Supplement of

Annual variability of ice nucleating particle concentrations at different Arctic locations

by Wex et al.

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1 Background measurements

Figs. S1 to S3 show frozen fractions (f_{ice}), i.e., the measured parameter, for field blanks together with some spectra of f_{ice} for pure water and for filter samples that were sampled directly before and after the field blank was taken. Field blanks were treated similar to filters onto which sampling was done, only were they not subjected to sampling air through them. They did, however, spend time in the sampler. The three different panels in Fig. S1 clearly show, that the background level is influenced by the atmospheric INP concentrations, as field blanks taken from April until October show a much larger signal than those collected during the other months. Therefore, and as the availability of field blanks varied between the different measurement stations (there were none for VRS, two for Ny Ålesund and Utqiaġvik each, and 9 from Alert), signals from the field blanks were not subtracted from the signals from the samples. However, in all cases and at all stations, the background was low enough to not have influenced the interpretation of the results from the filters presented in this study.

Some filters sampled during spring 2017 in Alert and from March until September 2015 in Ny Ålesund also had been examined. However, these filters had shorter sampling times of only one day and less than 60 L of air had been sampled onto each single circular 1 mm filter piece. f_{ice} determined for these filters were close to the background determined from the blank filters, and therefore these data were not used in this study.

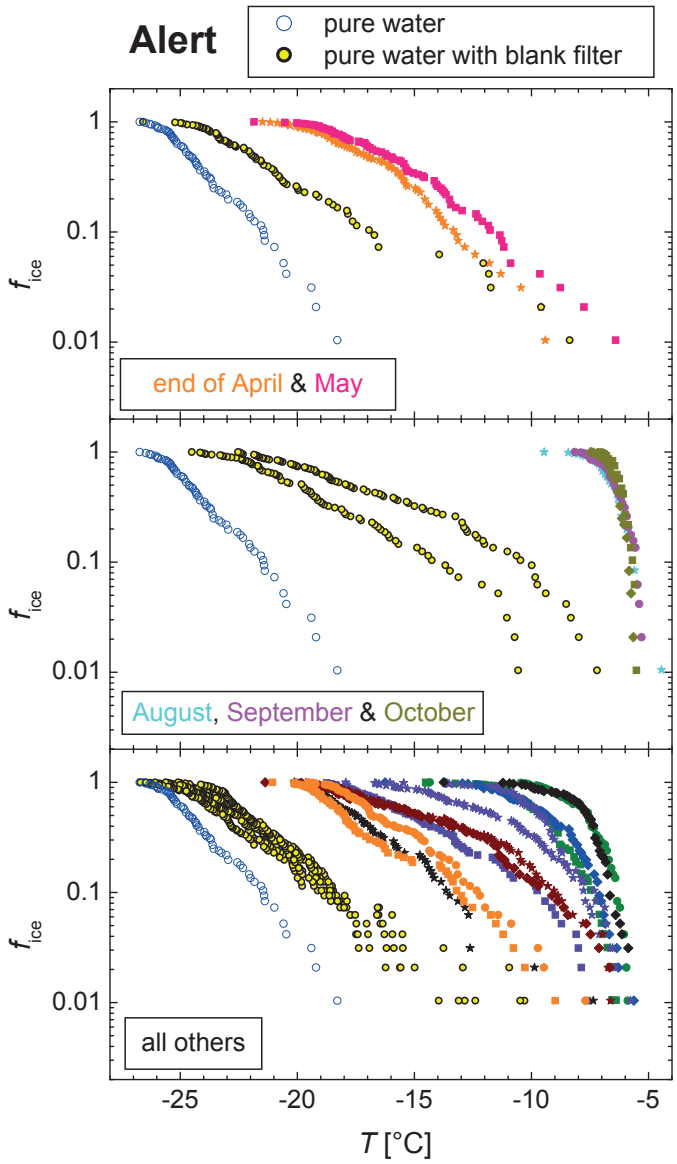

Figure S1. f_{ice} derived for measurements of pure water (blue open circles), blank filters (black circles with yellow filling) and filter samples sampled prior and after the blank filter was taken. The color code for the filter samples is the same as used in Fig. 1.

