The ARM CPM/GCSS M-PACE Intercomparison

MPACE = Mixed-Phase Arctic Cloud Experiment

Collaborative effort of

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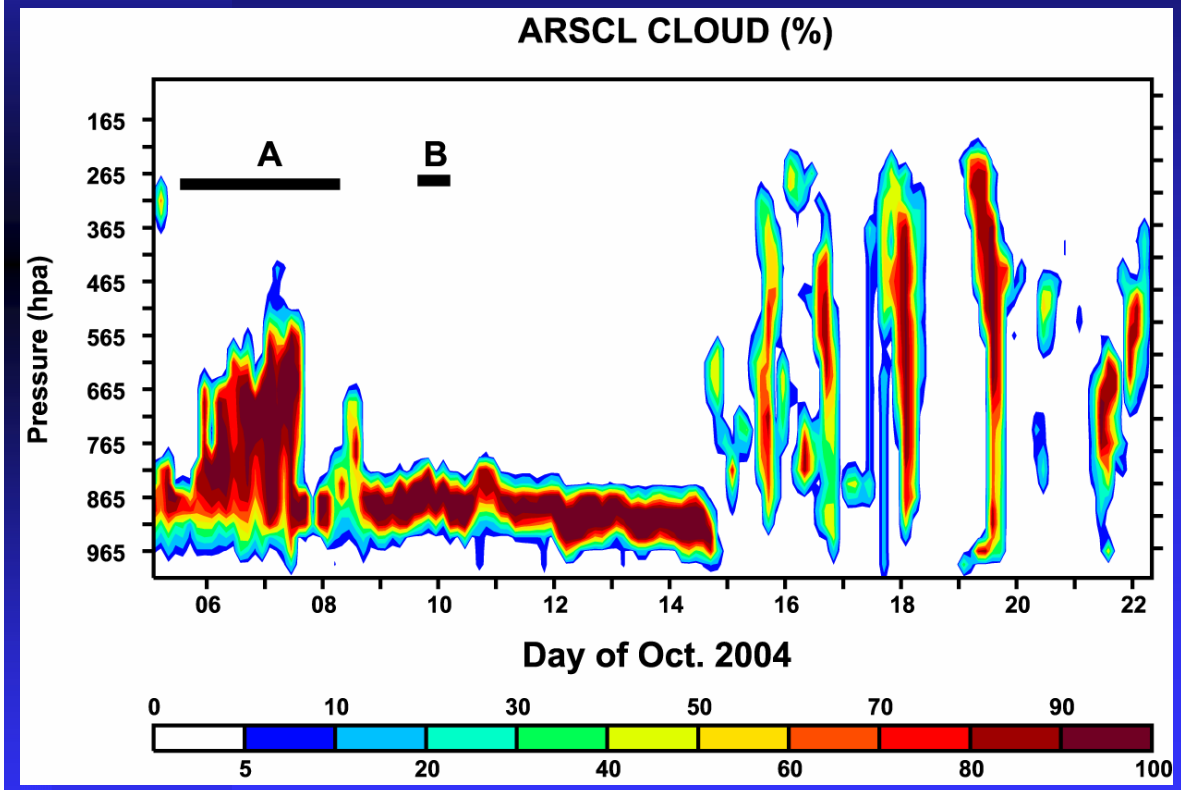
Science Goals

- Document the current state of mixed-phase cloud microphysics in models
- Understand differences between models in their simulations of mixed phase cloud microphysics
- Spur improvements in the representation of mixed phase cloud microphysics in climate and cloud resolving models.

