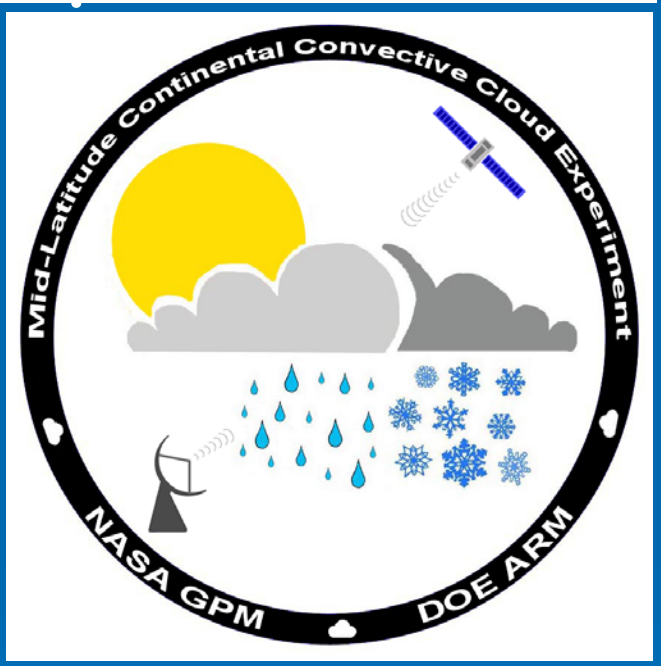
DOE – ARM / NASA- GPM

Midlatitude Continental Convective Cloud Experiment (MC^3E)

- SGP
- May – June 2011



Michael Jensen (BNL), Pavlos Kollias (McGill)

Anthony Del Genio (NASA GISS) Scott Giangrande (McGill)

Partnering with NASA GPM, CASA, NSF DC-3, Oklahoma University, NSSL, OK Climate Survey, NASA CloudSat

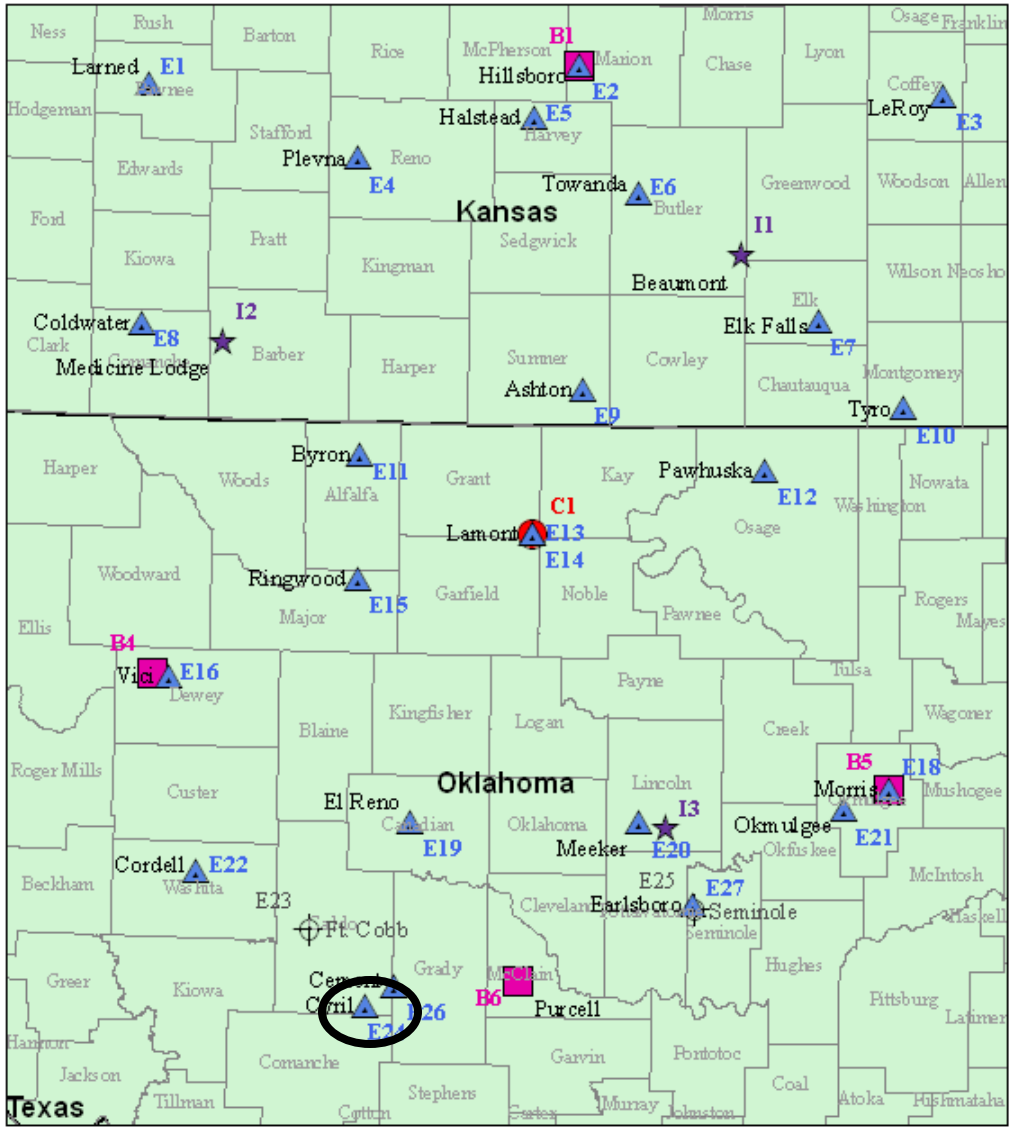
ARM Key Science question #4: How do radiative processes interact with dynamical and hydrological processes to produce cloud feedbacks that regulate climate change?

