



ARM

CLIMATE RESEARCH FACILITY

SPartICus: Small Particles In Cirrus

ARM Aerial Facility Field Campaign

Science Steering Committee

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Ackerman, David Mitchell***



U.S. DEPARTMENT OF
ENERGY

Office of
Science

SPartICus Science Objectives

- **What is the nature and variability of the particle size distribution in cirrus?**
- **How do cloud-scale dynamical processes control the evolution of cirrus properties through nucleation, particle growth, and sublimation?**
- **What degree of complexity is required in cloud property retrieval algorithms, and what minimal set of algorithms can be used to rigorously describe cirrus microphysical properties using ground-based ACRF data?**

SPartICus Summary

- Routine aircraft in situ measurements in cirrus over SGP
- Total Hours: 200 hr (190 research / 10 test flight)
- 47 Flight Days (1-3 flights per day)
 - 23 SGP Flights
 - 21 CALIPSO/CloudSat Flights (9 combined with SGP flights)
 - 3 TERRA
 - 8 Orographic, wave clouds, or other cirrus not associated with remote sensors

Platform: SPEC, Inc. Learjet 25

Instruments

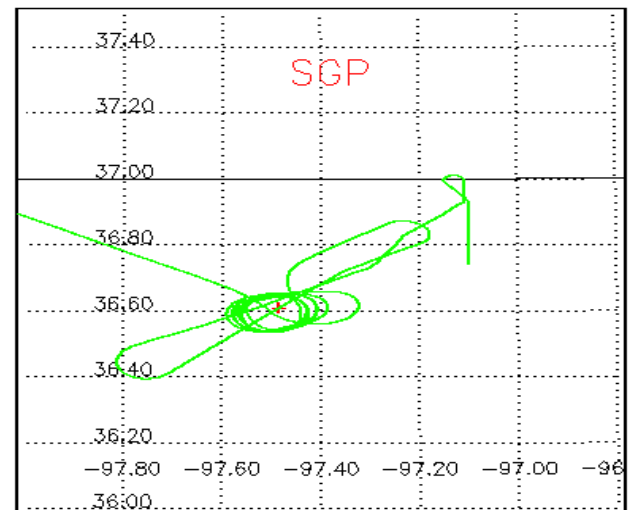
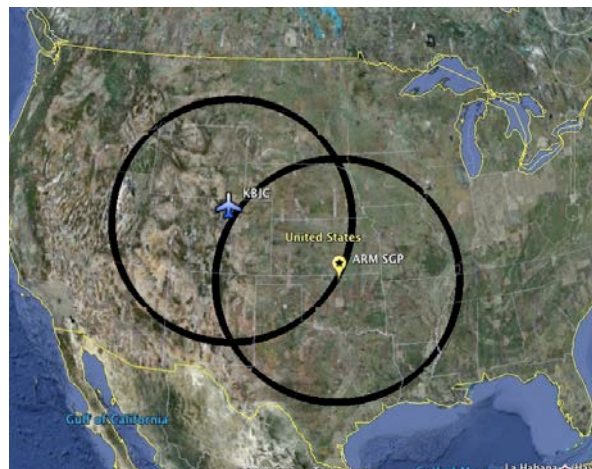
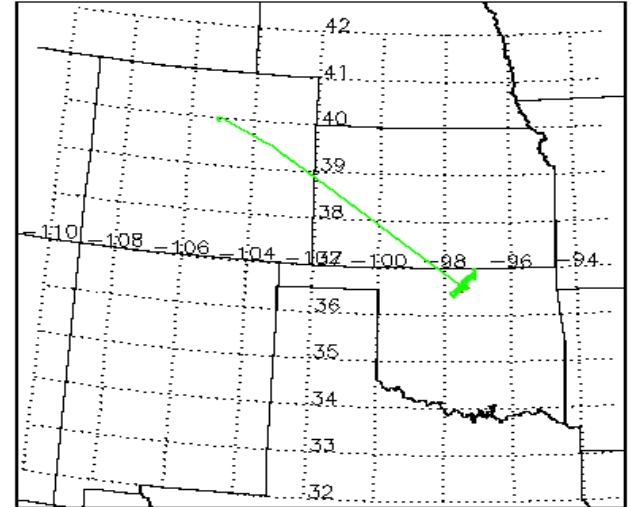
- FSSP, CDP, 2D-S, 2D-P, CPI
- Deep Cone Nevzorov (CSI for 7 flights)
- Rosemount, AIMMS-20
- Water Vapor: DLH (PI Glenn Diskin)



SPEC LEARJET MODEL 25

Flight Domain and Objectives

- 1) Focused flights over ARM SGP site
- 2) CloudSat/CALIPSO underpass along satellite orbital track
- 3) Cirrus within the flight domain