Periods of Interest

Barrow Cloud Observation



Period A

Multi-layer mixed-phase stratus formed in low-level uplift

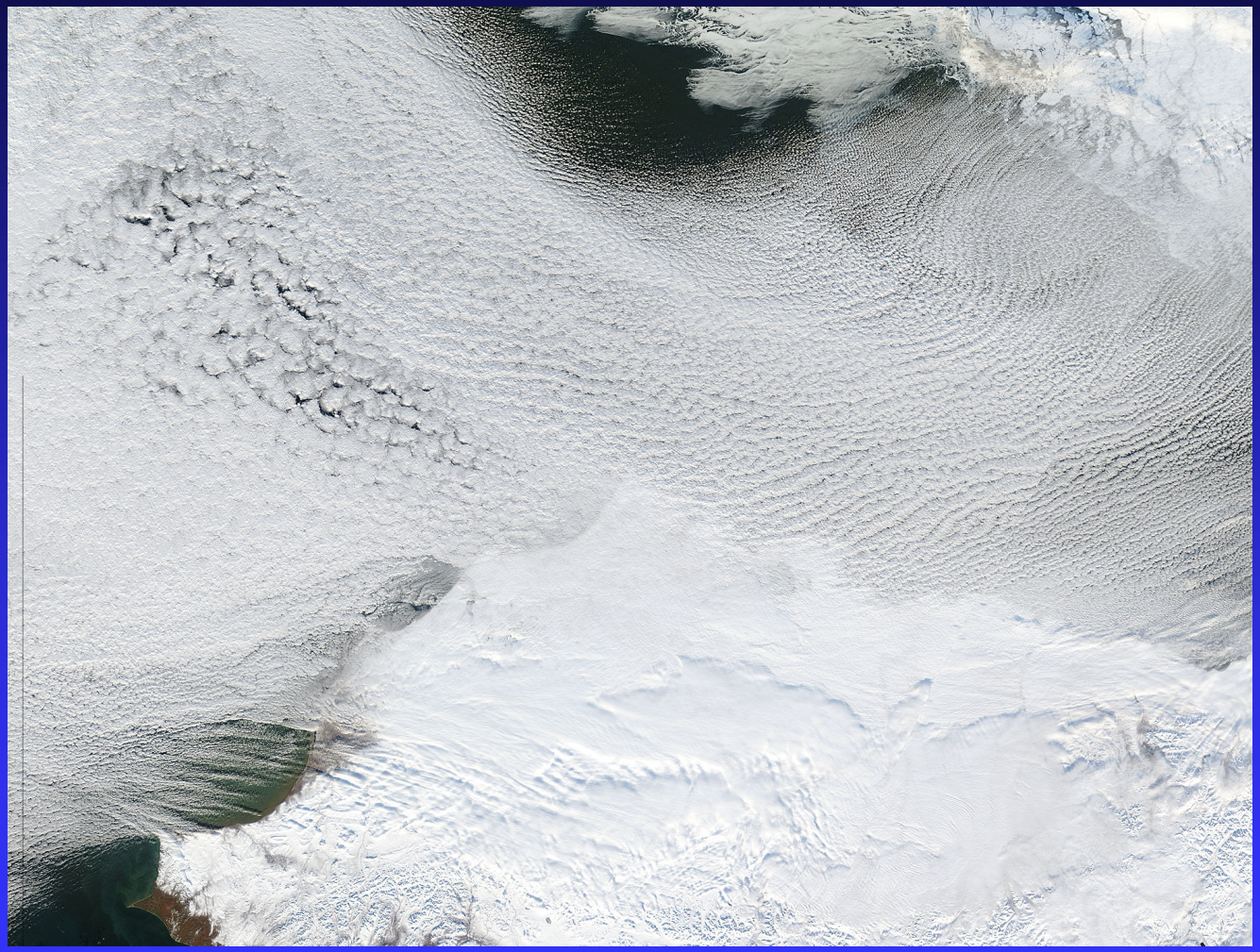
Suitable for SCM/CRM models

Period B

Cold-air outbreak, well-mixed, mixed-phase, single layer stratocumulus

Suitable for SCM/CRM/LES models

