Atmos. Chem. Phys. Discuss., 3, S200–S203, 2003
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Lidar and in situ observations of continental and Saharan aerosol: closure analysis of particles optical and physical properties" *by* G. P. Gobbi et al.

Anonymous Referee #2

Received and published: 24 March 2003

This paper aims at retrieving aerosol properties through the comparison of in situ and remote sensing measurements by lidar made during the MINATROC campaign in June 2000. This is a difficult task and the procedures used are convincing. The paper is well written although including long discussions and the analysis of results is clearly shown to lead to a significant convergence on aerosol properties.

I would have a few comments and questions, detailed herebelow, I would like to see taken into account in the final version.

The inversion of lidar data is required to retrieve the backscatter and extinction coefficients. The procedure is described in section 2.1, but it is not clear how this is done and what are the errors due to this procedure on the derived coefficients. Details should be

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given.

Step 1 is normalisation to a model atmosphere : which atmospheric model is used ? What is the normalisation altitude level ? What are the expected difference with the true atmospheric density at this level and what is the expected error propagating to the backscattering and extinction coefficients ? My understanding is that output of step one is the attenuated backscatter coefficient.

Step 2 : precise how is backscatter coefficient obtained : the first profile is the attenuated backscatter, the others are step 4 results ?

Step 3 : precise here which "model" or relationship is used to derive the extinction coefficient (so it is better referring to what is discussed just after).

Step 4 : what is the output of step 4 : I assume the new backscatter coefficient used as new step 1 ?

Step 5 : precise convergence on which parameter and to which degree of agreement.

The relationships between backscatter and extinction are referenced differently for Saharan dust in the paragraphs following the procedure description : Barnaba and Gobbi, 2001 or Gobbi, 2002. Please clarify.

In section 3 : it is stated that the maximum height reached by aerosols is better evidenced on the depolarised signal (as compared to the signal backscattered at the same polarisation). This is not true if the shape of aerosol particles is spherical.

Section 4.1 : precise that measurements with the impactor are made at the same location as other in situ measurements

Correction of the hygroscopicity is important. Are Dwet and Ddry diameters in each class of particles ? give indicative values of a and b used (or better a table). Where are the relative humidity values taken from ? How is this correction applied as a function of altitude ?

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In section 4.2 the determination of the refractive index is discussed with respect to a minimisation of the difference between observations and calculations for the whole series of measurements. A cost function is thus defined, but I do not understand why in the summation absolute values are chosen instead of usual variances ? I would recommend using the squared relative difference since this is a statistical approach.

The value derived for the refractive index does not seem statistically significant. Discuss the significance of the minimum obtained with respect to errors.

Are the final index value obtained and the size distribution measured consistent with the relationship used in the inversion of the lidar data ?

Section 4.3 : this section contains a lot of information, and more figures may be useful to better present results.

Discussion on sensitivity to relative humidity and depolarisation is difficult to follow and Figures 3 a and b are not clearly evidencing relationships. CouldnŠt it be summarised differently in a 2D graph allowing to identify the different types of aerosols (illustrating summary of last paragraph).

Are a and b coefficients rapidly varying as a function of time ?

Same remark as previously for the cost function.

A figure illustrating the variation of the backscatter coefficient difference as a function of index would be worth including, to more precisely show how it evolves for a selected period of days, assuming the same aerosol type is present and better define the uncertainty on the retrieved indices.

Triangles cannot be seen in Figure 3b.

Section 4.4 is not properly entitled. Results presented on the extinction surface and volume should be in a dedicated section. Errors should be discussed in the analysis of the cost function to clarify significance of results.

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