ARM Orientation for New and Current Principal Investigators

Jim Mather, Jimmy Voyles, and Raymond McCord

Third ASR Science Team Meeting
Crystal City, VA
March 12, 2012

Outline

Part 1: ARM Facility Overview

- ARM and ASR, Goals and Mission
- ARM Climate Research Facility Overview
- Facility Changes: Recovery Act and New Sites
- Field Campaigns
- Data Products and Processes

Part 2: Interacting with the ARM Facility

- Finding, Ordering and Using ARM Data
- Submitting Research Highlights
- Submitting Field Campaign Requests
- Keeping up with ARM News and Information
- More Information and Feedback

Strategic Planning
The Energy-Environment-Climate Nexus

Greenhouse gases are emitted during energy production… and climate change will impact energy production

Building on our CESD mission:

To advance a robust predictive understanding of Earth's climate and environmental systems and to inform the development of sustainable solution to the Nation's energy and environmental challenges.
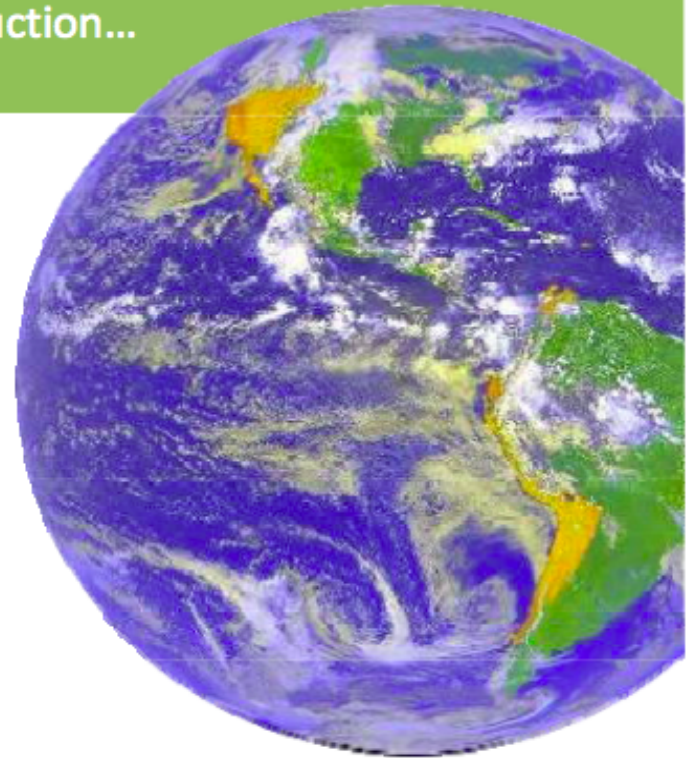
Climate & Environmental Sciences Division Strategic Goals

1. **Synthesize new process knowledge and innovative computational methods advancing next generation, <u>integrated models of the human-earth system</u>.**

2. **Develop, test and simulate <u>process-level understanding of atmospheric systems and of terrestrial ecosystems</u> extending from bedrock to the top of the vegetative canopy.**

3. **Advance fundamental understanding of <u>coupled biogeochemical processes</u> in complex subsurface environments to enable systems-level prediction and control.**

4. **Enhance the unique capabilities and impacts of the ARM and EMSL <u>scientific user facilities</u> and other BER <u>community resources</u> to advance the frontiers of climate and environmental science.**

5. **Identify and address <u>science gaps</u> that limit translation of CESD fundamental science into <u>solutions for DOE's most pressing energy and environmental challenges</u>.**

ARM and ASR

We continue to hear a lot of confusion from many corners about the relationship between ARM and ASR.

ARM is an observational scientific user facility with the mission described on the previous slide (http://www.arm.gov).

ASR is a separate, parallel DOE program that is research-based. Members of the ASR science team constitute an important part of the ARM user community though ultimately ARM serves the larger climate research community (http://asr.science.energy.gov).

So – for example – one should refer to ARM sites or ARM data but research done with ARM data would often be done as part of an ASR science project.

ARM Mission and Vision Statements

Mission

The ARM Climate Research Facility, a DOE scientific user facility, provides the climate research community with strategically located in situ and remote sensing observatories designed to improve the understanding and representation, in climate and earth system models, of clouds and aerosols as well as their interactions and coupling with the Earth's surface.

Vision

To provide a detailed and accurate description of the earth atmosphere in diverse climate regimes to resolve the uncertainties in climate and earth system models toward the development of sustainable solutions for the Nation's energy and environmental challenges.

6
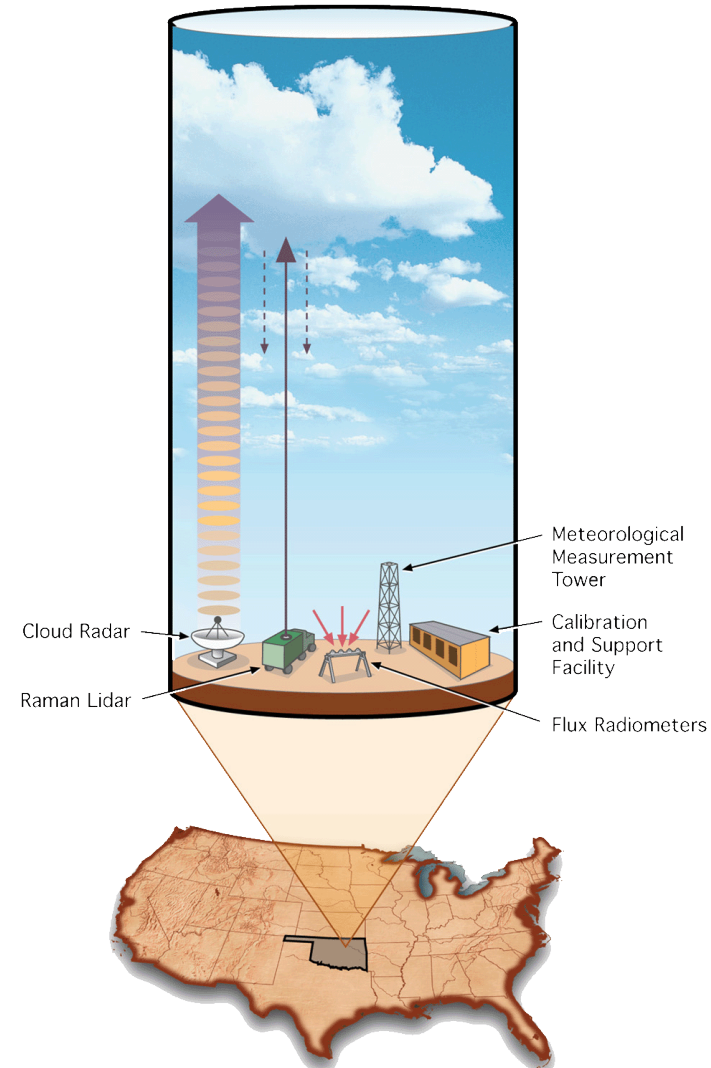
Atmospheric System Research (ASR) Mission Statement

