Midlatitude Continental Convective Cloud Experiment (MC^3E) Breakout

Jensen/Petersen – Overview of Science Objective and Operations

Petersen – NASA GPM Aircraft Operations

Collis – SGP X-band radar network: Ideas on scan strategies

Bharadwaj – Deployment plan and polarimetric capabilities of the ARM X/C-band radars

Giangrande – Precipitation, Profiling and MC3E

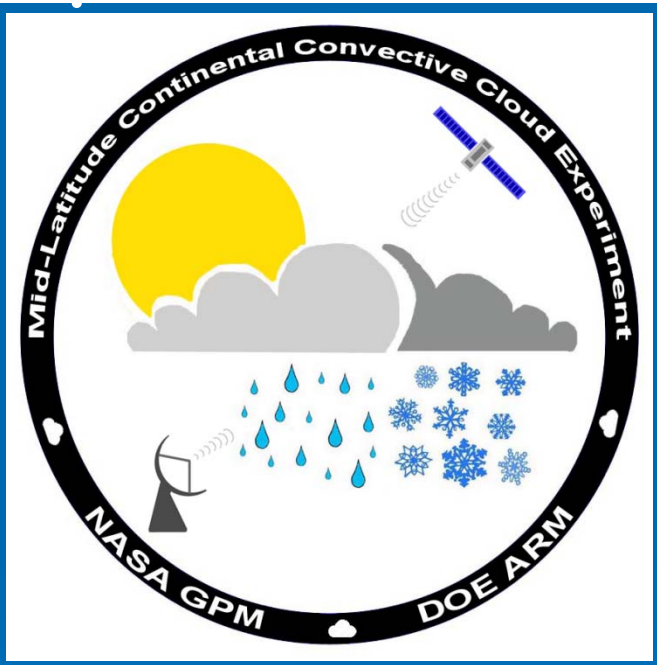
Williams – NOAA Wind profiler systems

Discussion

DOE – ARM / NASA- GPM

Midlatitude Continental Convective Cloud Experiment (MC^3E)

- SGP
- May – June 2011



Michael Jensen (BNL)

Walt Petersen (NASA MSFC)

First Annual ASR Science Team Meeting

17 March 2010 – Bethesda, MD

MC3E April 15 – May 31, DOE ARM Central Facility

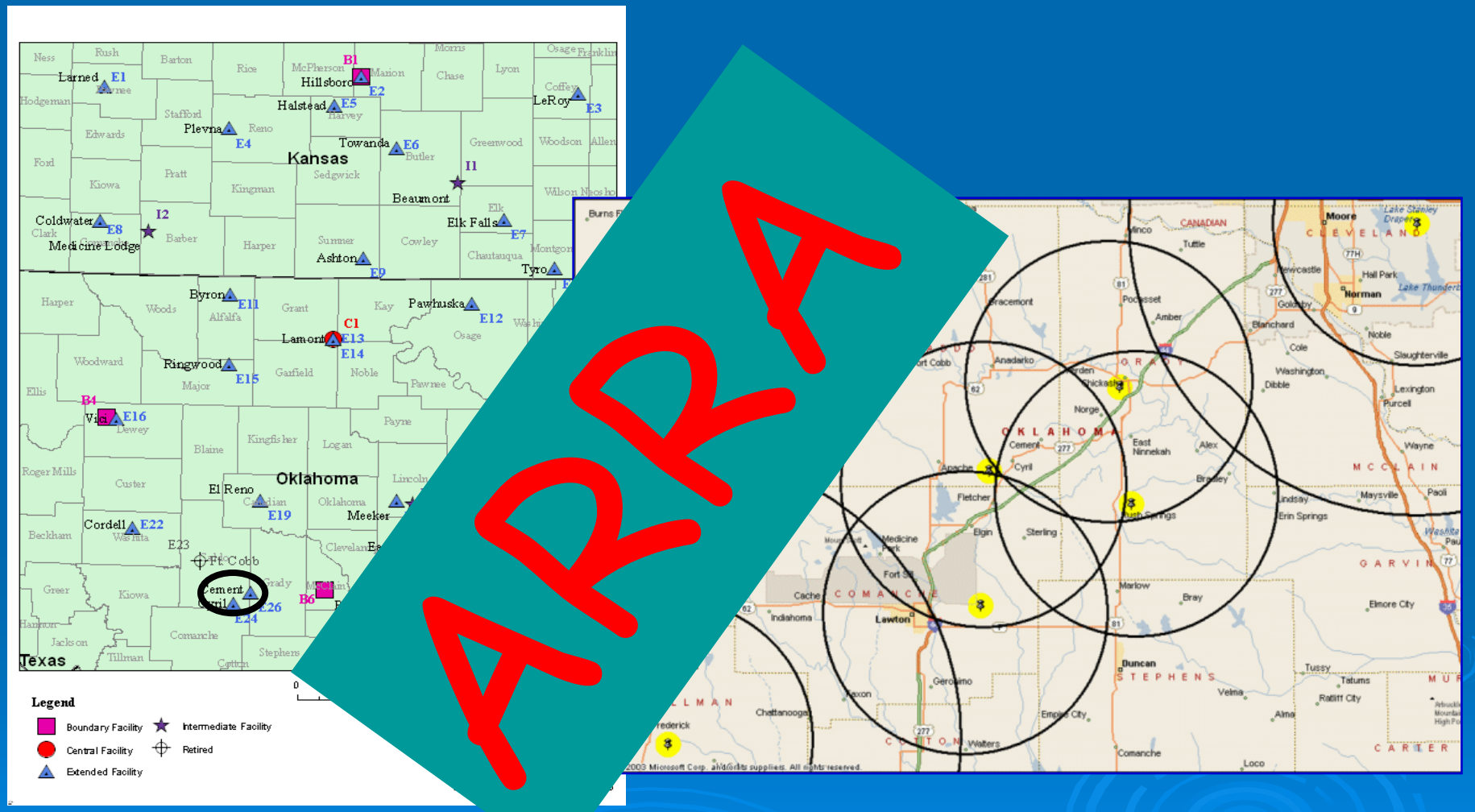
Represents a collaborative effort between the DOE ARM Program and the NASA Global Precipitation Measurement (GPM) mission