Measurement	Responsible Party	Status
Aircraft Parameters (position, attitude, etc)	Lawson	Final Data in IOPshare (by 3/31)
State Variables (T, P, etc)	Lawson	Final Data in IOPshare (by 3/31)
Water Vapor (DLH)	Diskin	Prelim. Data available. Final due 4/7
AIMMS-20 (T, P, Winds)	Lawson	Final Data in IOPshare (by 3/31)
2DS (PSD & Images)	Lawson	Final Data in IOPshare (by 3/31)
CDP (PSD)	Lawson	Final Data in IOPshare (by 3/31)
FSSP (PSD)	Lawson	Final Data in IOPshare (by 3/31)
CPI (Images)	Lawson	Final Data in IOPshare (by 3/31)
Nevzorov (Total Water)	Lawson	Final Data in IOPshare (by 3/31)
Raman Lidar Extinction	Comstock	Jan-Jun Data will be archived with Sparticus dataset (4/30)
CSI (Total Water)	Comstock	Calibration Needed (target 4/30)
Data Quicklooks and Calipso Images	Comstock	Final versions will be produced and archived after final data submitted

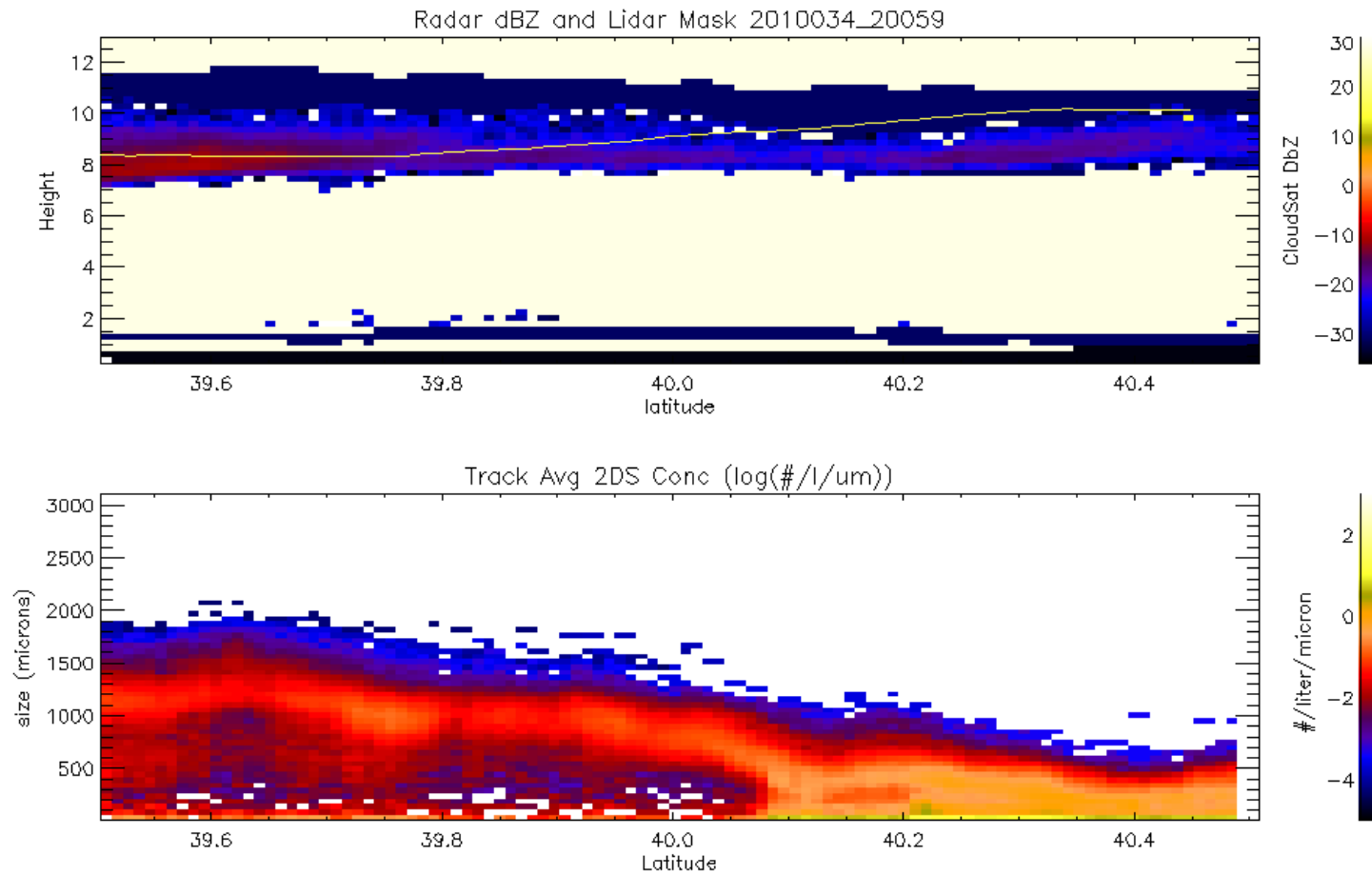
Science Objectives

- **Nature and variability of Cirrus Properties?**
 - **Lawson, Diskin**

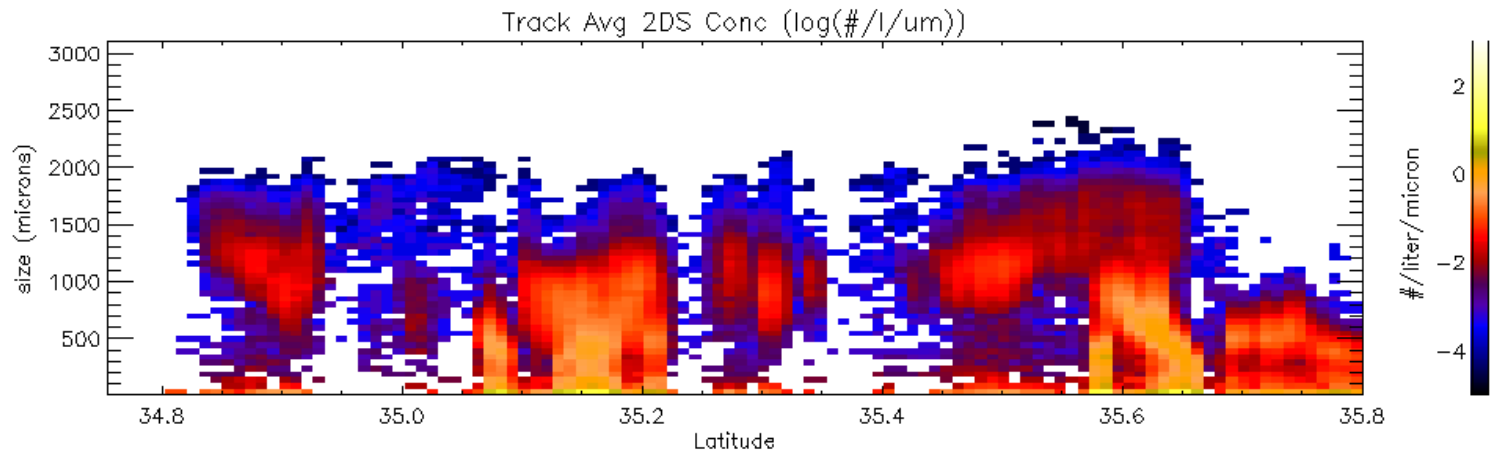
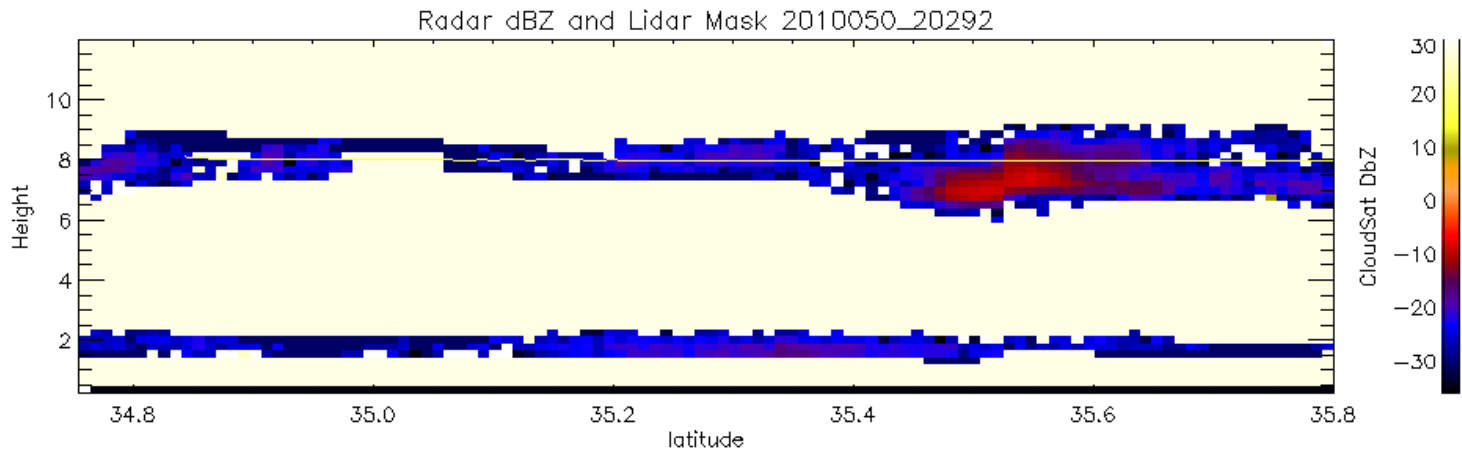
- **Coupling between cloud and larger scale dynamics and cirrus evolution?**
 - **Xiaohong Liu**