The goal of ASR, in partnership with the ARM Facility, is to quantify the *interactions among aerosols, clouds, precipitation, radiation, dynamics, and thermodynamics* to improve fundamental **process-level understanding**, with the ultimate goal to reduce the uncertainty in global and regional climate simulations and projections.
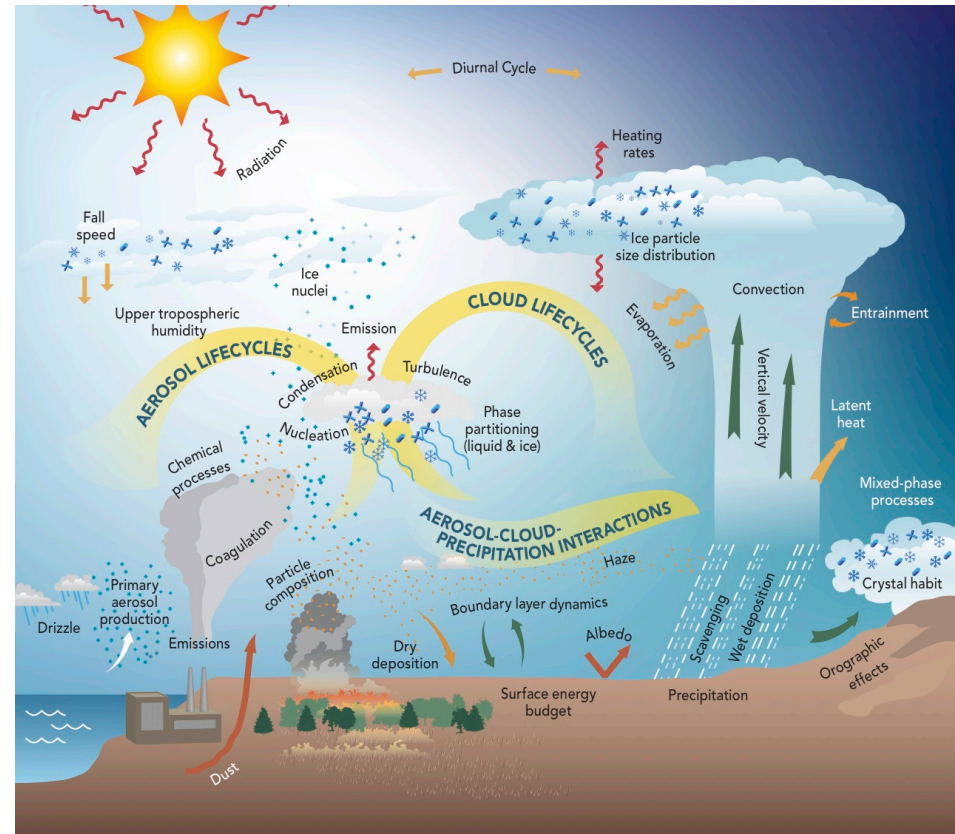
Facility Components

- Research sites – permanent, mobile, and aerial
- Instruments and measurements
- Data processing, data quality, Data Archive
- Field campaigns – ground-based and airborne
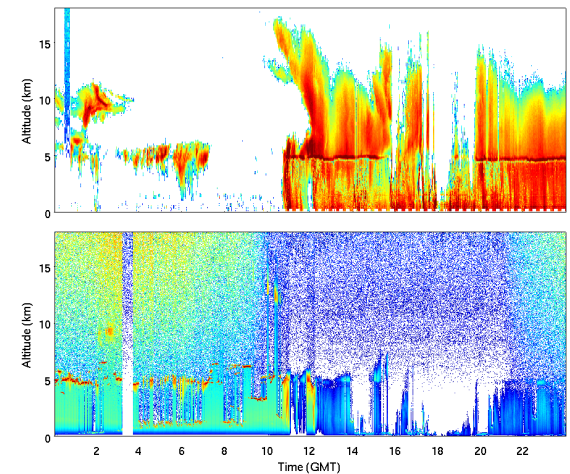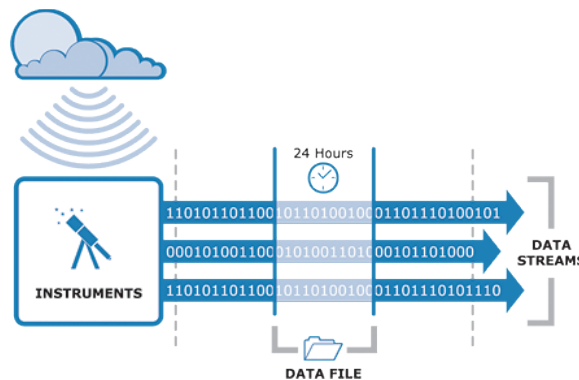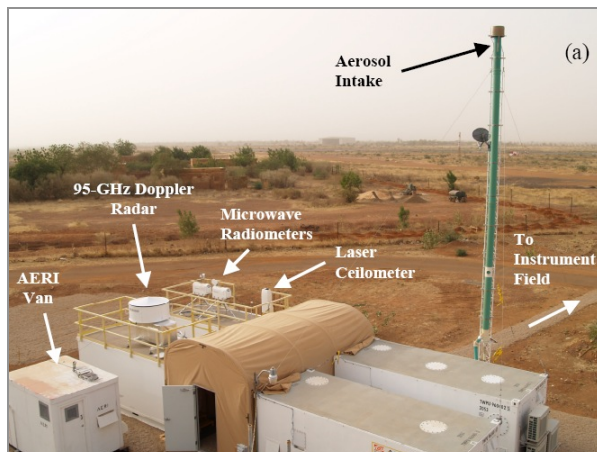
ARM Climate Research Facility Management

DOE Program Managers
Wanda Ferrell, ARM
Rick Petty, AAF

Facility Science Board
Climate Research Appointees and ASR Science Working Group Chairs

Laurel Chapman
Science Liaison

Jim Mather
Technical Director

Jimmy Voyles
Chief Operating Officer

Raymond McCord
Archive Manager

Beat Schmid
AAF

Doug Sisterson
SGP, AMF2

Mark Ivey
NSA, AMF3**

Kim Nitschke
TWP, ENA*, AMF1

Infrastructure Management Board

* ENA = Eastern North Atlantic, the new permanent site in the Azores
** AMF3 = Third Mobile Facility with an initial extended duration deployment to Oliktok Point, AK

Research Sites
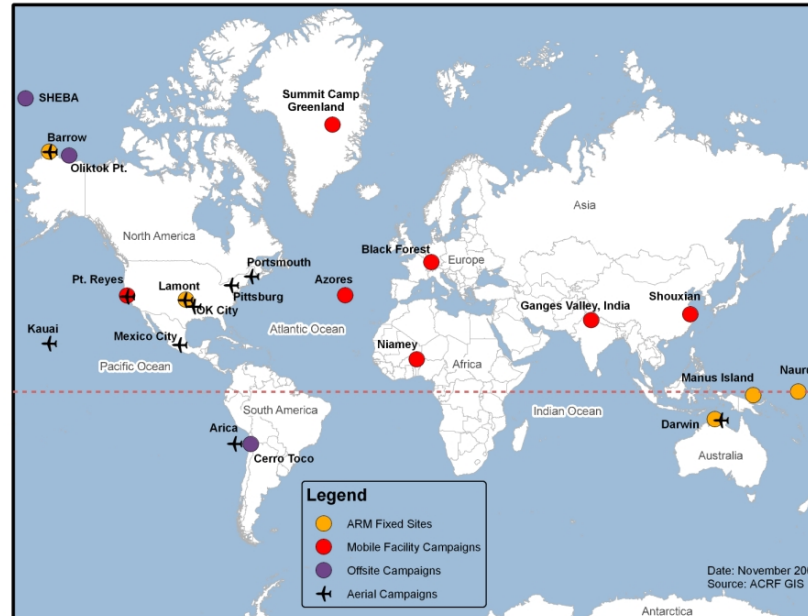
- Southern Great Plains (1993)
- North Slope of Alaska: Barrow (1998) and Atqasuk (1999)
- Tropical Western Pacific: Manus (1996), Nauru (1998), and Darwin (2002)
- First ARM Mobile Facility (2005); Second ARM Mobile Facility (2010)
- ARM Aerial Facility (2007)

Measurements and Instruments

- Cloud profiles: millimeter radar and lidar
- T/RH/Wind profiles: radiosondes
- Column water: microwave radiometer
- Column aerosol: solar spectral radiometer
- In situ aerosol optical and cloud nucleation properties
- Surface radiation budget
- Surface meteorology

