# MC3E Breakout
## Tuesday, March 13 1:00 – 2:30 PM

1:00 – 1:10 **Jensen** – MC3E Overview and Status

1:10 – 1:20 **Collis** – MC3E Precipitation Radar

1:20 – 1:30 **North** – 3-D wind retrievals during MC3E

1:30 – 1:40 **Kalesse** – Cloud classification during MC3E

1:40 – 1:55 **Xie** – MC3E Forcing dataset

1:55 – 2:10 **Fridlind** – MC3E + CStAT = A Simple Model for Multi-PI
   Collaboration

2:10 – 2:20 **Krueger** – Convection and the Boundary Layer during
   MC3E

2:20 – 2:30 **Tao** – Diurnal Variations during MC3E

# The Midlatitude Continental Convective Clouds Experiment (MC3E): Introduction and Overview of Field Campaign Observations
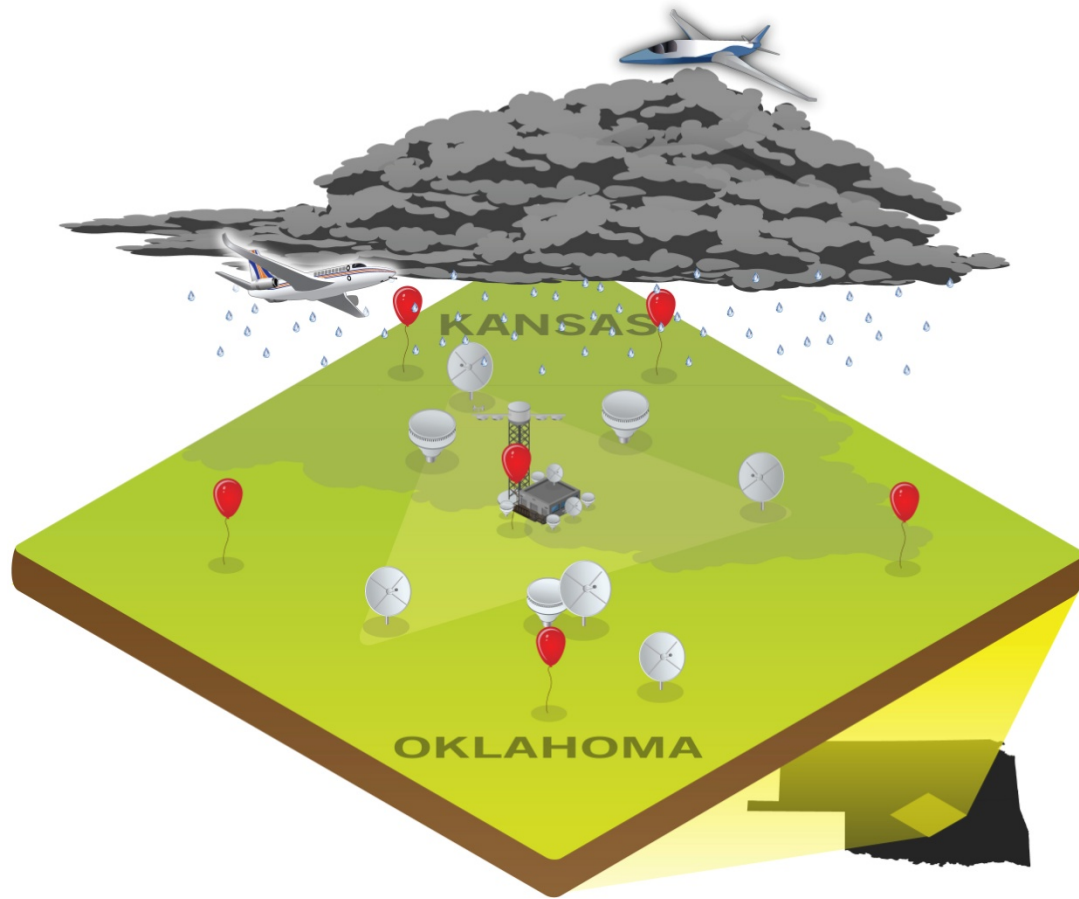


