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Atmospheric Measurement Techniques Discussions

Interactive comment on "Global stratospheric aerosol extinction profile retrievals from SCIAMACHY limb-scatter observations" *by* F. Ernst et al.

Anonymous Referee #1

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Paper = Global stratospheric aerosol extinction profile retrievals from SCIAMACHY limb-scatter observations Authors: F. Ernst, C. von Savigny, A. Rozanov, V. Rozanov, K.-U. Eichmann, L. A. Brinkhoff, H. Bovensmann, and J. P. Burrows

Good paper showing the capability of Limb Scatter (LS) sensors to retrieve valuable information on stratospheric aerosols.

A few remarks: A. Fundamental issues

(1) The retrieval algorithm is based on OSIRIS work, and tuned up for OSIRIS available wavelengths. Because of hardware design, OSIRIS has only one available wavelength

for aerosol, namely 750 nm (outside of Chappuis and as long wavelength as possible). SCIAMACHY does not have that limitation and can use a range of wavelengths, which is a very important point since the independent retrieval of aerosol extinction at several wavelengths can yield information on particle size, which in turn can be used to model the aerosol phase function. In LS, all happens in scaterring and one needs as much information on the phase function as possible: LS needs size information to help in setting up the phase function. (2) On the choice of using the 470 nm channel to effectively increase the contrast aerosol vs Rayleigh. OSIRIS is using that channel because at their Single Scattering Angles (SSA=around 90 deg, +- 30), the aerosol scattering is practically invisible at this wavelength. For SCIAMACHY with a Sun-synchronous orbit, SSA varies from backscatter (SSA=155) to forward scatter(SSA=38). While at SSA=155 stratospheric aerosol is practically invisible at wavelengths below 700nm, at SSA=38, one may no longer assume that the 470 nm channel is completely Rayleigh. (3) The use of the Henyey-Greenstein (HG) approximation for the aerosol phase function is odd. Stratospheric aerosols are known to be mostly spherical particles, sulfates (of known index of refraction) and Mie Scatter theory should be used directly to evaluate the phase function. The problem is complex as it is and we need to use as simple methods as possible. The authors do not provide justification for using HG with "4 water soluble and 8 insoluble aerosol components". Since (a) the authors are very keen on sensitivity studies and (b) the RT model rests on the value/shape of the phase function, how come the authors did not do a sensitivity study on their choice of model for phase function? (4) In their sensitivity studies, the authors found "that the parameter with the largest impact is surface albedo". Yet they rely on climatogical values for albedo instead of using the Effective surface albedo which can be retrieved directly by comparing the absolute value of the measured radiances with the modelled ones. (5) the sensitivity of aerosol product to ozone amount is not necessary since the wavelengths used (470 and 750 nm) are outside the Chappuis band (6) the sensitivity of aerosol product to atmospheric density depends on the SSA and may be much larger than the quoted 6%. At large SSA (Southern latitudes), the aerosol phase function is small and aerosol

contribution is ssmall compared to Rayleigh: the errors due to atmospheric density on retrieved aerosol would therefore be larger. Conversely at Northern polar latitudes. (7) 35 km may be low for normalization since there may still be non negligeable aerosol at that altitude (8) Impact of a priori profile: It may be worthwhile to show the Averaging Kernel matrix. It must be close to unity matrix since the a priori profiles have litlle effect on retrieved values. (9) The aerosol retrieval is going to be more difficult at high SSA (Southern latitudes for SCIA) than at low SSA (Northern latitudes), and that is because of the phase function and therefore the relative contribution of aerosol wrt Rayleigh. Your sensitivity wrt albedo only shows that. The apparent reversal in Southern polar region is due to high zenith angles which reduce effect on albedo

B. Test editing issues (1) The introduction is rather long. Suggest breaking off some paragraphs into a section named "Background" (2) May be worthwhile to stress advantage of LS data set wrt to Solar Occultation (SO): large geographical coverage, which can/will allow to be used in global atmospheric model assimilation. SO datsets are very accurate but limited in scope and can be used to "spot validate" LS. (3) NPP has changed its name: It is no longer: "NPOESS preparatory mission, where NPOESS stands for National Polarorbiting Operational Environmental Satellite". It is now, much simpler: Suomi National Polar-orbiting Partnership (NPP) (4) The one-page rationale on radiance normalization may not be needed and a reference to von Savigny's paper may be sufficient h

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