



National Aeronautics
and
Space Administration

EARTHDATA

Expanding CALIPSO Data Visibility through the ASDC

Feb 2025

Hazem Mahmoud¹, Ph.D. ASDC DAAC Scientist

Cheyenne Land¹, Ingrid Garcia¹, Walt Baskin¹,
Bryan Getzewich²

(1)ADNET

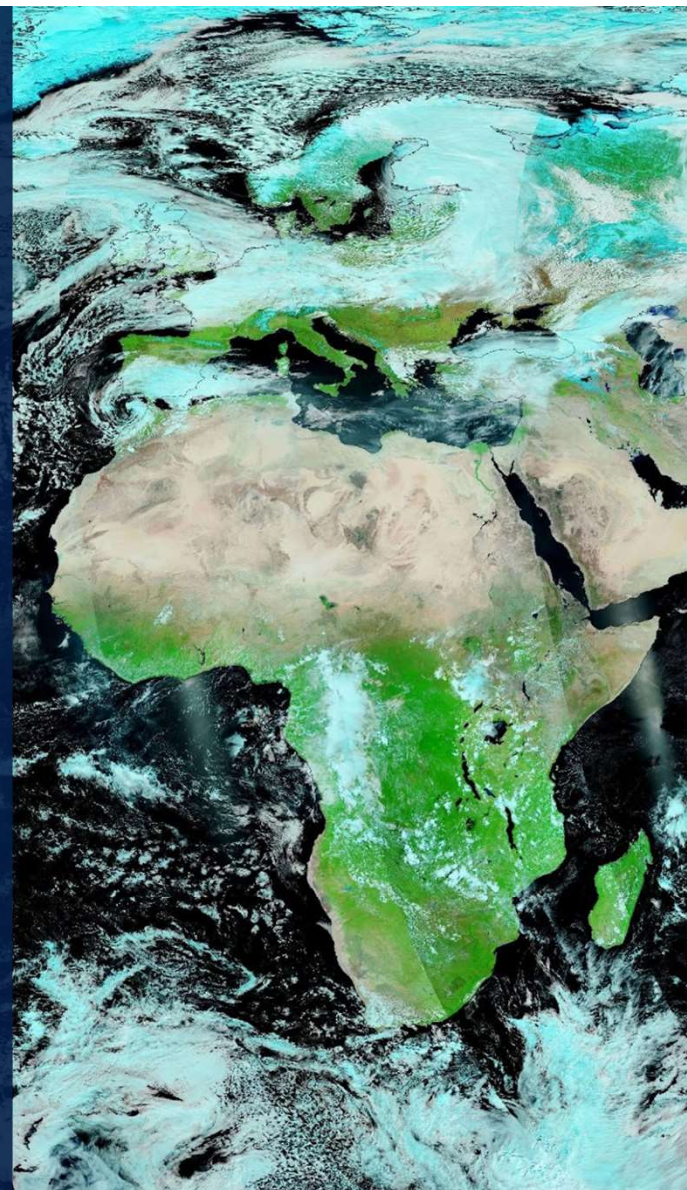
(2)NASA



**Atmospheric
Science
Data Center**

Agenda

- ASDC Overview
- ASDC Data Distribution Tools and Services
- CALIPSO Data Products and Distribution Metrics
- CALIPSO Data on the Cloud
- Questions

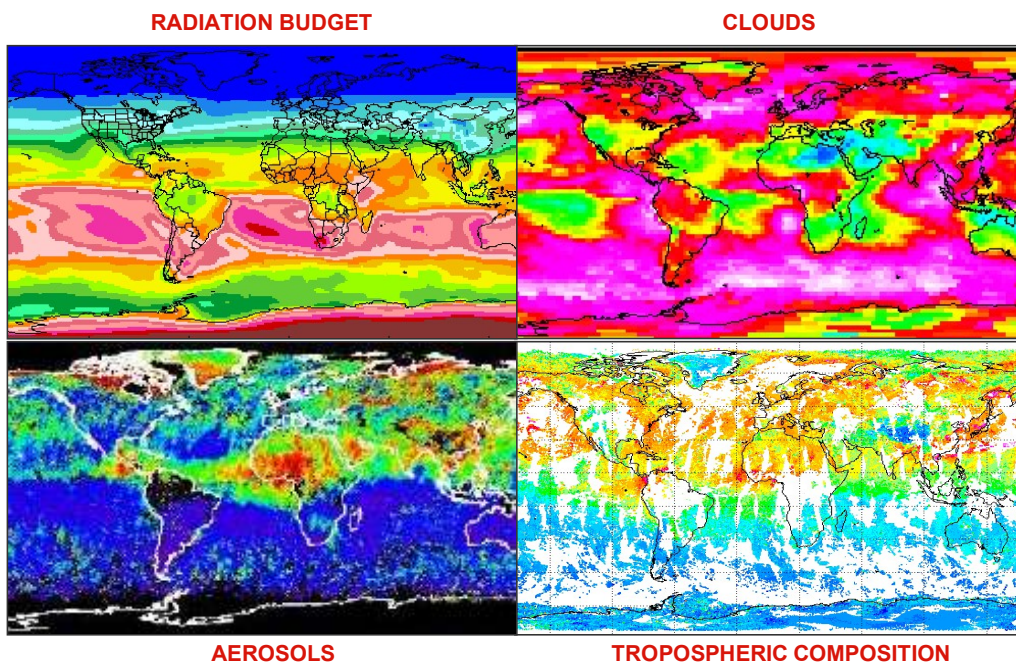


Earth Science Data and Information System *ESDIS*

NASA's Distributed Active Archive Centers (DAACs)

A federated approach to data management





ASDC at a glance

- ✓ 100+ Science projects
 - TEMPO ◦ MISR ◦ MOPITT ◦ MAIA ◦ CERES
 - CALIPSO → RSIG (EPA)
 - Airborne field campaigns
- (KORUS AQ, DISCOVER AQ, FIREX AQ)**
- ✓ 3000+ unique science products
- ✓ Data usage
 - 4,600+ Terabytes ◦ 160,000+ users
 - 158 countries
- ✓ Data archive
 - 8+ Petabytes ◦ 141 million files (4,400 TB) on high-speed disks
- ✓ Data in cloud (ongoing)
 - Data and services in the cloud
 - Scalable infrastructure

Primary Functions of ASDC

Ingest receive data from data provider

Archive preservation & provenance

Distribute tools and services

Process create higher level products

Outreach & Support research community

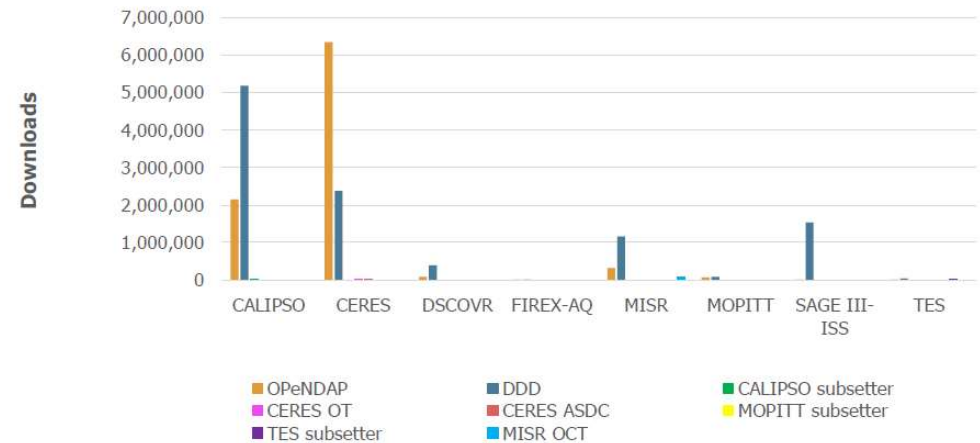
CALIPSO Metrics

CALIPSO is the most downloaded mission from ASDC before TEMPO.

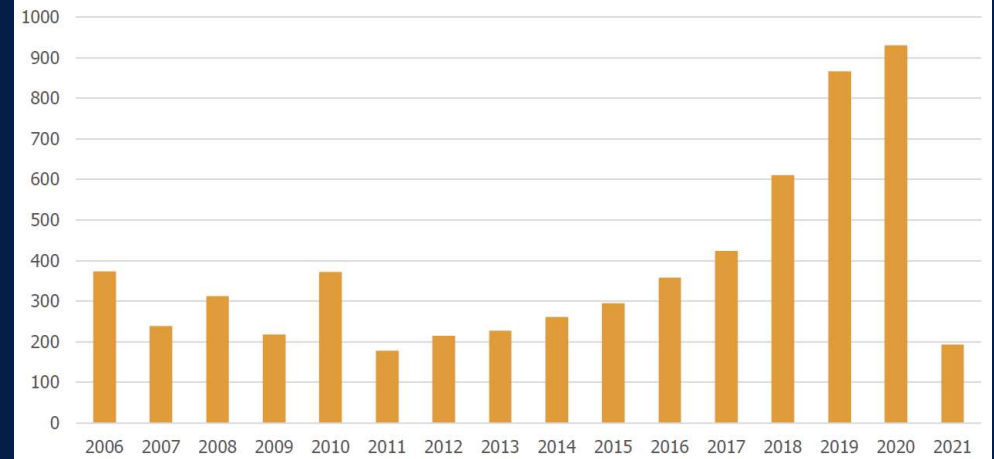
The User community is continuously expanding.



Products Comparison



Count of User's Orders Start Year

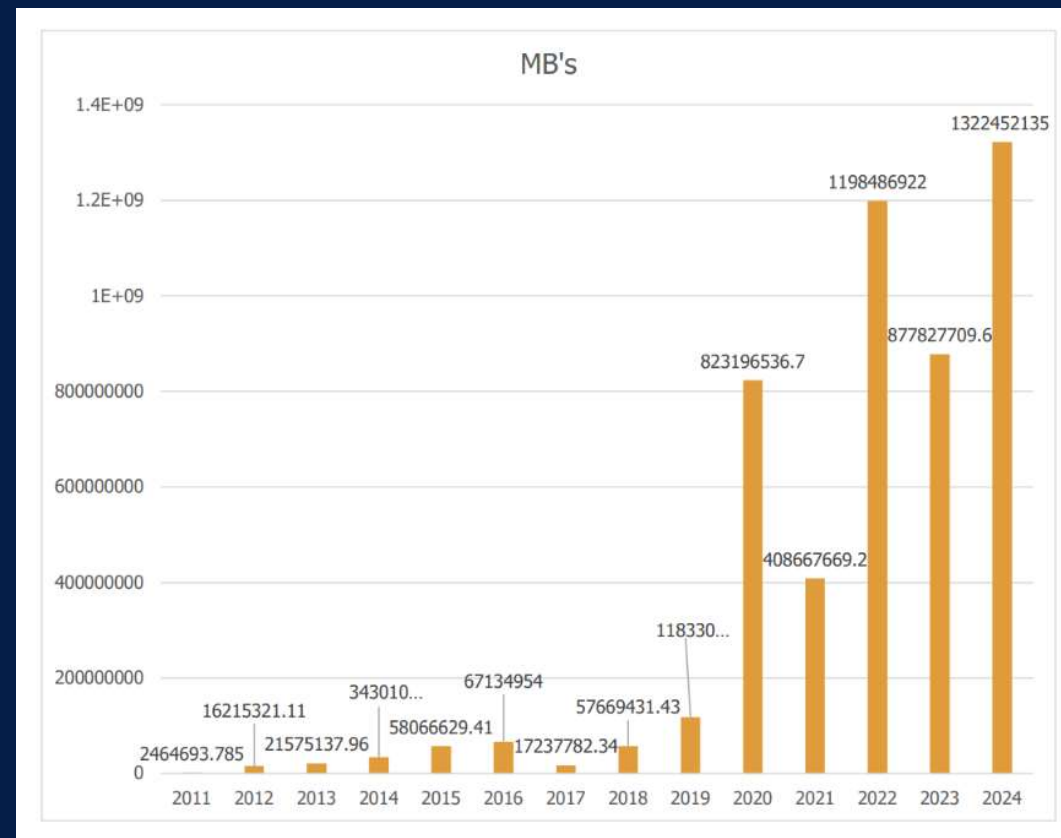


One year after the end of life

The metrics were obtained via the

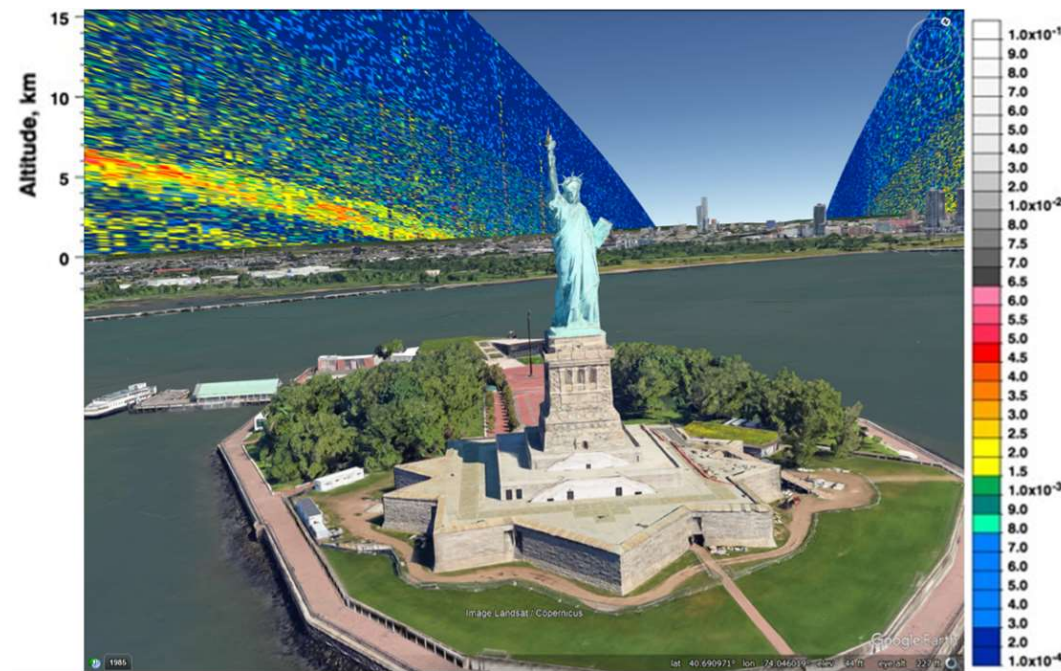


EARTHDATA

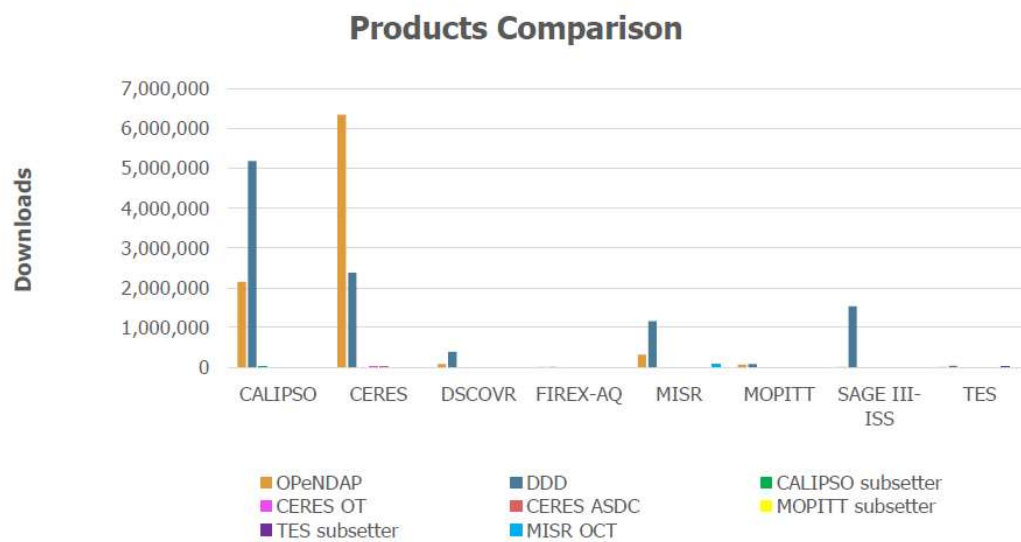


CALIPSO determining smoke plume thickness from Canada Wildfires 2023

We used CALIPSO LIDAR 532 nm Total Attenuated Backscatter data to determine the smoke plume top height and thickness. CALIPSO is a low Earth orbit (LEO) satellite-based instrument that provides a detailed 2D profile of smoke and clouds in the atmosphere. The image illustrates a CALIPSO profile portraying the Canadian wildfire smoke (that affected NYC) on June 5th at 20:10:27 UTC. Note that the CALIPSO vertical profile in the background of the Statue of Liberty is 5X the true altitude for visualization purposes.

