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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Sensitivities of Amazonian clouds to aerosols and updraft speed" *by* Micael A. Cecchini et al.

**Anonymous Referee #1**

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Review of Sensitivity of Amazon clouds to aerosols and updraft speed, by Cecchini et al.

This manuscript uses aircraft in situ observations of developing cumulus clouds over the Amazon to explore the connection between control variables (here the concentration Na of aerosol particles entering clouds from below, the height h above cloud base, and the updraft speed, w) and cloud microphysical properties (cloud droplet concentration, effective radius and spectral shape) at levels above cloud base. The connections are determined by an approach that attempts to isolate the effect of a particular control variable by holding the other control variables fixed (partial derivative approach). This is carried out in practice by binning the data into three dimensional bins of Na, h and w. The findings indicate that the primary controls on effective radius are h and Na, and that the primary control on Nd is Na with w also positively influencing Nd. LWC is



mainly controlled by h and w. These results seem to make physical sense. There are new findings about factors controlling the drop size shape that will be of interest to the community. The manuscript is relevant to the cloud community, although it is not clear what modelers would do with the results. I find the manuscript suitable for publication in Atmospheric Chemistry and Physics, and offer some suggestions for revision.

SPECIFIC COMMENTS:

1. The finding that Nd is strongly correlated with Na differs from studies in shallow broken cumulus (e.g. Vogelmann et al. 2011, BAMS, Fig. 10) where Nd does not appear to be strongly correlated with Na and LWP decreases with Na. Some discussion of contrasts with prior work would put this work into the context of previous work.

2. The justification for why Na is used rather than CCN does not make sense to me. The CCN measurements include supersaturations up to 0.55%, so why not just choose a fixed supersaturation (interpolate if needed) and use CCN. The authors should use both CCN and Na and compare the results.

3. The authors should investigate the impacts of the rather large bin sizes they need to compute the partial derivatives on the values of the derivatives.

4. P1, Line 32. I disagree that height above cloud base is a good proxy for time in cloud. A much better estimate would be h/w, which actually has the units of time and would be the exact time in cloud if w is constant with height. The authors should re-evaluate their conclusions in the light of this error.

5. McFiggans et al. (2006, ACP) have a good review paper exploring factors controlling cloud microphysics. The results here could be put into the context of the findings in that paper.

6. P5, line 27. What are linear and angular coefficients?

7. Was there any correlation between w and Na? How might this change the results?

8. P11, Line 24-26. I couldn't follow this argument at all. Others will probably have difficulty with it. Sensitivity in Nd to what?

9. P12, Line 14. Insensitive rather than insensible.

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