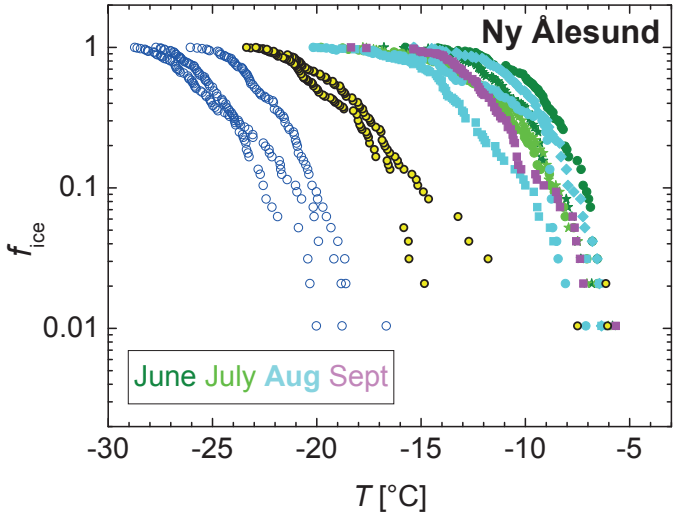

Figure S2. Similar to Fig. S1, but for Ny Ålesund.

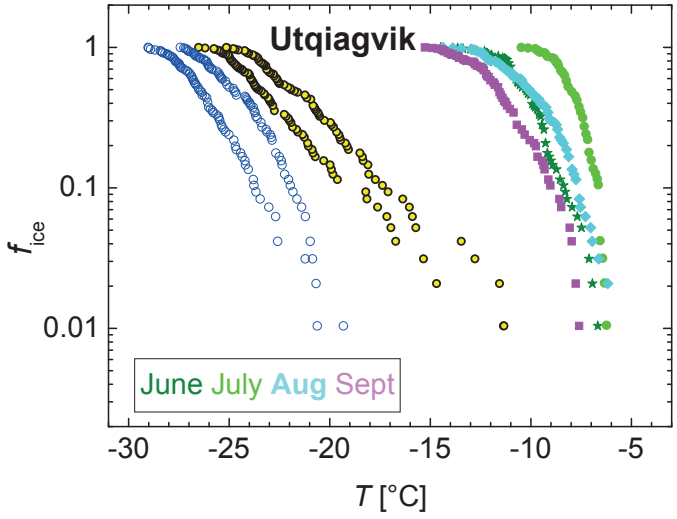

Figure S3. Similar to Fig. S1, but for Utqiaġvik.

2 Back-trajectories

Figs S5 to S7 show the back-trajectories that were derived for the 17 selected filters examined in detail in Sec. 3.3. For Utqiaġvik, 5-day and 10-day back-trajectories are shown separately in Figs S6 and S7 and the information on the altitude of these back-trajectories is explicitly shown in Fig. S8.