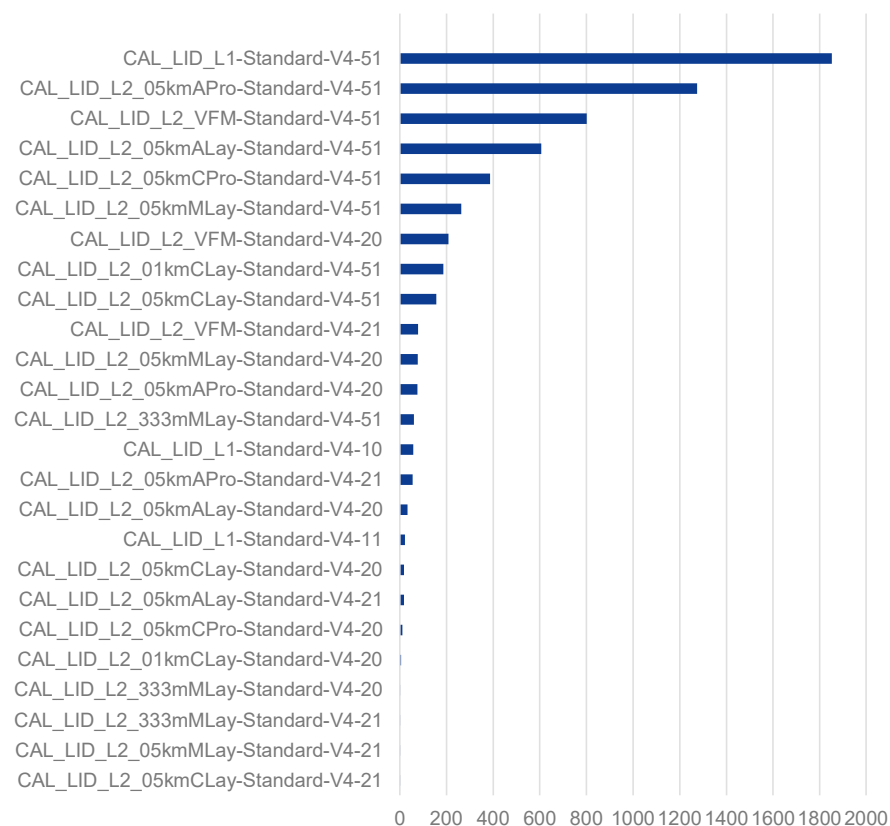


Subsetter Metrics



EARTHDATA

Number of subset orders 2024

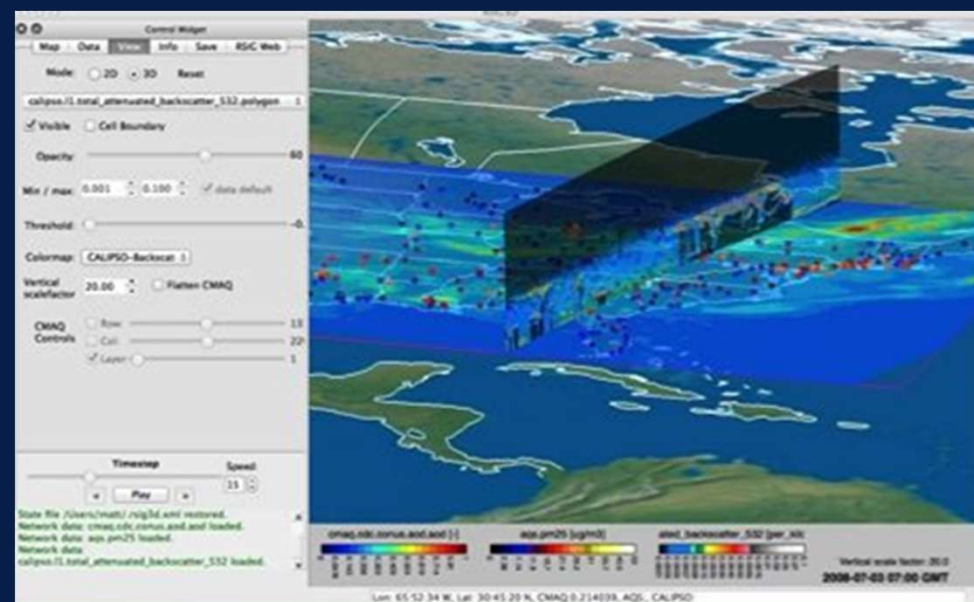


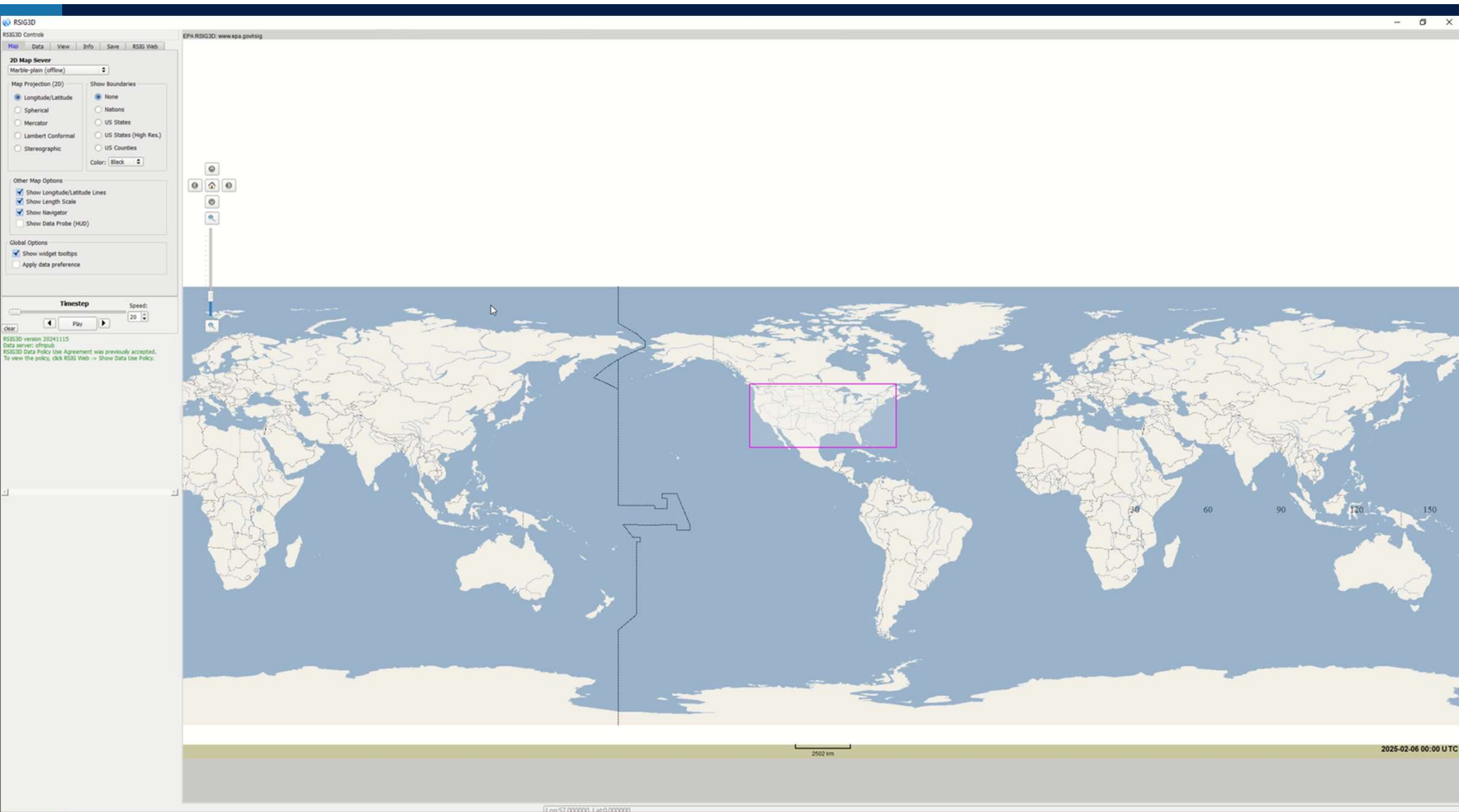
CALIPSO Data in the Cloud

- Primary motivations
 - To allow the science community to do unprecedented science with unconstrained processing and storage capacity across all EOSDIS data in a highly available environment (AWS)
 - The size of future datasets makes on-premise archiving undesirable
 - TEMPO, CLARREO-PF and PREFIRE are ingested on the cloud using Cumulus
- EOSDIS pays for the storage. Users pay for their own compute resources.
- Data download will still be available free of charge.
- User experience will not be interrupted or degraded.
- Activities are being planned in a way to avoid introducing technical and schedule risks and dependencies.

The Remote Sensing Information Gateway

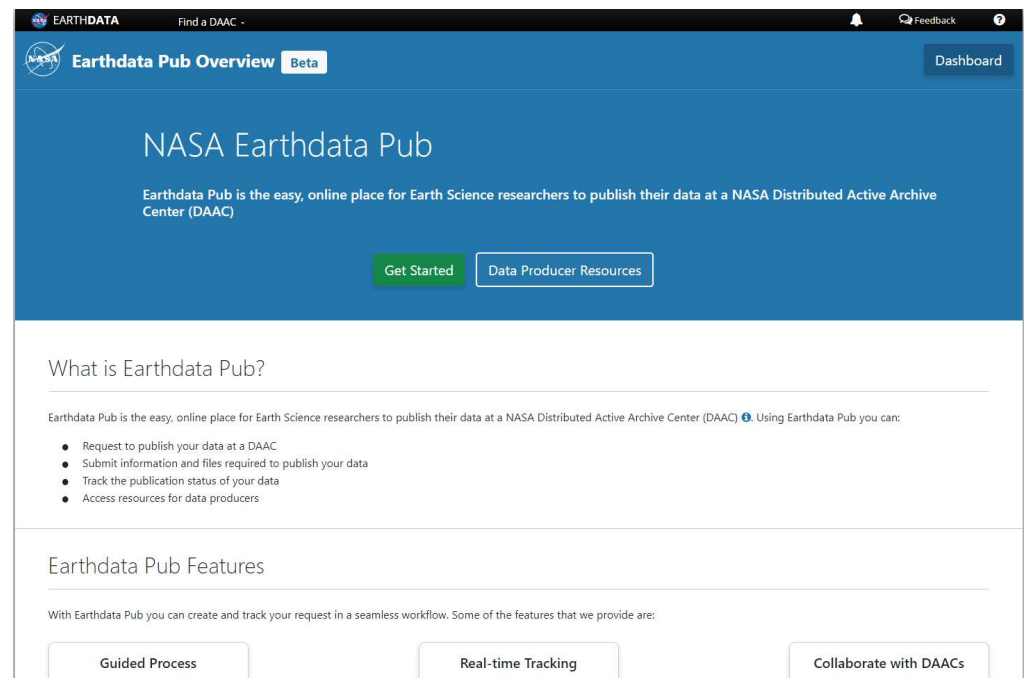
- Access to terabytes of air quality datasets, including satellite, modeled, and in-situ sensor data.
- Easy access to filtering parameters (quality flags, cloud fraction)
- Regrid data to CMAQ model grids





Earthdata Pub

- Request to publish your data at a DAAC
- Submit information and files required to publish your data
- Track the publication status of your data
- Access resources for data producers



Earthdata Forum

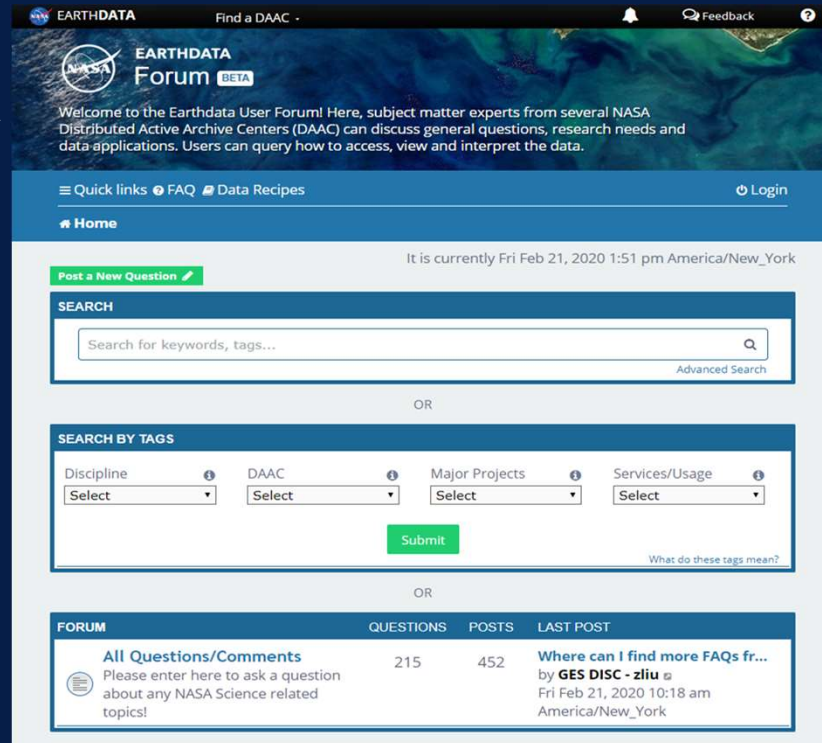
Science Data Users can seamlessly search for information even if they do not know which DAAC the data belongs to.

