A proposal for a

Midlatitude Continental Convective Clouds Experiment (MC^3E)

Who? Mike Jensen (BNL), Pavlos Kollias (BNL), Tony Del Genio (GISS), Jim Mather (PNNL)

When? May – June 2009

Location? ARM SGP

Motivation

" We propose to turn more attention to precipitation….the amount of liquid being removed from the atmosphere is a key link to the radiation budget " (Warren Wiscombe, ARM Chief Scientist Proposal, 2005)

"We need to evolve beyond the artificial state where we deal with clouds and precipitation as separate chain of events of the water cycle" (Graeme Stephens, CPWG meeting 2005, Annapolis, MD)

"SGP precipitation IOP – evaluation of 2d and extension to 3d rain rate retrievals using existing instrumentation and guest instrumentation (precip radar, disdrometers, etc.)" (Deep Clouds Summary, CPWG meeting 2005, Annapolis, MD)

"…rather small changes in a model's convective precipitation efficiency can generate changes comparable to those observed (in TOA radiative fluxes from 1984-2001)" (Clement and Soden, 2005)

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

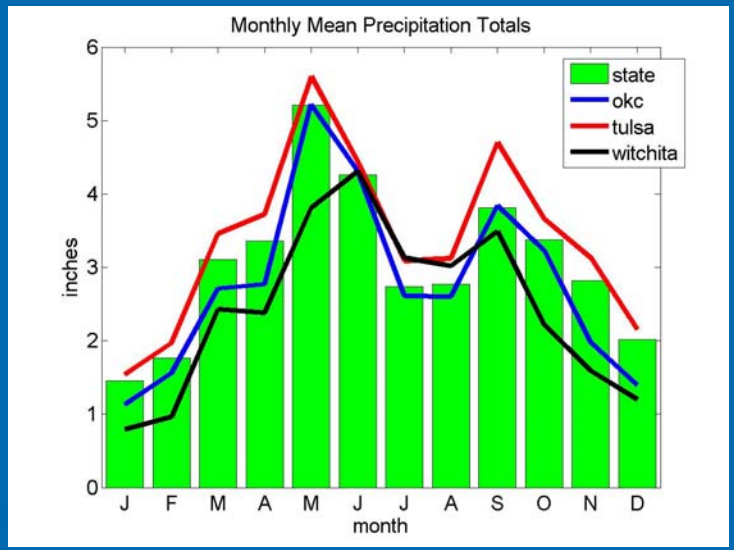
8) Large-scale forcing

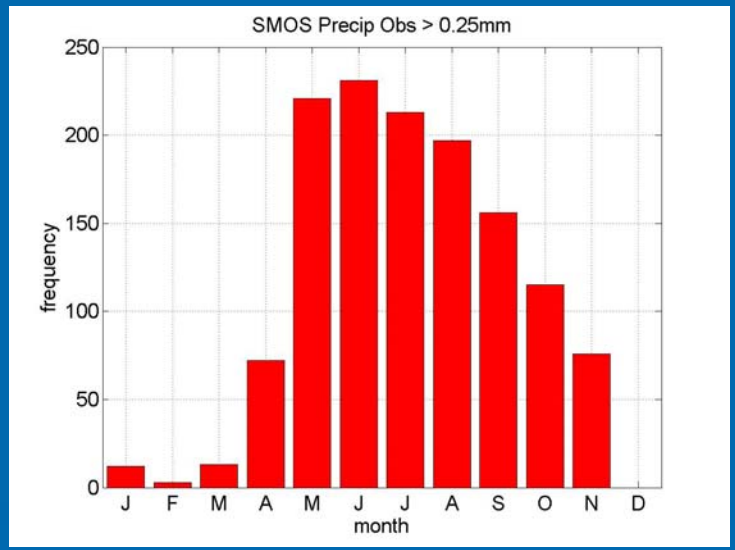
Big Question: Given PBL (T,q) and vertical profiles, can the precipitation at the ground be predicted?

