

Finding ARM Data – A Tutorial

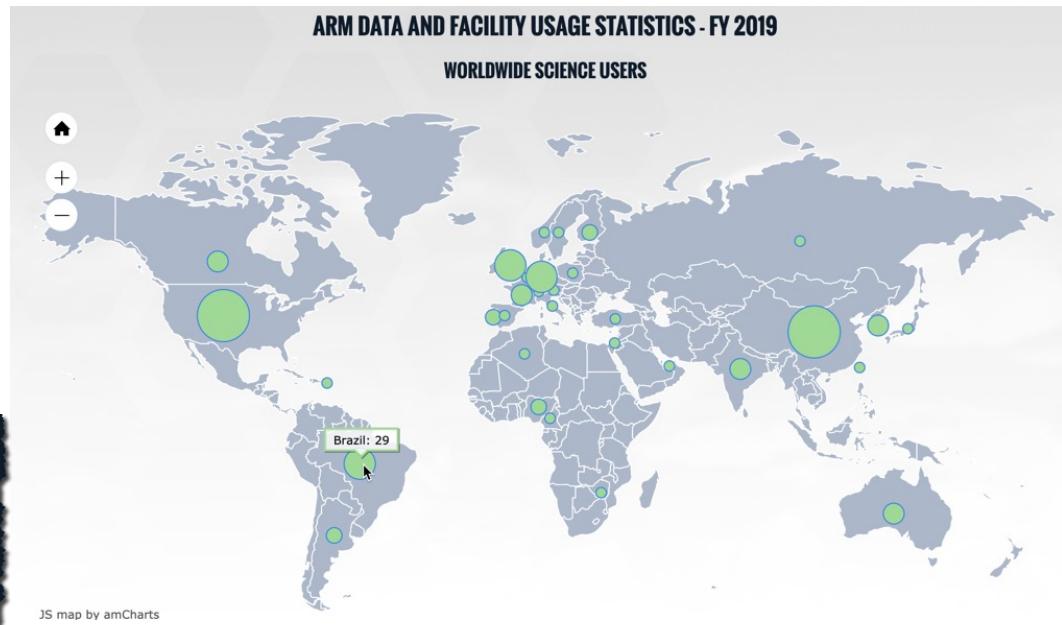
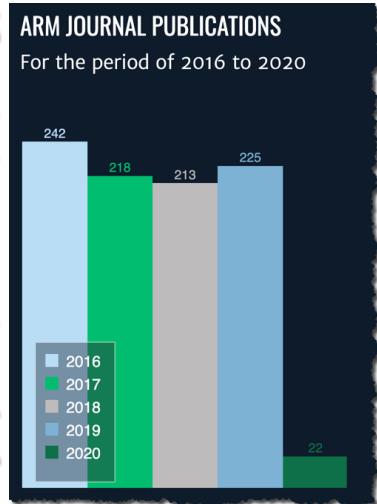
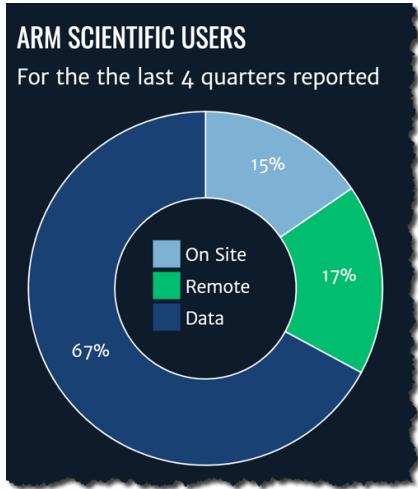
Open-Science-Workshop-2022

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G. Prakash, Ric Cederwall, Hannah Collier, H. Shanafield