Michael P. Jensen
Brookhaven National Laboratory

13 March 2012
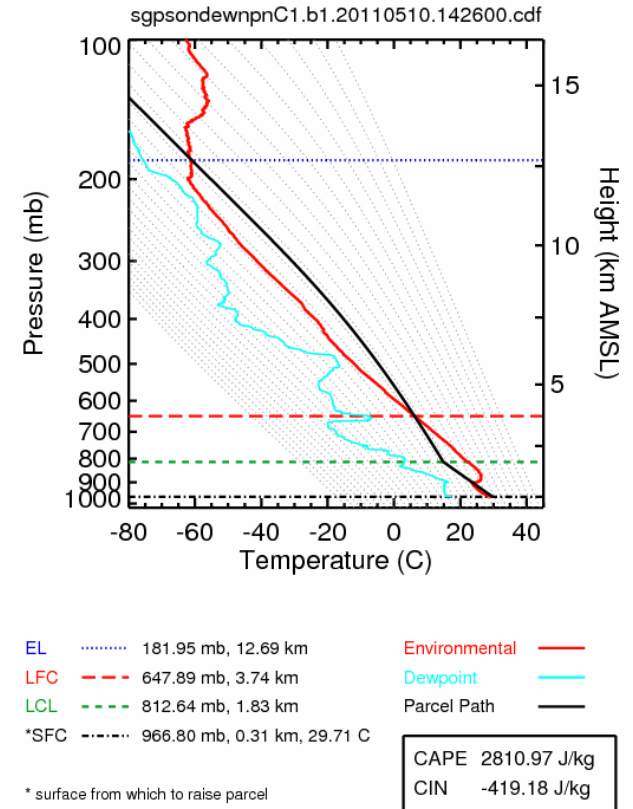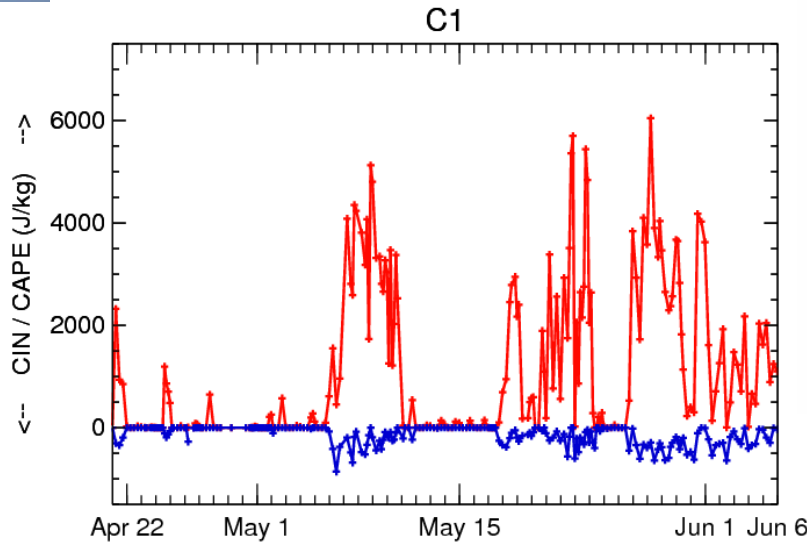ASR Science Team Meeting, Arlington, VA

# Quick Overview of MC3E

Who?     DOE Atmospheric Radiation Measurement Program
         NASA Global Precipitation Measurement Ground Validation

What?    Ground-, Aircraft-, Satellite-based observations of convective cloud
         systems. First demonstration of many of the new ARRA instruments

Where?   Centered at the ARM Southern Great Plains site in Lamont, OK
         Extended facilities from Southern Kansas to south of OKC

When?    April 22 – June 6 2011

Why?     1) Advance the understanding of the different components of convective
         parameterization

         2) Improve the fidelity of satellite  estimates of precipitation over land.
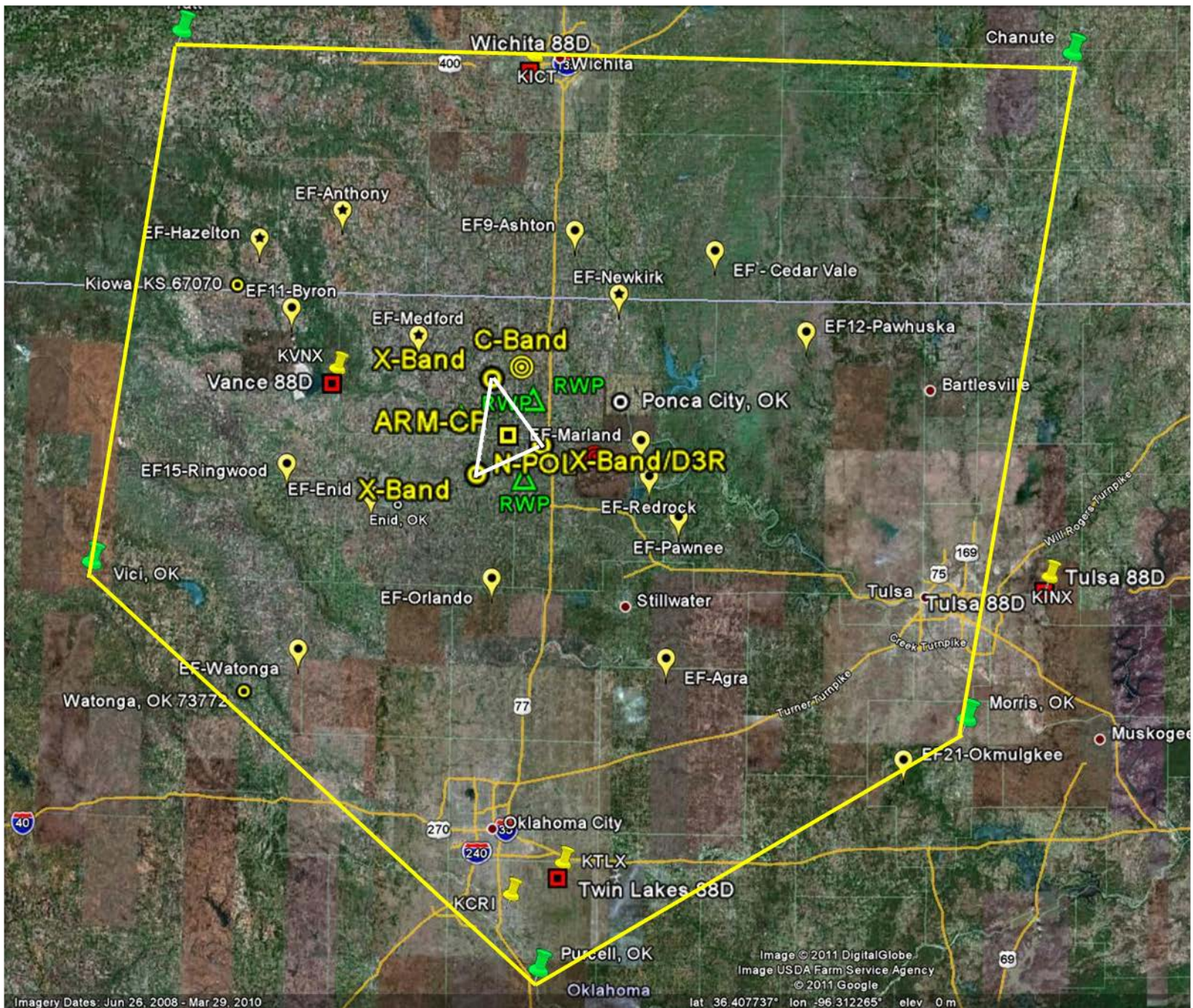
# MC3E sounding operations

