

Overview of GCSS Polar Cloud Working Group Activities

Hugh Morrison and James O. Pinto
Co-chairs, Polar Cloud Working Group

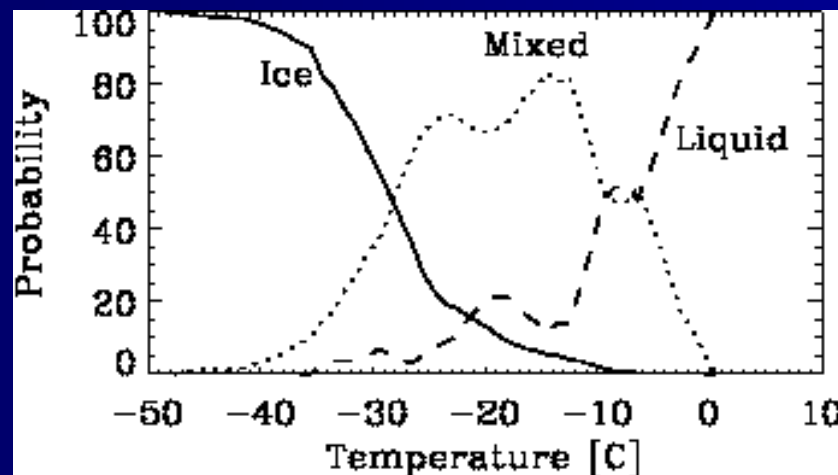
National Center for Atmospheric Research

1st Pan-GEWEX meeting, Frascati, Italy, 9-13 October 2006

Motivation for Research on Mixed-Phase Clouds

- Mixed-phase and supercooled water clouds dominate the total cloud fraction in the arctic.
- Discrimination between liquid and ice clouds is vital in calculating the SEB.
- Phase of clouds also determines their precipitation efficiency.
- The ability of models to accurately represent the widespread presence of the supercooled liquid is vital for GCM feedback experiments in which the surface and atmosphere are coupled.

Frequency of Occurrence of Cloud Phase – Western Arctic Ice Pack



Morrison et al., 2005, GRL

Current Goals of Polar Clouds Working Group

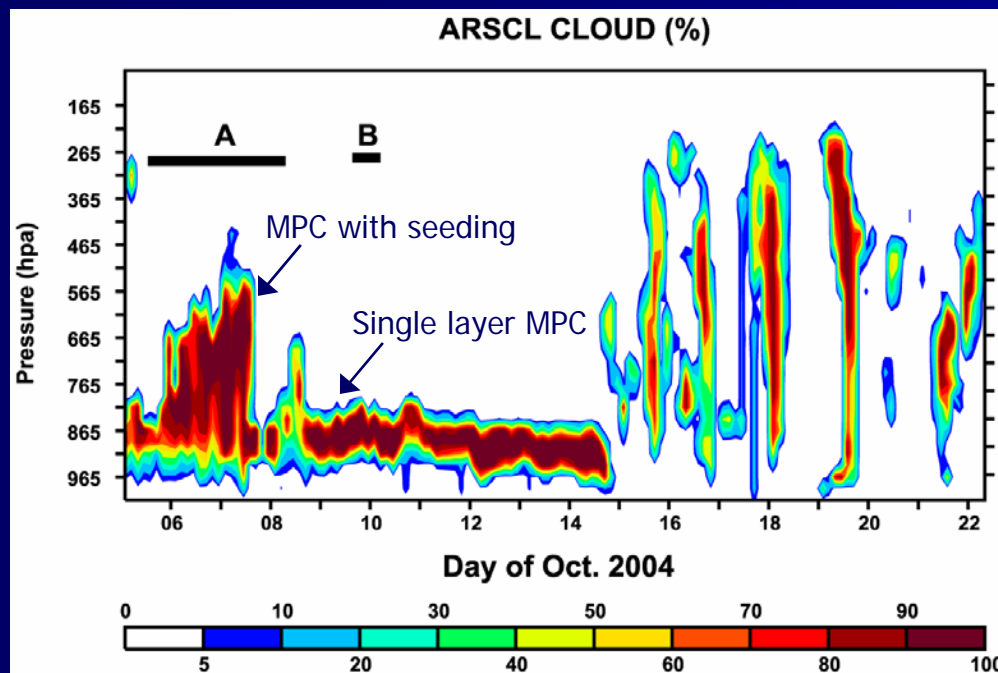
- i. Document the current state of how mixed-phase clouds are treated in a collection models and understand differences.
- ii. Improve understanding of polar mixed-phase cloud processes.
- iii. Improve representation of processes impacting the simulation of mixed-phase clouds in weather prediction and climate models.

