ARM User Facility Updates

JENNIFER COMSTOCK, NICKI HICKMON, GIRI PRAKASH, AND JIM MATHER

ARM ASR PI Meeting August 07, 2023

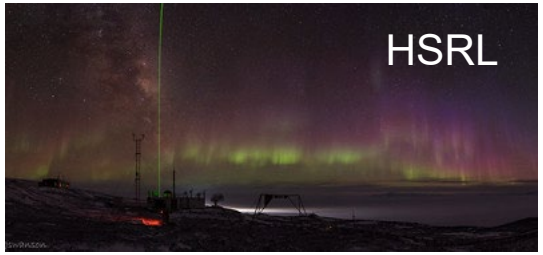
Capabilities and Science Products Update

JENNIFER COMSTOCK

ARM Associate Director for Research

New Measurement Capabilities

- Cloud radar upgrades (Ka-band zenith radar)
  - Extended Interaction Klystrons (EIK), antennas, vector analyzer, traveling wave tube power supplies
- High Spectral Resolution Lidar (HSRL) – AMF3, NSA
- Expansion of aerosol & trace gas measurements
  - North Slope Alaska – partnership with NOAA
    - Black carbon concentration & size distribution
    - Coarse mode aerosol size distribution
    - Aerosol composition & concentration
  - Coarse mode aerosol – ENA, AMF2 and AMF3
  - Calibration equipment
  - Trace gases
- AMF3 BNF – Tower and supplementary sites

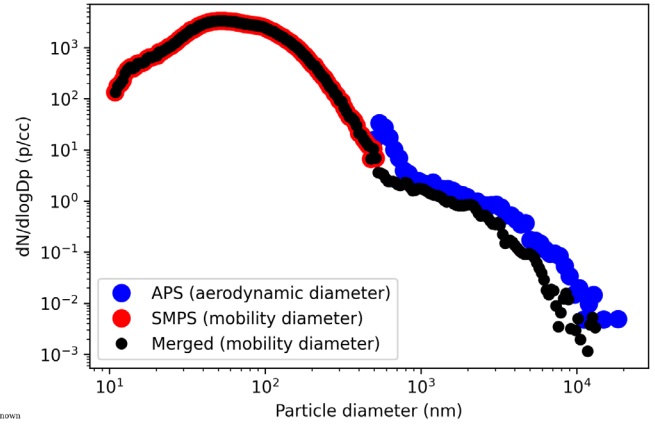


Aerosol Observing Systems

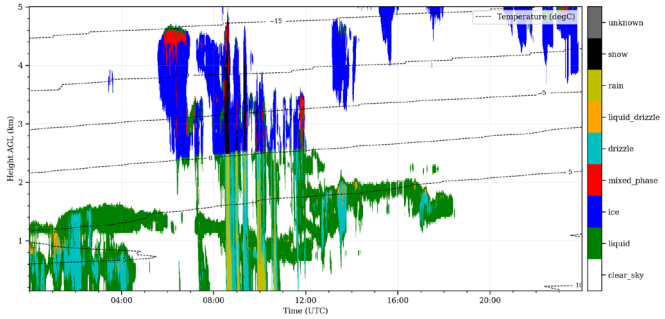
Science Products Updates

- Aerosol Processes (John Shilling)
  - Merged Aerosol Size Distribution – ML QA/QC
  - Kappa – hygroscopicity parameter
  - CCN Profiles
- Boundary Layer Processes (Damao Zhang)
  - Planetary Boundary Layer Height
  - AERI based thermodynamic profiles
    - Transition AERIoe → TROPoe
  - Cloud Thermodynamic Phase
- Precipitation Products for SAIL (Scott Collis)
  - Gridded X-band radar products
  - Quantitative snowfall estimates

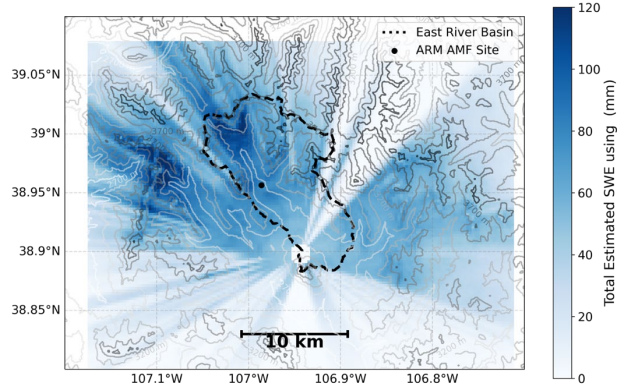
Aerosol Size Distribution



Thermodynamic Cloud Phase

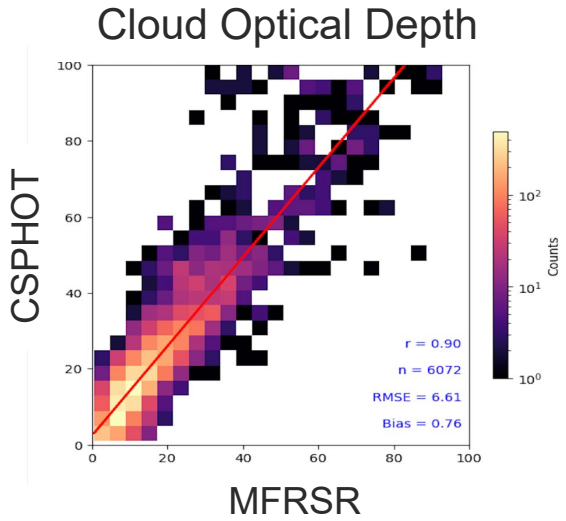


Snowfall

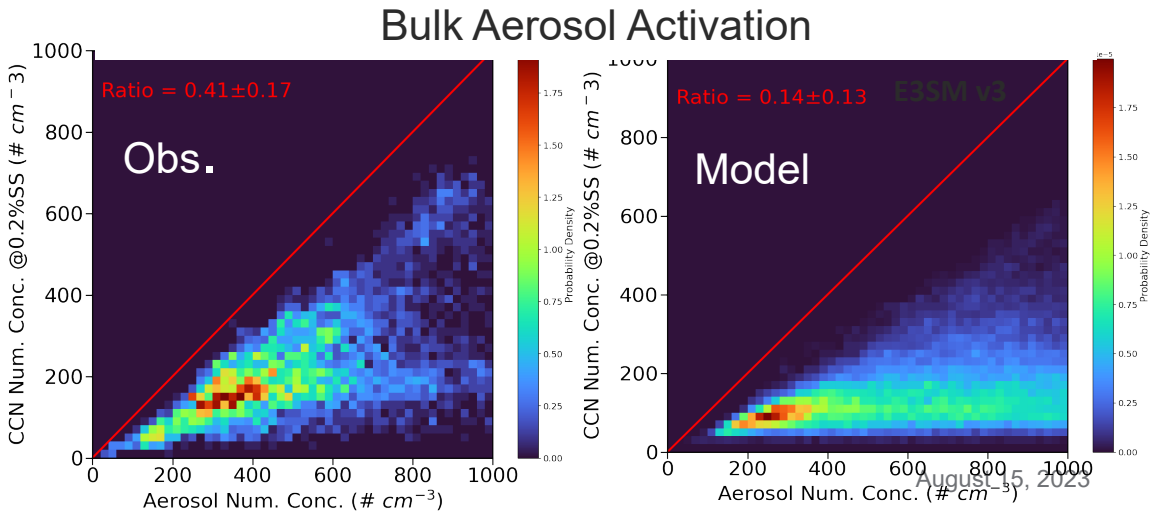


Science Products Updates

- Cloud Products (Scott Giangrande)
  - New cloud radar products
    - TRACER, SAIL, & EPCAPE
    - Cloud boundaries and layers (ARSCL)
    - Scanning cloud radar gridded products
  - Improved cloud microphysical retrievals
    - Radar: LWC, IWC, Effective Size
    - Sunphotometer - COD, drop R_{eff}, LWP



- Modeling Products (Shaocheng Xie)
  - ARM Process Oriented Diagnostics
    - Land-atmosphere interactions and aerosol-cloud interactions
  - Radar-Lidar Simulator – EMC^2
    - Sub-column generator for clouds & precip.