Overarching Science:
A complete characterization of convective cloud systems in order to:

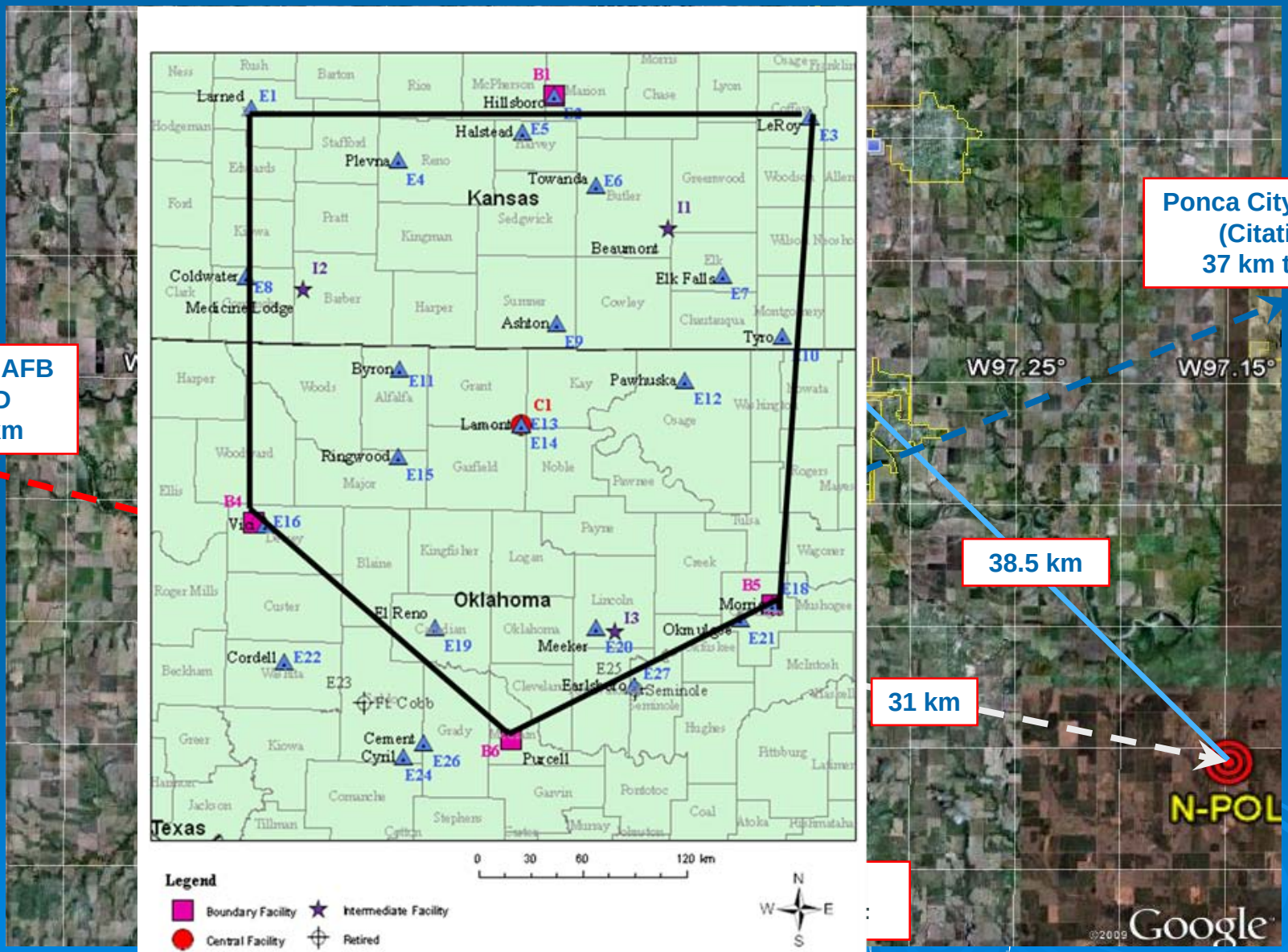
1) Advance the understanding of the different components of convective parameterization
   - Focus: Convective initiation and up/downdraft coupling to precipitation and cloud microphysics.