Scientists & Data Providers can effectively assist their user community in more accurately using their products.

DAACs & Subject Matter Experts (SMEs) can quickly link users to existing resources.

DAAC User Services can swiftly provide inquirers with an authoritative source related to DAAC data products & services.

Tag posts with “ASDC” or “TEMPO”



The screenshot shows the Earthdata Forum website. At the top, there's a header with the NASA logo, 'EARTHDATA Forum BETA', and a search bar for 'Find a DAAC'. Below the header, a welcome message states: 'Welcome to the Earthdata User Forum! Here, subject matter experts from several NASA Distributed Active Archive Centers (DAAC) can discuss general questions, research needs and data applications. Users can query how to access, view and interpret the data.' The main navigation bar includes 'Quick links', 'FAQ', 'Data Recipes', and a 'Login' button. A 'Home' link is also present. The central area features a 'Post a New Question' button and a 'SEARCH' section with a text input field and an 'Advanced Search' link. Below the search bar, there's a 'SEARCH BY TAGS' section with four dropdown menus: 'Discipline', 'DAAC', 'Major Projects', and 'Services/Usage', each with a 'Select' option. A 'Submit' button is located below these dropdowns. At the bottom, there's a 'FORUM' section with a table showing 'QUESTIONS', 'POSTS', and 'LAST POST'. The table has one row with the title 'All Questions/Comments', 215 questions, 452 posts, and a last post by 'GES DISC - zliu' on 'Fri Feb 21, 2020 10:18 am America/New_York'.

FORUM	QUESTIONS	POSTS	LAST POST
All Questions/Comments Please enter here to ask a question about any NASA Science related topics!	215	452	Where can I find more FAQs fr... by GES DISC - zliu Fri Feb 21, 2020 10:18 am America/New_York

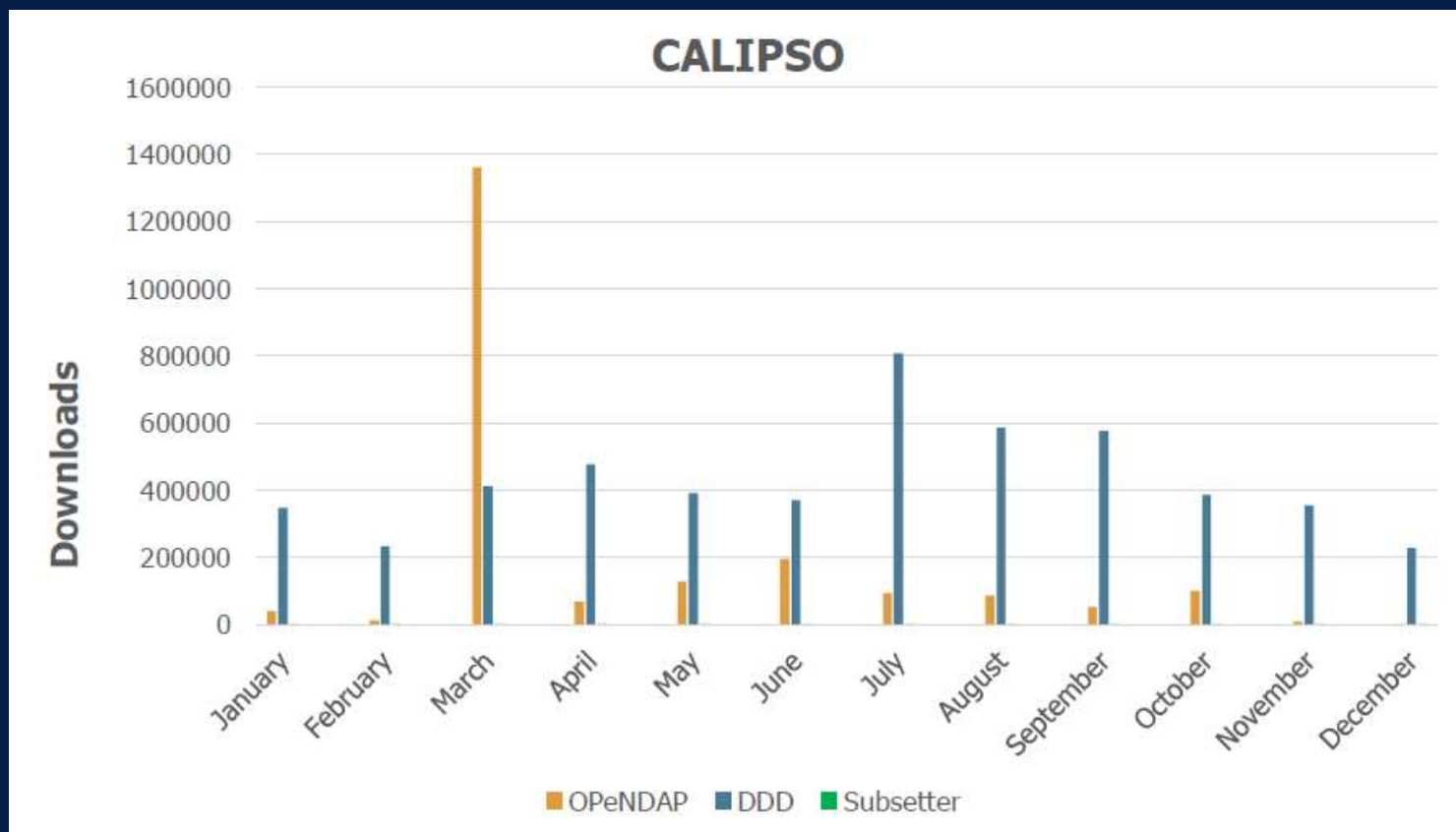


<https://forum.earthdata.nasa.gov/>

A satellite view of Earth from space, showing the curvature of the planet and various geographical features like clouds, oceans, and landmasses. The image is dark blue, suggesting a night or deep space perspective.

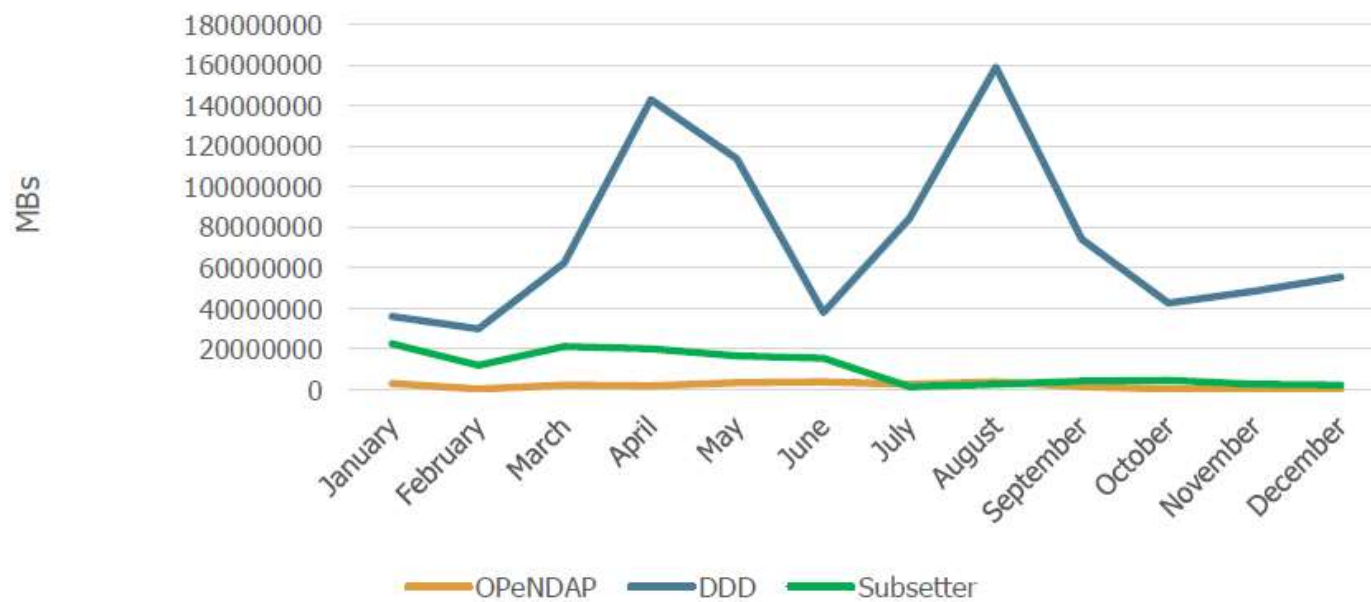
EARTHDATA

earthdata.nasa.gov



EARTHDATA

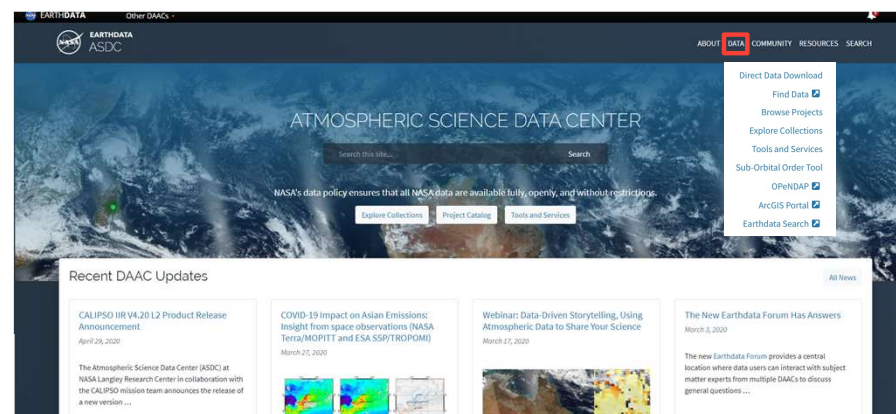
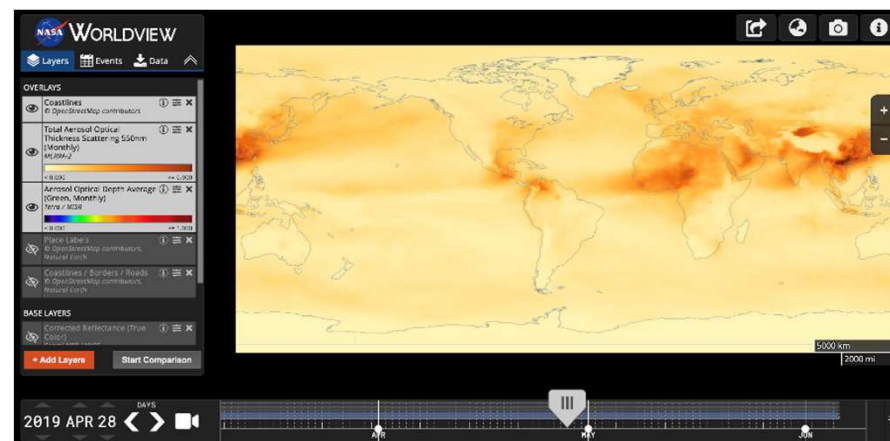
CALIPSO



EARTHDATA

ASDC Data Distribution: Tools and Services

- ✓ [NASA Earthdata Search](#)
 - metadata ◦ browse ◦ download
 - customize ◦ HTTPS and AWS S3 direct data access
- ✓ [NASA Earthdata WorldView](#)
 - visualize ◦ GIBS API
- ✓ [NASA Earthdata Harmony](#)
 - transform ◦ subset ◦ reformat
- ✓ [NASA Earthdata GIS](#)
 - ArcGIS Image & Feature Service
 - OGC WMS, WFS & WCS
- ✓ [OPeNDAP](#)
 - transform ◦ subset ◦ reformat



