

ARM Orientation: Overview and History

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ARM Chief Scientist
Brookhaven & NASA

Can you believe this guy?

You want me to be Chief Scientist?



ARM in a nutshell

- Largest global change research program funded by the U.S. Department of Energy (\$44M/yr; ~\$10M/yr for Science Team)
- 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

Where did ARM come from?

A bit of 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



Radiation a solved problem?

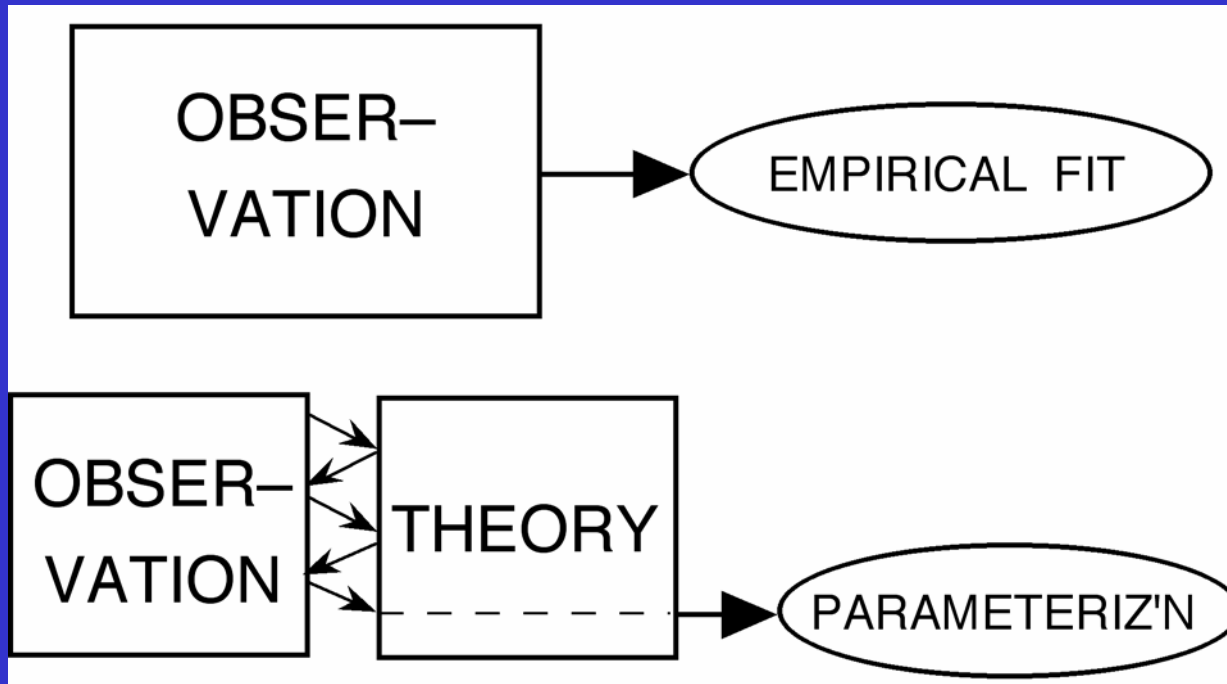
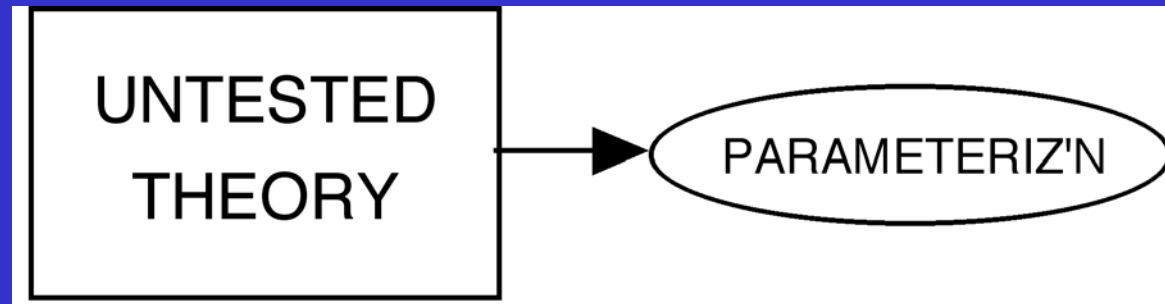
Renaissance of climate theory (1970–) forced resuscitation of moribund atmospheric radiation field, ...

but only as a demand to produce better parameterizations.

Neither fundamental theory nor improved observations designed to test models were emphasized....