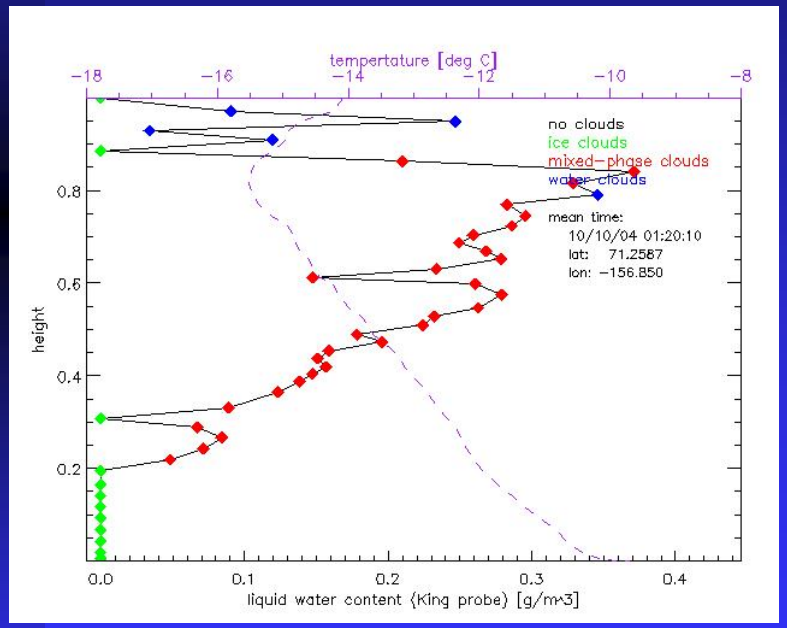
Period B

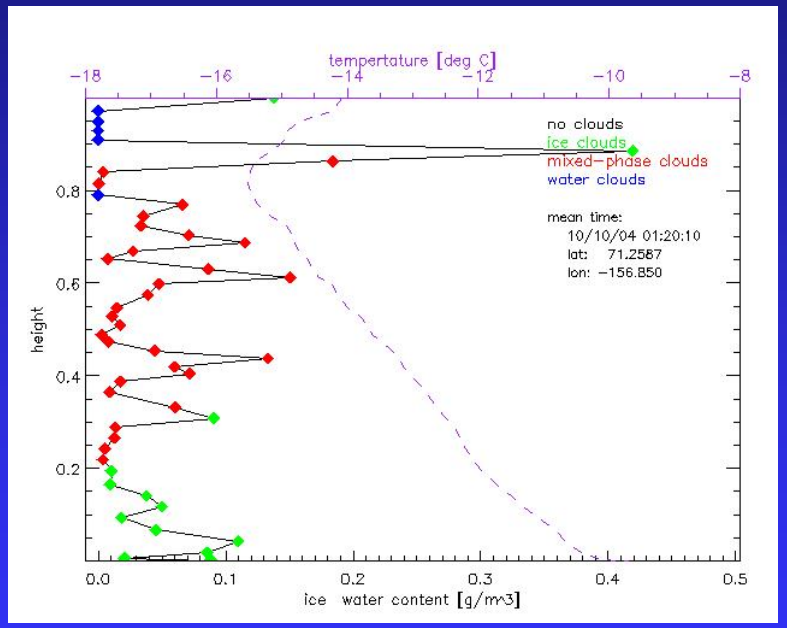


NASA TERRA Visible Composite for October 9

Citation Aircraft Data

Provided by Greg McFarquhar & Gong Zhang

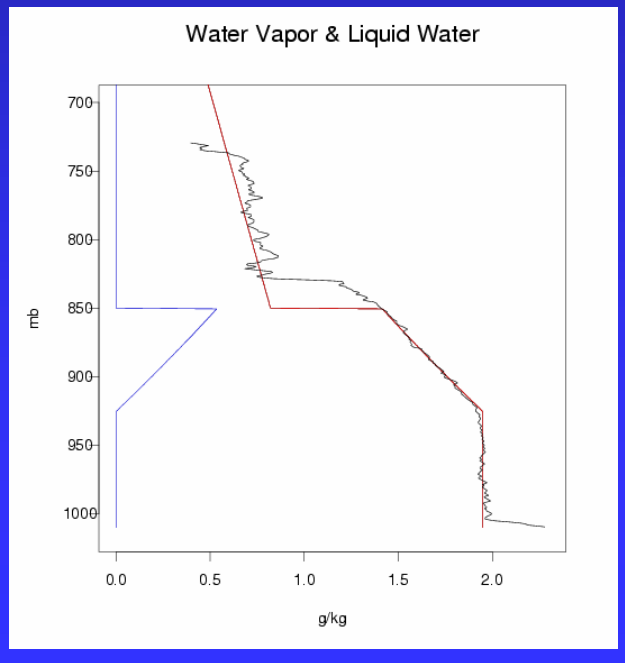


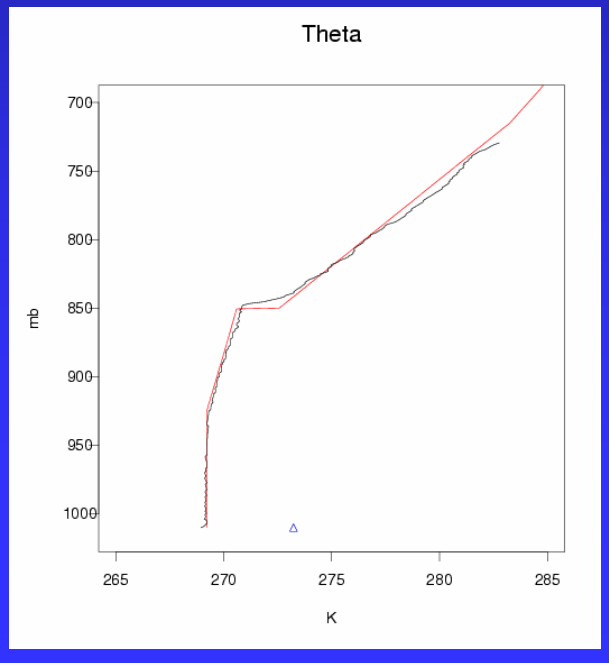