Community Engagement

Triennial Review Actions

- Develop outreach strategy with focus on modeling and satellite communities
- Develop metrics to assess ARM's impact on earth system model simulations

Outreach Activities

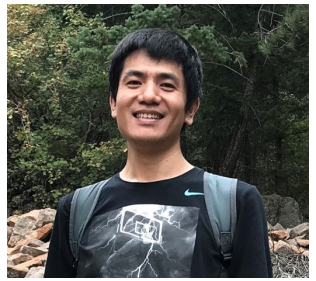
- Satellite community – NASA, JPSS
- European community – ACTRIS, EarthCARE
- Earth system modeling community
- ARM UEC subcommittee on facilitating communication with the modeling community

Outcomes

- Facilitate model evaluation
- Support ARM focused model intercomparisons
- Focus on key processes with biggest gaps – aerosols, ACI, land-atmosphere interactions
- Build case libraries around key evaluation efforts
- Develop additional simulator capabilities

New Hires and New Roles

- Data Analysts
  - **Peng Wu** – Cloud and precipitation properties, model-observation evaluation, satellite observations
  - **Israel Silber** – Cloud microphysics, remote sensing retrievals, instrument simulators
  - **Jingjing Tian** – Land-atmosphere-cloud interactions, radar and satellite remote sensing
  - **Sid Gupta** – Aerosol-cloud interactions, airborne measurements, meteorology
- New Lead Translator – **John Shilling**



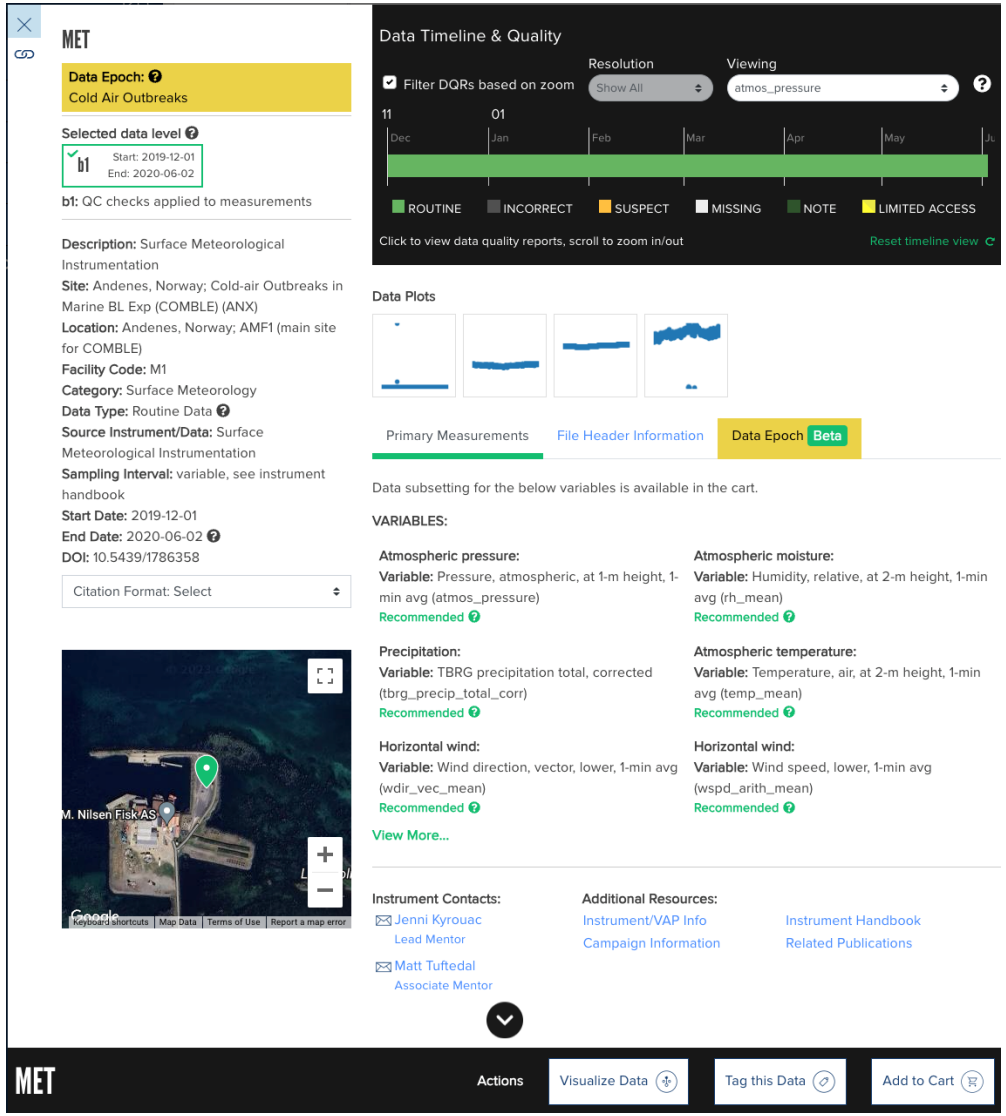
ARM Operations Updates

NICKI HICKMON

ARM Associate Director for Operations

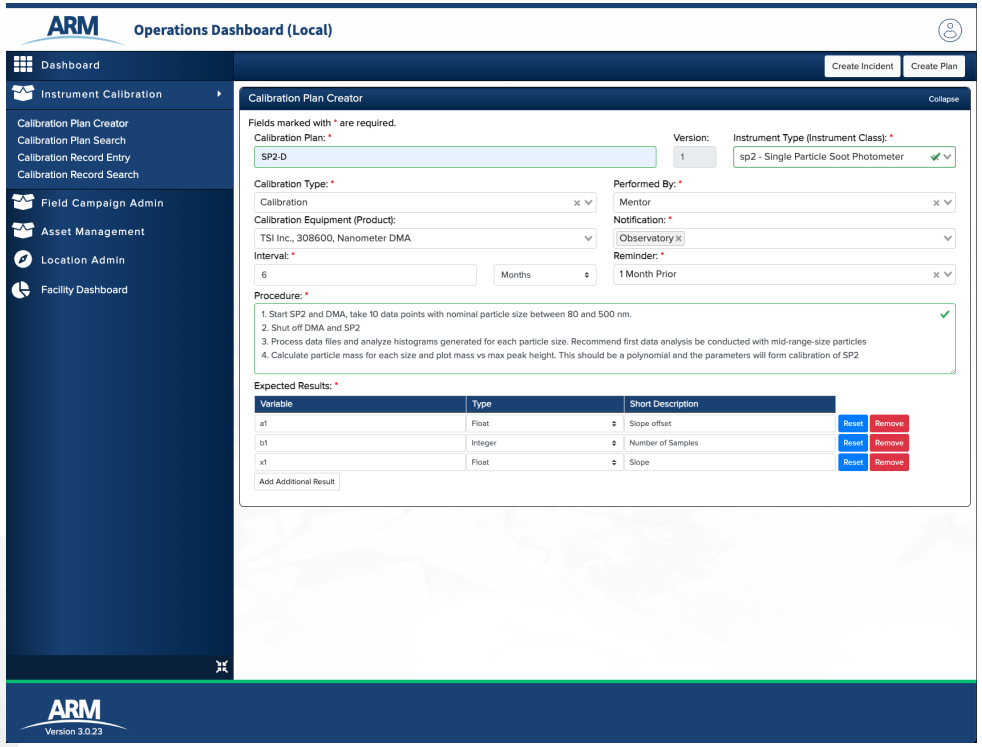
Tools For Future

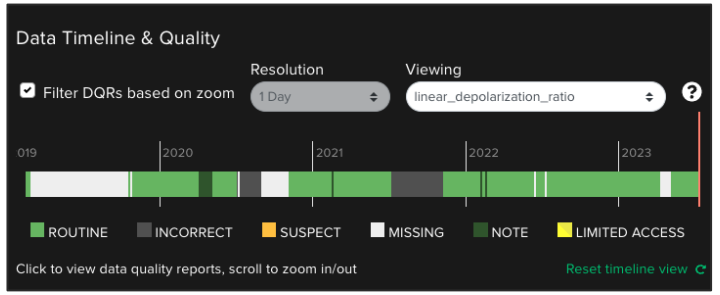
- ARM tool development is working to get each piece of this data efficiently captured for efficient propagation to all tools
- Future filtering and customization of information
- Interfaces for user, mentors, translators, management
  - Troubleshooting
  - Discovering
  - Monitoring
  - Data Analysis