- 3D Clouds: Scanning ARM Cloud Radar
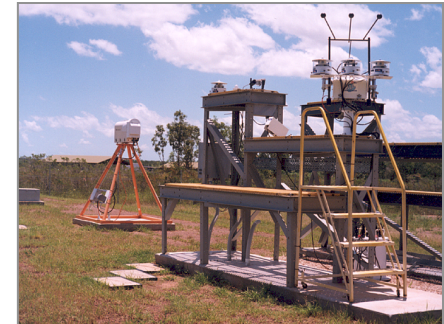
Additional measurements at some sites include 3D precipitation from cm-wavelength radar, vertical velocity from Doppler lidar, and water vapor profiles from Raman lidar
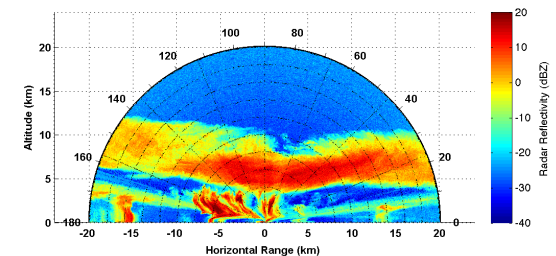
Recovery Act Status

- All instruments installed with the exception of the AMF1 radars and the Darwin AOS

- MAOS deployed at BNL during summer of 2011 and is currently at LANL for PACE campaign and training.

- Working through set of known radar issues (come to Tuesday evening session for details)

- Data from many instruments are available at the archive

- Aircraft instruments flown as part of CARES and CalWater

- The Recovery Act project, begun in the spring of 2009 will formally finish at the end of this month.

http://www.arm.gov/about/recovery-act

12

Two New ARM Sites in 2013

Azores

The **Azores** are an island group in the **Eastern North Atlantic (ENA)** ocean in a region characterized by marine stratocumulus. Marine stratocumulus have a strong influence on climate yet are poorly represented in global climate models.
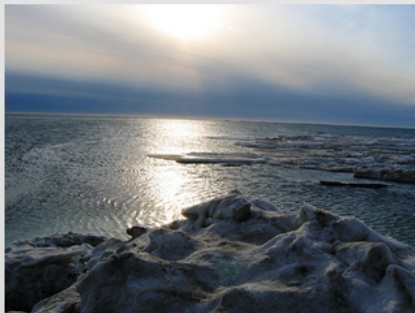
Oliktok Point

The **Oliktok Point** site is located approximately 300 km Southeast of the existing ARM site in Barrow and provides an opportunity to link coastal conditions from the standard ARM measurement suite with near-coast conditions using an **Unmanned Aerial System** (UAS).

Breakout Session on Tuesday at 1pm.

Breakout Session on Wednesday at 7:30 pm.
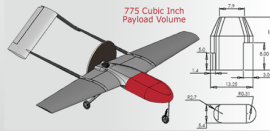
- Sites scheduled to come on line by end of FY13
- The facility at Oliktok Point is a mobile facility deployed for an extended term
- Instruments at these sites match those found at other sites including many of the enhancements added through the Recovery Act and plans to add UAS at Oliktok

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Instrumentation for the New ARM Sites

Atmospheric and Boundary State
- MET, PWD, TSI
- Sondes, ECOR, 915 RWP (NSA), 1290 RWP (ENA)

Lidars
- HSRL, MPL, Doppler

Cloud and Precipitation Radars
- Scanning Cloud, Scanning Precipitation
- Ka Zenith Pointing

Precipitation
- Parsivel, Video Disdrometer, Weighing Bucket, TPS

Radiometry
- Solar Broadband (Up/Down), IRT
- MFRSR, MFR, AERI or ER-AERI, MWR3C

Aerosol Observation System
- Scattering, Absorption, Size Distribution
- Trace Gases

Oliktok
Unmanned Aerospace Vehicles

Oliktok Infrastructure
- Instrument, Operations, and UAS Enclosures
- Electrical Power Generator Module

Azores Infrastructure
- Instrument Enclosures
- Operations Enclosure
- Electrical Power and Hydrogen Generators

Azores Research Site
Kim Nitschke - Site Operations Manager
Los Alamos National Laboratory

Oliktok Point Research Site
Mark Ivey - Site Operations Manager
Sandia National Laboratory

Fundamentally New Arctic Measurements

775 Cubic Inch Payload Volume

Unmanned Aerospace Vehicles for Coordinated Multi-Sensor Measurements

Tethered Sonde and In-Situ Measurement Package

➤ **Multiple UAVs' and Associated Infrastructure**
➤ **Instrument Suite Under Discussion Options Include;**
  ✓ **Condensation Particle Counter**
  ✓ **Optical Particle Counter**
  ✓ **Aethalometer**
  ✓ **Radiometry and Atmospheric State**
  ✓ **Cloud Condensation Nuclei Counter**
  ✓ **Stabilization Platform**

Issues under discussion include characteristics of Azores precipitation radar (X- or C-band) and characteristics of the UAS and associated payload.

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Recent and On-Going Field Campaigns

Midlatitude Continental Convective Clouds Experment (MC3E): April 22 – June 6, 2011 at the SGP ARM site. MC3E was joint with NASA and focused on deep convection and precipitation.

Ganges Valley Aerosol Experiment (GVAX): June 2011 – March 2012 Deployment of the AMF1 to Nainital India with an emphasis on aerosols and their impact on clouds and precipitation.

ARM MJO Investigation Experiment (AMIE): October 2011 – March 2012 featuring the AMF2 in the Maldives and enhanced operations at Manus. Focus on tropical convection in collaboration with the NSF DYNAMO campaign.

http://campaign.arm.gov/
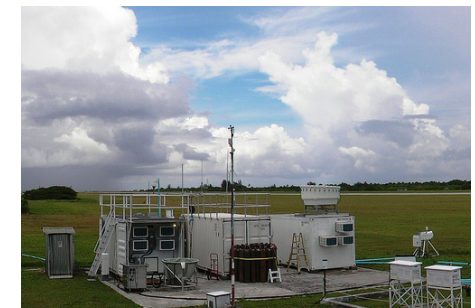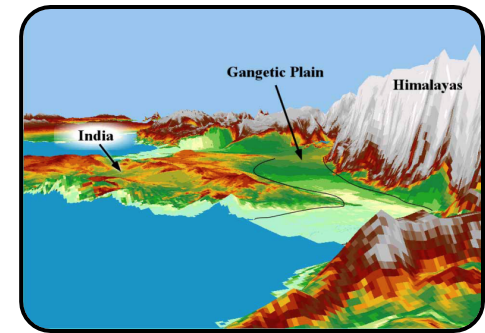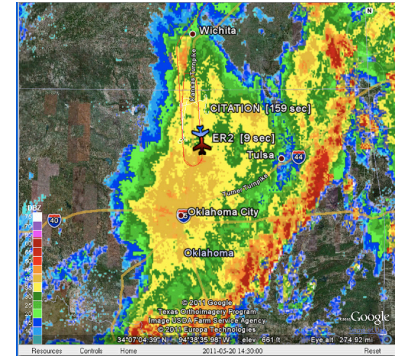
Two-Column Aerosol Project (TCAP)

TCAP is designed to study aerosol properties and their interaction with clouds.

The experiment will be based on Cape Cod and will include observations over the adjacent ocean.

