Atmos. Meas. Tech. Discuss., 3, C2411–C2414, 2011
www.atmos-meas-tech-discuss.net/3/C2411/2011/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Statistically optimized inversion algorithm for enhanced retrieval of aerosol properties from spectral multi-angle polarimetric satellite observations" *by* O. Dubovik et al.

M. King (Referee)

michael.king@lasp.colorado.edu

Received and published: 7 January 2011

General Comments: The paper "Statistically optimized inversion algorithm for enhanced retrieval of aerosol properties from spectral multi-angle polarimetric satellite observations" by Dubovik et al. is a truly revolutionary enhancement of a multi-source inversion retrieval method applied to satellite measurements of reflected sunlight and degree of linear polarization. It develops the mathematics, and describes it in a most elegant and sophisticated manner, how one can simultaneously invert multi-angle po-

larization and radiance measurements from POLDER on the PARASOL spacecraft to derive, simultaneously, multiple aerosol optical and microphysical properties (aerosol size distribution, real and imaginary refractive index) as well as parameters of a non-isotropic underlying surface. Constraints are introduced to smooth out the aerosol size distribution (volume distribution as a function of radius) and aerosol refractive index (as a function of wavelength), and also to retrieve components of the RPV BRF model of surface reflectance (with spectral constraints on the parameters). Additional properties of the atmosphere, such as a measure of aerosol nonsphericity as well as vertical distribution of the aerosols are introduced, as well as a hot spot parameter in cases in which the angles of observation permit such observations. An extremely novel and powerful method is introduced, in which multiple days are used and constraints are added for spatial variability in aerosol size distribution and temporal variation in surface reflectance is added, further smoothing out random fluctuations that are inherent in simple pixel and single day retrievals.

This is without doubt one of the most powerful and novel papers I have read in quite some time, and highly worthy of publication without delay. It represents many years of development, and builds substantially on earlier work on development of aerosol retrievals of size distribution, nonsphericity, and refractive index from ground-based sunphotometer measurements from AERONET. In addition, a later development using AERONET together with a sky scanning and surface scanning airborne radiometer, first demonstrated the ability to simultaneously retrieve aerosol and surface BRF characteristics. This paper expands this domain to satellites looking down at the Earth's surface.

Since most aerosol retrievals from space rely on table lookups with the primary derived parameter being aerosol optical thickness, it would be most useful somewhere in the paper to make clear that aerosol optical thickness, per se, is not one of the retrieved variables. Rather the aerosol size distribution (normalized) and aerosol concentration are, from which aerosol optical thickness can be calculated using the retrieved aerosol

optical properties. This is subtle, but is one of the primary comparisons used in comparison with AERONET over Mongu and Banizoumbou in Section 6.

Specific comments:

A large number of English and editorial corrections are warranted, but these have been conveyed to the author separately. I focus here on the most important:

1. Page 4978, line 21 - the view zenith angle should be defined as μ1 = cos(theta1). This is a minor typesetting mistake.

2. Page 4979, lines 13-15 - many of teh subscript for omega0 should be 'i' rather than the apparent 'j'.

3. Page 4982, Eq. (7) - the first partial derivative should be with respect to epsilon. Similarly in the text in line 22 (the partial derivative of N(epsilon) should be with respect to epsilon).

4. Page 4983, Eq. (8) - the derivatives of N(epsilon) should be with respect to epsilon. This occurs twice. In addition, the first summation should be i=1,...,Nr.

5. Page 4984, lines 25 and 26 - 'flattened spheroids' could be clarified as 'flattened oblate spheroids' and 'elongated spheroids' could be clarified as 'elongated prolate spheroids'.

6. Page 4990, lines 12, 15, 21 - Breon should be spelled 'Bréon'.

7. Page 4990, line 18 - 'BPDF' should be (I believe) 'BPRF'.

8. Page 4995, line 4 - M represents ' the number of terms used in expansion of the phase matrix into Legendre polynomials'. It has nothing to do with 'Fourier' expansion.

9. Page 4995, line 17 - change 'derivates' to 'derivatives'.

10. Page 5005, lines 10 and 14 - reference is made to Eq. (23) and (23a) which appear later in the manuscript. I think the equations being referred to are different.

Please check.

11. Page 5006, Eq. (22) and line 5 - refers to ah. This scalar needs to be included in Table 2 as a derived property.

12. Page 5009, line 5 - change 'constrains' to 'constraints'.

13. Page 5011, line 2 - change 'constrains' to 'constraints'.

14. Page 5013, lines 14 and 15 - the sentence 'The definition of this matrix can be designed as follows' can and should be eliminated.

15. Page 5017, lines 17-23 - these several sentences are written poorly, with incomplete sentences. They should be reworked to clarify the points being made.

16. Page 5020, line 28 - change 'expensively' to 'extensively'.

17. Page 5023, line 14 - change 'course' to 'coarse'.

18. Page 5025, line 9 - change 'albdeo' to 'albedo'.

19. Page 5026, lines 14 and 15 - change 'POLDAER' to 'POLDER'.

20. Page 5030, line 2 - change 'AEROENT' to 'AERONET'.

21. Page 5040, line 2 - change 'Eqs. (C7-C9)' to 'Eqs. (C8-C10)'.

22. Page 5046, line 22 - remove '2' and '3' from the title of this paper.

Table 1 - change 'MESUREMENT' to 'MEASUREMENT'.

Table 2 - add a(subh) to the list of AEROSOL parameters.

Fig. 3 - the error in the right hand panel has already been noted by the authors and corrected.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 4967, 2010.