Goal: Improve climate models!!

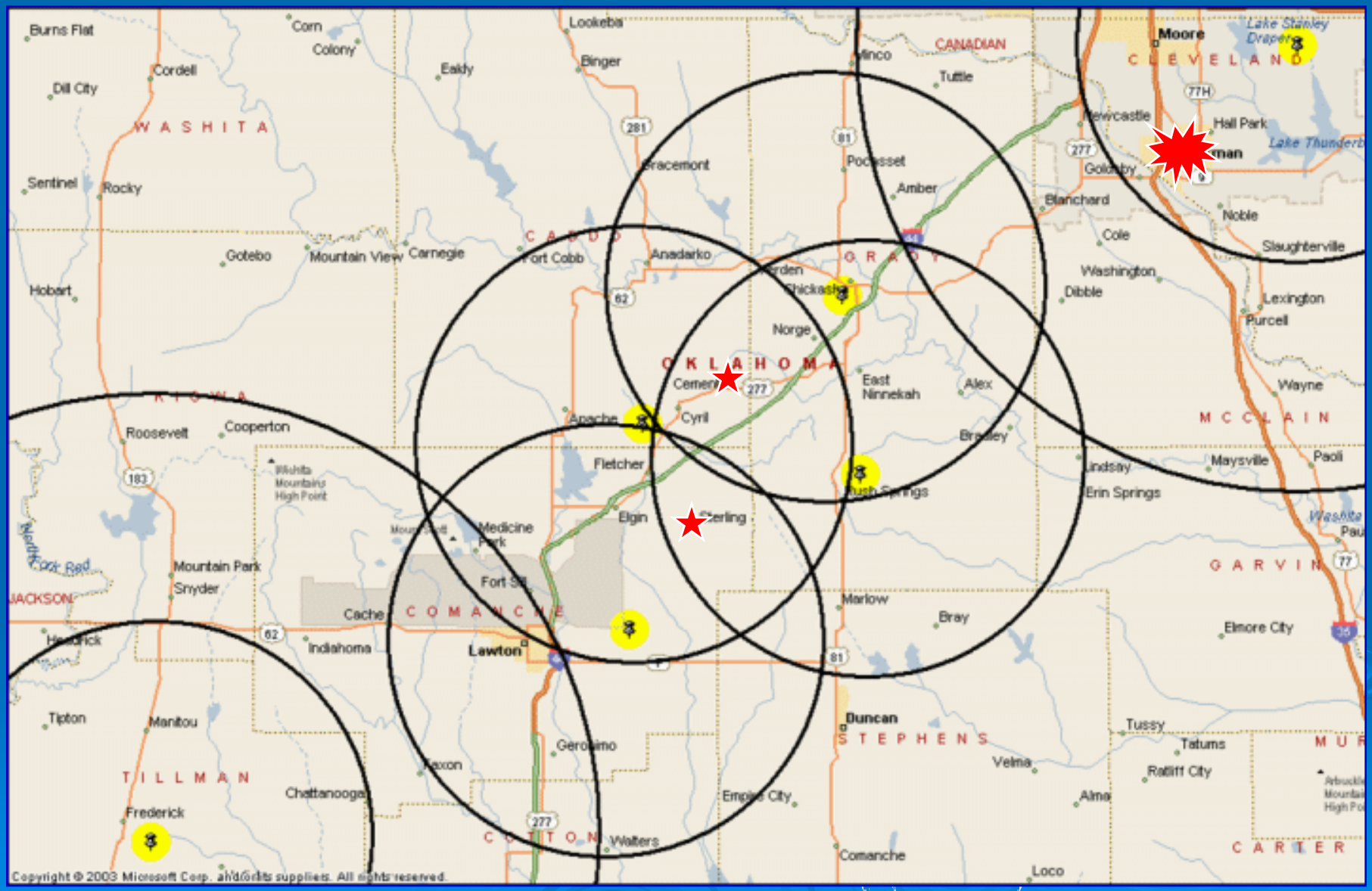
Elements Convective Parameterization

1) Pre-convective environment
2) **Convective Intiation**
3) **Updraft/Downdraft Dynamics**
4) Condensate Transport/Detrainment
5) **Precipitation/Cloud microphysics**
