Major Comments

- While the processes (e.g. temperature dependence and mechanism) of rime splintering and collisional breakup are described in lines 48-57, frozen droplet shattering is only mentioned in passing in the introduction (lines 69-72). Even if frozen droplet shattering is not influential in this case, I would still devote another sentence or two to describing it after the other SIP processes.
- I had difficulty understanding the aerosol treatment described in lines 137-145. Was a representative aerosol profile derived from the values in different temperature ranges cited (> 261 K, 258-261 K, etc.)?
- I struggled to get the takeaways from Sections 3.1.1 and 3.1.2. Three suggestions in this regard.
  - You start by discussing the ice crystal shape classification in lines 231-235 but then transition to modeled versus measured. I would move anything about the shape classification to where you discuss it further (lines 257-272). Given how little rime splintering changed the simulated ICNC, is it not surprising how large the percentage of observed rimed crystals is in Figure 3b? I felt Fig. 3b warranted more discussion.
  - It would be easier to make the model-measurement ICNC comparison visually if the values of Figure 3a were actually atop those of Figure 4a.
  - It was not clear to me what changed between 12:00 and 13:00 UTC (i.e. Figs 4
and 5). In particular, I thought it was interesting that γ_BR controls the vertical structure of ICNC and secondary production rates in Fig. 5 but not Fig. 4. Do you have a hypothesis why this is so?

- Given the discussion of updraft throughout (e.g. in regard to WBF or around lines 305-313), profiles or maps of vertical velocity would be helpful to see whether reduced precipitation in the breakup simulations is due primarily to microphysical or dynamic factors or both.

- I would choose a metric other than the spatial Pearson correlation coefficient for precipitation evaluation; otherwise, the $r^2$ values in Table 3 seem to contradict the statement that “COSMO benefits from the inclusion of collisional breakup processes in simulating precipitation.” You could, for example, calculate the statistical distances between the distributions shown in Figure 8 with the Kullback-Leibler divergence. There is a scipy Python package here:

Please also note the supplement to this comment:
https://acp.copernicus.org/preprints/acp-2020-1326/acp-2020-1326-RC1-supplement.pdf