Perverse modus operandi of atmospheric radiation before ICRCM



**Normal science
modus operandi**

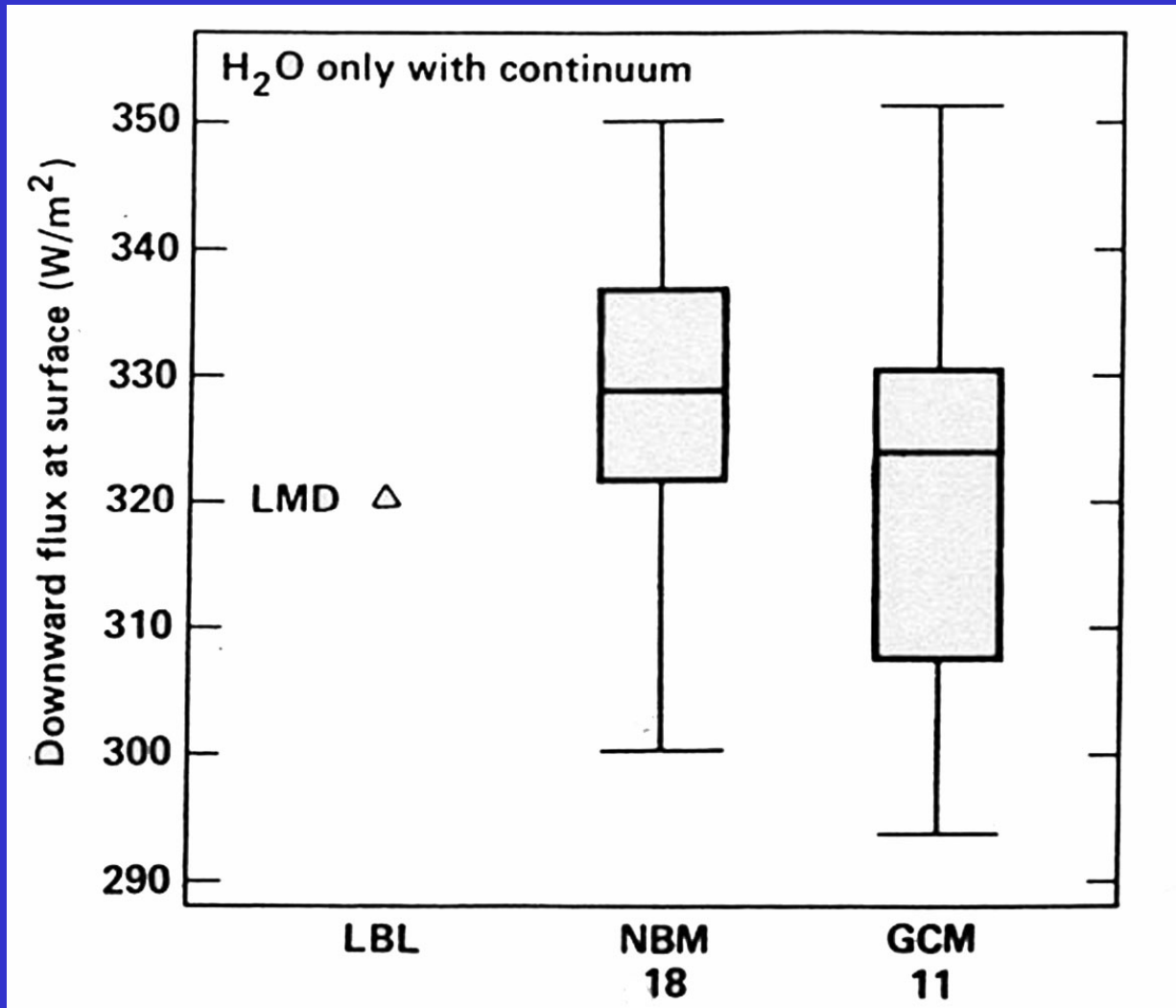


ICRCCM exposed theoretical disarray in clear longwave problems

- 40+ models (international)
- fluxes at 3 levels compared
- differences up to 50-70 W/m²
- spread among narrow-band models (≤ 20 cm⁻¹ resolution) as big as for wide-band and emissivity models
- even line-by-line models (≤ 0.01 cm⁻¹ resolution) had to agree on common ground rules to achieve 1–2 W/m² agreement



ICRCCM-1: 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)

“The purely calculational phase of ICRCCM, which has lasted more than 4 years, is winding down. The participants feel that the rather large discrepancies revealed during that phase cannot be decisively resolved by further calculation, but only by well-calibrated spectral observations.”

“Thus, the ICRCCM has concluded that existing observations, while they shed light on various issues facing ICRCCM, cannot definitively resolve the large inter-model discrepancies.”



ICRCCM-1: Paris Workshop Report (1988)

“Indeed, already 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 (primarily lidar and microwave) under active development.”

[This became SPECTRE.]



Radiation field observations circa 1985

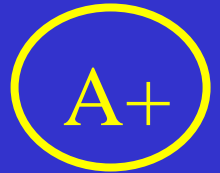
- Piggy-backed on dynamics &/or cloud physics experiments ... but only if cheap and unobtrusive
- Technology stagnated at 1950's level (mostly Eppley broadband radiometers)
- Calibration bad & difficult ; unknown thermal offsets lingered into the 1990s
- 30 W m^{-2} agreement with models called "good" ; discrepancies buried under excuses like "unknown aerosol"



