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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Stratocumulus cloud thickening beneath layers of absorbing smoke aerosol" *by* E. M. Wilcox

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I thank the reviewer for carefully reading the discussion paper and raising some issues that have led to a clearer and more precise revised manuscript.

Comment: Capital T in A-Train

Reply: T in A-Train is capitalized throughout in the revised manuscript.

Comment: A choice of OMI AI around 1 might be a better one to characterize clean situations.

Reply: In response to this comment I have further clarified the choices for AI threshold below and in the revised manuscript. Since the low OMI AI population of samples in the

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Interactive Discussion

Discussion Paper

study (referred to as “clean” in the discussion paper) may include samples with a layer of scattering aerosol (such as sulfate particles), I have also decided to be more precise in the language used in the revised manuscript by replacing “clean” and “polluted” as discussed further below.

A molecular atmosphere will yield an OMI AI of 0 (see equation 1 in Torres et al. 2007). Positive values indicate the presence of UV absorbing aerosol and negative values indicate scattering aerosols. The approach employed in this study is to explore the difference between cases of high smoke loading and cases of low smoke loading. The definition of high and low in this case is necessarily arbitrary. Nearly all of the OMI AI values within the domain range from -1.5 to 3.5. I have chosen to use OMI AI>2 to isolate samples that are unambiguously overlain by a relatively large amount of absorbing aerosol. OMI AI<1 is chosen to isolate samples with unambiguously less overlaying absorbing aerosol. The gap between the two populations allows for some noise in the measurement as well as the other sources of uncertainty discussed in the paper (namely variability in particle optical properties and to a lesser extent the vertical distribution of the aerosol). Though the choice of these thresholds is arbitrary, the results shown in figures 4 and 5 are qualitatively robust to reducing the thresholds by 1 or using a single threshold of either 0 or 1 to discriminate between the two populations. Further discussion of the OMI AI measurement and these thresholds has been added to sections 2 and 4 in the revised manuscript.

In the discussion paper the terms “clean” and “polluted” are used to discriminate between the high smoke loading and low smoke loading samples. Since the low smoke loading samples include cases with OMI AI<0, it is possible that these samples include some cases with scattering aerosols, which should not be classified as clean. However, since the goal of the paper is to isolate the effect of absorbing aerosol over cloud, these samples can appropriately be classified as having a low amount of absorbing smoke aerosol. Therefore, the division of the samples has been retained in the revised manuscript. Also, as a practical matter, if the low smoke loading category was

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limited only to those samples with OMI AI of exactly zero, or close to it, the size of the population would be too small to construct robust statistics. Although the categories remain the same, the labeling of “clean” and “polluted” has been removed in the revised manuscript in favor of the more precise “high” or “low absorbing smoke loading”.

Comment: (p18645 l1) Partly cloudy at AIRS footprint, or overcast at the 25 km scale?

Reply: The AIRS data are only employed at the 45 km resolution, however “overcast” in this sentence refers to overcast at the 0.25 deg. grid resolution. The text has been edited to clarify this point.

Comment: It might be useful to add a histogram of SST to see which bins matter most.

Reply: A histogram of the distribution of samples across the SST range now appears in fig. 4a.

Comment: It might be interesting to add a plot of (zonal mean) variation of both SST and LWP with latitude to see whether the co-variation is (partly) explained by distance from the ITCZ.

Response: The dependence of LWP on SST is an important subject, but tangential to the main point of this paper. For this reason, and so as not to distract from the narrative line of the paper, I have decided not to add the suggested figure. However, the reviewer is on to something. Comparison of the mean fields of SST and quarter-degree gridded overcast LWP indicate that in the southern half of the domain, the spatial patterns of the mean fields coincide, i.e. both increase to the northwest. In the remainder of the domain, there is no clear spatial coherence of the mean fields. This point is clarified in the first paragraph of section 5 of the revised paper. As noted in the discussion paper, a full exploration of the relationship between LWP and SST would require further analysis.

Reference:

Torres, O., A. Tanskanen, B. Veihelmann, C. Ahn, R. Braak, P. K. Bhartia, P. Veefkind,

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and P. Levelt: Aerosols and surface UV products from Ozone Monitoring Instrument observations: An overview, J. Geophys. Res., 112, D24S47, doi:10/1029/2007JD008809, 2007.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 18635, 2010.