- **Remote Sensing?**
 - **Mace, Cooper, Schwartz, Mitchell, Mishra**

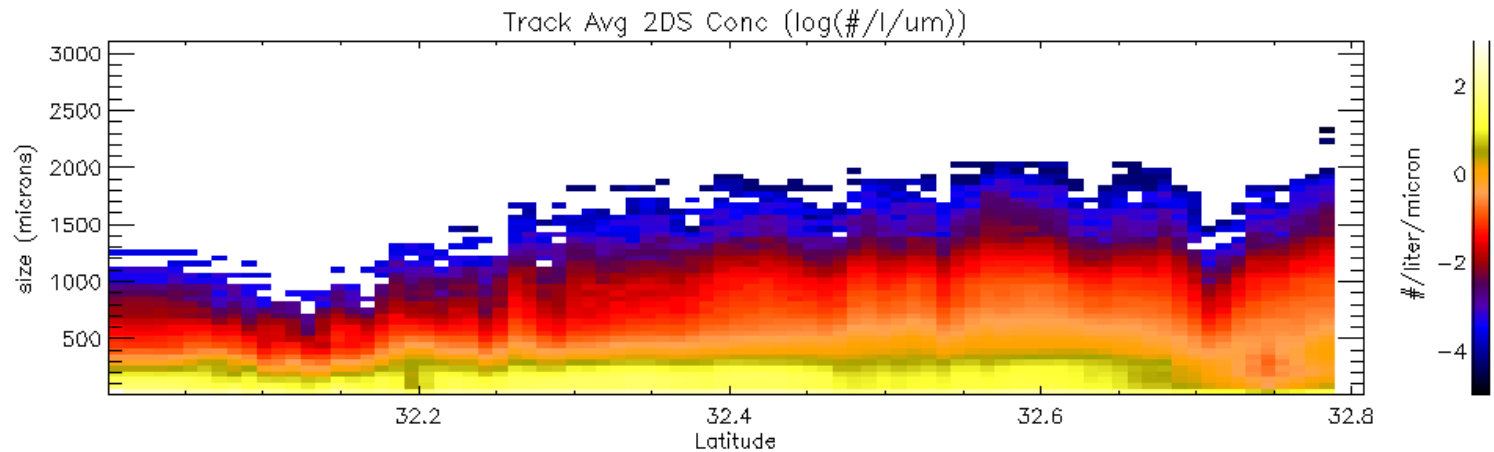
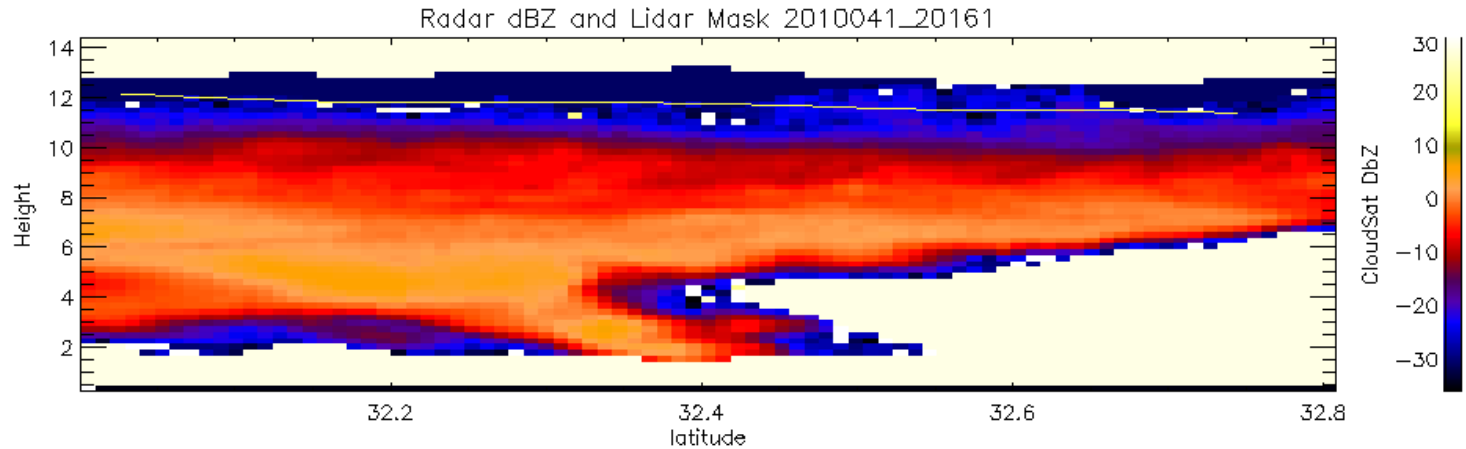
2010/02/03 Nebraska Homogeneous Thin Cirrus