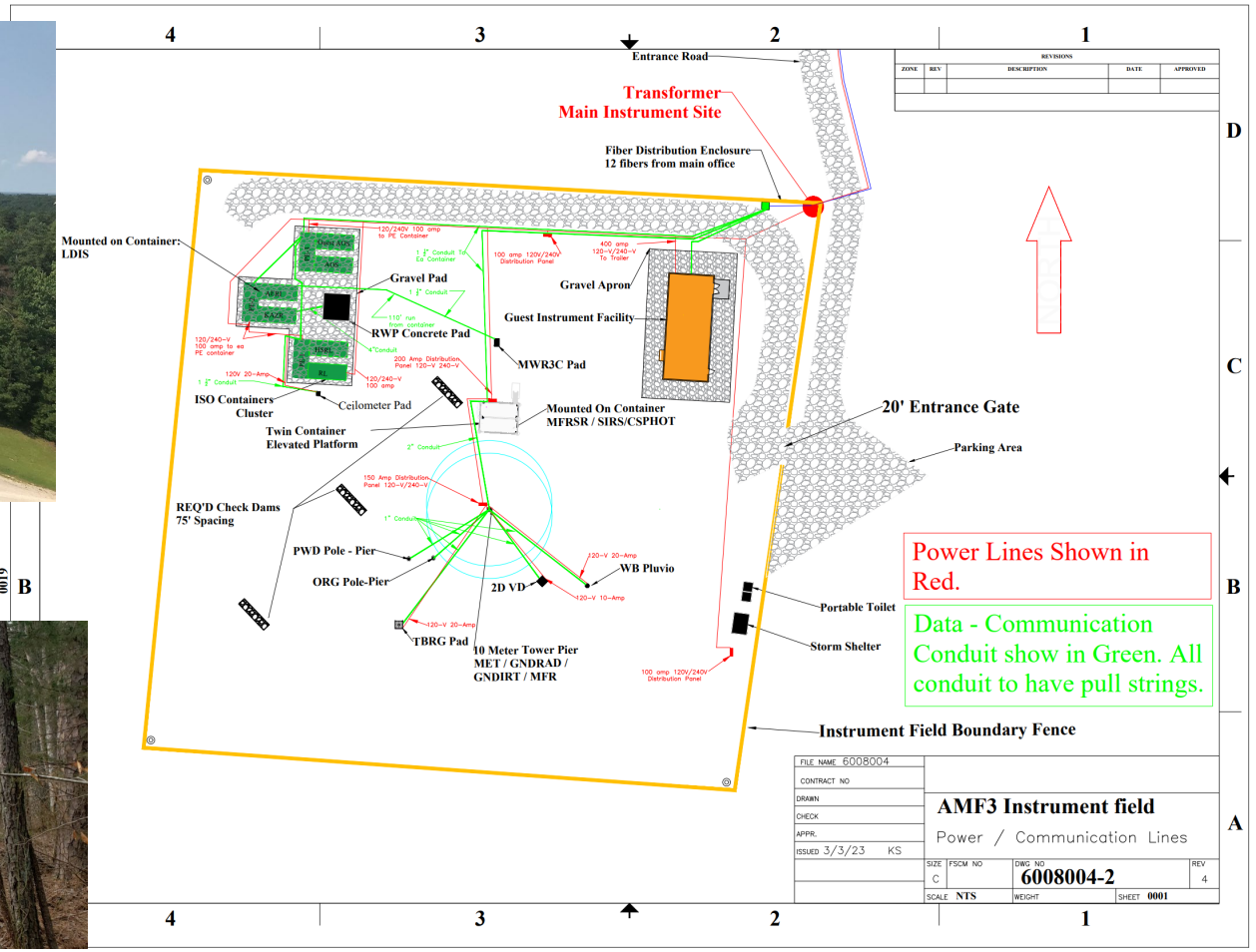
New ARM Calibration System

- Digitizing Calibration Plans
- Assigning Calibration Events to Assets
- Dissemination of Calibration Information
  - Data Discovery
  - Public-Facing Record Viewer
- Communication Strategy
  - Webpage
  - News Stories
  - Webinar





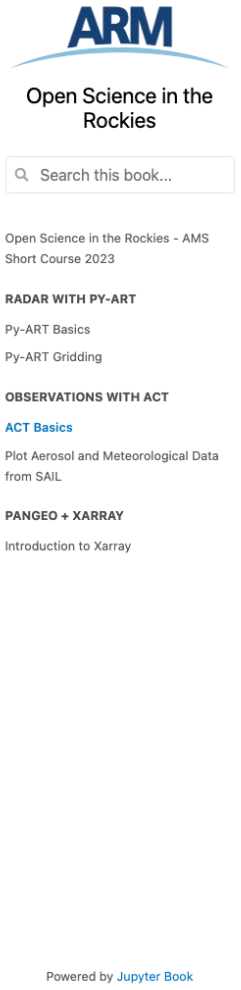
AMF3 Bankhead National Forest (BNF)

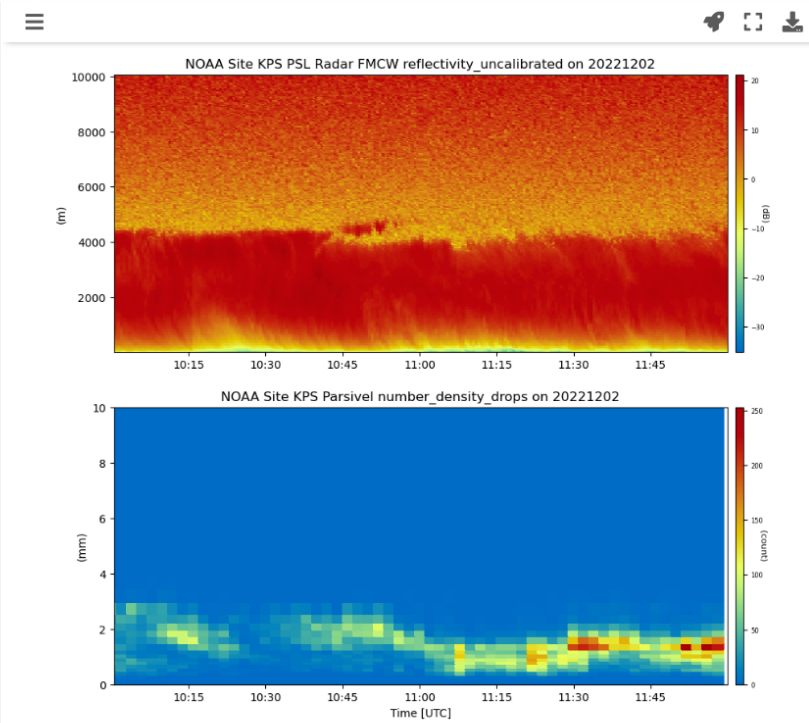


https://www.arm.gov/capabilities/observatories/bnf

Workforce Development Coordination

- Collaborative short courses, workshops, tutorials, and su
- Available & reusable educational material & examples
  - https://arm-development.github.io/ARM-Notebooks
- Past Events:
  - AMS Annual meeting short course
    Open Science In the Rockies (Dan Feldman)
  - AMS Radar Meeting: Open Radar Science
- Future Events:
  - AMS Annual Meeting
  - FY25 ARM summer school





In-Situ Precipitation Accumulation at the AMF2 site

```
username = 'armlive_training'
token = '6f097a7b99e39d19'

# Access the laser disdrometer data
laser_disdrometer_files = act.discovery.download_data(username=username,
                                                      token=token,
                                                      datastream="gucldM1.b1",
                                                      startdate="2022-12-02",
                                                      enddate="2022-12-02")

# Read the laser disdrometer data into an xarray dataset
laser_disdrometer_ds = act.io.read_netcdf(laser_disdrometer_files)
```