- More than 25 staff launched 4-8 sondes/day at 6 sites
- More than 1400 radiosondes over 6 week period
- Variational Analysis Product – S. Xie (LLNL)



sgpsondewnpnC1.b1.20110510.142600.cdf

| EL | ·········· | 181.95 mb, 12.69 km | Environmental | —— |
| LFC | – – – | 647.89 mb, 3.74 km | Dewpoint | —— |
| LCL | – – – | 812.64 mb, 1.83 km | Parcel Path | —— |
| *SFC | –··–··– | 966.80 mb, 0.31 km, 29.71 C | | |

* surface from which to raise parcel

| CAPE | 2810.97 J/kg |
| CIN | -419.18 J/kg |

# MC3E Sampling: Ground

- **Multi-Freq./ Doppler / polarimetric/ profiling radars**
  - **Sub-pixel DSD/rain variability**
  - **3-D (solid/liquid/mixed) HID**
  - **Cloud water**........(maybe)
  - **Kinematics**

- **Network embedded in sounding array**
  - **CRM Forcing**
  - **Budgets**
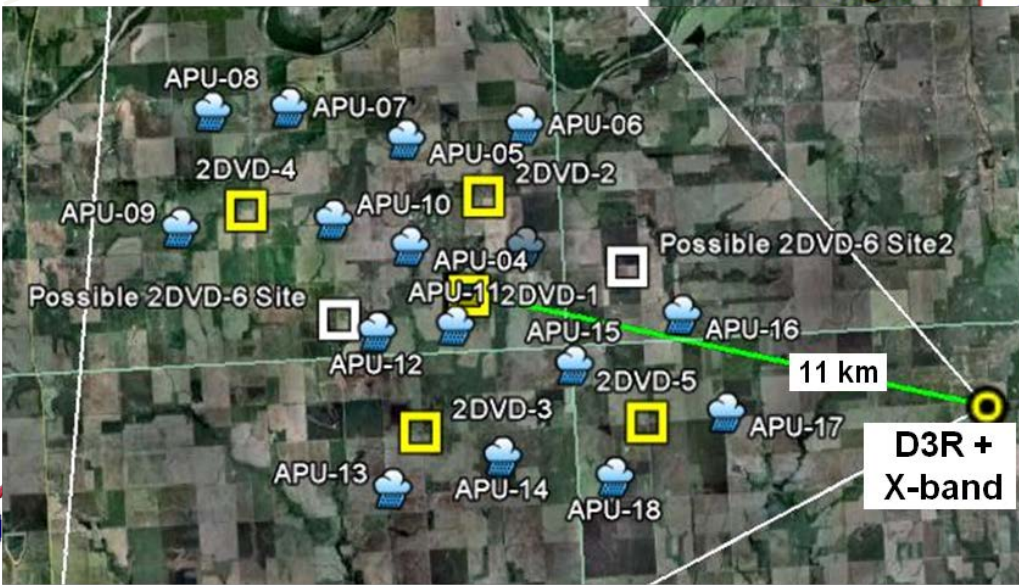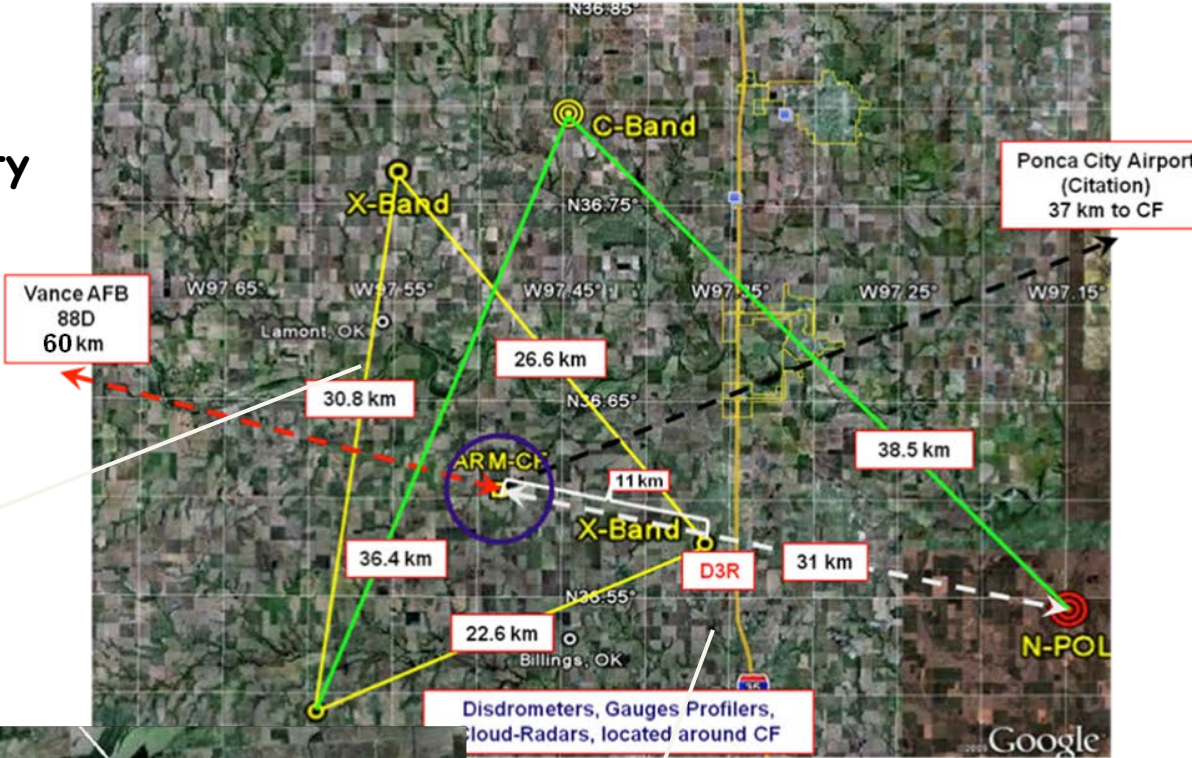


## NASA Disdrometer network

- 5   2DVD 3rd Generation, compact
- 16 Parsivel (Autonomous)
- 1-3 Joss (915 Profiler collocated)
- 20-40 Rain gauges collocated

# ARM Cloud Radars During MC3E



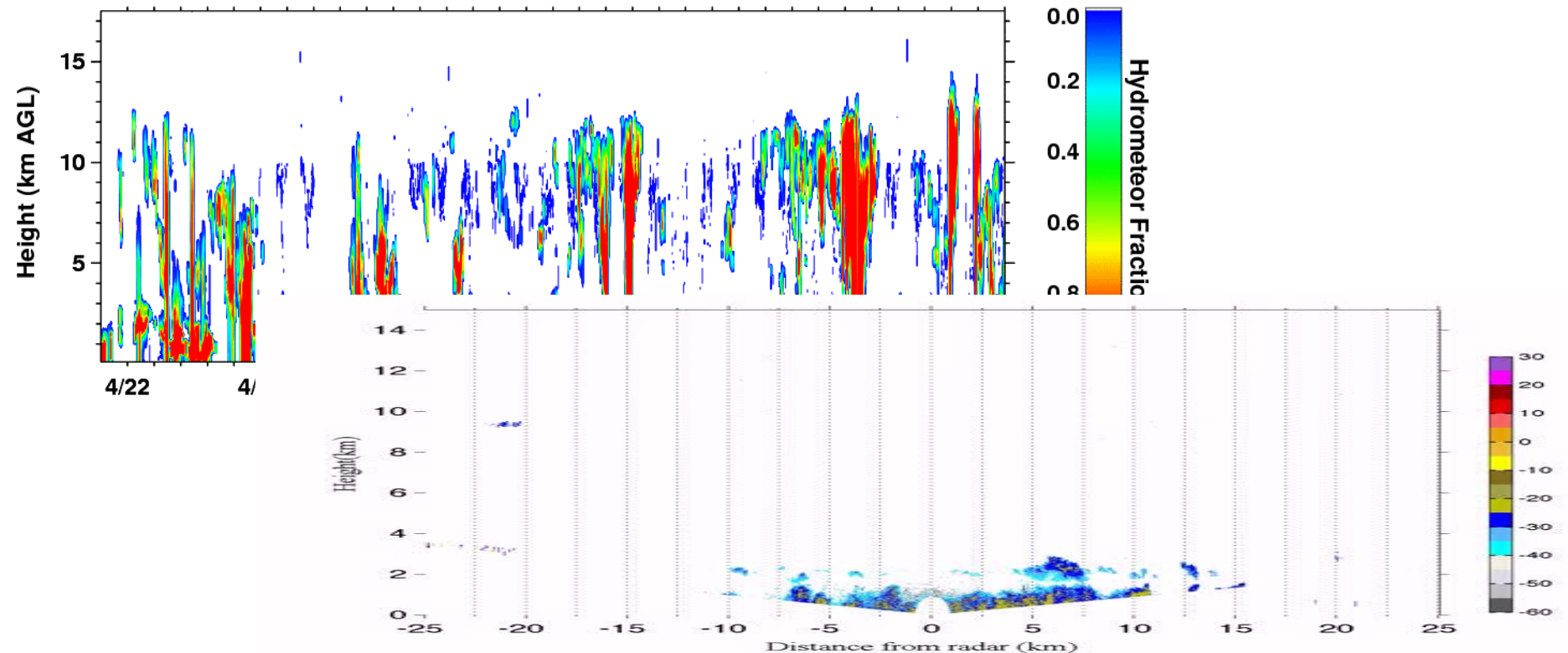KAZR installed – Dec. '10 (data collection started 1/18)