Atmospheric Radiation Measurement

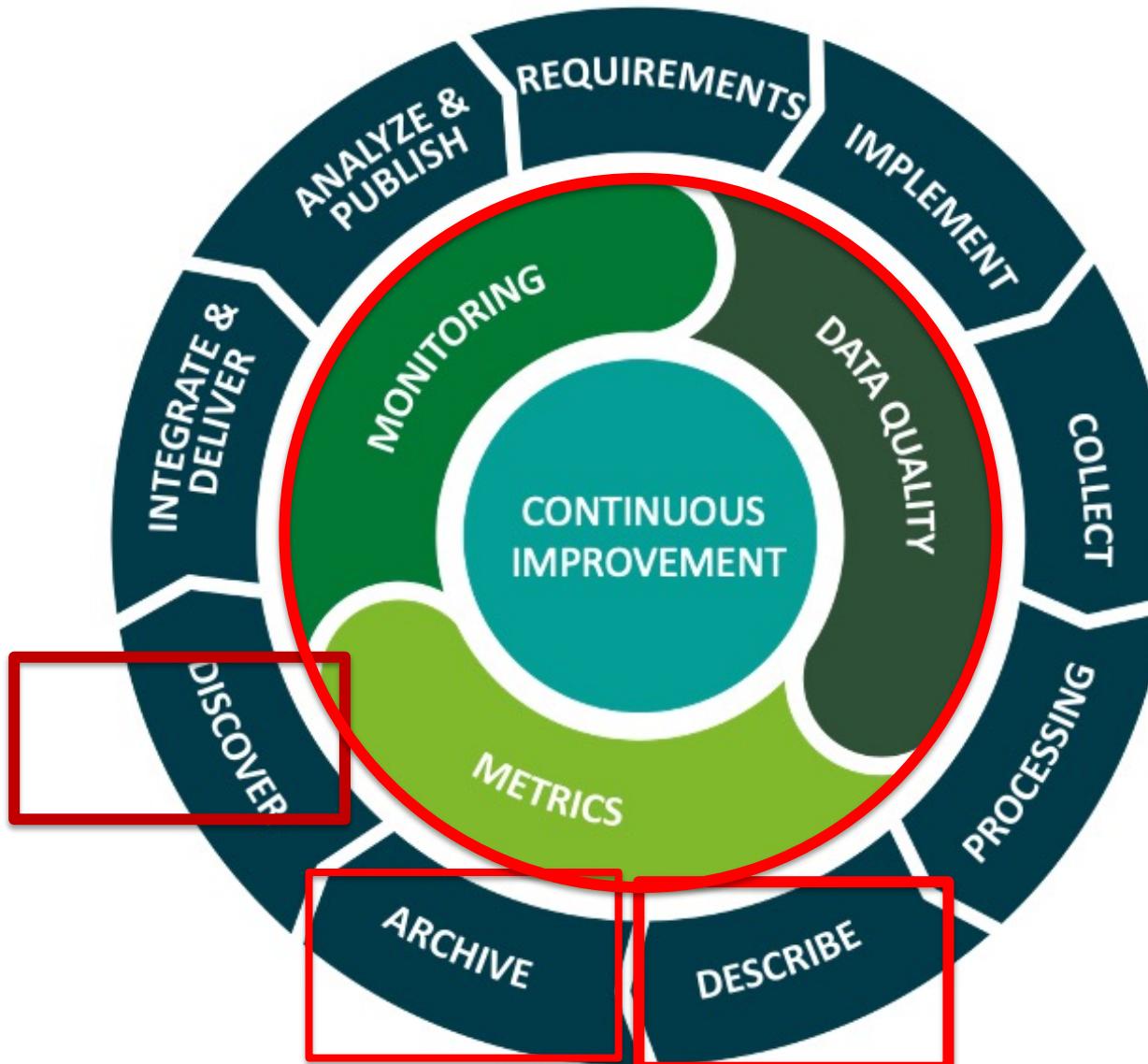
- 450+ instruments deployed
- 2000+ active data streams
- 2 PB of Archived data
- 1,000+ Unique scientific users
 - ▶ > 200+ publications/yr



A key contributor to climate research

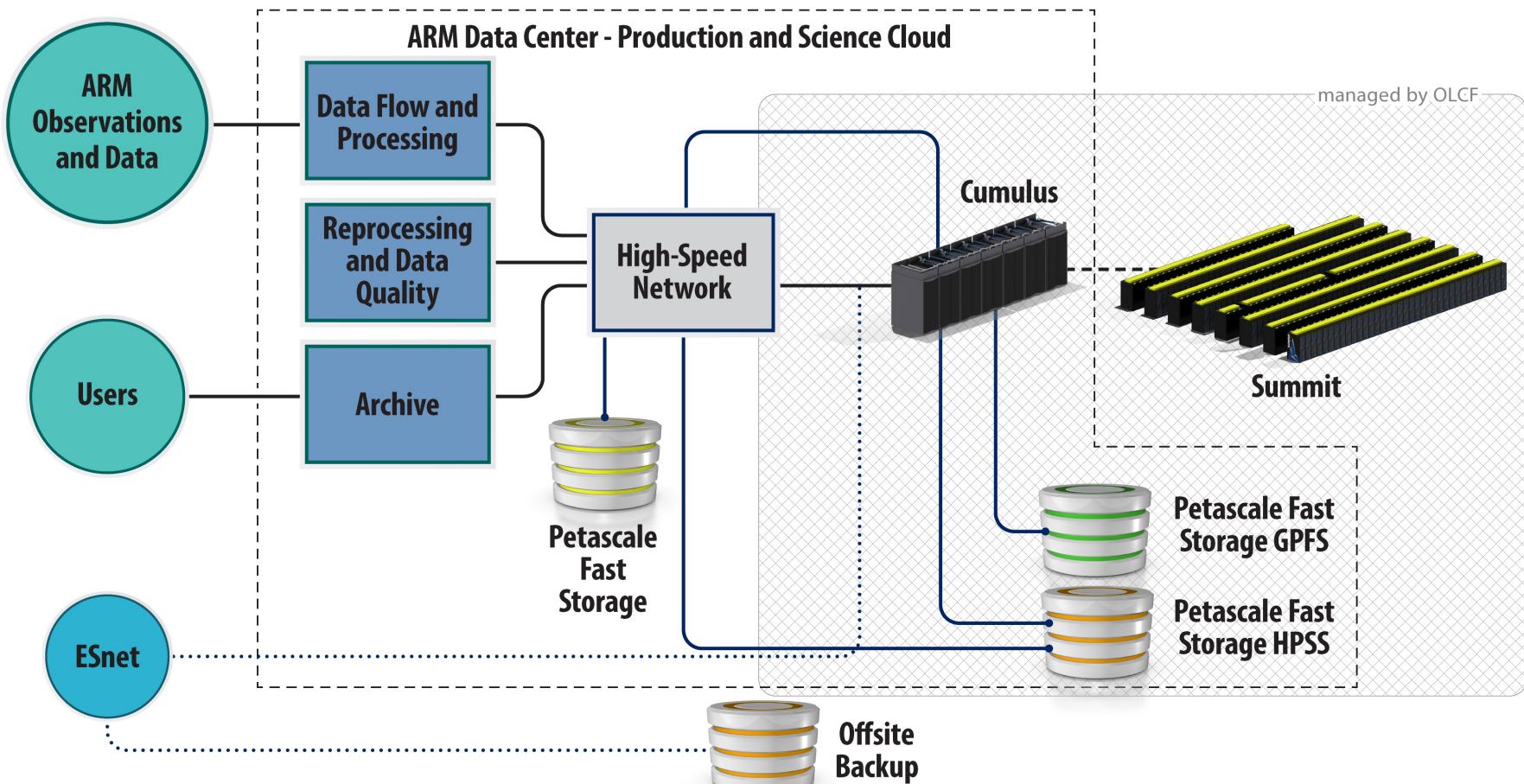
What is metadata: we work with scientists, complete metadata key to getting science & data to users

