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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Synergetic aerosol retrieval from SCIAMACHY and AATSR onboard ENVISAT" *by* T. Holzer-Popp et al.

Anonymous Referee #1

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General comments

The authors describe an aerosol retrieval method in which they use two instruments, AATSR and SCIAMACHY, both on ENVISAT. The radiometer AATSR is used to determine the AOD at 555nm which subsequently is used with the spectrometer SCIAMACHY to determine the Ångström coefficient and thus aerosol type. AATSR is only applied over dark surfaces. The method is an application of an earlier version of the algorithm that was used for ATSR-2/GOME, both on ERS-2.

What extra information is obtained by using both instruments: AATSR is only used over dark surfaces where the AOD can be relatively well determined, due to its small pixel cloud contamination can be well established and since over land three wavelengths

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can be used, also the Ångström coefficient and thus aerosol type could be determined. I do not see what the extra information is provided by the use of SCIAMACHY, since the multiple wavelengths are just used to determine the wavelength dependence that could also be obtained from AATSR. Is it in the accuracy because there are more wavelengths and thus a more accurate fit? However, due to the large pixel size the risk of cloud contamination is increased, and thus the Ångström coefficient could be affected because cloud reflectance tends to have another spectral dependence than aerosol reflectance.

The authors make an effort to show the information content provided by SCIAMACHY, and conclude that SYNAER can determine more than 2 independent aerosol properties in addition to AOD and surface brightness (section 2.2, last par.). To my understanding from reading the paper, surface brightness is that for a dark surface and AOD is in that case provided by AATSR. Figure 1 shows that there are at most 2 independent DoF for the SCIAMACHY, since AOD and (dark) surface albedo are already known (p. 2915, lines 25-end).

What would be the DoF if only AATSR would be used, given the same inputs?

Section 3.3 deals with brighter surfaces. However, the necessity of using the dark field method is emphasized all over the paper, even in the discussion where only dark fields are mentioned. Why are brighter surfaces not treated from the beginning? This would make the method more generally applicable.

Detailed comments

p. 2910, line 17: why in lower troposphere and not column integrated? How about disconnected layers with different aerosol content? Please provide references for AOD in free troposphere and stratosphere

p. 2911, line 11: how is established that the ‘correct’ AOD is delivered? Line 20: what is ‘very weak sampling’? p. 2912, line 4: is

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it 52 or 55 degrees as is often mentioned in the literature p. 2913, line 9: remove ‘been’ line 10: which RT code? line 22: retrieval is an ill-posed problem with lack of information, so why do the authors state here that there is too much information? p. 2916, line 2: depends line 10 obviously line 13: field p. 2924, line 18: intervals p. 2925, line 16: mis-distance/miss-time: suggest to use ‘temporal and spatial differences’? p. 2926, line 6 and following paragrahs: what is meant with ‘mis-interpretations …comparisons: isn’t the aerosol variability the reason why commonly only data are considered which were collected within a narrow time and spatial window? This may still go wrong in cases of strong local gradients, but this will not improve by the analysis described in section 4.1. I seem to miss the point of the variogram analysis: what is the interpretation of Figure 8? Would one really expect any correlation between highly variable parameters such as aerosols measured 1000 or more km apart? What does it mean when , e.g., RSME=01 and then doubles? RSME for stations 2000 km apart in different continents are very different, why? Please explain the significance of this analysis and how we can interpret it. In general, I would expect that particles in the accumulation mode, which determine AOD at 550 nm, have an infinite lifetime (cf. Hoppel et al., 2002, 2005, full refs below) and hence their concentrations are mainly affected by washout or by emissions. However, because of the very large SYNAER pixes size, the analysis of the correlations over 50 km is relevant (this underlines my general question why SCIAMACHY is needed in addition to AATSR). p. 2928, line 1: Figs 11 and 12: somewhere figure count went wrong since here we see Figure 10 and 11. However, these figures are too small to see the features discussed (lines 15 and further, Figure 10 caption, colour scale is virtually invisible on both Figures line 2: this article is on improvement and upgrade from version 1.0 to version 2.0. Since version 2.0 processing was started, why don’t the authors present results from v2.0 and /or show what the improvement is by comparison of v1.0 withv2.0? I’d expect significant improvement, why else is a new version needed? p. 2929, line 12: what is meant with ‘These features are precluded … ‘ Isn’t AOD the integral over the whole column? line 22-23: in-

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dications on composition were also published in Robles-Gonzalez (JGR, 2006, 2007). line 25: Ångström coefficients seem to be the only criterium to select composition. Hence a comparison could be made with AERONET. I did not see such comparison in this paper. p. 2930, lines 7-16: why were sites used for comparison which are clearly not suitable due to strong local variations? p. 2931, line 25: the limitation to spherical particles is not necessary since good approximations are available for the phase function of dust particles and have been used to improve the retrieval (POLDER).

Hoppel, W. A., G. M. Frick, and J. W. Fitzgerald, 2002. Surface source function for sea-salt aerosol and aerosol dry deposition to the ocean surface, J. Geophys. Res., 107(D19), 4382, doi:10.1029/2001JD002014. Hoppel, W. A., P. F. Caffrey, and G. M. Frick, 2005: Particle deposition on water: Surface source versus upwind source. J. Geophys. Res., 10, D10206, doi:10.1029/2004JD005148.

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