

Response to the reviews on “Influence of natural and anthropogenic aerosol on cloud base droplet size distributions in clouds over the South China Sea and Western Pacific”

We would like to thank the reviewer for providing comments and suggestions to this manuscript. Reviewer comments are in black text, responses to comments is in red text, and added text to the manuscript is in blue text.

Response to Reviewer

L465-6. This is not normalization. LWC within a size bin must be considerably less than LWC of the entire spectrum. Thus, concentrations in all bins are reduced by this “normalization.” This reduction would be greater for the smaller size bins that would have less LWC due to smaller sizes to the third power. Multiplying by the ratio of LWC within each bin to the mean or median LWC of the spectrum would be a normalization. Or concentrations could be normalized according to the size widths of the bins? This needs explanation. Is whatever normalization that was or should be applied a common practice in cloud microphysics research?

The reviewer misunderstood the calculations as a result of our method not being clearly explained. We have changed the description and added an equation so that the method is now clear.

The following was added:

Figure 12 A shows the statistics of the normalized mass distribution function defined as

$$m_n(D) = \frac{\frac{\pi}{6} \rho_w n(D) D^3 \Delta D}{\sum_D \frac{\pi}{6} \rho_w n(D) D^3 \Delta D}$$

for all the droplet spectra in the marine category. The normalized mass distribution function was used to account for the fact that the aircraft sampled at different distances above cloud base and therefore encountered measured droplet spectra with different values of LWC. The remaining panels (Figs. 12 B-C) show the statistics of the normalized mass distribution functions for the other two aerosol source regions together with the marine spectra.

L475-6. This assertion requires explanation. Calculate the broader spectra and demonstrate. Is this over the entire size range or over some part of the droplet size range. Moreover, ship emissions are included in Fig. 12B not 12C, which is biomass. But even so panel B includes industrial. So, it is a further assertion to single out ships from industrial when both are included in Fig. 12B.

The sentence was removed.

L484-489. This paragraph is an out of context assertion. In order to stand it requires data backup and proper context.

The paragraph was removed.

L36-38. This is an assertion that was not demonstrated. Explain the meaning of Fig. 3. There are 10 plots in A & B. Are they related one-by-one to each other or is this just a coincidence? How are the two panels related? Apparently, you want to show that the cloud measurements were above the LCL.

This comment is related to figure 3, but the line number reference doesn't match. The reviewer is correct that we wanted to show the cloud measurements were at a range of altitude above the LCL. We added text to explain this.

The cloud penetration altitudes are shown in figure 3B. These figures together show that the cloud base penetrations used in this analysis occurred no more than 400 m above cloud base.

L287-291. How do the emissions of a research vessel compare to those of cargo and tanker vessels? I doubt that Sally Ride used Bunker Fuel. What fuel did it use?

The Sally Ride uses diesel fuel, but at a finer grade than the bunker fuel used by tanker vessels at the time of CAMP²Ex. We made a note of this in the paper.

The R/V Sally Ride uses finer grade diesel fuel compared to the bunker fuel used by cargo and tanker ships at the time of CAMP²Ex, although similar chemical components can be detected in the ship plumes from both fuel types.

L603. Four hours seems like a short time for a ship plume to disappear. Is there a reference to this fact?

We agree that four hours was an arbitrary time. We felt that beyond that time there would be too high of an uncertainty in the plume position. We chose the four-hour limit based on past work in Aliabadi et al. 2016. Reference was added to the paper.

Minor suggestions:

L30. Insert clean before marine.

Added clean

L33 & 35. SO₄ should not be the same. Consistent with L350 & L513 SO₄ should be 2.3 µg/m³ in L33. Also consistent with L350 & L513 ORG should be 2.2 µg/m³ in L32 and NH₄ should be 0.3 µg/m³. The others in L32-3 are consistent with L349 & L350 and L523-4.

Fixed to be the same as the values in section 4

L43 & 45. Insert clean before marine.

Added clean

L46. Add d to influence.

Added

L63-64. Insert Hallett et al. (1989).

Reference added

L77. Insert Hudson et al. (2009) and Hudson & Noble (2014). I appreciate N_c. But now N_c can be employed in L80, L276, L402 and L455.

References added. N_c changed throughout.

L81. Insert Hudson & Yum (2002).

Reference added

L86-7. Move constantly in front of into.

Changed

L107. Add Twohy et al. (2001).

Reference added

L290. Complementary.

Fixed.

L331. Change aerosols to particles.

Changed to particles

L339. Insert clean before marine.

Added

L401. Delete in length.

Deleted

L588. Remove away.

Removed