Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "Time-dependent entrainment of smoke presents an observational challenge for assessing aerosol–cloud interactions over the southeast Atlantic Ocean" *by* Michael S. Diamond et al.

Michael S. Diamond et al.

diamond2@uw.edu

Received and published: 26 July 2018

Thank you for your review and constructive suggestions for clarifying the manuscript. We are incorporating your advice into the manuscript and will provide a detailed point-by-point reply in the Author's Response after we have had a chance to see all reviewer comments and short comments.

Before then, however, we would like to share a response to your main comment regarding the definition of the "below cloud" average and concerns about the below cloud

average taking into account more vertical data for averaging.

For our below cloud average, we use all non-cloudy data below 500 m: this sometimes yields data from 500 m to near-surface, but more often the P3 did not sample all the way to the near-surface. It would be difficult to restrict the below cloud averages to a 100 m vertical range consistently because the P3 did not always sample at the same altitude in the MBL. One idea could be to restrict the analysis to 100 m below cloud base, although the ambiguity in establishing the cloud base (which was generally not as well defined as cloud top and complicated by the occasional presence of shallow cumulus below the Sc decks) was what led us to establish the "below 500 m" definition originally. When the analysis for Figure 1a is performed using the "100 m below cloud base" definition (defining "cloud base" simply as the lowest altitude observation with Nd > 10 cm-3) the R2 is 0.62 and the slope is 0.43, not significantly different from the R2 of 0.73 and slope of 0.45 found in the original analysis. As pointed out above, and as can be seen in Figures 4 and 6, the MBL was generally well-mixed during ORACLES-2016 sampling, which does help explain why the results are fairly insensitive to the exact definition of the below cloud average. This may be a larger concern for follow-up analyses using ORACLES-2017, CLARIFY, and ORACLES-2018 data, as those campaigns observed decoupled MBLs much more frequently than ORACLES-2016 did.

We should also mention that despite generally averaging over a greater vertical distance, the exact number of 1 Hz observations that go into the averages is not necessarily greater for the below cloud than the above cloud leg because the P-3 may have spent more time just above cloud than below 500 m during a particular maneuver.

On the other end, we did experiment with increasing the vertical extent of the above cloud averages to 250 m and 360 m to better match the analyses of Costantino & Bréon (2010) and Rajapakshe et al. (2017), respectively. Correlations with Nd uniformly drop as the above cloud averaging distance increases for CCN, SO4, and rBC. As mentioned on page 8, lines 15-17, one explanation for this is that the coarser average

includes cases with narrow separations between the overlying aerosol and cloud tops.

Printer-friendly version

Discussion paper