Toward this end we have:

- 1) Convened a special session on mixed-phase clouds at the 2005 Fall AGU
→ 30 presentations including a very well attended poster session
- 2) Worked closely with ARM Cloud Param and Modeling Group on developing the MPACE mixed-phase cloud case studies.
- 3) Participating in MPACE model intercomparison and are developing additional Arctic mixed-phase cloud data sets.

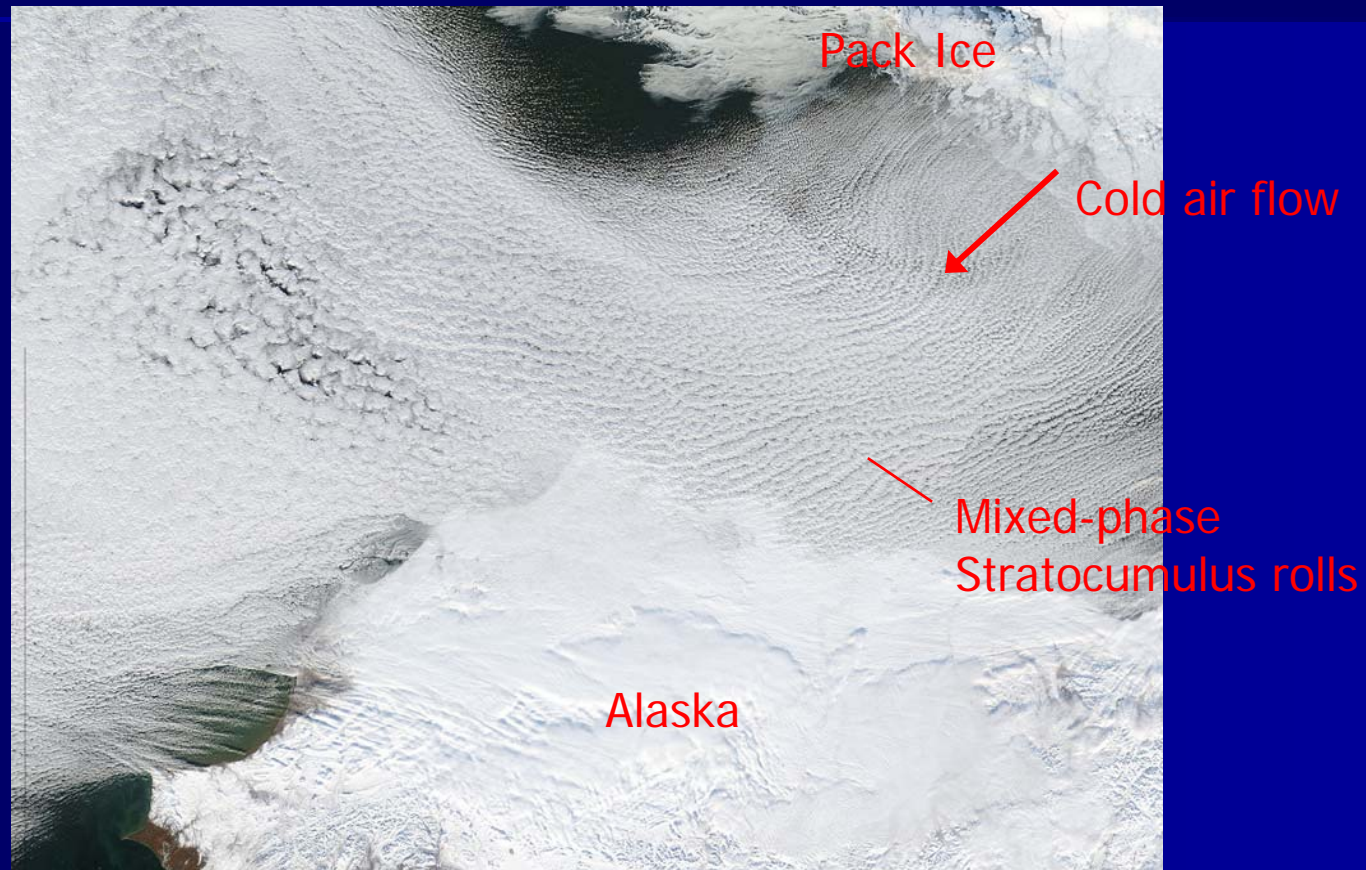
Joint ARM/GCSS WG5 Model Intercomparison

- Case studies developed from the Mixed-Phase Arctic Cloud Experiment (MPACE) during Fall 2004 over the northern Alaska coastline.
- Focus is on two sub-periods: A (seeding) and B (single).
- Detailed observations available from aircraft, satellite, and ground-based remote sensors.