<https://asdc.larc.nasa.gov/>

User Support and Other Resources

Example scripts

- Python/Jupyter Notebook ◦ R scripts
- contributed tutorials/scripts

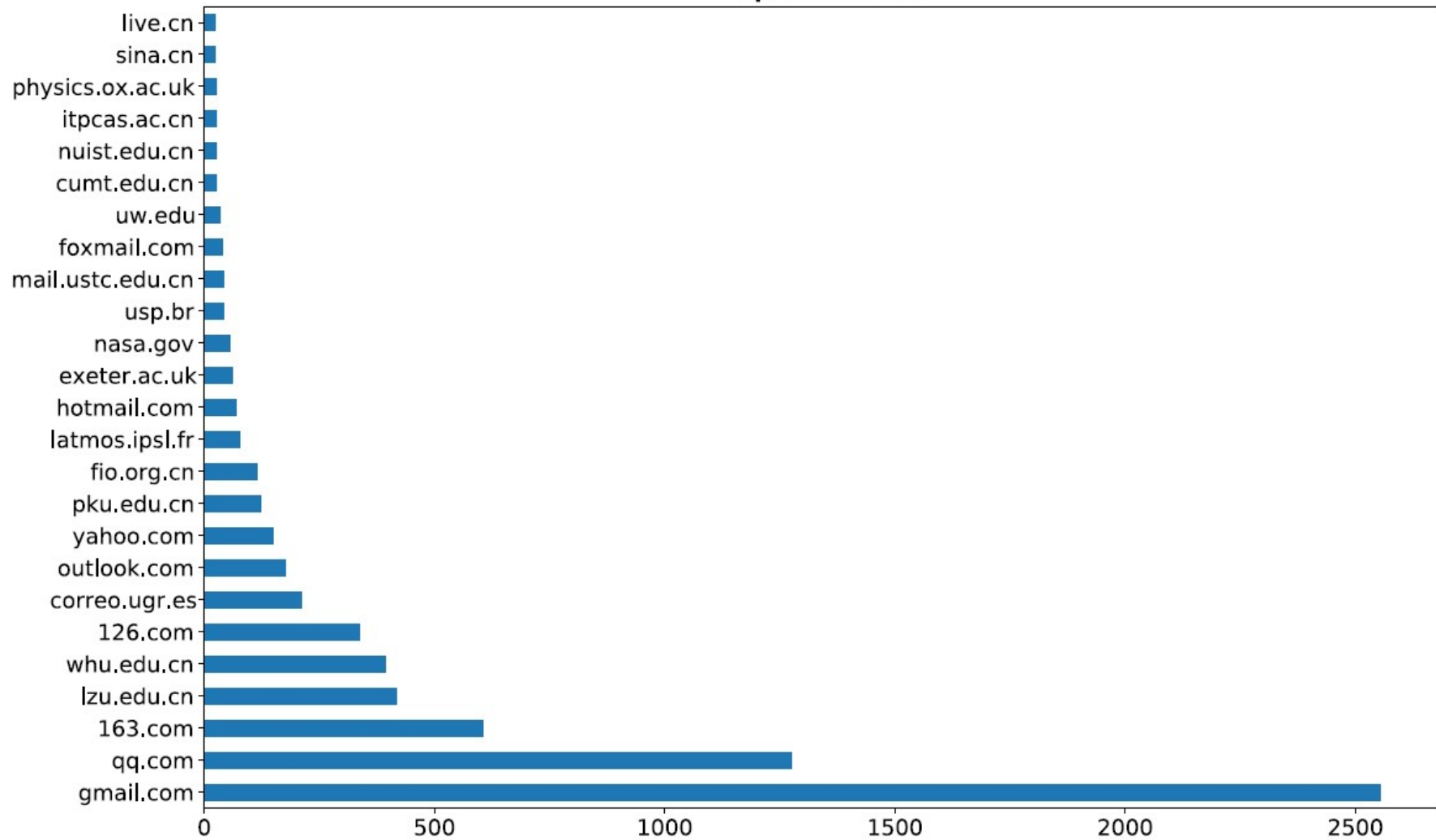


MATLAB

Earthdata Forum <https://forum.earthdata.nasa.gov/>

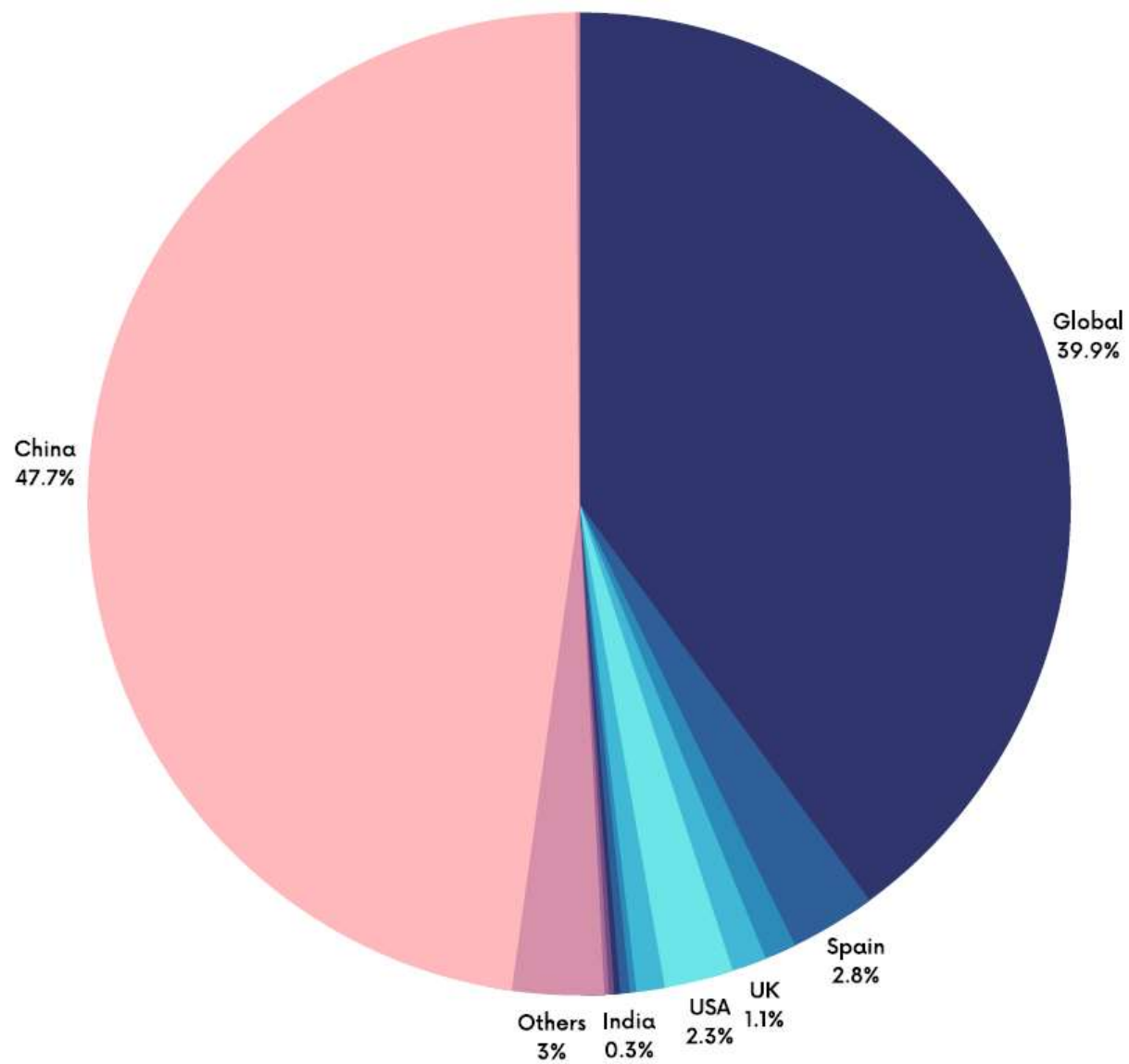
ASDC User Support support-asdc@earthdata.nasa.gov

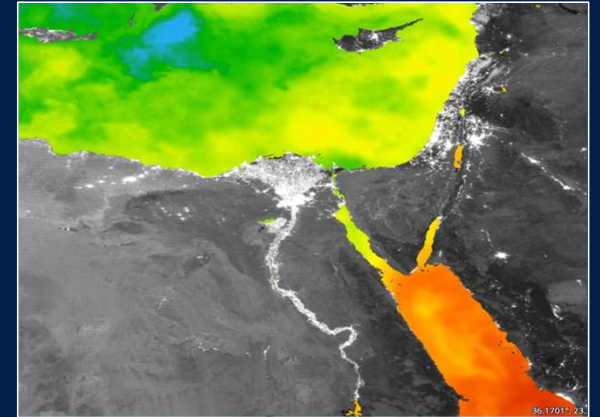
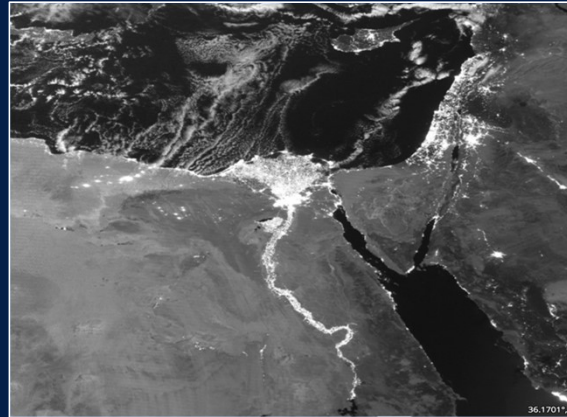
Top 25 email list





EARTH





NASA's Earth Data is the single largest repository of Earth science data in the world.

Atmospheric Science Data Center

NASA Langley Research Center
Hampton, Virginia (USA)

<https://asdc.larc.nasa.gov/>

Hazem.Mahmoud@nasa.gov

EXPLORE EARTH

- ASDC Overview
- DSCOVR Data Products and Distribution
- Data Distribution Tools and Services
- DSCOVR data on the Cloud
- Discussion



EARTHDATA

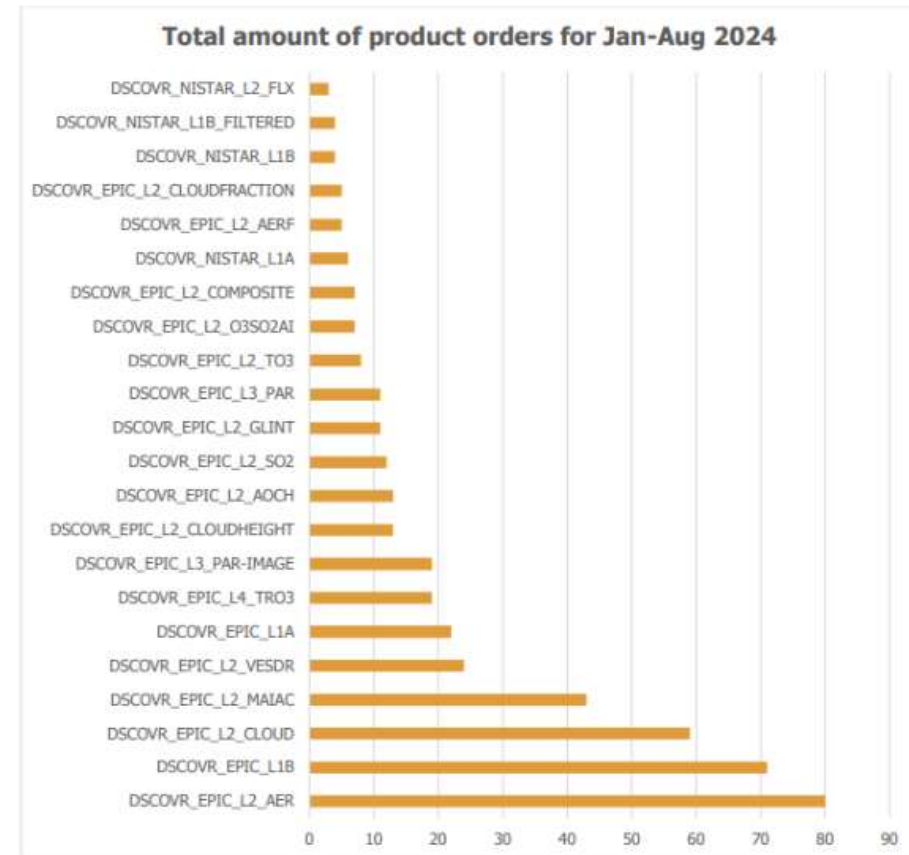
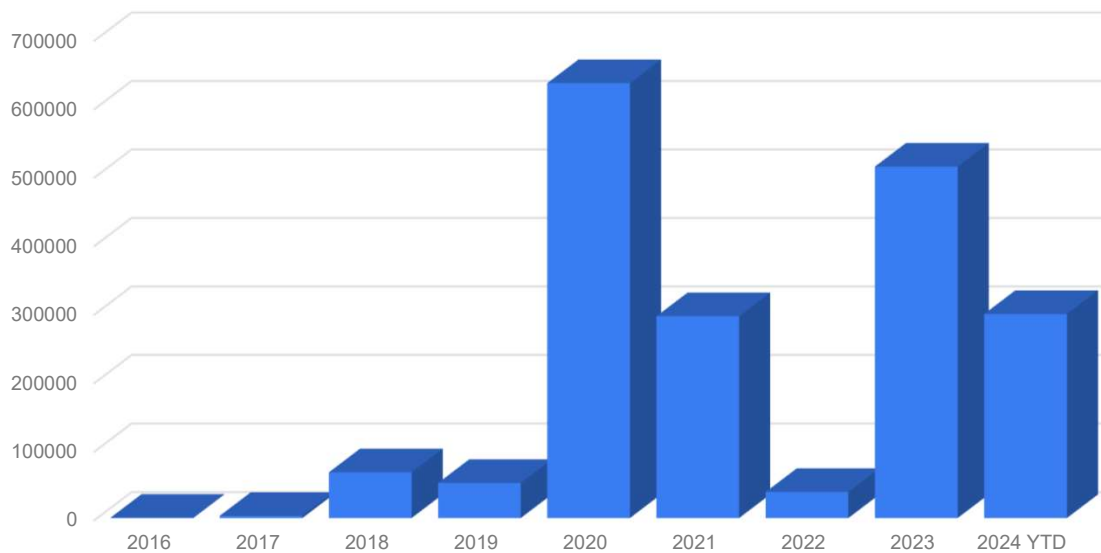
The Science Directorate at NASA's Langley Research
Center

DSCOVER Data Products: Number of Files and Size per Product for 2024

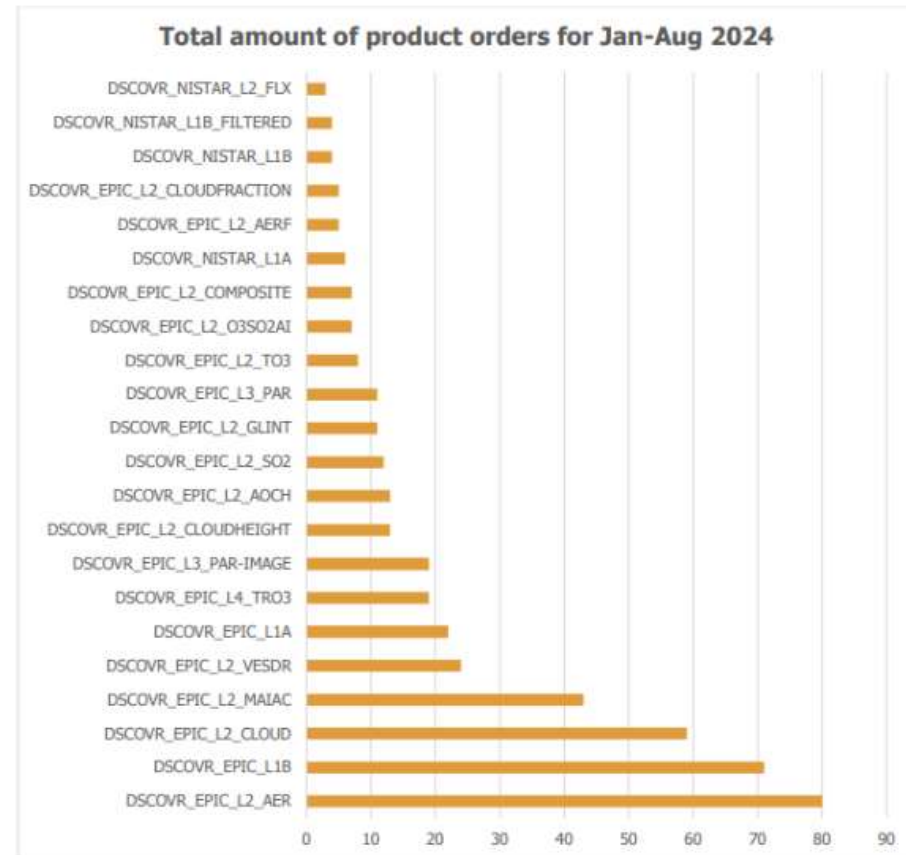
Volume downloaded:

- 2023: 71 TB for 512K granules
- 2024 YTD: 53 TB for 297K granules

EPIC/NISTAR Total Granules Distribution per year

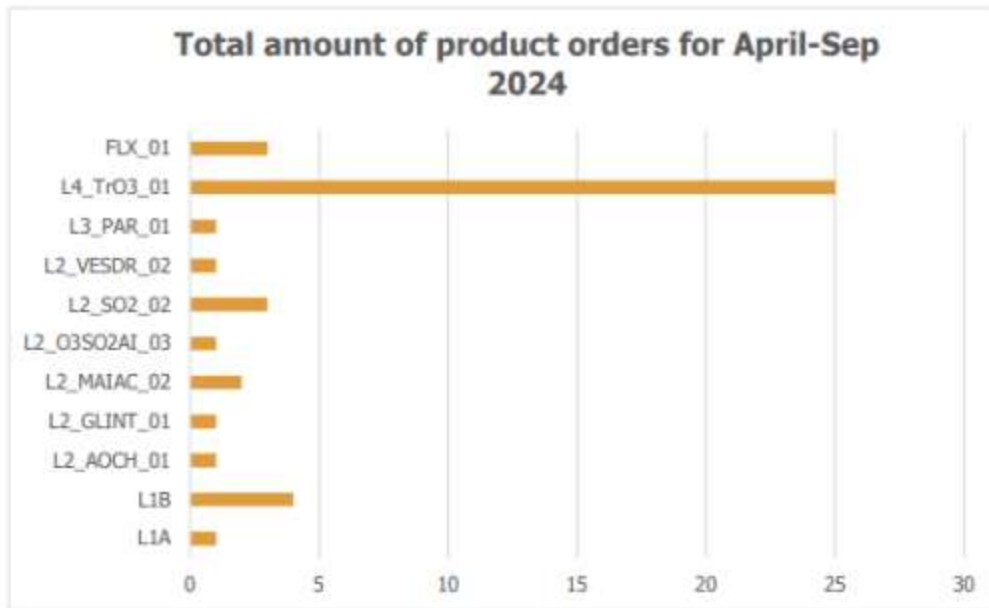


2023 vs. 2024



Users per Country

OPeNDAP Orders



Country	#Orders 2023	Country	# Orders Jan-Aug 2024
United States	323	United States	169
China	154	China	119
Germany	32	Korea South	24
Finland	14	United Kingdom	16
France	10	India	15
United Kingdom	9	France	13
India	9	Germany	11
Portugal	7	Japan	8
Switzerland	5	Belgium	7
Italy	4	Finland	5
Korea South	4	Indonesia	5
Poland	3	Ethiopia	5
Colombia	3	Taiwan	4
Bangladesh	3	Israel	4
Japan	3	Sweden	4
Turkey	3	Singapore	3
Ecuador	3	Italy	3
Australia	3	Canada	2
Russian Federation	2	Chile	2
Jordan	2	Thailand	2
Brazil	2	Venezuela	2
Chile	2	Argentina	2
Greece	2	Mexico	2
Romania	2	Portugal	1
Belgium	2	Belarus	1
Iran	2	Uzbekistan	1
Egypt	2	Vietnam	1
Vietnam	1	United Arab Emirates	1
Taiwan	1	Nigeria	1
Guatemala	1	Austria	1
Malta	1	Pakistan	1
Algeria	1	Lebanon	1
Ukraine	1	Bolivia	1
Pakistan	1	Brazil	1
Honduras	1	Poland	1
Mexico	1	Australia	1
Philippines	1	Spain	1
Ethiopia	1	Kenya	1
Namibia	1	Afghanistan	1
Indonesia	1	Czech Republic	1
Senegal	1	Turkey	1
Uruguay	1	Tajikistan	1

DSCOVER data in the Cloud

- Primary motivations
 - To allow the science community to do unprecedented science with unconstrained processing and storage capacity across all EOSDIS data in a highly available environment (AWS)
 - The size of future datasets makes on-premise archiving undesirable
 - TEMPO, CLARREO-PF and PREFIRE are ingested on the cloud using Cumulus
- EOSDIS pays for the storage. Users pay for their own compute resources.

DSCOVER EPIC Level 2 UV Aerosol Version 3

45,165 Granules 2015-06-16 ongoing    

DSCOVER_EPIC_L2_AER_03 is the Deep Space Climate Observatory (DSCOVER) Enhanced Polychromatic Imaging Camera (EPIC) Level 2 UV Aerosol Version 3...

GEOS5 • DSCOVER_EPIC_L2_AER v03 - NASA/LARC/SD/ASDC



DSCOVER EPIC Level 2 UV Aerosol Version 3

111 Granules 2015-06-16 ongoing      Earthdata Cloud

DSCOVER_EPIC_L2_AER_03 is the Deep Space Climate Observatory (DSCOVER) Enhanced Polychromatic Imaging Camera (EPIC) Level 2 UV Aerosol Version 3...

GEOS5 • DSCOVER_EPIC_L2_AER v03 - NASA/LARC/SD/ASDC



Why NASA is studying Earth's Atmosphere?

- To go to space.
- Weather Forecasting & Data Assimilation.
- Air Quality Assessment.
- Ozone Layer Monitoring.
- To understand Earth's Climate.



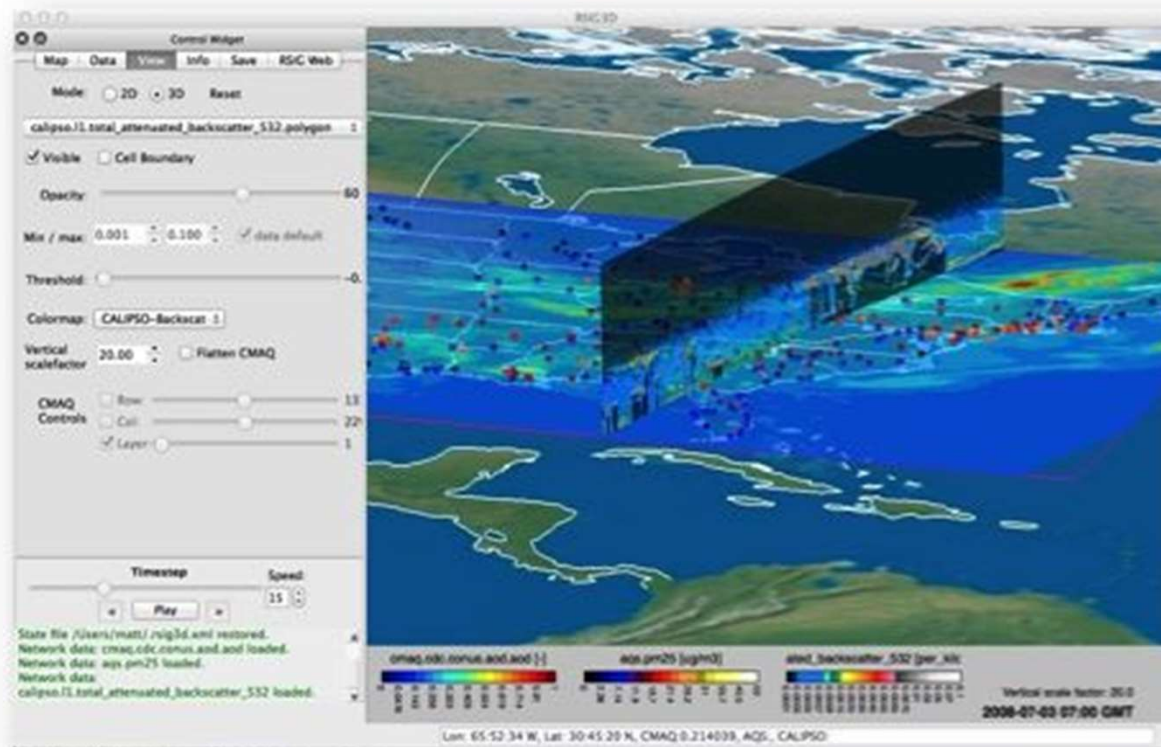
EARTHDATA

But First! What's a DAAC?

NASA's Distributed Active Archive Centers (DAACs)

A federated approach to data management

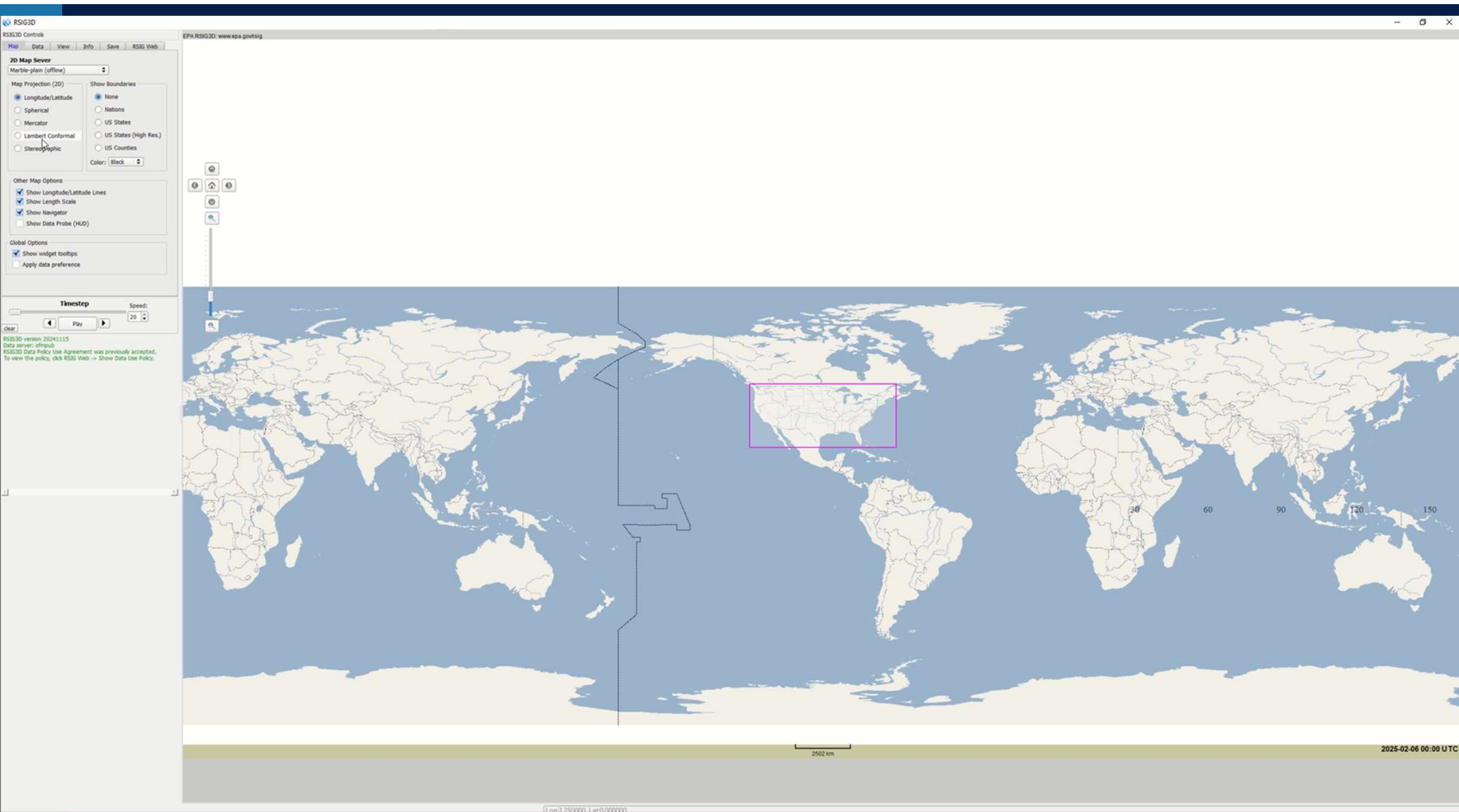




RSIG3D



EARTHDATA



Surface & Near-Surface Observations



Airborne Observations



Spaceborne Observations



Air Pollution Historic Impact on Human

Credit: Herald-Examiner
Collection photo courtesy of
The Los Angeles Public Library

California Pollution
Law passed

Poza Mexico
22 dead

Air Quality Control
Act passed

EPA created to
enforce pollution
laws.

1947

1950

1955

1970

1930

Meuse River Valley,
Belgium
63 dead

1948

Donora, PA industrial area of
steel zinc and sulfuric acid
factories. Fog settled in within
a week. 20 people died and
7000 were seriously ill.

1952

London Fog
4000 dead

1963

Clean Air Act was
amended 1970 for vehicle
emissions



Credit: The Brussels Times

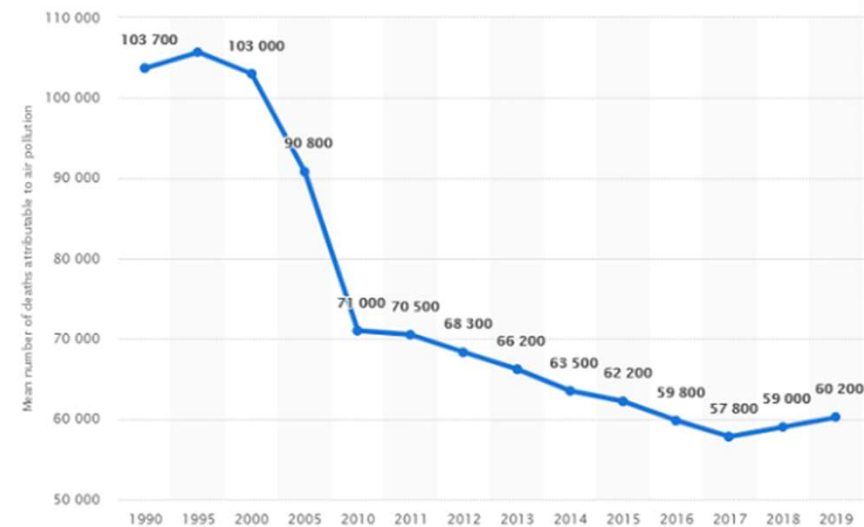
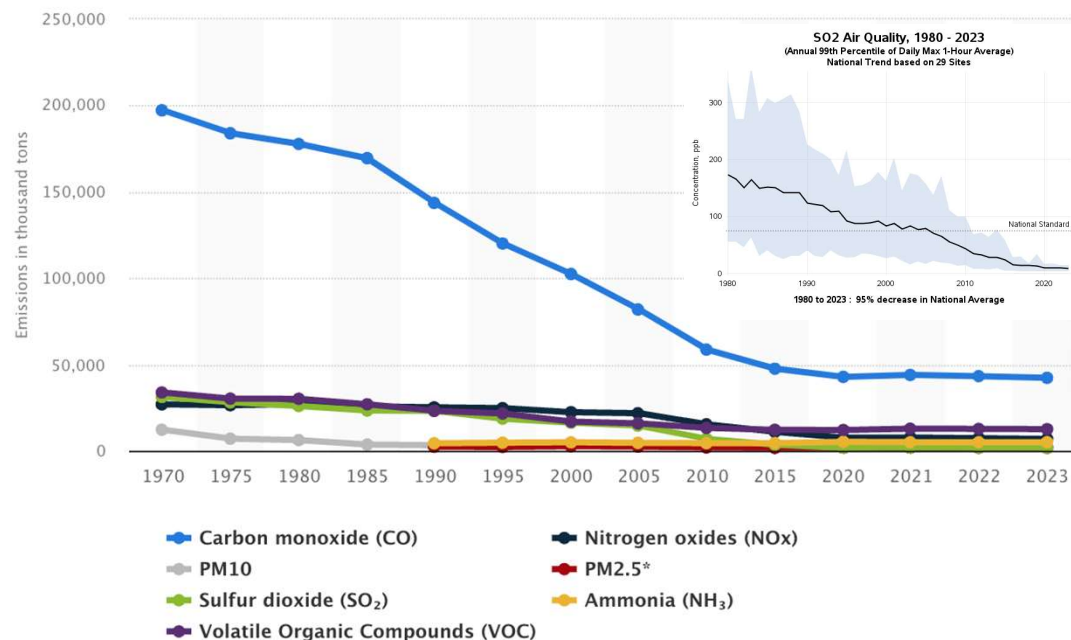


