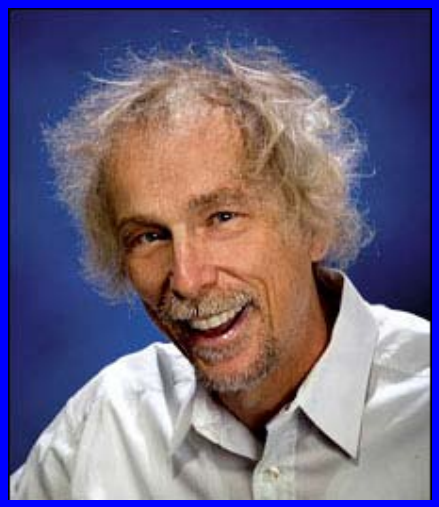
ARM
Atmospheric Radiation Measurement

ARM Orientation: Overview and History

Warren Wiscombe
ARM Chief Scientist
Brookhaven & NASA

ARM Chief Scientist Team



Andy Vogelmann

Ric Cederwall

Yangang Liu

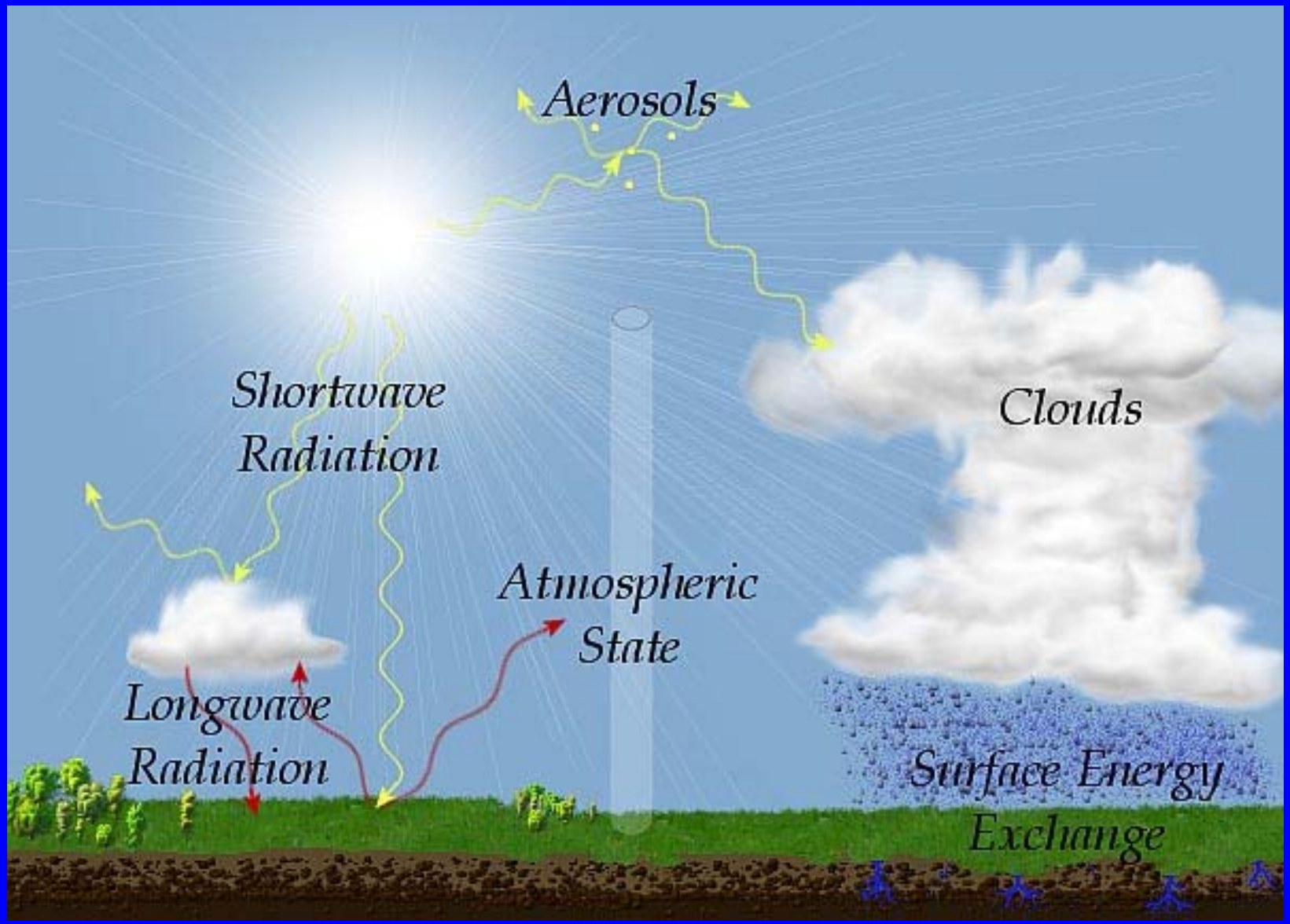
Sharon Zuhoski

Pavlos Kollias

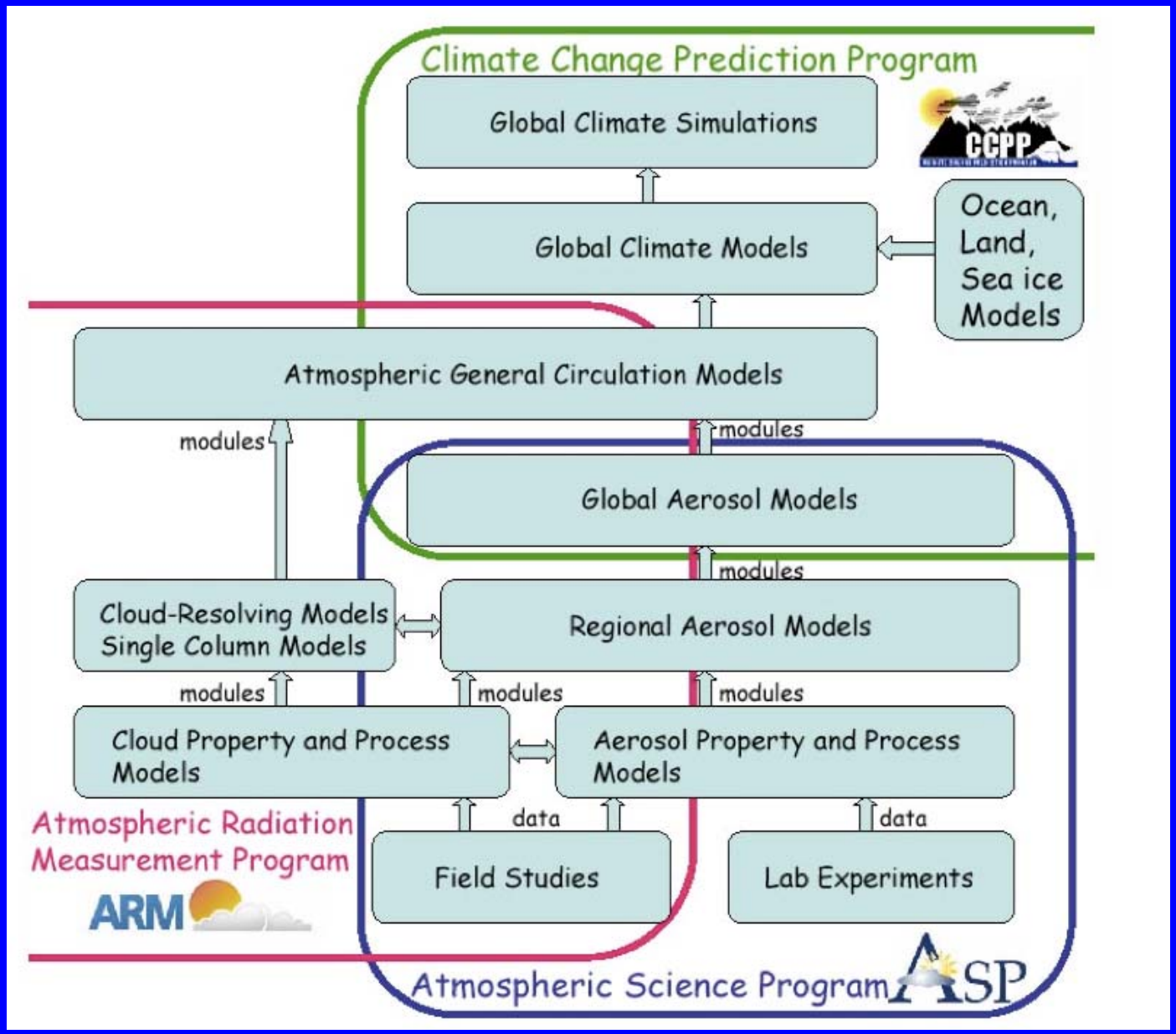
ARM in a nutshell

- Created to improve cloud and radiation physics and cloud simulation capabilities in global climate models
- Provides products from continuous AND episodic field measurements to advance global climate models
- Largest global change research program funded by the U.S. Department of Energy ($50M/yr; ~$14M/yr for Science Team)

ARM Focus Areas



ARM's place in DOE climate program



What are ARM's expectations?

- Good science – first and foremost !
  - two papers/year per grant (average)
  - at least one science highlight ("nugget") per year
  - annual RIMS progress report
- Participate in…
  - one Working Group (there are 4)
  - a field campaign (encouraged)
  - a Focus Group (your option)
  - annual ARM Science Team Meeting (bring poster & submit as PDF file)

What are the two major components of ARM?

