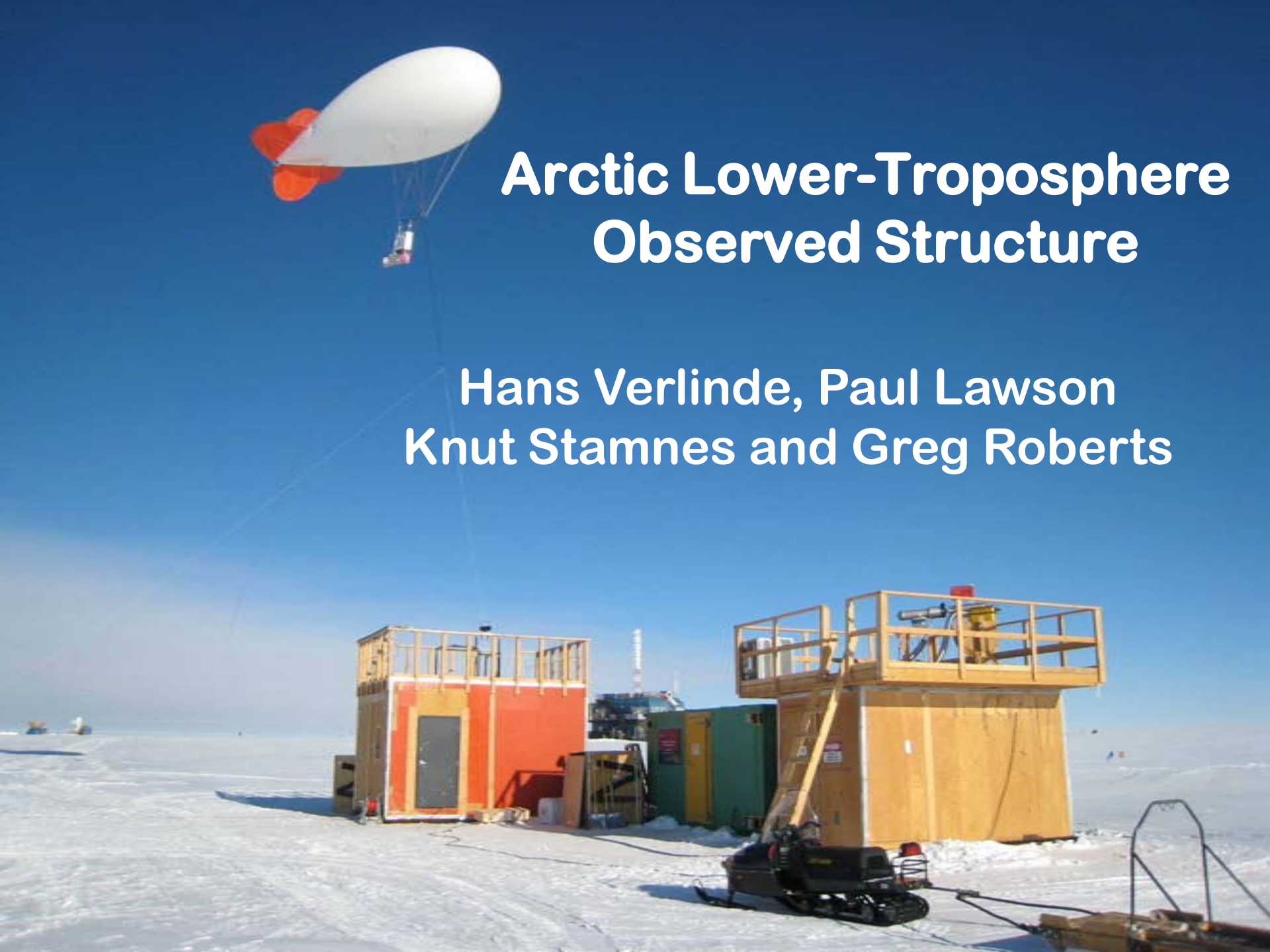
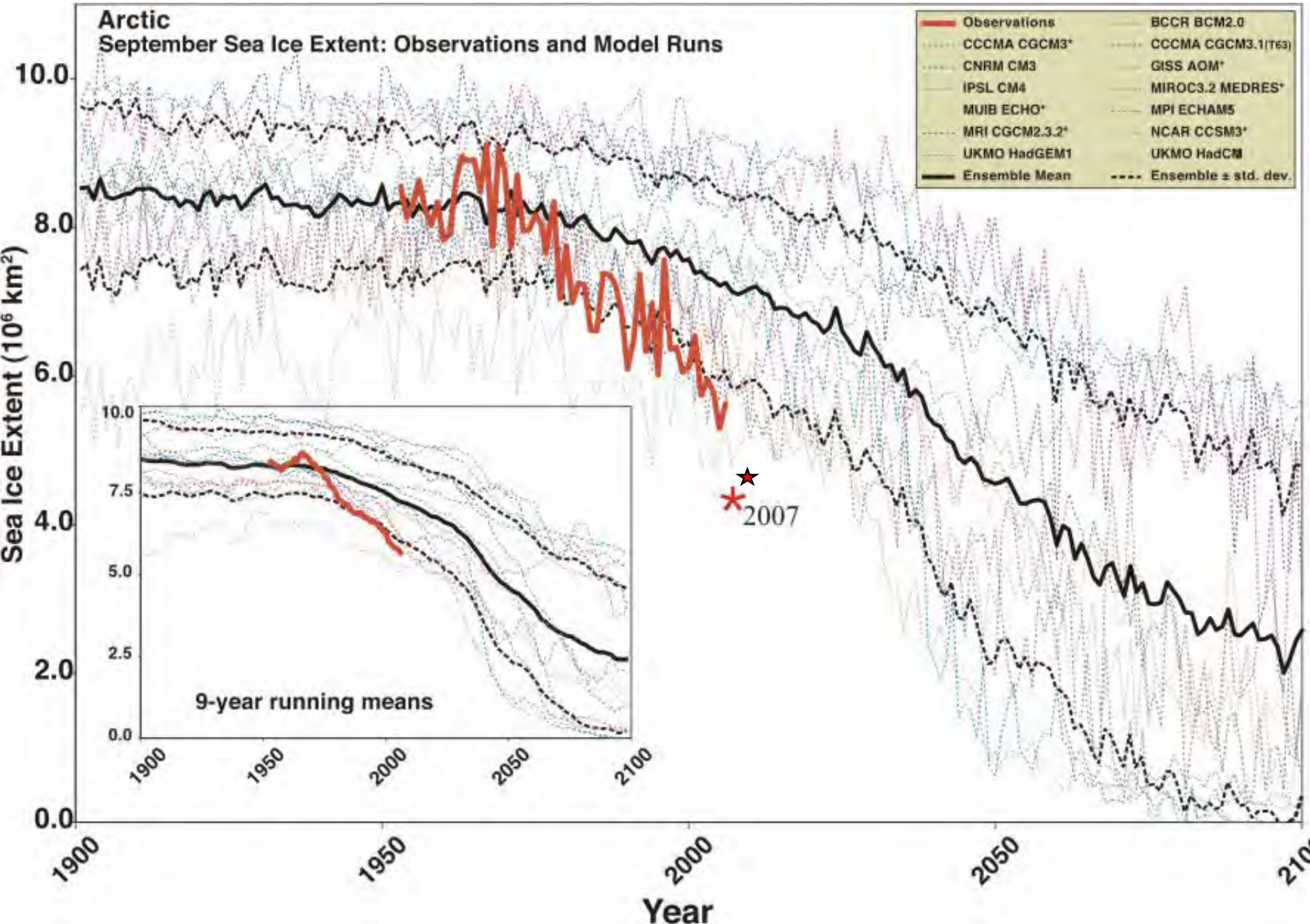


