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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observations of high droplet number concentrations in Southern Ocean boundary layer clouds" *by* T. Chubb et al.

Anonymous Referee #3

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I have reviewed the manuscript "Observations of high droplet number concentrations in Southern Ocean boundary layer clouds" by Chubb et al. The work presents results from a small subset of HIPPO flights and examines the microphysical properties of boundary-layer clouds from a small set of observations made near Tasmania. The work highlights that a wide range of cloud droplet number concentrations were observed during these flights. The authors hypothesize that the large number of drops could be related to either anthropogenic emissions or sea-spray aerosol. Based on their analysis of model back trajectories the authors argue that the most likely cause of the large numbers of particles is the generation of sea-spray aerosol associated with very strong winds. It is important to note that this finding is not based on direct observations, but rather on the elimination of a number of other potential sources of the particles.

Overall, the manuscript provides a clear and concise description of the results, and I feel that the manuscript would likely be acceptable for publication in Atmospheric Chemistry and Physics with some minor changes. That said, the study would be much more convincing (and useful to the community) if additional data sets were available to give an idea of the importance of the contribution of sea-spray aerosol in a larger sense, if more measurements of aerosol chemistry could be used to help highlight the nature of aerosol that is observed, and application of a more detailed chemistry model to better understand the aerosol sources (including the potential role of mineral dust). I have provided some more detailed comments below.

Specific comments Page 25505, line 7. I would suggest adding the word “observed” after “droplet sizes”.

Page 25505, line 13 (and other locations). The use of “high” and “low” to mean “large” and “small” could be confusing to the reader. I would suggest changing the occurrences with large and small to be more accurate.

Page 25505, line 29. “Provide” should be “provided”.

Page 25508, line 5. I would suggest adding “associated” after “low-level winds”.

Page 25508, line 16. It would be helpful, at some point in the document, to indicate the airspeed of the aircraft. That would make it easier to understand the impacts of the sampling speed on the results.

Page 25509, line 18. Additional detail about the ascent/decent profiles would be helpful. For example, what was the approximate ascent/decent rate of the aircraft? Were these profiles designed to overlap each other?

Page 25513, line 20-25. The text argues that the potential temperature profile shown for profile 2 is more complex than that for profile 1, but that isn’t clear to me from the figure unless the authors are referring to the buffer layer. Perhaps the small spatial extent of the figure hides the relative complexity? The text also states that large values

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of CDP liquid water content are consistent with a cumulus cell. Given the aircraft speed, how large would this cell have to be to provide the continuous profile shown in the figure? Is that reasonable?

Page 25516, line 7. It would be good to add a note to the caption of Figure 5 about the offset applied to some profiles.

Page 25517, line 3. The text states that there is a peak in NU near cloud top, but that isn't clear to me from the figures.

Page 25517, line 27. You might want to add "thermodynamically" before the word "stable".

Page 25522, line 11. The text in this paragraph states that HIPPO-4 RF06 is not a good example of a pristine flight nor a polluted one, but early in the section, Profile 1 is descried as "very clean". This description appears to be a bit inconsistent.

Line 25523, line 9. The text states that the trajectories from 500 and 1500 m are very similar, and if dust is a major issue than the aerosol loading should be the same (or at least close in value). Is this due to deeper boundary layers (and associated vertical mixing) over Australia?

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 25503, 2015.