High Latitude Aerosol-Cloud Interaction during MARCUS: The role of CCN variability and links to Precipitation

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Question: Is observed variability in cloud droplet number and associated *marine cloud brightening* in the East Antarctic Marginal Ice Zone associated with distinct variability in air mass history?

Introduction

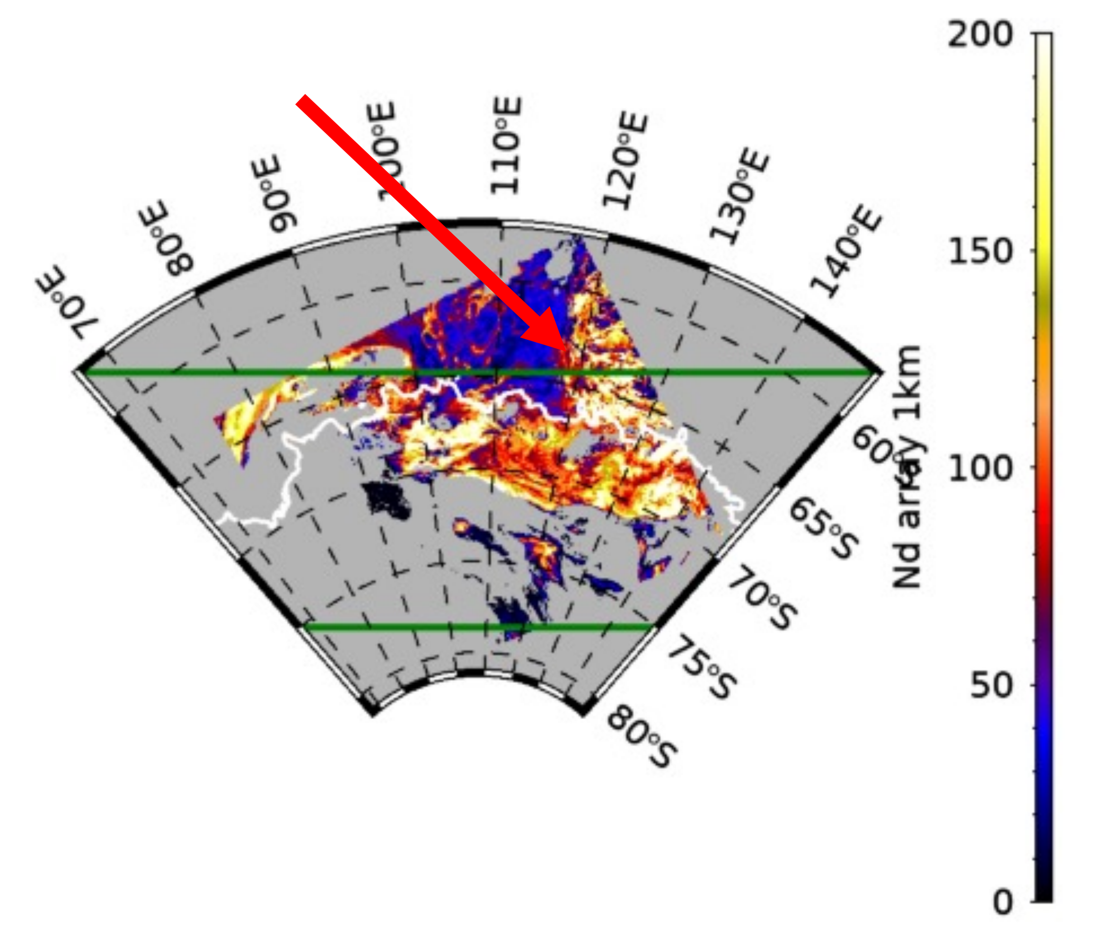
- The Southern Ocean (SO) is a pristine region removed from anthropogenic influence (1).
- Over the broader SO, aerosol and CCN demonstrate large seasonal oscillations thought to be associated with marine biology (2).
- Over the broader SO, marine Boundary Layer (MBL) Clouds also demonstrate seasonal oscillations in droplet number (N_d) (3).
- In the Marginal Ice Zone of East Antarctica (MIZ), aerosol numbers and chemistry vary substantially based on air mass history (4)

