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Atmospheric Measurement Techniques Discussions

Interactive comment on "Retrieval of stratospheric aerosol density profiles from SCIAMACHY limb radiance measurements in the O_2 A-band" *by* B. Ovigneur et al.

Anonymous Referee #2

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A. General remarks (1) The paper presents an approach to retrieve stratospheric aerosol vertical distribution from SCIAMACHY limb radiance measurements, using the O2 A absorption band spectral range. The large variation of atmospheric absorption across the narrow A band region allows one to "slice" the atmosphere in the vertical direction, and effectively separate the atmospheric and surface contribution to the total limb radiance.

(2) The authors should be commended for their effort since dealing with the A band is always extremely difficult, requiring line-by-line modelling of absorption/emission and a good knowledge of the instrument characteristics (spectral slit function, cross talk

straylight).

(3) The paper is clear and well written. It is written as step approach to the problem, starting from the data and learning from the data, progressively building the case. It is a good illustration of present results.

B. Critique of the method

(1) In limb scatter measurements, it is relatively easy to retrieve an effective surface albedo independently by considering the limb radiance magnitude above the aerosol layers (Height>35km) and below the height range affected by straylight (typically height<45km) in spectral range outside of the main gaesous absorption regions and where Rayleigh is not too large (mostly above 500nm)

(2) Confining the aerosol retrieval to the very narrow A band does not allow for retrieving any information on aerosol size, which is a major drawback specially for limb scatter sensors since the scattering properties (scatter coefficients, phase function) strongly depend on particle size distribution.

(3) Additionally, emission in the A band along the line of sight could affect retrievals and must be accounted for in the forward model

(4) The results presented in the paper show comparison with SAGE II aerosol products on the order of 30-50% RMS after adjustment for size distribution. Better results can be obtained for aerosols from limb scatter measurements by independantly retrieving extinctions over a larger range of wavelengths (from 500 nm to 1000nm). This method allows one to infer the value of an effective Angstrom coefficient, which can then be used iteratively to improve the retrieval of aerosol vertical distribution. This method has been tested over large datasets and is being implemented in the OMPS/LP program. Application of this method to the SCIAMACHY dataset have been described by Taha et al.

(5) There is no error analysis. We must expect some error analysis in this journal ar-

AMTD

4, C494–C497, 2011

Interactive Comment

ticle. Need comments on the covariance matrix, estimates of the standard deviation evaluated as square root of covariance matrix There is hint at error magnitude when talking about the 'unexplainable' spread of 0.1 particlescm-3 its monthly running value of 0.3 particlescm-3, that is accounted to "the effect of measurement biases and forward model errors on the retrieval". That is a $\pm$30 percent error RMS.

C. Specific remarks

(1) In Fig. 6. (Second panel): Lambertian surface albedo retrieved at 500 nm. How is this retrieval done? The paper does not discuss the retrieval at 500nm? I guess assuming no wavelength dependence on albedo? Though the text mentionned "surface albedo is determined for each individual wavelength to account for the spectral variability of surface reflection". Need comments on what is assumed here?

(2) The spread of the data around its monthly running value in the order of 0.1 particlescm-3. The author states that this is significantly above the retrieval noise level <1% at the altitude range 14–30 km. What does that mean? THere is no mention of sensitivity of limb radiance to aerosol: A 100% fluctuation in aerosol could lead to a 1% in radiance magnitude at some wavelengths.

(3) The authors state: "For the time series in Fig. 6 the SCIAMACHY tangent height varies only by $\pm$100m". You mean that you estimate the errors on tangent height to be less than $\pm$100 meters over the time span of the slected dataset?. If that is so, I would say that this is extremely tight for a limb sensor. I would not think that SCIAMACHY would be that accurate/consistent on pointing. You may need to double or triple that estimate. Which still allows you to make the point that "the corresponding fluctuation in the aerosol density is ... well below the observed data spread and thus we can rule out variations of the tangent height to explain this feature".

(4) The authors state: "At this wavelength (500nm) the limb radiance has significant sensitivity to stratospheric aerosol". True and not true. At small Single Scatter angle, the limb radiance is somewhat sensitive to aerosol at 500nm, with sensitivity increasing

AMTD

4, C494–C497, 2011

Interactive Comment

at longer wavelengths. At larger Single Scatter angles, the limb radiance is not much sensitive to aerosol

(5) Fig 9. One of these two plots is not necessary since, as correctly stated by the author in the text, single scattering angle and latitude are related for this sun-synchronous space platform. Keep the fig vs single scatter angle, which in fact shows that for Limb Scatter sensor, the sensitivity of limb radiance to aerosol decreases as single scatter angle increases is a rather profund fashion. It does seem from that figure that the A-band method of aerosol retrieval is limited to single scatter angle larger than 60 degrees

(3) The authors vary the mean radius to match with SAGE II products. How about also varying the width of the log normal distribution?

(4) The authors state that "limb radiance measurements at shorter wavelength may provide useful information on the size of stratospheric aerosol". What we need is a wide range of wavelengths, therefore not only shorter wavelenghts, but also longer ones. Retrieving aerosol is in fact easier at longer wavelengths as sensitivity of limb radiance to aerosol increases with wavelengths

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Interactive comment on Atmos. Meas. Tech. Discuss., 4, 1795, 2011.