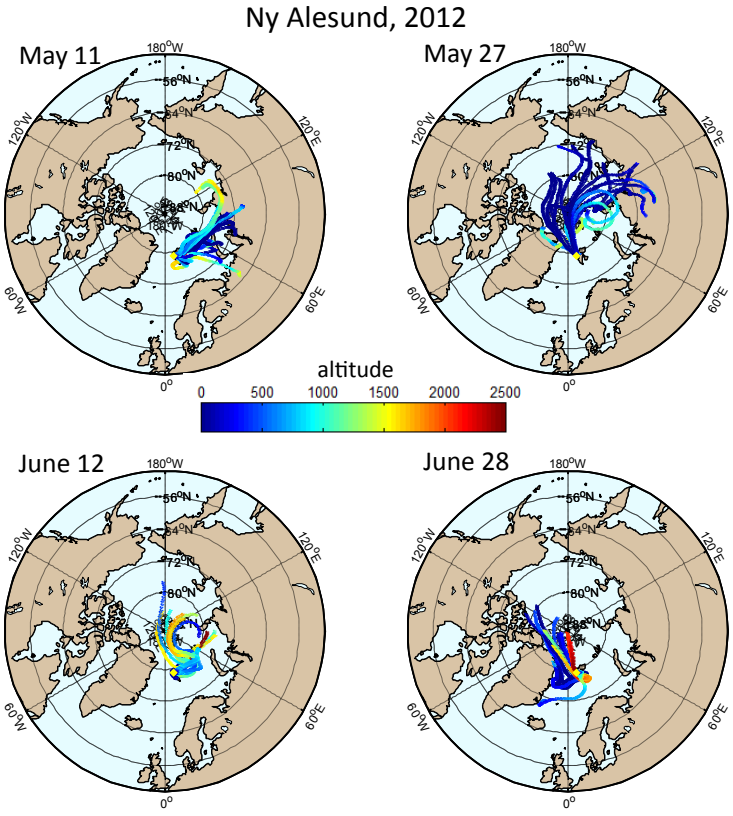

Figure S4. 5-day back-trajectories for the filter samples from Ny Ålesund discussed in Sec. 3.3.

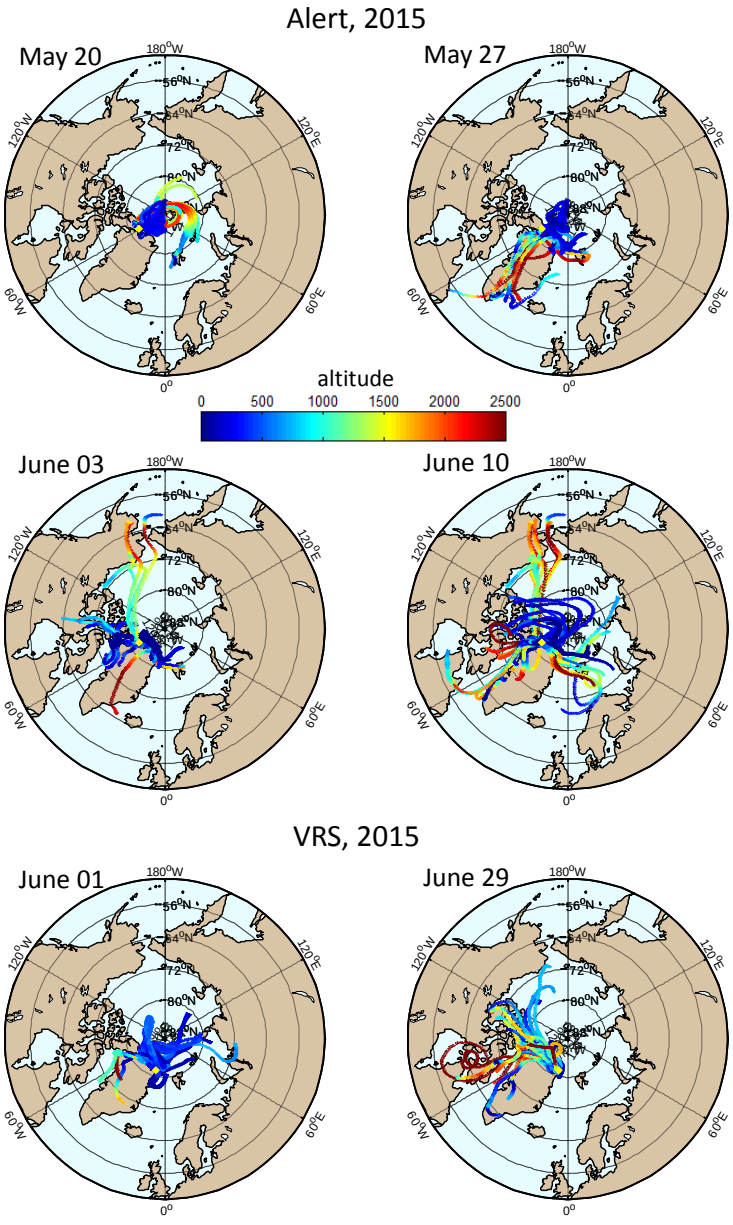

Figure S5. Similar to Fig. S4, but for Alert and VRS.