- Develop and run ground-based (in situ and remote sensing) measurement facilities
- Acquire data 24/7, archive and publish it

Infrastructure

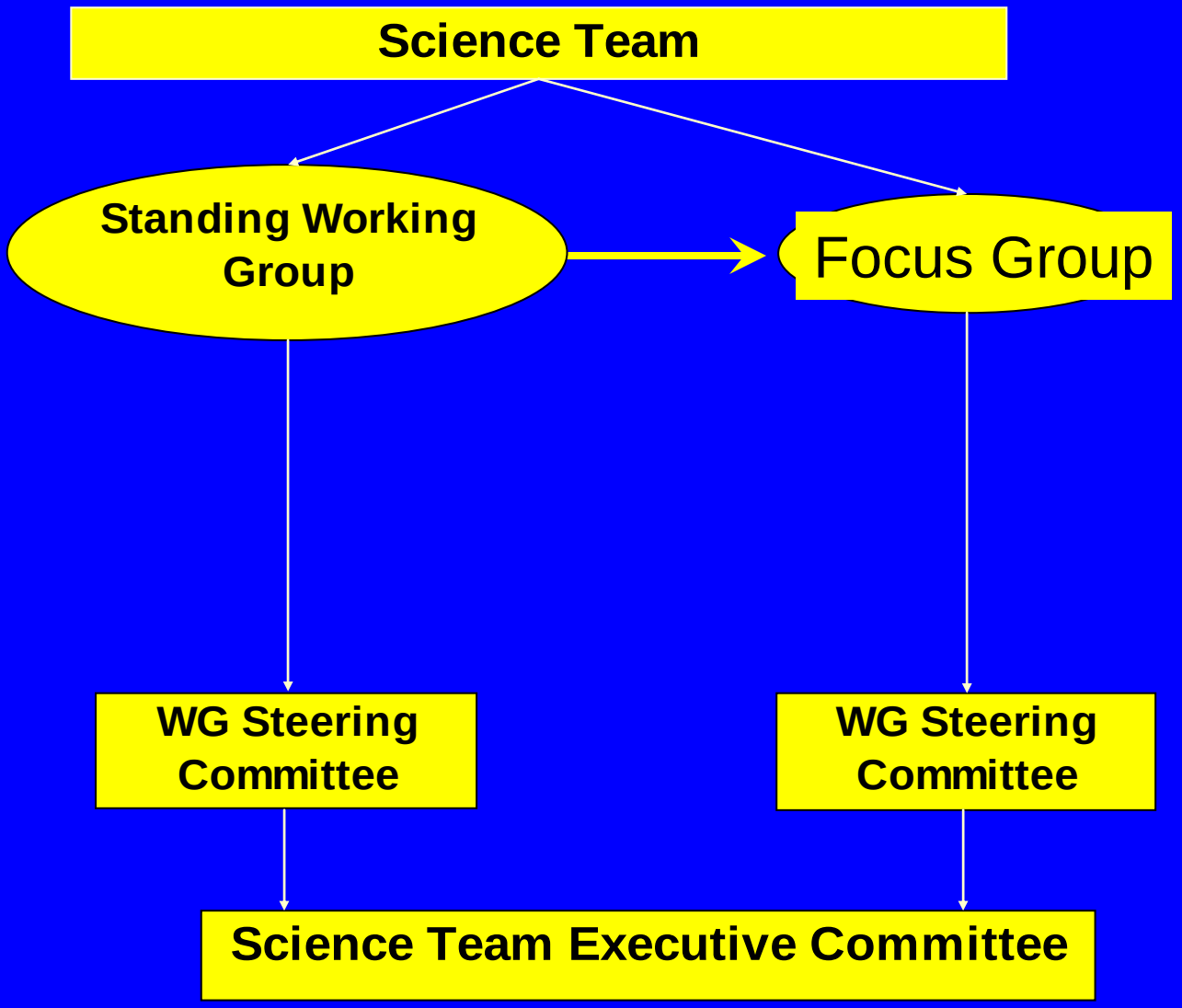
Data analysis

Physical modeling

Parameterization development and testing

Science

ARM Science Team Structure



Working Groups

- Cloud Modeling
- Cloud Properties
- Radiative Processes
- Aerosol

Existing Focus Groups

- CLOWD (Clouds with Low Optical Depth)
- BBHRP (BroadBand Heating Rate Profile)
- Radar

New Focus Groups

- Vertical Velocity for Climate Modelers
- Longwave/Microwave
- Surface Fluxes

Two things characterizing each WG...

- Radiative Processes (oldest):
  - broadband flux meas'ts
  - spectral resolution
- Cloud Modeling:
  - variational analysis (for initializing models)
  - studies of ARM IOPs
- Cloud Properties:
  - microwave/radar instruments and algorithms
  - ARSCL (unified specific'n of cloud boundaries)
- Aerosol:
  - far-flung aircraft campaigns
  - indirect effect

We also expect you to interact with the ARM Infrastructure

For starters, get to know:

- ARM Instrument Overlord (Jimmy Voyles)
- ARM Archive Overlord (Raymond McCord)

Help set priorities, make recommendations

Tell Raymond about data problems

Create then contribute value-added "PI Products"

What should you become familiar with?

- problems@arm.gov
- VAPs (Value Added Products)
- "Translators": infrastructure scientists who communicate Working Group VAP and meas't requirements to developers & instrument leaders
- Instrument Mentors (infrastructure)
- Data – ARM Archive (www.arm.gov)
- Data quality reports, Data Quality Office
- IOP planning and operation

Science Team Meeting structure

- Working Group meetings – Mon
- Plenary sessions: Invited talks
  - (WGs on Tue, from outside ARM on Thu)
- Poster sessions/socials Tu and We evenings
  - Poster talks selected by ARM Exec Comm
- Breakout sessions – attend, organize as interested
- Wed afternoon: "white time"
- Many unannounced Infrastructure meetings
- Exec Comm on Thu-Fri

We toured CIRPAS at the last STM

Where did ARM come from? A nutshell history

ICRCCM-1: Intercomparison of Radiation Codes in Climate Models (1980s)

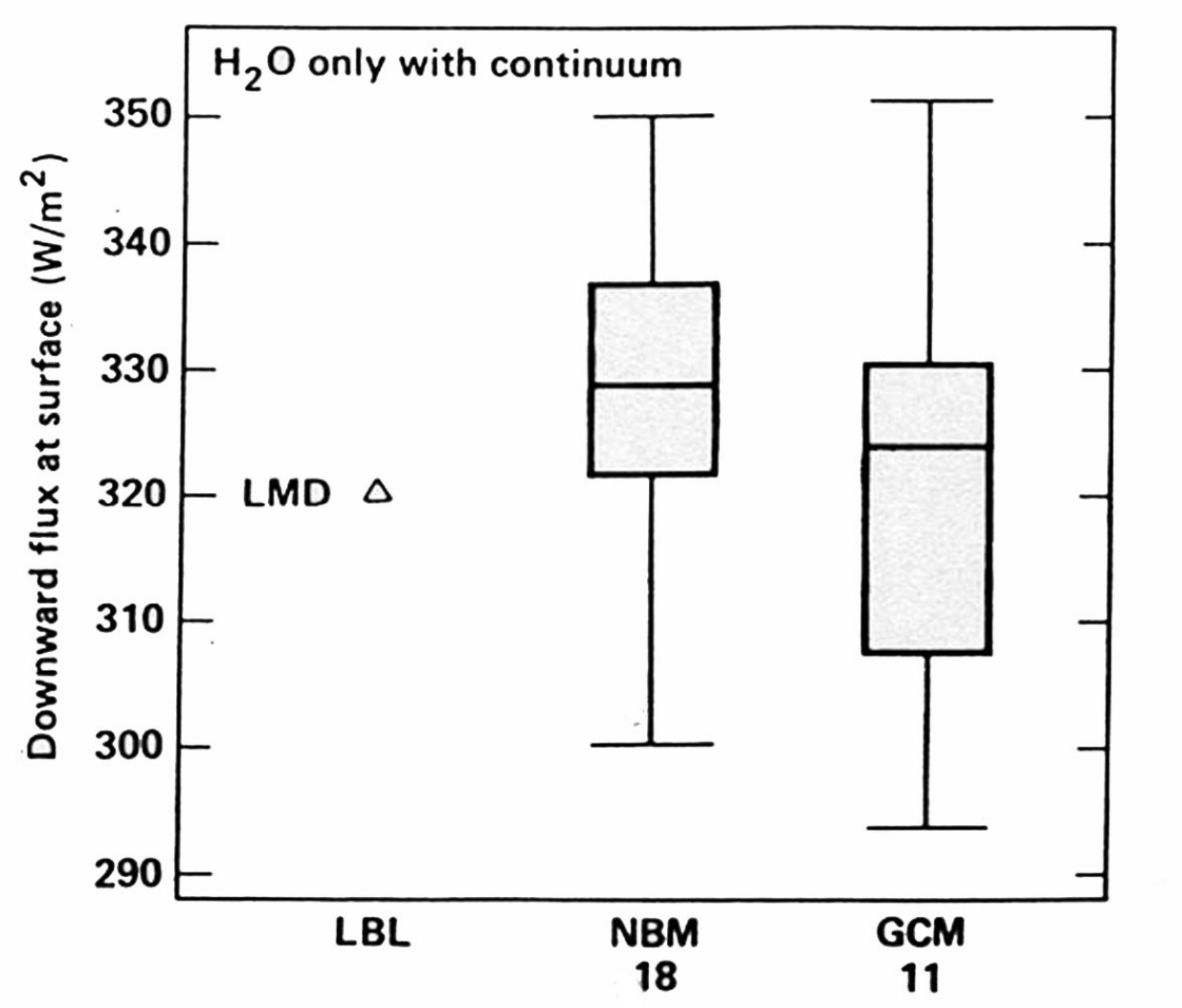
SPECTRE (SPECTral Radiance Experiment) is an outgrowth of ICRCCM (1991)

ARM is an outgrowth of SPECTRE

ICRCCM exposed theoretical disarray in clear longwave problems

- 40+ models (international)
- fluxes at 3 levels compared
- differences up to 50-70 W/m^2
- spread among narrow-band models ($\leq$ 20 cm^{-1} resolution) as big as for wide-band and emissivity models
- even line-by-line models ($\leq$ 0.01 cm^{-1} resolution) had to agree on common ground rules to achieve 1–2 W/m^2 agreement

