Review of MS acp-2019-611, revised version, Nov. 22, 2019

This is an important paper, taking advantage of advances in imaging cloud ice particles from airplanes to deduce whatever may be deducible about secondary ice production, an important and long-standing problem in cloud physics. It is acceptable for publication, I think, in its present form, but I will make several suggestions for minor revisions in the presentation.

Line 121 extent instead of extend; Lines 131-132 -- the last two sentences of this paragraph do not communicate much to a reader at this point, without a physical explanation of how the HM process is expected to operate and what the alternatives are.

Section 3.1 I don't agree with the use of the word "assumptions" here. The two on lines 191-193 are more properly called approximations. I think the argument that most of the small, hexagonal ice xtals derive from "secondary ice" is very strong, but we don't need to "assume" it. And number 2 likewise is not an "assumption" in any sense of the word -- it's an approach used in the analysis. Then on p. 6, the use of the word "characteristic" is, to me, quite inappropriate. I would favor "typical" or "approximate" sizes or residence times. I do understand what the author means here, but upon encountering the word characteristic so many times, at first I couldn't follow the meaning.

Line 291 -- using counting rate instead of concentration takes the meaning out of the measurement. It is explained that the sample volume is quite uncertain, but the concentration is of course what is important, so it should be identified here in the text and it should be noted that the concentration scale is on the figure. Personally, I would have put the concentration scale on the left and the counting scale on the right in the figures. The explanation of the sample volume problem is good.

Lines 534-538 The argument about small particles having shorter residence times than larger ones doesn't make any sense at all to me, nor is it particularly important to the argument here, I think. "Residence time" must depend critically upon updraft, downdraft, turbulence, fall speed, and the various possible "sinks." Small ice in mixed or supercooled cloud has limited "residence time" mainly because it grows past being small, obviously. Line 543 "characteristic" again. Not a good word, for me. But the small hexagonal plates are a wonderful observation. It's too bad that there aren't any comparable small needles around -5C!, but maybe they would be too thin

for the instrument to detect. The thin plates and their interpretation are for me a rather wonderful observation, and surely they grow around -1 or -2C, but the original secondary ice "must" have descended from above??

Line 798 --Now it's 10? I thought it was more like 20, before.

I think that temperatures should be included in the figure captions for all of the multi-image figures.

This paper generates suggestions in me, for field and laboratory approaches testing some of the rather speculative (but not unreasonable) interpretations of the ice data.

The many other suggested secondary ice mechanisms are mentioned in the introduction and then each is again discussed at some length near the end. This is a very long paper, and for my taste, I would have left out the re-cap of every secondary ice thought, at the end. Perhaps in favor of more details about what the difference might be between the recycling-water-drops hypothesis and the HM process ("rime shattering," though the actual mechanism behind the lab results seems to me not demonstrated).

I recommend acceptance. This is an important work.