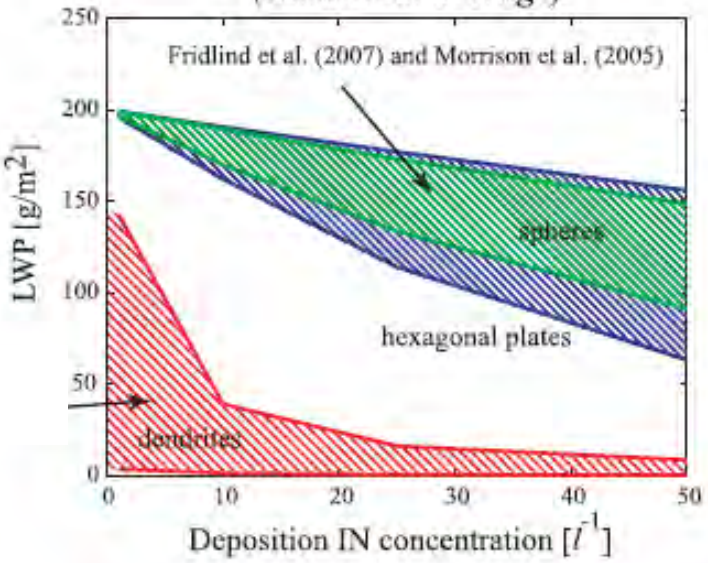
Arctic Lower-Troposphere Observed Structure

Hans Verlinde, Paul Lawson
Knut Stamnes and Greg Roberts

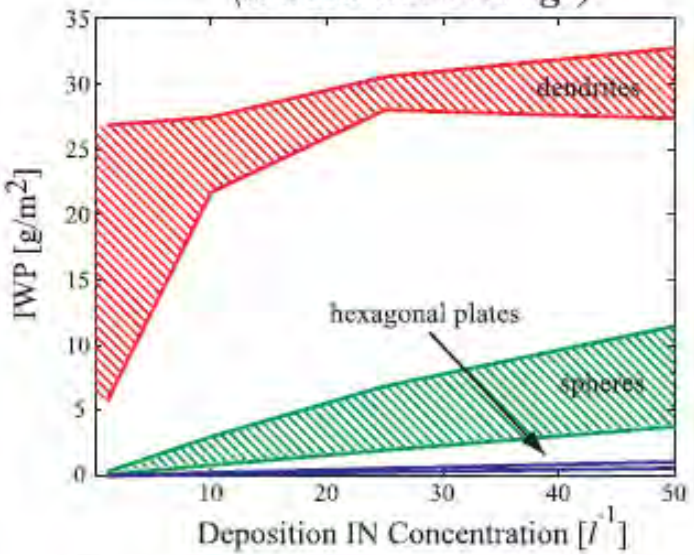

Arctic
September Sea Ice Extent: Observations and Model Runs
Observations
BCCR BCM2.0
CCCMA CGCM3*
CCCMA CGCM3.1(T63)
CNRM CM3
GISS AOM*
IPSL CM4
MIROC3.2 MEDRES*
MUIB ECHO*
MPI ECHAM5
MRI CGCM2.3.2*
NCAR CCSM3*
UKMO HadGEM1
UKMO HadCM
Ensemble Mean
Ensemble ± std. dev.
Sea Ice Extent (10^6 km^2)
10.0
8.0
6.0
4.0
2.0
0.0
1900
1950
2000
2050
2100
Year
2007
9-year running means
10.0
7.5
5.0
2.5
0.0
1900
1950
2000
2050
2100

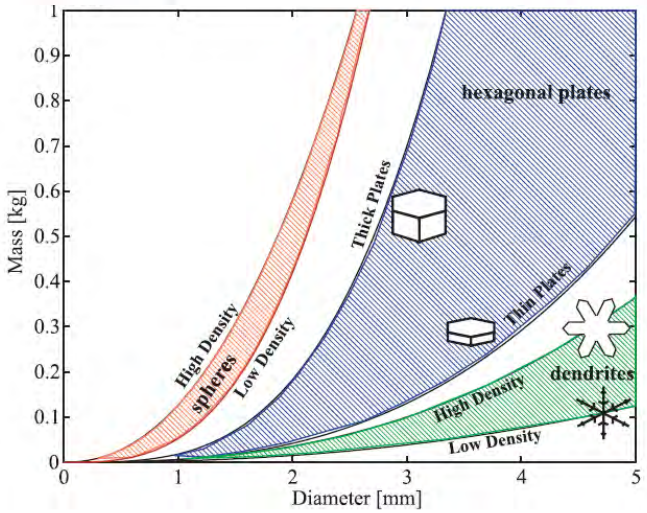
Different Habit Parameterizations: Different ice concentration sensitivity

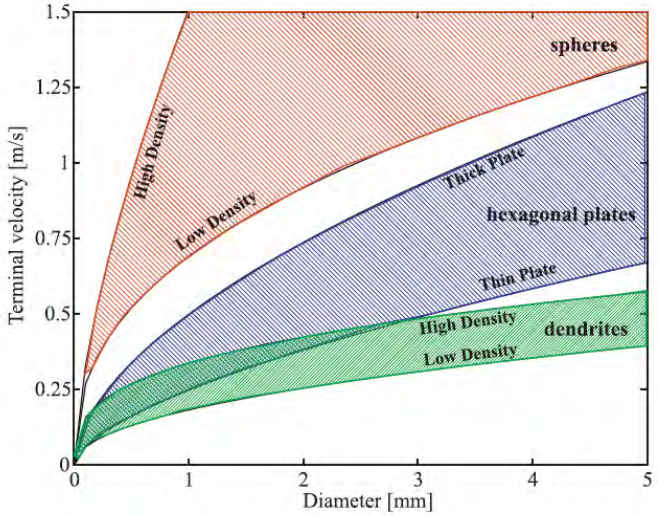
Liquid water path (simulation average)



Ice Water Path (Simulation Average)

