

The linkages of aerosol and ice initiation in Arctic mixed-phase clouds as observed by long-term ACRF ground-based and A-train satellite observations

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1. Motivation and goal

Mixed-phase clouds play an important role in the climate system, especially in the Polar regions, but are still poorly understood and simulated. There is an order of magnitude difference among existing heterogeneous ice nucleation parameterizations. The goal of this study is to explore the linkages of aerosol and ice initiation in Arctic mixed-phase clouds with the synergy of ACRF ground-based high temporal and detailed measurements and A-train satellite arctic wide measurements.

2. Seasonal aerosol and cloud variations observed at Barrow

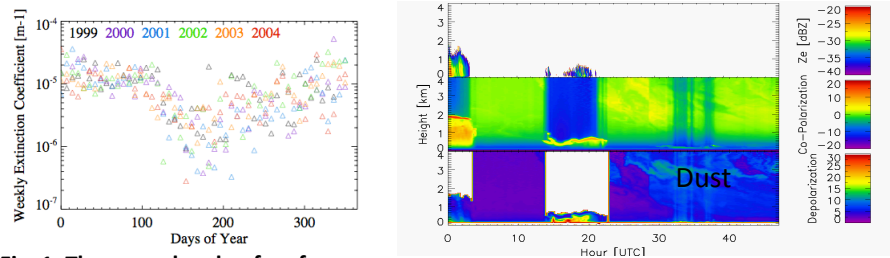


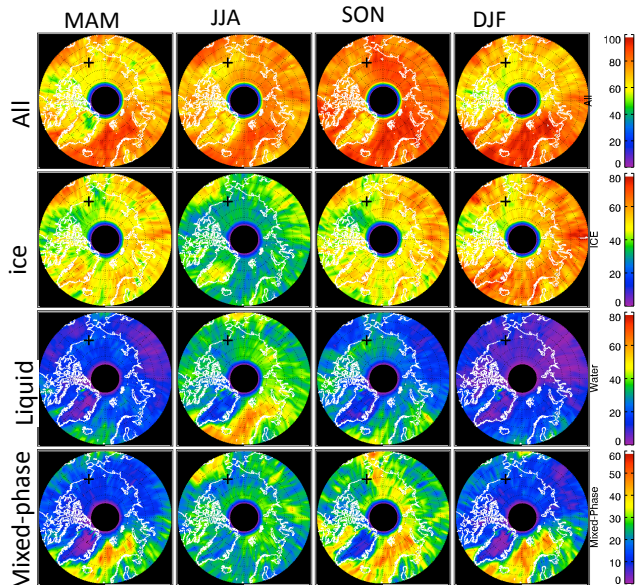
Fig. 1. The annual cycle of surface aerosol extinction at the Barrow site.

Fig. 2. An example of Spring time dust storm (17-18 March, 2011) observed at the Barrow site.

3. Seasonal aerosol and cloud variations observed by A-train satellites

Fig. 3. Ice, liquid, and mixed-phase cloud distribution in Arctic as observed by CloudSat and CALIPSO.

The “+” indicates the Barrow site, which is a nice location to capture the seasonal arctic mixed-phase cloud variations.



4. The impact of aerosols on ice generation in Arctic mixed-phase clouds

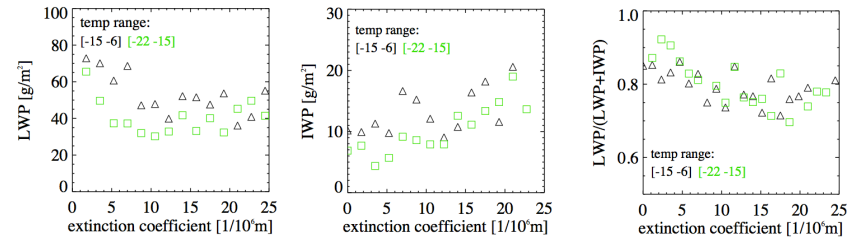


Fig. 4. Boundary layer mixed-phase cloud properties vary with aerosol extinction coefficient at the Barrow site.

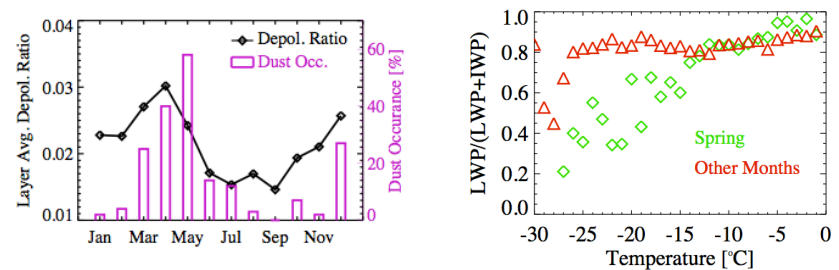


Fig. 5. At the Barrow site, spring time dust affect liquid-ice mass partition in mixed-phase clouds significantly.

5. Satellite observations confirm the enhanced spring time ice generation in arctic mixed-phase clouds

The stratiform cloud distribution as a function of cloud top temperature and Z_e maximum within the 500 m of cloud top of mixed-phase clouds in Arctic and Antarctic from CloudSat and CALIPSO. Z_e magnitude differences at a given temperature indicate different ice number concentrations.

The different seasonal variations of ice generation in Antarctic and Arctic regions, which indicates strong aerosol impacts on heterogeneous ice nucleation.

