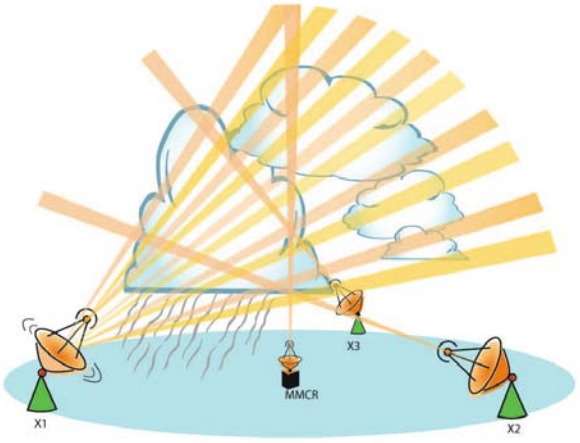
ARM's efforts to address the need for 3D cloud and precipitation measurements



Pavlos Kollias

The ARRA arrived at the doorstep of ARM and…

ARM will get into 3D measurements, **stop explaining why**

Solve the following (in couple months):

C-band radar = a+b×(X-band) radars

1 or 2 degree beamwidth?

W and X or Ka and Ku?

Mobile? Tropics? Mid-latitudes?

But first answer the following (today):

What can we detect?

Resolution?

Uncertainties?

Value Added Products?

3D cloud and precipitation measurements: Raison d' être

- **3-D radiative transfer issues**
  - Radiative flux profile (heating rates)

- **Lifecycle of convective systems – all phases of evolution**
  - Initiation
  - Updraft and downdraft structure
  - Hydrometeor evolution with time and location in updraft
  - Partition of condensate into precipitation and outflow (anvil)

- **Evaluation of**
  - Cloud System Resolving Models (one pathway to parameterization development and to climate models)
  - Satellite retrievals of cloud system properties

Current observational gaps in atmospheric science: transition from cloud to precipitation, cloud lifecycle, entrainment, cloud dynamics

Time-Space Variability of Cloud Systems

The requirement in ARM's soda straw observations is to detect all hydrometeors in the column - Remains a challenge!

Do we have the same requirement in the 3D box?
Do we need holistic views of clouds/precipitation?

ARM's efforts to address the need for 3D cloud and precipitation measurements

Cloud **Re**solving **Mo**del **Ra**dar (CREMORA) - ARM STM 2006

ARM **V**olume-Imaging **A**rray (AVA) - Whitepaper 2007

Multi-scale **O**bserving **F**acility (MOF) - Whitepaper 2009

Steps forward:

ARM-CASA Partnership
ARM-GPM proposed field campaign
Wind Profiler IOP
Radar simulator feasibility studies
WACR -> SWACR
SBIR -> SMMCR

Lessons learned from:

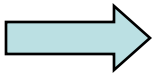
CLASIC (Oklahoma)
TWP-ICE (Darwin)
COPS (Germany)
CASA
NASA/GPM
GATE, TOGA-COARE
TRMM-KWAJEX

Characteristics of the **M**ulti-scale **O**bserving **F**acilities (MOF)

Suitable sites for this approach:
Oklahoma - Mid Latitudes
Darwin - Tropics
Mobile Facility - Marine

Large Domain
200x200 km
Large Scale Precipitation
Instrument centric view
Traditional Approach

Inner Domain
20x20 - 30x30 km
Holistic View
High Resolution
Network Approach



Detect shallow clouds
Shallow precipitation
Cloud-Aerosol Interaction
Cloud dynamics
Cloud Lifecycle

Value-Added Products

Inner Domain (C/P)	Approach	Resolution	Uncertainty
Boundaries	Scanning & Profiling Radars	100 m	Low
Horizontal Velocity	Scanning & Profiling Radars	100 m	Low
Vertical Velocity	Scanning & Profiling Radars	100 m	Low
LWC	Multi-Wavelength	100 m	Moderate
IWC	Multi-Wavelength	100 m	Moderate
Hydrometeor ID	Polarimetry, velocity, dBZ	100m	Low

Large Domain (P)	Approach	Resolution	Uncertainty
Boundaries	Weather Radar	1 km	Low
Horizontal Velocity	Doppler Weather Radar	1 km	Moderate
Vertical Velocity	Doppler Weather Radar	1 km	High
LWC	Weather Radar	1 km	Moderate
IWC	Weather Radar	1 km	Moderate
Hydrometeor ID	Polarimetric Weather Radar	1 km	Low