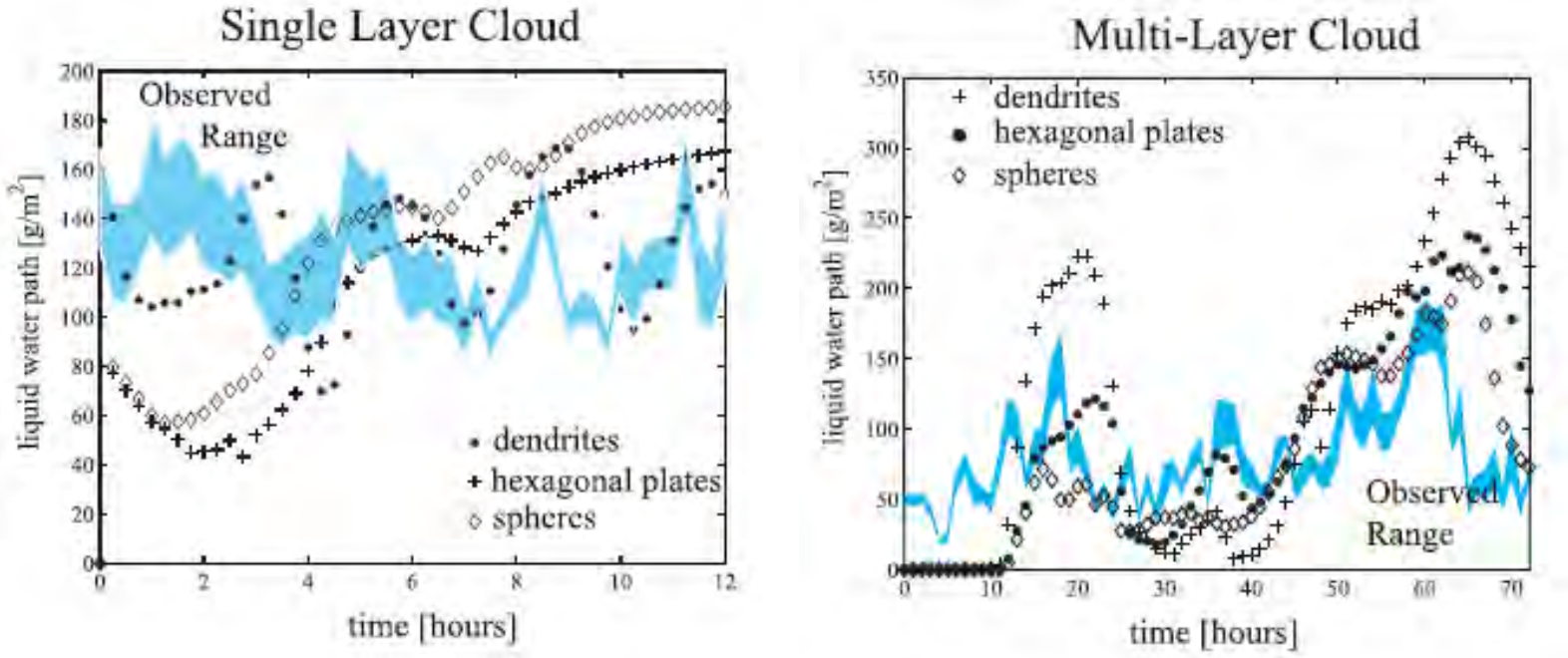






Avramov and Harrington, 2009

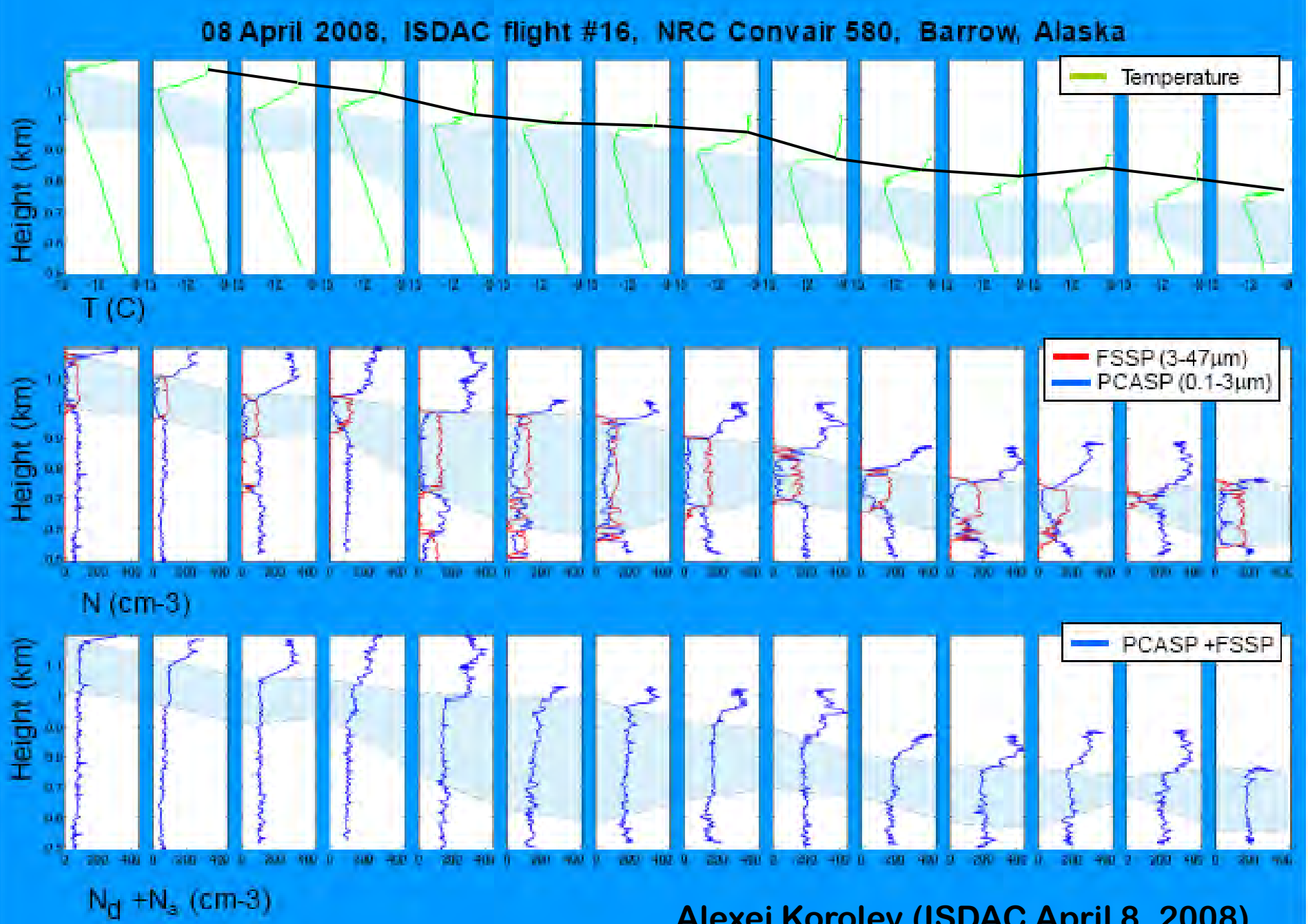
- Habit Impacts -



Dendrites => Best match for single layer case. Low ice nuclei concentrations required

Hexagonal plates and Spheres => Best match for multi-layered case. Require 25 times the ice nuclei concentration for dendrites.

