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Atmospheric Measurement Techniques Discussions

Interactive comment on "Determination of aerosol properties from MAX-DOAS observations of the Ring effect" *by* T. Wagner et al.

Anonymous Referee #2

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Manuscript no. AMTD-2009-10 Authors: T. Wagner, T. Deutschmann, and U. Platt Title: Determination of aerosol properties from MAXDOAS observations of the Ring effect

General comments

The MAXDOAS technique represents a relatively new and promising development in the area of atmospheric passive remote-sensing applications, with great potential for unattended monitoring of the vertical distribution of important tropospheric trace gases as well as aerosol optical properties. This paper explores the potential of Ring effect observations (a side product of scattered light DOAS observations), as an additional source of information to better constrain the determination of aerosol properties in MAXDOAS retrieval types, so-far based on intensity and O2O2 absorption measurements. A newly developed approach to quantitatively simulate the effect of inelastic ro-

tational Raman scattering (Ring effect) in Monte-Carlo radiative transport calculations is used to investigate the dependence of the Raman scattering Probability (RSP) parameter for a large range of observational geometries and aerosol loads. Comparisons with a limited data set of MAXDOAS observations (2 days) show that main observed features of the RSP variations can be reproduced by the model and qualitatively understood. Although the main conclusions from the study, i.e. to what extent the Ring effect add pertinent and useful information to MAXDOAS aerosol determination, are still rather speculative and would certainly deserve more in depth analysis, the paper present enough of innovative and pertinent discussions and will certainly reach a large audience within the scientific community. Also the manuscript is clearly and concisely written. References to existing literature are comprehensive and figures of good quality. I recommend publication in AMT after careful attention to the specific comments and remarks given below.

Specific comments

Major point

One important conclusion from the study (maybe the most important one) concerns the large Ring effect dependence in the zenith viewing mode. It is argued that this should allow aerosol retrievals to be obtained from traditional zenith-sky observations, with potential application to existing historical long time-series. Although this seems to be a quite exciting conclusion, I am a little bit skeptical about the actual applicability of the method since the RSP parameter not only depends on the AOD but also on the aerosol vertical distribution as visible from fig. 6a, which can in no way be inferred from zenith-sky measurements alone. The disturbing effect of thin cirrus clouds is also very strong, but this limitation is well identified in the paper.

Minor points

Abstract (and in several places throughout the paper): the authors insist on the argument that both Ring effect and O4 slant columns should have similar dependence

due to the fact that both quantities depend on the light path length in the lower atmosphere. Although this is certainly true to some extent, only O4 directly depends on the light path length, while the Ring effect (which is directly linked to Raman scattering by air molecules) is also strongly modulated by the ratio of the intensities due to Rayleigh and Mie scattering. This explains the observed inverse relationship between RSP and intensities for near-sun measurements, when aerosol forward scattering becomes dominant (see e.g. figure 3). In brief, I think the similarity argument should not be stressed too strongly since it might give the wrong (or negative) impression that O4 and Ring effect show the same effect which is inexact.

P. 730, L. 12: please note that the Hermans et al. O4 cross-section, although measured in the lab, have been obtained in atmospheric conditions (in a very long multi-pass absorption cell).

P. 731, L. 15-20: the corrections for the O4 and RSP values in the reference spectrum are somewhat confusing. Some plots show negative RSP values (figs. 9 & 10), which suggests that these values have been sometimes subtracted from simulations instead of being added to measured quantities. It is also unclear how these values have been determined from radiative transfer simulations (under which assumptions ?)

P. 734, L. 25: here, it is maybe worth to mention the reasons for the decreased radiance at low elevation angle (due to reduced light path length) and the increased radiance for zenith (I suppose due to multiple scattering effect)

P. 738, L. 1: it is argued that a study of the wavelength dependence of the Ring effect might allow to discriminate the effect of clouds from those of aerosols. Without more discussion, this assertion seems rather speculative. What are the main arguments to support this statement ?

Editorial comments

P. 733, L. 24: typo – replace “telecsope” by “telescope”. Same line: add “s” to depth.

P. 734, L. 8: replace “potential effect” by “suspected presence”. Also refer to sect. 5.2 regarding the thin (cirrus) clouds issue.

P. 737, L. 1: replace “. . . influence of surface near aerosol. . .” by “. . . influence of near surface aerosol. . .”

The reference to Greenblatt et al. (1990) is missing

The reference to Chance et al. (1991) listed at the end of the manuscript is not cited in the body text

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Interactive comment on Atmos. Meas. Tech. Discuss., 2, 725, 2009.