History

- Precip IOP suggested by Jim Mather at Fall 2005 CPWG meeting
- Proposal presented by Pavlos Kollias at Spring 2006 CPWG, CPMWG mtgs
- Proposal endorsed by CPWG at Spring 2006 meeting
- Pre-draft proposal sent to CMWG steering committee (Oct. 06)
- Proposal presented by Pavlos Kollias at Fall 2006 CMWG meeting
- Proposal being considered for endorsement by CMWG SC
- Pre-draft proposal shared with deep convective cloud breakout (Today)
- Pre-proposal due to ACRF (March 07)

When? May-June 2009





Surface Remote Sensing (Radar) based approach

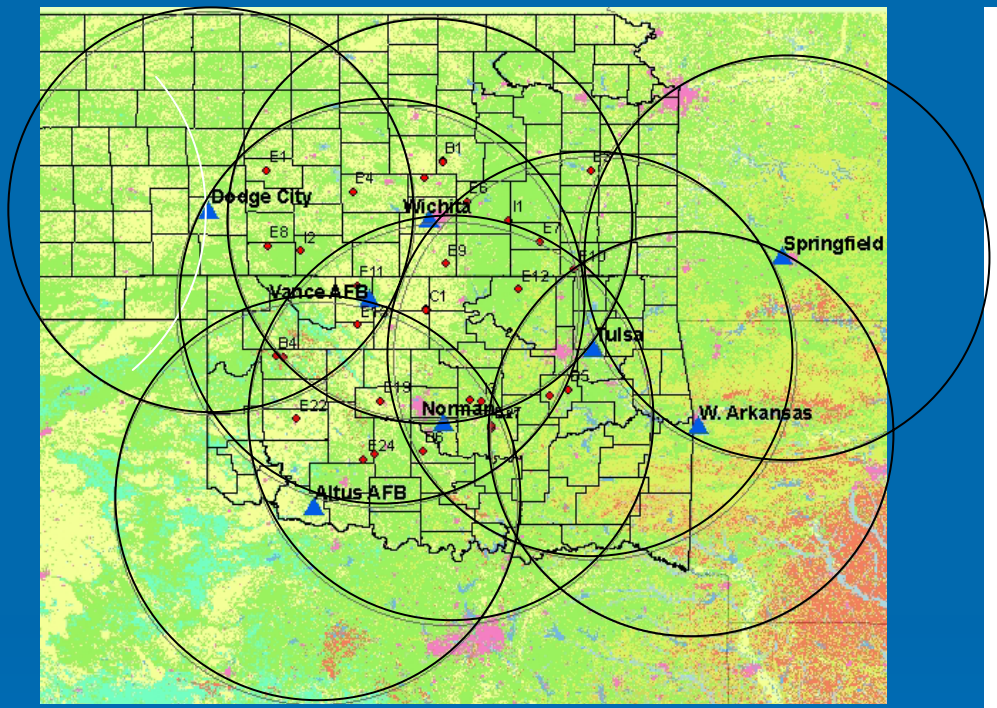
A combination of:

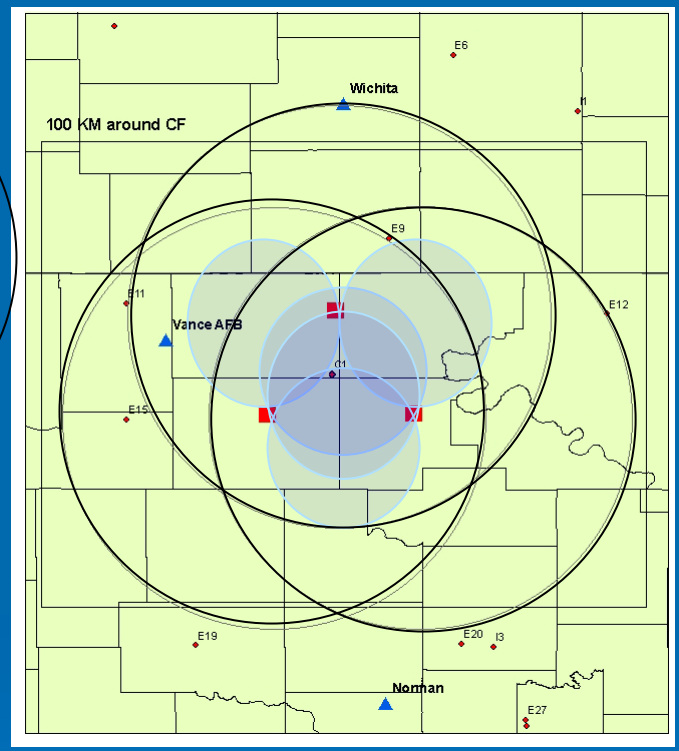
1. ARM-funded IOP measurements
2. Routine non-ARM data resources
3. ARM external datasets
4. Routine ARM observations
5. Externally funded IOP measurements