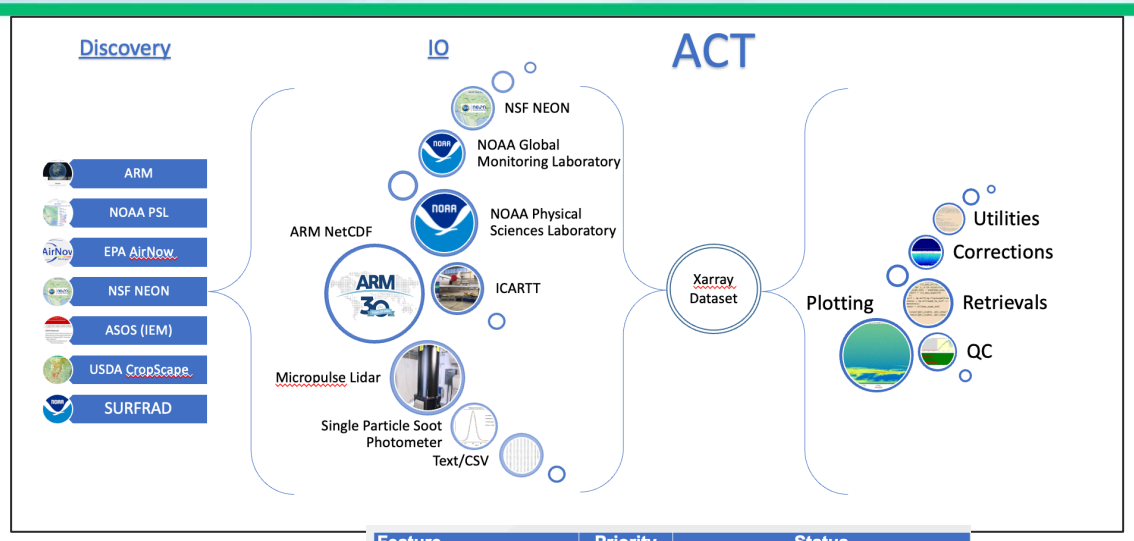
Open Source

https://github.com/ARM-Synergy
https://github.com/ARM-Development
https://github.com/ARM-DOE

- ARM data Community Toolkit (ACT)
- Python-ARM Radar Toolkit (PyART)
- ARM data-oriented diagnostics package for climate model evaluation
- ARM data integrator
- Camspec-air

Related Open Source Highlights

- PyFLEXTRKR (Python FLEXible object TRacKeR)
- EMC2 (Earth Model Column Collaboratory)
- tobac (Tracking and Object-based Analysis of Clouds B)



Feature	Priority	Status
Aircraft or UAS Related Functionality	High	Ability to read ICARRT data added but no work on visualizations or quality control yet
Retrievals	High	PBL Height using Heffter method SP2 retrievals using PySP2
Windows Compatibility ✓	High	Continuous integration tests running on windows VMs
ARM Data Surveyor ✓	High	Command line interface for basic ACT plotting now in ACT's scripts directory
Performance Improvements ✓	High	Implemented Lazy Loading to greatly improve import speed.
Statistics Tracking ✓	Medium	Logging daily statistics from GitHub traffic
I/O Improvements	Medium	NOAA, NEON, and SURFRAD readers were added but more could be done
Tutorial and Example Development ✓	Medium	New and improved example gallery with expanded examples
Discovery Improvements	Low	NOAA, NEON, SURFRAD, EPA discovery modules but more could be done
Visualizations	Low	Violin, scatter, and groupby plotting functionality added in but more is needed (Pie, interactive, etc...)

Table 1. Priorities and current status of tasks from the second ACT roadmap. ✓ indicates tasks that the ACT development team considers complete.

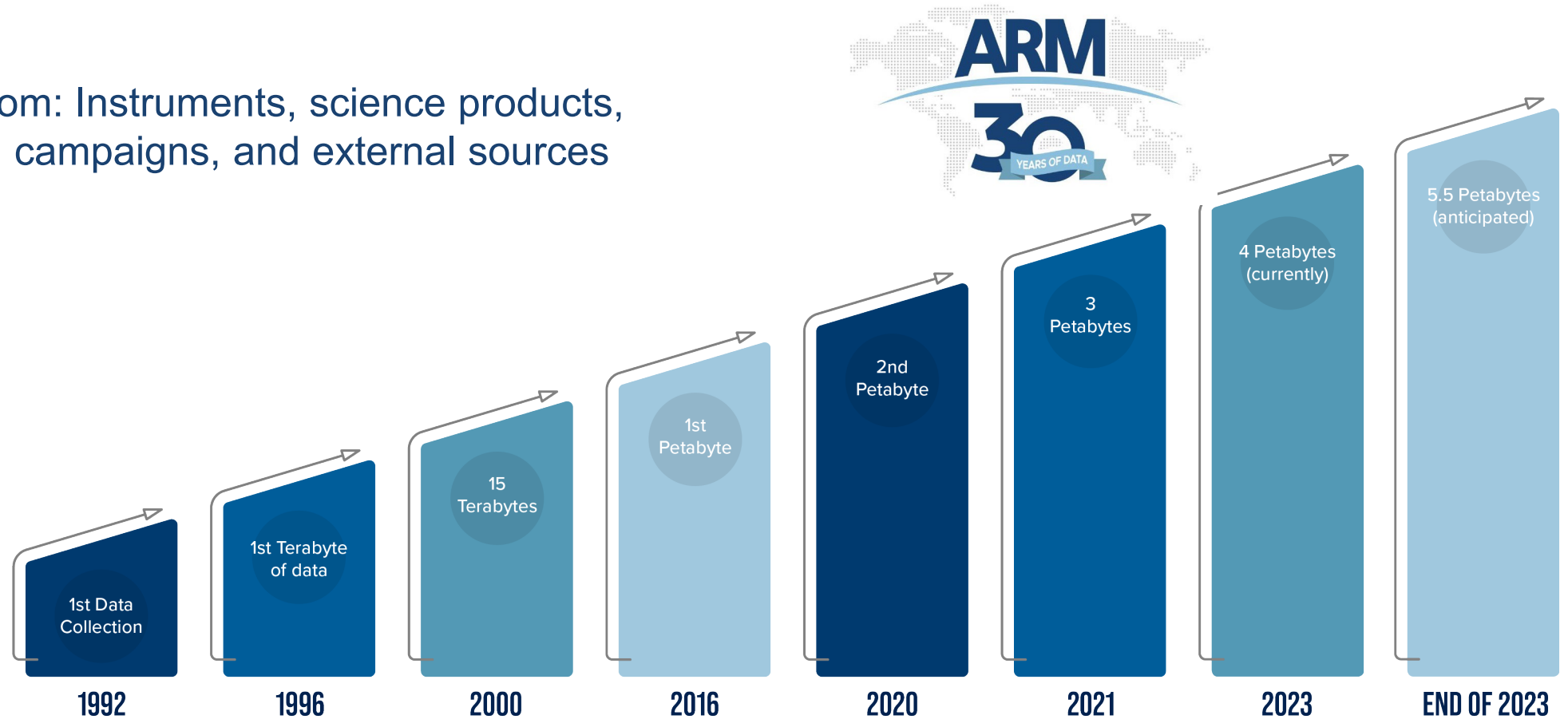
ARM Data and Computing Updates

GIRI PRAKASH

ARM Chief Data and Computing Officer

Data At a Glance

- Data From: Instruments, science products, models, campaigns, and external sources