ICRCCM-1 example: surface downward longwave flux for midlat summer H2O profile



line by line, narrow-band, and GCM calculations

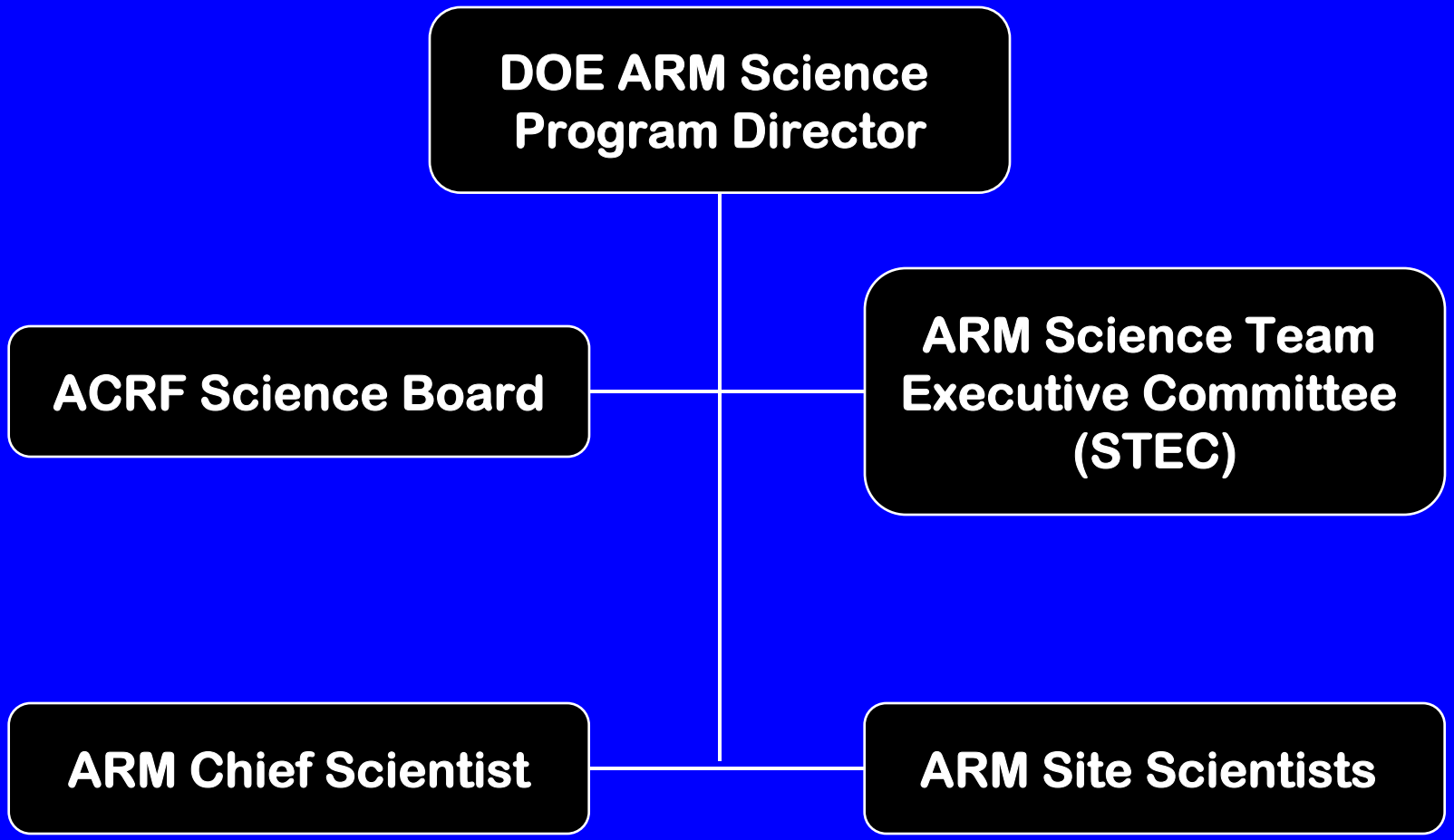
source: WMO Report

ICRCCM-1: Paris Workshop Report (1988) set our feet on the road to ARM

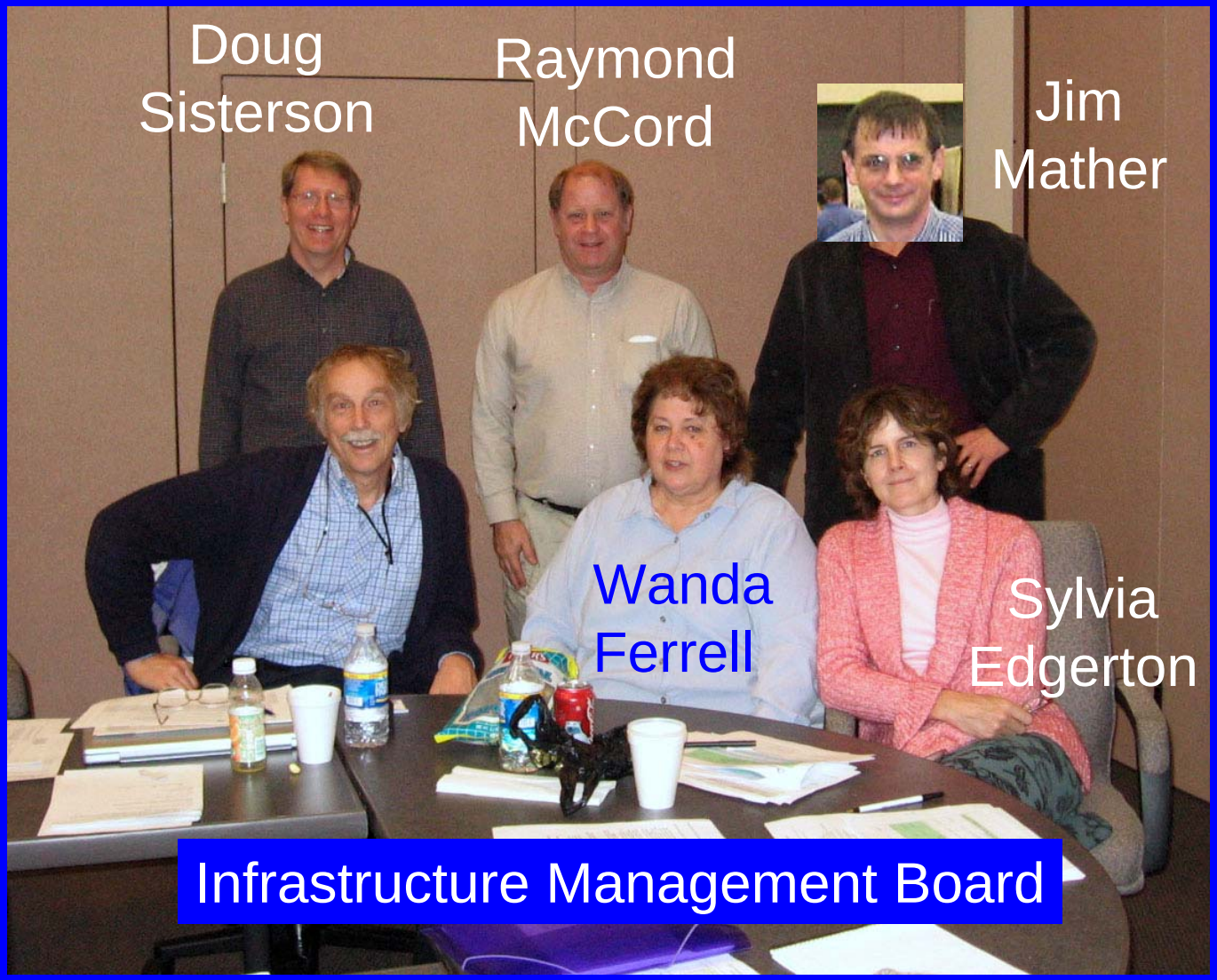
"The participants feel that the rather large discrepancies cannot be decisively resolved by further calculation, but only by well-calibrated spectral observations."

"In the 1984 report of the ICRCCM Frascati, Italy, workshop, a new sort of surface-based measurement program was called for, taking advantage of existing spectrometers and some of the advanced profiling technologies under active development."