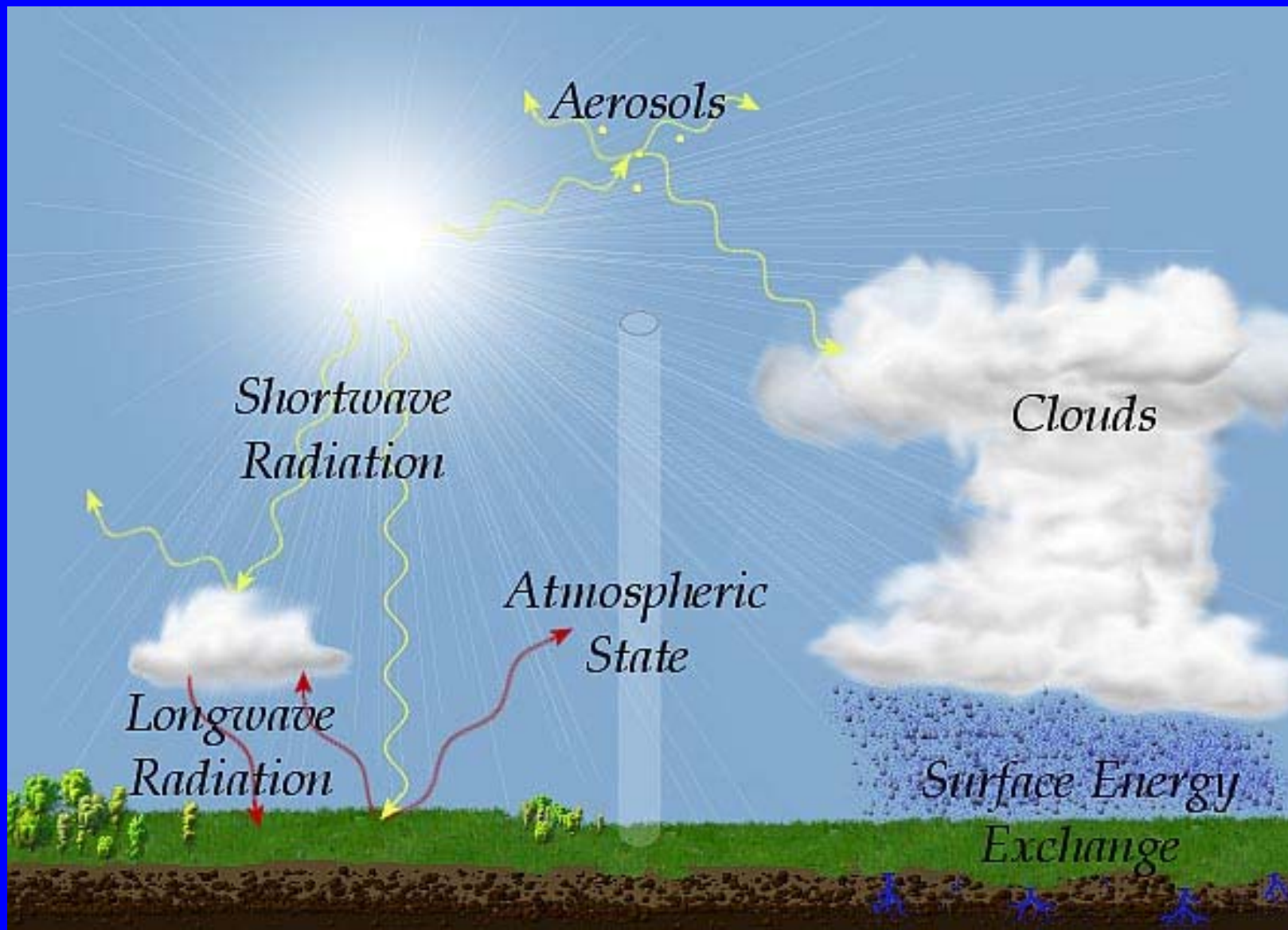


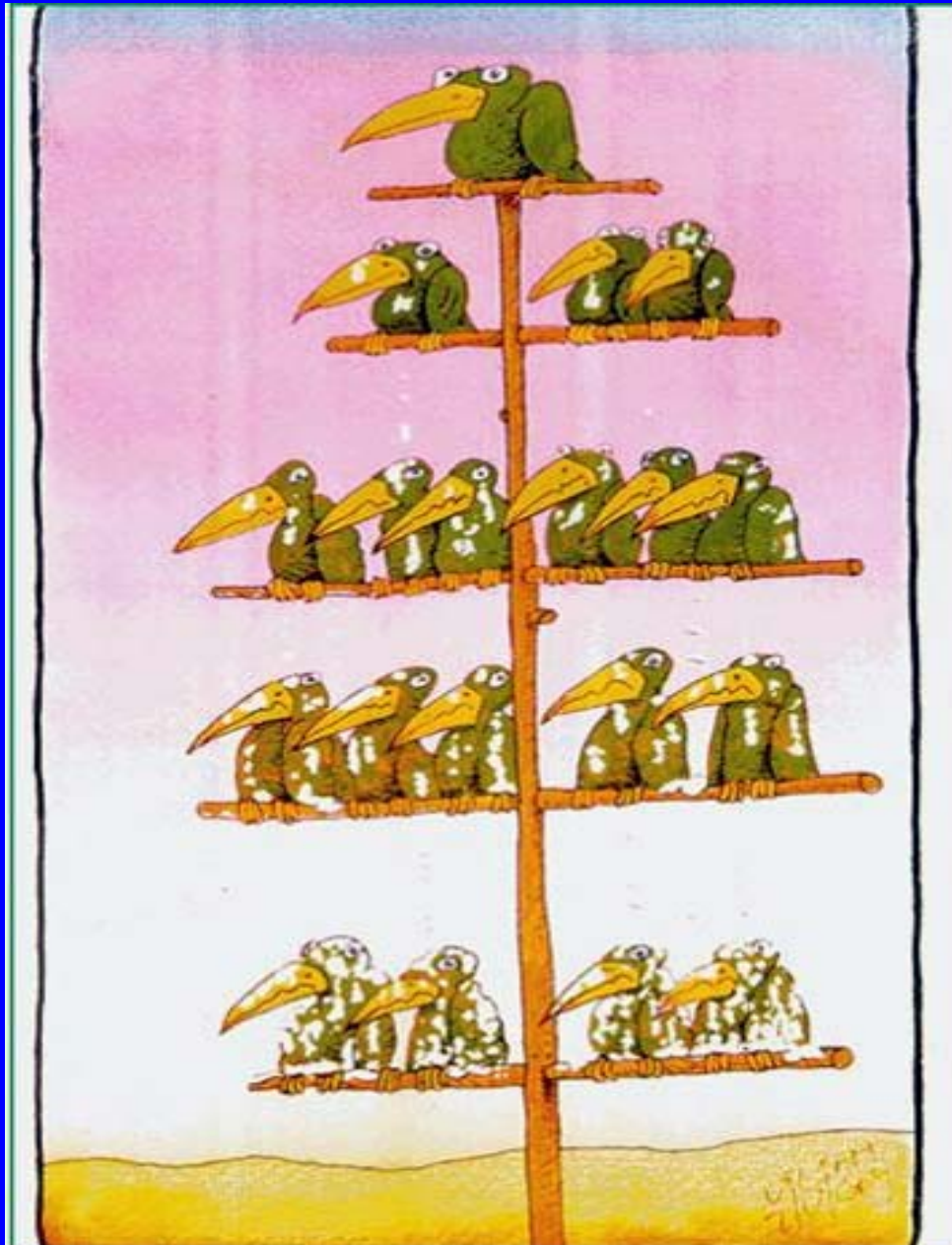
Radiation field observ'ns circa 1985, cont.

- Broadband radiometers averaged over angle, wavelength, time, and space, hence lost almost all information content
- ... making comparisons with theory unproductive of model improvements
- Simultaneous, vertical profiles of model input variables rarely measured
- Infinitesimal amount of data — often not statistically significant