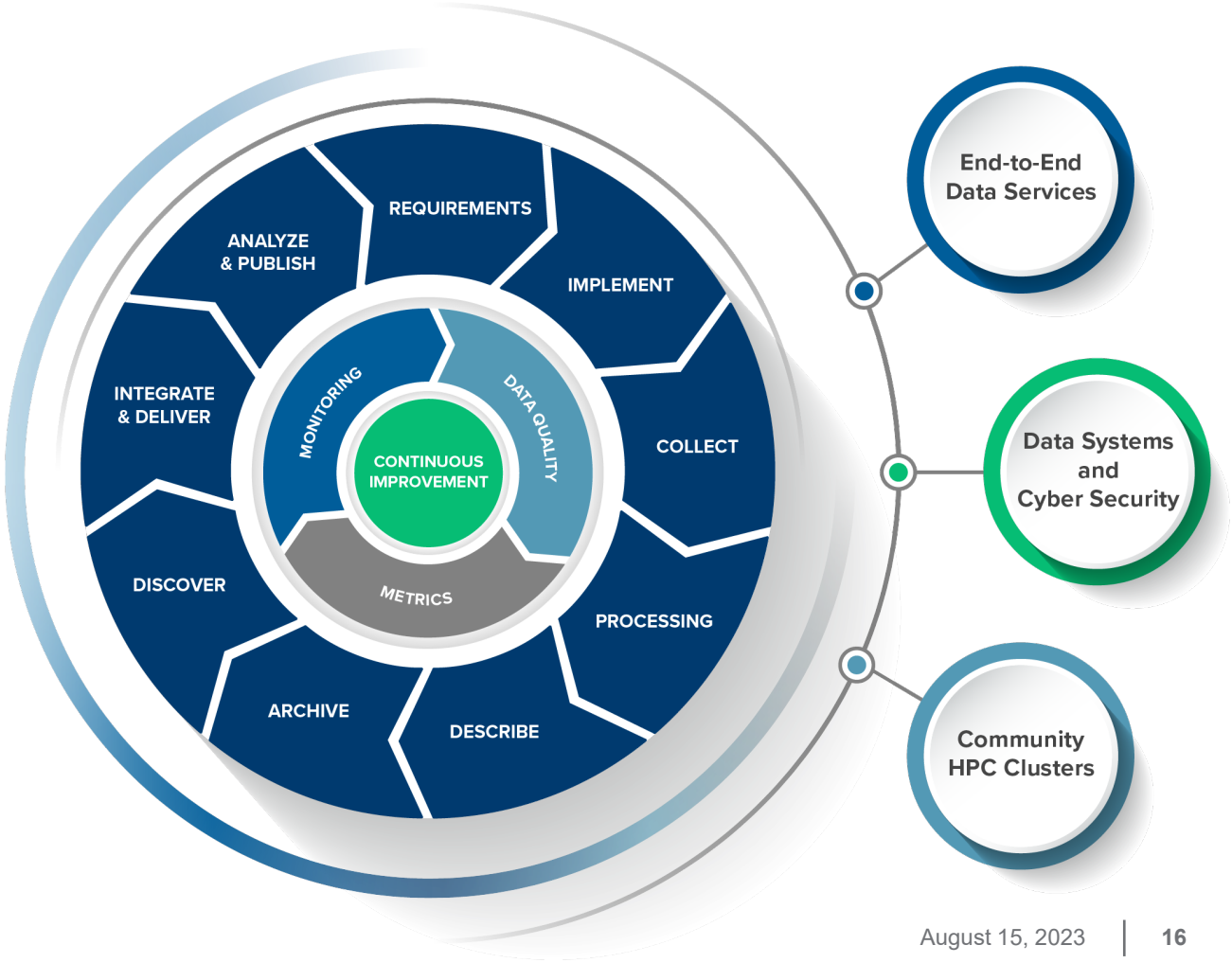


ARM Data and Computing Services

The ARM Data Services, is an integrated data, software, and computing ecosystem designed for scientists, users, and operations

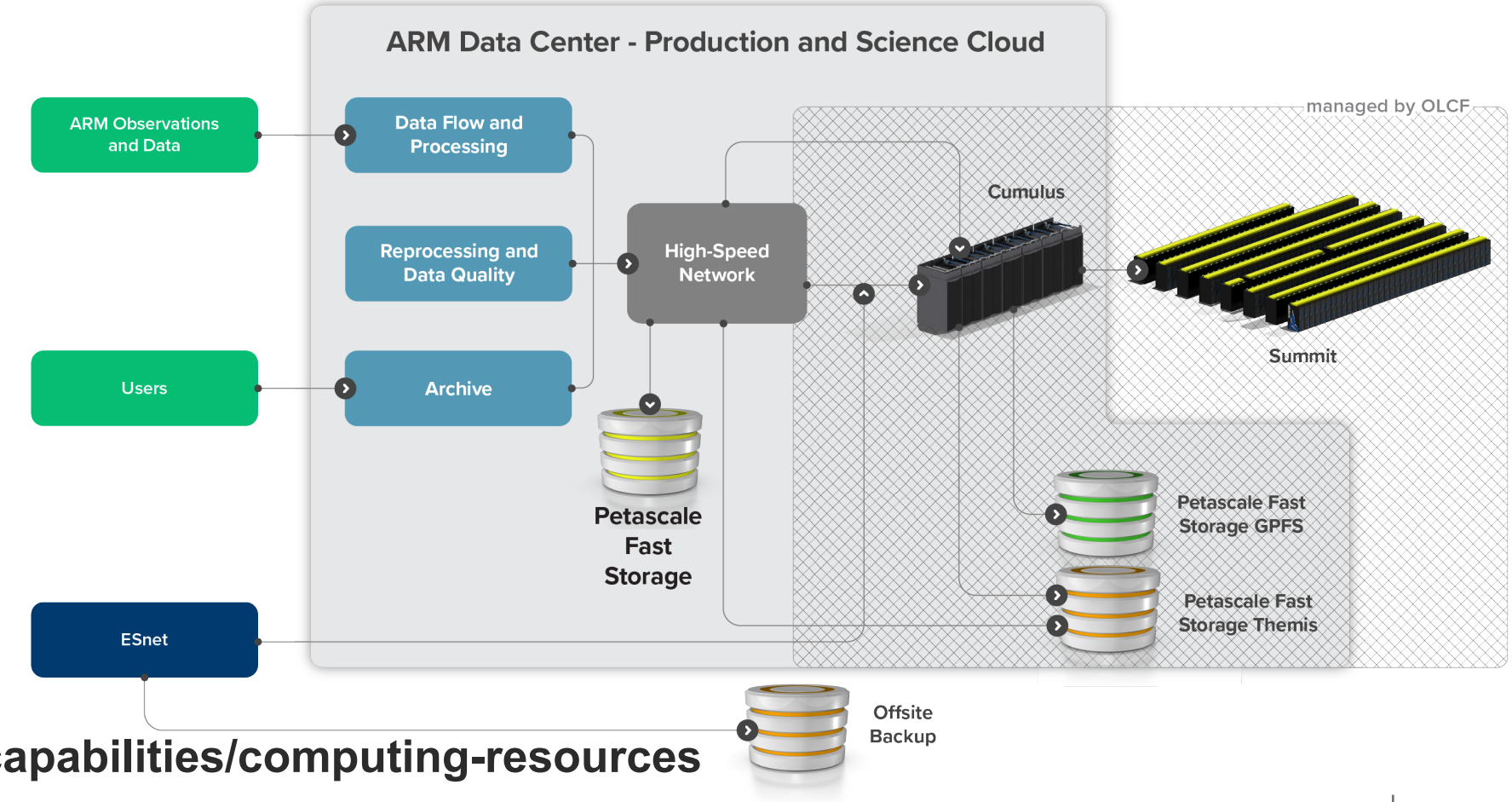
Continues improvement of:

- Data flow operations and monitoring
- Data Processing and Archival
- Data Interoperability:
  - Advanced strategies for utilizing metadata
  - Data Discovery & Data workbench
  - FAIR, Standards, and Protocols
- High-performance computing (HPC)
- User Management and Citations
- AI-based approach in data management



ARM Computing Capabilities - Cumulus

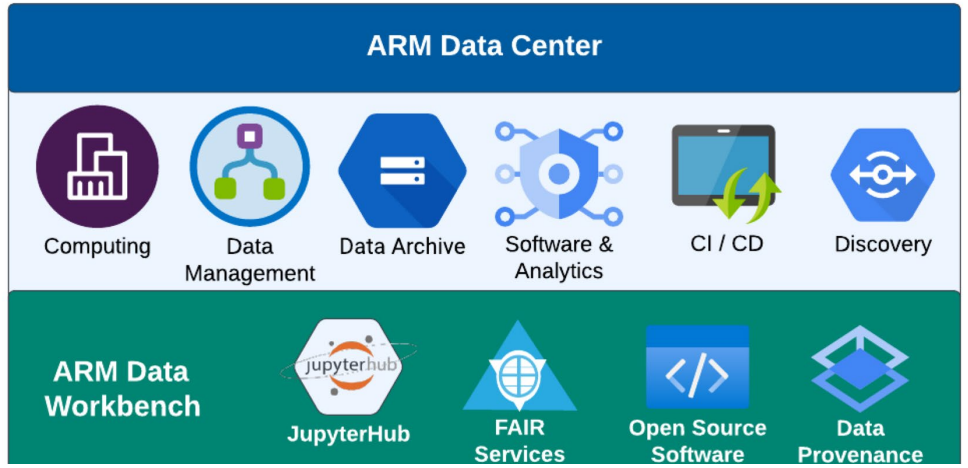
- Enables fast parallel processing of:
  - Data analysis using large volumes of ARM data
  - Data ingest operations
  - Complex ARM datastreams (e.g., Radars, Value Added Products)
  - Large Eddy Model Simulations of ARM cases (LASSO)