ARM Science Management



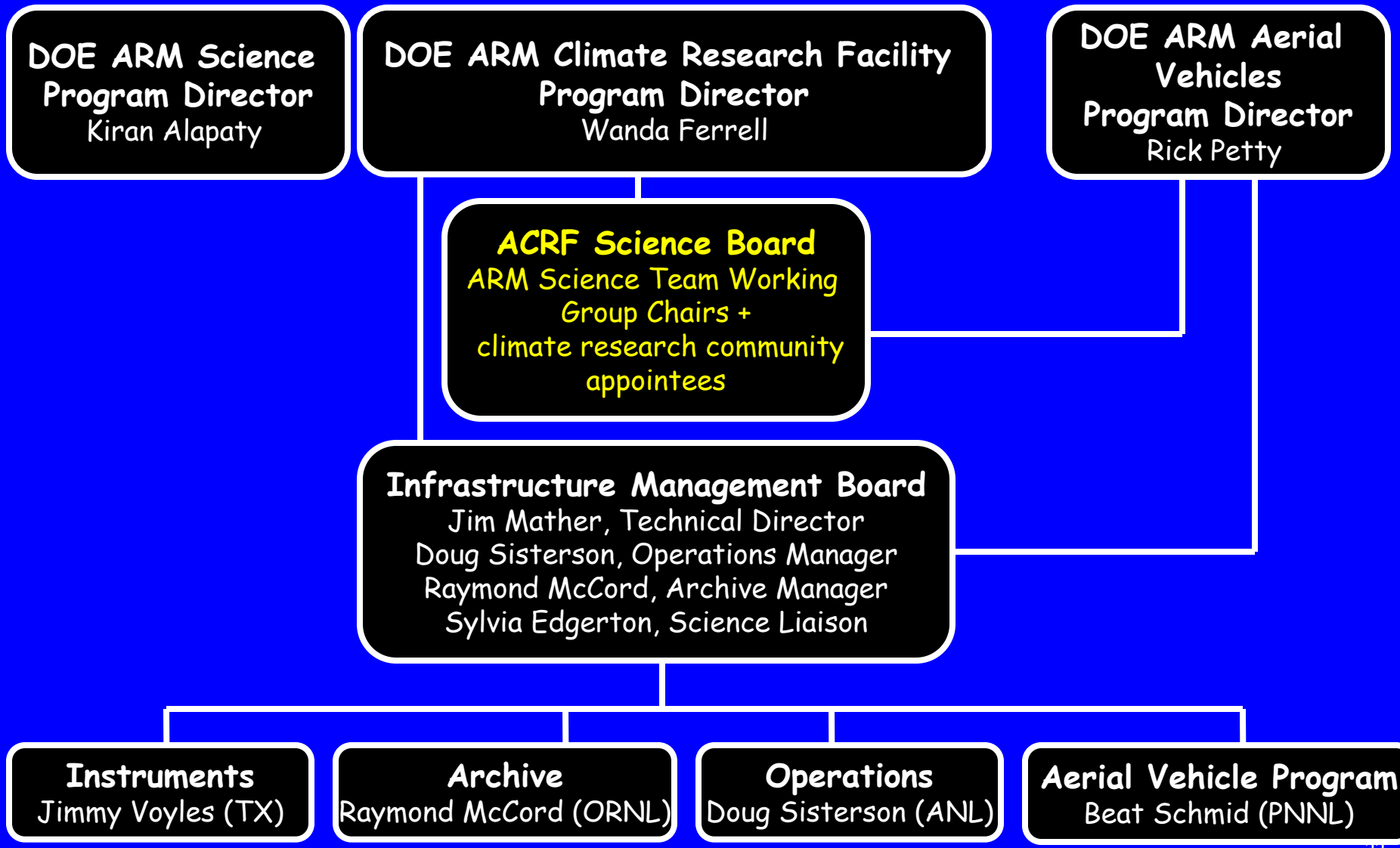
ARM Leaders



Bob Ellingson

Tom Ackerman

ARM Organizational Structure

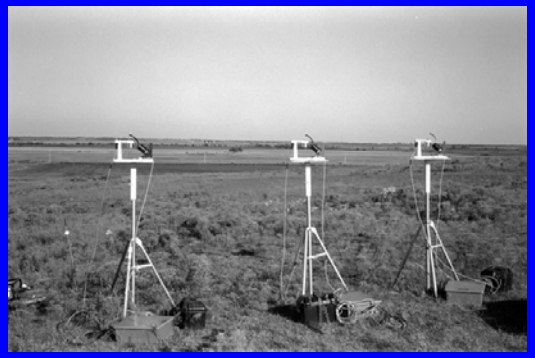


ARM is a DOE User Facility

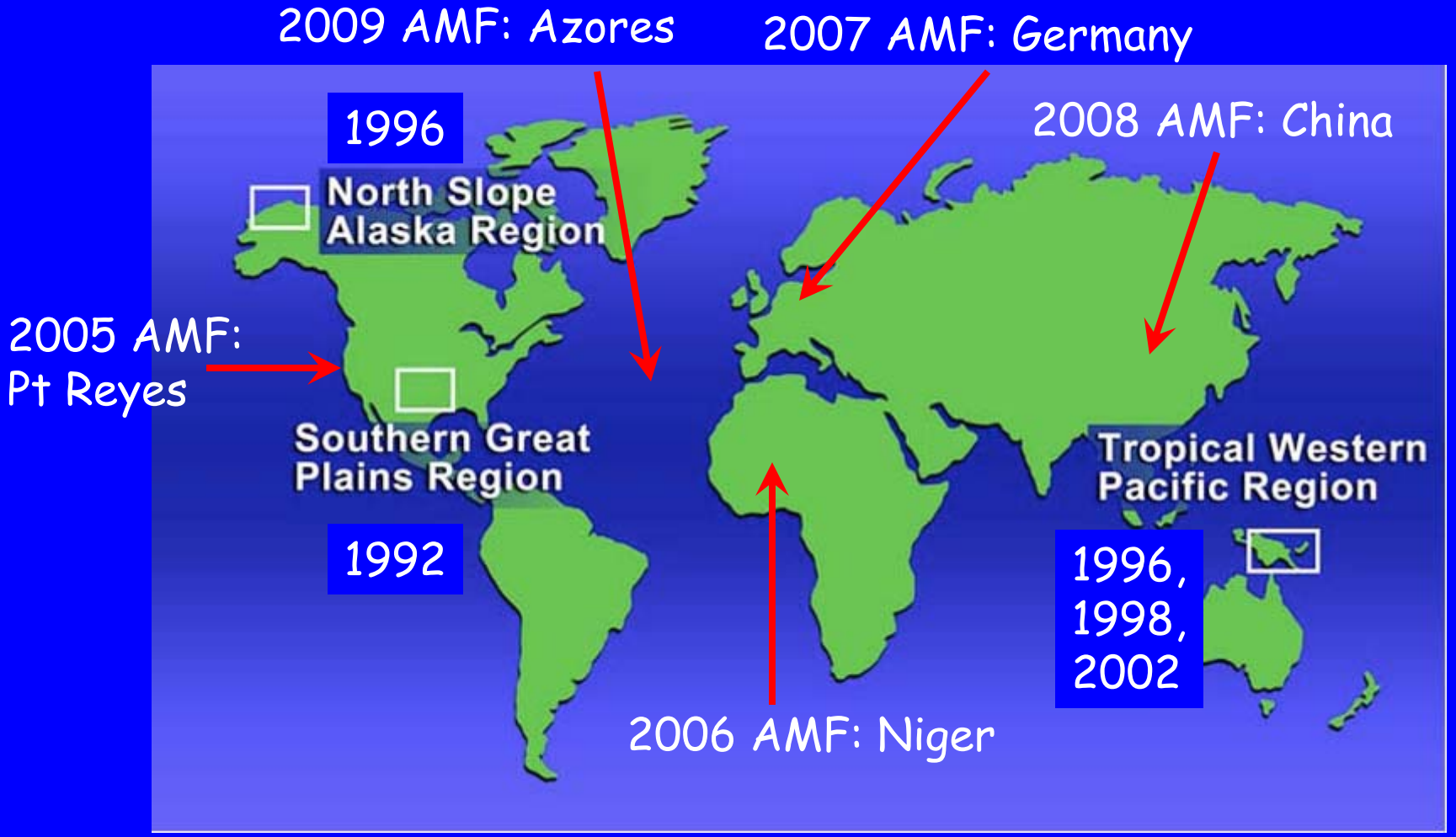
- called ARM Climate Research Facility (ACRF)
- ARM no longer exists just to serve its own Science Team, but the broader climate community
- Outside community can submit proposals for use of ACRF, including Mobile Facility
- Larger proposals reviewed by ACRF Board (Aug)
- Smaller proposals (under $25K) reviewed by IMB
- Recent examples: magnetic field, tectonic motions, radon, validation for NASA satellites

ARM Measurement Philosophy

- Multiple fixed sites plus mobile facilities
- Multi-year routine meas'ts of climate quality
- Mix of bleeding-edge and standard instruments
- Episodic field campaigns (IOPs)
- Aircraft capabilities (AVP)
- External data (satellite, Mesonets, analyses,...)
- Measure same variable multiply