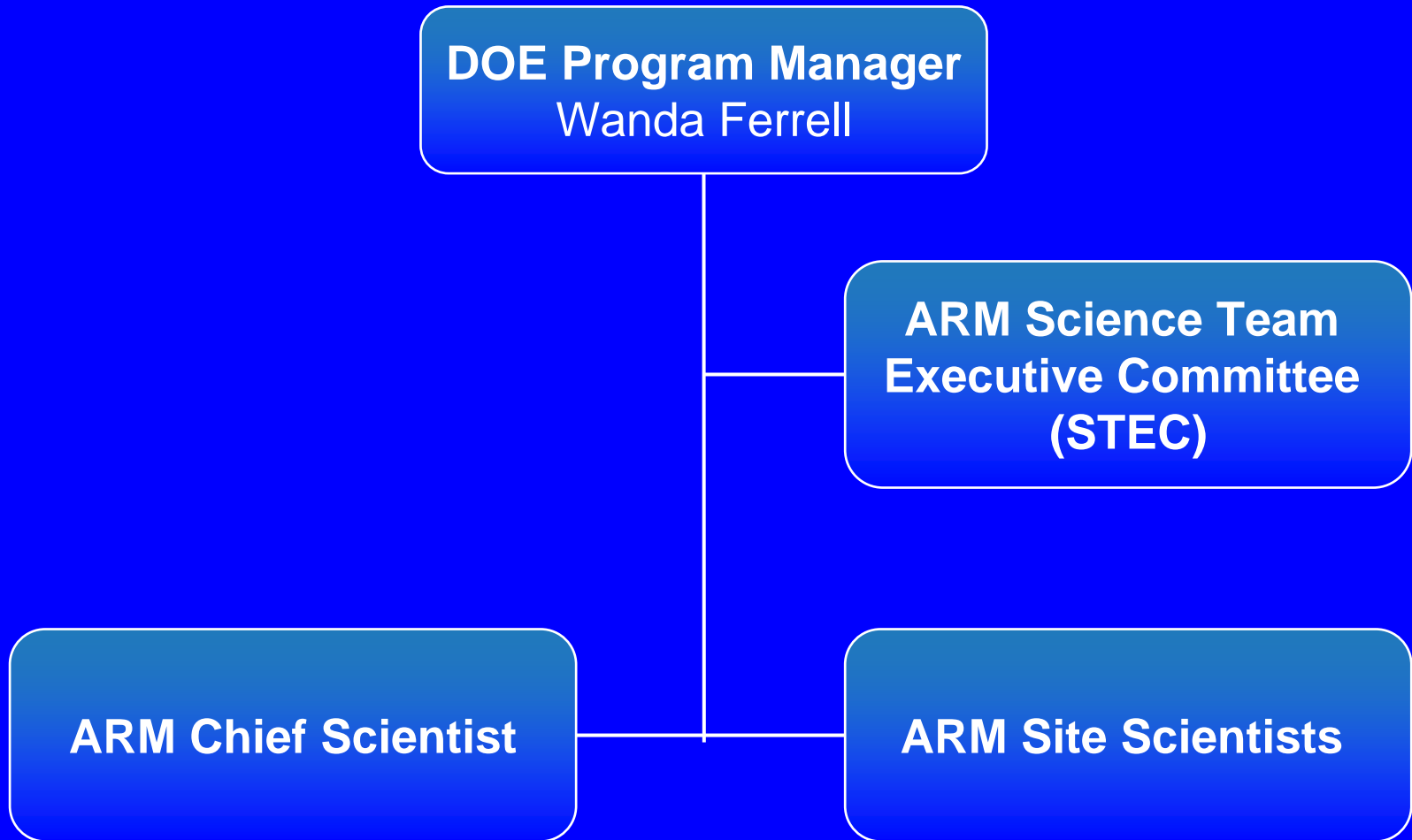
ARM Focus Areas



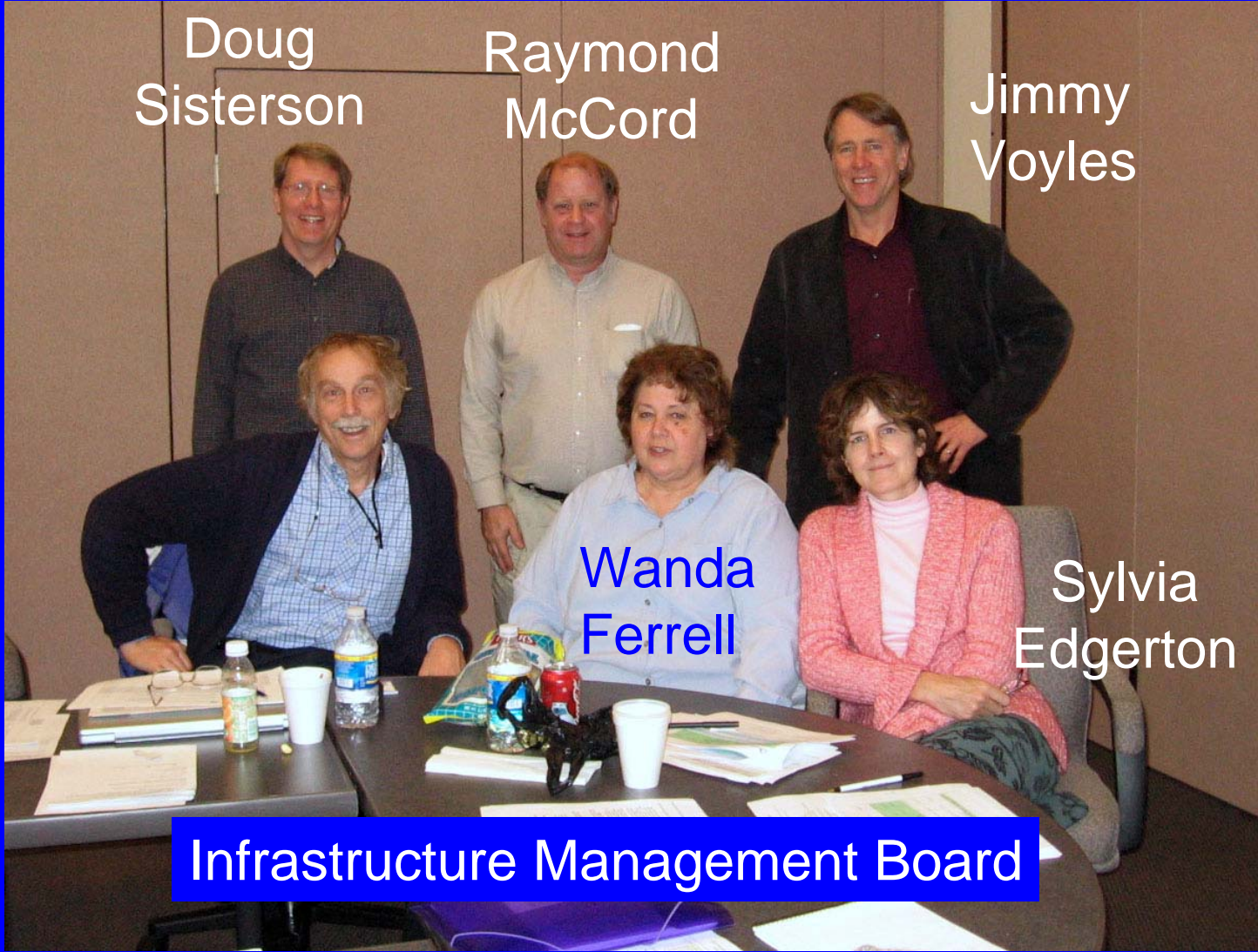


ARM Organizational Structure

ARM Science Management



ARM Leaders



Doug
Sisterson

Raymond
McCord

Jimmy
Voyles

Wanda
Ferrell

Sylvia
Edgerton

Infrastructure Management Board

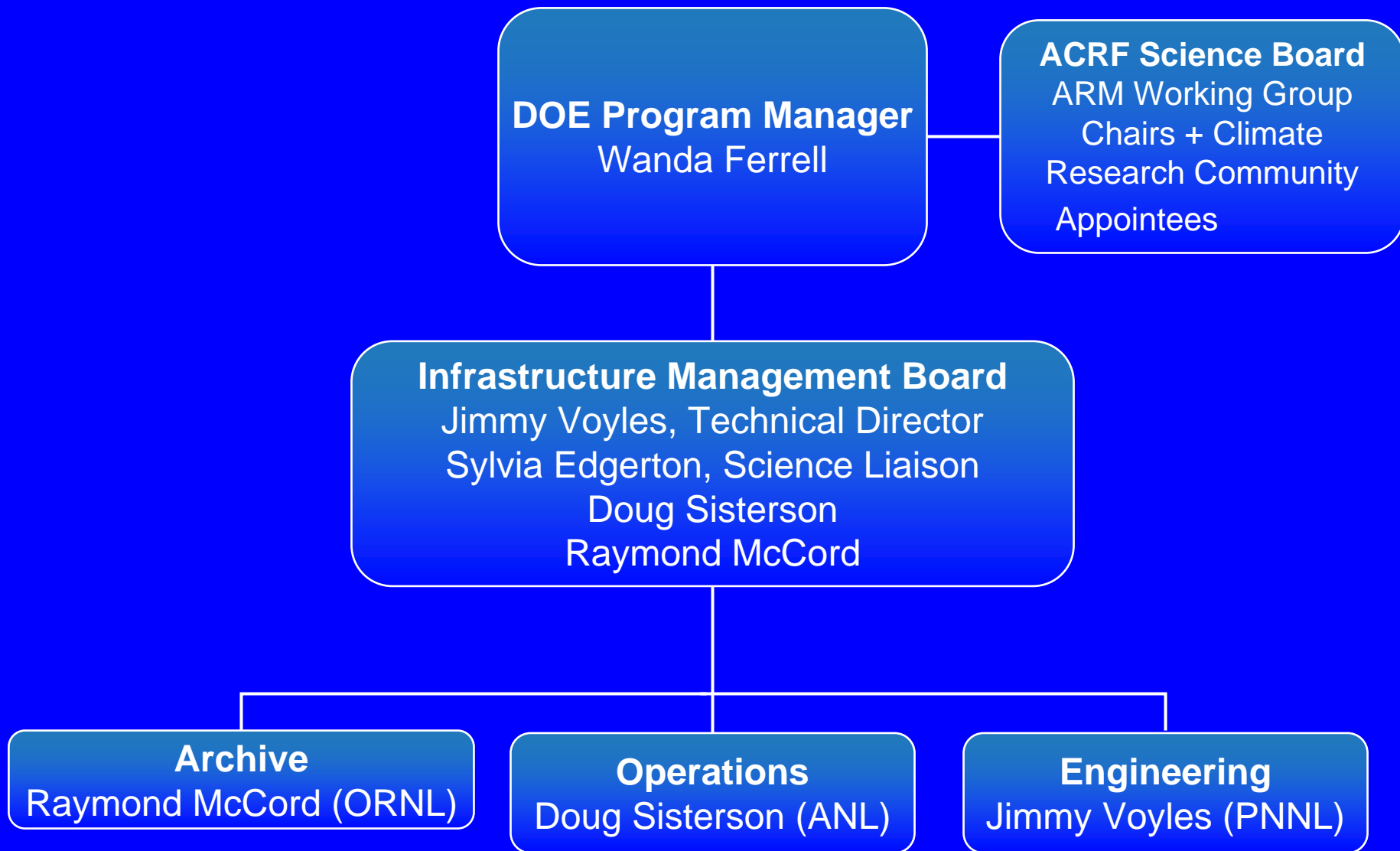


Bob
Ellingson



Tom
Ackerman

ARM Infrastructure Management



ARM is now a DOE User Facility!