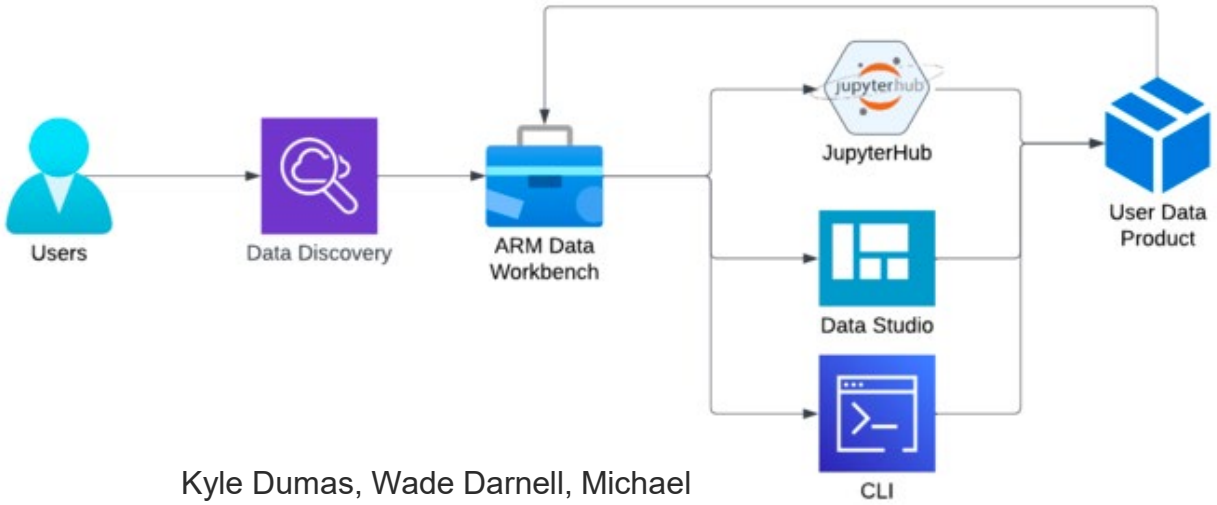


https://arm.gov/capabilities/computing-resources

Data Workbench: Enabling Data Interoperability

- Aims to achieve transformative knowledge discovery by providing modular computing, data, and software capabilities
- Facilitate easier interaction with ARM data and enable interoperability with other data sources
  - Provide a collaborative and dynamic computation environment for data analysis, scientific computing, and machine learning (e.g., JupyterHub)
  - Facilitate data access to external datasets (e.g., weather radar, satellite, model data, etc.)
- Enable FAIR-based access to ARM data and computing for initiatives such as AI4ESP





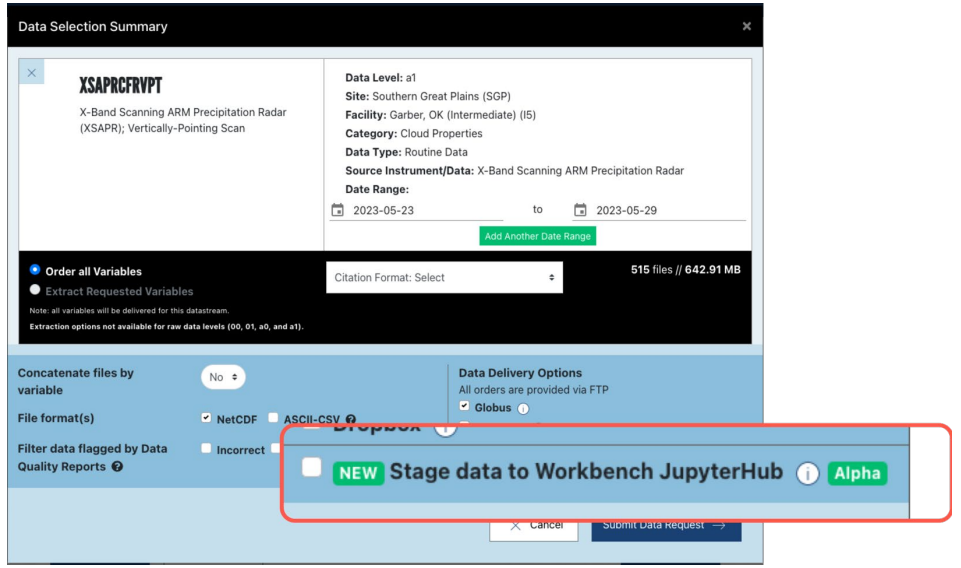
Kyle Dumas, Wade Darnell, Michael Giansiracusa

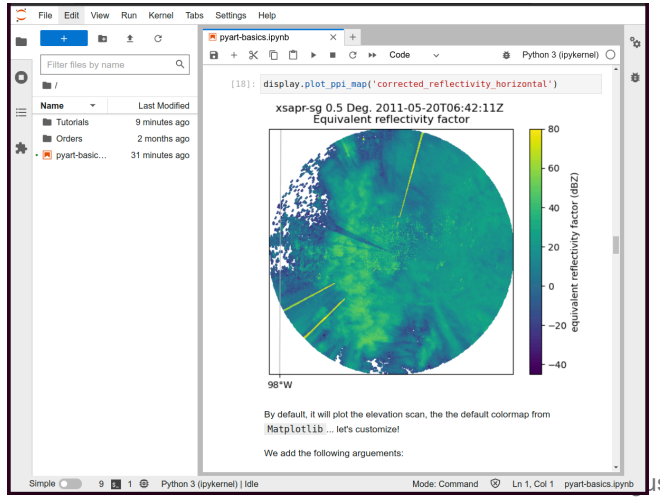
ARM JupyterHub Workbench: Bringing Data & Computing Resources Together

Available Options:

- Default data users to explore ARM data
- Elevated JupyterHub access for analyzing ARM data
- Research system account: ARM developers, translators, and mentors
- Educational users: workshop and course-specific Jupyter resources
- HPC users: Jupyter is provided as a default options to use the Cumulus cluster

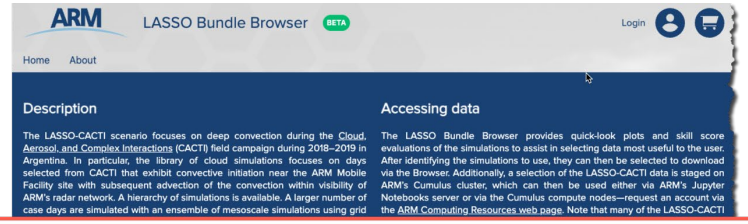
More details:
https://armcrf.servicenowservices.com/kb?id=kb_article_view&sysparm_article=KB0011049





LASSO CACTI Data Release Update

- Can be explored and downloaded using the LASSO CACTI Bundle Browser
  - https://adc.arm.gov/lasso
- Two case dates with
  - Observation summary plots
  - Mesoscale simulations data
  - Large Eddy Simulations data
- Users can download using Globus, THREDDS, and FTP
- Data available via Jupyter notebook (for Cumulus users)
- Data and science contact: Bill Gustafson
  - Breakout session <<Today @ 2 pm>>
- Please stop by the data booth to learn more