SACR installed – Feb. '11 (ingested data begins 4/30)
Issues with scanning pedestal, W-band transmitter
Scanning data 5/24 – 6/6
(Poster - Borque et al.)

Scott will talk about Precip Radars

# Inner Domain Thermodynamic Profiling during MC3E

- Objective: to characterize "small-scale" horizontal gradients in temperature and water vapor in pre-convective and convective environments

- Approach: deploy ground-based infrared spectrometers (i.e., AERIs) at each of the ARM X-band radar locations; retrieve T/q profiles from radiance observations

- Status as of Sep 2011:
  - Data collection was reasonably complete
  - Analysis of calibration underway
  - Initial retrievals will be performed in coming months



AERI installation at Garber

Lamont
SGP CF
Billings
Garber

16 km

Google Earth
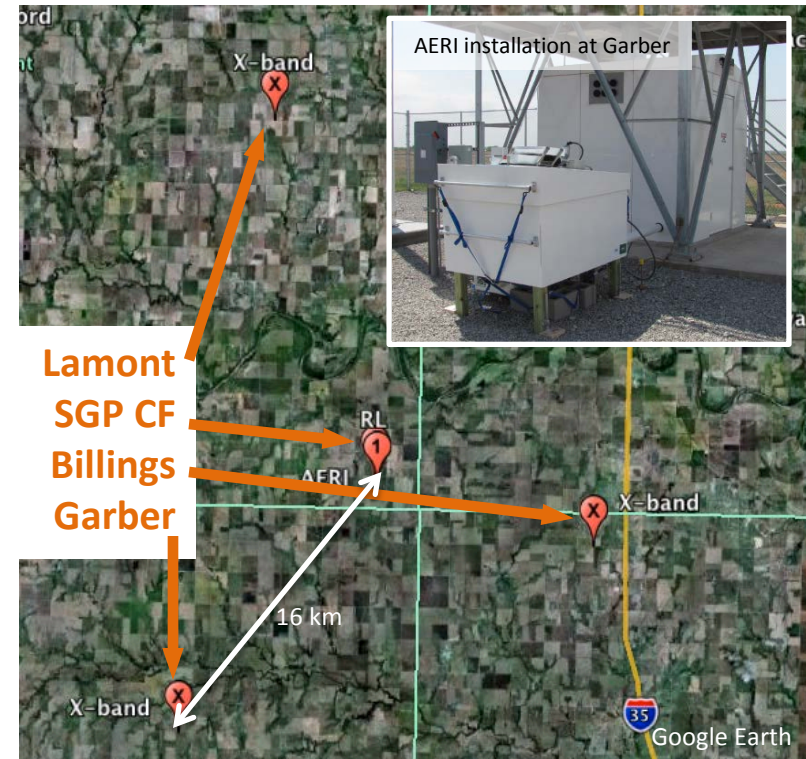


**AERI Data Availability during MC3E**
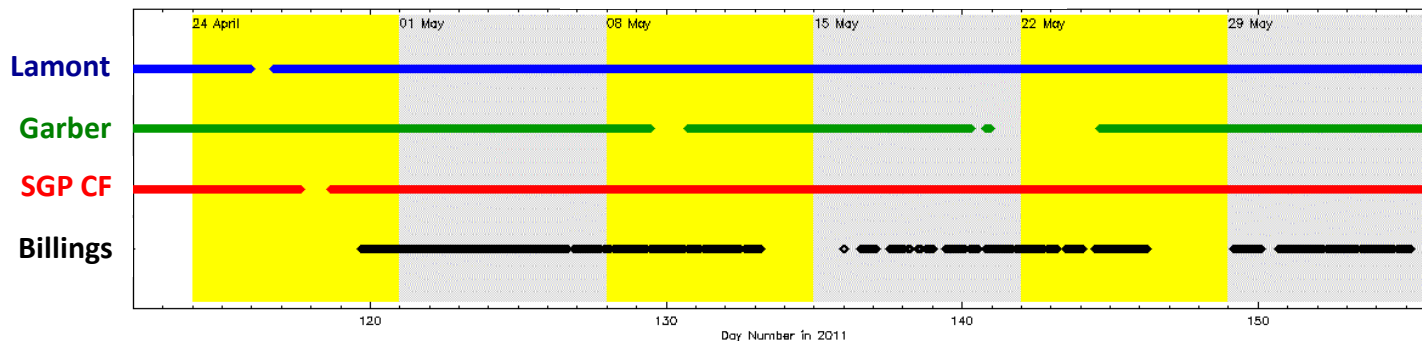
Contact:
Dave Turner
dave.turner@noaa.gov

# GPM Airborne Assets during MC3E

| GPM Core Satellite "Simulator" | In Situ MIcrophysics |
|---|---|



- **NASA ER-2: Satellite simulator**
- **86 flight hours**
- **Base: Albuquerque (Kirtland) AFB , NM**

- **UND Citation**
- **Microphysics**
- **50 flight hours**
- **Base: Ponca City, OK**



| Instrument | Characteristics |
|---|---|
| AMPR (Radiometer, H +V) | 10.7, 19.35, 37.1, 85.5 GHz |
| Resolution @ 20 km range | 0.6 km (85.5 GHz), 1.5 km (37.1 GHz), 2.8 km (10.7-19.35 GHz) |
| CoSMIR(Radiometer, H+V) | 37, 89, 165.5, 183.3+/-1, 183.3+/-3, 183.3+/-8 GHz |
| Resolution @ 20 km range | 1.4 km footprint at nadir |
| HIWRAP Ka-Ku band Radar | 13.91/13.35 GHz, 35.56/33.72 GHz |
| Transmit peak power | 30 W (Ku), 10 W (Ka) |
| 3 dB beamwidth | 2.9º Ku, 1.2º Ka |
| MDS ($dBZ_e$, 60 m res., 3.3 µs chirp pulse, 10 km range) | 0.0, -5.0 $dBZ_e$ |

| Instrument | Measurement |
|---|---|
| King | Cloud liquid water |
| PMS 2D-C/CIP | Cloud particle spectra |
| HVPS | Precipitation particle spectra |
| CPI | Cloud particle images |
| CDP | Cloud droplet spectra |
| Nevzorov | Total water content |
| Rosemount icing probe | Supercooled liquid water |
| CN/UHSAS | Aerosol |