6) Influence on environment
7) Influence on Radiation
8) Large-scale forcing

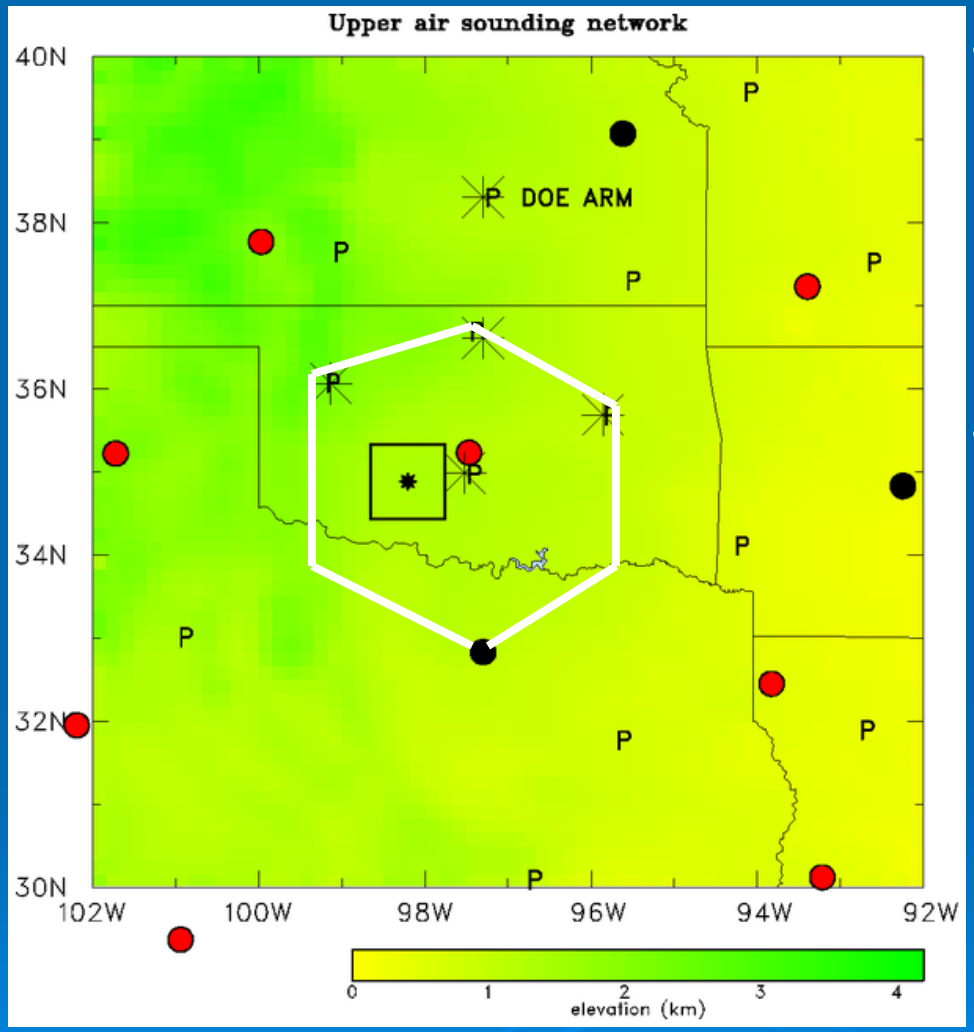
Big Question: Given PBL (T,q) and vertical profiles, can the precipitation at the ground be predicted? (A. D. Del Genio)


