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Atmospheric Measurement Techniques Discussions



# *Interactive comment on* "The GRAPE aerosol retrieval algorithm" *by* G. E. Thomas et al.

**Anonymous Referee #1**

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Note that I have reviewed this manuscript already for another journal. Unfortunately, the authors have not changed the manuscript based on the comments that I provided.

Overall recommendation

The manuscript presents an algorithm and its theoretical sensitivities. Several papers have been published on this subject over the last decade and I did not find new insights in this manuscript. However, if a large dataset is going to be produced with the algorithm as described in this manuscript, the information could be valuable for the user community. In that case major revision of the manuscript is needed, as indicated in the general and specific point below.

General

This manuscript describes the GRAPE aerosol retrieval algorithm and provides a the-



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oretical sensitivity analysis. The algorithm is based on optimal estimation and focuses on the retrieval of the aerosol optical depth, the effective radius and the surface albedo. Critical a priori information includes the aerosol composition and size distribution, the surface albedo and the spectral behavior of the surface albedo. The sensitivity analysis shows that the expected precision of the retrieved optical depth is of the order 0.1, and for the effective radius approximately 50%.

This manuscript is one of many papers that have been written on aerosol retrieval algorithms and their theoretical sensitivities. Although many papers have been published, the authors fail to include their results with these publications. At least comparisons to the standard algorithms of MODIS, MISR, MERIS should be made, as well as other studies related to ATSR-2 and AATSR. This is one of the main shortcomings of the manuscript.

From an algorithm point of view I was disappointed to see that only the nadir view of the ATSR-2 and AATSR instruments were used in the GRAPE algorithm. The two-views is the most important part of the instrument concept and very interesting for aerosol retrieval. The reasons for leaving out the forward view should be discussed in the manuscript.

Although sensitivity analyses are essential for algorithm development, I prefer papers that combine such analysis with real data, for example by presenting validation results. The current manuscript gives the impression of a purely theoretical exercise, with little connection to the real world. Given the fact that there is lots of ATSR-2 data available, including or discussion of validation data will give more meaning to the theoretical results.

The results of a precision of 0.1 for the aerosol depth are rather disappointing. The reason for such low precision should be addressed in the manuscript. Is this the result of the instrument signal-to-noise ratio or due to large a prior errors, or something else? Validation data of MODIS show considerable better results than a precision of 0.1.



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Would applying the MODIS algorithm to ATSR-2 data give much better results than the GRAPE algorithm?

The manuscript is not clear on the objective of the GRAPE algorithm. Is this algorithm mainly applied to ocean data, as suggested by the choice of wavelengths described on page 6, or also over land?

Specific points

A specific section on the state vector, it's a-prior values and the variance co-variance matrix should be added. Currently the elements of the vector is not described specifically. From the context, my guess is that it contains the optical depth (what wavelength??), the effective radius and the surface albedo (at what wavelength??).

The a-prior over land of the MODIS white sky albedo seems unrealistic to me. The surface contribution to the TOA will be dominated by direct reflection, hence the BRDF function for this sun-satellite geometry should be used. The 0.01 1-sigma error for the albedo is over-optimistic. Given the importance of this error for the retrieval, the choice for this value should be discussed and included in the sensitivity analysis.

The description on the off diagonal elements of the covariance matrix (top of page 12) confused me. I assumed that the state vector contained the albedo at one wavelength and used a fixed spectral shape, however the text on page 12 suggests something else. Pleas explain.

A table should be included with the range of effective radii and Angstrom parameters for the different classes.

Include a description or table of the number of nodes in the look-up tables.

On page 10 it is stated that ocean surface reflection can be modeled as Lambertian surface without accounting for the BRDF effects. I would doubt this statement, as developers of other aerosol retrieval algorithms specifically accounted for these effects over the ocean. Analysis s needed to support this statement.



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In section 3.3 several sensitivity analyses are performed, however the results are in several places described in a qualitative rather than a quantitative manner. For example in 3.3.1: "..differences are much greater ...", : in 3.3.3 "The two sets show strong similarities, but are not identical, indicating that the retrieval is somewhat sensitive ...". All these statements should be made quantitative and the results should be put in one table to be able to compare the results.

If there is a data set available produced with the algorithm described, indicate where it can be obtained.

Presentation

The manuscript contains a lot of figures that look almost the same, for example Figure 13 and 14. I would suggest showing to cut back on the number of plots by only describing the results (e.g Figure 11) and/or showing a few (difference) plots. In the current manuscript the reader has look very carefully at the plots to show certain effects. Such effect should be more high-lighted.

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Interactive comment on Atmos. Meas. Tech. Discuss., 2, 981, 2009.