- called ARM Climate Research Facility (ACRF)
- What does this mean to you? Now ARM does not just exist to serve its own Sci Team, but a broader community
- Outside community can submit proposals for use of ACRF, including new Mobile Facility (proposals can be quite small)
- Recent examples: magnetic field, tectonic motions, radon, validation sites for NASA OCO

ARM Measurement Philosophy

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



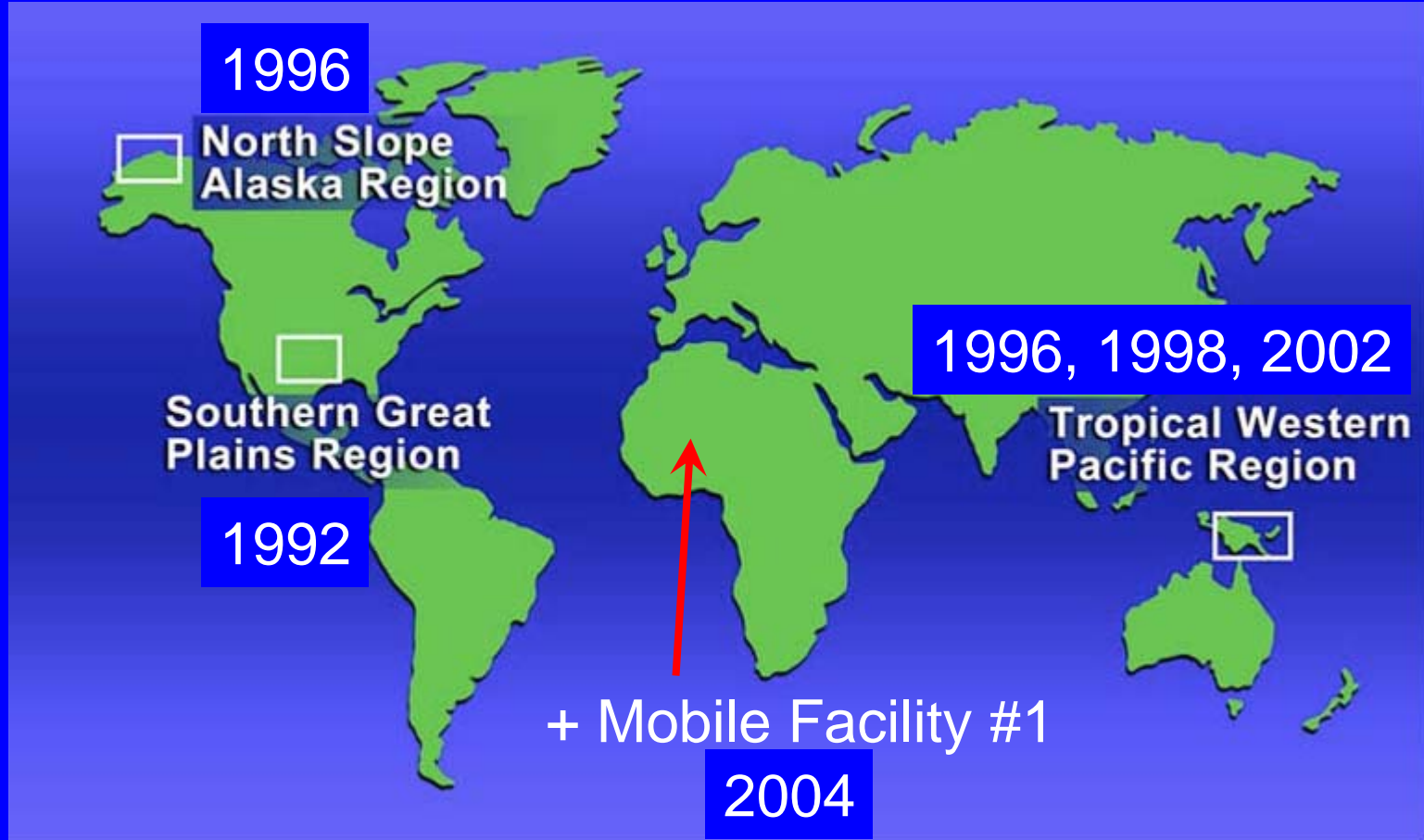
Mar 2006



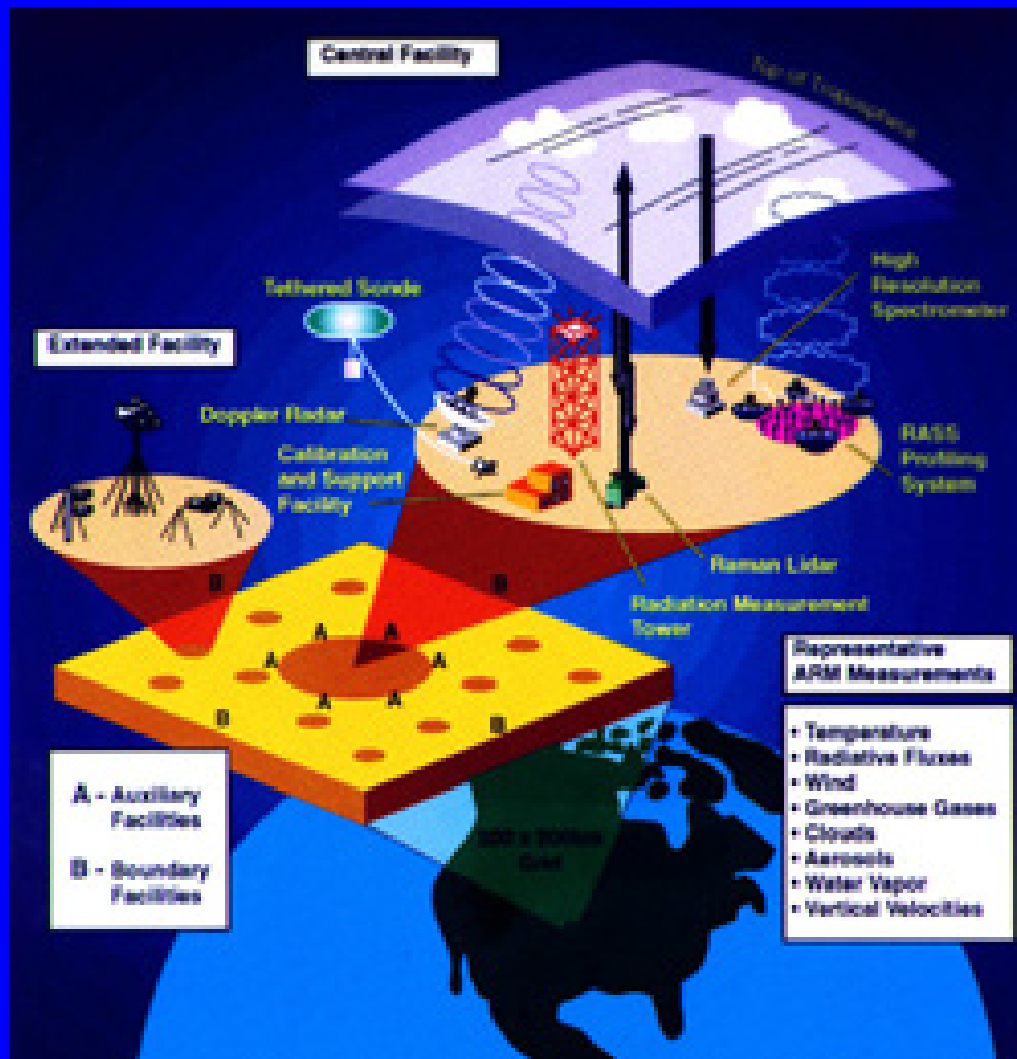
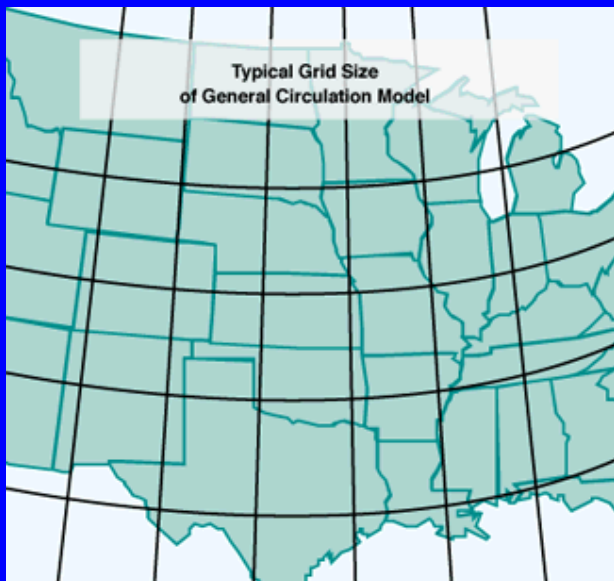
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ARM sites