Credit: The Library of Congress

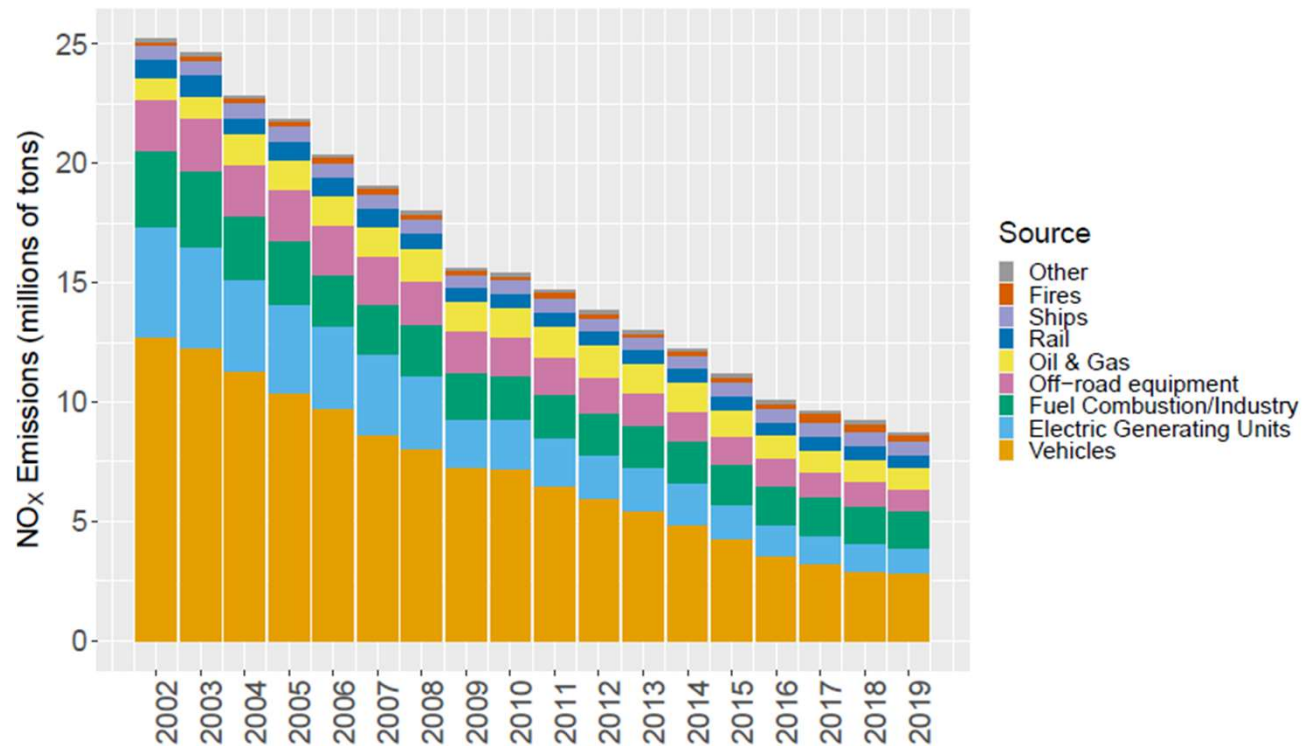


Credit: Public Domain

Air pollutant emissions in the United States from 1970 to 2023, by pollutant (Excluding Fires and Sandstorms)



Number of deaths attributable to air pollution in the United States from 1990 to 2019



Annual total U.S. anthropogenic NO_x emissions from the EQUATES CMAQ-ready emissions in millions of short tons broken down by 9 broad source categories: vehicles; electric generating units; fuel sources from combustion, industry and other sources; off-road equipment; oil and gas, railroad locomotives (rail); commercial marine vessels (ships); prescribed and wild fires; other sources (including fugitive dust, agriculture, residential wood combustion).

THE RELATIVE SIZE OF PARTICLES

From the COVID-19 pandemic to the U.S. West Coast wildfires, some of the biggest threats now are also the most microscopic.

A particle needs to be 10 microns (μm) or less before it can be inhaled into your respiratory tract. But just how small are these specks?

Here's a look at the relative sizes of some familiar particles »

HUMAN HAIR 50-180 μm »
FOR SCALE

FINE BEACH SAND 90 μm »

GRAIN OF SALT 60 μm »

WHITE BLOOD CELL 25 μm »

GRAIN OF POLLEN 15 μm »

DUST PARTICLE (PM₁₀) <10 μm »

RED BLOOD CELL 7-8 μm »

RESPIRATORY DROPLETS 5-10 μm »

DUST PARTICLE (PM_{2.5}) 2.5 μm »

BACTERIUM 1-3 μm »

WILDFIRE SMOKE 0.4-0.7 μm »

CORONAVIRUS 0.1-0.5 μm »

T4 BACTERIOPHAGE 0.225 μm »

ZIKA VIRUS 0.045 μm »



Pollen can trigger allergic reactions and hay fever—which 1 in 5 Americans experience every year.
Source: Harvard Health

The visibility limits for what the naked eye can see hovers around 10-40 μm .



Respiratory droplets have the potential to carry smaller particles within them, such as dust or coronavirus.



Wildfire smoke can persist in the air for several days, and even months.

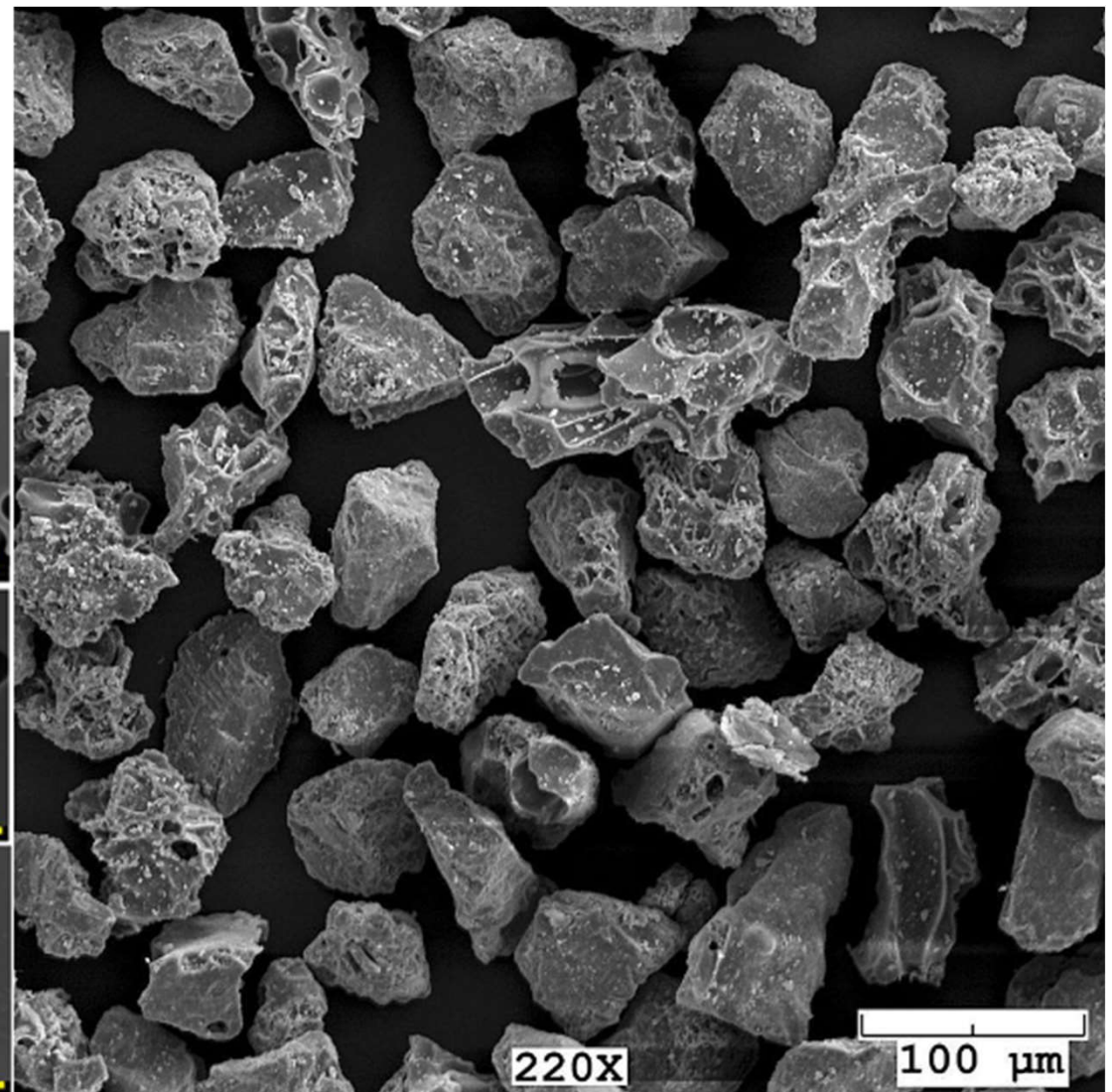
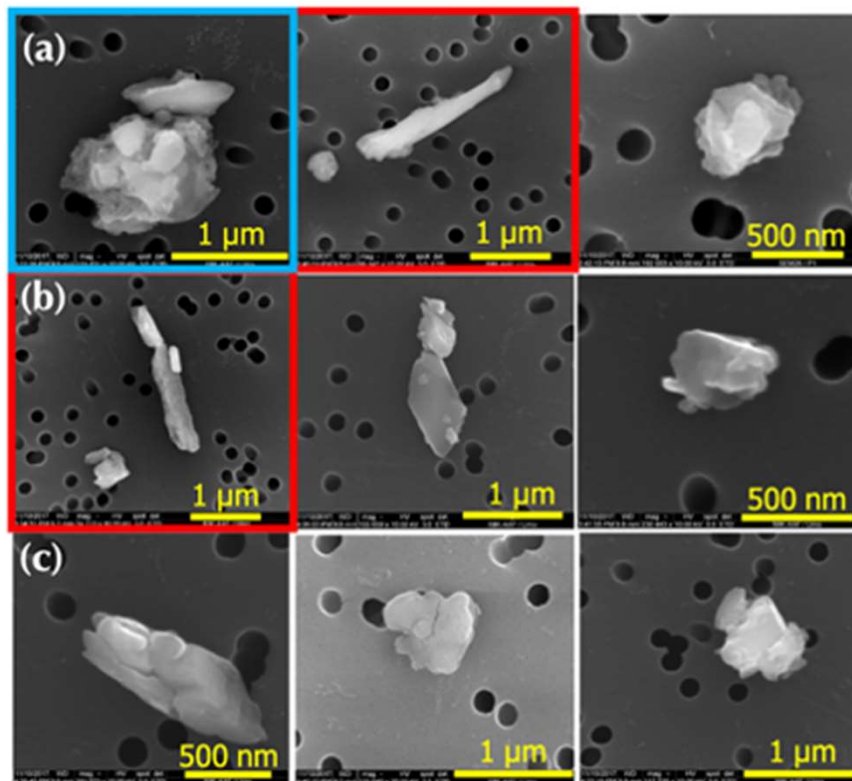
SOURCES Ceresheim, Doris; Lowrey, EPA, Financial Times, News Medical, Science Direct, SCMR, Susan Sokolowski, Patoclar, U.S. Dept. of Energy
COLLABORATORS **RESEARCH + WRITING** Carren Ang, Iran Ghazi | **DESIGN + ART DIRECTION** Herman Schell



<https://www.visualcapitalist.com/visualizing-relative-size-of-particles/>

Aerosols

UMO et al. 2021



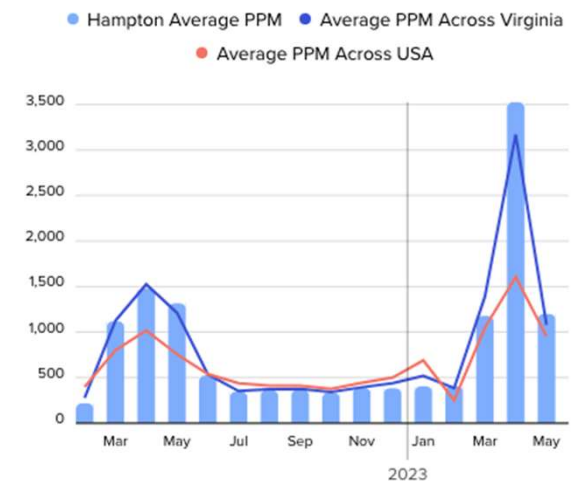
Sources of Air Pollution in Hampton, VA

- Vehicle Emissions
- Industrial Activities
- Shipping and Port Activities
- Power Generation
- Residential Heating and Cooking
- Construction
- Wildfires
- Pollen
- Landfills



Hampton, VA Pollen PPM

February 2022 – May 2023

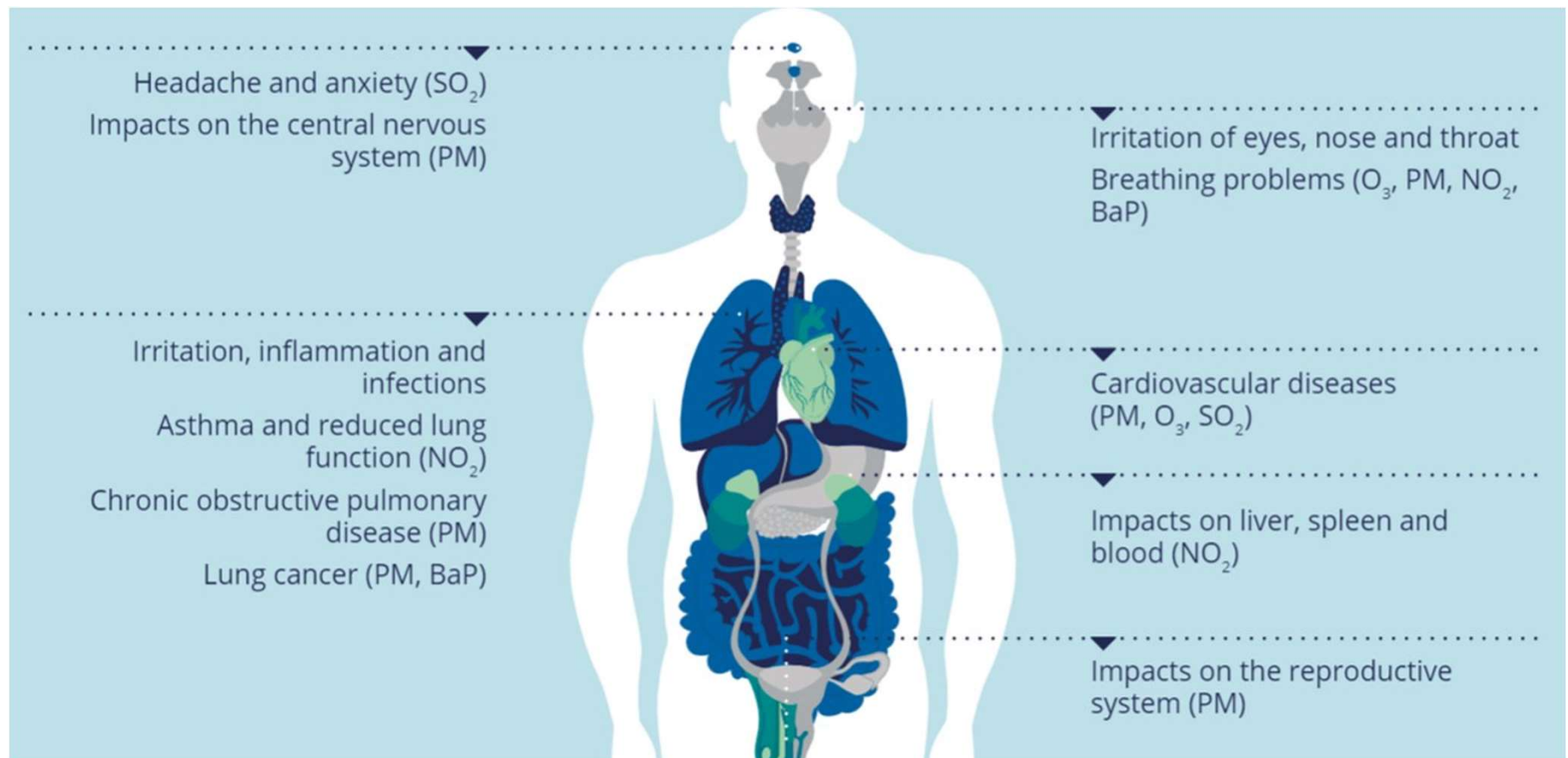


WYNDLY | wyndly.com



Creative Commons: Credit: [Kevin Trotman](#)