2) Improve the fidelity of satellite estimates of precipitation over land.
   - Focus: Observation and quantification of dominant column microphysical processes impacting satellite-based passive/active microwave retrievals

Deployment at Southern Great Plains ARM site



Deployment at Southern Great Plains ARM site



Data products appropriate for modelers

- Continuous forcing dataset

  (ARM infrastructure)

- Surface precipitation maps

  (ARM extended facilities, NASA disdrometers, radar)

- 2D & 3D wind retrievals

  (scanning, profiling radars, 4DVar)

- Cloud hydrometeor determination

  (spectra – polarimetry)

- Cloud and Precipitation microphysics

  (multi-wavelength, disdrometers, polarimetry, aircraft)

GPM GV Physical Process Studies

- **Satellite Retrieval Algorithm Physics: GPM Mission expands measurements, global coverage and application- more processes and issues to consider!**

Dual Frequency Precipitation Radar

Detection/Classification

Rain/no-rain
Hydrometeor phase/profile:
Liquid, freezing/melting, frozen
Rain type (convective/stratiform)

Attenuation:

PIA Algorithm:

Uncertainty due to DSD, CLW, mixed phase, σ_{sfc} , water vapor sensitivity

DSD, Precipitation Rate:

DSD:
Dual-frequency retrieval error and propagation into rate/content retrievals

Z-R/S at the light rain rates and in snow

Sub-pixel precipitation heterogeneity/ variability

Passive Microwave Radiometer

Land

Ice and mixed phase coupling to rainfall

land-surface emission

Coastal transition

Detection/Classification:

Snowfall detection thresholds and surface/atmospheric emission

Rain no rain (warm rain, light rain, shallow melting layer)

Rain type (convective/stratiform)

