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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Estimating marine aerosol particle volume and number from Maritime Aerosol Network data" *by* A. M. Sayer et al.

Anonymous Referee #3

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This paper reports two sets of results, both being very instructive. Firstly, they use multi-spectral extinction measurements and a pre-determined maritime aerosol model to retrieve such important aerosol characteristics as column-integrated number concentration and average particle volume. Secondly, they compare their results with the corresponding MODIS products to provide the first accuracy assessment of the latter.

The paper is very well written as well as logically organized and should be published. However, there are some issues that the authors should at least discuss.

1. As the main criterion of adequacy of their maritime model, the authors quote its ability to accurately reproduce the AERONET optical thicknesses. However, unlike extinction, the number concentration retrieval is extremely sensitive to the assumed or retrieved size distribution. This problem is well articulated in

H. González Jorge and J. A. Ogren (1996). Sensitivity of retrieved aerosol properties to assumptions in the inversion of spectral optical depths. J. Amos. Sci. 53, 3669–3683.

M. I. Mishchenko, L. D. Travis, W. B. Rossow, B. Cairns, B. E. Carlson, and Q. Han (1997a). Retrieving CCN column density from single-channel measurements of reflected sunlight over the ocean: a sensitivity study. Geophys. Res. Lett. 24, 2655–2658.

Neither paper is mentioned in this manuscript and in the preceding paper Sayer et al. (2012). It would, therefore, be very interesting to see if the quoted estimates of number concentration uncertainty derived from extinction measurements are consistent with previous findings, especially those in Jorge and Ogren (1996).

2. The authors use throughout the Mie theory, thereby assuming spherical particles. This approach appears to be justified given the standard presumption of a relatively weak dependence of the extinction cross section on particle shape. Yet Fig. 4 of

Mishchenko, M. I., L. D. Travis, R. A. Kahn, and R. A. West (1997b). Modeling phase functions for dustlike tropospheric aerosols using a shape mixture of randomly oriented polydisperse spheroids. J. Geophys. Res. 102, 16831–16847

shows a residual shape dependence of the order of 5-10% varying with particle size and size-distribution width. The authors should at least discuss whether this dependence can affect number concentration retrievals. Indeed, the results of Jorge and Ogren (1996) imply that refractive-index uncertainties can play a substantial role, their effect on extinction being roughly of the same magnitude as that of nonsphericity.

3. Unlike the extinction-based retrievals, the MODIS retrievals can be expected to be strongly affected by nonsphericity and refractive-index uncertainty. The authors may want to mention this as one of the reasons for relatively large MODIS number-concentration errors.

4. The authors conclude, at least implicitly, that number concentration retrievals from

space are problematic. This appears to support the earlier conclusion of Mishchenko et al. (1997a), which the authors may want to acknowledge and discuss.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 14959, 2012.