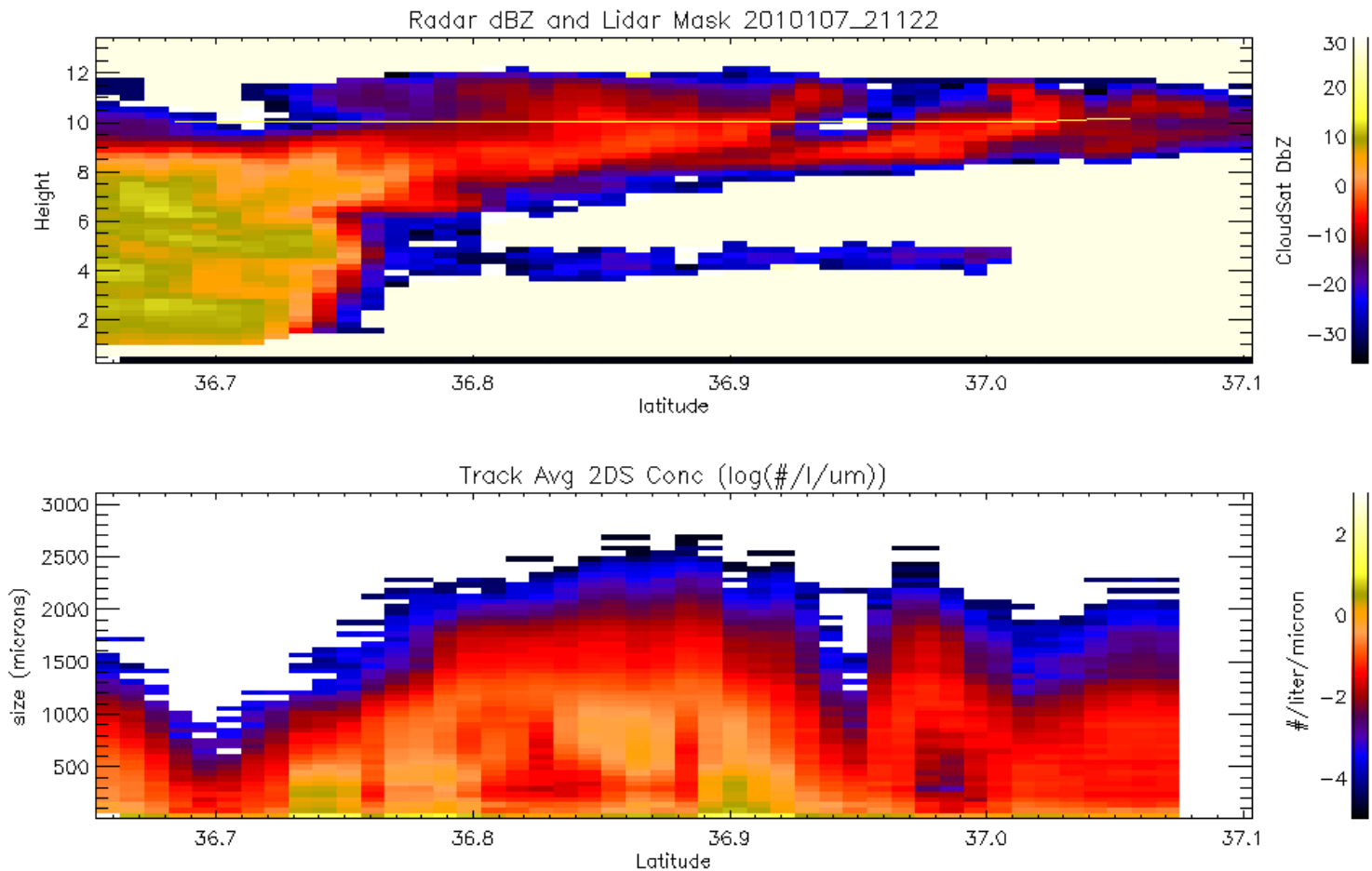
2010/02/19 Western Oklahoma Heterogeneous Thin Cirrus



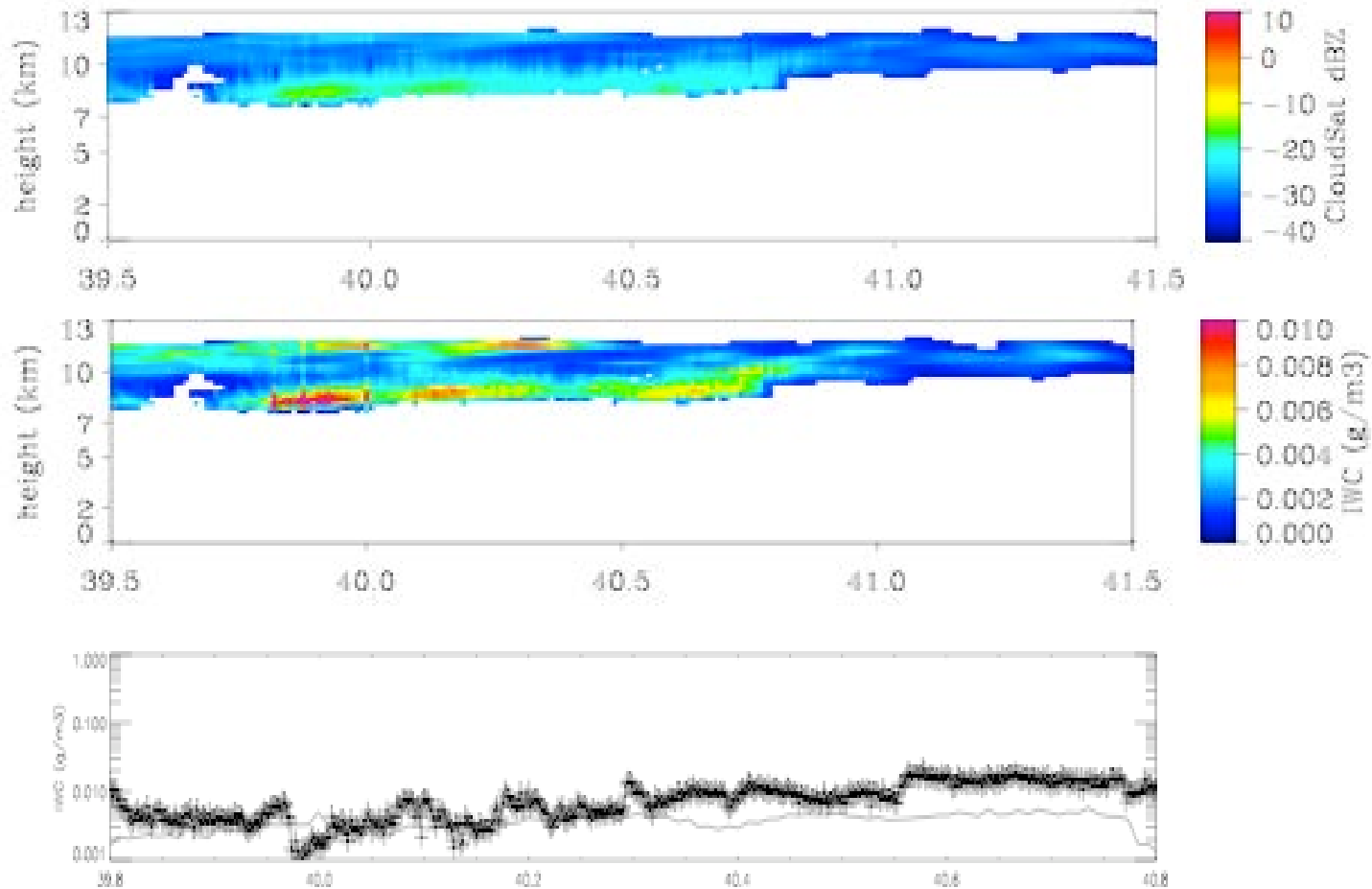
2010/02/10 North Central Texas Tops of Precipitating Systems