Radiative Transfer

Single vs. bulk ice scattering

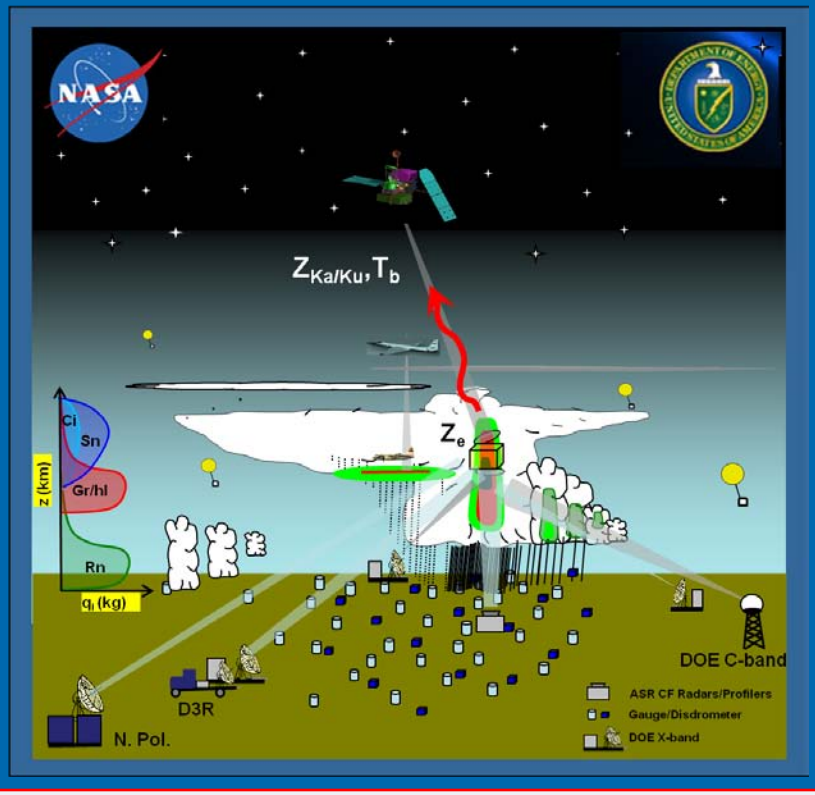
Water vapor, CLW, melting layer extinction

Models/Databases [Satellite Simulators]

Coupled CRM/LSM/RTM physical parameterizations

Address with targeted Field campaigns and PI-lead investigations

NASA GPM – DOE ASR 2011 MC3E



Loc./Date: Oklahoma, DOE-CART/Apr.-June 2011

GPM Focus: Mid-Latitude land (precip variety)

GPM Science Priorities

1. **Coordinated high altitude/in situ sampling**
   a. Ka/Ku-band radar w/multi-freq. radiometer over in-situ **ice microphysics**
   b. Pre/post storm **surface emission/backscatter properties.**

2. **3-D *hydrometeor distribution/type***
   a. Multi-instrument framework for **retrieving 3-D DSD** (disdrometer, multi-parm radar, profiler)
   b. Sub pixel scale DSD variability (.5 – 5 km)
   c. Cross validation/comparison of **multi-frequency** (Ka-Ku) and **dual-pol**. **retrieval techniques** including **hydrometeor typing**

3. **Satellite *simulator models (CRM/LSM/RT)***
   a. High quality sounding-based **forcing data**
   b. Microphysical and kinematic validation.
   c. Land surface impacts

NASA Instruments contributed:

- Aircraft: ER-2, UND Citation (in situ) (HIWRAP, CRS, AMPR, CoSMIR)
- Radars: NPOL (S-band dual-pol), D3R (Ka-Ku dual-pol), S/UHF profiler
- Surface: 5- 2D Videio,16- Parsivel disdrometers, 20 rain gauges

To be combined with DOE radar, sounding, and surface networks

Hypothesis Testing
Mid-Latitude Continental Precipitation

- Hypothesis 1: A high resolution, dual frequency radar algorithm can detect changes in D_0 that parallels changes measured by in-situ observations at a level that corresponds to 10% in rainfall.

- Hypothesis 2: Existing satellite radiometers can isolate the signals coming from precipitation and the surface to the ±5K level for well characterized surfaces such as the DOE SGP site.

- Hypothesis 3: The fidelity of radiometer-diagnosed precipitation estimates can be improved with a priori knowledge of precipitation regime.

- Hypothesis 4: Radar based DSD measurements (from dual-frequency and dual polarization) are consistent with slant path microwave radiances (e.g. ADMIRARI) to a level that can be explained with realistic cloud water amounts.

- Hypothesis 5: Over a well characterized region, coupled cloud-resolving and land surface models have sufficient fidelity to reproduce TOA radiances consistent with observed microphysical and state parameters in the column and at the surface.

Discussion topics (led by Kollias and others)

- Scanning strategies
- Deployment and siting of NASA N-Pol and D3R
- Radiosonde array
- Other deployment/siting issues
- Next meeting?