Impact on Human Health



EARTHDATA

European Environment Agency 2023

<https://www.eea.europa.eu/en/topics/in-depth/air-pollution/eow-it-affects-our-health>

National Aeronautics and
Space Administration



EARTH FLEET



Key

- International Partners
- U.S. Partner
- ISS Instrument
- JPSS Instrument
- Cubesat
- Launch Date TBD
- Earth System
- Observatory Mission
- (Pre) Formulation
- Implementation
- Operating
- Extended

Invest/CubeSats

- NACHOS 2022
- CTIM 2022
- NACHOS-2 2022
- MURI-FD 2023
- SNOOP* 2024
- HYTI* 2024
- ARGOS* 2024

JPSS Instruments

- OMPS-LIMB 2022
- LIBERA 2027
- OMPS-LIMB 2027
- OMPS-LIMB 2032

ISS INSTRUMENTS

MISSIONS

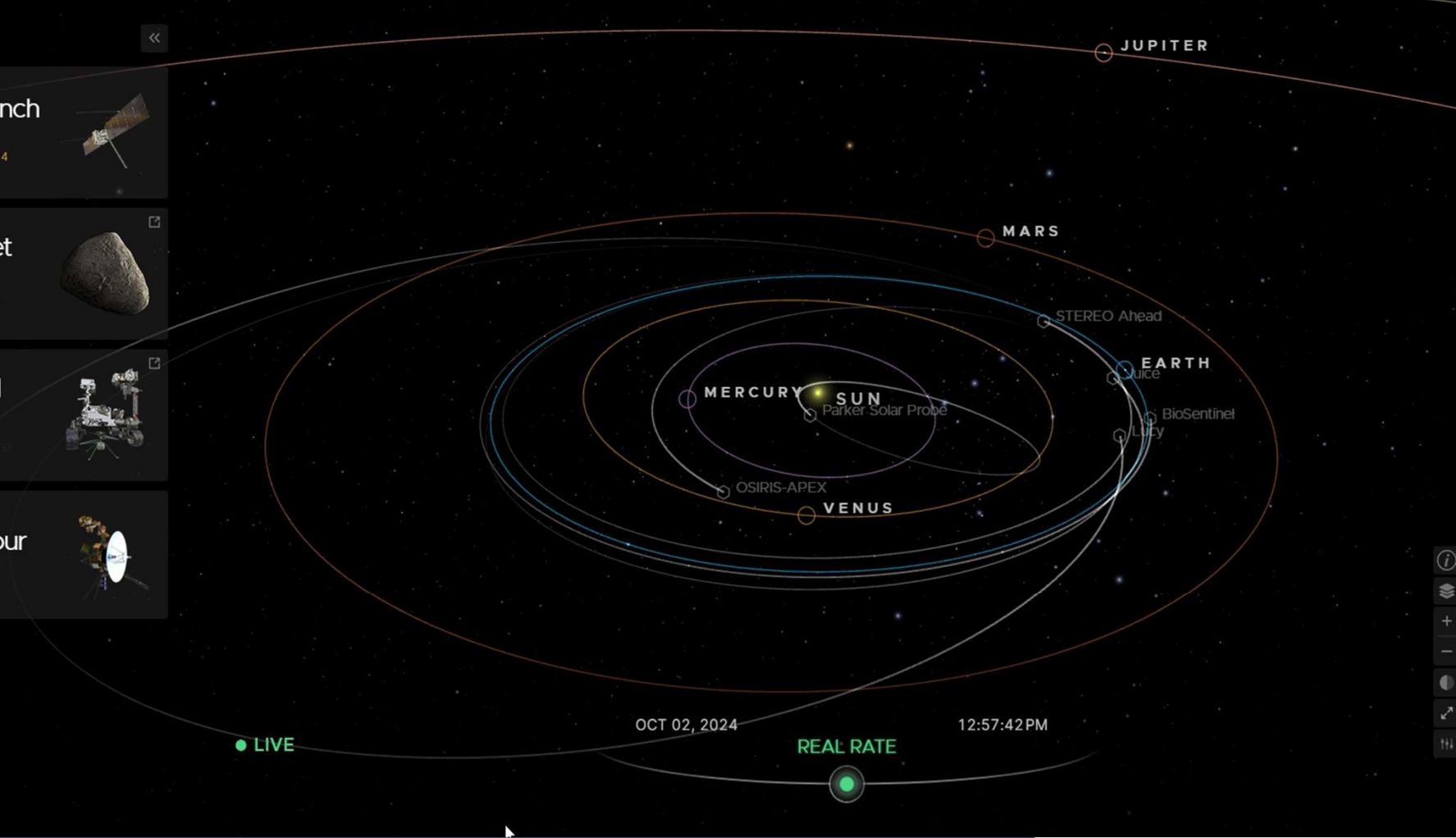
Featured Stories and Events

Europa Clipper Launch
MISSION LAUNCH
OCTOBER 10TH, 2024

Asteroid and Comet Missions
EYES ON ASTEROIDS

Entry, Descent, and Landing
PERSEVERANCE

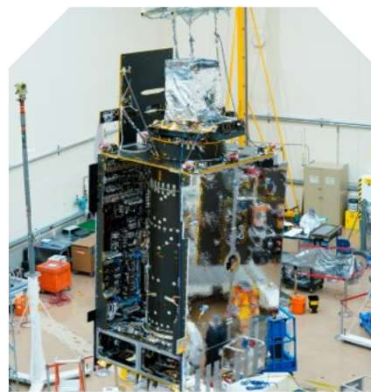
Voyager's Grand Tour
1977 - TODAY



Information and navigation controls including a search icon, share icon, menu icon, and a vertical stack of icons for zooming and playback.

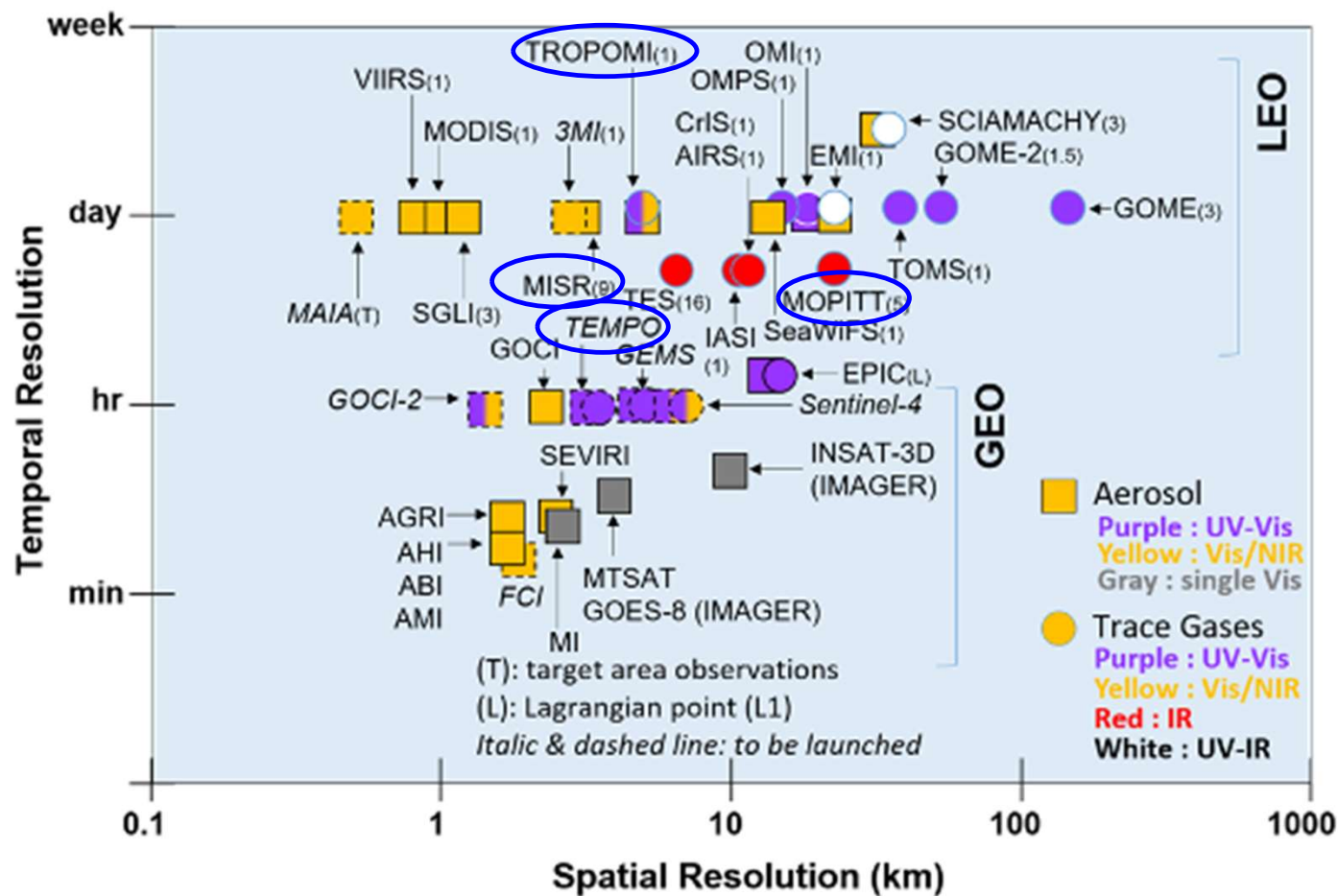
Tropospheric Emissions: Monitoring of Pollution

- Hourly daytime air pollution measurements over North America.
- NASA's first Earth Venture Instrument (EVI), selected in 2012.
- First Light August 2nd 2023 Mission objective is 20 months.
- **Geostationary orbit** means TEMPO can scan the continent continuously.
 - High temporal resolution
 - High spatial resolution
- Baseline data products:
 - Ozone
 - Nitrogen dioxide
 - Formaldehyde
 - Cloud Fraction



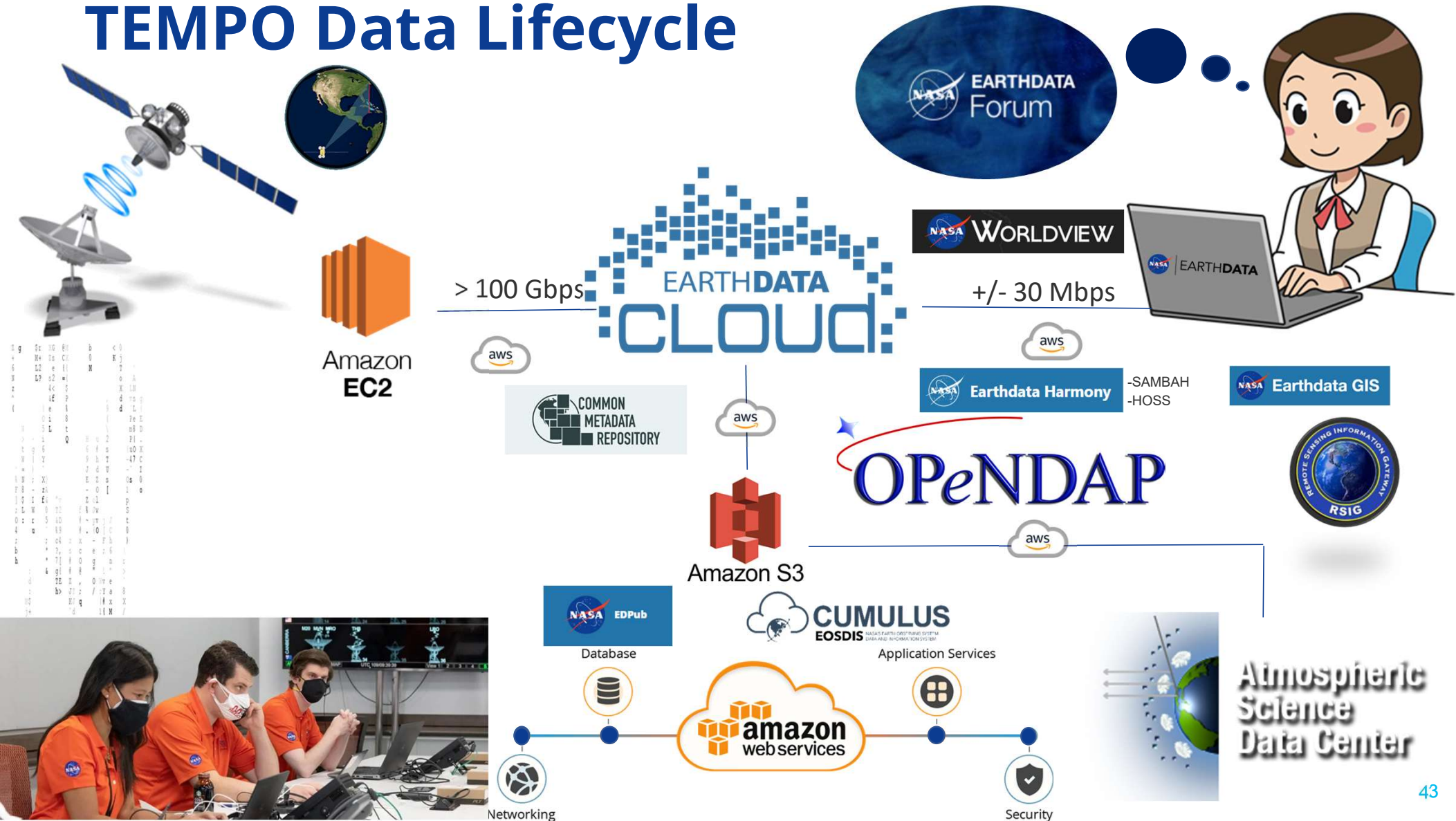
Credit: NASA's Scientific Visualization Studio