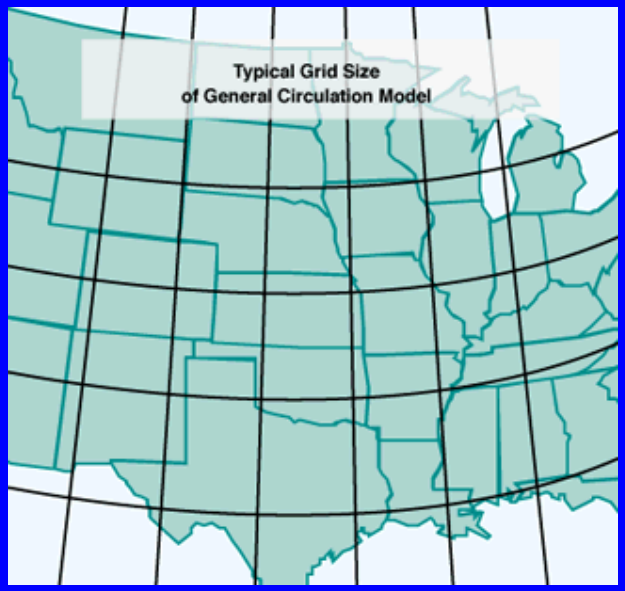
ARM sites

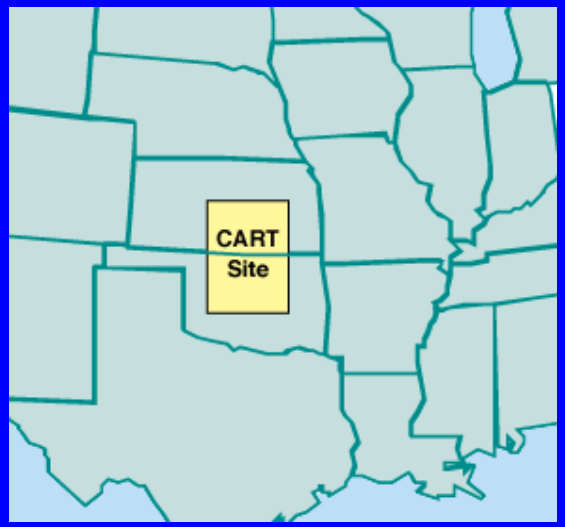


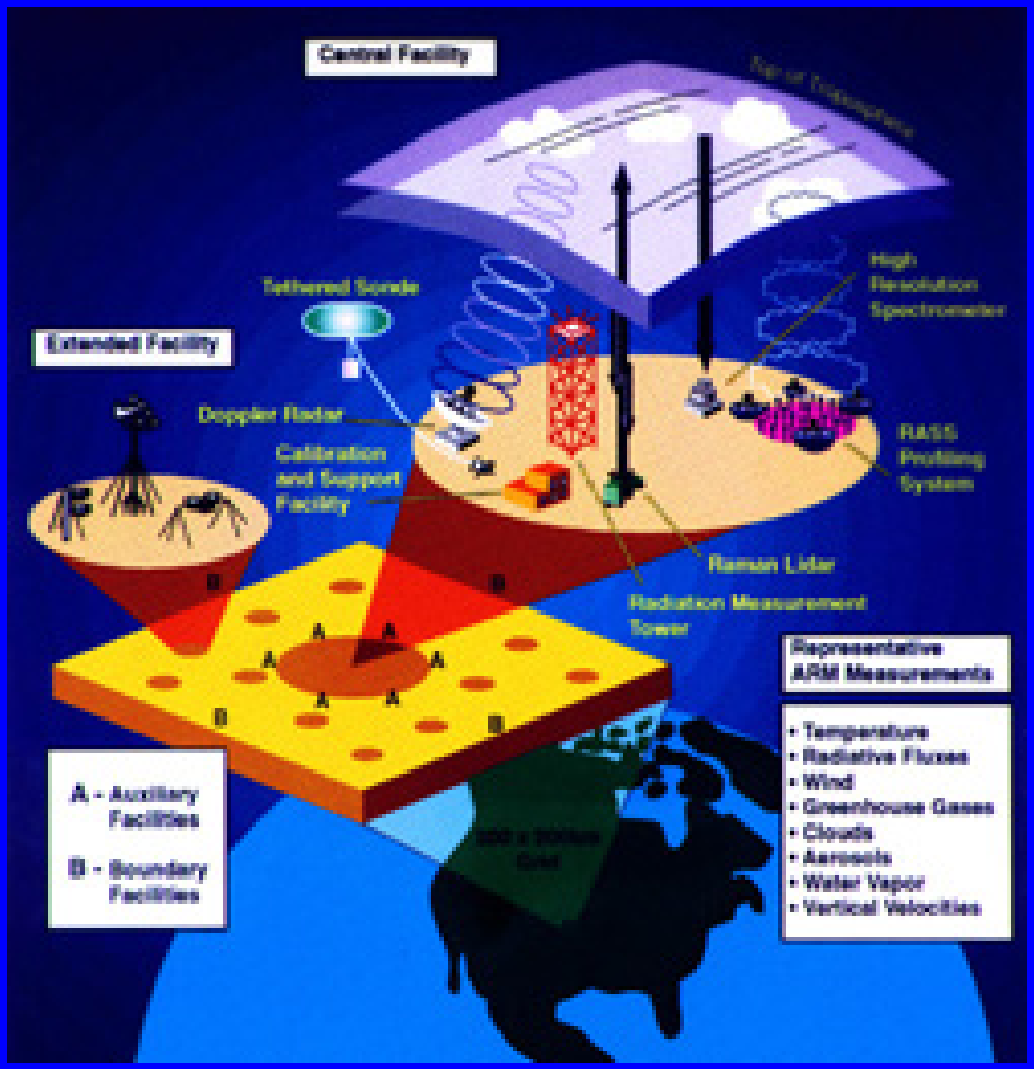
AMF = ARM Mobile Facility

ARM super-site concept has caught on

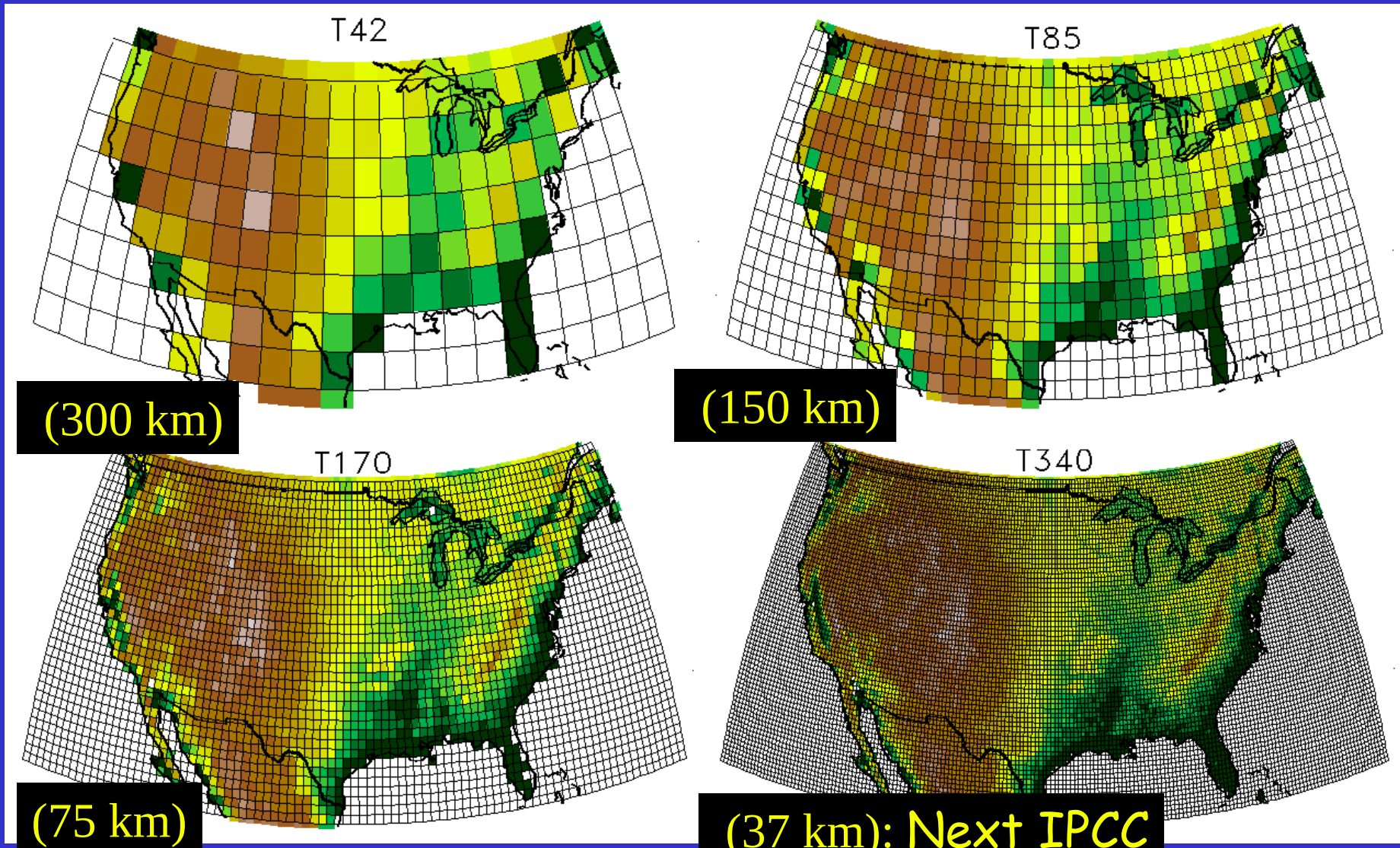
SGP was designed to cover a 1990 GCM grid square





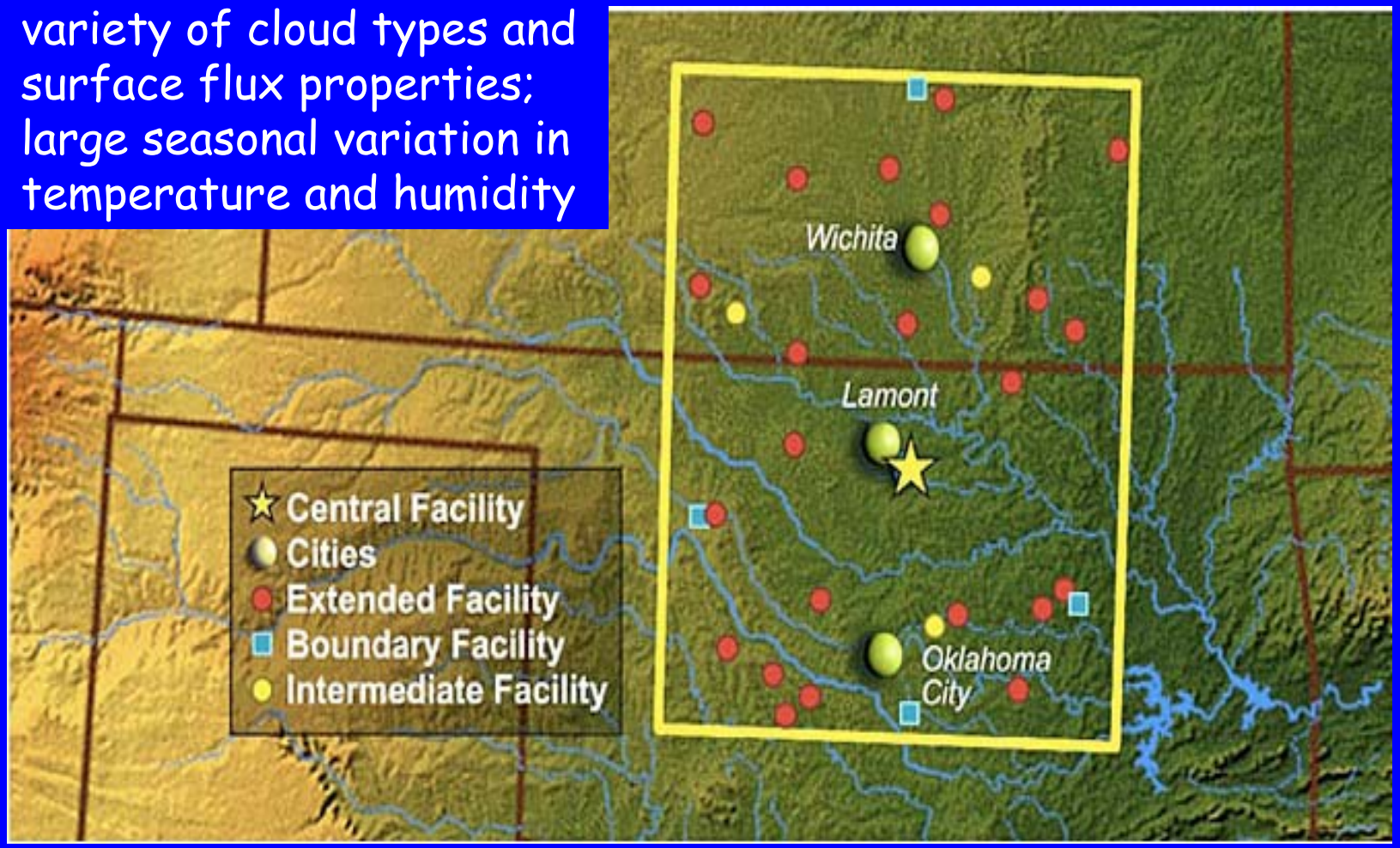


Horizontal Grid Resolutions, future GCMs



SGP (23 Extended, 4 Boundary, & 3 Intermediate Facilities)

variety of cloud types and surface flux properties; large seasonal variation in temperature and humidity