ARM



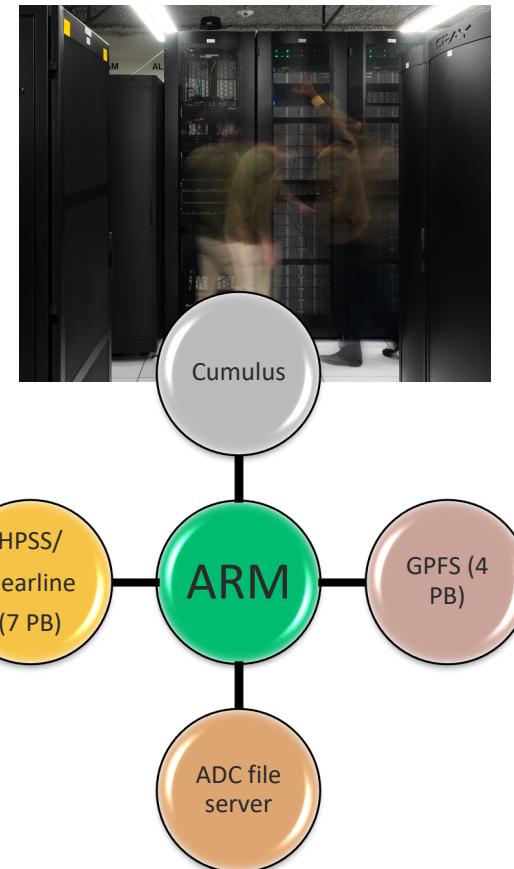
ARM - Community Computing Architecture

ARM



The New Cumulus Cluster

- ▶ The new cluster offers a dense node architecture (128 cores per node)
- ▶ Provides 16,384 total computing cores
- ▶ 4 PB Global Parallel File System (GPFS)
- ▶ Providing seamless connections between ADC database, next generation-HPSS, and ARM HPC
- ▶ Support for *Singularity containers* (improve application portability)
- ▶ Jupyter notebook support (available soon)
- ▶ Wide range of software stacks (compilers (GCC/Intel), open source libraries, IDL, MatLab etc..)



HPC Science projects: Cumulus request via HPCR :
<https://arm.gov/capabilities/computing-resources>

Find your data on our website

ARM

ARM

<https://arm.gov/>



DATA ▾

CAPABILITIES

RESEARCH ▾

NEWS & EVENTS ▾

ABOUT ▾

Search ARM.gov



Atmospheric Observatories

➤ Instruments

VAPs

Modeling

Computing Resources

e.g., <https://arm.gov/research/campaigns>

<https://arm.gov/research/campaigns/amf2021tracer>

The world's premier ground-based observations facility advancing atmospheric and climate research

DOES POLLUTION MAKE THUNDERSTORMS MORE SEVERE?

To find out, researchers will study the effects of aerosols on storms in the Houston, Texas, area for a full year.

UNDERSTANDING THE FUTURE OF WATER

A 21-month ARM campaign in Colorado will establish what is being called "the world's first bedrock-to-atmosphere mountain integrated field laboratory."

ARM'S DECADAL VISION, PART 1

The first article in a series about ARM's four Decadal Vision themes details how ARM intends to improve measurement strategies and instruments.



[BROWSE DATA](#)

https://adc.arm.gov/discovery/#/results/site_code::guc/start_date::2021-09-01/end_date::2023-06-15



GUC DATA SOURCES

NAME	FULL NAME	BROWSE DATA
ACSM	Aerosol Chemical Speciation Monitor	 Browse Data
AERI	Atmospheric Emitted Radiance Interferometer	 Browse Data
AOS	Aerosol Observing System	 Browse Data
AOSMET	Meteorological Measurements associated with the Aerosol Observing System	 Browse Data
AOSSP2BC	Aerosol Observing System Single Particle Soot Photometer Black Carbon	 Browse Data
CAMINST	camera that monitors an instrument	 Browse Data
CAMSITE	camera that monitors a site area	 Browse Data
CCN	Cloud Condensation Nuclei Particle Counter	 Browse Data
CEIL	Ceilometer	 Browse Data
CO-ANALYZER	Carbon Monoxide Analyzer	 Browse Data

Categorized: instruments and VAPs into classes

ARM



<https://arm.gov/>



DATA ▾

CAPABILITIES

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Search ARM.gov



Atmospheric Observatories

➢ Instruments

VAPs

Modeling

Computing Resources

E.g., keyword search under instrument, VAP, or data-sources lists

Showing 1 of 1

NAME	FULL NAME	ACTIVE	TYPE	START	END
S02-AIR	Sulfur Dioxide Monitor aboard Aircraft	✓	Baseline	25 April 2016	8 December 2018

Showing 1 of 1

We offer various ways to search data on DD



Data Search

Search by category, measurement, datastream + more.

