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Title: High ice water content at low radar reflectivity near deep convection: Part II. Evaluation of microphysical pathways in updraft parcel simulations
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General Comments:

This paper uses a sophisticated parcel model to investigate likely ice formation mechanisms and growth processes responsible for conditions in deep convective clouds associated with commercial and military jet aircraft engine failures (i.e. engine power loss, flameouts and damage). While the parcel model is not capable of realistically simulating all relevant cloud processes, and thus is not robust enough to unambiguously identify these processes associated with jet engine problems, it represents a useful first step towards identifying these processes. That is, it identifies processes that are more likely associated with engine problems, and vice-versa, thus laying the groundwork for more comprehensive 3-D cloud resolving modeling to determine the likely processes associated with engine problems.

While this paper focuses on deep convective cloud conditions (in the transition region between the convective and stratiform regions) at the -40°C level, this temperature level is associated with a minority of the engine problem events documented in Mason et al. (2006). Unless this is no longer true, this point should be stated in the paper, and the authors should explain why they chose to focus on this temperature level.

It is interesting that capped columns appear to be the dominant ice crystal shape associated with aircraft engine problems, as it suggests that the ice may have formed in the temperature regime associated with isometric (i.e. quasi- equal axis) ice crystals (-8 to -10°C). Ice crystal diffusional growth rates depend on the vapor gradient and the ice surface kinetics (i.e. the accommodation coefficient), and these isometric ice crystals have unique surface kinetics such that the efficiency by which water vapor molecules incorporate into the ice crystal lattice is minimal; see Chen and Lamb (1994, JAS) for more detailed information. It is not clear whether the parcel model used accounted for these unique surface kinetics or “inherent growth ratios”; this should be mentioned.

Surface kinetics could be important since this produces anomalously low growth rates for isometric ice crystals (see Takahashi & Fukuta 1988, J. Met. Soc. Japan; Takahashi et al. 1991, J. Met. Soc. Japan), resulting in less ice surface area for water vapor uptake in the cloud updraft. Hence, conditions may exist (e.g. low updraft case) where supersaturations are initially determined by the available ice surface area and updraft speed, and new ice surface area cannot be produced rapidly enough to balance the production of supersaturated water vapor, leading to conditions where supersaturations eventually exceed water saturation. Such relatively high supersaturations may subsequently affect the cloud microphysics in interesting ways, and it is important to know whether these effects are treated in the parcel model.

The paper is well written and organized and the figures are of good quality. Relevant literature has been cited.

Specific Comments:

1) Page 16563, 1st paragraph: The Hallett-Mossop process also depends on the cloud droplet size distribution (i.e. the numbers of droplets having d > 23 microns). What do the estimated ice splinter production rates imply about the cloud droplet spectra?

2) Page 16567, lines 6-9: This study addresses conditions characterized by anomalously high IWCs. Since ice particle aggregation rates are directly related to the ice mass flux (e.g. Mitchell 1988, JAS), aggregation rates should be relatively high under these high IWC conditions. It is not clear why collisions between ice particles are expected to be inefficient (low aggregation efficiencies) under the modeled conditions; side planes have complex structures and form between -20 and -40°C (Bailey & Hallett 2009, JAS). The neglect of aggregation may be unavoidable for this modeling framework, but it does not appear to be a realistic assumption.

3) Page 16567, line 26: The process of raindrop breakup has not been discussed.

4) Page 16573, line 17: Based on the PSD in Fig. 13, the green dashed curve (f_{sh} = 50) is not markedly bimodal, but it exhibits a shoulder deviating from unimodal behavior.

5) Page 16573, line 27: What does the current literature support for f_{sh}?

Minor Comments:

1) Page 16568, line 23: repetition of “aloft”

2) Page 16571, line 6: Does parcel desiccation occur through precipitation?

3) Page 16571, line 9: Suggest replacing “under” with “during” to avoid confusion (e.g. under-saturated conditions).

4) Page 16606, Fig. 13: In 3rd line of caption, it seems cm^{-3} should be L^{-1} based on the text.