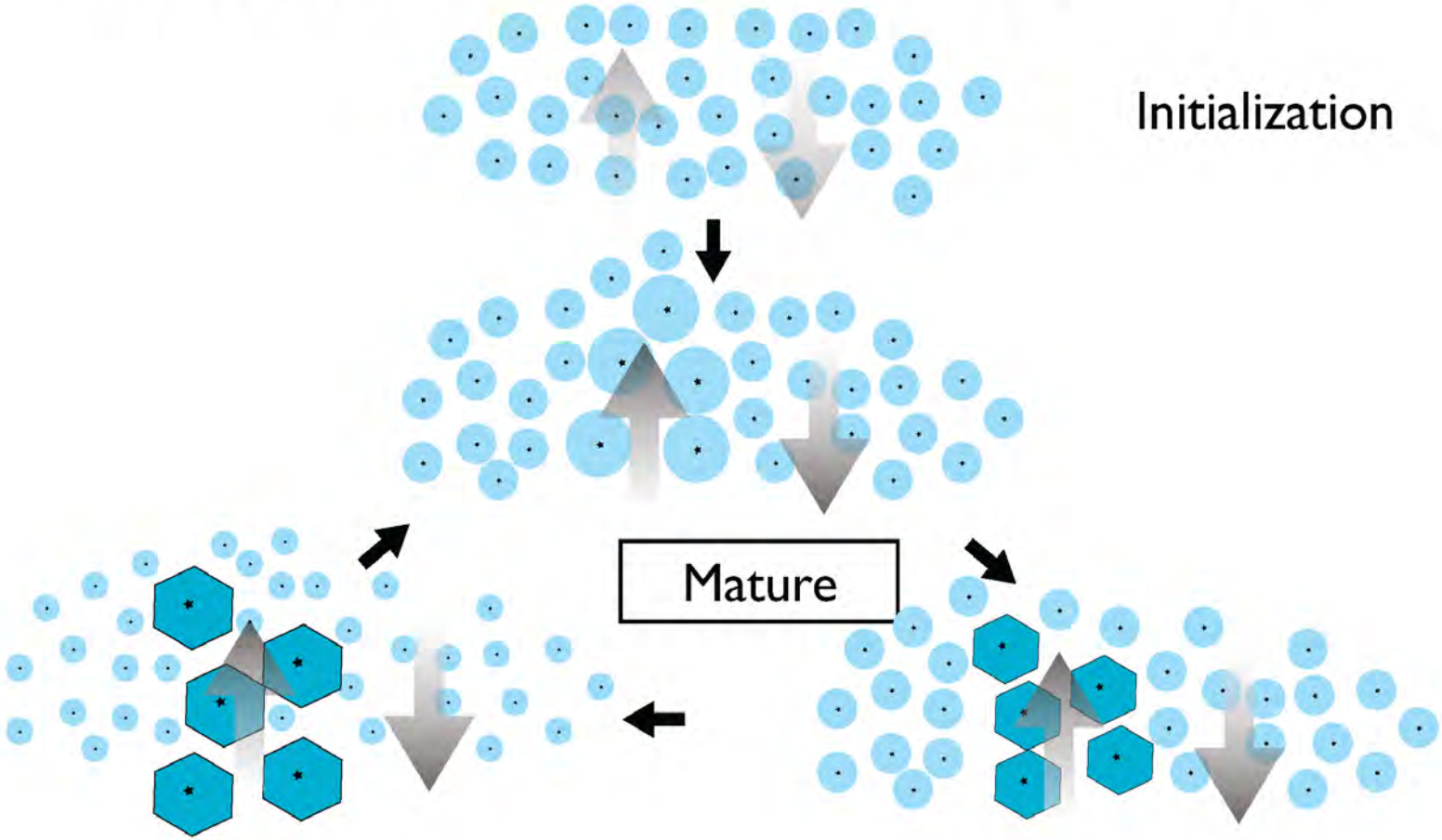
Avramov and Harrington, 2009



Alexei Korolev (ISDAC April 8, 2008)

Immersion Freezing

Conceptual Model for Mixed-Phase Stratus



de Boer

ALTOS: Science Questions

- What is the distribution of microphysical properties of low-level Arctic clouds?
  - Ice crystal habits
  - Depend on environment?
- What is the horizontal variability in microphysical properties of low-level Arctic clouds?
  - Determining factors?
- Do gravity waves impact microphysical properties of low-level Arctic clouds?
  - Micro- & macroscopic properties
- Retrieval verification
  - Statistical distributions
- Ice shattering
  - Low aspiration balloon measurements

ALTOS: Measurements

- Tether Balloon
  - Lightweight Cloud Particle Imager
  - Ice Nuclei (filter)
  - Cloud Condensation Nuclei
  - Basic Met: T, Td, p, u, v
  - (Long-wave radiation)
- Surface Instrumentation
  - Full radiometer package
  - MWR
  - Surface Met
  - (MMCR, MPL)
- Environment Canada fog measurements
  - Including radiation, full microphysics, aerosol sampling
  - Video Sonde
- (UAV in-cloud sampling)
  - Scripps/UAF

Sampling Strategies

- BL Profiling
- Cloud Profiling
- Constant altitude

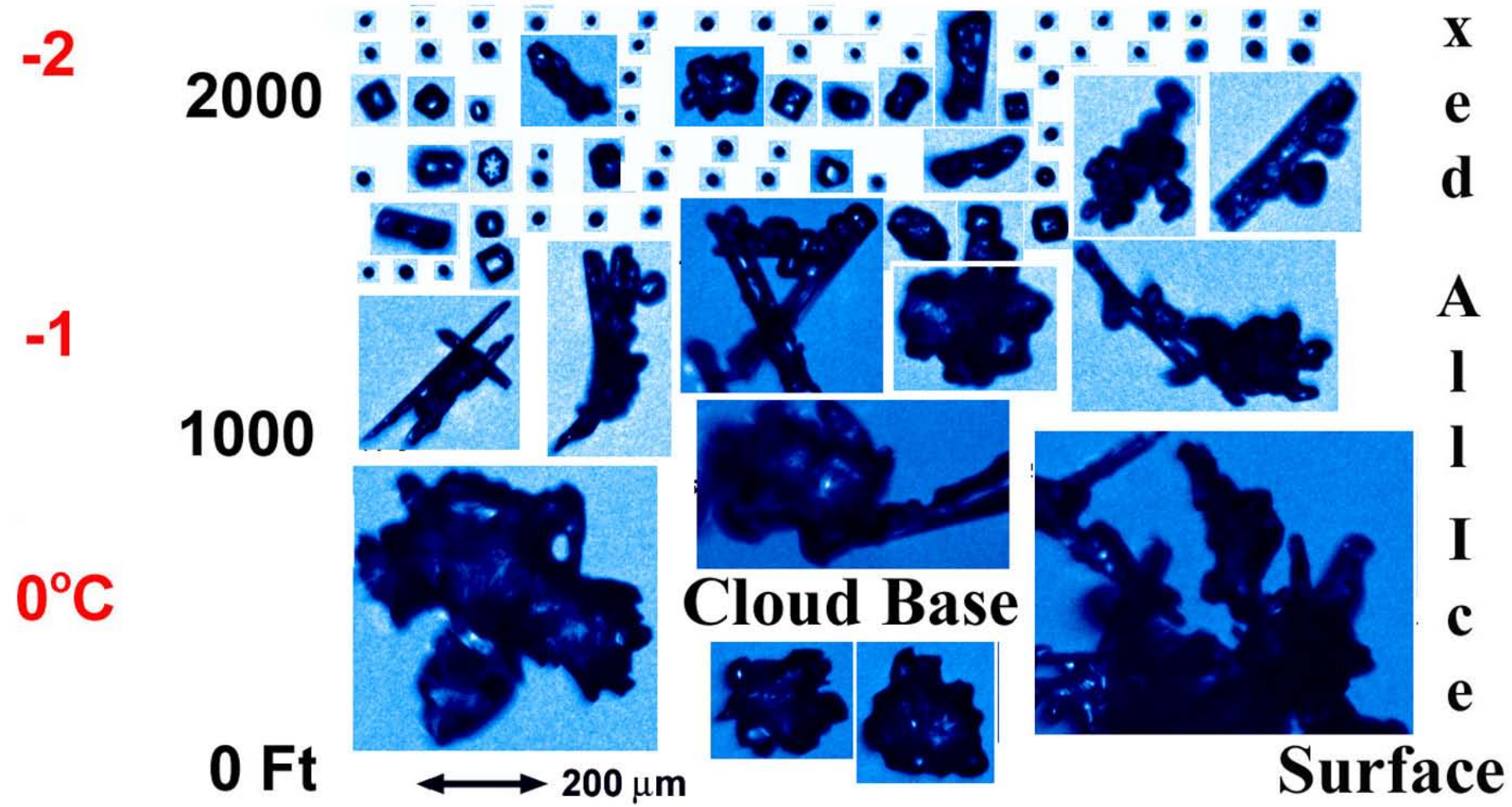
Instrument Package Images Cloud Particles, Measures Pressure, Temperature, Dew Point, Winds, Ice Nuclei, Records GPS, Contains Onboard PC, Flash Disk and Telemetry