The screenshot shows a search bar with 'trace' typed in. Below it, under 'Field Campaign', is a result for 'amf2021tracer Tracking Aerosol Convection Interactions Experiment (TRACER)'. Under 'Facility', there are two results: 'hou.M1 Houston, TX; AMF1 (main site for TRACER)' and 'hou.X10 Houston, TX; External Data at main site for TRACER'.

Search by classes of instruments, type of data, and more.



Aerosols



Atmospheric State



Cloud Properties



Radiometric



Surface Properties

Search by campaign name or site:

Field Campaign Data Products

Data from intensive field campaigns that are conducted by ARM, these include routine as well as PI contributed data.

We will start with the first and most popular:
key word searching facilitates discovery by
various parameters of interest

ARM

<https://adc.arm.gov/discovery/#/>

The screenshot shows the ARM Data Search interface. At the top, there is a navigation bar with links for HOME, DATA SEARCH, SUPPORT, ACCOUNT Login, and CART. A large globe graphic in the center has a hand cursor icon pointing to it with the text "Click to interact". Below the globe, a search bar contains the word "pressure". To the left of the search bar, a sidebar labeled "Data Search" includes a "Search by category, measurement, dataset" input field. Below the search bar, a "Measurement" section lists "atmpres Atmospheric pressure". The bottom of the page shows a footer with the U.S. Department of Energy logo and the number 12.

ARM

HOME DATA SEARCH SUPPORT ACCOUNT Login CART

CORE TRUST SEAL

Feedback

Click to interact

pressure

Data Search

Search by category, measurement, dataset

Measurement

atmpres Atmospheric pressure

<https://adc.arm.gov/discovery/#/results/s::pressure>

U.S. DEPARTMENT OF ENERGY | 12

Recommendations: facilitating discovery by various parameters of interest from data discovery (DD)

<https://adc.arm.gov/discovery/#/>



Core measurement

Aerosol Optical Depth
Aerosol Extinction
Angstrom Parameter
Asymmetry Parameter
Backscatter depolarization ratio
Backscattered Radiation
Advection Tendency of Temperature (VAP)
Horizontal Wind Direction Profile
Horizontal Wind Speed Profile
Large-Scale Vertical Velocity
Precipitation Drop Size Distribution
Precipitable Water
Precipitation
Pressure
Surface Pressure
Relative Humidity
Relative Humidity at Surface
Temperature
Surface Temperature
Water Vapor Mixing Ratio
Wind Direction at Surface
Wind Speed at Surface
Cloud Optical Depth
Cloud Cover
Cloud Frequency
Cloud Location

Ice Generalized Effective Diameter

Ice Water Content
Ice Water Path
Liquid Effective Radius
Liquid Water Content
Liquid Water Path
Broadband Surface Albedo
Downwelling Broadband LW Flux
Broadband LW Flux Profile
Downwelling Broadband SW Flux
Broadband SW Flux Profile
Single Scattering Albedo
Surface Skin Temperature
Spectral LW Flux
Spectral SW Flux
Spectral Surface Albedo
Ground Heat Flux
Latent Heat Flux
Sensible Heat Flux
Soil Moisture Content
Horizontal Wind Components
Horizontal Wind Components at Surface
Greenhouse Gas
Advection Tendency of Moisture (VAP)
Advection Tendency of Moisture (VAP)
Upwelling Broadband LW Flux
Upwelling Broadband SW Flux

Results can be filtered, for example by the campaign of interest

ARM

<https://adc.arm.gov/discovery/#/results/iopShortName::amf2021tracer>

Field Campaigns 		1	
<input checked="" type="checkbox"/> Tracking Aerosol Convection Interactions	Experiment (TRACER)	38	
		Clear »	Apply »
► Data Type 	1	csphotppv3	Cimel Sunphotometer (CSPHOT): principal planes data, version 3
► Datastreams 	45	gndirt	Infrared Thermometer: Ground surface temperature
► Facilities 	4	met	Surface Meteorological Instrumentation
► Data Levels 	2	mfrsr7nch	Multi-Filter Rotating Shadowband Radiometer (MFRSR) with 7 Narrowband Channels: raw irradiances
► Source 	30	sondewnpn	Balloon-borne sounding system (BBSS): Vaisala-processed winds, press., temp, &RH
► Data Products 	38	vdis	Video Disdrometer Drop Size Distribution
► Instrument Category 	6		
Hide Advanced Filters			
<input checked="" type="checkbox"/> Sites: <input checked="" type="checkbox"/> HOU		Location	
		Houston, TX; Tracking Aerosol Convection interactions ExPeRiment (HOU)	 
		Houston, TX; AMF1 (main site for TRACER) (M1)	

Abundant details in this view includes: Levels of data available, DOI assigned by data level and available in multiple formats

ARM

https://adc.arm.gov/discovery/#/results/id::houvdisM1.b1_median_volume_diameter_micro_vdis_sfcmet?dataLevel=b1&showDetails=true

VDIS

Selected data level ?

b1 Start: 2021-08-07 End: 2022-01-09

b1: QC checks applied to measurements

Description: Video Disdrometer Drop Size Distribution

Site: Houston, TX; Tracking Aerosol Convection interactions ExpeRiment (HOU) Location: Houston, TX; AMF1 (main site for TRACER) (Lat: 29.67, Long: -95.059)

Facility Code: M1

Category: Surface Meteorology

Data Type: Routine Data ?