Also effective radii and cloud particle concentrations for liquid and ice

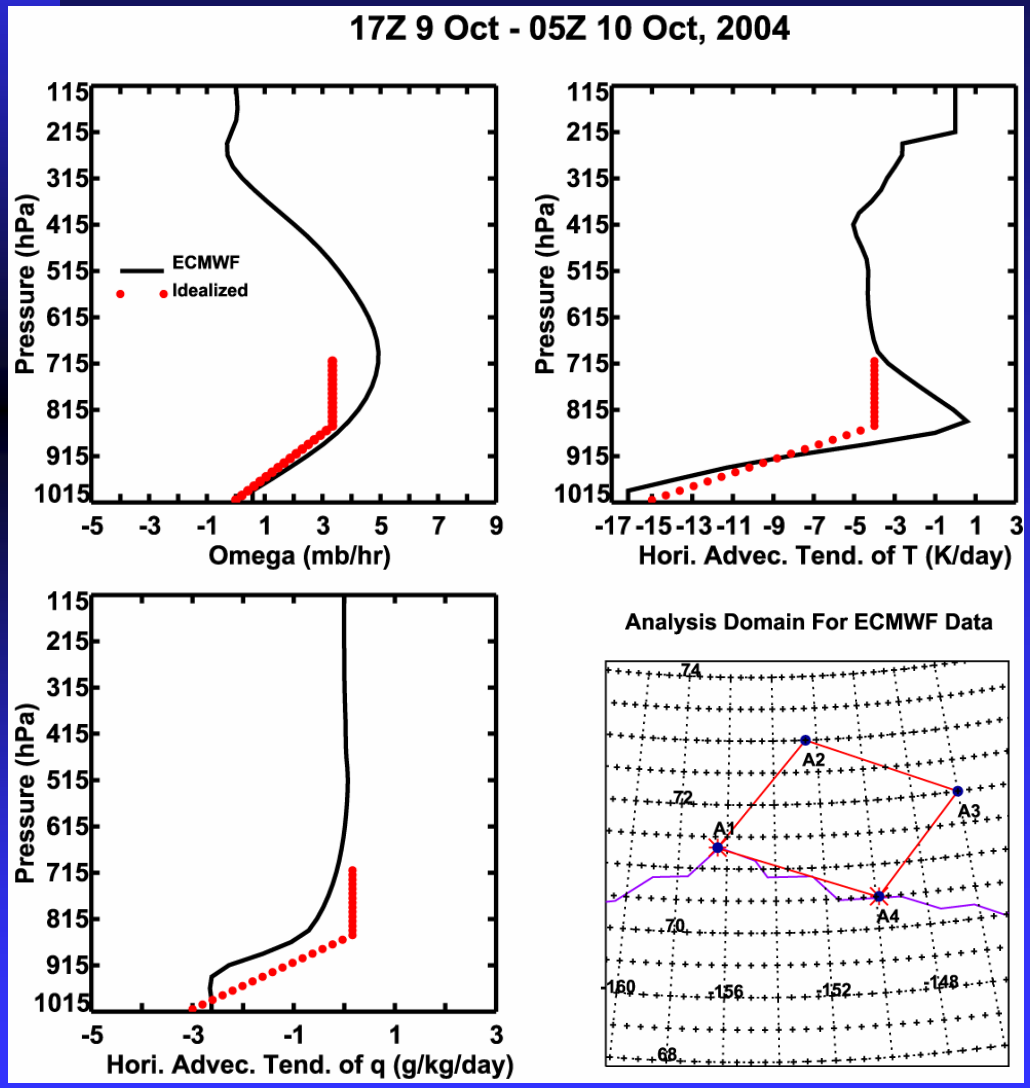
Model Specifications

- Simulate 17Z 9 October to 5Z 10 October
- Well-mixed liquid phase only boundary layer as initial condition *(note initial condition has a liquid water path of ~ 200 g