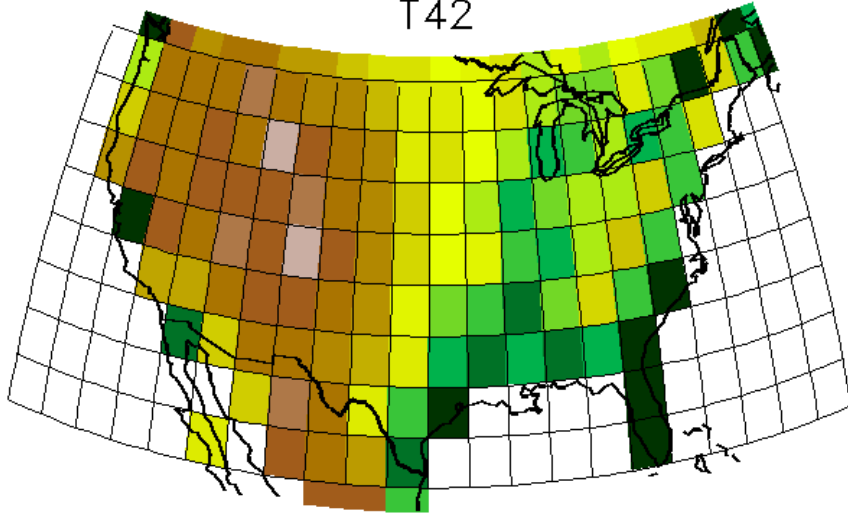
SGP was designed to cover a 1990 GCM grid square



Horizontal Grid Resolutions, future GCMs

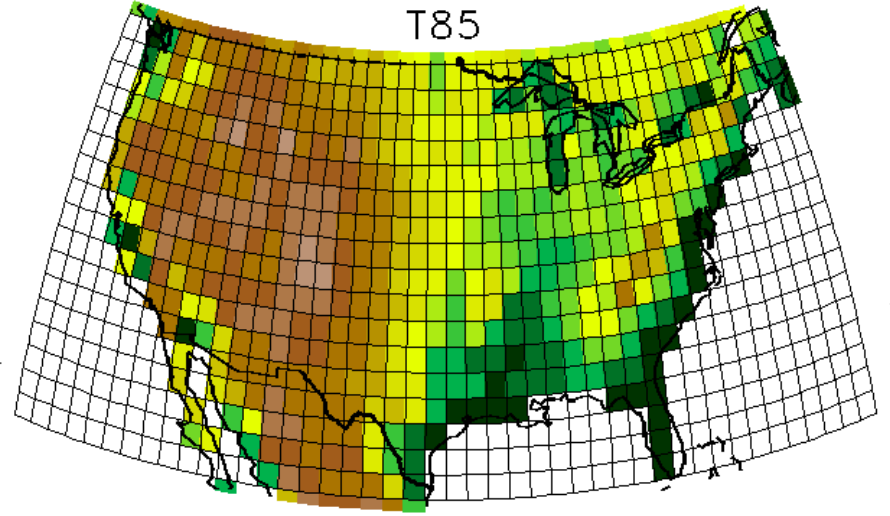
(300 km)

T42



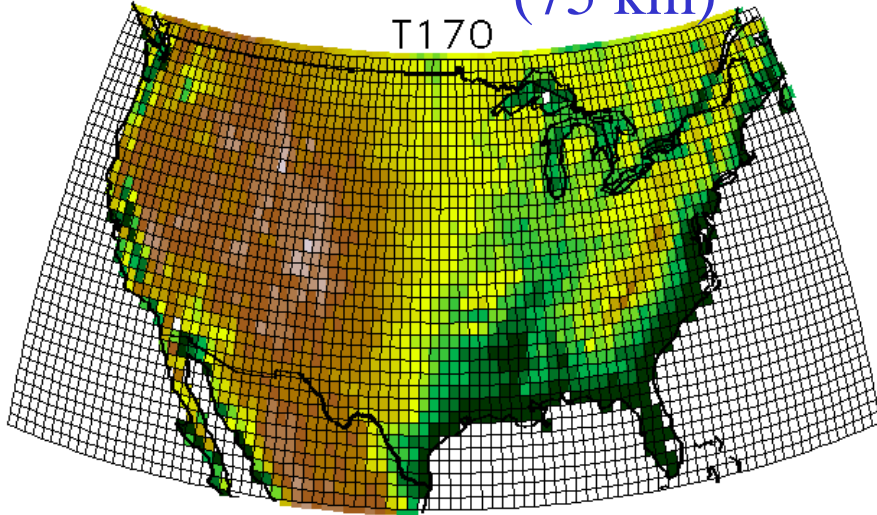
(150 km)

T85



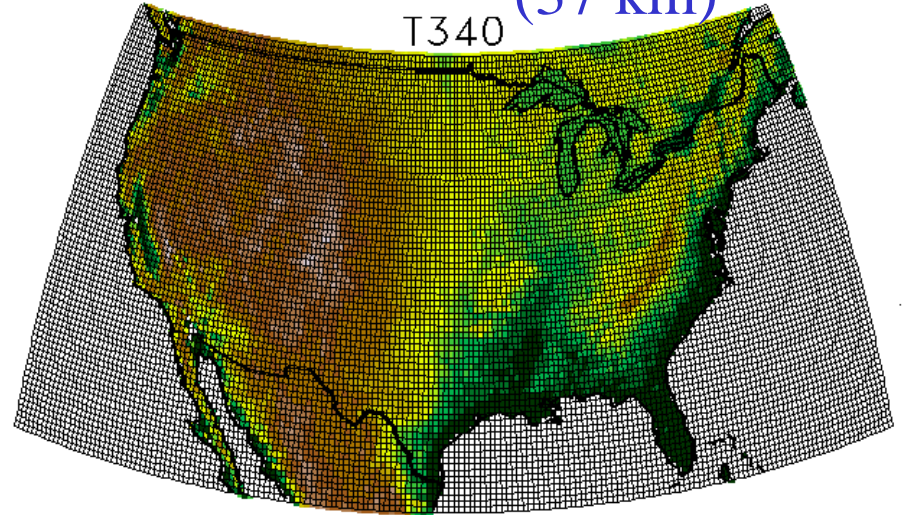
(75 km)

T170



(37 km)