TCAP will span the period July 2012 – June 2013 and will include an extensive set of observation systems:

- AMF1
- AAF G1 Aircraft
- Mobile Aerosol Observing System
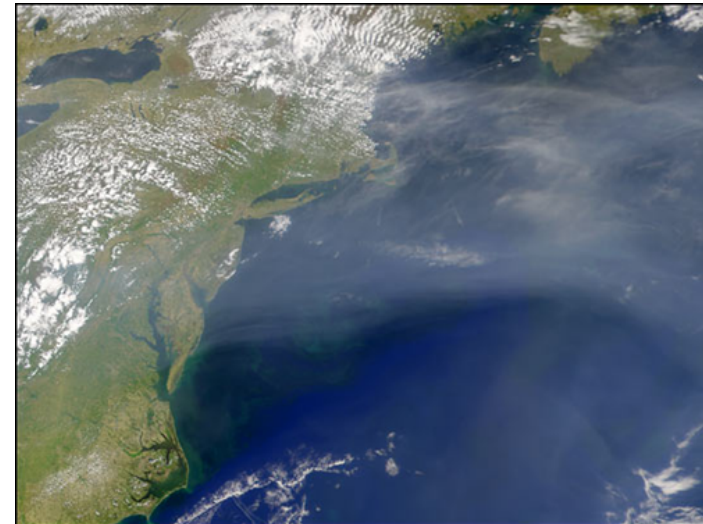
Marine ARM GPCI Investigation Campaign (MAGIC)

MAGIC will be the first marine AMF deployment. The AMF2 will be deployed on a cargo vessel shuttling between Long Beach and Honolulu from October 2012 – September 2013.

The AMF2 will approximately follow the GPCI transect – a transect that spans the transition from cumulus to stratocumulus and is used for model comparisons.

The round-trip from Long Beach to Honolulu and back takes approximately 2 weeks. So the AMF2 will make the trip approximately 25 times carrying instruments to study clouds, aerosols, radiation, and standard meteorological parameters.

Green Ocean Amazon 2014 (GOAmazon2014)

GOAmazon2014 will see many of the same instruments deployed for TCAP – again including the AMF1, the G1 and the MAOS – but now in the Amazon rain forest near the inland city of Manaus.
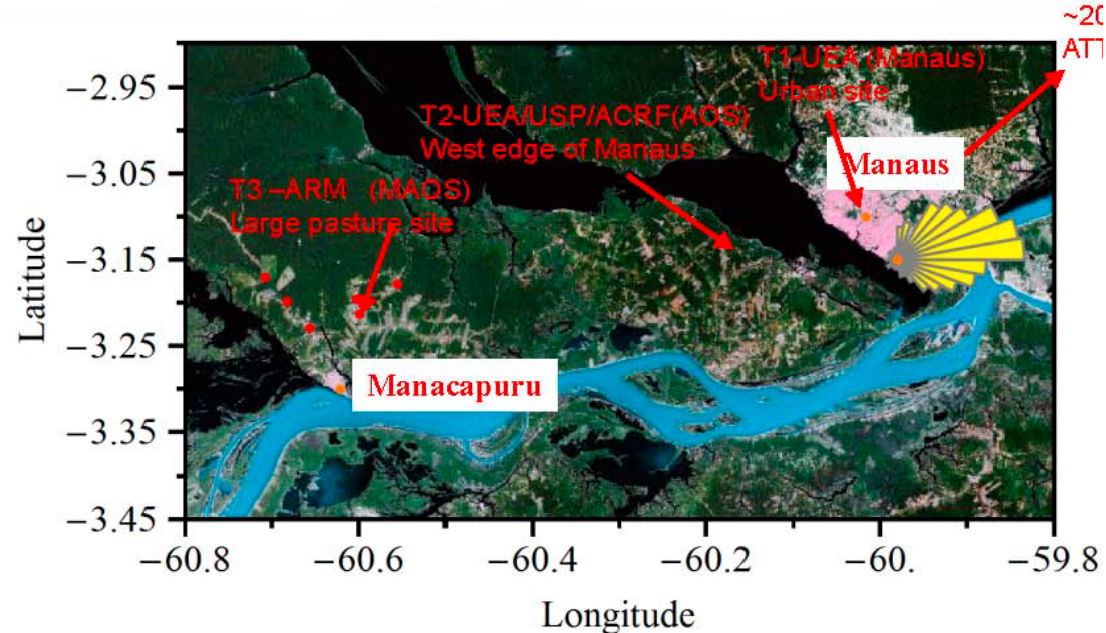
GOAmazon will further bring bring together scientists studying diverse disciplines including aerosol chemistry, tropical convection, surface biological processes and modeling of these diverse systems.

GOAmazon2014 is scheduled to span the full calendar year 2014.

Overview: Data Products
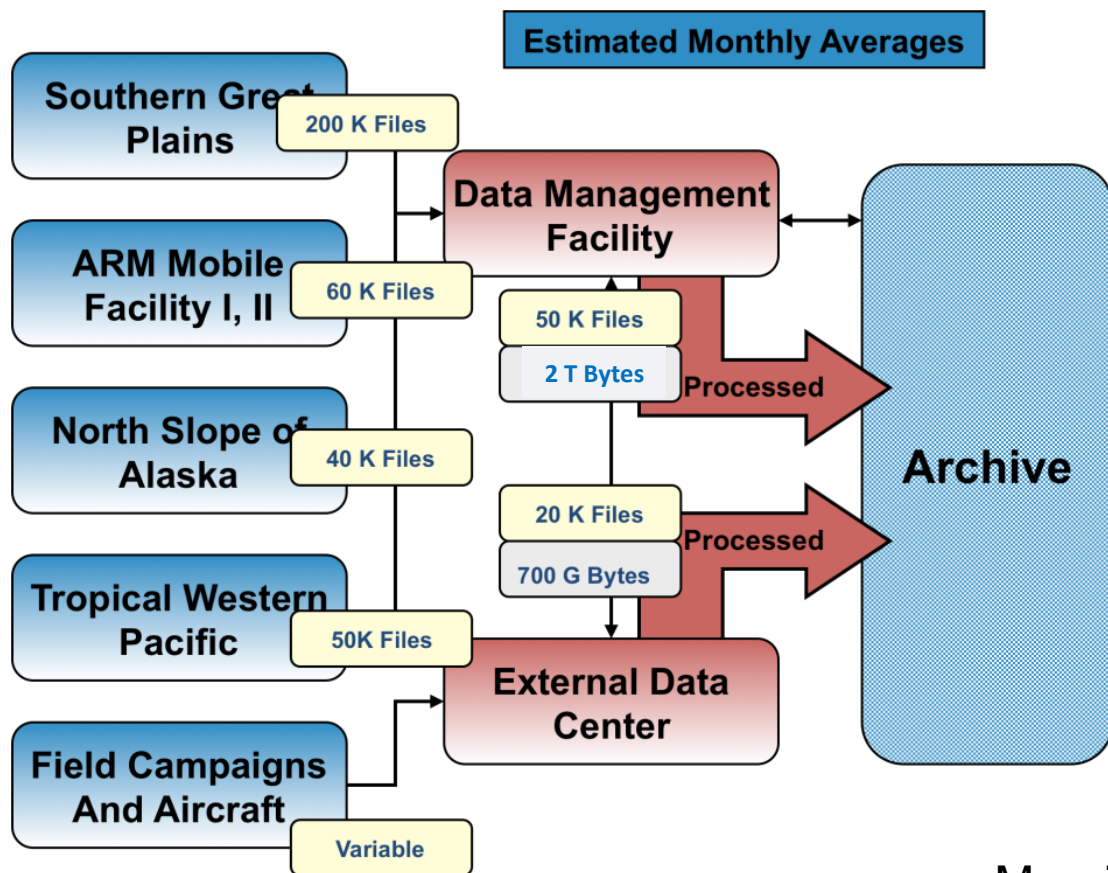
Most instrument data are processed to a standard NetCDF format before being delivered to the Archive.