# UND Citation

Andrea Neuman (UND), Mike Poellet (UND)
Jennifer Comstock(PNNL), Jason Tomlinson (PNNL)
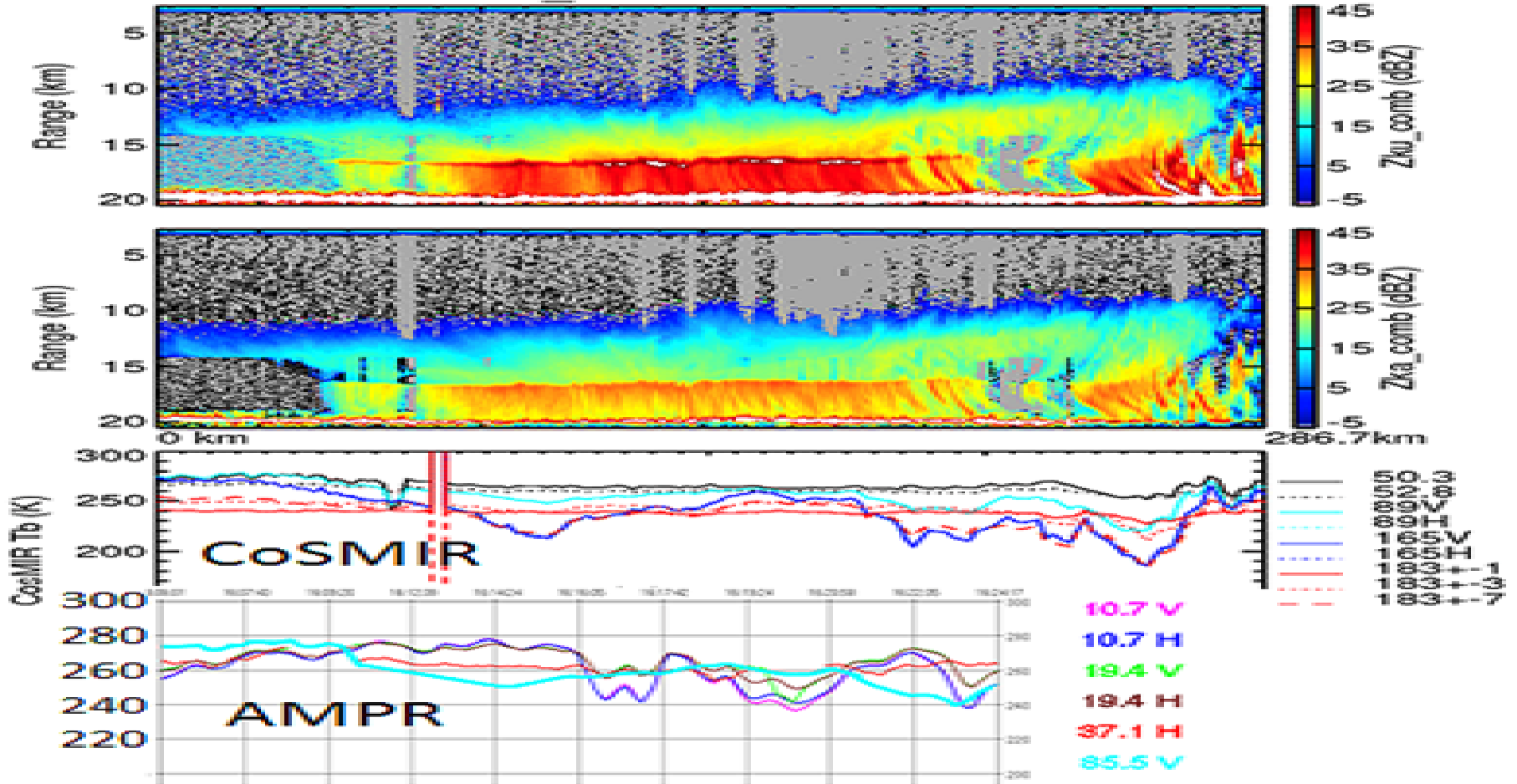15 flights (Good UHSAS, HVPS data on 9 flights)
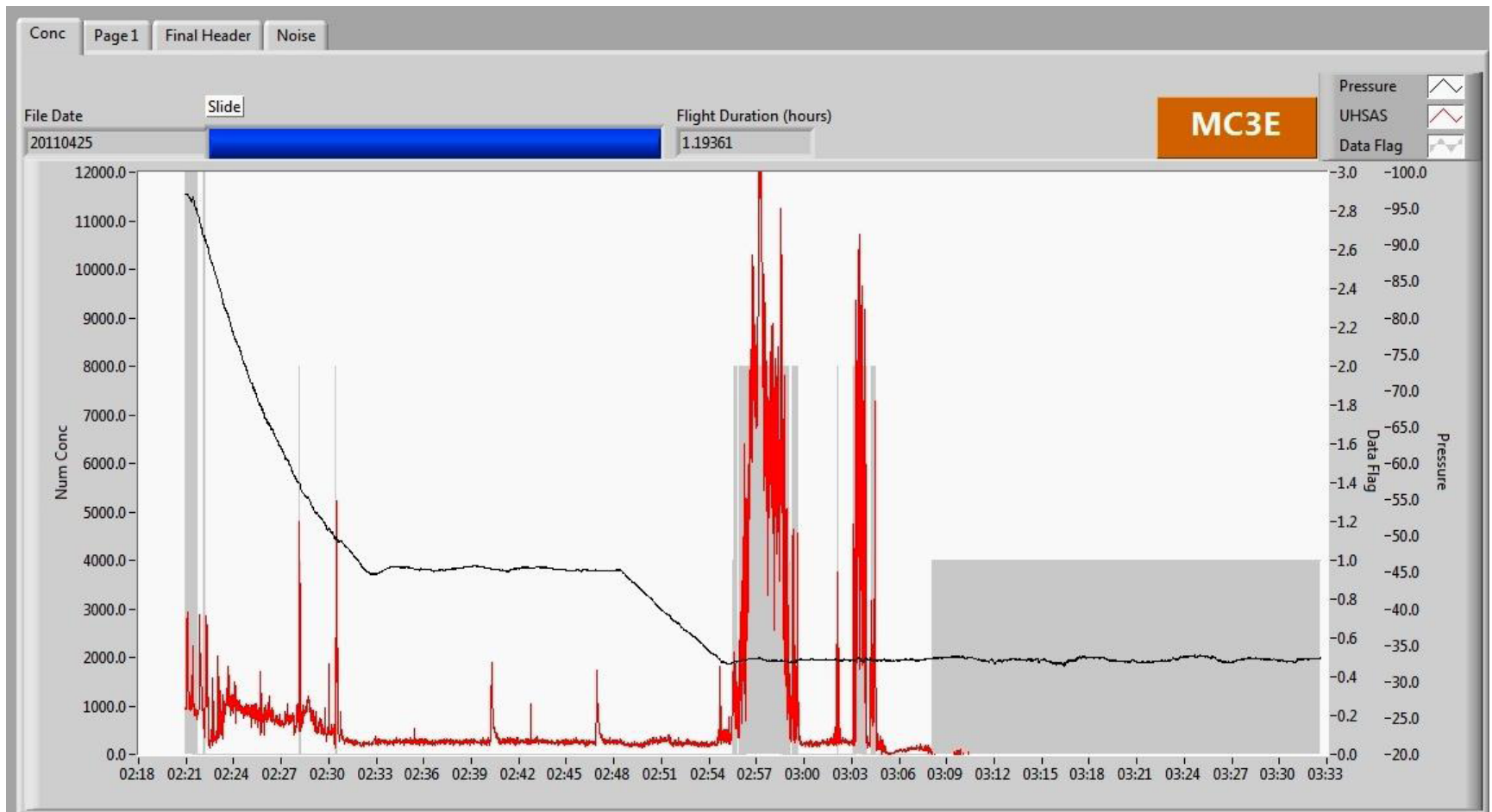
# ER-2