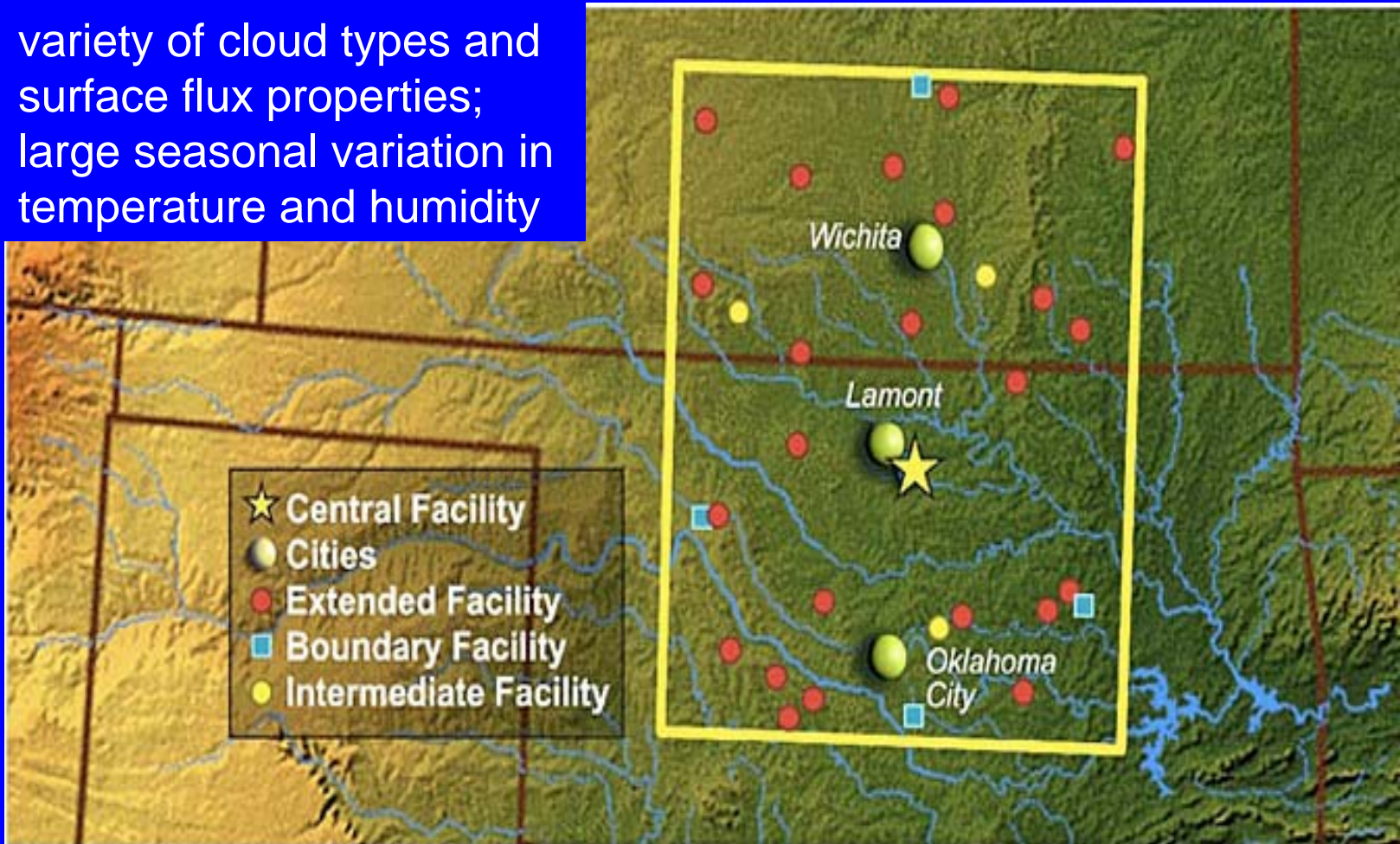
T340



Next IPCC

SGP (23 Extended Facilities, 4 Boundary Facilities)

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



Southern Great Plains site



Mar 2006

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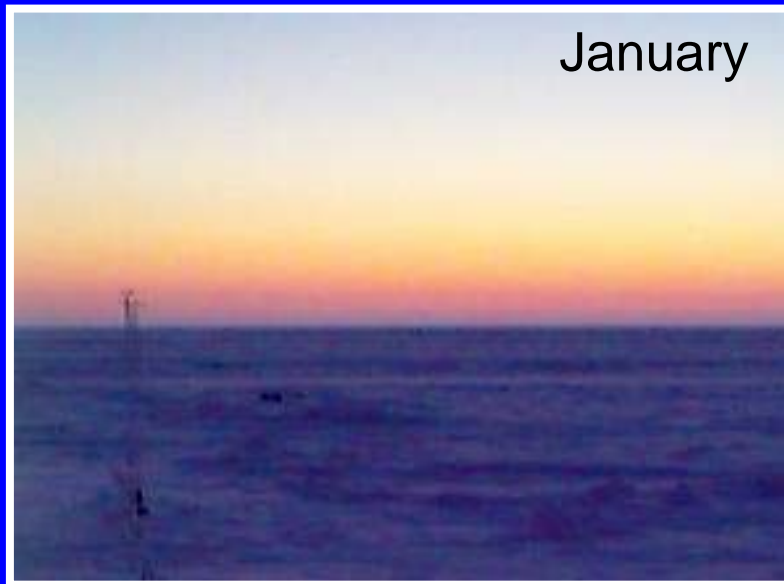