m^{-2} consistent with MWR observations at Barrow and Oliktok Point)*





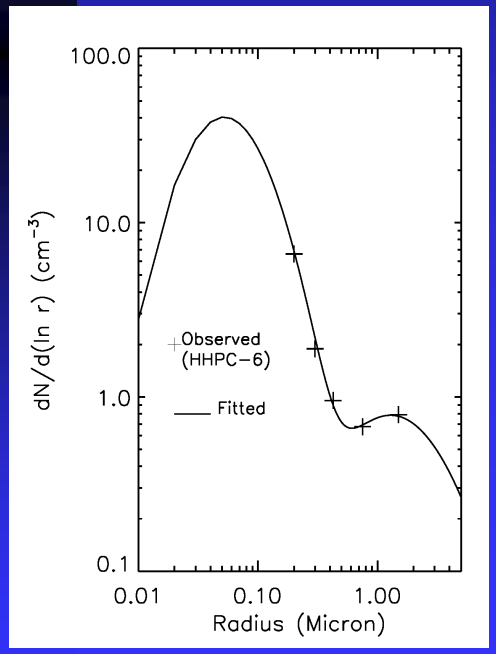
Model Forcings



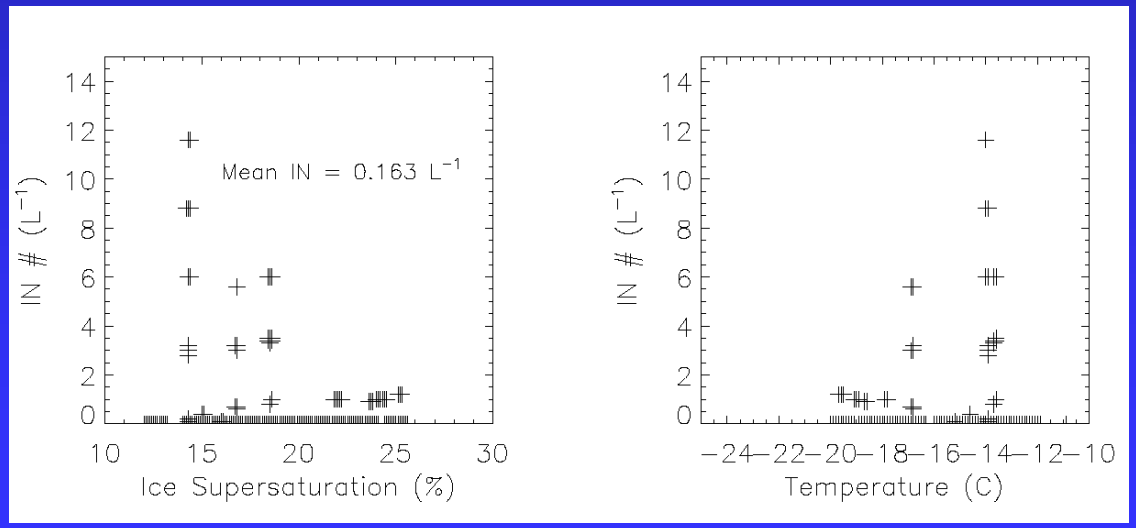
- Specified ECMWF surface fluxes of 136.5 W m^{-2} sensible and 107.7 W m^{-2} latent heat
- Interactive model-computed radiation