9 missions (3 land surface)
5 flights coordinated with UND Citation and within 100 km of CF

# Summary of conditions sampled during MC3E

| Category | Description | # days sampled | Days |
|---|---|---|---|
| 1 | Convective Line / Cell events | 8 | **4**/22,25;  **5**/11,18,20,23,24,31 |
| 2 | Widespread Stratiform Rain | 3 | 4/27, 5/1, 5/10 |
| 3 | Elevated Weak (Overnight) Convection | 3 | **4**/23, 24; **5**/18 |
| 4 | Boundary Layer Clouds | 10 | **4**/26; **5**/5,13-15,19,27-29;**6**/1 |
| 5 | Mid- or Upper-level clouds | 7 | **5**/2,3,8,9,25,26; **6**/2 |
| 6 | Clear | 14 | |

- Coordinated aircraft missions focused on categories 1 & 2

- Dedicated boundary layer cloud flight by UND Citation 5/27 & 5/30

- Enhanced sounding operations focused on categories 1-3

# Where can we get data?
# It depends which data you want

ARM MC3E observations - IOP archive (**http://iop.archive.arm.gov/arm-iop/2011/sgp/mc3e**)
      Soundings (except CF), ARM 2DVD, BNL MWR (S05),
      VARANAL, Citation HVPS & UHSAS

Standard ARM observations (including ARRA instrumentation) – **www.archive.arm.gov**
      All "raw" radar/lidar observations, radiation, surface meteorology, CF soundings, etc…

Value-added (Evaluation) products - **http://www.arm.gov/data/vaps**
      C-SAPR Gridded Radar Moments (MMCG) [10 days +]

NASA DAAC
      N-Pol radar, Disdrometer network, ER-2, Citation
      **ftp://gpm.nsstc.nasa.gov/gpm_validation/mc3e/**

Yet to come!
      KAZR-ARSCL (Johnson et al.), QPE (Collis et al.), Vertical Velocity (North et al.),

# MC3E Posters (19)

Bartholomew - ARM's Disdrometer Suite: Capabilities and Deployment

Borque et al. - Low-level Divergence Measurements During MC3E

Collis et al. – Moments to Models: Progress Towards a Suite of Precipitation Radar VAPs

Crowell and Turner - Using Dynamic and Thermodynamic Profiler Retrievals to Improve the Forecast of the May 24, 2011 Outbreak: an Observing Systems Simulation Experiment

Dunn et al. - Characterizing Convective and Stratiform Precipitation Regimes Observed During MC3E Using C-SAPR Radar

**Giangrande et al. - Precipitation Estimation from the ARM Distributed Radar Network During the MC3E Campaign**

Jensen et al. - Large-scale atmospheric state and cloud/precipitation characteristics during MC3E

Khaiyer et al. - Improved TOA Broadband Shortwave and Longwave Fluxes over Various ARM Domains

Lesage and Krueger – Analysis of convectively generated cold pools and fronts from mesonet data

**Newsom et al. - Comparison of Vertical Velocity Observations Between the ARM Doppler Lidar and the 915 MHz Radar During MC3E**

North et al. - Validation of Multiple-Doppler Analysis of Convective Clouds Using the ARM Precipitation Radar Network During MC3E

Rutledge et al. – Analysis of X-SAPR and C-SAPR data from MC3E

Schatz et al. - The New and Improved Southern Great Plains

Sivaraman et al. – Routine Planetary Boundary Layer (PBL) Height Value-Added Product (VAP) Development Using Radiosonde Measurements

Tridon et al. - Collocated UHF and Ka-band Radar Measurements for Rain Profile Retrievals at ARM SGP Facility

Turner - Retrieved Temperature and Humidity Profiles from the AERI During MC3E

Williams - Merging Doppler Velocity Spectra in Time and Height to Overcome Mismatch in Radar Pulse Volumes from Collocated Radars

Wu et al. - MC3E: Post-mission Simulations

Xie et al. - Development of Multi-scale Large-scale Forcing Data Sets for MC3E Cloud Modeling Studies