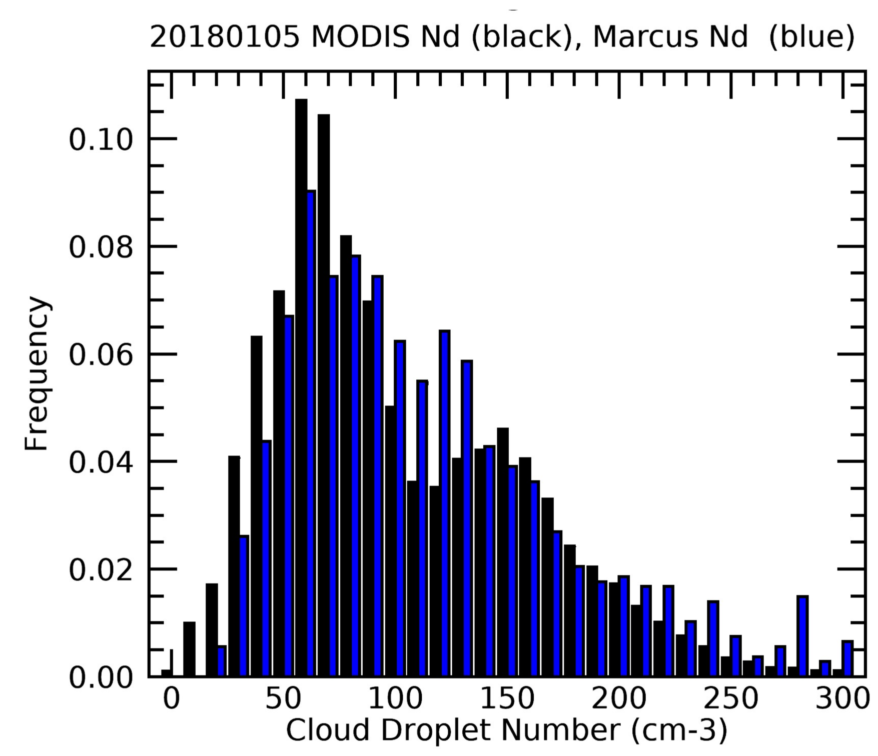
Method

- Remote sensing observations from ARM MARCUS on the Aurora Australis and CAPRICORN on the RV Investigator (Summer 2018).
- MODIS L2 Collection 6 (Summer 2018).
- HYSPLIT 5-day back trajectories from low level clouds in MIZ using GDAS meteorology.
- N_d and other cloud cloud properties are derived from surface-based lidar and radar data (5) and from MODIS Level 2 retrieved microphysics (6).

Results

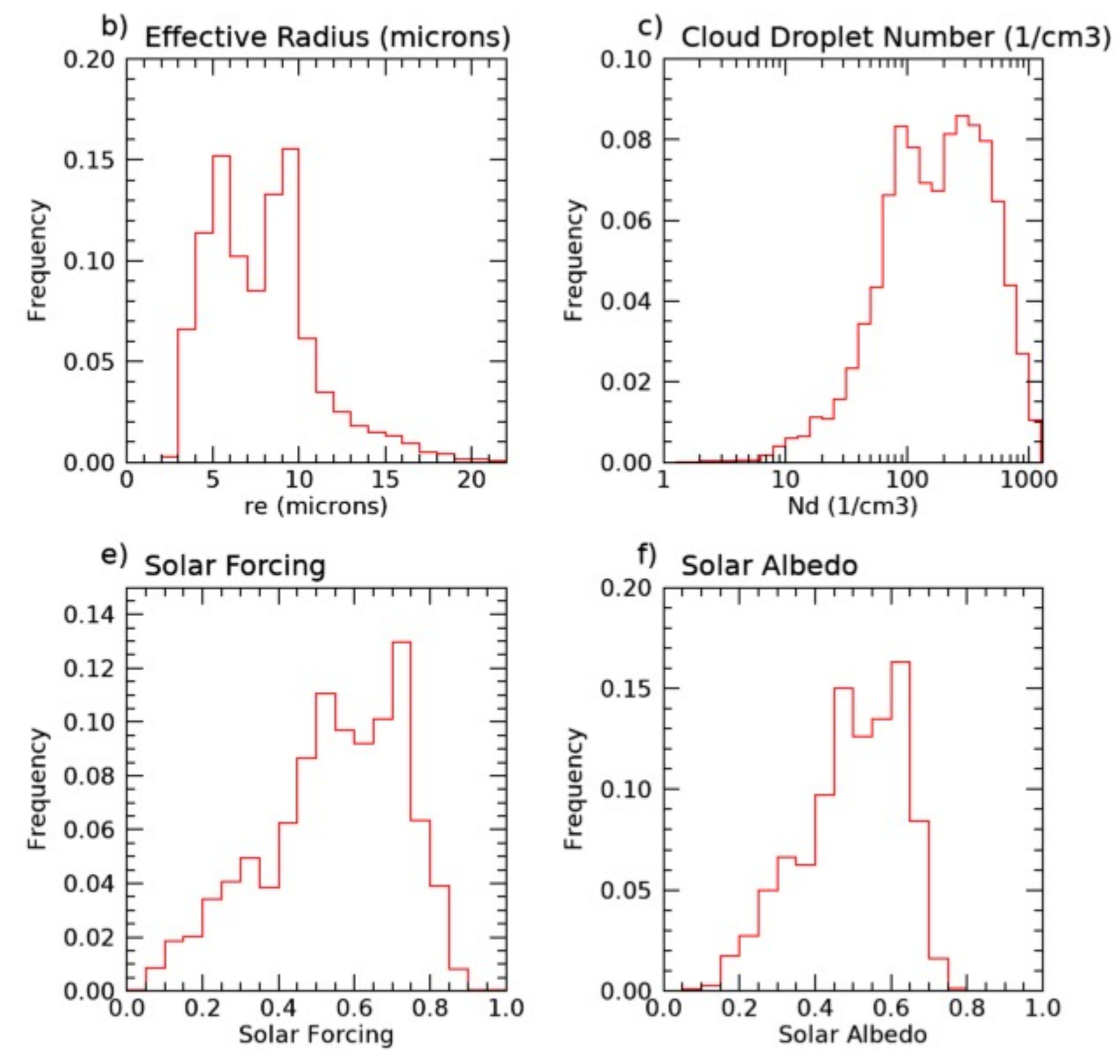
We find distinct boundaries in MBL cloud N_d over the MIZ during Summer. Shown below is N_d derived from level 2 Aqua MODIS data (6). Red arrow points at an N_d boundary along 119 East that was sampled by the MARCUS instruments on the Aurora Australis.