North Slope Alaska

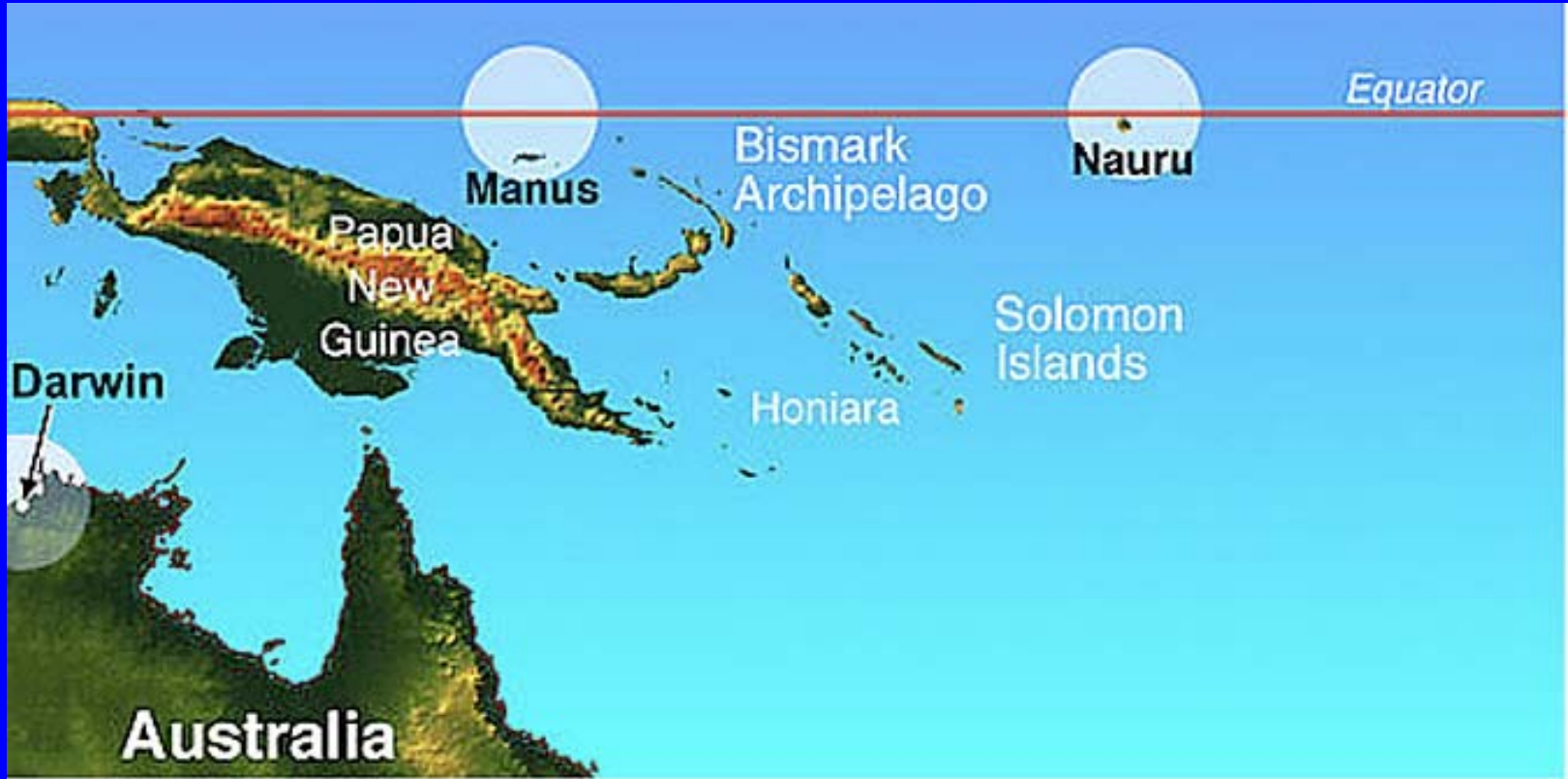


We have no presence on the sea ice except during field campaigns like SHEBA (97-98) and MPACE.

SHEBA (Surface Heat Budget Arctic)



Tropical Western Pacific ARM sites (3)



Deep convection; El Nino; high water vapor

Tropical Western Pacific sites





ARM Representatives at Darwin site opening ceremonies

An IOP: TWP-ICE, Darwin, Australia



ARM Mobile Facility — Niger, Africa



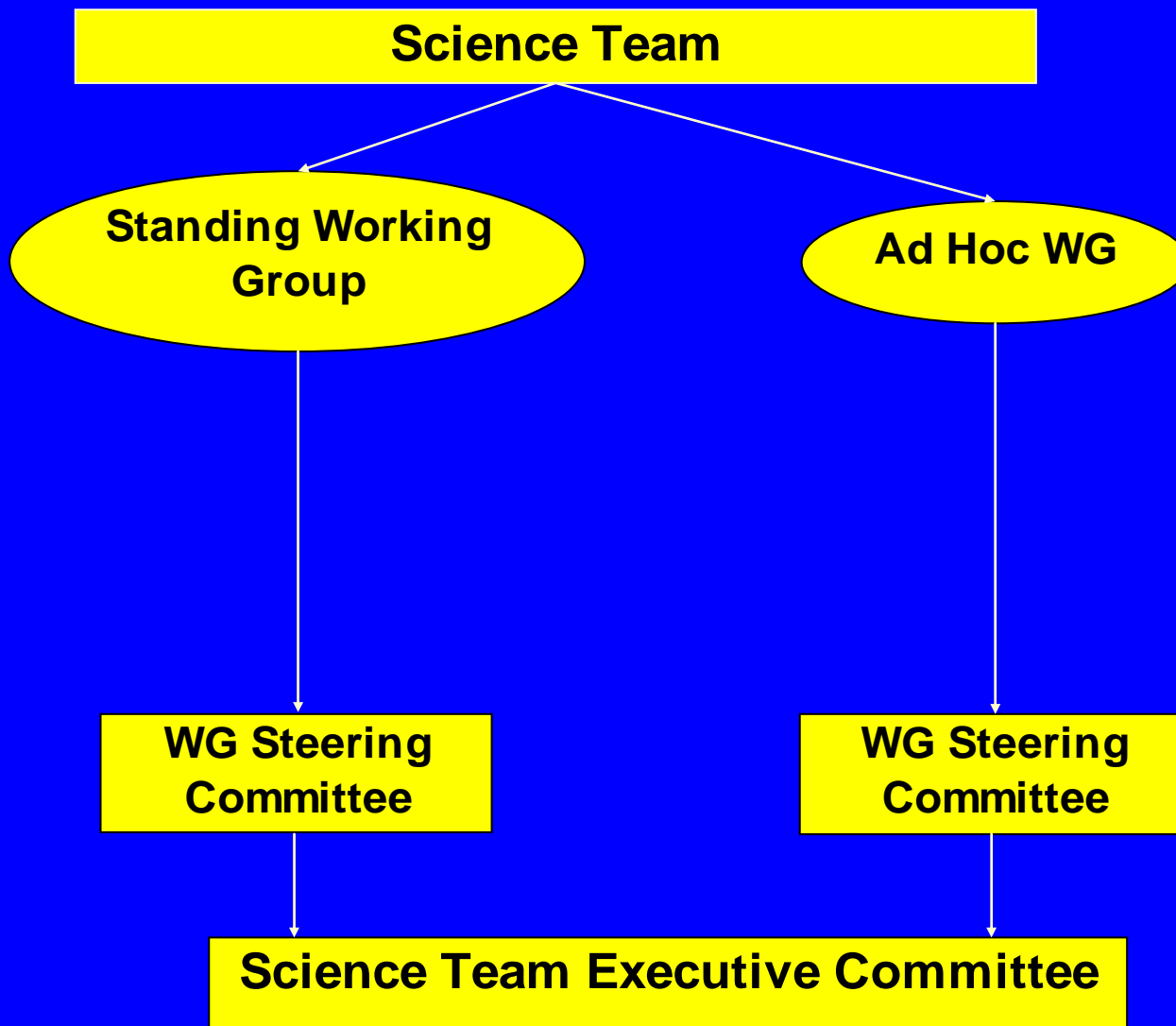
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ARM Orientation

What are ARM's expectations?

- **Good science - first and foremost!**
 - Two papers per year per grant (average)
 - science highlights to Chief Scientist
- **Participate in**
 - a Working Group (there are 4)
 - a climate modeling group (possibly)
 - a field campaign (encouraged)
 - annual ARM Science Team Meeting (bring poster)
- **Interact with the Infrastructure**
 - help set priorities, make recommendations
 - report on data quality, problems
 - create/hand over value-added products ("VAPs")

ARM Sci Team Structure



Standing Working Groups

- Instantaneous Radiative Flux (IRF)
- Cloud Properties (CP)
- Aerosol
- Cloud Parameterization and Modeling (CPM)

Ad hoc working groups (aka Focus Groups)

CLOWD (Clouds with Low Optical Depth)

BBHRP (BroadBand Heating Rate Profile)

Two things characterizing each WG...

- **IRF (oldest):**
 - spectral resolution
 - fighting/improving broadband flux meas'ts
- **CPM:**
 - Single Column Model IOPs
 - Cloud-Resolving models
- **CP:**
 - Microwave/radar instruments
 - ARSCL (unified specific'n of cloud properties)
- **Aerosol:**
 - Cessna paradigm
 - indirect effect

What should you become familiar with?

- Data - ARM Archive
- IOP planning and operation
- Instrument develop't & oper'n, Instrum. Mentors
- Data quality reports, Data Quality Office
- problems@arm.gov
- VAPs
- Translators: translate WG VAP and meas't requirements to developers & instrument leaders

Science Team Meeting structure

- **Plenary sessions**
 - Invited talks (from WGs & from outside ARM)
- **Poster sessions: best way to learn about ARM**
 - Poster talks selected by ARM Exec Comm
- **Extended abstract + poster as PDF file**
 - Due at meeting but often delivered later
- **Breakout sessions - attend, organize as interested**
- **Working group meetings - Mon**
- **Many unannounced Infrastructure meetings**