To measure several quantities important for the consideration of convective parameterization and cloud-resolving model simulations

Centerpiece: Radar Remote Sensing

Multi-scale and Multi-frequency





NEXRAD Network

Area I : Cloud/Precipitation

Tri-Doppler and Profiling

Updraft/Downdrafts and Cloud μ-physics

X-band network (proposed)

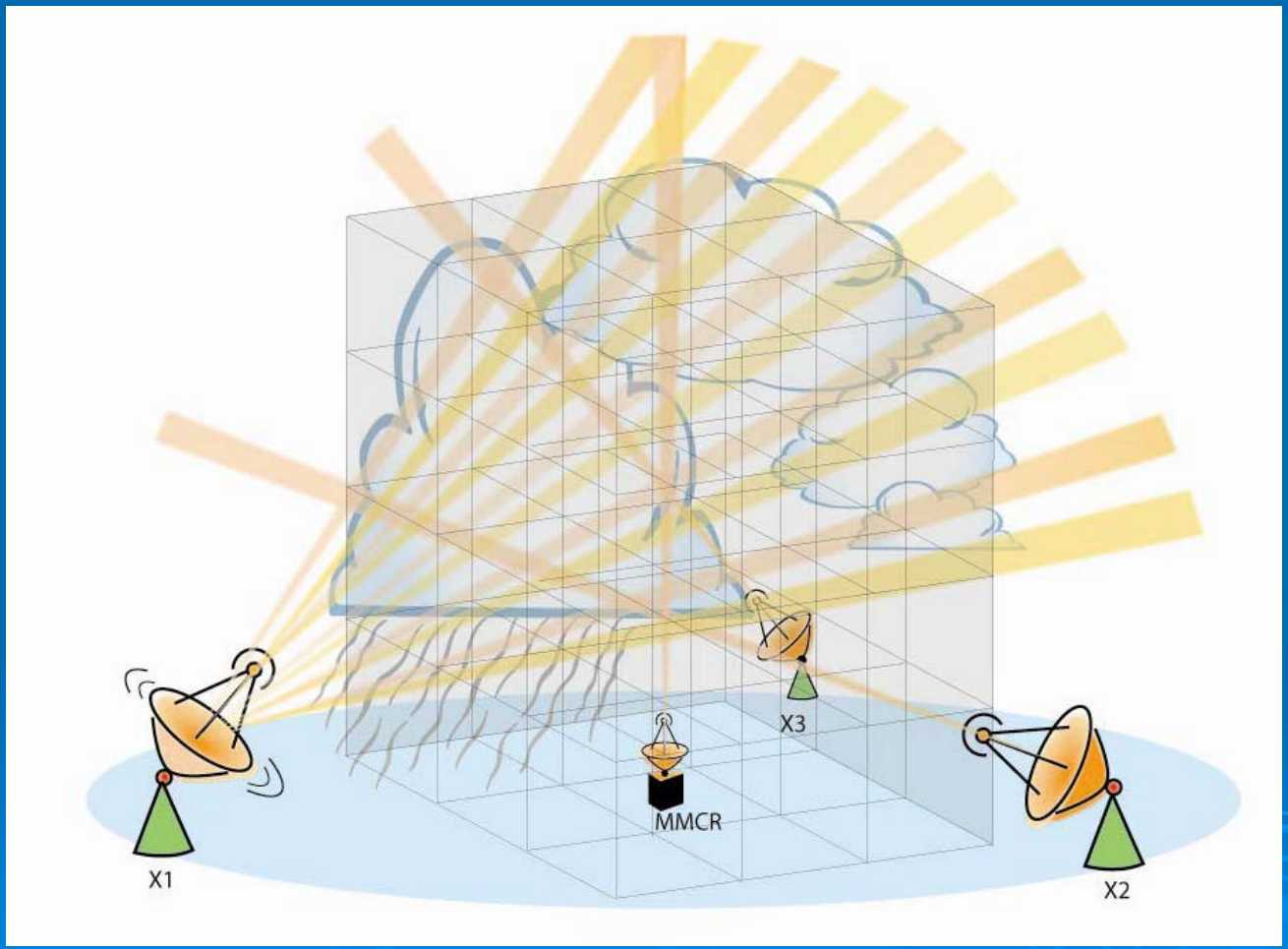
Area II: Dual Doppler

Convergence/Divergence

Cloud/Precip. Morphology

Scanning Radar array

- Scanning procedure to best resolve cloud physics and atmospheric dynamics at CRM cloud scales