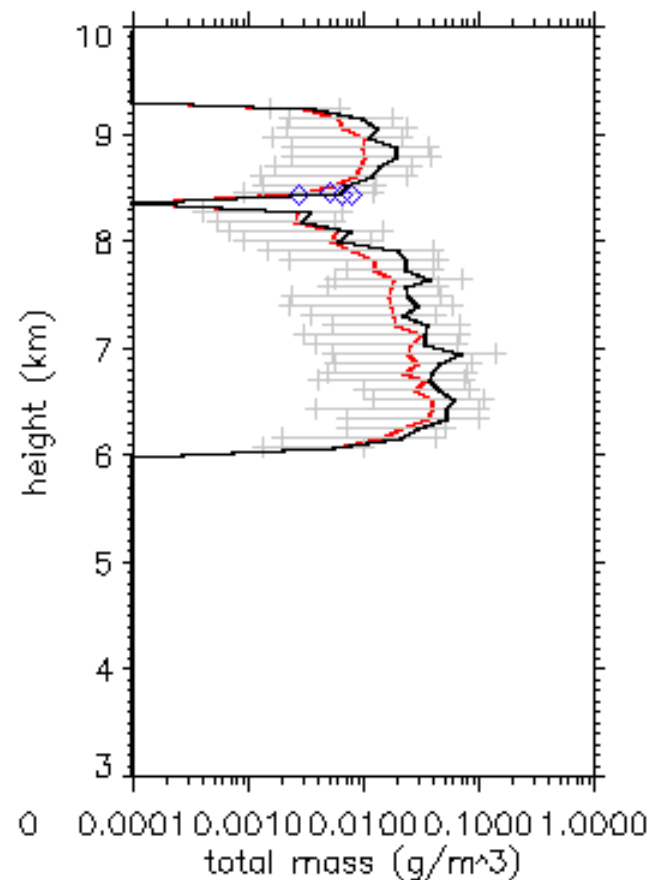
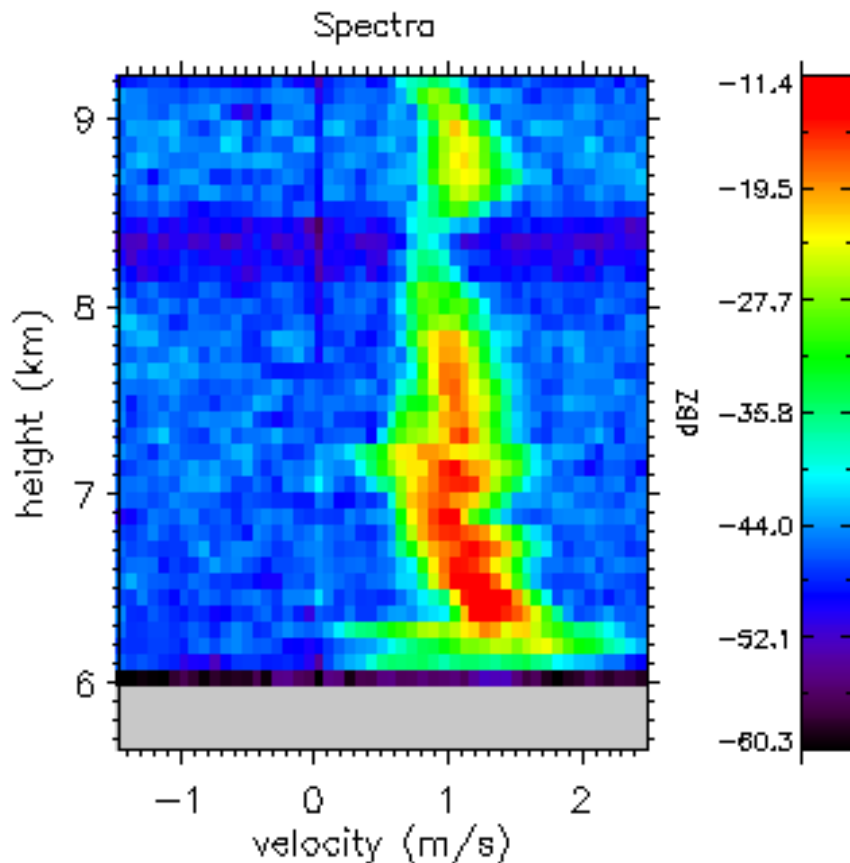
2010/04/17 Just East of SGP Anvil



