Dear Editor, dear reviewer!

thank you again for careful reading and the comments. We considered them in the revised version.

Ref#1:

1) I support the general statement that heterogeneous freezing played a major role during the period. The only thing I still don't quite agree with is the idea that homogeneous nucleation should only occur when the INP reservoir is completely empty. Homogeneous nucleation can also occur in parallel with heterogeneous nucleation if the updrafts are strong enough and the supersaturation is getting large enough (see, for example, Krämer et al. 2016 or Rolf et al. 2012 or Kärcher et al. 2022). This happens in the case when the existing ice surface after/during heterogeneous freezing is not sufficient to reduce the ice supersaturation via diffusive growth of the ice crystals. The short term updrafts by gravity waves of up to ~1 m/s reported in Podglajen et al. are sufficient to add homogeneous freezing even in the presence of INP particles (see for instance Fig.7 in Rolf et al. 2012 or Kärcher et al Sec. 4.3). In Kärcher et al., only warm conditions were investigated. For cold conditions, as present in this study, I would expect the supersaturation to respond even more strongly to an additional updraft and even more likely to initiate homogeneous freezing because the saturated vapor pressure has a strong temperature dependence. The statement of "homogeneous nucleation should only occur when the INP reservoir is completely empty" is not particularly relevant to the first part of the paper series. I leave it to the editor to decide whether this needs to be explained further in Part 1 of the manuscript or it should be better mentioned in Part 2.

We agree and changed the text accordingly.

On page 15 (given in red), we write:

…. will not lead to an empty or almost depleted INP reservoir so that favorable conditions for homogeneous freezing were given ….

On page 16 we write:

However, even in the case of a highly polluted UTLS we cannot completely rule out that occasionally situations occurred in which almost smoke-free conditions were given in a number of air parcels after the consumption of all or most of the smoke INPs so that homogeneous freezing became an additional ice nucleation option. As shown by Rolf et al. (2012), Krämer et al. (2016) and Kärcher et al. (2022), homogeneous ice nucleation is possible in the presence of a low number of INPs when the updrafts are strong enough so that the diffusional growth of the few heterogeneously nucleated ice crystals by water vapor deposition is not sufficient to reduce the relative humidity in the ascending air parcel significantly and to prevent that the ice saturation ratio Si in the lofted air parcel reaches and exceeds the onset ice saturation ratio Si,on for homogeneous freezing.

On page 22 (summary) we write:

It is a reasonable option that a certain amount of air parcels were free or almost free of smoke INPs after numerous updraft events so that conditions became favorable for homogeneous ice nucleation on background aerosol particles.

2) Another small thing is, that you should avoid the very strong wording of "unlimited INPs" see line 496. Please change it to something like "large" or "virtually unlimited"... Otherwise, it would exist forever. I also believe that the INP reservoir is large, but it is definitely not infinite.

We change that on page 22.

3) Line 456: Please remove "the" in "a the updraft event"

Done!