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# Investigating the controls on the ice crystal number concentration using satellite observations

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The ice crystal number concentration ($N_i$) is a key radiative and microphysical property of ice clouds. However, due to sparse in-situ measurements of ice cloud properties, the controls on the $N_i$ have remained difficult to determine from observations. As more advanced treatments of ice clouds are included in global models, it is becoming increasingly important to develop strong observational constraints on these ice cloud processes.

In this work, we use the DARDAR-LIM retrieval of $N_i$ to examine the controls on $N_i$ at a global scale. Using a classification for cloud type and reanalysis data to determine the meteorological state, the effects of temperature, a proxy for in-cloud updraught and aerosol concentrations are investigated. Along with a strong impact of temperature and updraught on the $N_i$, variations in the cloud top $N_i$ consistent with both homogeneous and heterogeneous nucleation are observed. Comparisons with reanalysis aerosol and a proxy for the occurrence of ice nucleating particles show a varying role of aerosols based on the aerosol and cloud properties.

This dataset provides a new way to investigate the properties of ice clouds and their controls at a global scale. The results presented here increase our confidence in the retrieved $N_i$ and provide a basis for further studies into mixed phase and ice cloud processes.