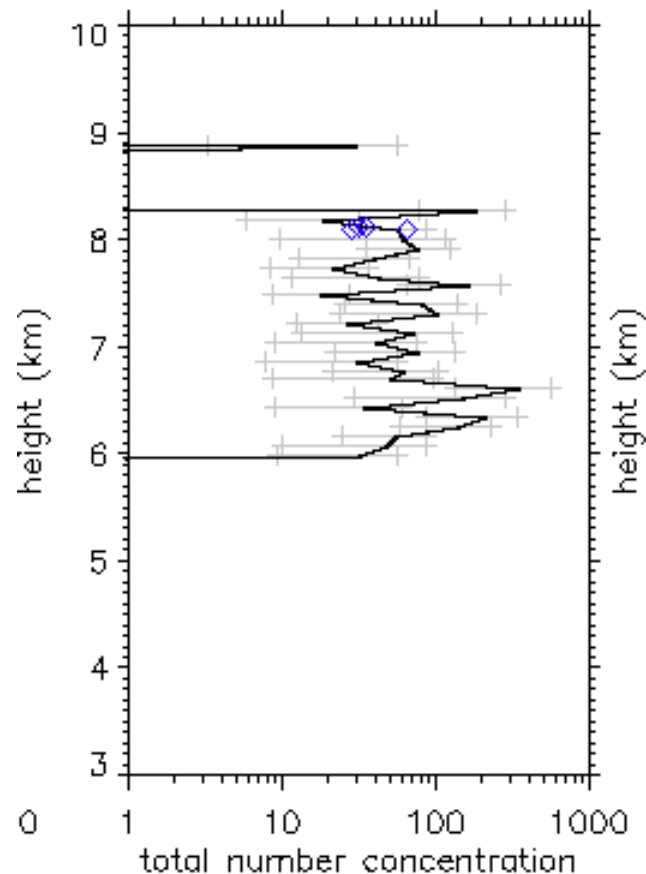
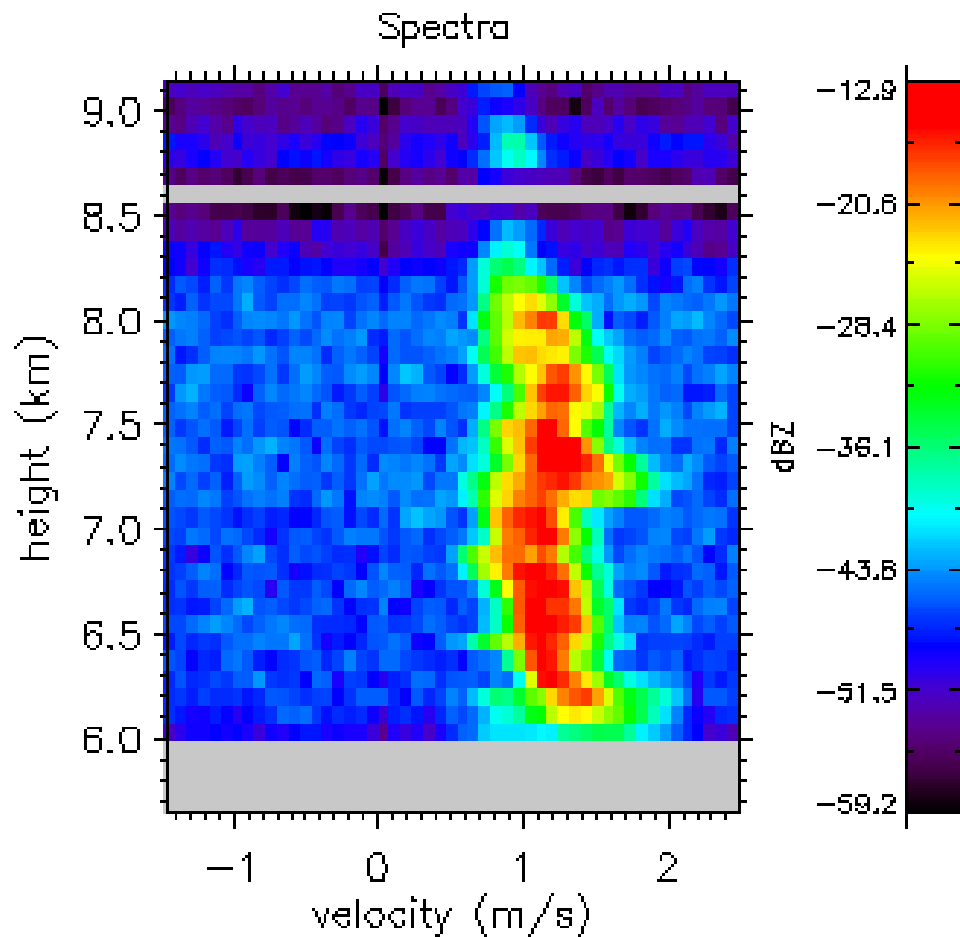
2010/03/17 SW Wyoming and NE Colorado Cloudsat-Calipso Retrieval



