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Reply on RC1

Vaughan T. J. Phillips et al.

Author comment on "Comment on "Review of experimental studies of secondary ice production" by Korolev and Leisner (2020)" by Vaughan T. J. Phillips et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-123-AC1, 2021

We thank the reviewer for the interesting comment.

It is unclear if the relative humidity shown is with respect to water or ice. We will assume it is with respect to water.

The laboratory studies about sublimational breakup that we referred to in our comment show that such breakup only occurs at relative humidities with respect to ice of less than about 70-80%. Following the melting scheme by Phillips et al. (2007, JAS), the onset of melting occurs when the surface temperature of the ice during sublimation reaches 0 degC. We predict that this occurs when the ambient air temperature exceeds about 1.5 degC (codes available from us on request), for the three CRYSTAL-FACE aircraft descents shown by the reviewer. At that ambient temperature for onset of melting (1.6 degC), the relative humidity with respect to ice is 80%.

For the three CRYSTAL-FACE descents shown by the reviewer, sublimation below the melting level can only occur between 0 and 1.6 degC, an extremely narrow range of heights where a uniformly high relative humidity with respect to ice was observed (> 80%, we infer).

So, the reviewer's data does not prove the absence of breakup during sublimation generally, since no-one has ever claimed that at such high relative humidities there would be any breakup. In the comment, we actually base our breakup estimate on a scenario with a relative humidity of about 70% or less.

Equally, CRYSTAL-FACE happened long before the shattering bias was discovered for optical probes. Thus, the probe-tips had not been invented then. So the unfiltered ice concentrations (> 30 microns) shown by the reviewer are likely dominated by artificial fragments from impact of snow on the aircraft probe (e.g. Korolev et al. 2011).