RC1

Comment on "Measurement Report: A comparison of ice-nucleating particle and cloud condensation nuclei sources and properties during autumn at contrasting marine and terrestrial locations" by Wilbourn et al.

This manuscript presents aerosol, cloud condensation nuclei, and ice-nucleating particle measurements at two contrast sites, i.e., the marine site at ENA and the continental site at SGP. The description of the measurement is clear and comprehensive. There are concerns regarding the data cleaning and clarity of data result interpretation. Addressing the following major comments is imperative before the manuscript can be considered for publication:

AR: The authors appreciate the comments. We believe that the readability and the quality of this paper have improved with the changes made to the current version of the manuscript. Below, we provide our point-by-point responses.

Major comments

1. Data cleaning is missing in this study. Do you consider the CPC data cleaning at the ENA site? In line 382, the total particle number concentration should be much lower than ~3000 cm^{-3} after data cleaning. A previous study by Gallo et al 2020 (https://acp.copernicus.org/articles/20/7553/2020/) has shown that the ENA site is very often polluted.

AR: L353-356 – The authors thank the referee for providing us with a useful reference. Concerning the anthropogenic influence, especially at ENA, we considered the CPC data cleaning by means of black carbon mass concentrations (m_{BC}) as a pollution indicator and excluded notable m_{BC} spikes. We now clarified this point with the suggested reference in Sect. 2.5.2 – "Black carbon can be indicative of anthropogenic influence. For instance, at ENA, due to airport operations, a minute average n_{aer} can instantaneously exceed 8000 cm^{-3} (Gallo et al., 2020). Therefore, the periods corresponding to spikes in black carbon above 50 ng/m^3 were removed from the overall data set to remove local anthropogenic influence (Sanchez et al., 2021)." With this data cleaning process, we were able to remove notably high n_{aer} reported in Gallo et al. (2020). As a result, our median n_{aer} is 393.25 cm^{-3} as stated in Sect. 3.1. This number is within the seasonal baseline n_{aer} values of 346 cm^{-3} (winter) to 428 cm^{-3} (summer) from the Aerosol and Cloud Experiments campaign in 2017 as reported by Gallo et al. (2020).

In addition, in Sect. 1 (L399-404), we added the following sentences – "This number at ENA is within the seasonal baseline n_{aer} values of 346 cm^{-3} (winter) to 428 cm^{-3} (summer) from the ACE-ENA campaign in 2017 (Gallo et al., 2020). Even long-term ENA-CPC data from 2015 to 2021 support the seasonal variation between ≈ 300 cm^{-3} (winter) and ≈ 600 cm^{-3} (summer) at ENA (Ghate et al., 2023). At SGP, our median n_{aer} of 3055 cm^{-3} is similar to the previous total aerosol abundance measured at SGP for air masses flow from typical Midwest (2304 cm^{-3}) and Northwest (3369 cm^{-3}) in May 2003 reported in Wang et al. (2006)."

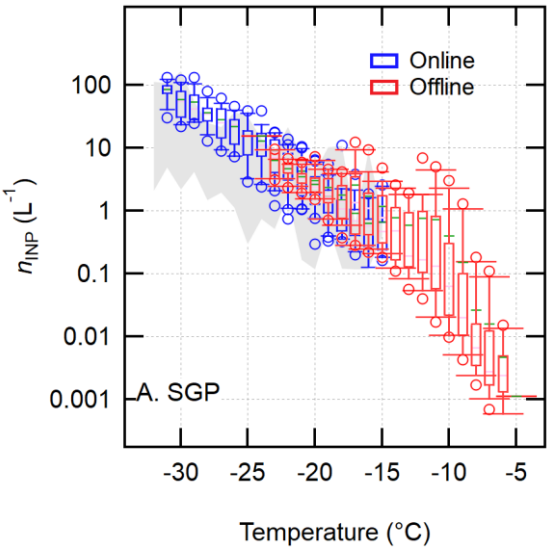
Minor comments

1. L 41: -32 ºC or -38 ºC for the homogeneous freezing?

AR: L60-61 – Corrected. New sentence reads as " to approximately -35 °C (238 K) or below."

2. L528: It is unclear to me what agreement (i.e., agreement between what and what) you are referring to.

AR: Figure 8 & associated text in L595 onward – We now clarify a good agreement between online and offline n_{INP} measurements is observed at SGP in Sect. 3.4.



The figure above shows the comparison of online vs. offline $n_{INP}(T)$ spectra with blue and red box plots, respectively, from SGP. The online PINE-3 spectra from SGP are time-averaged for 48-hour to match with the aerosol sampling time intervals for the offline INP analysis. The offline spectra are all non-heated data. Individual boxes display median (orange line), average (green line), 25% & 75% percentile (whiskers), and outliers beyond 5% & 95% percentile values. The grey-shaded area shows the maximum and minimum $n_{INP}(T)$ measured by DeMott et al. (2015) for SGP.

3. L554-555: My impression is that PINE-2 usually measures immersion freezing INPs, as the supersaturation created inside the chamber. Please correct me if I am wrong.

AR: L640-650 – The referee is right that PINE mainly measures immersion freezing INPs. However, PINE can measure INPs formed through pore condensation freezing and deposition freezing processes at ice supersaturation yet water subsaturated conditions. More clarification is provided in Sect. 3.4. The authors also made our clear point that the deposition mode was missing in offline analyses.

4. L575-580: The CAF values show large variations for two sites. Only comparing the median value is not reasonable. Better compare the probability density function of CAF at two sites.

AR: The authors agree. Considering we do not have size-dependent chemical composition measurements, the authors realize that the comparison of CCN and INP is complex to deduce valid conclusions in this measurement report. We removed Section 4 Discussions, SI Section S14, and Figure 10, which discussed this INP-CCN comparison. We also removed CCN discussions from the Abstract, Section 3.5, Fig. 9, Table 2, and Table S7.

L456 -: We revised the manuscript focusing on INP research. Such long-term INP data from SGP and ENA are unique and novel. The revised manuscript discusses the trends and general comparison between the two sites. We considered the probability density function of INP concentrations and ice nucleation efficiency, n_s, in the revised manuscript in Sect. 3.2 (L456-). We also changed the title to "Measurement Report: A

comparison of ground-level ice-nucleating particle abundance and aerosol properties during autumn at contrasting marine and terrestrial locations" to represent the revised content and edits we made according to the referee's suggestions and comments.

5. L608: Change "can be" to "is likely".

AR: Due to the reason addressed above, this part is now removed from the manuscript.

6. A recent study by Ghate et al. 2023 (https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2023JD038636) should be discussed when discussing the aerosol and CCN at the ENA site.

AR: L400-402 – Thank you for this useful reference. We now added, "Even long-term ENA-CPC data from 2015 to 2021 support the seasonal variation between ≈ 300 cm^{-3} (winter) and ≈ 600 cm^{-3} (summer) at ENA (Ghate et al., 2023)." in Sect. 3.1.

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