Aerosol Specifications

Dry aerosol specification

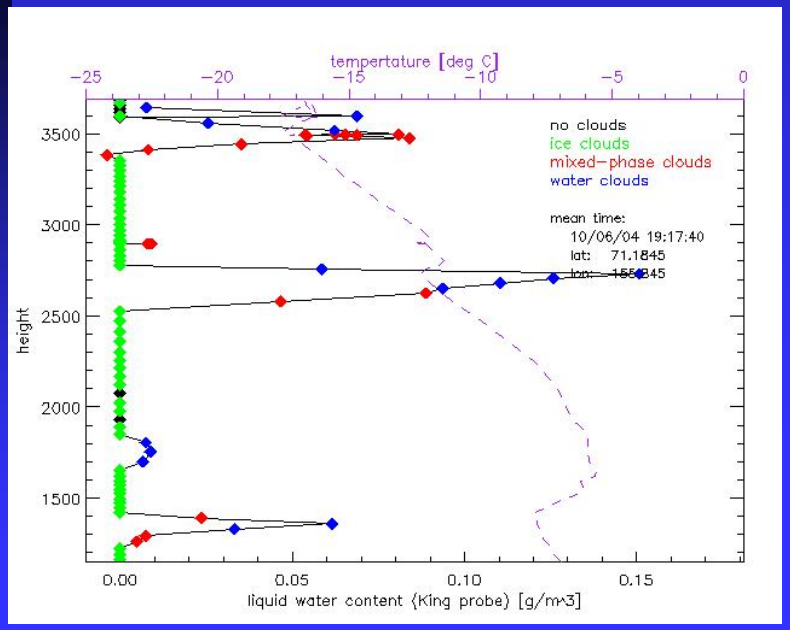


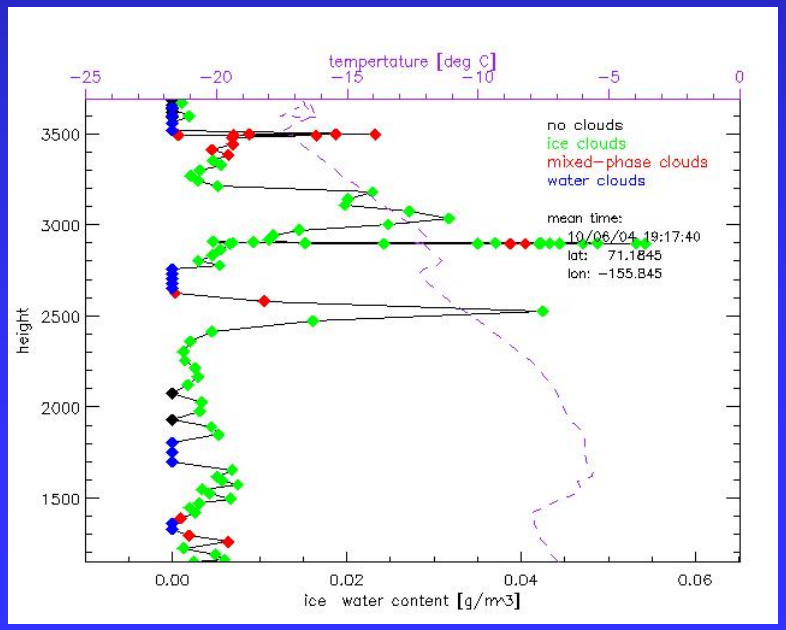
Ice Nuclei Activation