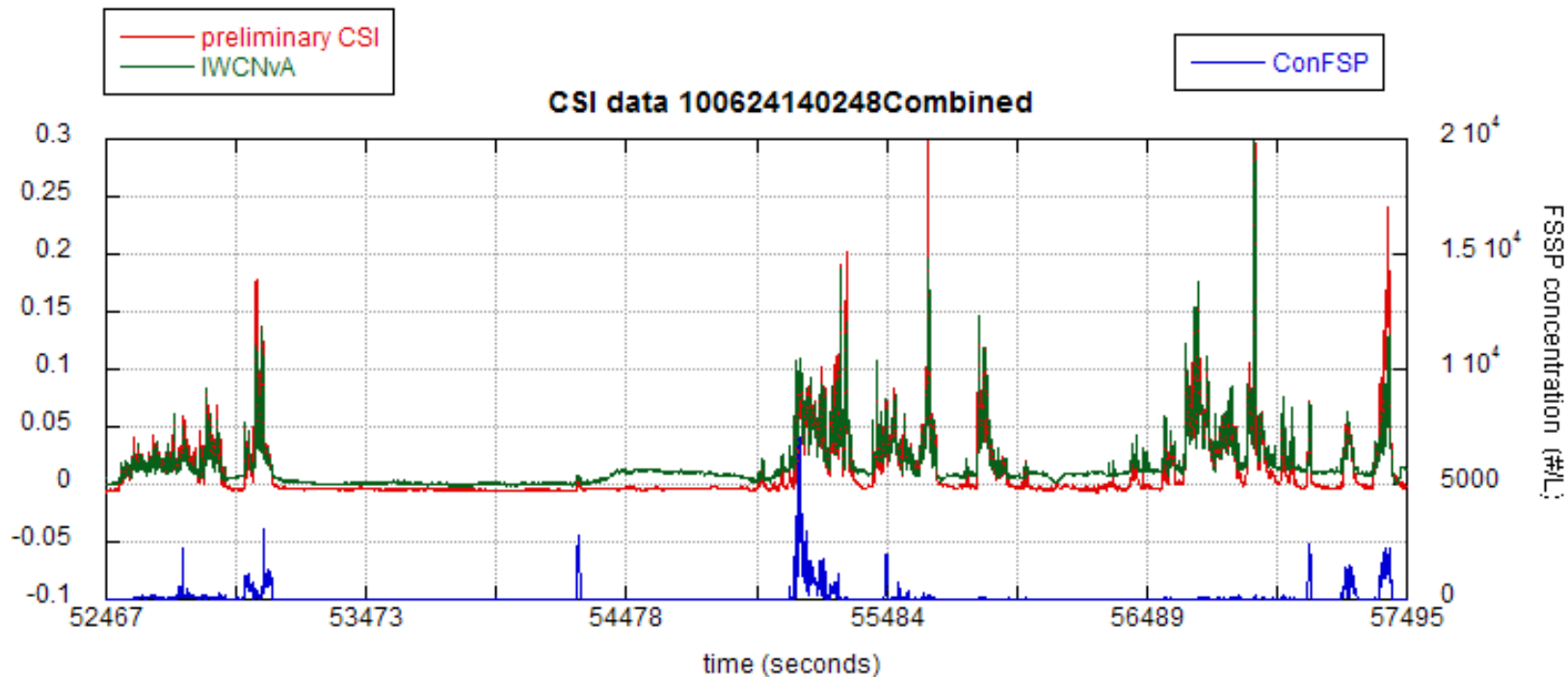
Cloud Property Retrievals from Doppler Spectra over SGP 2010/02/27 at 0214 UTC



Cloud Property Retrievals from Doppler Spectra over SGP 2010/02/27 at 0223 UTC



Preliminary CSI Data Compared with Nevzorov and FSSP



Closure Studies with Cloud Probe data will be used to assess total water measurements.

Research Topic

Jennifer Comstock, Minghuai Wang, Xiaohong Liu

How are the properties of cirrus clouds affected by nucleation mechanisms and sub-grid-scale variability of water vapor and vertical velocity?

Using Measurements (Comstock):

- Examine nucleation zone characteristics (T, RH, Vert. Vel., N_{ice} , etc.)
- Characterize sub-grid variability of WV and Vert. Vel. and their correlation to microphysical properties

Using Models (Wang and Liu):

- Improve statistical cirrus cloud scheme in CAM5 (Wang and Penner 2010) using sub-grid scale analysis of SPartICus aircraft and SGP data.