When necessary, higher-order Value-Added Products (VAPs) are developed. VAPs serve a variety of purposes including:

- Merging data from multiple instruments
- Providing derived parameters
- Adding QC/QA information

Value Added Product Stages

Stage 0: Initiation	Stage I: Development	Stage II: Evaluation	Stage III: Release
Idea reviewed for merit	Programming begins	Provide metadata information	Implement and meet standards
Recommendation leads to prioritization	Regular progress review (3-month maximum)	Provide minimum data/plots	Create documentation
Team identification	Internal testing and quality control	Data evaluation by beta	Release code to operations
Implementation plan	VAP manager monitoring	Decision to: continue evaluation or	Run process in operations and process historical data
Submit Engineering Change Request/Order	Decision to begin user evaluation		

development

release

terminate

Key Contacts for New Datastreams

Working Group Chairs

- Cloud lifecycle: Matthew Shupe, Anthony Del Genio
- Aerosol lifecycle: Allison McComiskey, Jian Wang
- CAPI: Dave Turner, Steve Ghan

Translators

- Observation: Mike Jensen, Connor Flynn, Sally McFarlane
- Modeling: Shaocheng Xie, Jerome Fast

Program Contacts: http://www.arm.gov/about/contacts

People Database: http://www.arm.gov/people

Data Archive

- The Data Archive collects and delivers about 10-15 terabytes of data per month (400K -1,000K transactions!)
- Nearly 7000 registered users from over 15 U.S. agencies, 475 universities, and 71 countries
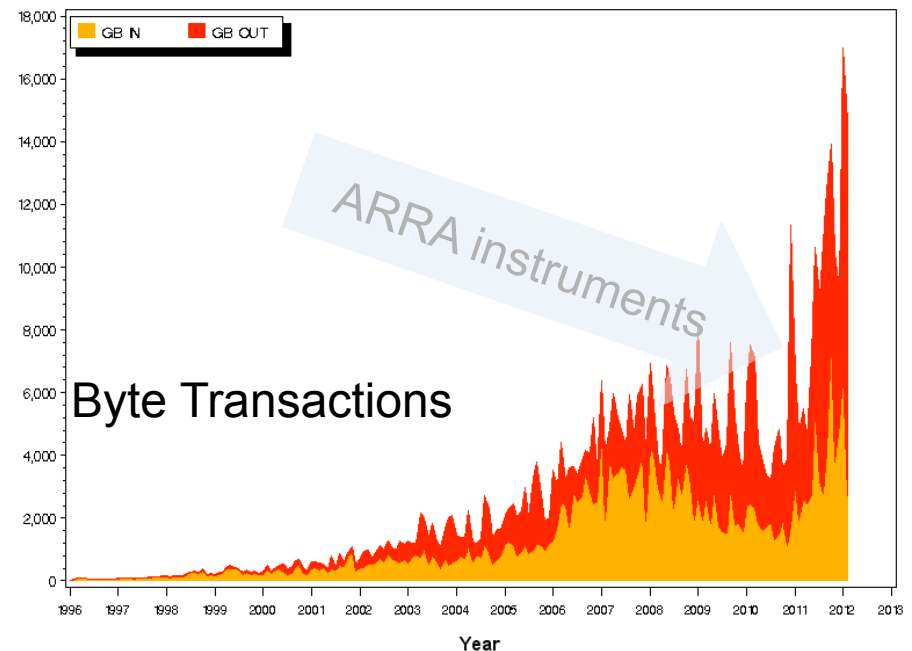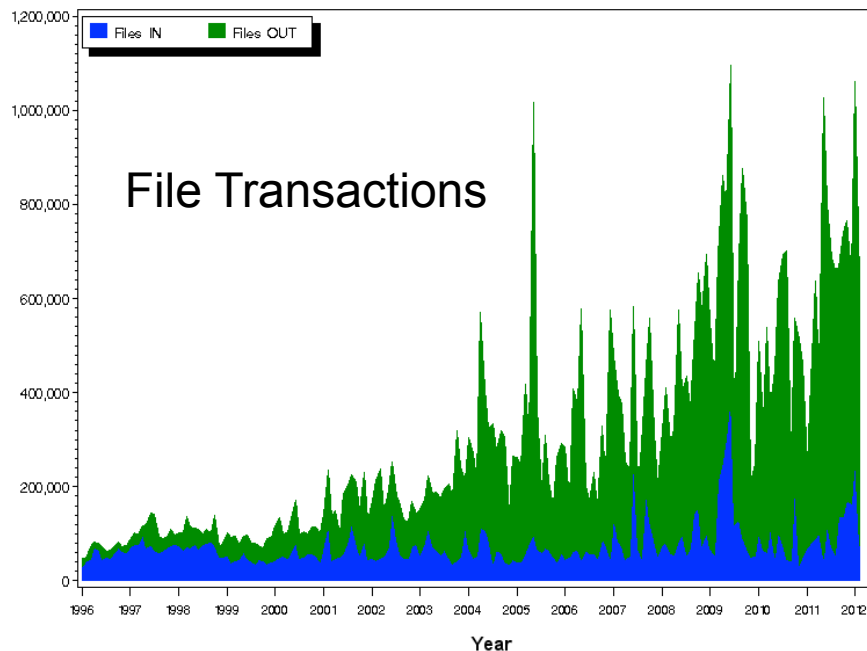
File Transactions

Byte Transactions

ARRA instruments

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How do I ...

- Find a datastream
- Order a datastream
- Read a NetCDF file
- Cite ARM data products
- Visualize very large data products
- Review data quality information and measurement recommendations

Navigating ARM Web "space"
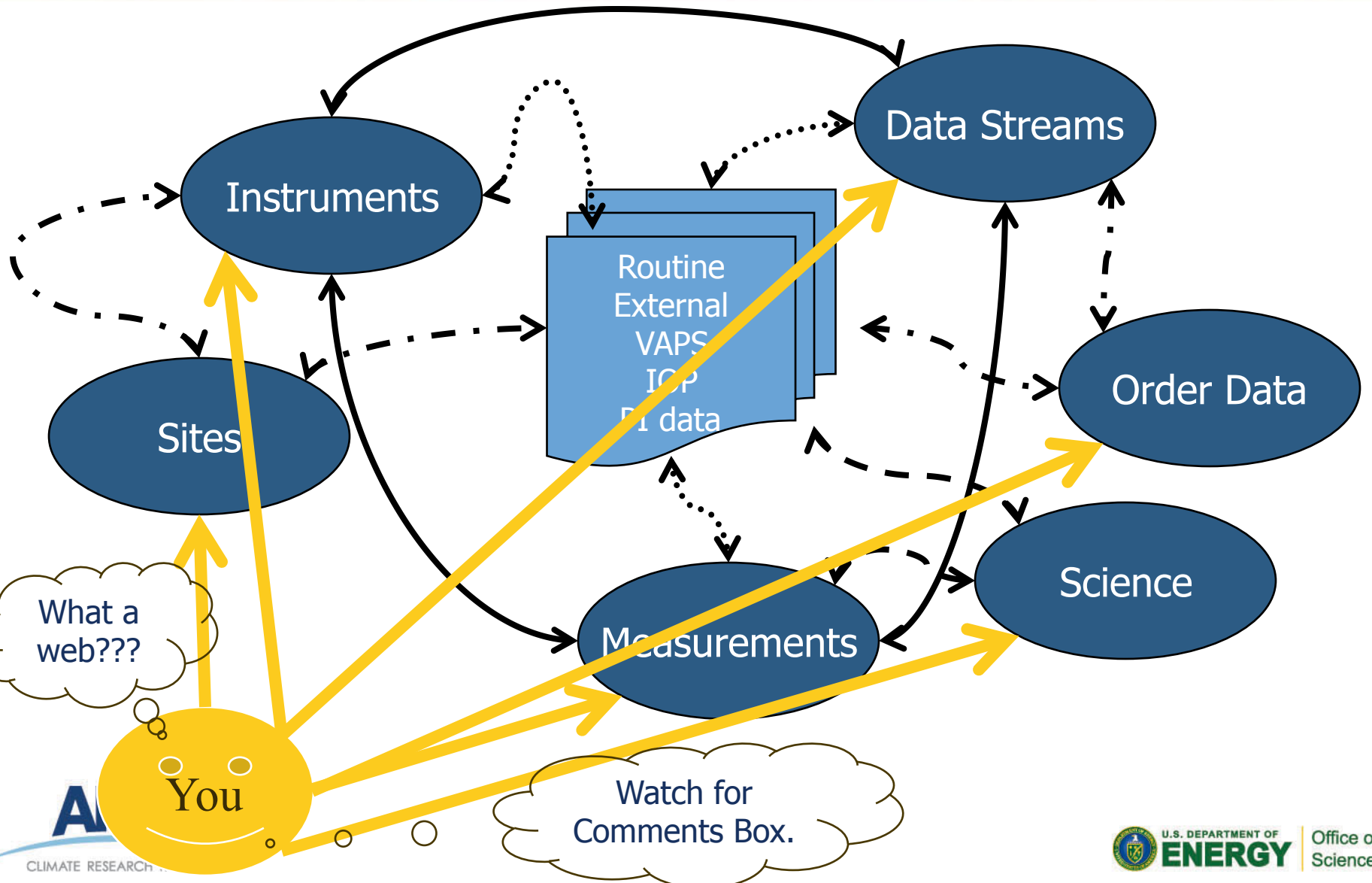
How Do I Find a Datastream for a Specific Measurement?