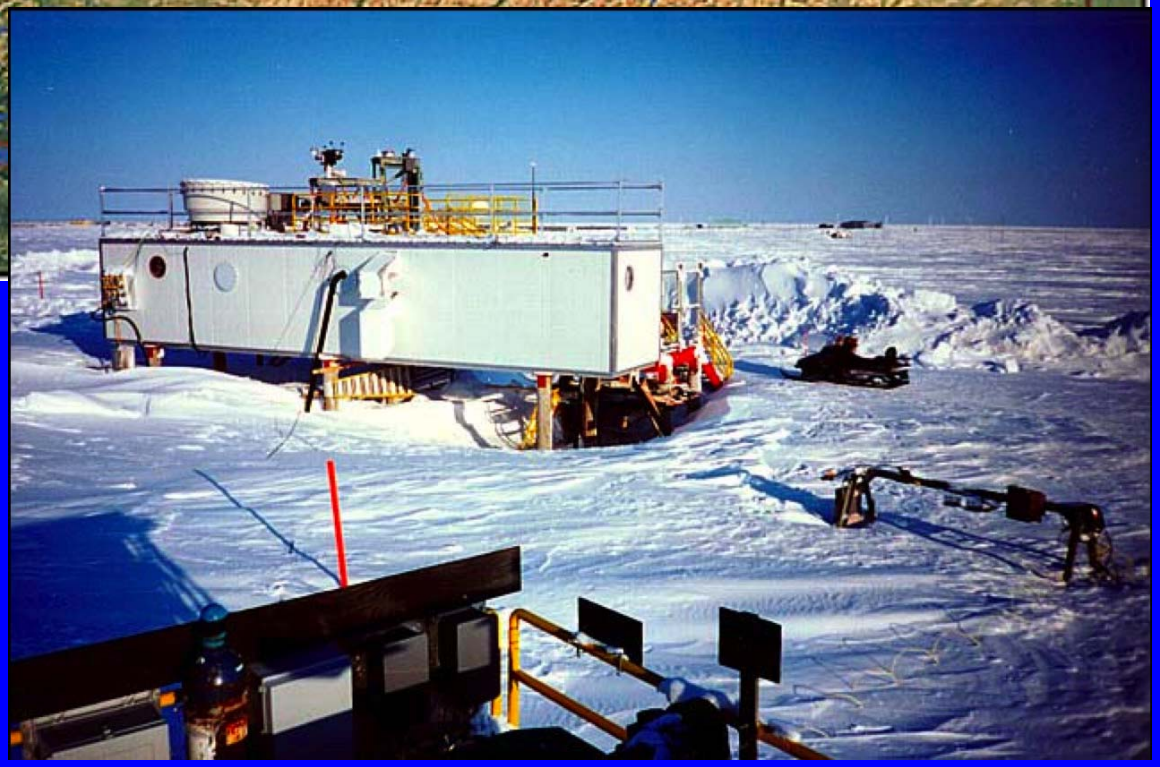


SGP is a slight rise in flat farmland

Southern Great Plains site

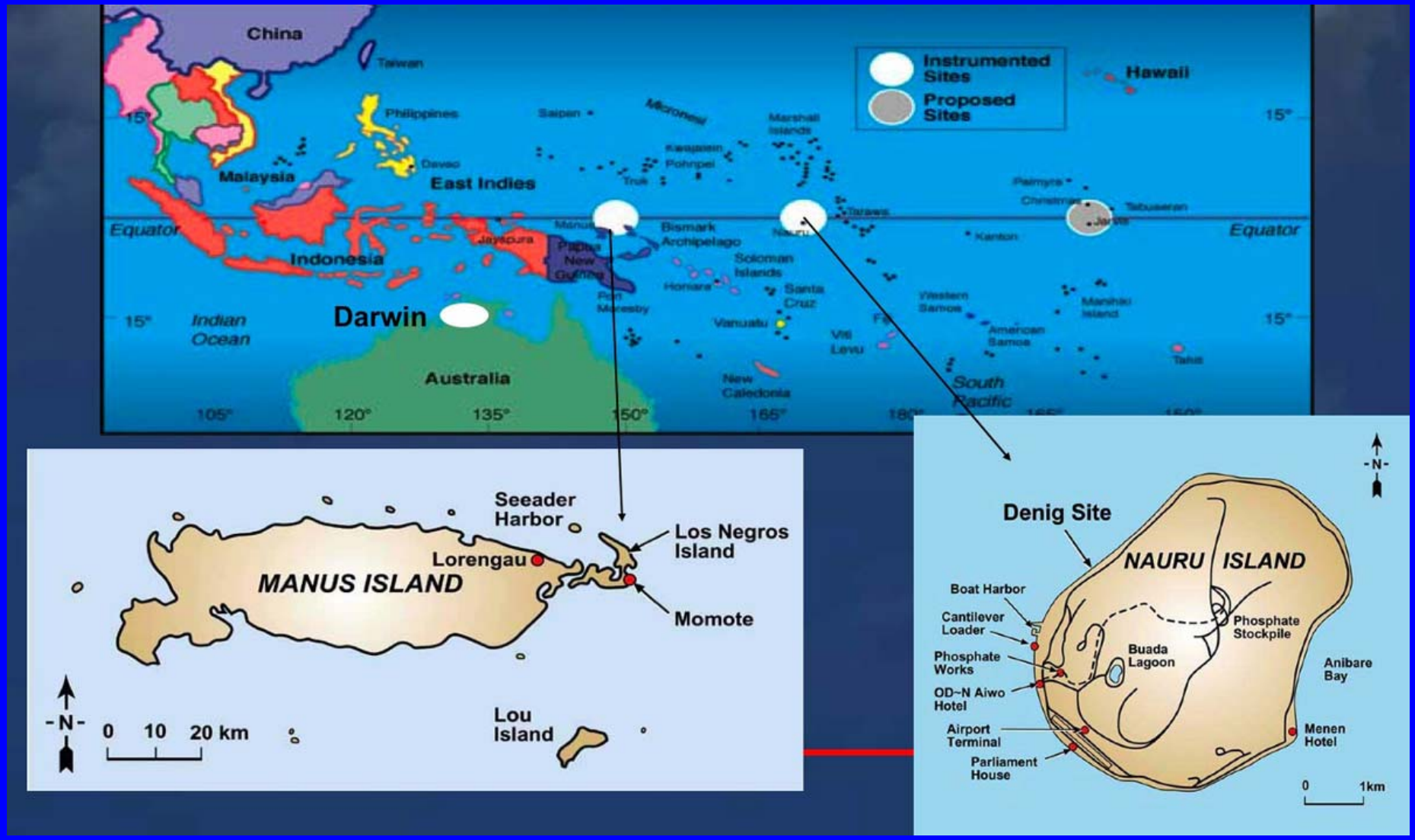
Southern Great Plains

North Slope Alaska (no sea ice coverage)



SHEBA (Surface Heat Budget Arctic, 1997-98)

3 Tropical Western Pacific sites chosen for deep convection, high water vapor, El Nino



Tropical Western Pacific sites

A 2006 IOP: TWP-ICE, Darwin, Australia

ARM Mobile Facility 2006 — Niger, Africa

ARM Mobile Facility 2007 — Black Forest, Germany

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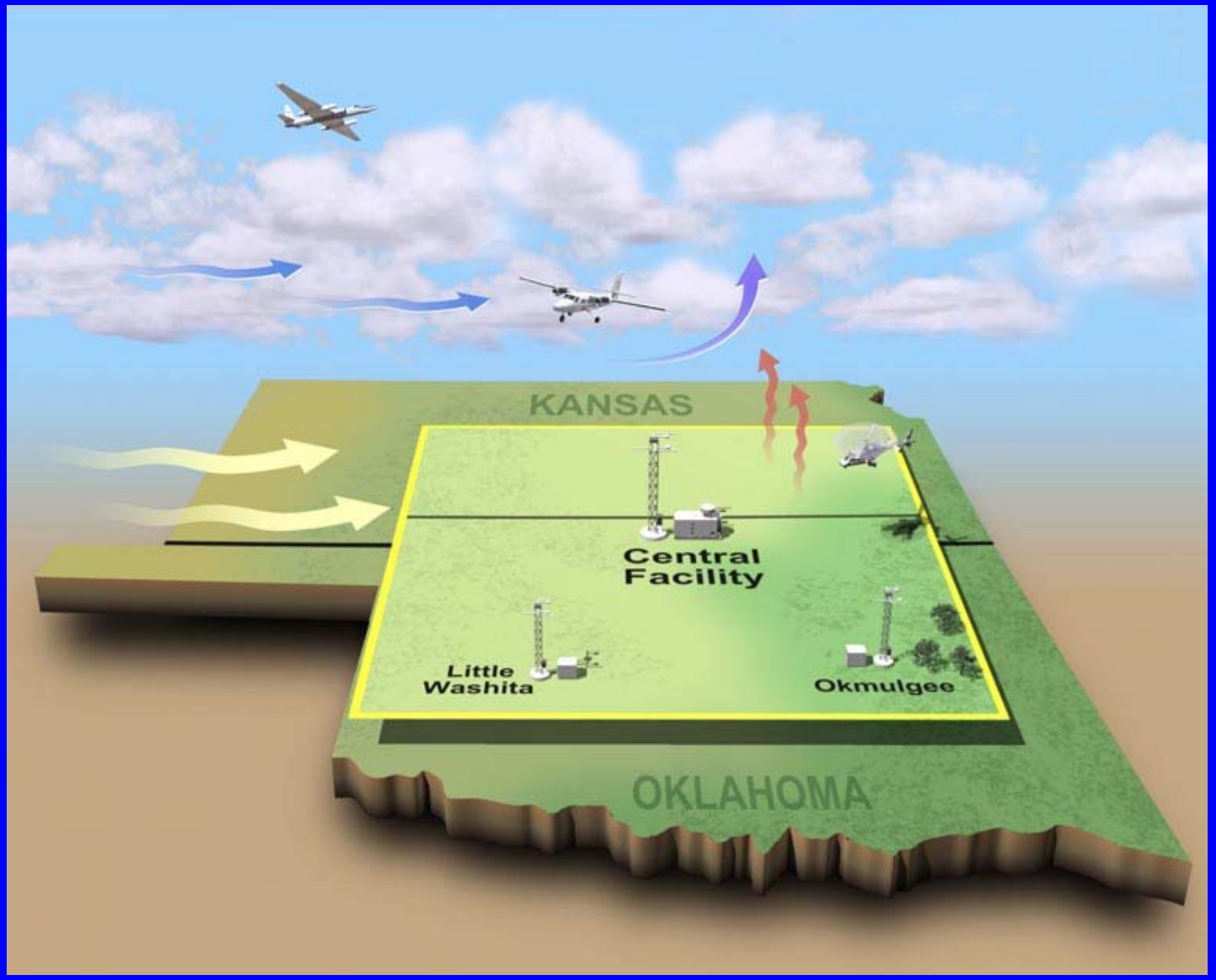
CLASIC IOP, SGP, June 2007



CLASIC IOP, SGP, June 2007

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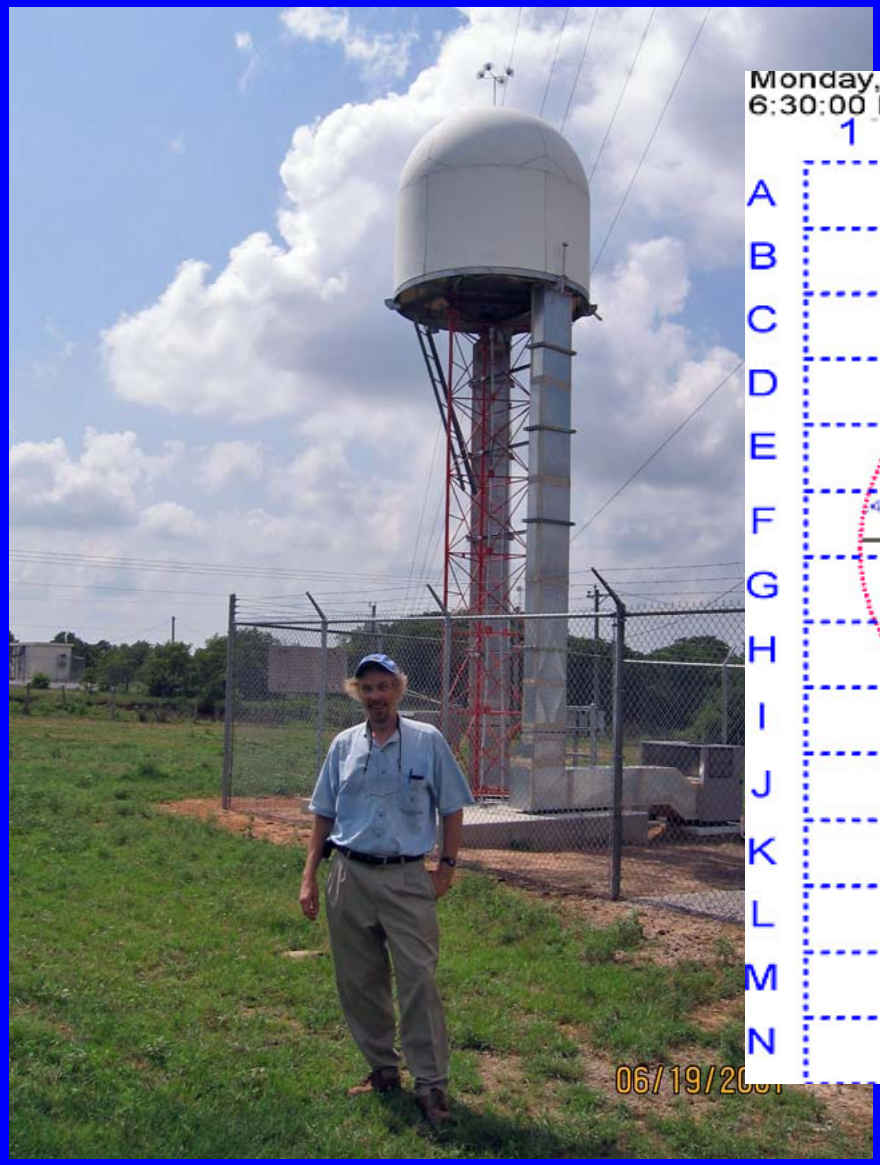
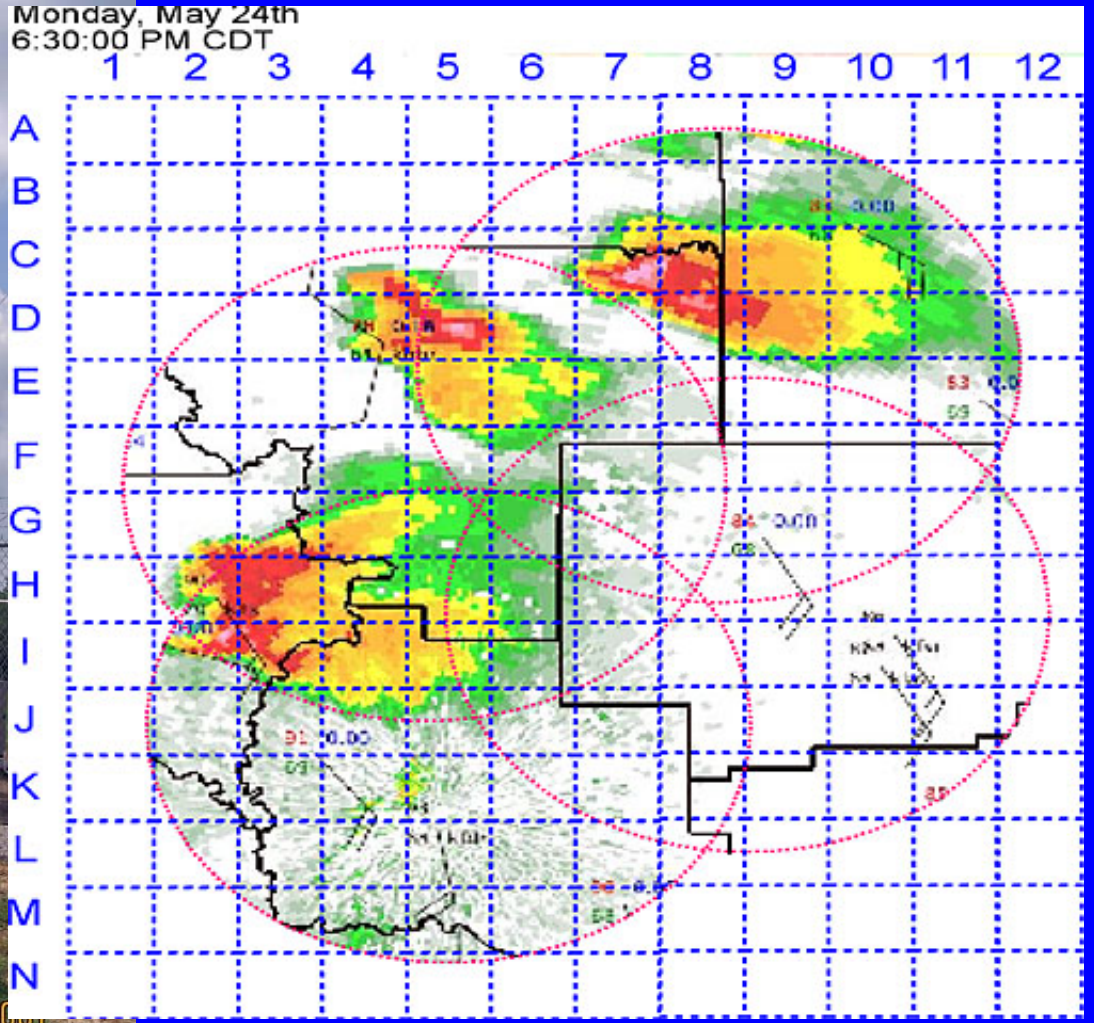