Kansas
Oklahoma
Texas
Larned E1
Hillsboro B1 E2
Halstead E5
LeRoy E3
Plevna E4
Towanda E6
Beaumont I1
Coldwater E8
Medicine Lodge I2
Elk Falls E7
Ashton E9
Tyro E10
Byron E11
Pawhuska E12
Lamont C1 E13 E14
Ringwood E15
Vici B4 E16
El Reno E19
Meeker E20
Okmulgee I3 E21
Morris B5 E18
Cordell E22
E23
Ft Cobb
Earlsboro E25 E27
Cyril E26
Purcell B6
Ness
Rush
Barton
Rice
McPherson
Marion
Chase
Lyon
Morris
Osage
Franklin
Coffey
Hodgeman
Stafford
Harvey
Reno
Edwards
Greenwood
Woodson
Allen
Ford
Pratt
Kiowa
Kingman
Sedgwick
Butler
Wilson
Neosho
Elk
Clark
Barber
Harper
Summer
Cowley
Chautauqua
Montgomery
Woods
Alfalfa
Grant
Kay
Nowata
Washington
Osage
Woodward
Garfield
Noble
Pawnee
Rogers
Mayes
Ellis
Major
Dewey
Payne
Tulsa
Blaine
Kingfisher
Logan
Creek
Wagoner
Roger Mills
Custer
Lincoln
Mushogee
Oklahoma
Beckham
Washita
Cleveland
Seminole
McIntosh
Haskell
Greer
Kiowa
Grady
Hughes
Pittsburg
Latimer
Hamilton
Jackson
Comanche
Garvin
Pontotoc
Coal
Atoka
Pushmataha
Tillman
Cotton
Stephens
Murray
Johnston
0
30
60
120 km
Legend
Boundary Facility
Intermediate Facility
Central Facility
Retired
Extended Facility
N
W
E
S
Source: ACRF GIS, October 2006

CASA IP1 Radar array and ARM RWP locations



Network considerations



- A larger network (~300 km)^2 would sample more systems and better capture the large-scale forcing signal.
- This proposed larger network makes use 4 ARM sounding sites and the operational site at Fort Worth. 2 additional sites would be needed. CSU sonde system is a possibility for one of them.

ARM-funded IOP Measurement Priorities

- Model Forcing Dataset
  - Sounding network
  - Appropriate for determining continuous forcing dataset
- 4D Atmospheric state description
  - Soundings (Array and soundings of opportunity)
  - Radar Refractivity
  - Surface Observations
- 4D Cloud and Precipitation characteristics
  - CASA, CIRPAS 9.4 Ghz Phased-Array, McGill scanning 94-GHz, ARM SBIR scanning 35-GHz
- Updraft/Downdraft dynamics
  - CASA, 915 MHz wind profilers, cloud radars

NASA-Provided Infrastructure

Calibrated measurement continuity across full spectrum of precip. rates/types

Ka-Ku Scanning Transportable Dual-Polarimetric Radar (dual-aperture)

- Match DPR frequencies, direct link to PIA and dual-wavelength vs. dual-pol methods
- Extension to clouds, light precipitation, and improved sampling of ice, snow, mixed phase
- Mobility enables placement in variety of network configurations/regimes with relative ease

NASA PMM N-POL S-band Scanning Dual-Polarimetric Radar

- Transmitter, receiver, and antenna upgrades completed by fall 2010.
- Transportable platform for study of heavy/moderate precipitation regimes
- Dual-pol retrieval of 3-D DSD information and qualitative ice microphysics information

2D Video Disdrometer (or other TBD) Dense Array, supplemented by rain gauges

- Validation/extension of GV satellite simulator and ground radar DSD retrievals/precipitation rates (liquid/frozen)
- Spatial/temporal covariance of particle size distributions and precipitation rates

Wind Profiler

- Vertical profiles of Z, DSD collocated with disdrometers under coverage umbrella of radar

Aircraft

- High altitude (ER-2 w/ GMI and DPR simulators) — Aircraft already reserved
- In-situ AC (e.g., UND Citation) for microphysics — Cost estimate obtained

Other Known (CloudSat): W-band radar w/RHI-scanning/V-pointing

Data products appropriate for modelers

- Continuous forcing dataset

  (ARM infrastructure)

- Radar refractivity

  (KOUN/OU ?)

- Surface precipitation maps

  (Mesonet/ARS Micronet)

- 2D & 3D wind retrievals

  (scanning, profiling radars, 4DVar)

- Cloud hydrometeor determination

  (spectra – polarimetry)

- Cloud and Precipitation microphysics

  (multi-wavelength, disdrometers, polarimetry)