- **Period A** consists of several distinct liquid cloud layers extending up to 3 km, with ice crystals falling from the top layer to the surface.
- **Period B** consists of a single-layer low-level mixed-phase cloud forced by cold air advection over the open ocean, with ice precipitating to the surface.

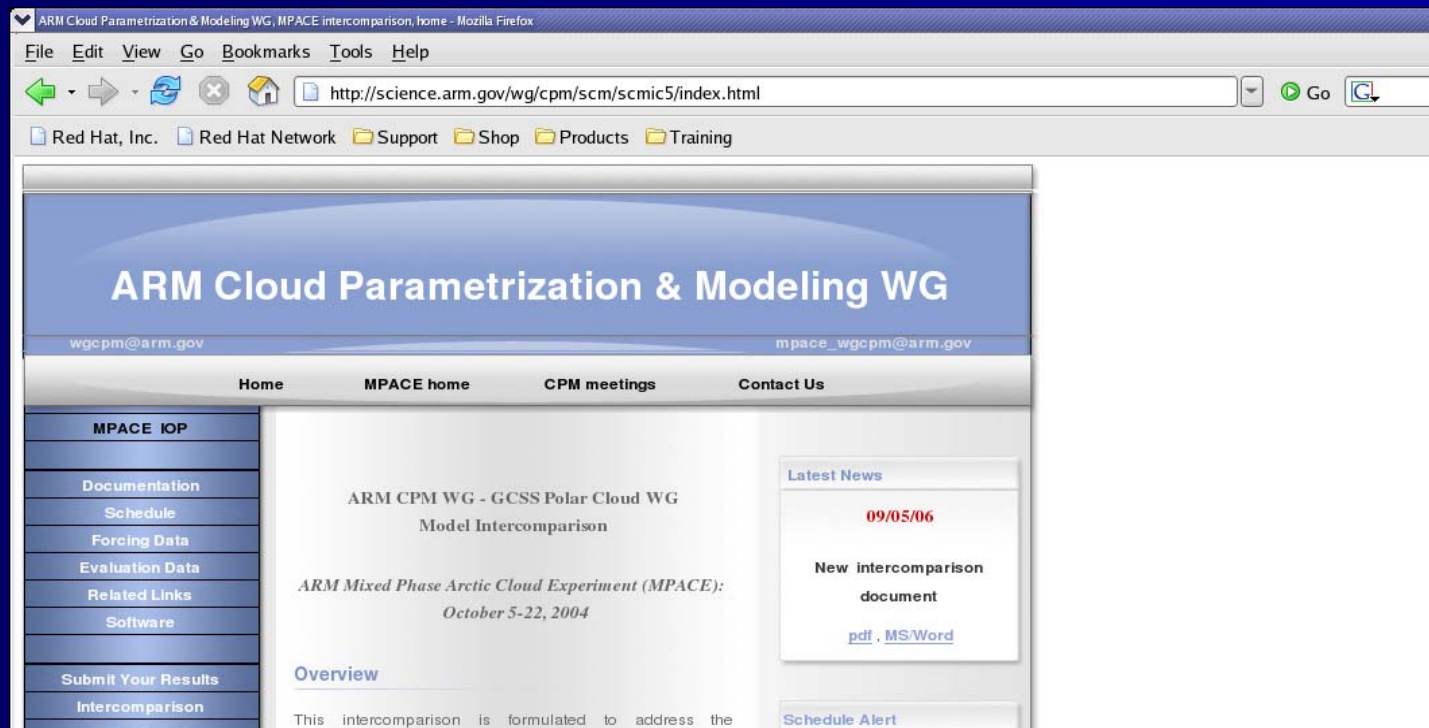
Period B



Composite visible satellite image from the NASA Terra satellite for October 9.

