Atmos. Chem. Phys. Discuss., 6, S4811–S4814, 2006
www.atmos-chem-phys-discuss.net/6/S4811/2006/


Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Classification of aerosol properties derived from AERONET direct sun data" *by* G. P. Gobbi et al.

**G. P. Gobbi et al.**

Received and published: 24 November 2006

Anonymous Referee #2 Received and published: 1 November 2006 General comments: The paper describes a simple classification scheme for the interpretation of sun photometer observations of aerosol properties. The method is in particular well suited for the application to AERONET data. The paper is well written and the method is in general well explained. However, I am not totally convinced that the method really provides a comprehensive tool, which covers the full diversity of existing aerosol properties. In addition, I have some doubts, if the proposed scheme really follows the best possible strategy. Nevertheless, I think the paper can indeed contribute to the simplification and - probably more important - homogenisation of the large number of global sun photometer measurements. I therefore recommend the publication after the clarification of a few aspects (see below).

Detailed comments:

Referee#2: The proposed classification scheme is one of several possible schemes, into which the original information (optical depth at different wavelengths) can be transformed. The authors should more convincingly motivate this specific choice. In particular, it is not clear to me if this scheme makes really optimum use of the available information from the measurement.

Authors reply: In the manuscript we state we are exploiting another piece of sunphotometer information, i.e., the spectral curvature of extinction. To determine curvature we do not need more than 3 channels and the ones we employ are the best channels of Aeronet. Larger errors associated to other channels (as the UV or IR ones) would definitely deteriorate the quality of the results (as indicated by the paper error analysis). The manuscript also describes several different schemes that have been proposed to address the retrieval of aerosol properties from the spectral curvature of extinction. Comparison of these methods should indicate to the readers which one provides the optimal product they need. With respect to our scheme, the "quasi orthogonality" of the growth patterns of fine and coarse mode AOD found strongly supports the choice of this approach. To meet the reviewer's point we shall stress in the manuscript that this is "a" tool, not "the" tool to exploit this piece of information.

Referee#2: On page 4, second paragraph it is mentioned that the model calculations are performed based on the Mie-theory. How representative are these calculations for non-spherical particles? Especially mineral dust and soot, for which the method is applied, are typically non-spherical.

Authors reply: To answer this point we will add the following sentences into page 4: "With respect to spherical ones, non-spherical particles are expected to introduce an AOT change smaller than 15% (e.g., Mishchenko et al., 1997, JGR, 16,831-16,847). In fact, supermicron non-spherical particles tend to generate similar extinction as spherical ones, with AOT differences between the three wavelengths (namely, 440, 670 and



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870nm) of less than 5%, rapidly decreasing to 0% for increasing sizes.(e.g., Figs. 4, 5 and 6 in Mishchenko et al., 1997). Conversely, fine mode particles are characterized by similar losses in extinction (with respect to spherical ones) at all the three wavelengths. (e.g., Figs. 4, 5 and 6 in Mishchenko et al., 1997). This behavior is expected to have a minor impact on the Angstrom coefficients. Overall, we expect this approach not to be significantly affected by the aerosol shape."

Referee#2: How representative are the chosen bimodal size distributions? In reality, the aerosol compositions, especially close to the sources, might be much more complex.

Authors reply: Indeed aerosols are characterized by a variety of size distributions and no multi-wavelength AOD scheme can retrieve a full aerosol size distribution on its own. To address the reviewer's point we shall stress the fact that "the range of size distribution parameters employed are based on AERONET retrievals made at sites both in aerosol source regions and downwind of sources, and therefore encompass the expected range in particle size distribution dynamics". Also the variability of refractive indices is derived from AERONET statistics. In this respect, we devised Fig. 2 to show the effect of refractive index variability on our scheme.

Referee#2: In section 3 it is stated that only one "reference grid" is used for the interpretation of the measurements. Is this really justified?

Authors reply: The discussion of Figure 2 shows that the largest differences amongst grids arise in the evaluation of Rf in the presence of varying refractive indices. Minor differences are observed in fractional extinction by the fine mode (eta). Since in Section 3 we wanted to address the relative changes at each location (fine mode growth or coarse particle contamination) we believe use of one single grid is functional to providing a common ground to all the stations addressed.

Referee#2: Correction: Page 4, last paragraph: "AdA-coordinates" should be replaced by a better description.

Authors reply: We define AdA as a "space" at the beginning of section 2. We shall change this definition into "coordinates" so to use this single terminology in the whole paper.

Authors comment: Following suggestions from colleagues, we would like to introduce in the manuscript a table containing the coordinates of the grid points employed in Figs. 1 and 3.

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Interactive comment on Atmos. Chem. Phys. Discuss., 6, 8713, 2006.