CLASIC IOP, SGP, June 2007

Mobile Facility to China, 2008

Mobile Facility to Azores, 2009

On to Chile, 2009

ARM SGP field campaigns, Dec 07

Aura satellite validation

Orbiting Carbon Observatory Validation **PLANNING**

Characterization of Daytime Convective Boundary Layer

Hydro-Kansas Field Experiment

Magnetic Field Observations at Purcell

Precisions Gas Sampling Validation Field Experiment 2007

PURCELL RAIN MICROPHYSICS STUDY

RAMIX - Radon Measurements of Atmospheric Mixing

SINGLE FREQUENCY GPS WATER VAPOR NETWORK

WIND PROFILER PRECIPITATION STUDY

Other ARM field campaigns, Dec 07

NSA:

NSF UV Monitoring Support

Indirect and Semi-Direct Aerosol Campaign (ISDAC)

Pyranometer IR Loss Study

TWP:

Orbiting Carbon Observatory Validation (combined with SGP)

AMF

GERMANY **COMPLETED**

CHINA **IMPLEMENTING **

AZORES **IN PLANNING**

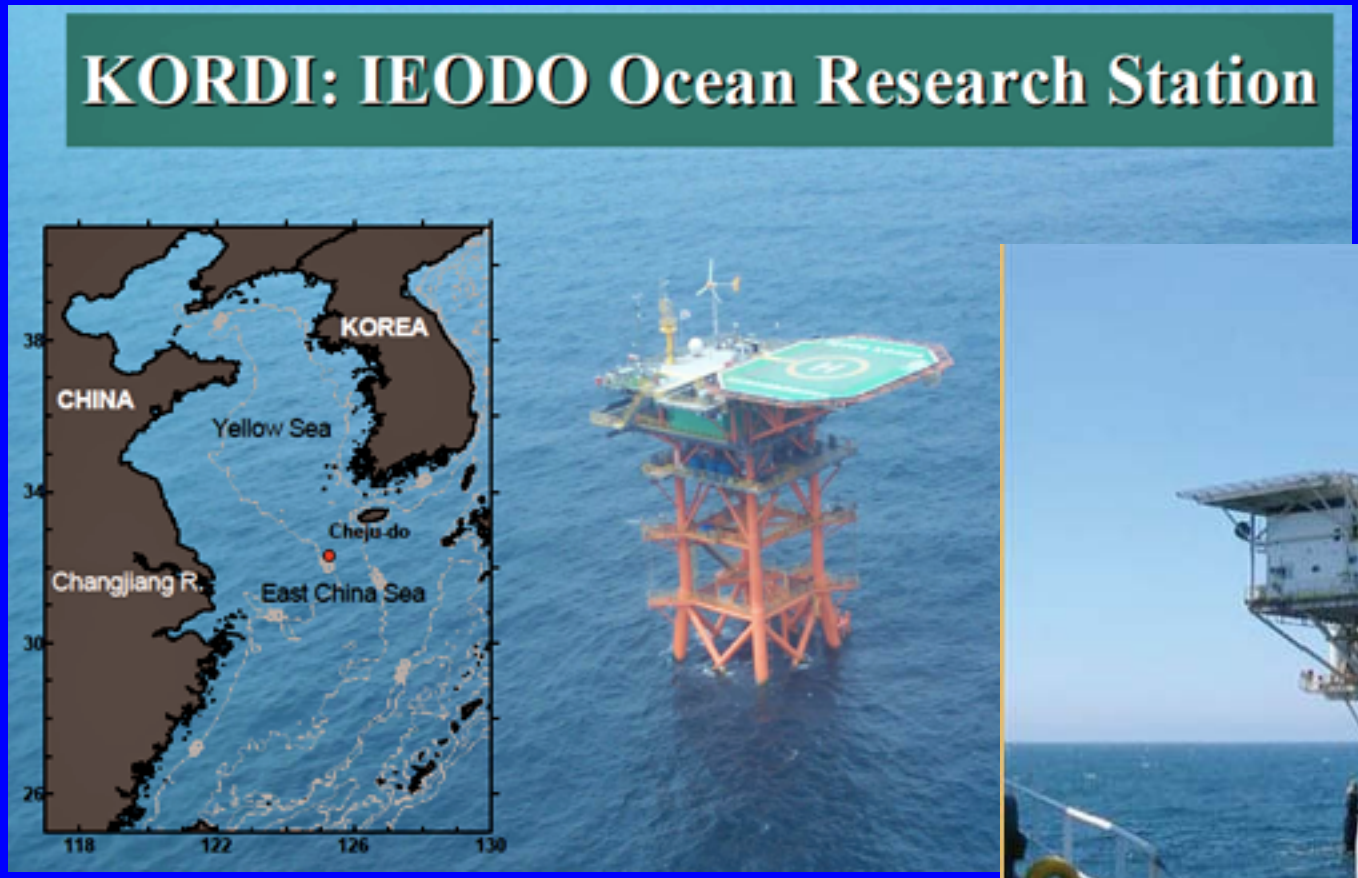
CHILE **IN PLANNING**

What else are we working on?

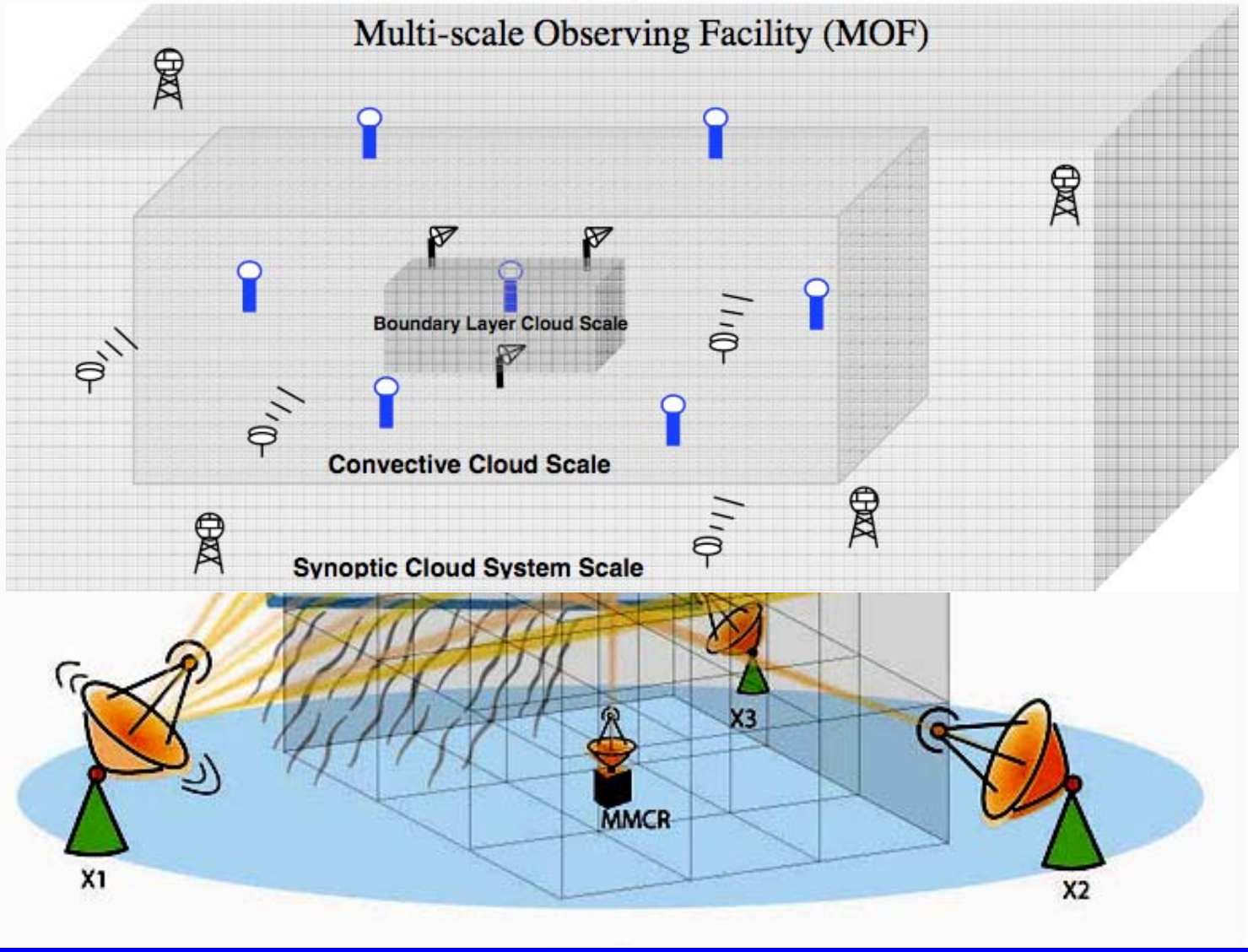
1st Radiative Heating Profile Workshop, Scripps, Jan 2007

