Previous Aerial Campaigns

and

Selected Results and Lessons Learned From Previous IOPs

AMF3/Oliktok Breakout Session, ARM Science Team, March 2013

Scott Richardson
We are pursuing establishment of a designated DOE User Facility at Oliktok Point.
USAF Oliktok Point Long Range Radar Station: Sandia has a permit from the USAF for use of selected facilities at Oliktok Point, just as Sandia has a permit for use of selected areas on Kirtland AFB; Oliktok is one of several old Distant Early Warning (DEW Line) radar stations that are still active.
SHEBA
(Surface Heat Budget of the Arctic Ocean)

- 1997-98
- Main platform: Surface inst., aircraft
- Initial arctic campaign
- ARM – Surface based remote sensing
- NSF – C130
- Lesson learned
  - Prevalence of mixed phase clouds
SHEBA Campaign, Ice Breaker and Ice Camp
• Beaufort Sea ~ 75 N, 145 W

• The Des Groseilliers moored to a large floe and drifted with the pack ice until October 1998.

• This was the principal research platform for the SHEBA field observations.

• The ship and measurement sites (ARM instruments included) drifted with the pack ice from September 1997 to October 1998.
MPACE
(Mixed-Phase Arctic Cloud Experiment)

- Fall 2004
- Main platform: Aircraft (UND Citation), sondes

- Focused attempt to examine mixed phase clouds when most prevalent
- Better understanding of modeling mixed phase clouds

Lesson learned: Icing is a problem
ISDAC  
(Indirect and Semi-Direct Aerosol Campaign)

• Spring 2008

• Main platform: Aircraft (Canadian NRC-Convair)

• Follow-up to MPACE in different aerosol environments

• Together with MPACE, gained a better understanding of single layer, surface-forced boundary layer clouds (Morrison et al.)
Conceptual Model: Single layer cloud

**Microphysics**
- Liquid forms in updrafts and sometimes within the inversion layer
- Ice nucleates in cloud
- Rapid ice growth promotes sedimentation from cloud

**Radiative Cooling**
- Drives buoyant production of turbulence
- Forces direct condensation within inversion layer
- Requires minimum amount of cloud liquid water

**Dynamics**
- Cloud-forced mixed layer with strong narrow downdrafts, weak broad updrafts
- Small-scale, weak turbulence in cloudy inversion layer
- Large-scale advection of q important

**Surface Layer**
- Turbulence and q contributions can be weak or strong
- Sink of atmospheric moisture due to ice precipitation
- Surface type (ocean, ice, land) influences interaction with cloud

**Thermodynamic Structure**
- Temperature and q inversions
- Source of moisture aloft and/or surface layer
- Cloud mixed layer may be coupled to surface or decoupled by intervening stable layer

Morrison et al. 2011
ALTOS
(Arctic Lower Troposphere Observed Structure)

- Fall/winter 2010
- Main Platform: Tether Balloon System
- Attempt to get statistical representation of in-cloud processes
  - Examine (attempt to separate) microphysics and dynamics
- Moved away from aircraft due to icing issues
- The need remains
ALTOS – Lesson’s learned

• Difficulty of in cloud measurements in icing environments
  – Tethered system preferred
  – Characterize environment
    • Complicated atmospheric structure with Brooks Range to south

• UAV option for extended measurements
  – Aircraft icing always problematic - avoid
    • Contingency plan to get out/through icing
  – Or if in cloud is required
    • Inexpensive aircraft
    • Build into the management plan to anticipate losses
Up Next: AMF3 Deployment
END
MPACE Flight Domain

Map showing various locations:
- Barrow
- Oliktok Point
- Wainright
- Atqasuk
- Prudhoe Bay
- Umiat
- Toolik Lake

Distances:
- 95 km between Wainright and Atqasuk
- 267 km between Atqasuk and Barrow
- 360 km between Umiat and Toolik Lake
- 201 km between Prudhoe Bay and Toolik Lake
Flying an instrumented tethered balloon in cloud was the activity that required Restricted Airspace during M-PACE, and that also requires it during the upcoming ALTOS field experiment. Restricted Airspace also makes flying unmanned aircraft much easier under FAA rules.
Categories of Instrumentation at Barrow

- Surface Meteorological Sensors
- Wind, Temperature and Humidity Profilers
- Cloud Observation Instrumentation
- Downwelling Radiation Sensors
- Upwelling Radiation Sensors
- Aerosol Instrumentation
- Gas Instrumentation

Emphasis for the next decade:
Scanning instruments,
3D and 4D cloud profiles
Oliktok Point Arctic Research Facility (OPARF)
DOE has requested from the FAA the creation of a Warning Area over International Waters adjoining Oliktok to accommodate unmanned aircraft flights and other research activities out over the Arctic Ocean focused on the rapid retreat of the sea ice; Warning Areas confer similar advantages to Restricted Airspace.
Restricted Airspace R2204 at Oliktok Pt; originally obtained by Sandia for a field experiment at Oliktok in 2004 (Mixed-Phase Arctic Cloud Experiment [M-PACE]); It’s airspace that, when activated (at DOE discretion), DOE controls; Restricted Airspace is the mechanism through which FAA keeps non-participating aircraft out of an area.