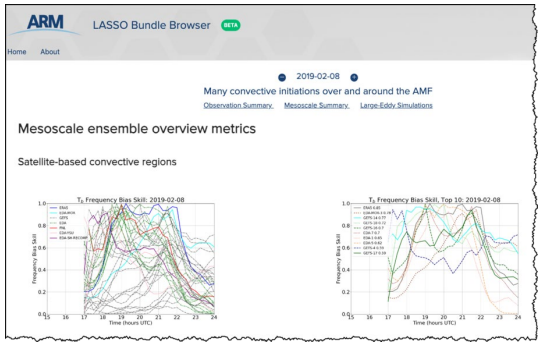


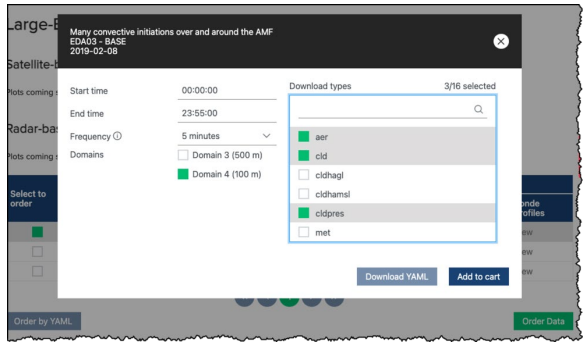
Selected case days for which large-eddy simulations and mesoscale simulations were run

Date	Description	Observation Summary	Mesoscale Simulations	Large Eddy Simulations
2019-02-08	Many convective initiations over and around the AMF	View	View	View

Additional days for which only mesoscale simulations were run

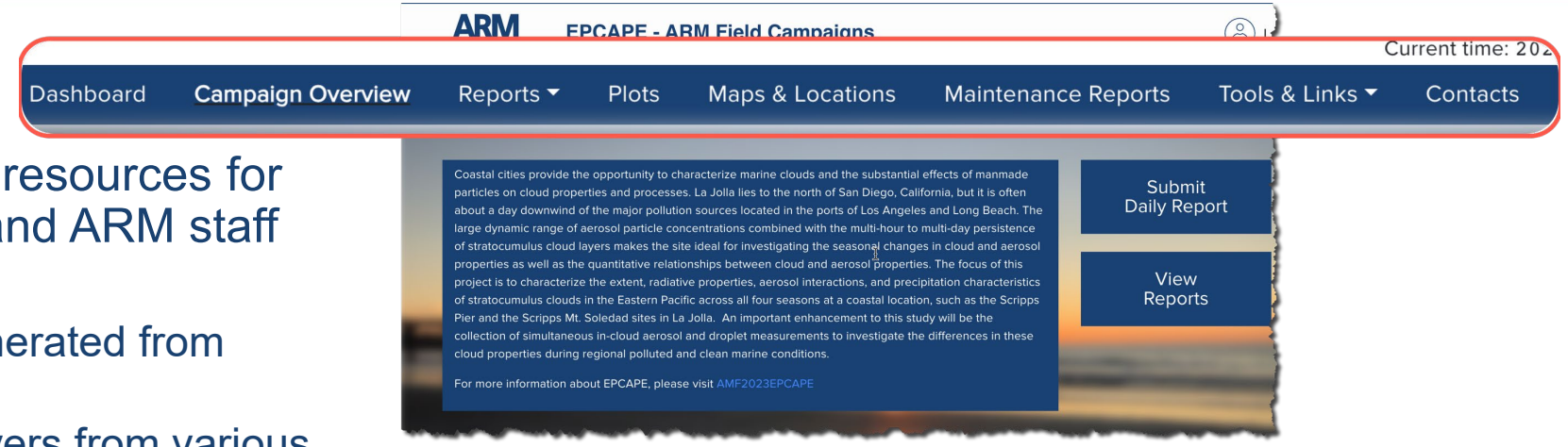
Date	Description	Observation Summary	Mesoscale Simulations
2019-03-15	Large convective system advects over site but the initiation was not observed	View	View





Field Campaign Notebook – Empowering Effective Operations

- Provides operational and logistical resources for field campaign PI team, site staff, and ARM staff
  - Input and access daily reports
  - Explore and browse data plots generated from instruments
  - View real-time satellite imagery layers from various data sources
  - Range of resources to help understand ARM data, including documentation, tutorials, and support from ARM staff.
- Available for
  - SAIL
  - TRACER
  - EPCAPE
  - AAF
  - TBS (upcoming)



https://adc.arm.gov/afcd

ARM Facility Changes and Engagement

JIM MATHER

ARM Director

Advancing Capabilities Within Constraints

- New capabilities
  - Aircraft, Southeast US site
  - New measurements and data products
- Budget pressure
  - New capabilities
  - Unexpected costs
- Balancing new scope with scaling back in other areas
  - Reduction in SGP supplemental sites
  - Removal or scaling back of some instruments:

Reducing Instrument Scope

- Reduced Scope
  - Scanning Cloud Radar
  - X-band radar (SGP)
  - HTDMA & Humidigraph
  - MFRSRs and IRTs (at SGP extended facilities)
  - EBBR
- Phasing Out
  - IR Sky Imager
  - Solar Array Spectroradiometer

About ARM: Future Directions

U.S. DEPARTMENT OF ENERGY

ARM

U.S. DEPARTMENT OF ENERGY | Office of Science

DATA ▾ RESEARCH ▾ CAPABILITIES ▾ NEWS & EVENTS ▾ ABOUT

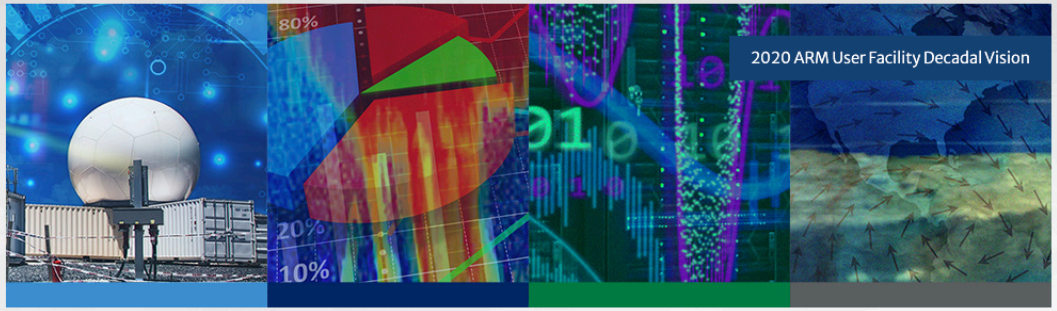
Search ARM.gov

Management Structure | Facility Documents | History | Future Directions | Facility Usage

ABOUT

FUTURE DIRECTIONS

ARM works with scientific users to continually evolve to enable the next generation of scientific inquiry.



The Atmospheric Radiation Measurement (ARM) user facility is continually changing in response to evolving science, user needs, and available technology. ARM engages with users through its constituent groups, with Atmospheric System Research (ASR) scientists (especially with the annual Joint ARM User Facility/ASR Principal Investigators Meeting), and the broader community through workshops, conferences, and collaborative activities.

In addition to interactions with the scientific community, the direction of ARM is governed by the strategic direction set by DOE.

A NEW VISION FOR ARM

Through community engagement, ARM in 2020 developed a new Decadal Vision document to address increasingly complex science challenges related to the facility's mission over the next five to 10 years. The updated vision statement is: **to provide the research community with the best array of field observations and supporting state-of-the-art data analytics to significantly improve the representation of challenging atmospheric processes in earth system models**.

This vision will be sustained by activities organized within the following four themes:

MEASUREMENTS

Provide comprehensive and impactful field measurements to support scientific advancement of atmospheric process understanding. ARM strives to deliver the highest level of information possible at its observatories. To maximize its science impact, ARM plans to deploy observatories where the science community most needs them, provide the most comprehensive and useful measurements possible, and expand the spatial footprint of ARM measurements.

DATA ANALYTICS

Achieve the maximum scientific impact of ARM measurements through increased engagement with observational data by ARM staff, including the application of advanced data analytical techniques. In addition to exploring new measurement opportunities, ARM is considering how it can extract additional benefit from existing measurements through a focus on data analysis. ARM is looking at fundamental work that needs to be done with ARM data as well as potential applications of advanced data analytics.

DATA SERVICES

2020 DECADAL VISION

Read the report that sets forth ARM's path for the next five to 10 years.