Svalbard Deployment

Stamnes

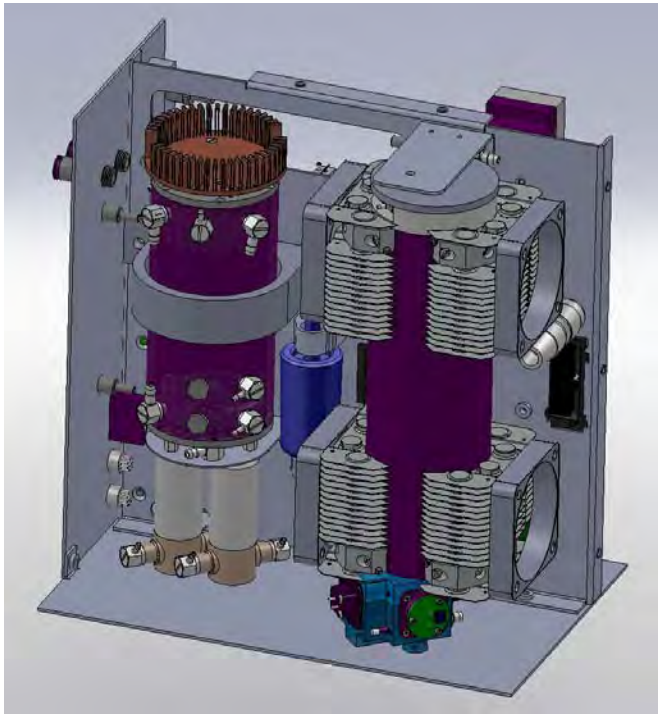
June 2, 2008

Warm Mixed-Phase Cloud with Large Ice at Cloud Base



Mini-CCN instrument

Supersaturations	0.1 to 1% scan (5 min)
Flow rate	100 to 150 cm^3 min^{-1}
Column length	130 mm



dimensions:
20 cm x 20 cm x 10 cm

weight and power:
1.5 kg & <25W

Greg Roberts – Scripps

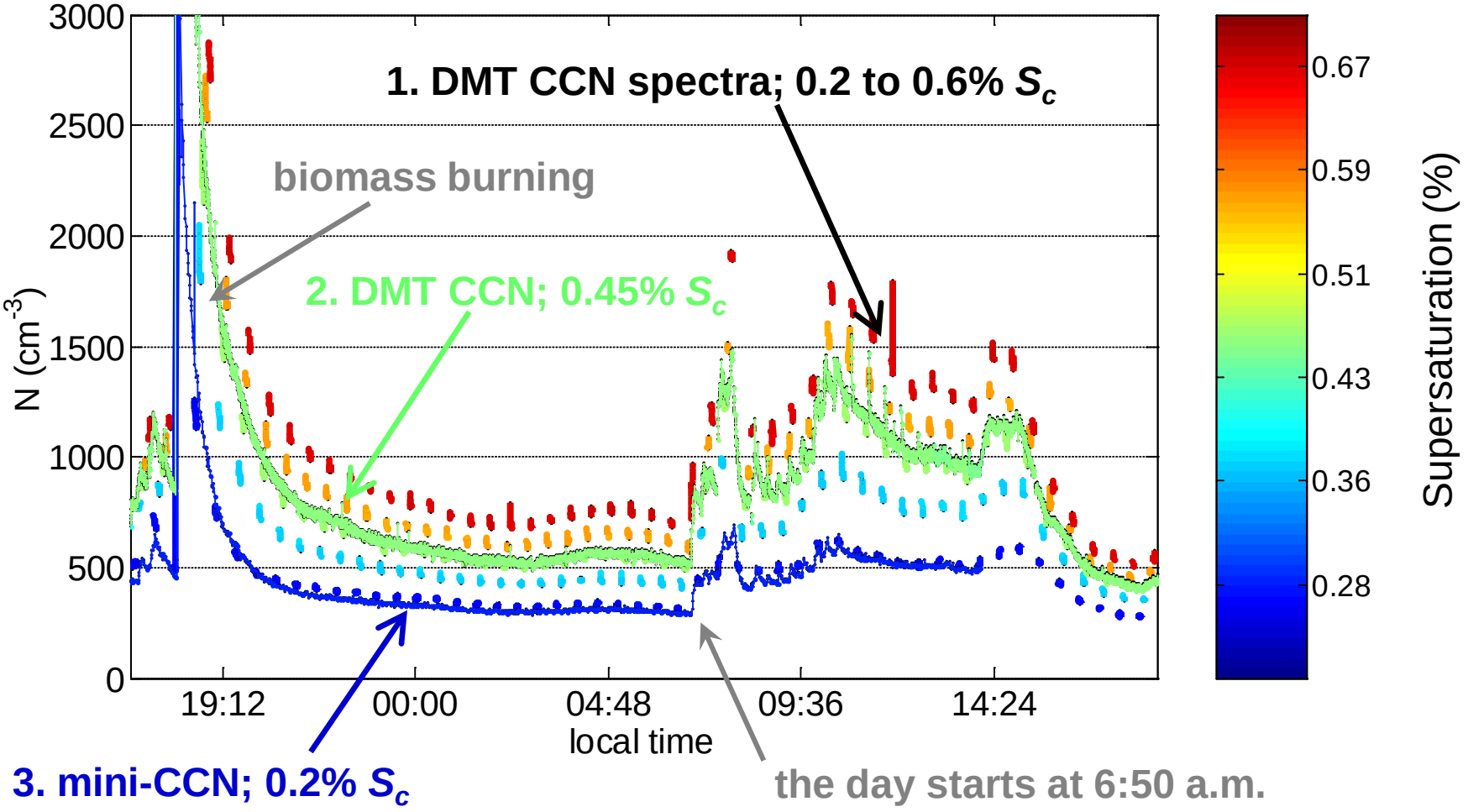
Development of streamwise CCN

scale = 1 m

1st version	2nd version	DMT	mini version
April 2002	January 2003	July 2004	August 2006