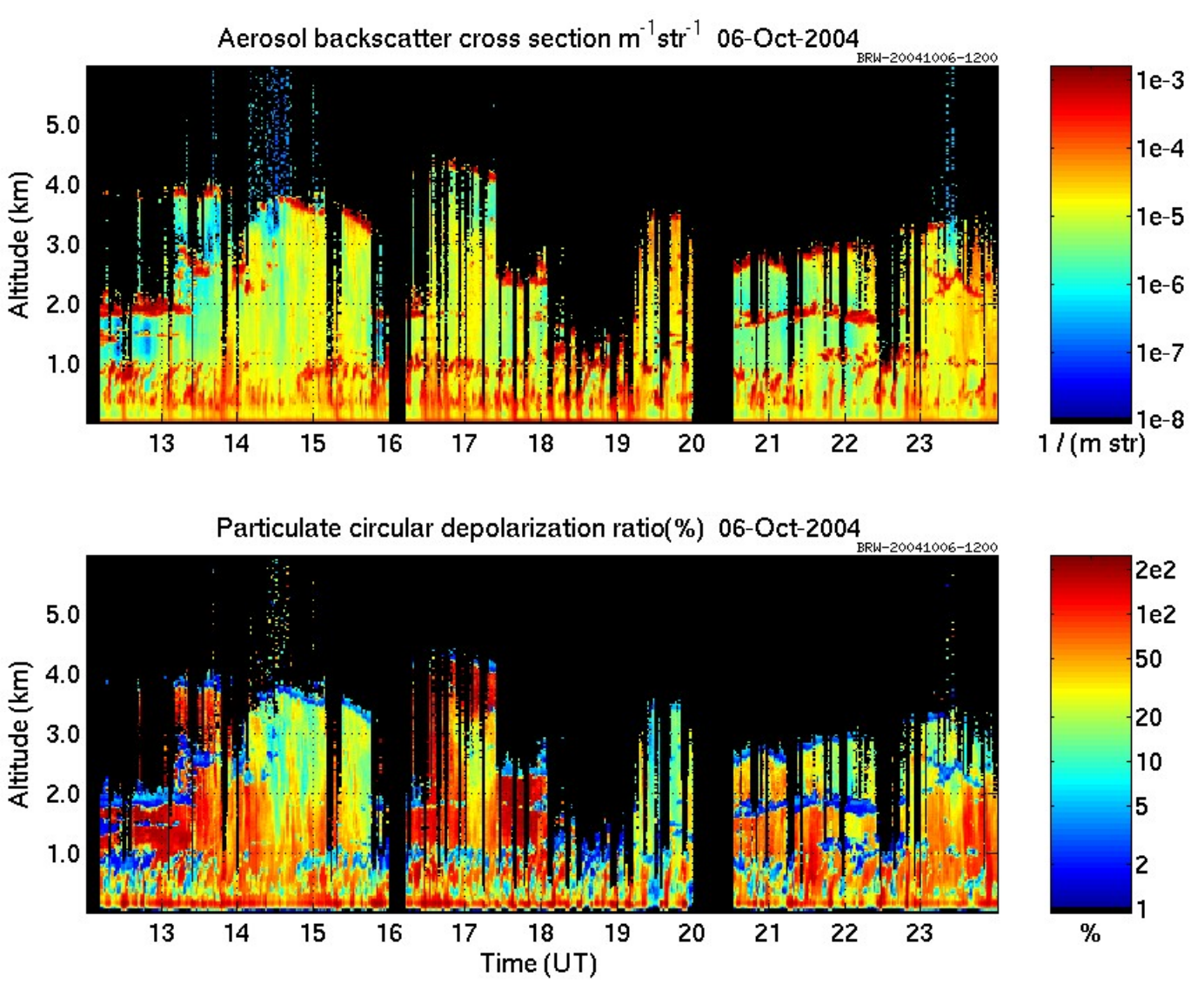
Period A

- Multi-layer stratus
- Thin liquid water layers with ice crystal precipitation falling between and beneath liquid water layers