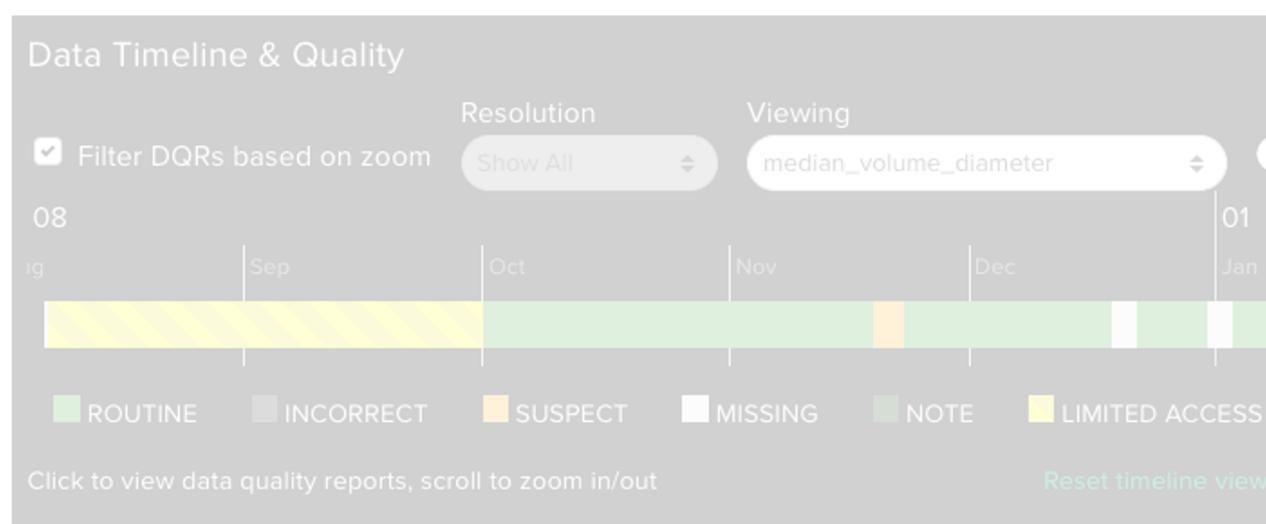
Source Instrument/Data: Video Disdrometer

Sampling Interval: 1 minute

Start Date: 2021-08-07

End Date: 2022-01-09 ?

DOI: 10.5439/1025315



Data Plots



Primary Measurements

File Header Information

Abundant details in this view includes: Data timeline & quality by variable and data plots; PMTs and ability to preview the file header

ARM

https://adc.arm.gov/discovery/#/results/id::houvdisM1.b1_median_volume_diameter_micro_vdis_sfcmet?dataLevel=b1&showDetails=true

VDIS

Selected data level

b1 Start: 2021-08-07
End: 2022-01-09

b1: QC checks applied to measurements

Description: Video Disdrometer Drop Size

Distribution

Site: Houston, TX; Tracking Aerosol

Convection interactions ExpeRiment (HOU)

Location: Houston, TX; AMF1 (main site for
TRACER) (Lat: 29.67, Long: -95.059)

Facility Code: M1

Category: Surface Meteorology

Data Type: Routine Data

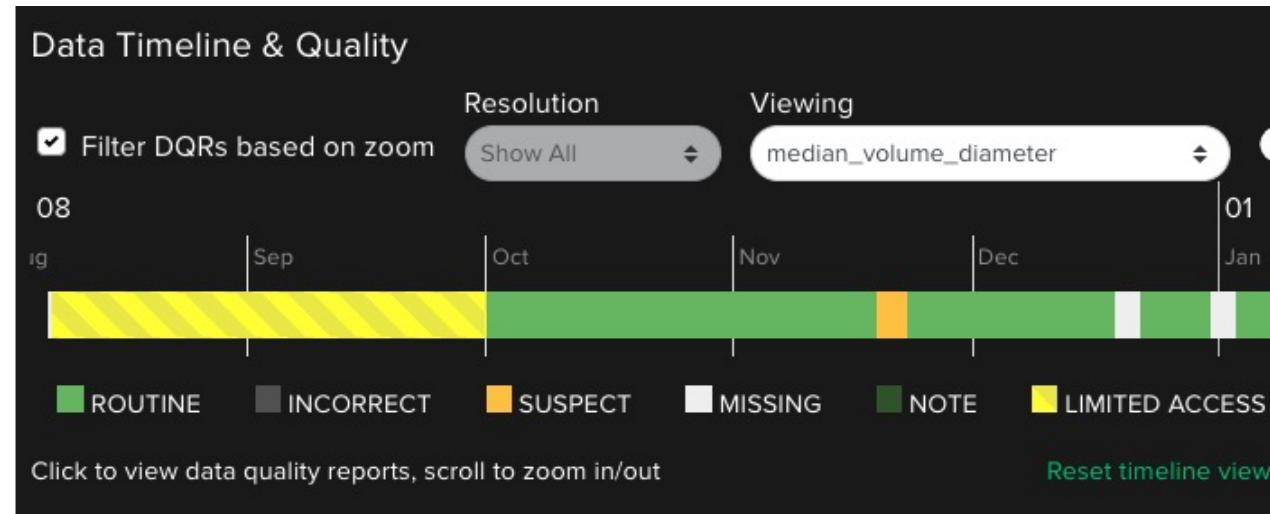
Source Instrument/Data: Video Disdrometer