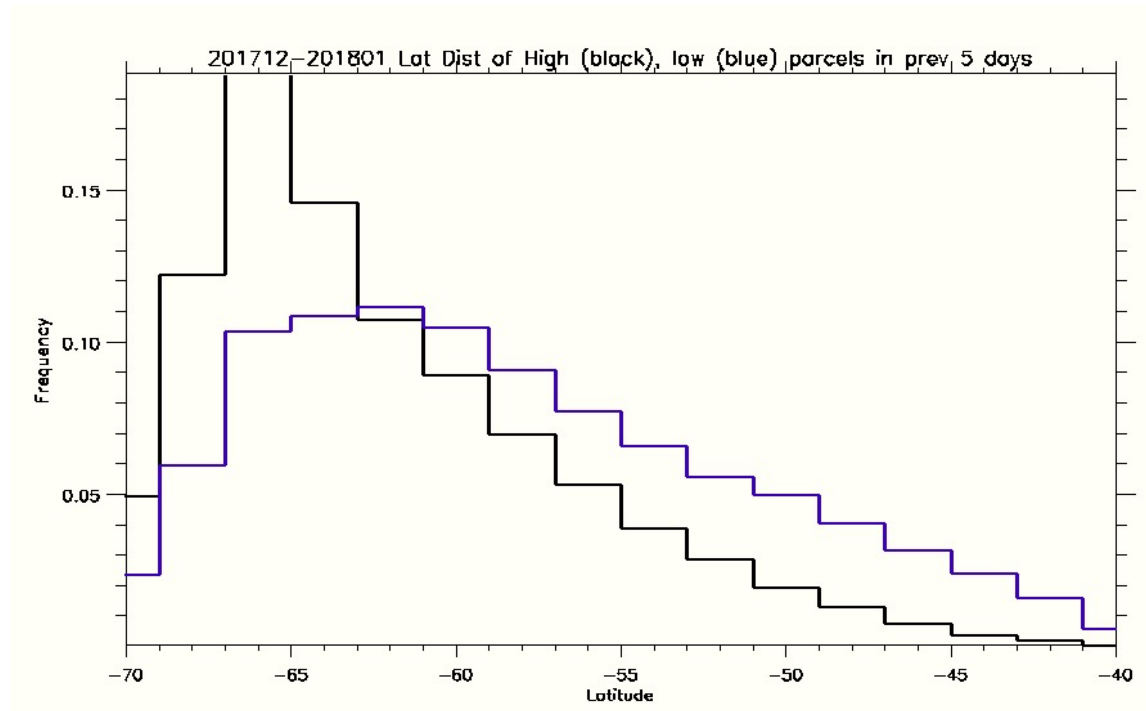




MODIS and MARCUS bimodal N_d PDFs from common regions and times in the MIZ on January 5, 2018.

From MARCUS and Capricorn (5), bimodality in cloud microphysics in the MIZ contribute to distinct bimodality in solar radiation suggestive of natural Marine Cloud Brightening (7).





Latitudes of 5-day back trajectories for high Nd (> 100 cm^{-3}, black) and low Nd (<50 cm^{-3}, blue) MODIS regions observed in the MIZ during summer 2018. **High N_d air masses spend significantly more time over high latitudes while low N_d air masses arrive from trajectories that originate over open oceans to the north.**

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