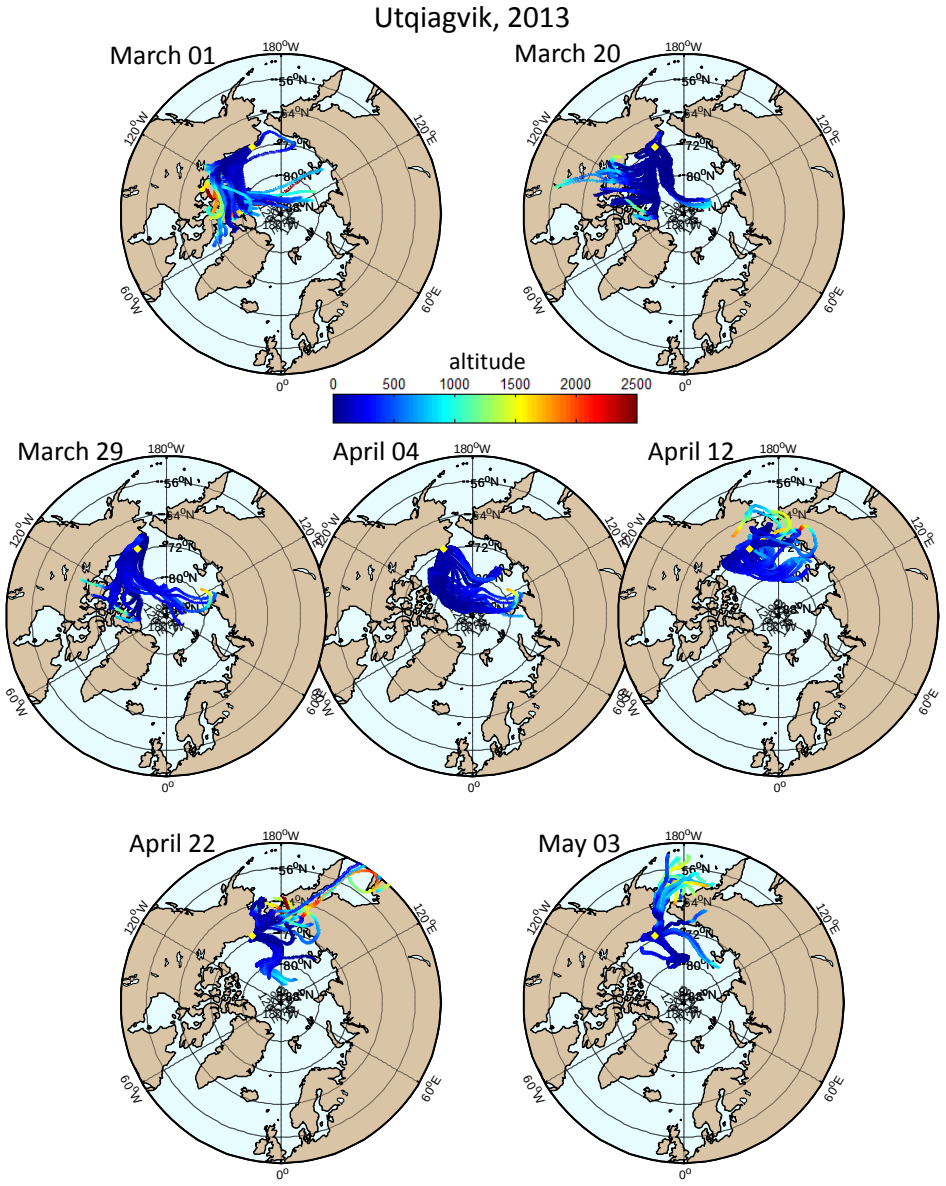

Figure S6. Similar to Fig. S5, but for Utqiaġvik.

