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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Tropical deep convective life cycle: Cb-anvil cloud microphysics from high altitude aircraft observations" *by* W. Frey et al.

Anonymous Referee #3

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Frey et al. General Comments

This paper provides reports on high-altitude measurements throughout the lifecycle of a convective Hector storm. A convincing argument is made for the importance of measurements in this region, and the categorization of the measurements into different stages of the same storm is interesting and valuable. The cloud system, measurements & instrumentation are well introduced and explained, and the paper is generally well written.

Aerosol measurements in cloud are not well explained; for example, what "aerosol backscatter" & "aerosol depolarization" from the MAS actually represents. The discussion seems to focus on ice crystal properties, but the terminology all references

aerosol. In addition, the section on aerosol/cloud particle number ratios, besides being long and unfocussed, was not convincing since there are likely problems with aerosol measurements being used in-cloud. Without further discussion/analysis of the sampling inlet, results shown could be due to shattering artifacts increasing aerosol number concentration, rather than actual changes in the aerosol/cloud ratios.

As the first reviewer stated, more use of microphysical images to back up hypothesized changes in ice crystal size & habit at different lifecycle stages would be useful. And as the second reviewer states, there are a number of assumptions made related to cloud freezing history and lifecycle that may not be valid.

I would encourage the authors to give as much care and attention to the last half of the paper as to the first half–and then the paper should be an acceptable and useful addition to the cloud physics literature.

Specific Comments

p. 11817, lines 24-25: I would argue that there have been a number of microphysical studies of high-altitude cirrus, particularly anvil cirrus, in the tropics. In the next paragraph you discuss what really hasn't been done much–examination of the TTL layer and the dissipating stages of storms. Thus, just remove this sentence and let the next paragraph speak for itself.

p. 11818, lines 18: "How" should be "what".

p. 11821, line 1: "perform" should be "performing".

p. 11822: The aerosol sampling inlet is not described, and may affect your results, particularly in cloud. See also later comments.

p. 11827, line 10: How is IWC measured?

p. 11828, line 13: "the AMMA clouds"–what development stage were these in, for comparison? How many clouds are represented in the median? If it is the median of

many cloud systems/stages, then I'm not sure how meaningful the comparison with one Hector case would be. Perhaps these issues/limitations should be discussed upfront, rather than as an aside at the end of the discussion.

p. 11829, line 19: "this illustration shows"–what illustration? It seems to me the subsequent discussion is hypothetical. Cannot the actual dissipation measurements be used to say something specific about the fate of this storm?

p. 11830: What particle size is the MAS sensitive to? Are we really discussing "aerosol" backscatter & depolarization here, since the measurements are in cloud?

Line 18: "it's" should be "its".

p. 11831, lines 11-15: Aerosol inlets are also subject to crystal shatter at high speed, unless specially designed for interstitial measurements. Characteristics of the inlet should be specified in the instrumentation section and its behavior in cloud should be examined and discussed.

p. 11831-11832: This section should be broken up into shorter, more digestible segments with specific foci.

p. 11832, lines 13-16: The temperature range is seemingly too cold for the traditional Hallett-Mossop process to be important.

p. 11833, lines 3-5: Shatter of larger crystals producing aerosol artifacts could also produce these results.

Line 20: Be consistent in using aerosol to cloud ratio or cloud to aerosol ratio, not both.

p. 11834, line 7: "microphysical" is misspelled.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 11815, 2014.