Sampling Interval: 1 minute

Start Date: 2021-08-07

End Date: 2022-01-09

DOI: 10.5439/1025315



Data Plots



Primary Measurements

File Header Information

Abundant details in this view can also include a download of the file header, more info on recommended variables



https://adc.arm.gov/discovery/#/results/id::houvdisM1.b1_median_volume_diameter_micro_vdis_sfcmet?dataLevel=b1&showDetails=true

Primary Measurements

File Header Information

Data subsetting for the below variables is available.

VARIABLES:

Hydrometeor Size Distribution:

Variable: Number density (num_density)

Recommended

Precipitation:

Variable: Rain amount (rain_amount)

Recommended

Hydrometeor size:

Variable: Median volume diameter, assuming an ideal Marshall-Palmer type distribution (median_volume_diameter)

```
netcdf houvdisM1.b1.20220109.000000 {  
dimensions:  
    time = UNLIMITED ; // (1440 currently)  
    drop_diameter = 50 ;  
variables:  
    int base_time ;  
        base_time:string = "2022-01-09 00:00:00 0:00" ;  
        base_time:long_name = "Base time in Epoch" ;  
        base_time:units = "seconds since 1970-1-1 0:00:00 0:00" ;  
    double time_offset(time) ;  
        time_offset:long_name = "Time offset from base_time" ;  
        time_offset:units = "seconds since 2022-01-09 00:00:00 0:00" ;
```

Variable: Rain rate (rain_rate)

Recommended

Precipitation:

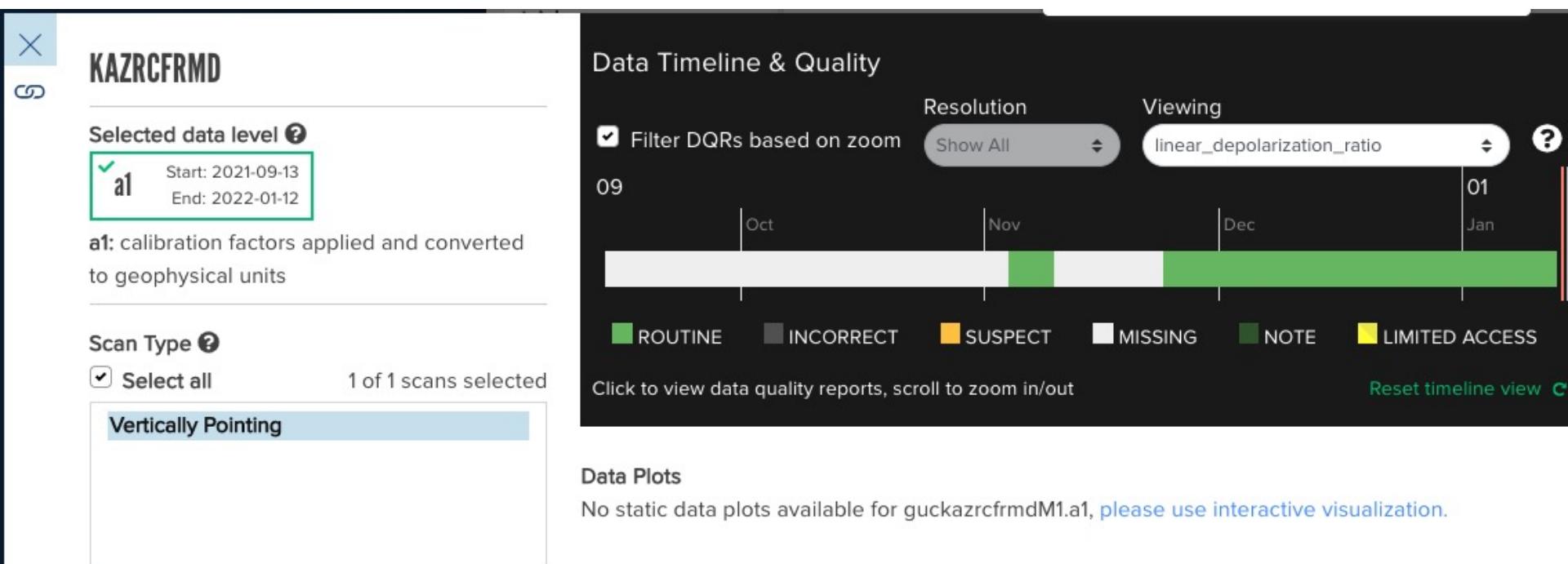
Variable: Sum of num_drops (total_drops)



Abundant details can also include a link to interactive visualizations when no plots exist, or when applicable type of radar scan