DECADAL VISION NEWS

Read all articles related to the current ARM Decadal Vision.

HOW CHANGE HAPPENS

ARM is always changing in response to new science and user needs, and available technology. Change starts with users.

View the Priorities
Users can view current and completed high-priority ARM activities.

Request for New ARM Capabilities
Have an idea or suggestion for a new measurement, data product, or data service for ARM? Tell ARM about it.

User Constituent Groups

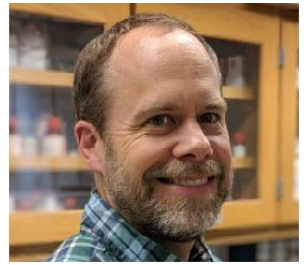
- User Executive Committee
  - Chair – Jennifer Delamere; Vice-Chair – Mike Jensen
  - Sub-groups: modeling, satellite coordination, calibration/uncertainty, early career engagement/diversity equity and inclusion
  - **Tuesday lunch session**
- Aerosol Measurements and Science
  - Co-Chaired by Gannet Hallar and Tim Onasch
  - Group reorganizing under for sub-areas: measurement techniques, quality, sampling and modeling
  - **Meeting Wednesday (breakout session 6)**
- Cloud Measurements and Science
  - Chaired by Christine Chiu
  - Organized around meteorological regimes, several specific data product types, and modeling
  - **Meeting this afternoon (breakout session 2) on priorities**

Lunch session today to get an introduction to all three groups!


Jen Delamere

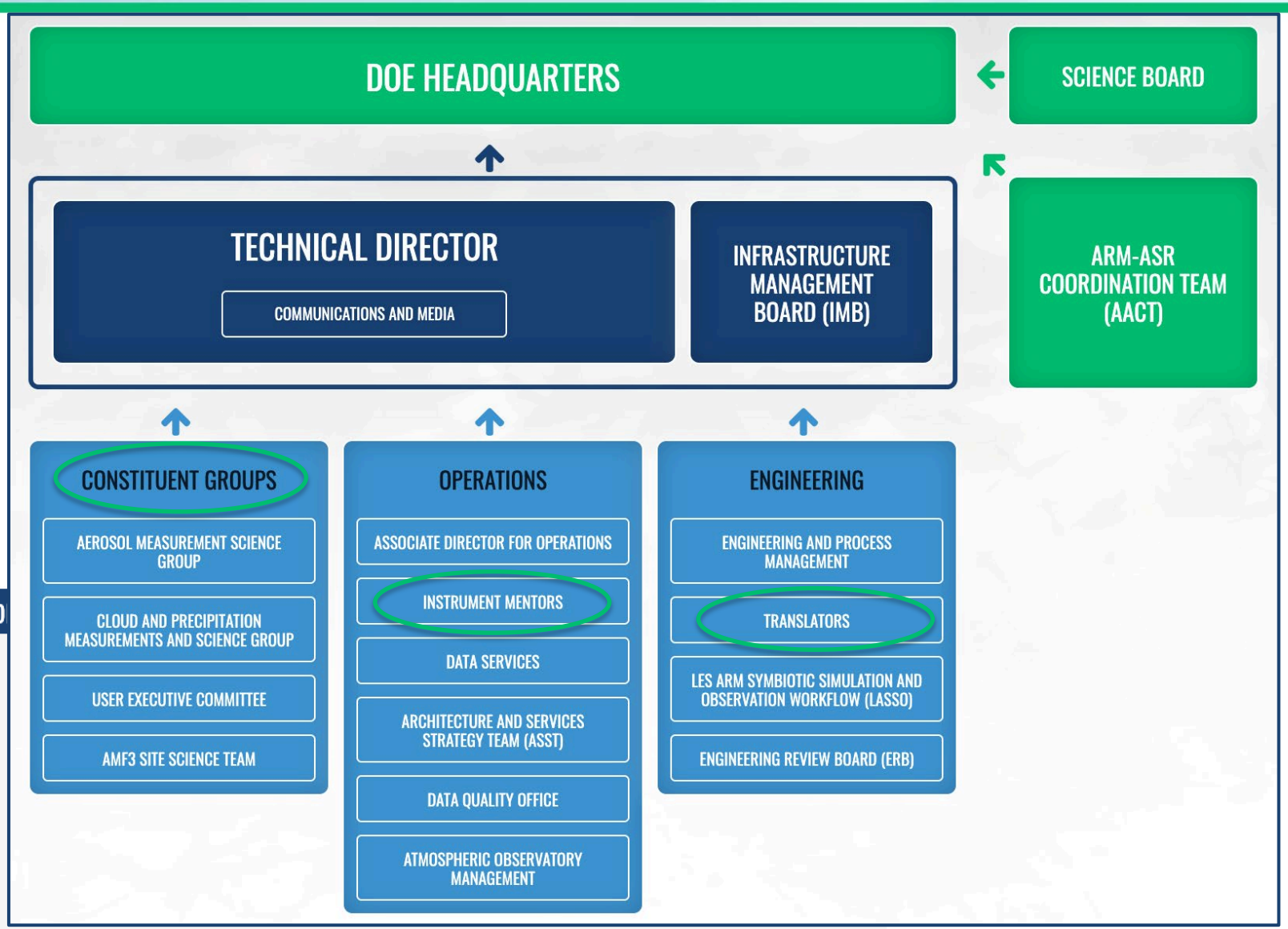

Mike Jensen


Gannet Hallar


Tim Onasch


Christine Chiu

Connecting with ARM



ATMOSPHERIC RAD

CONNECT WITH ARM

CREATE ACCOUNT

ORGANIZATION

POLICIES

DATA POLICIES

CAMPAIGN GUIDELINES

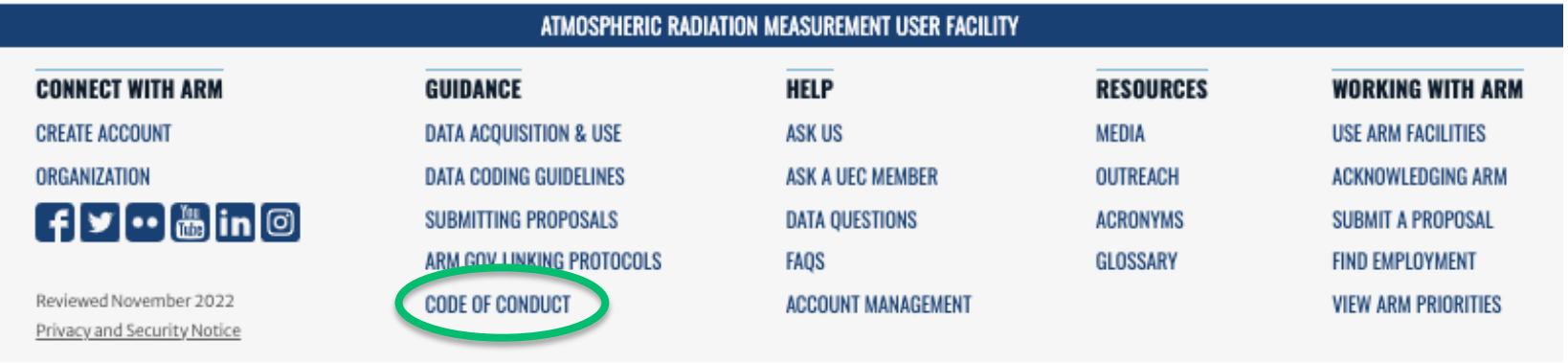
LINKING POLICIES

DIVERSITY, EQUITY, & INCLUSION

PRIVACY & SECURITY NOTICE

Reviewed September 2020

Code of Conduct and Bystander Training



- More clarity on expectations and points of contact
- Organizing bystander training
- UEC has coordinated presentation (from Dr. Solomon Bililign) and a breakout session (Tuesday lunch) related to diversity

User and ARM Staff Surveys

- Staff survey this spring
  - Strong – sense of mission, engaging with staff and users
  - Challenges on-line tools – and training, and time
  - More in ARM forums
- User Surveys
  - Most positive feedback related to impact and engagement with ARM staff
  - Lowest scores related to on-line tools
  - Look for another survey this fall

Clear need – more training on on-line tools