Roberts and Nenes, AS&T, 2005

DMT – mini-CCN comparison

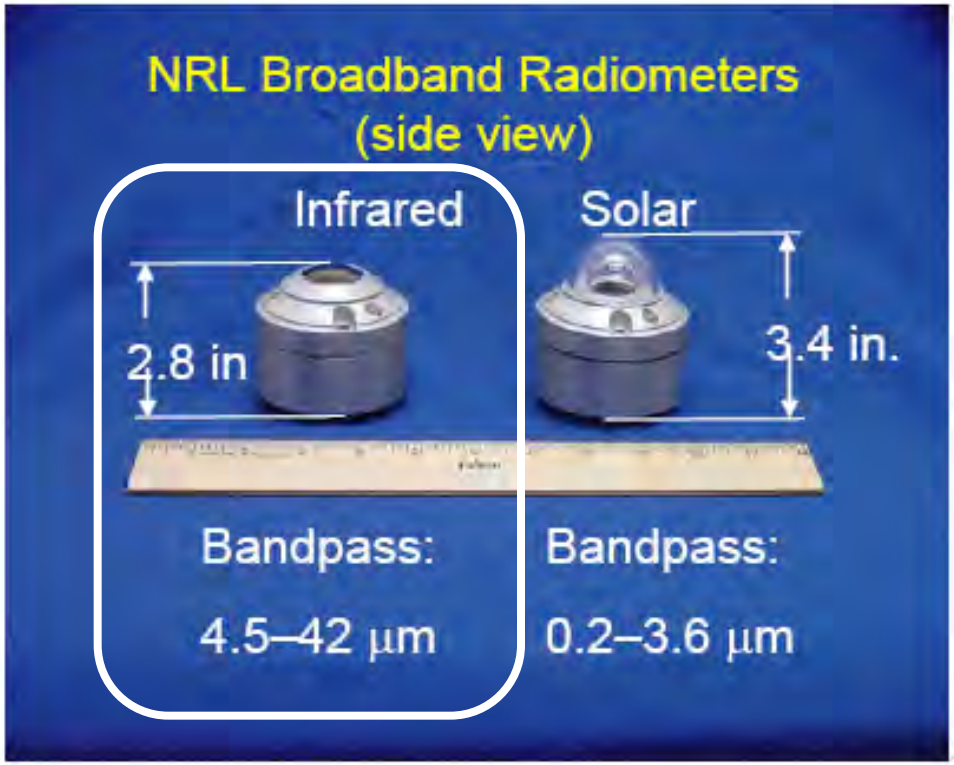


Three columns overnight at DMT

→ mini-CCN agrees well with DMT CCN

Greg Roberts – Scripps

NRL Broadband Radiometers (BBR)



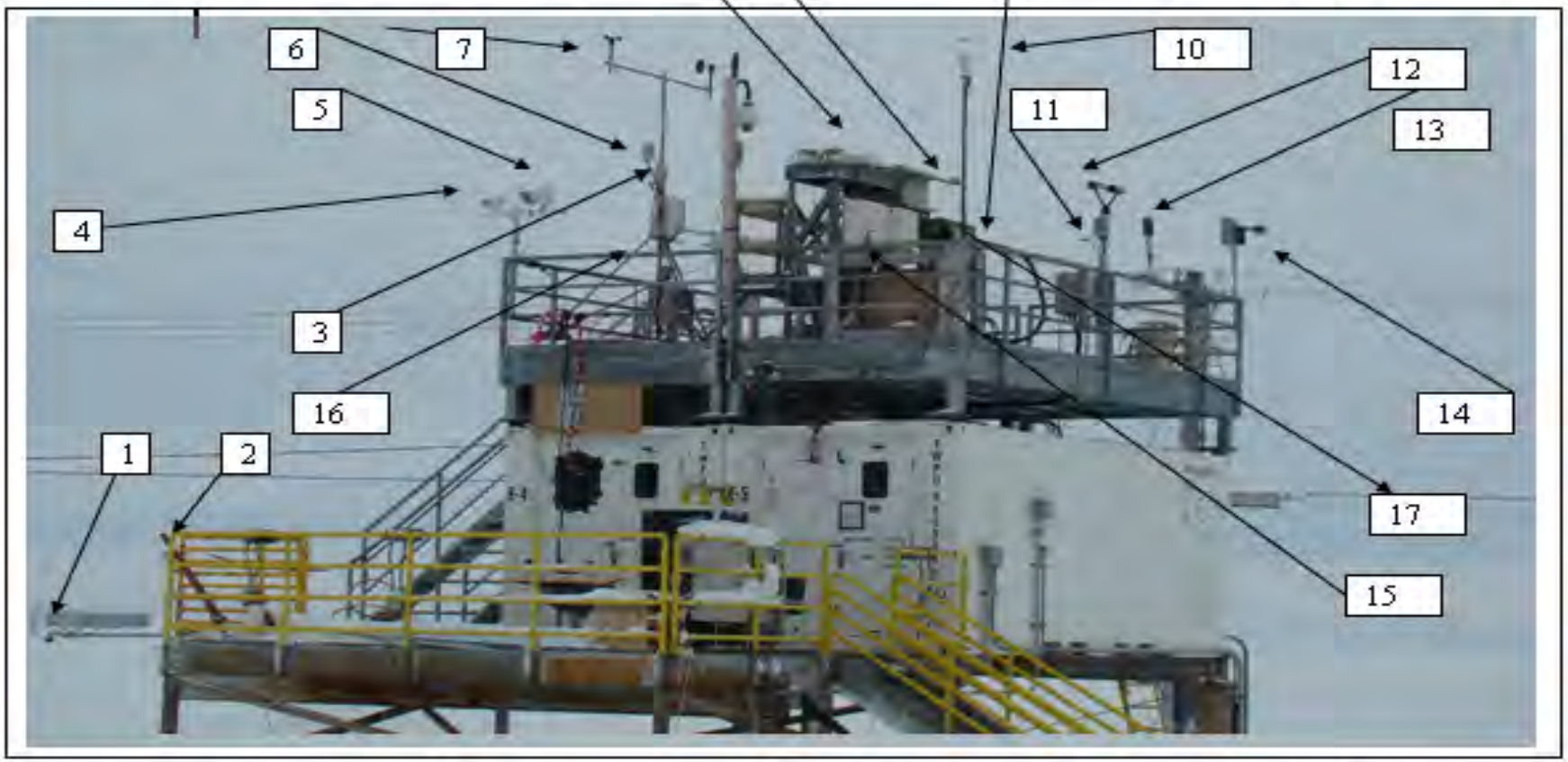
Description:

The **Broadband Radiometers (BBR)** consist of modified **Kipp & Zonen CM-22 pyranometers** (to measure solar irradiance) **and CG-4 pyrgeometers** (to measure

Field-of-view:	**Hemispheric**
Temperature Range:	**-65C to +80C**
Estimated Accuracy:	**3-5%**
Weight:	**2 lbs (0.9 kg)**
Power:	**28 VDC (use < 1A)**

