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Long-Term Lidar and Radar Observations of Arctic Stratus at Two Locations

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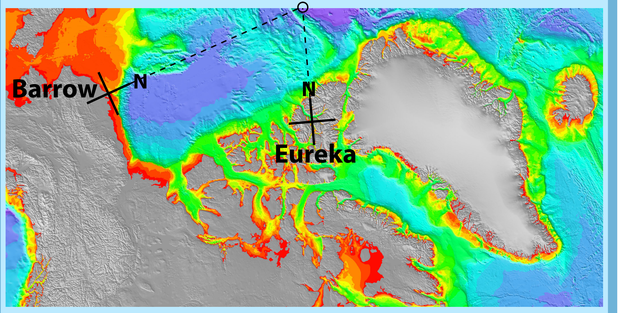
M.D. Shupe (NOAA Earth System Research Laboratory)

Introduction

Mixed-phase clouds remain a difficult problem for both the observational and modeling communities. In particular, improved understanding of mixed-phase clouds in the Arctic is crucial because of radiative effects they impart on a region that is particularly sensitive to change. In order to better understand these cloud structures, the University of Wisconsin Arctic High Spectral Resolution Lidar (AHSRL) has been deployed to two different Arctic locations. The first deployment lasted two months and was to Barrow, AK in support of the Mixed-Phase Arctic Clouds Experiment (M-PACE). The second deployment is ongoing, and so far over two years of data have been collected at Eureka, Canada. In both locations, the lidar was co-located with a NOAA Millimeter Cloud Radar (MMCR). Mixed phase stratus has been readily detected at both locations, and we currently have measurements for hundreds of hours of stratus cases. Results shown here are for both locations for single-ayer clouds only. Represented are 532 half-hour cases for Barrow, and 1569 for Eureka.

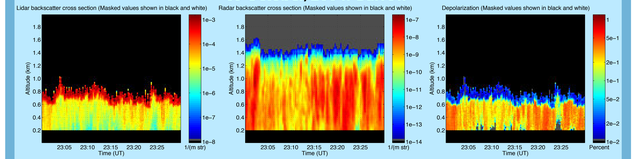
Observation Sites



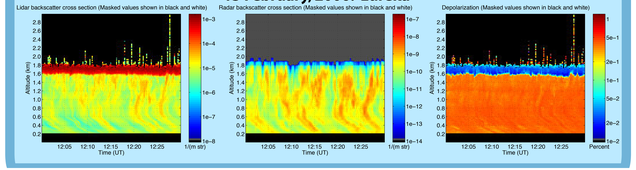
The seatainer housing for the AHSRL in Barrow (left) and Eureka (right). The map of the western Arctic (top) shows the differences in location between Barrow and Eureka. (Bathymetric chart produced by and courtesy of the NOAA IBCAO program: http://www.ngdc.noaa.gov/mgg/bathymetry/arctic/arctic.html) Also visible in the Eureka picture is the antenna for the NOAA millimeter cloud radar (MMCR).

Mixed-Phase Arctic Stratus

09 October, 2004: Barrow



15 February, 2006: Eureka

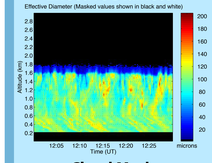


Lidar/Radar Microphysical Retrievals

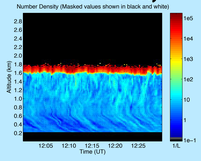
Based on method by Donovan and Van Lammeren (2001)

15 February, 2006: Eureka

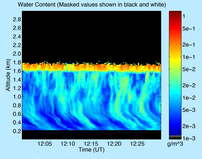
Effective Diameter



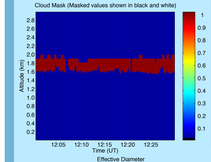
Number Density



Water Content

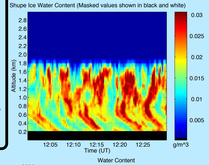


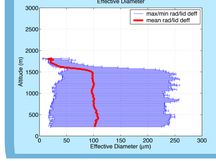
Cloud Mask

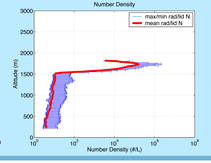


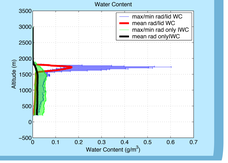
TOP: Retrieved effective diameter, number density and water content from the AHSRL/MMCR combination.
LEFT: A cloud mask derived from the MMCR and AHSRL.
RIGHT: Ice water content as derived from the radar only (reflectivity relationship: SHUPE, 2005).
BOTTOM: Mean vertical profiles of the retrieved quantities for this half hour period, with ranges plotted.