Each measurement page lists the datastreams that include that measurement. Click the datastream name for more information or click Build an Order.

How Do I Find a Datastream for a Specific Instrument?

Each instrument page lists the datastreams associated with that instrument.

You can click on a datastream name for more information, or click "Build an Order" to begin ordering data.

How Do I Find a Datastream by Name?

The Datastreams A-Z page lists all datastreams in alphabetical order by full name.

To access this page, select **Datastreams** under the **Data** tab on the ARM website.

Comparison of Interface Options

Data Browser	Routine ARM data	*"I know what I want. Do you have it?"* Searching with predefined selection criteria.
Thumbnail Browser	Most routine ARM data	*"I will know what I want when I see it."* Searching with a combination of predefined selection criteria and visual review of data plots
NCVWeb	Routine ARM Data	*"I want to see my own data plot."* Interactive data plotting tool with visualizing, extracting, statistics generation capabilities.
"IOP" Data Browser	IOP, PI, Showcase and beta data	*"I need to look in the odd parts bin."* Direct access to IOP data. Navigate /year/site/iop directory tree. Also use narrow Google search.
Data Cart	Routine ARM data and some IOP data	*"I need to read about what you have, then I will decide."* Discover areas of interest by browsing the ARM web documentation and collect items of interest.

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Typical Logic behind Data Access Tools

Identify "data of interest" (answer questions)

Display summary results from search (# files, # DQRs, # QLs)

Display detailed information (file list, DQRs, color map, QLs)

Order files

Data extraction
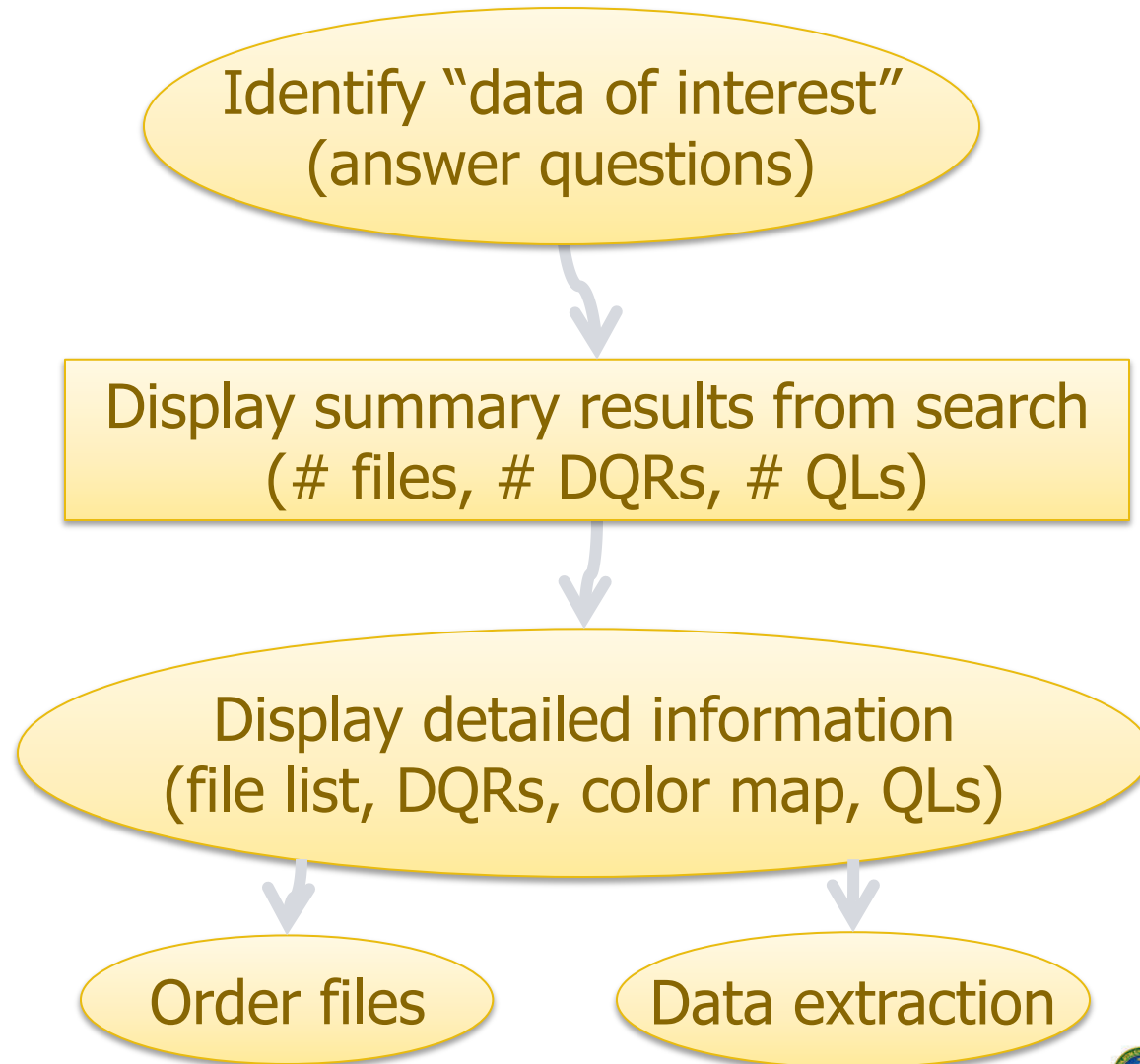
Who are you?
Who wants to know?

- Archive users must register.
- Notification helps you with data access.
- ARM infrastructure is a "National User Facility"
  - provides access to extra budget!!
  - OMB requests User Facilities to report user statistics for several "demographic categories"
- Some personal information is required*
  - *personal information is not reported individually and is accessible only to Archive staff after entry

How do I Order Data?

Use one of several Archive User Interfaces to find and order data.

OR

Use "Build an Order" function on several types of ARM web pages.

32

How do I Order Data?

Use "Build an Order" function on several types of ARM web pages

OR

one of several Archive User Interfaces to find and order data.

http://www.archive.arm.gov/

How Do I Read NetCDF Data?

NetCDF is an open source, self-describing, scientific data format. There are many tools available to read NetCDF. See a partial list on the ARM web data tab: www.arm.gov/data/tools. Further details are available at the Unidata NetCDF website.

