fit higher order Ring effect terms.

end of section 4: It should be noted that to properly analyze/interpret the fit coefficients, more radiative transfer calculations would have to be performed (e.g., for a 4th order polynomial at least 4 calculations).

Interactive comment on Atmos. Meas. Tech. Discuss., 2, 87, 2009.