ARM

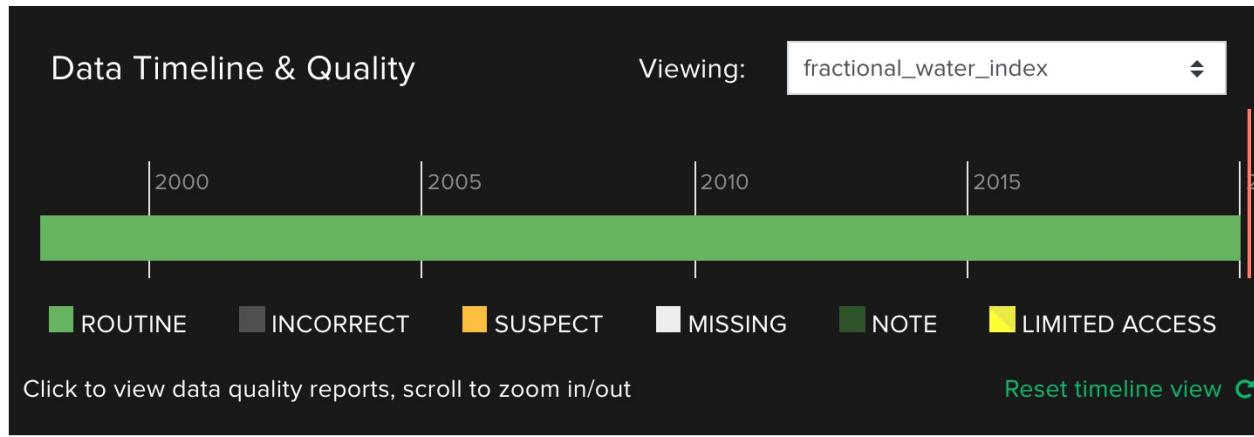
https://dq.arm.gov/dq-zoom/?ds=guckazrcfrmdM1.a1&variable=linear_depolarization_ratio&sdate=20220112&edate=20220112&coordinate=



More on Data Quality: Reporting

Data Quality Reports (DQRs)—visible while browsing for data, received with data orders, and accessible through the DQR web service.

User contributions: “informing ARM of any issue”



Data quality issues can be found after data is made available
Must communicate this to users.

Now to actually order the data!



ARM

ARM



HOME



DATA SEARCH



SUPPORT



ACCOUNT
Login



CART

Checkout

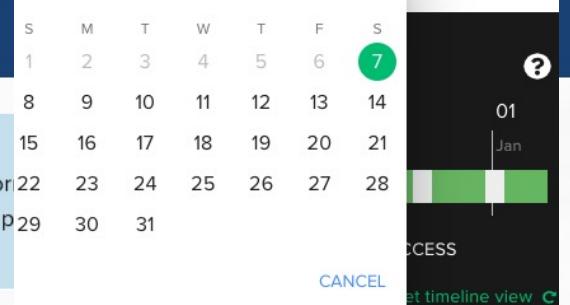
To complete your request, you may refine your dates and then select the 'Checkout' button. You will be asked to login using your ARM account or you may set up an account. Your data will be entered into the processing queue and fulfilled within the next few hours. You will receive an email when your data request is complete, notifying you of the location of the FTP server for retrieval.

Date Range:

2021-08-07

to

2022-01-09



HTML order confirmation emails now available

Data Discovery order confirmation emails are now available in HTML for all users. The emails are generated using the same template as the standard plain text format. You may configure your email format preferences from the account page by clicking here.

Your Cart has 149 files and size ~ 190.63 MB

Update Date Range:

2021-08-07

to

2022-01-09

<p>X</p> <p>VDIS</p> <p>Hydrometeor size</p> <p>The size of a hydrometeor, measured directly or derived from other measurements.</p>	<p>Data Level: b1</p> <p>Site: Houston, TX; Tracking Aerosol Convection interactions ExpeRiment (HOU)</p> <p>Facility: Houston, TX; AMF1 (main site for TRACER) (M1)</p> <p>Category: Surface Meteorology</p> <p>Data Type: Routine Data </p>
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Now simply check out, with method of delivery

ARM

Data Selection Summary



VDIS

Hydrometeor size

The size of a hydrometeor, measured directly or derived from other measurements.

Data Level: b1

Site: Houston, TX; Tracking Aerosol Convection interactions ExpeRiment (HOU)

Facility: Houston, TX; AMF1 (main site for TRACER) (M1)

Category: Surface Meteorology

Data Type: Routine Data

Source Instrument/Data: Video Disdrometer

Date Range:

2022-01-08

to 2022-01-09

[Add Another Date Range](#)

Order all Variables

Extract Requested Variables

Note: all variables will be delivered for this datastream.

Extraction options only apply when "Extract Requested Variables" is selected.

2 files // 2.56 MB

Citation Format: Select

Concatenate files by variable

No

File format(s)