Supported languages include:
C, C++, Fortran,
Matlab, IDL,
Python, Java, R, …

If you have questions – Ask! There is a lot of experience around the program.

www.unidata.ucar.edu/software/netcdf

How Do I Cite Data? *(new: DOIs!)*

- Digital Object Identifiers (DOIs) now assigned for each type of data stream.

- References for future replication of data access should include:

  - site, date range, and date downloaded from Archive

- Additional guidance on DOI is found at

  - http://www.arm.gov/data/docs/doi-guidance
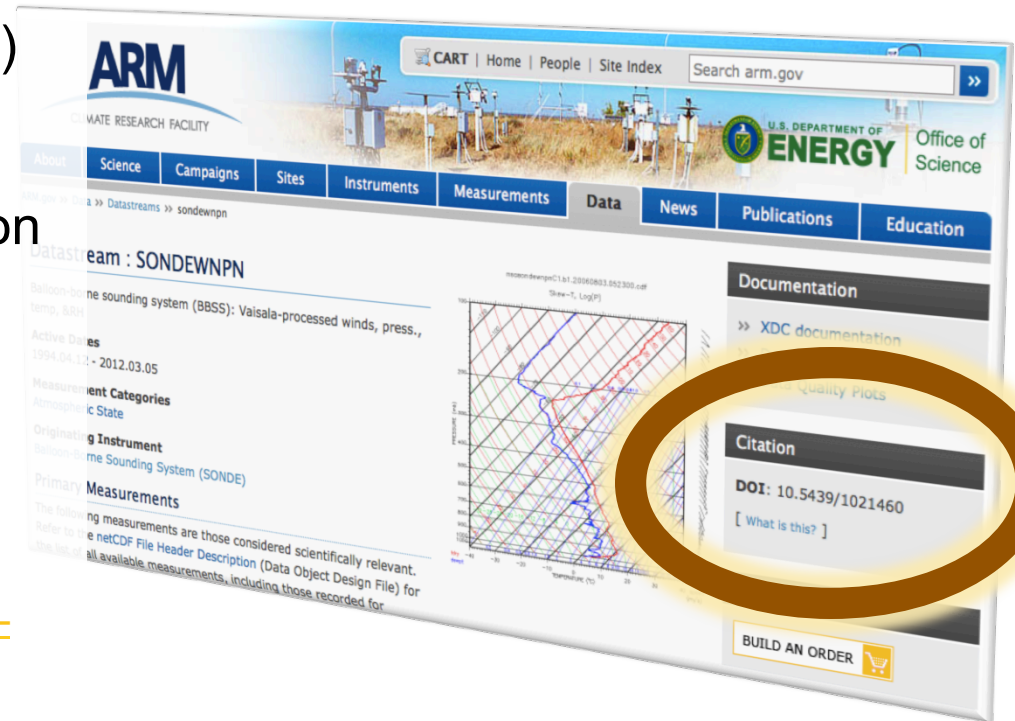
Sample Citation:
Atmospheric Radiation Measurement (ARM) Climate Research Facility. 1994, updated daily. SONDEWNPN. Oct. 2010–March 2011, 36° 36' 18.0" N, 97° 29' 6.0" W: Southern Great Plains Central Facility (C1). Compiled by R Coulter, J Prell, M Ritsche, and D Holdridge. Oak Ridge, Tennessee, USA: ARM Data Archive. Data set accessed 2011-04-13 at http://dx.doi.org/10.5439/1021460.

Come see Giri's poster!
Feedback wanted!

35

Visualize Very Large Data Products

- **Interactive visualization cluster at ARM Archive**
  - Designed for data analysis and visualization
  - NX client for remote access to Linux desktop
  - requires registration and limited authentication
  - ~15 TB of online radar data (and growing)
  - IDL, MATLAB, VisIt, Python/ PERL modules (Others?)
    www.archive.arm.gov/cluster.pdf

- **Other Archive Computing Clusters**
  - Batch data processing system
  - ARM GPU system
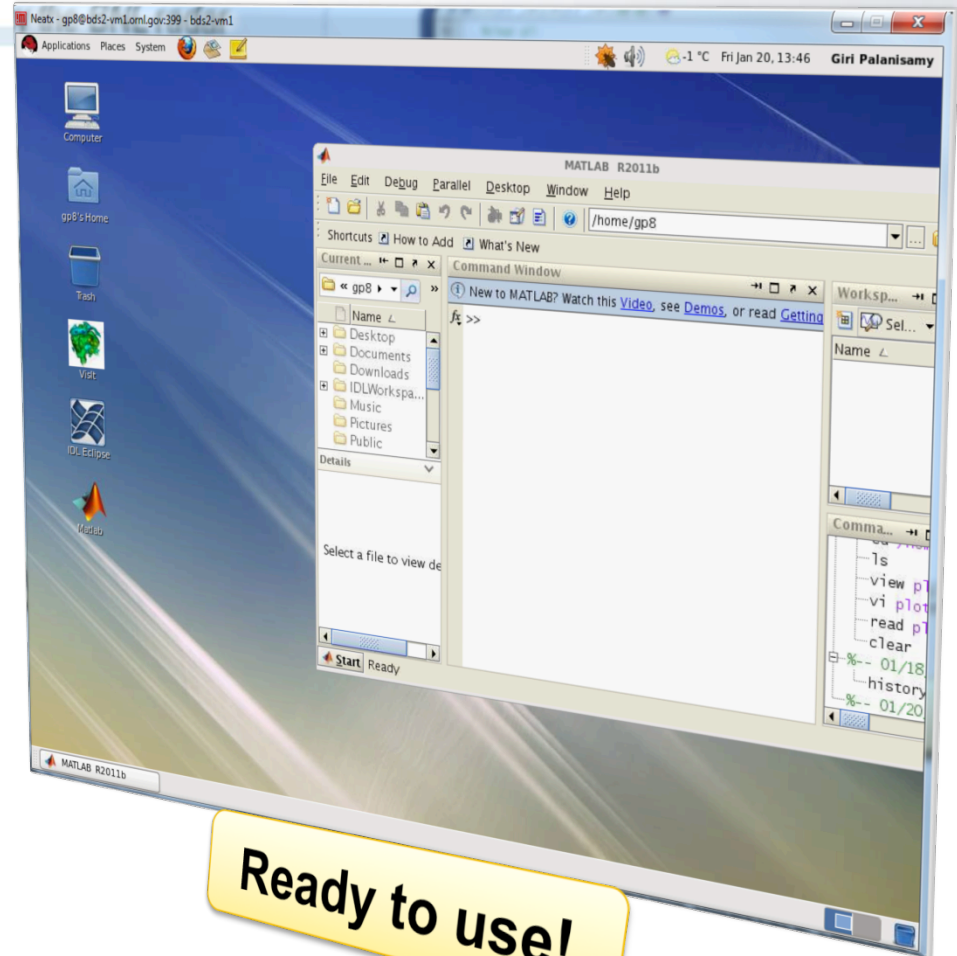
Ready to use!

Request Access: Contact ARM Archive (armarchive@ornl.gov, 1-888-ARM-DATA)

36

Data Quality Assessment

The assessment of data quality is managed by the ARM Data Quality Office
http://dq.arm.gov/

Types of Quality Information
- Automated products
  - QC flags
    - inserted in data files during processing
  - Summaries of flags (data color)
- Manual products
  - Data Quality Reports (DQRs)
    - web accessible reports
    - delivered as HTML files with data requests AND delivered retrospectively when created
    - event driven and problem-based
  - Instrument Mentor Monthly Summary Reports
    - web accessible; linked to instrument web pages
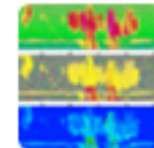
DQ HandS
- QC Metrics and Plots
- Plot Browser
- DQ wiki

NCVweb
- Interactive Data Plotting

DQ Reports
- Search All Reports
- DQ Assessment Reports
- Report Findings

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Recommended Measurements Discovery Tool

- **Many redundant ARM measurements**
  - ~5200 primary types
  - (e.g., 70+ air temp)

- **Web application focused on recommended sources for core physical quantities**
  - A short list (~40)

- **Discovery tool identifies data products defined by:**
  - Primary, secondary, tertiary sources
  - Measurement type
  - Measurement categories
  - Availability by location

- **And displays links to:**
  - Data product descriptions
  - Measurement descriptions

See Dale Kaiser (Wed. Posters)
Feedback needed!!