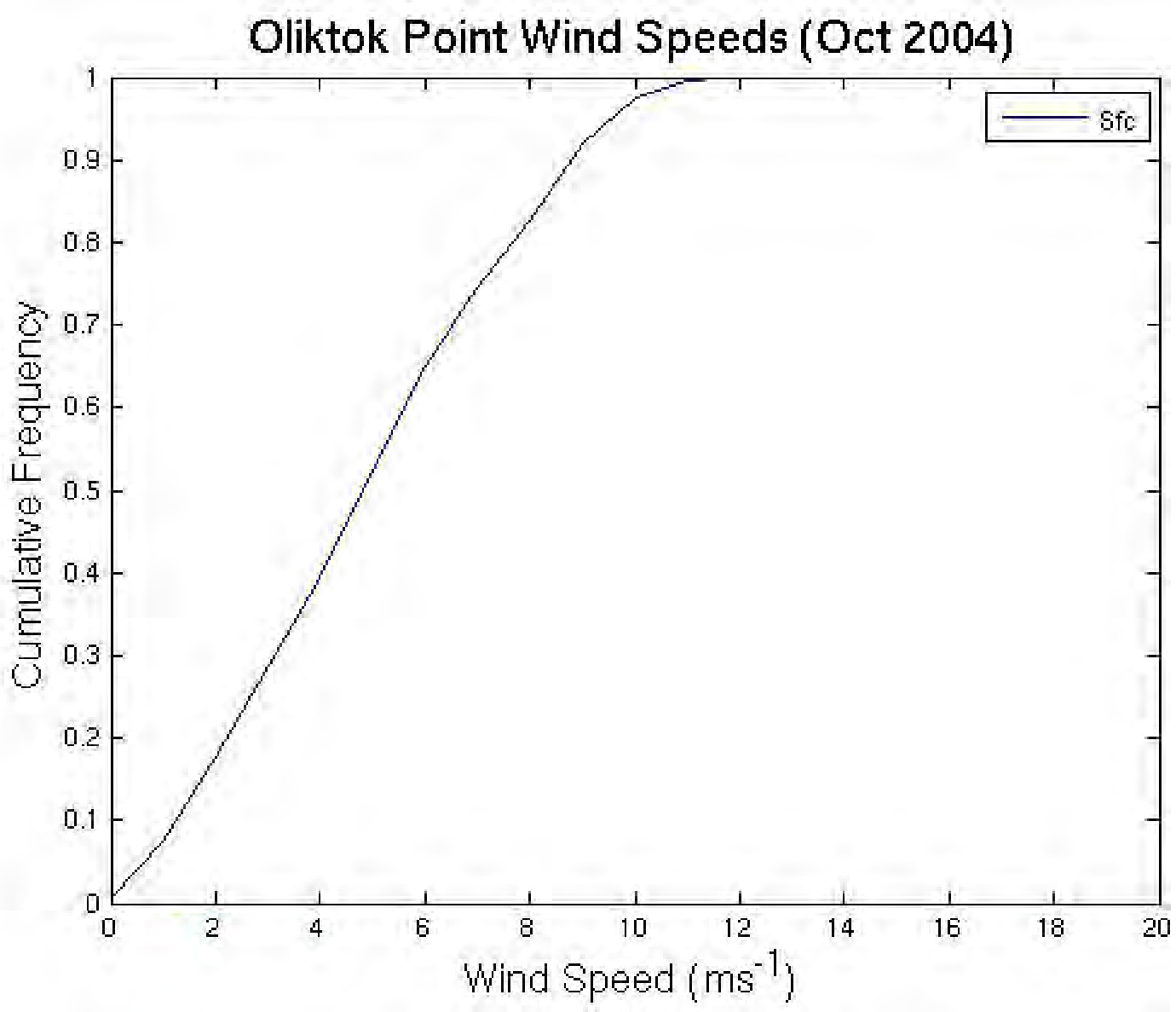
Environment Canada
Cloud Physics and Severe Weather Research Section, Toronto

BARROW NSA SITE
I.GULTEPE
Ismail.gultepe@ec.gc.ca

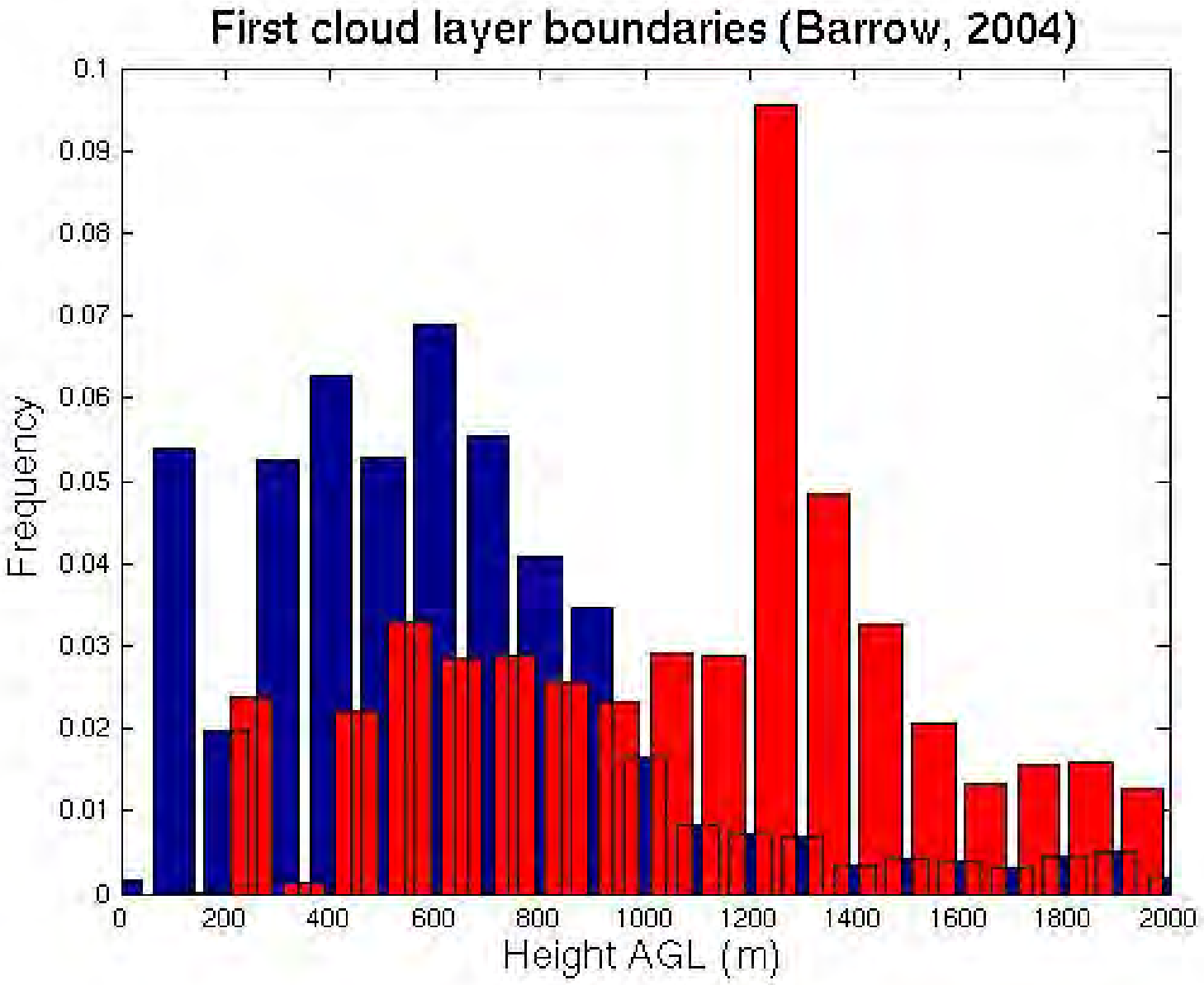


1. Snow depth sensor
2. Temperature sensor
3. RH1 and T
4. Vaisala surface temperature
5. Vaisala water phase sensor
6. RH2 and T
7. Wind speed and direction
8. SW and IR fluxes
9. SPN1; cloud cover, direct and diffuse radiative fluxes
10. Turbulence measurements
11. Hot plate (TPS) precip sensor
12. Distrometer (precip rate/extinction)
13. CAP aerosol measurements
14. Sentry Vis sensor
15. DMIST Vis sensor/camera
16. Ice particle counter (IPC)
17. FMD droplet spectra
18. VR G101 precip instrument
19. FD12P precip and Vis sensor