A 2nd Mobile Facility, for marine use

2nd Mobile Facility on a platform



We are moving slowly toward scanning radar



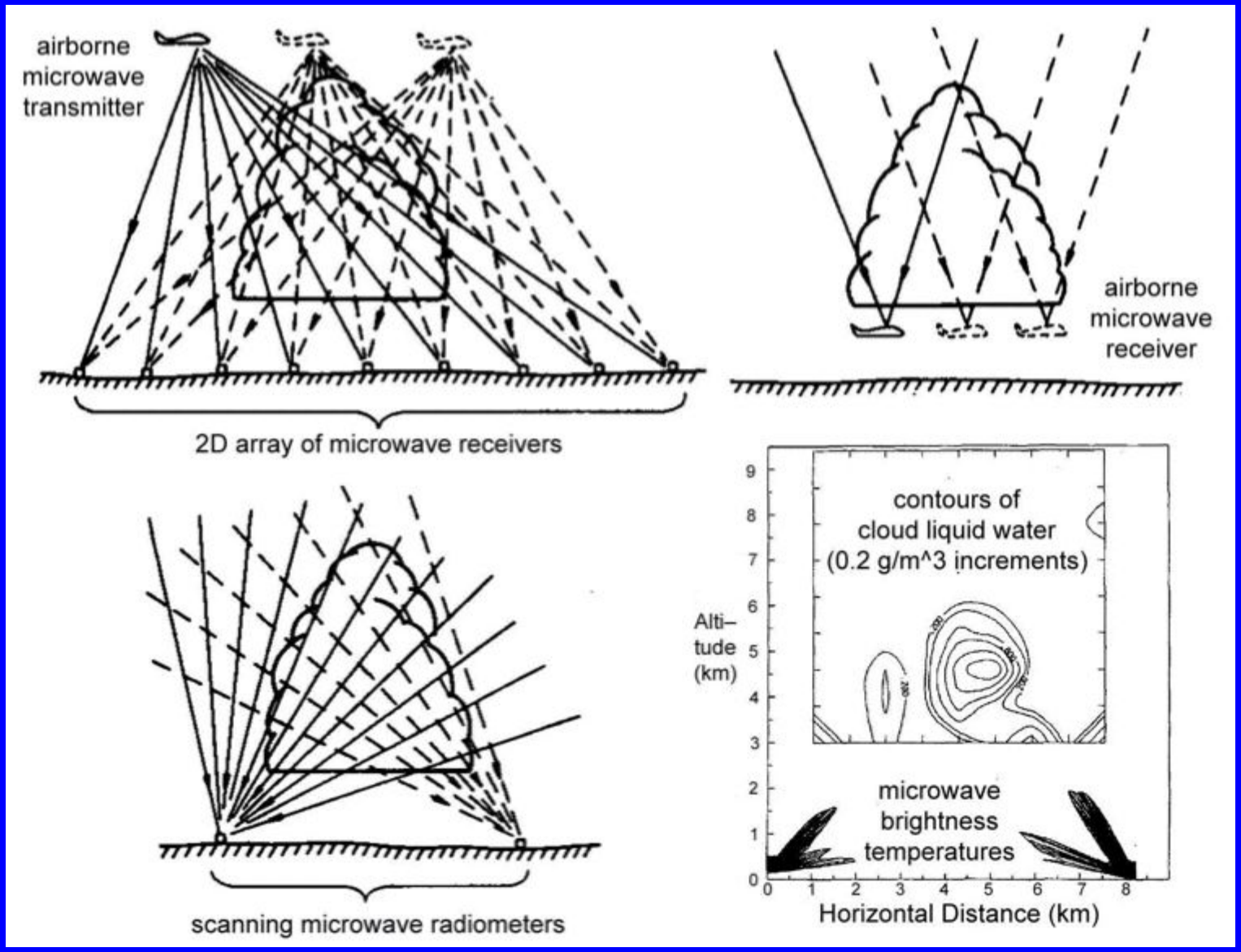
We are taking baby steps toward using small UAVs

Why small UAVs?

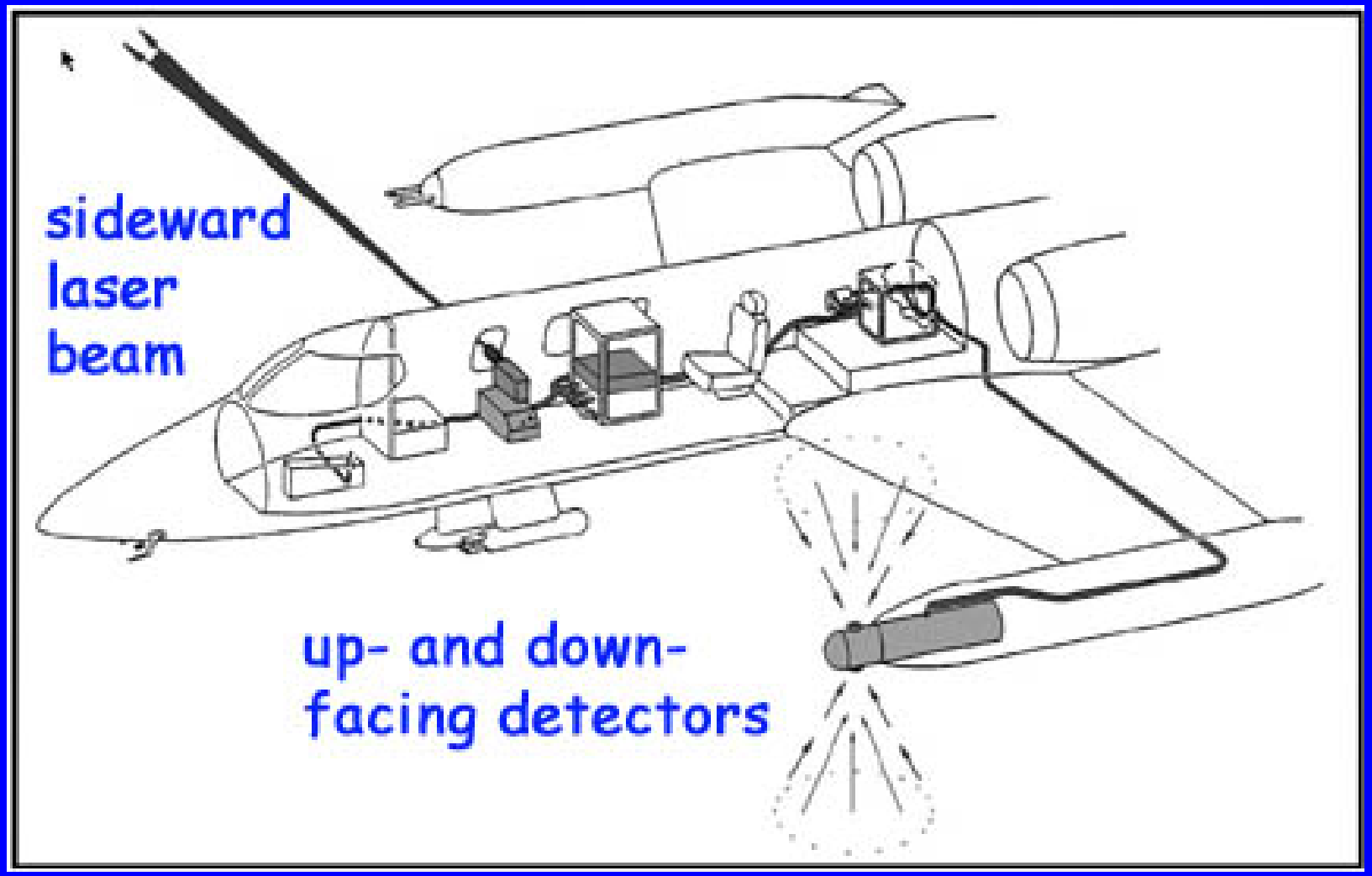
With small UAVs we can do things that are nearly impossible with crewed aircraft

We have permission to fly small UAVs at Oliktok Point

We are developing cloud tomography



We are using SBIR to develop multilple-scattering lidar



ARM Cloud Parametrization & Modeling WG - home - SeaMonkey

File Edit View Go Bookmarks Tools Window Help

Back Forward Reload Stop http://science.arm.gov/wg/cpm/scm/statistical_summaries.html

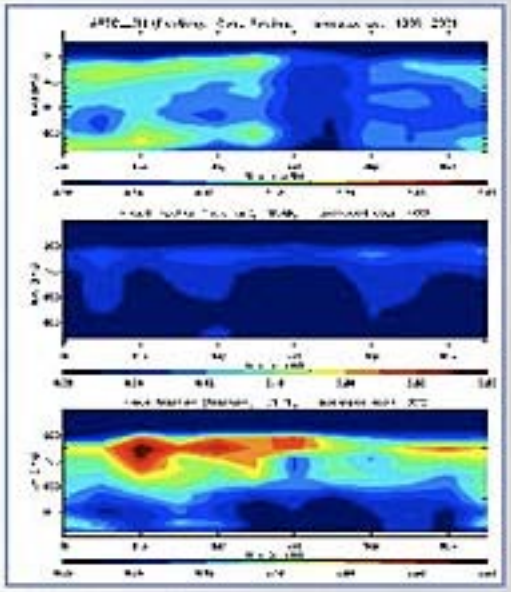
Home Bookmarks Red Hat, Inc. Red Hat Network Support Shop Products Training

Statistical Summaries of ARM data for Climate Modelers

The ARM program collects unique data related to radiation, clouds, water vapor, and aerosols of great value to climate modelers. This web page provides a few sample analyses of multi-year data from the Southern Great Plains site with comparisons to climate model simulations for the same location.

Seasonal Cycle at the Southern Great Plains

Cloud Fraction from the Cloud Radar



ARSCL , CAM and GFDL Cloud Fraction

Explore the data yourself

Would you like to explore the data yourselves?

Browse the Dataset

Quick look plots

Seasonal and diurnal cycle

The dataset extends the following years: **1999 - 2001.**

There is more data available including data for the satellite observations, surface sensible and latent heat fluxes, and surface meteorology.

Would you like to download the data for your own exploration?

The data used in the statistical summaries is from a 3 year analysis **(1999-2001)** which is

We are trying to produce data products that will help climate modelers

...and we visit climate modeling centers to learn their needs

Welcome aboard!