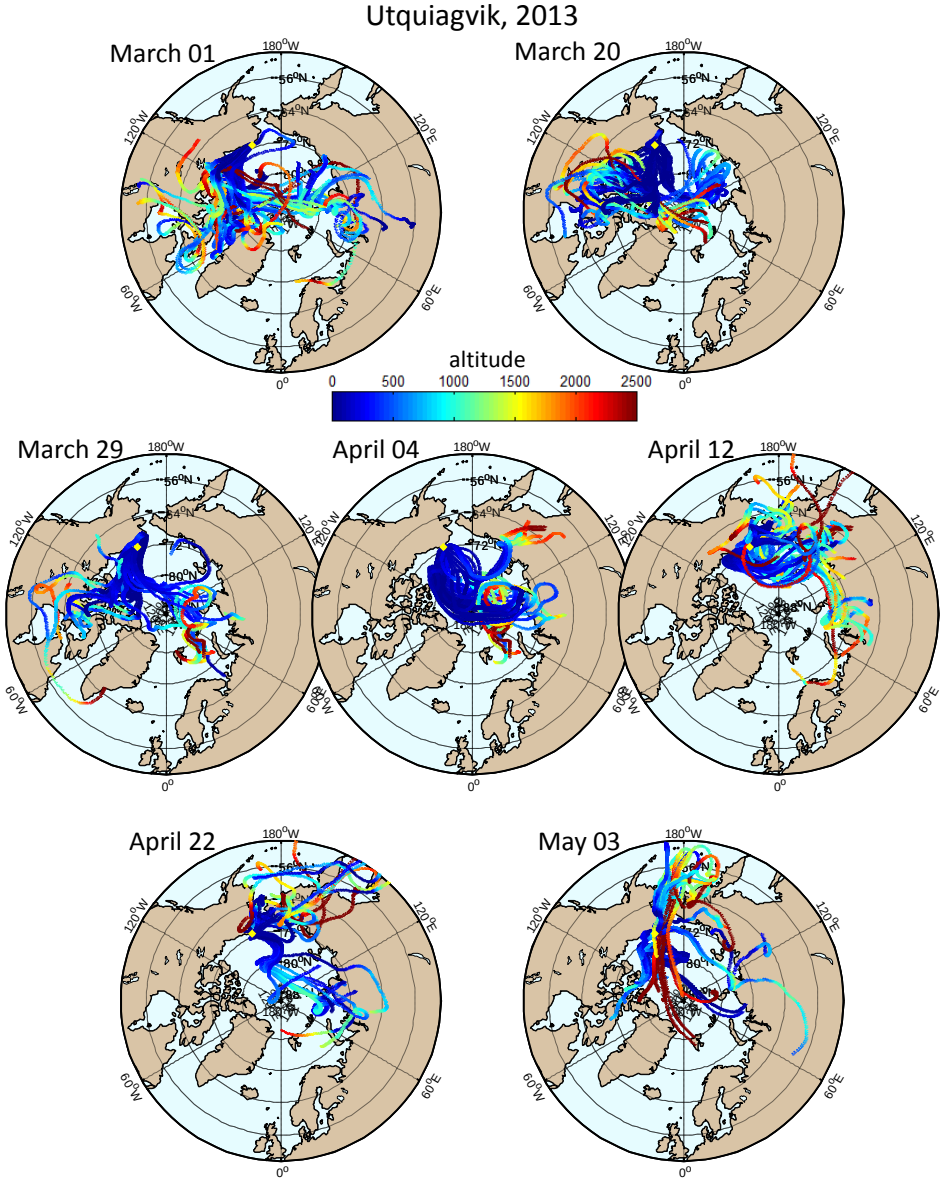

Figure S7. Similar to Fig. S6, but showing 10-day back-trajectories.

