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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Retrieval of stratospheric aerosol size information from OSIRIS limb scattered sunlight spectra" *by* A. E. Bourassa et al.

Anonymous Referee #2

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Reviewer Comments on - acpd-2007-0600 Retrieval of stratospheric aerosol size information from OSIRIS limb scattered sunlight spectra - by A.E. Bourassa, D.A. Degenstein, and E.J. Llewellyn ACPD, 8, 4001-4016, 2008

General Comments This manuscript extends an earlier paper discussing OSIRIS aerosol retrievals based on the ratio of limb scattering measurements at two wavelengths (470 and 750 nm) by adding a third wavelength at 1530 nm. A comparison between the predicted and measurements of the scattered radiances at this third wavelength is used to replace the assumed particle size distribution with one more consistent with the measured radiances at all three wavelengths. The resulting size distri-

bution is used to predict the aerosol extinction at 1020 nm for an OSIRIS event which is compared with coincident measurements from SAGE II and SAGE III. This is an interesting paper, however this reviewer feels that it needs significant revision before it is accepted for publication. The two primary issues immediately follow, and along a number of other detailed comments. (I) The authors should discuss how their retrieval of aerosol properties from limb scattering measurements relates to or differs from the other work in this area as discussed in Comment #2 below. (II) Given this is simply an extension of an earlier aerosol retrieval approach, the authors should present more in the way of validation of their aerosol retrievals than showing that they were able to slightly improve on their earlier intercomparison of a single OSIRIS measurement with coincident SAGE II & SAGE III measurements [Figure 17 of Bourassa et al. 2007]. Ideally the intercomparisons should be with SAGE III which would allow direct comparisons near the three wavelengths used by the OSIRIS retrievals, since SAGE III measures aerosol extinction at 449, 756, and 1538 nm. If not enough coincident events with SAGE III can be found then the authors should compare with SAGE II at 452 and 1020 nm or POAM III at 442, 780, and 1020 nm.

Detailed Comments

1) Page 4002, line 17-19: You might mention some of the other solar occultation instruments (SAM, POAM II & III, HALOE, ACE, etc.).

2) Page 4003, lines 1-5: How does the present aerosol retrieval technique described here (& your earlier paper) relate to the OSIRIS aerosol retrieval work of Auvinen et al. [J. Geophys. Res., 107(D13), 4172, doi:10.1029/2001JD000407, 2002] and Tukianen et al. [J. Geophys. Res., 113, D04308, doi:10.1029/2007JD008591, 2008]? How does your work relate to the SAGE III Limb scattering aerosol retrievals? [D. Rault, in Remote Sensing of Clouds and the Atmosphere IX, ed. Klaus P. Schäfer, Adolfo Comerón, Michel R. Carleer, Richard H. Picard, Nicolaos I. Sifakis, Proceedings of SPIE Vol. 5571, 205-216, 2004] and [D. Rault, in Remote Sensing of Clouds and the Atmosphere XII, edited by Adolfo Comerón, Richard H. Picard, Klaus Schäfer, James

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R. Slusser, Aldo Amodeo, Proc. of SPIE Vol. 6745, 674509, 2007]?

3) Page 4003, line 14-16: As noted by King et al. [J Atmos. Sci., 35(11), 2153-2167, 1978], the idea of relating aerosol particle size to the wavelength dependence of the aerosol extinction goes back at least to Ångström's 1929 work [Geogr. Ann., 11, 156-166, 1929]. Both King et al. and Ångström's 1964 paper cite as number of these earlier references.

4) Page 4005, lines 18-26: It should be recognized that the classic Ångström exponent relation applies to the total extinction as a function of wavelength. Here the scattering radiance is proportional to the product of the total scattering cross-section and the angular scattering phase function. While you can assume the total scattering cross-section is equivalent to the extinction cross-section without significant loss of accuracy for the wavelengths of interest here, the phase function will vary with scattering angle and aerosol particle size relative to the wavelength. For scattering at a given angle the exponent will in general vary with the scattering angle and with the characteristic particle size. While the total scattering will tend to increase with increasing particular size, the fraction of the scattering into a given direction will decrease at some scattering angles. While the fraction of forward scattering will tend increase with particle size, that means fraction of scattering into other directions will tend to decrease. For some scattering angle that decrease can be greater the relative increase in the total scattering (at least for some range of particles sizes). This means at least for some scattering angles, the systematically high predicted radiances do not necessarily mean that the size distribution included too many large particles.

5) Page 4008, line 23, & Fig 3: Is error bar the 1 standard deviation value, the 95% confidence limits, or what?

6) Page 4010, line 1: SAGE III has aerosol channels centered at 756 and 1538 nm, which are close enough to your measurements at 750 and 1530 nm to do direct comparisons. To the extent that you can use an Ångström power law with your scattering

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measurements (see comment #4), a comparison at 1530 nm would be a more sensitive test than at 1020 nm, because of the greater wavelength interval.

7) Page 4013-4016, Figures 1-4: In all four figures the 2 panels should be labeled 'a' and 'b', which are then used in the Figure captions.

8) Page 4014, Figure 2: Specify the wavelengths rather than saying 'visible and near IR', which is at best ambiguous (and wrong as you are using it). Strictly speaking, the visible spectrum is 400 to 700 nm, so 750 nm is near IR, not visible.

9) Page 4015, Figure 3: Fig. 3a should have a color scale.

10) Page 4016, Fig. 4b: Given you are demonstrating whether or not your OSIRIS retrieval is valid, a comparison between SAGE II and SAGE III is irrelevant. You should show the difference between OSIRIS and each of the other two instruments.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 4001, 2008.

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Interactive Comment