Replies to Reviewer 1 comment on "A new look at the environmental conditions favorable to secondary ice production" by Alexei Korolev et al.

I have a question and a comment to communicate. The question is, were the flight plans made to take APIPs into account? (aircraft-produced ice particles) This could be a serious issue especially, of course, when repeated penetrations in the same cloud have been made. The comment is (after saying that this seems to me a very important paper, and should be accepted) that the small ice particles that look like either fat ice columns or very thick, small plates. look to me like overgrowths on frozen, large, cloud droplets, not a result of overgrowths on the sort of shards that would result from the little explosions of freezing droplets. They are not at all what I would have expected from that. That does not help in identifying the actual cause of the freezing, of course, which seems to me the main mystery.
Charles Knight

Replies
Authors appreciate the Reviewer's comments and time spent to evaluate this work.
Below are the point-by-point replies to the Reviewer's comments (in Italic).

Q: *The question is, were the flight plans made to take APIPs into account? (aircraft-produced ice particles) This could be a serious issue especially, of course, when repeated penetrations in the same cloud have been made.*
Reply: The effect of APIP on the measurements is excluded for the cases 1,2,5,6. But, APIP may potentially affect cases 3 and 4. However, the authors consider that the APIP will be advected away from the area of measurements by the vertical updraft Uz~2-5m/s. In order to address the Reviewer's comments a section 4.3 was added in the text.

> **4.3 Effect of aircraft produced ice particles on the measurements**
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> Aircraft-produced ice particles (APIP) (e.g. Rangno and Hobbs, 1983; Woodley et al., 1991) may be confused with SIP ice crystals, and therefore, result in biases in interpretation of measurements. Contamination by APIP may occur if the aircraft re-enters the cloud region where the APIP were transported by vertical or horizontal advection. Typically, this may happen if the aircraft traverses through the region of its previous operation.
>
> The contamination by APIP is excluded for the cases 1 and 2 (**Figs.6,7**) (sections 4.1.1, 4.1.2) since the Convair580 flew along a nearly straight line and never re-entered regions of earlier operations (**Fig.4a**). The cases 3 and 4 (**Figs.9,10**) (sections 4.1.3, 4.1.4) might be contaminated by APIP since the clouds were sampled in an area close to which the Convair580 flew 8 minutes earlier. However, since cases 3 and 4 were sampled in a convective region with an updraft velocity u_z=2-5m/s (**Fig.8f**), the potential APIP were expected to be removed from the area of the measurements by vertical wind.
>
> Case 5 (**Fig.14**) (section 4.2.5) was sampled during ascent through the cloud (Fig.13h) at approximately 12:30 (see also **Fig.12a**). This cloud region was not affected by the previous operation of the Convair580, and therefore, contamination by APIP of this area is dismissed. Similarly, case 6 (Fig.15) (section 4.2.6) was sampled during descent through a mixed phase layer, which was not affected by previous Convair580 flight operations.

Q: *The comment is (after saying that this seems to me a very important paper and should be accepted) that the small ice particles that look like either fat ice columns or very thick, small plates. look to me like overgrowths on frozen, large, cloud droplets, not a result of overgrowths on the sort of shards that would result from the little explosions of freezing droplets. They are not at all what I would have expected from that. That does not help in identifying the actual cause of the freezing, of course, which seems to me the main mystery.*
Reply: This is one of the findings of this study, that the aspect ratio (R) of the small hexagonal ice particles observed in the same cloud region may vary in wide range 0.3<R<6. Large fraction of the small pristine ice particles has a nearly isometric shape with R~1. As discussed in the paper, most likely such shape is related to freezing of small droplets due to their impact with ice splinters. Further development of understanding of this question requires laboratory studies and it goes beyond the frame of this work.