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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Deriving the effect of wind speed on clean maritime aerosol optical properties using the A-Train satellites" *by* V. P. Kiliyanpilakkil and N. Meskhidze

Anonymous Referee #1

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Summary of paper

This manuscript reports correlation of optical depth of "clean marine" aerosol derived from lidar by satellite instrument CALIOP (Cloud-Aerosol Lidar with Orthogonal Polarization) with wind speed from the Advanced Microwave Scanning Radiometer (AMSR-E). Both instruments are in the A-train constellation. The paper makes use of products produced by the respective teams. Stringent criteria are applied to identify single layer aerosol that is predominantly of marine origin.

The principal finding is reported in Figure 5 and the equation at page 4611, line 11, that shows a sigmoidal relation between optical depth and wind speed. This finding is in

contrast to much previous work summarized in Figure 6 that shows generally greater aerosol optical depth (factor of up to 3 at low wind speed) and generally increasing without indication of any bound at large wind speed. These differences are very large and potentially of considerable importance to the role of marine aerosols on Earth radiation budget, for example.

Somewhat surprisingly to me the paper states: "Figure 6 shows that the relationship derived here is generally comparable to previously published data," though it goes on to note, however, "some considerable differences" which are subsequently discussed and speculated upon. However at page 4614, first para, the manuscript suggests that the leveling off of the AOD at higher wind speed may be a retrieval artifact arising from multiple scattering effects from whitecaps, "correction for which is not included in current CALIPSO aerosol algorithm." The manuscript calls for further study "to evaluate the maritime aerosol AOD behavior under very high wind conditions." These caveats are absent from the abstract, which explicitly calls attention to the leveling off at high wind speed and a maximum value for maritime AOD.

Maps of seasonal marine AOD (Figure 1) are also of interest. One might imagine this data set to be useful to modelers. The manuscript reports (page 4608, line 25) that "The global mean AOD 532 for single-layer marine aerosol is found to be 0.052 $\pm$ 0.038." It is not specified whether the uncertainty represents a standard deviation or standard error of the mean.

The histogram of height of the top of the marine aerosol layer, Figure 3, is also interesting; I expect that there is much variability of the layer thickness with wind speed (and also season, location) that is not examined. No representation appears to be made whether this histogram is meant to be representative of the global marine aerosol, which would make it of interest analogous to the reported optical depth.

Overall review

This paper simply correlates freely available data products supplied by NASA but pro-

vides little insight. There is no theory of why one would expect loading or optical depth of primary marine aerosol to increase with wind speed or what relation might be expected. An increased wind speed would increase both the production rate of the aerosol (from bubble bursting associated with whitecaps or from spume) but increased wind speed U will also dilute the aerosol such that for a given production flux density the column burden would decrease as 1/U. Details would depend on factors such as upwind fetch. No consideration is given to the fact that the aerosol present at a given observation time will have been produced upwind and at earlier time (and likely, therefore, with different wind speed) and how this might affect the correlation with local wind speed that is presented.

The correlation that is presented (page 4611, line 11) contains 5 parameters with as many as 4 significant figures. I have no doubt that this is statistically significant (the authors state that R^2 = 0.97), but I question whether it is scientifically significant. The standard deviations presented in Figure 5 at any wind speed range from almost 50% of the value given by the equation (at higher wind speed) to almost 100% of the value (at low wind speed). As such, the expression presented, especially as presented without uncertainty range, lends a misleading sense of confidence.

I note that an interactive comment to this paper has been presented (Sayer, ACPD, 2011) that suggests that the lidar ratio employed in the NASA data product used in this study is too low, by approximately 60%. Correction of the data employed in the study under review to account for this would bring the results of Figure 5 more in line with those of other investigators shown in Figure 6 but would not appear to resolve the matter of leveling off of the AOD at high wind speed.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 4599, 2011.