Comment on acp-2022-761
Anonymous Referee #2

Referee comment on "Ice Nucleating Particles in Northern Greenland: annual cycles, biological contribution and parameterizations" by Kevin Cheuk Hang Sze et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-761-RC2, 2022

Review Sze et al. (2022): Ice Nucleating Particles in Northern Greenland: annual cycles, biological contribution and parameterizations

Summary

In this study a two-year dataset of INP concentration measurements from an Arctic site is presented, to better understand the short- and long-term variability of this climate-relevant variable. Currently, only a few INP concentration measurements with a monitoring character exist, especially not in such a climate-sensitive location as the Arctic, which is why this study is of relevance to the aerosol-cloud interaction community. However, I have some major concerns which should be addressed before publication.

Major comments

- Parameterization: Which fraction of your sample is within a certain factor of the developed parameterization? E.g., are you able to predict the INP concentration accurately within a factor of 10, as deviations larger than this value can impact cloud microphysical and radiative properties (Phillips et al., 2003)?

- Case study: The linkage of an observed higher cloud ice fraction to an increased INP concentration in April 2020 as compared to the previous year is insufficient. First, to my knowledge, there is no evidence that ground-based INP concentrations can impact cloud properties observed on top of the cloud. Second, other parameters differ between April 2019 and 2020, for example, mean wind speed (potential impact from blowing snow) or a lower surface temperature in April 2019 (e.g., a greater impact of pre-activation of INPs; Conen et al., 2015). Moreover, it would be interesting to investigate if there was an enhanced impact from glacial dust sources or a higher biological activity in the ocean. In addition, in the late winter months, the Arctic haze phenomena (e.g.,
Shaw, 1995) can impact aerosol populations, which is not discussed here.

**Minor comments**

- What is the relevance of mixed-phase clouds in the Arctic winter regarding the radiative forcing?
- Is there an impact of blowing snow on the aerosol filters?
- In some cases, the mentioned publications are examples and do not represent all existing literature. Please check and make use of "e.g." in such cases or complete the cited literature.
- You mention that blank filters were collected weekly, but do not present them here. How high were the INP concentrations from those filters and did you consider using them for a background correction of the INP concentration?
- Lines 35 – 36: Reference for this statement missing.
- Lines 94 – 97: It might be worth mentioning that also the impact of glacial dust is increasing due to retreating glaciers (e.g., AMAP, 2021).
- Lines 125: What is the pore size of the polycarbonate filters?
- Line 152: What is the uncertainty in temperature regarding the 6 second time resolution of the camera and using a 1 °C/min cooling rate?
- Line 253: Can you quantify the variability in INP concentration better, e.g., using the standard deviation?
- Line 277: Statement „Their respective INP parameterizations are often used in atmospheric models“ needs a reference.
- Lines 333 – 334: Are there publications that can strengthen this statement („A common background of mineral dust particles throughout the year may exist“)?
- Lines 354 – 355: It might be worth explaining on which measurements the parameterizations from Cooper (1986) and Fletcher (1962) are based to understand the difference of three orders of magnitudes as compared to your parameterization.
- Line 426: In April 2019 there is a correlation coefficient of 0.86 between INP concentrations at -18°C and surface temperature.

**Technical comments**

- Line 5: The abbreviation „VRS“ is not used in the abstract, thus should not be introduced here.
- Line 473: „biolgocial“ should be „biological“.
- Check the use of hyphens: I believe it should be „ice-active“, „temperature-dependent“, etc.

**References**

AMAP, 2021. Arctic Climate Change Update 2021: Key Trends and Impacts. Summary for