38

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How Do I Submit a Research Highlight?

Research Highlights are an efficient way to exchange results with your colleagues. They're used in annual reports and other high-level documents, as well as in program reviews and outreach materials.

http://asr.science.energy.gov

To access the Research Highlights Submittal Form:
1. On the ASR website, click **Science**.
2. Click **Research Highlights**.
3. Click **Submit a Highlight**.

How Do I Submit a Research Highlight?

Select or submit up to two associated publications.

Select your area of research and ASR working group.

Enter the title and use the Look Up button to select up to two contacts.

Indicate if funded by ASR or ARM and if ARM data was used

Enter the Introduction, Main Discussion, and Conclusion.
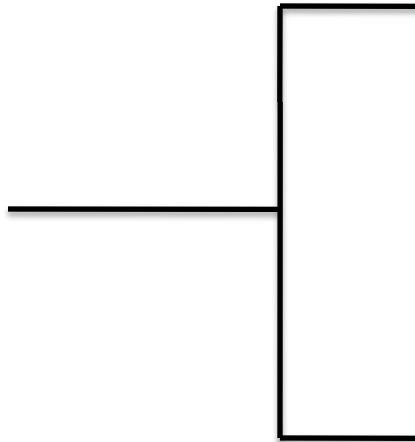
You can enter up to two images with captions, but they are not required.

Journal or Book Reference(s) (if applicable): (Look Up)
Your reference from the Publications Database. Limit two references. If you have not submit the references, please (Add) it now.

Area of Research:
Radiation Processes

Working Group:
Aerosol Life Cycle
Cloud Life Cycle
Cloud–Aerosol–Precipitation Interactions

(To select more than one, shift+enter.)

Title of Highlight:

(There is a 95 character limit.)

Who is submitting this highlight? (Look Up)
(Limit two contacts; contributors will be visible in the journal reference.)

Funding Source: ASR Funded ○   ARM Funded ○   Both ●
                        Neither ○

Did you use ARM Data or Facility?:   Yes ●   No ○

Please limit the total of your introduction, main discussion, and conclusion to 5000 characters (this includes blank/white spaces). If you would like to include scientific characters or any other special characters, please use the ISO 8859-1 standard for HTML conversion or spell it out. For assistance with characters conversion, contact the administrators.

Introduction:

Main Discussion:

Conclusion:

Images: (optional)
Only images in JPEG, BMP, GIF, or PNG can be accepted up to **10 Mb**. The image caption is limited to 500 characters.
Read the "Tips and Tricks" before uploading multiple images to Research Highlights.

IMAGE1: [   ] Browse.. Image Caption: [   ]
IMAGE2: [   ] Browse.. Image Caption: [   ]

Submit   Reset

ARM
CLIMATE RESEARCH FACILITY

How Do I Submit a Field Campaign Request?

- First, review the guidelines for submitting proposals.

- Next, submit a preproposal; a short summary of the proposed campaign.

- Wait for a response from the Infrastructure Management Board (IMB) and/or ARM Science Board.

- A full proposal or science plan may be requested.

How Do I Stay Connected?

- **ARM News Center**
  http://www.arm.gov/news/

- **Facebook**
  http://www.facebook.com/arm.gov

- **Twitter**
  http://twitter.com/armnewsteam
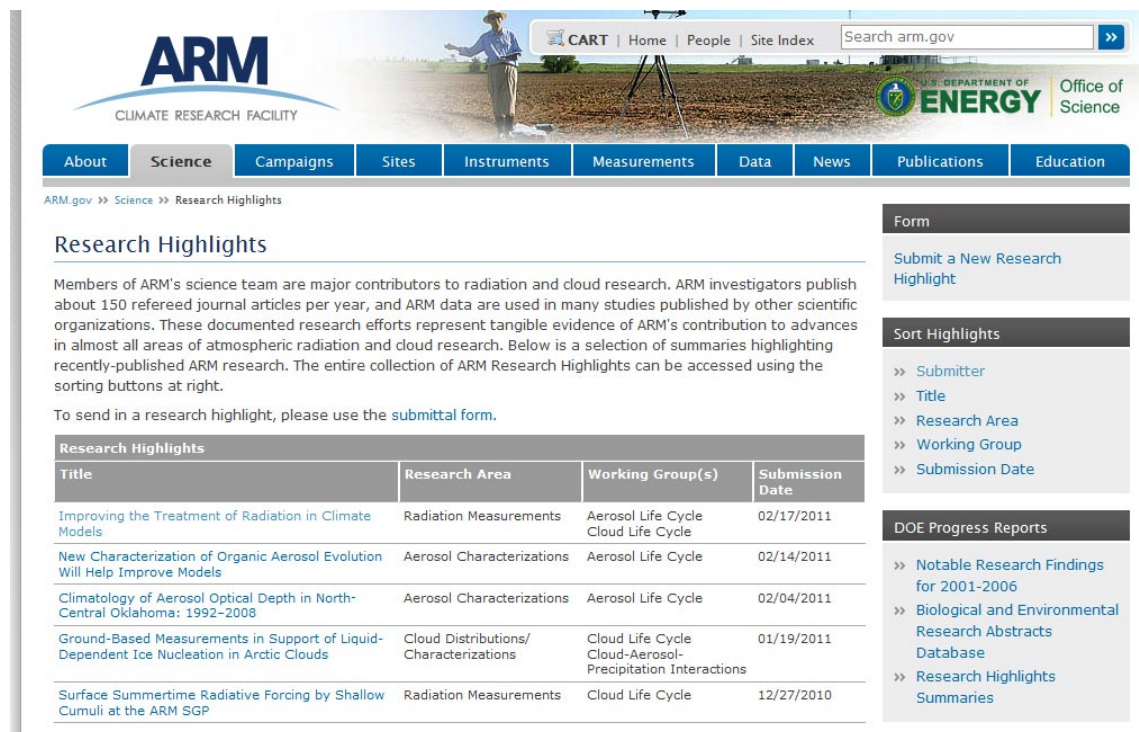
How Do I Stay Connected?

- Research Highlights
http://www.arm.gov/news/research or
http://www.arm.gov/science/highlights

44

How Do I Submit a Question?

http://www.arm.gov/

- Data/instrument issue
  - Use comment box on their web pages
- General questions
  - Go to Contacts page, linked off of every web page
- Needed measurement suggestions
  - Contact any SISC member or send it in through the web on the Contacts page

For More Information on ARM

- Description of sites, instruments, data

- Upcoming campaigns

- Science highlights

- ARM News (subscribe to RSS feed)

- Wiki pages

- Provide Feedback

- Contacts

Visit the ARM website:

http://www.arm.gov

Or visit us on Facebook, Twitter, or YouTube

For More Information on ASR

- Description of program goals
- Description of working groups
- Science highlights
- Meeting information
- Links to ARM resources
- Contacts

Visit the ASR website:

http://asr.science.energy.gov/

ARM User Survey

Does ARM Data Meet Your Research Needs?

- To help us understand how you, the ARM user community, interact with ARM data, we invite you to take our short survey. Your answers to this survey are very important, as they will guide improvements to the pathways for finding, ordering, and delivering ARM data and improving the communication of data quality information.

See email from February 22

Survey will remain open through March 23