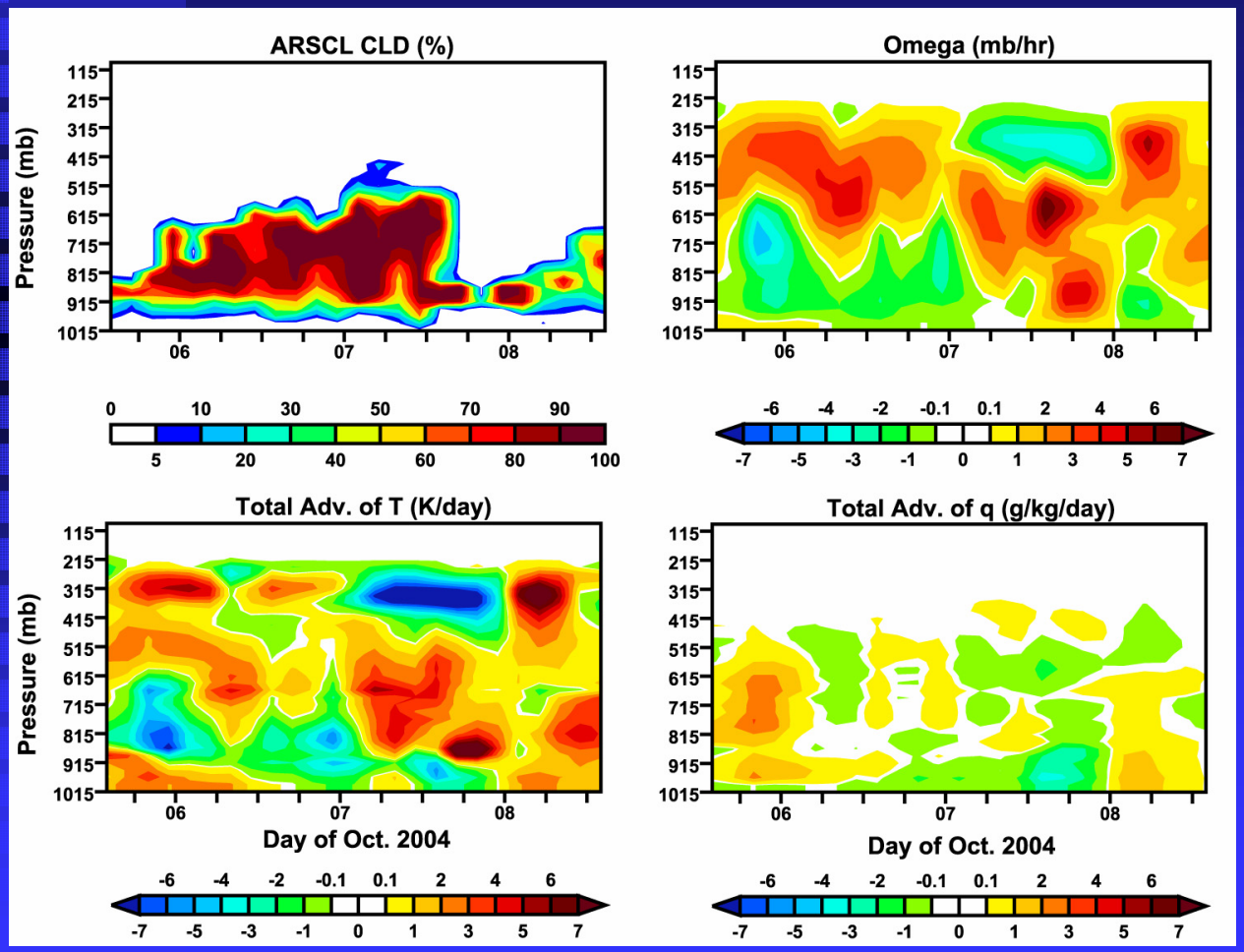


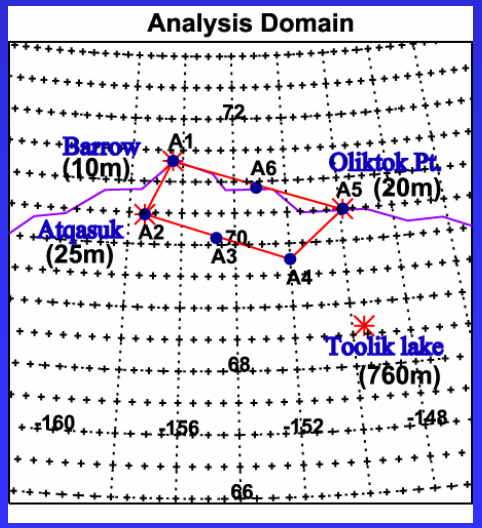
Arctic High-Spectral Resolution Lidar



Model Forcings

- From Variational Analysis Deduced from ARM Radiosonde Network





Sensitivity Studies

- **No ice microphysics**
  - What is the role of ice microphysics in mixed-phase clouds? Can the high amounts of liquid water in Period B be sustained in the presence of ice crystals?
- **Increased vertical resolution**
  - Is high vertical resolution (~100 m) necessary to simulate the thin liquid water layers?
  - Are the microphysical simulations strong functions of vertical (and/or temporal) resolution in models?

Next

- Ann Fridlind: LES simulation of Period B
- Hugh Morrison: SCM simulation of Period B
- Steve Klein: Web Page, Timeline and Discussion