NetCDF ASCII-CSV

Filter data flagged by Data Quality Reports

Incorrect Suspect

Data Delivery Options

All orders are provided via FTP

Globus

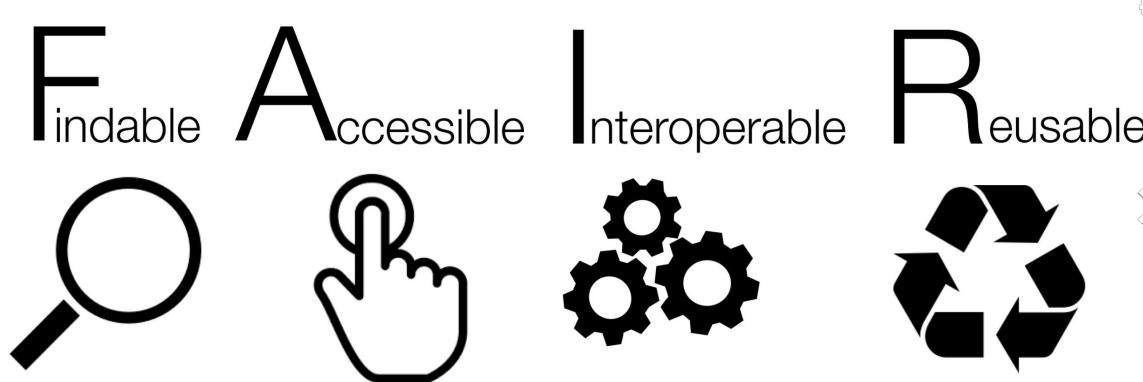
THREDDS

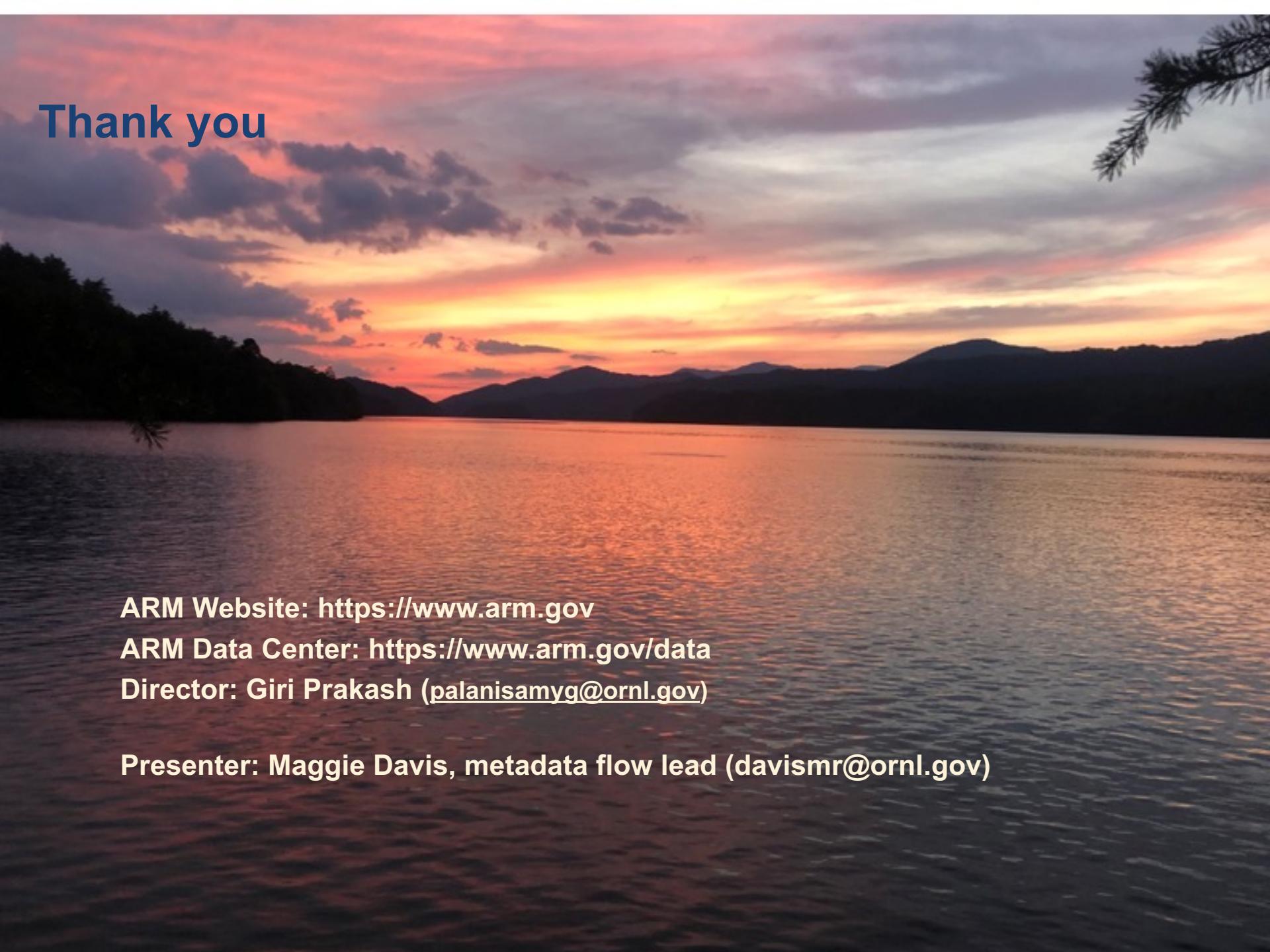
Dropbox

[Submit Data Request →](#)

Summary

- ▶ ARM facilitates easy discovery for users through an interactive portal and accompanying details pages
- ▶ Longevity of data relies on full metadata – promotes long term preservation,
- ▶ Enables data interoperability;
- ▶ Provides proper credit to data contributors





Thank you

ARM Website: <https://www.arm.gov>

ARM Data Center: <https://www.arm.gov/data>

Director: Giri Prakash (palanisamyg@ornl.gov)

Presenter: Maggie Davis, metadata flow lead (davismr@ornl.gov)