Radar IWC (Shupe, 2005)



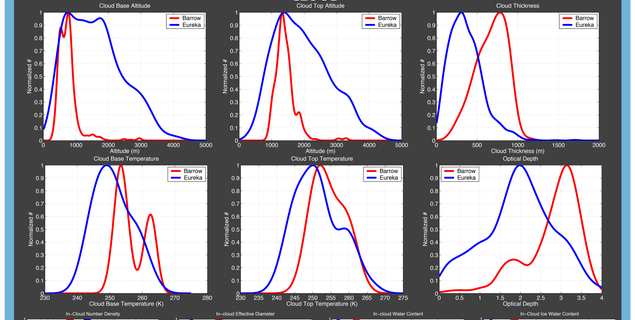


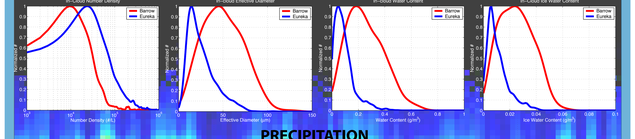




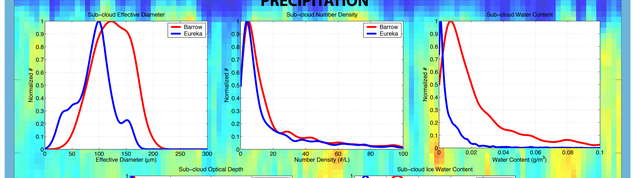
Long-Term Stratus Properties

CLOUD

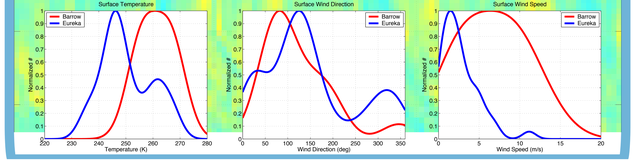




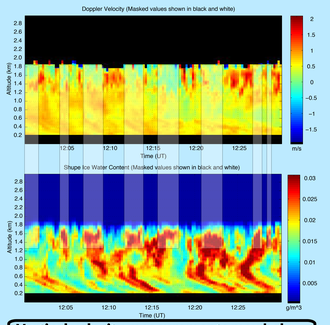
PRECIPITATION



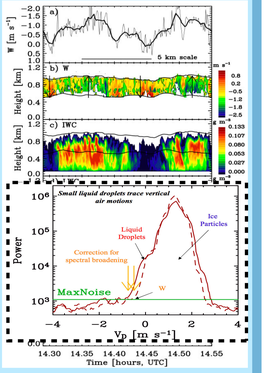
SURFACE



Vertical Motion

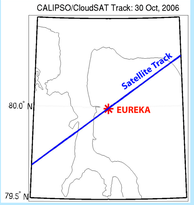


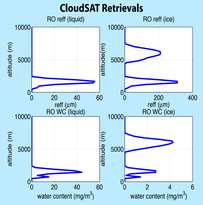
Vertical velocity measurements may help in explaining the horizontal variability of the observed precipitation structure. Here, the doppler spectra are used to look at vertical motion in the cloud layer.

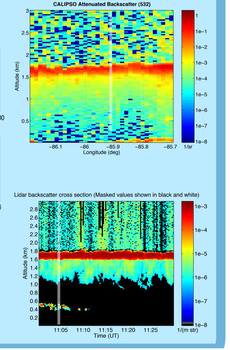


Figures courtesy of M. Shupe

A View From Above







The CloudSAT and CALIPSO platforms allow for greater spatial coverage of these clouds. Shown are examples from October 30, 2006. Similarities between the ground and space based observations are shown at right.

Acknowledgements

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