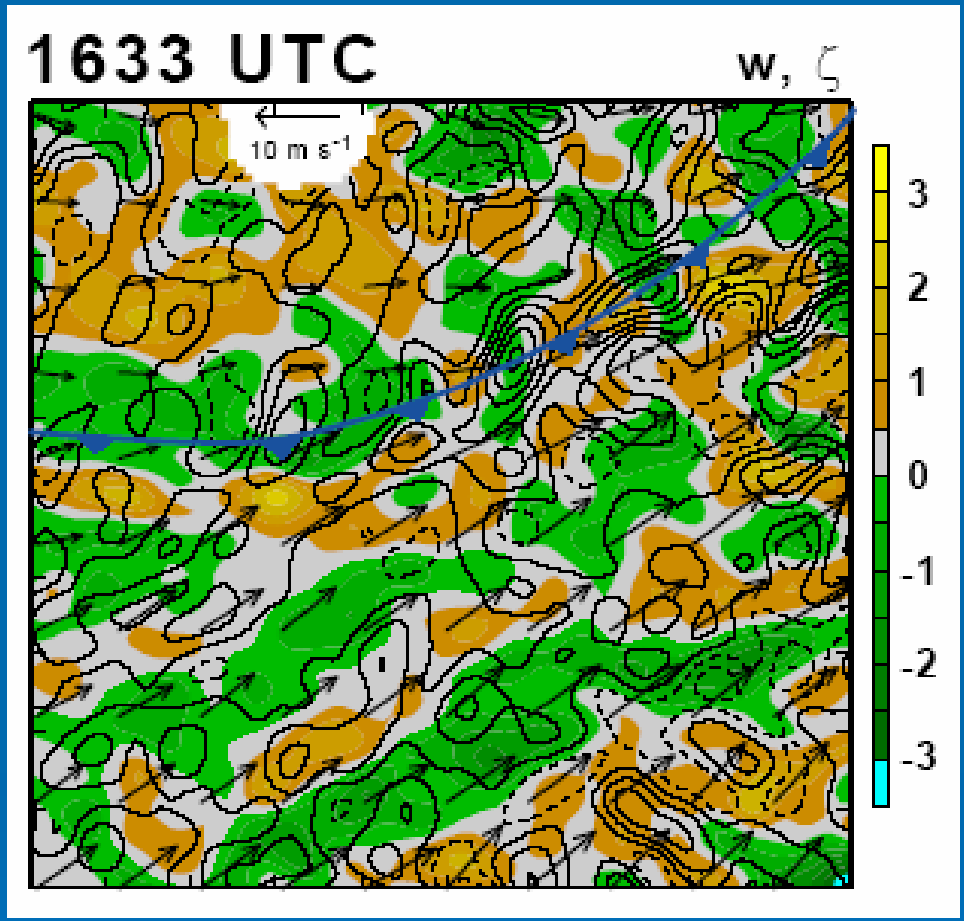


Fig. 5. Horizontal cross section of vertical vorticity (contoured at 1 × 10-3 s-1) at 1 km and near-ground winds (ms-1; dashed contours are negative) overlaid upon the vertical velocity (w; color shading) at 1 km at 1633 UTC. The distance between tick marks on the domain borders is 4 km. (from Stonitsch J., and P. Markowski)

Radar measurements of Atmospheric Refractivity

(i.e. RH variations)