Operating Conditions



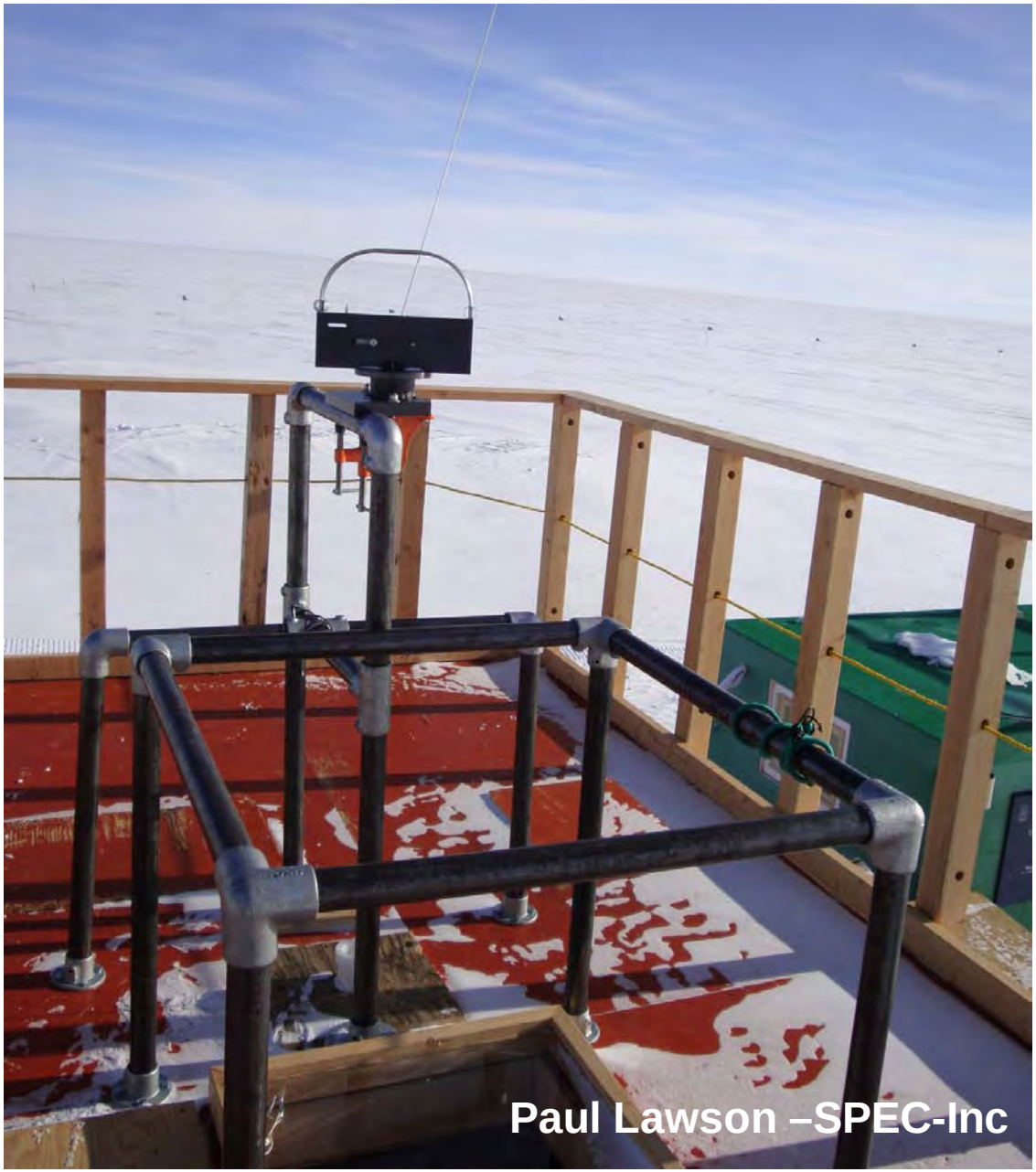
Operating Conditions



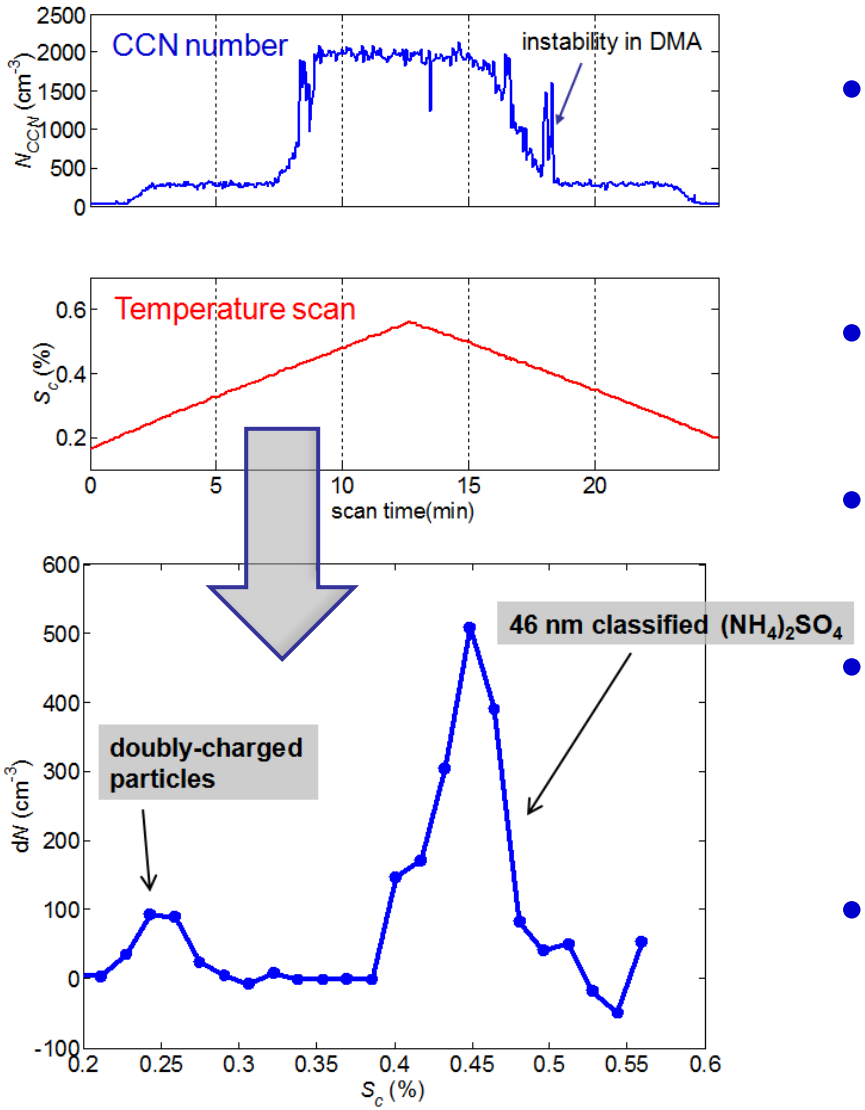
Electrical Power Provided via the Tether to the Balloon Instrument Package for Long-Duration Measurements

Tether is Guided Through a Hole in the Roof

Custom Gantry Guides Tether Above Roof



CCN spectra (single column)



- Current use of streamwise CCN generates a single super-saturation (S)
- Scan temperature and flow rates to retrieve CCN spectra
- Top figure shows activation of classified aerosols
- Bottom figure shows S distribution for classified aerosols
- Goal → achieve spectra between 0.1 & 1% S in 5 min.

Greg Roberts – Scripps