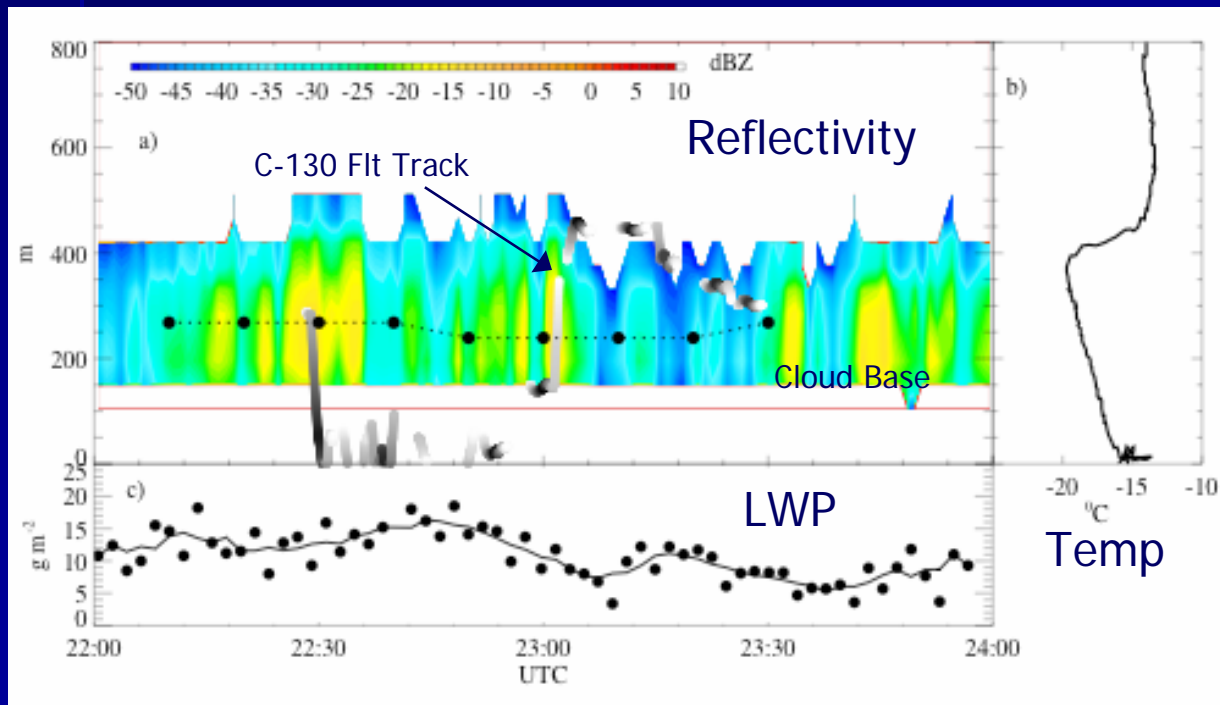
Logistics and Status

- Model results have been recently submitted (Sep 2006) and analysis is now underway (includes CRM, SCMS from NWP and Climate Centers).
- Initial results are to be presented at the ARM Cloud Parameterization and Modeling Working Group meeting in San Francisco, CA (Oct 30-31, 2006).
- 17 participants from U. S., Canada, Japan, and E. U.
- For more details go to <http://science.arm.gov/wg/cpm/scm/scmic5/index.html>
- **Additional data on these cases are available at:** <http://gcss-dime.giss.nasa.gov/>



Proposed GCSS WG5 SHEBA Model Intercomparison – Stage II

- Detailed aircraft and ground-based observations available from the 1997-98 Surface Heat Budget of the Arctic Ocean (SHEBA) experiment and First ISCCP Regional Experiment - Arctic Clouds Experiment (FIRE-ACE).
- Focus is on a single-layer mixed-phase boundary layer cloud on May 7-8.



Vertical profiles of a) radar reflectivity, b) temperature, and c) liquid water path at SHEBA on May 7 (from P. Zuidema, Univ. Miami).

Proposed Follow-on Case Study

- The **SHEBA** case provides a nice contrast to **MPACE**:
 - ☐ **Sea ice** versus **open ocean** surface
 - ☐ **Polluted** versus **pristine** aerosol conditions
 - ☐ **Highly** versus **moderately** supercooled mixed-phase clouds
 - ☐ **Small** versus **large** liquid and ice water paths
 - ☐ The SHEBA case is more representative of clouds over the interior Arctic, MPACE is more representative of a subset of clouds over open ocean at the sea ice edge.
- The SHEBA intercomparison will help to address **how mixed-phase clouds are maintained in the absence of strong forcing** (in contrast to MPACE), and how this persistence can be represented in models.
- Initial single-column and large eddy modeling results look promising.
- Proposed timeframe to solicit participation is summer 2007.

Future Activities

- Investigate the transition of low-level polar clouds from mixed-phase to all-ice (diamond dust) conditions.
- Incorporate observations from future field experiments, especially in conjunction with the 2007-08 International Polar Year.
- Extend studies to Antarctic clouds.

For more information or interest in being added to the WG5 mailing list, contact: Hugh Morrison (morrison@ucar.edu) or James Pinto (pinto@ucar.edu).

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