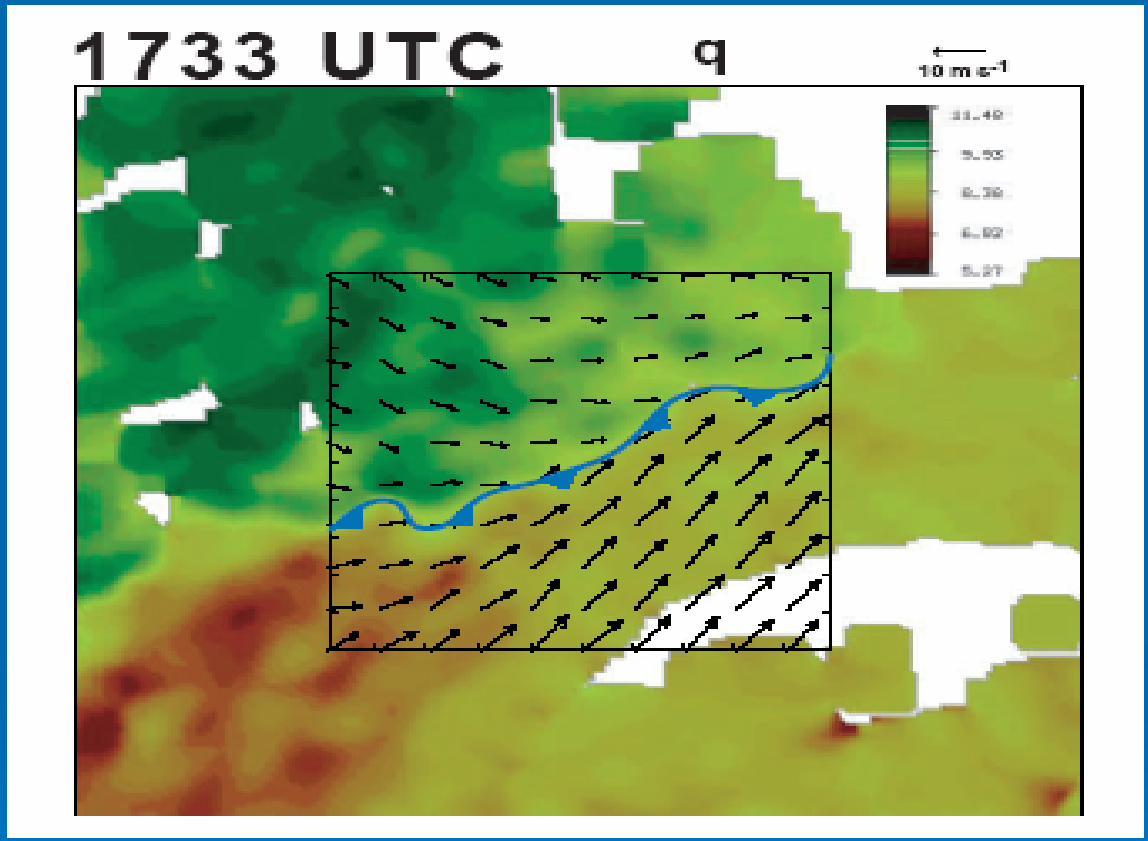


Fig. 3. Surface wind vectors and refractivity-derived specific humidity (q; color shading) at 1733 UTC. Dimensions of the interior box are 20 × 20 km2, while the color moisture field spans 40 × 40 km2. (from Stonitsch J., and P. Markowski)

Candidate instruments and what they provide(1)

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

Instrument	Quantities Observed	Conv. Param Elements
Scanning [X-band] radars (3, ARM/guest)	Cloud/Precip properties, Refractivity, Updraft/downdraft structure	1,2,3,4,5,6
Phased-array radar	Cloud/precip properties	2, 4, 5
C-Pol or S-Pol radar	Cloud/precip properties, Refractivity (i.e. RH variations)	1,2,4,5,6
Aerosonde (guest)	BL horizontal structure	1,6,7,8
Increased radiosondes (ARM)	Vertical profiles of atmospheric thermo	1, 6, 8

Candidate instruments and what they provide (2)

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

Instrument	Quantities Observed	Conv. Param Elements
Nexrad WSR-88D (non-ARM)	Large-scale precip.	4,5,8
OK Mesonet (external ARM)	Sfc. met	1,6,8
Disdrometers (ARM, guest)	Precip properties	5
MMCR (ARM)	Cloud properties	2,3,4,5

Action Items

We are soliciting an endorsement of this proposal from:

1. Cloud Parameterization and Modeling Working Group
2. Cloud Properties Working Group (received 3/06)

This would lead to the presentation of a formal proposal to the ACRF Science Board