

General comments:

The manuscript provides an intriguing exploration of the sources and properties of INPs and CCNs, while the study addresses an intriguing and important topic, significant improvements in clarity, structure, grammar, data analysis, and the careful drawing of conclusions are necessary to meet the rigorous standards of scientific publication.

Major comments:

1. The manuscript is challenging to follow. The scientific objectives are not articulated clearly and lack a defined scope. It's crucial for the manuscript to provide a clear and comprehensive explanation of the relationship between CCN and INPs. As immersion freezing INPs are initially CCN before acting as nuclei for ice crystal formation, What does a strong correlation imply? This issue is compounded by a disjointed logical structure, making it difficult for readers to follow the progression of your study. In addition, a well-organized manuscript with a clear introduction, methodology, results, and conclusion is critical needed.

2. The manuscript's conclusions are replete with conjectures and assumptions not robustly supported by the data presented. e.g. how can the author conclude the influence of the mineral dust on INPs at ENA without any aerosol size distribution and also no chemical components. Scientific studies should draw conclusions directly and cautiously from the results, avoiding overgeneralization and unwarranted speculation. It's essential to clearly state the limitations of your study and discuss the conclusions within the context of these limitations.

3. The analysis presented appears to be superficial and does not delve deeply into the complexities of the data. A more rigorous and detailed statistical analysis is crucial to understand the nuances and implications of your findings fully.

Specific comments:

1. In the Introduction, mischaracterize immersion freezing mechanisms INPs. The immersion freezing should also include the condensation freezing.

2. Regarding the comparison between PINE and offline freezing droplet measurements, it appears that no direct comparison has been provided. From the current presentation in Figure 6 and Figure 8, at least, it is not discernible. These figures should be redrawn to clearly illustrate the comparison and provide a more direct and insightful analysis of the results.

3. About BC measurement using PASP, 'with the absorption at 529 nm most 330 representative of black carbon aerosols'. The PASP can provide aerosol absorption coefficients at three wavelength, the red light can represent BC characteristic more.