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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol concentrations determine the height of warm rain and ice initiation in convective clouds over the Amazon basin" *by* Ramon Campos Braga et al.

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The authors have presented the case that cloud active aerosols at cloud base are responsible for determining the cloud depth at which precipitation forms. As pointed out in the introduction, this is not a new discovery and has been investigated in many regions by many researchers other than the ones that are heavily referenced in this paper. Although the failure to be more inclusive in mentioning these other studies is not a fatal flaw in this paper, it does weaken its overall premise and conclusions. There are more serious issues that I would like addressed before this study is published.

Instrument issues

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Discussion paper

I could not find in either this paper or the Braga et al (2016) sufficient discussion on the processing of spectrometer measurements. In particular:

1) Coincidence corrections. Lance (2012) clearly shows that the CDP (unmodified with secondary mask) and CAS seriously undercount at > 500 cm-3. Lance (2012) says nothing about interarrival times and coincidence. Interarrival is used for shattering, so I don't understand the justification for not correcting the concentrations. Many of the concentrations reported > 1000 cm-3 will likely be at least 50% larger whch will seriously impact the derived LWC and subsequent Na.

2) In the images from the CIP, there are many out of focus droplets (donuts). The Korolev (2007) correction has to be done, otherwise the derived water content will be an overestimate and the height of precipitation might be incorrect.

3) Was the PCASP operated with a heated inlet? If so, corrections are needed to size distribution.

4) A fair amount of the paper is devoted to illustrating that the CAS and CDP compare within expected uncertainties. Given that this has already been done in the Braga et al. (2016), this is redundant and doesn't add much new information to the results.

Science Issues

5) Modify title please. The current title is misleading and not correct. It currently implies that all aerosols determine the depth of precipitation initiation. The results do not support this strong of a statement. Some types of aerosols play a role in determining the height of warm rain initiation, i.e. CCN/IN and their concentration have an impact as is clearly shown in this paper. A more accurate title might be "Further evidence for the impact of cloud base CCN/IN on the height of precipitation initiation"

6) The determination of Na needs much more explanation. The Na vs Precipitation depth is key to the conclusions and needs amplification. Why should the slope of the LWC vs Mv relationship with height provide a good estimate of Na? I understand that

LWC = Nd*Mv but this is not discussed, nor is how Mv is derived. In addition, all the plots that determine Na should be shown. If they are anything like the one shown in Braga et al 2016, Fig. 14a, there can be a very large spread in values of LWC at each Mv and subsequent uncertainty in the Rea. Fig. 15 in Braga et al (2016) clearly show that there is a lot of dispersion when comparing Na and Nd. The best fit line in their Fig. 14a does not appear to fit the points and certainly can't justify reporting Na to such precision.

7) Nothing is said about the uncertainty in the determination of level of precipitation wrt to vertical motions and where the precipitation actually initiated, i.e. it could have actually been below the level of measurement before being lofted upwards. This uncertainty can be estimated using the measured vertical motions.

8) Nothing is said about the time it takes to make the measurements at the various cloud levels and how these levels were selected. This will give some idea of the time during which the cloud is growing an how long it took to initiate precipitation.

9) Secondary nucleation is a very poor term because in a classical parcel model in an updraft, new particle nucleation occurs above cloud base until there are no more cloud active CCN at the level of SS. The implication here is that new CCN are being entrained and that is why the Nd increases with altititude, but this is likely not the case. When running a parcel model with a prescribed updraft and CCN spectra, the supersaturation increases in altitude as the parcel rises adiabatically and cools. The CCN will activate depending on their SS spectra and the available water. This needs revising.

10) The relationship Dr = 5*Na needs revising to take into account the data processing and uncertainties that I raise above, and needs an error bar.

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