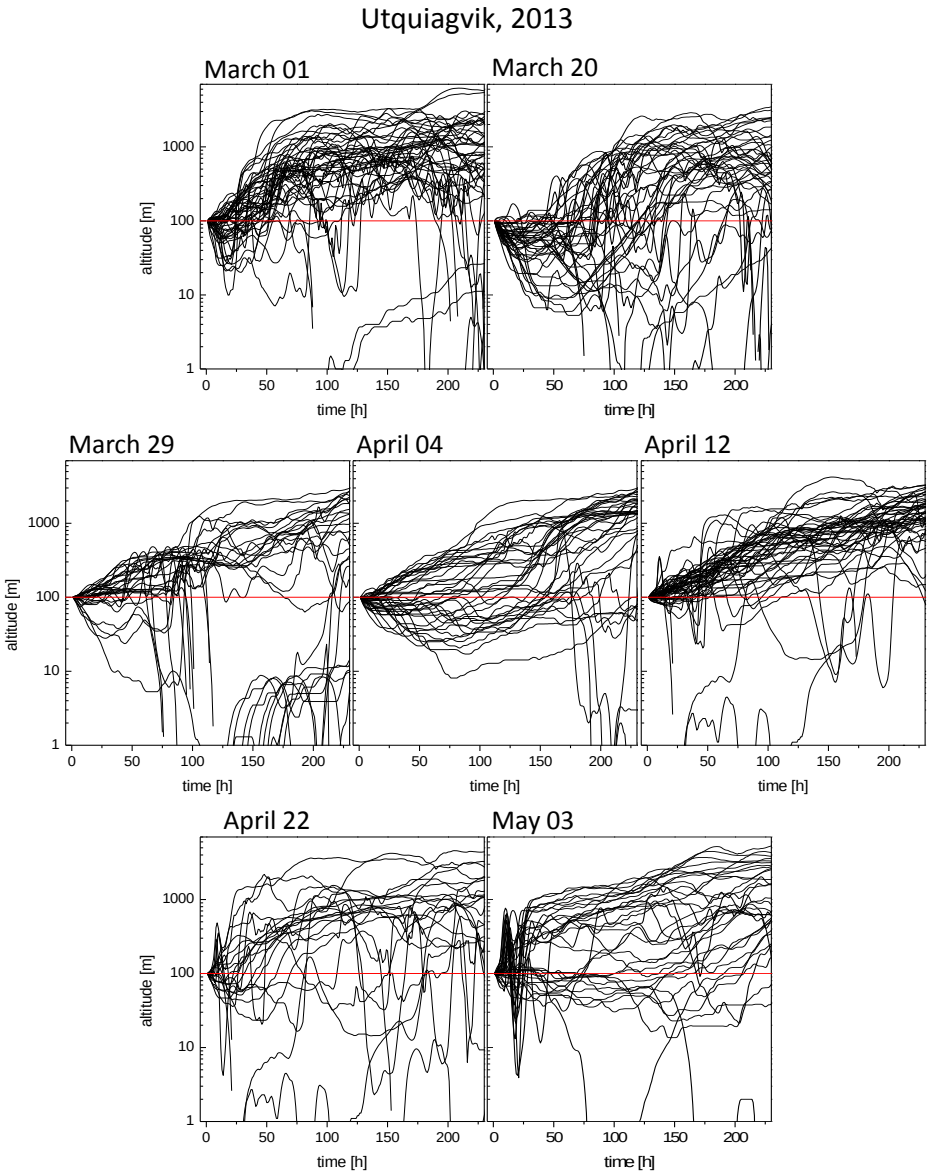

Figure S8. Altitudes of the 10-day back-trajectories displayed in Fig. S7.

3 Recommendations

We felt it could help future research if we shared some recommendations, based on lessons we learned. These are the following:

- It could be advantageous to sample on filters that allow for washing off particles, as this enables to do dilution series. With this, obtained data can cover a broader T range (e.g., polycarbonate membrane filters, Prince et al., 2018), compared to that obtained in the present study.

- A higher time resolution used in the filter sampling will facilitate source apportionment. Still, care has to be taken to sample enough material to be above the detection limit, as for the present study samples on which less than 60 L of air had been sampled onto each single circular 1 mm filter piece (i.e., into each examined droplet) could not be used as they were too close to the background (see above, SI 1). Therefore shorter sampling times have to be counterbalanced by higher flow rates during sampling. Supressing the filter background, if possible, would be of advantage, too.

- Sampling with in-situ devices (Rogers et al., 2001; Prenni et al., 2007) can complement off-line filter analysis, measuring down to lower T. However, they need comparably high N_{INP} to overcome their detection limits and hence typically do not obtain values at higher T where N_{INP} is lower.

- Parallel sampling of additional sufficient material to derive chemical composition enables more indepth testing of possible components present in INP. This might help to connect INP to their sources or to at least enable to corroborate the biogenic nature of those INP active at high T, using e.g. a test of the heat sensitivity of INP for the latter.

References

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