Air Quality from Space

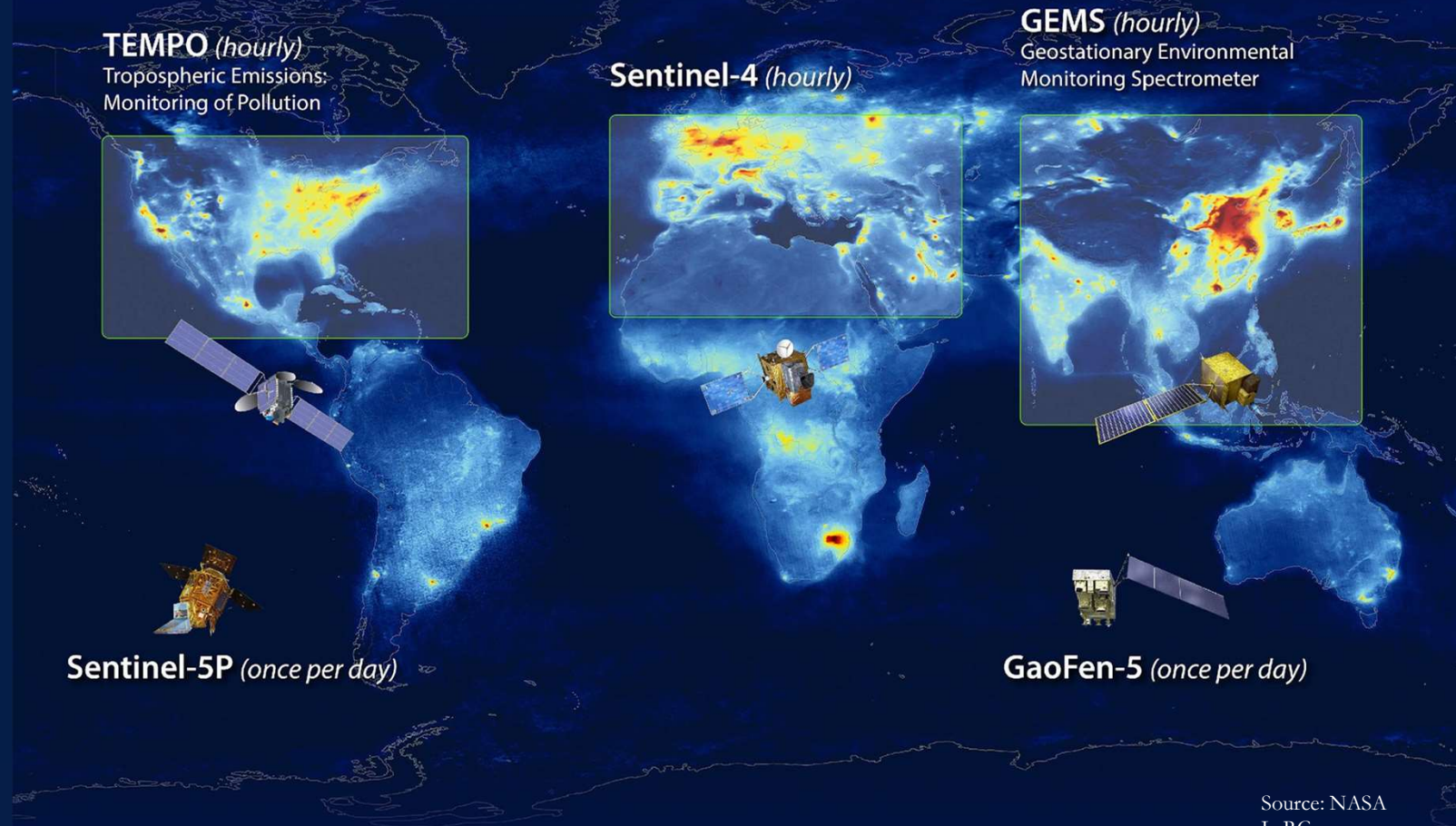


Kim et al. (BAMS 2020)

TEMPO Data Lifecycle



Atmospheric Composition Geostationary Constellation



TEMPO Operations

Nominal scans

2048 North/South pixels
1181 East/West steps per hour
2 x 4.75 km² at center of field of regard

Optimized scans

Higher temporal resolution AM and PM scans over coasts (40 minutes)

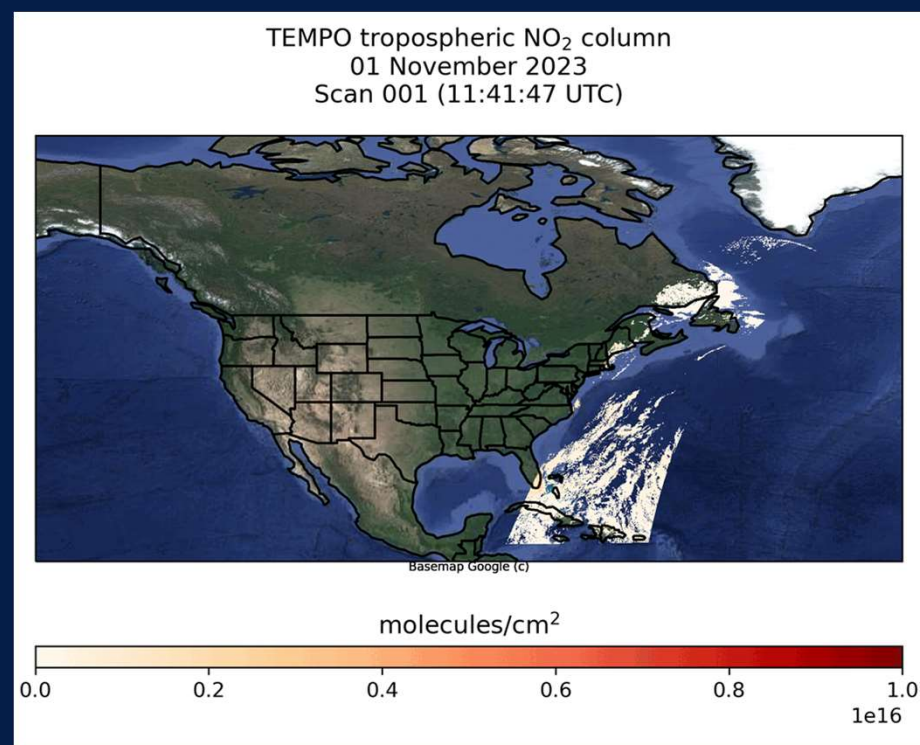
Twilight scans (city lights)

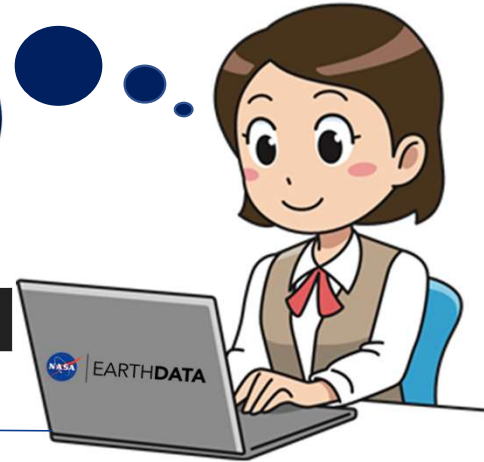
Performed during darkness, before morning scans

High-time scans

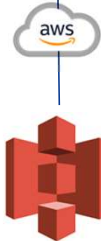
Frequent scans (5 to 10 minutes) over selected longitudes

Rare → can be requested but require science team approval



The logo for EarthData Cloud features a stylized graphic of blue squares arranged in a grid-like pattern that tapers off to the right, resembling a digital or data visualization. Below this graphic, the text "EARTH DATA" is written in a blue, sans-serif font, with "EARTH" in all caps and "DATA" in a slightly larger, bold font. Below "EARTH DATA", the word "cloud" is written in a large, blue, lowercase, sans-serif font.

+/- 30 Mbps



Amazon S3



CUMULUS
EOSDIS NASA'S EARTH ORBITING SYSTEM
DATA AND INFORMATION SYSTEM

Application Services



- SAMBAH
- HOSS



OPeNDAP



Database



Security



**Atmospheric
Science
Data Center**



TEMPO Level 2 & Level 3 products

Product	Level(s)	Description	Most relevant variables in level 2 and level 3 file
NO2	2 & 3	Nitrogen dioxide total, tropospheric, and stratospheric columns	vertical_column_troposphere, vertical_column_stratosphere
HCHO	2 & 3	Total formaldehyde columns	vertical_column
O3TOT	2 & 3	Total ozone columns	column_amount_o3
CLDO4	2 & 3	Cloud parameters	cloud_fraction, cloud_pressure

Level 2: Information provided at TEMPO's native resolution (hourly sampling frequency or less; ~10 km²); usually one hour East-West scan is broken in 9 to 10 level 2 files.

Level 3: All level 2 data from a TEMPO East-West scan on a regular grid (0.02° x 0.02°)



JupyterLab (auto-q)

https://openscapes.2i2c.cloud/user/hazemmahmoud88/lab/workspaces/auto-q/tree/RTC%3A

File Edit View Run Kernel Git Tabs Settings Help

Launcher

RTC:

Notebook

Python 3 (pykernel)

desktop [x]

VS Code [x]

Console

Python 3 (ovkernel)

Other

Terminal

Text File

Markdown File

Python File

Show Contextual Help

Jupytertext

Python - Percent Format

MyST Markdown

Name Modified

Aeronet 4 months ago

AMS2025 24 days ago

Convergence 5 months ago

Desktop 10 months ago

DEVELOP 24 days ago

Documents last year

Downloads last year

EGU 14 minutes ago

EMIT-Data-Resources last year

EPA 3 hours ago

HAQAST 3 hours ago

kerchunk_jsons 7 months ago

MAIA 2 months ago

Music last year

myData 8 minutes ago

Pictures last year

prefire 24 days ago

Public last year

RSIG 31 minutes ago

Salt 4 months ago

shared 13 days ago

shared-readwrite last year

Templates last year

TEMPO AOD last month

TEMPO RGB 15 minutes ago

tolnet 6 months ago

Videos last year

AGU-2023-Playbook-TEMPO-shared.ipynb 6 months ago

ATM_SURFACE_TEMP_HUM_WIND_PRES_day_m... last year

CPF_harmony-py_Subsetter_V0.ipynb 8 months ago

DatasetSearch.ipynb 24 days ago

dscov_uvai_exploration_13.ipynb 9 months ago

GMAO_11.ipynb 5 months ago

h4toh5 5 months ago

h42h5.ipynb 5 months ago

How_to_Access_DSCOV_EPIC_L2_TO3_Using_G... 24 days ago

MISR_AM1_RP_GM_P121_O120807_AA_F03_002... 5 months ago

MISR_AM1_RP_GM_P121_O120807_AA_F03_002... 5 months ago

output_animation.mp4 last year

Ozone.gif last year

Pandora85s1_NewOrleansLA-XULA_L2_mv3p1-... last month

S3-Access-TEMPO-Copy1.ipynb last year

S3-Access-TEMPO-L3_v2.ipynb last year

S3-Access-TEMPO-L3_v3.ipynb last year

S3-Access-TEMPO-L3_v4.ipynb 9 months ago

S3-Access-TEMPO-L3.ipynb last year

S3-Access-TEMPO.ipynb 24 days ago

S3-Access.ipynb 9 months ago

Spain_Paris_of_dscov_uvai_exploration_2i2c.ipynb 6 months ago

Subscriber.ipynb 1 minute ago

Simple 0 4 Mem: 775.77 / 1899.00 MB

Would you like to get notified about official Jupyter news?
[Open privacy policy](#) Yes No

Launcher 1 12:08 PM 2/3/2025

Your Needs:

"I will consider my time well spent if I learn how to by the end of this training." responses

- ☐ How to access and analyze data, specifically from TEMPO and TROPOMI
- ☐ Effectively analyze and communicate data
- ☐ Find, filter, and visualize mapping data using GIS
- ☐ Use satellite data and work with partners
- ☐ Find and access different NASA Earth Science datasets
- ☐ Access data and know how to process it
- ☐ Better access NASA satellite data
- ☐ Manipulate and organize spatial data in a way that is effective to a broad array of topics.
- ☐ See an issue or project need and translate it into a meaningful result



EARTHDATA

NASA Data Processing Levels

0

- Unprocessed, reconstructed, full resolution instrument data

1A

- Unprocessed, time-referenced instrument data

1B

- Data processed to sensor units

2

- Derived geophysical variables at same resolution and location as L1

3

- Variables that are mapped on a uniform space-time grid (e.g., data using EASE-Grid)

4

- Modeled output or variables derived from multiple measurements

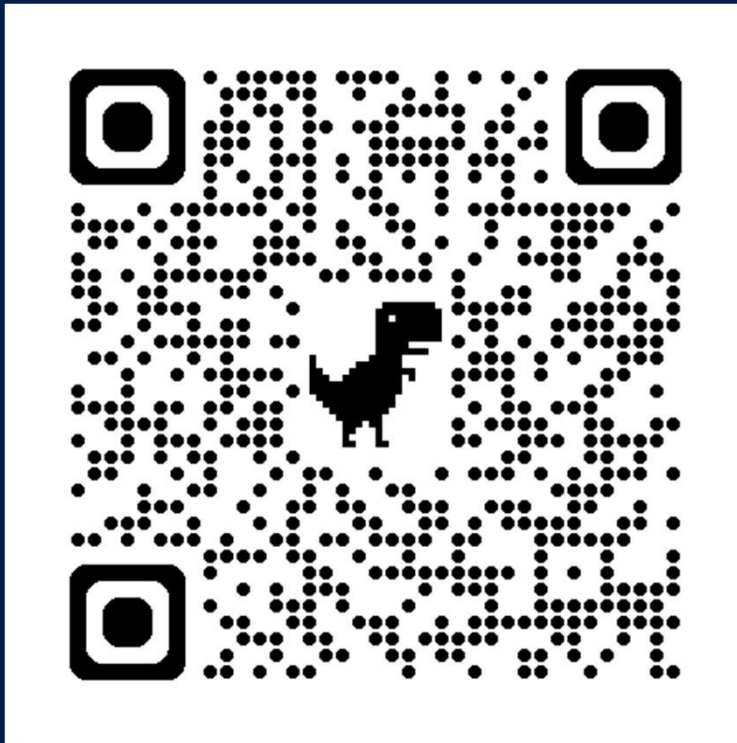


EARTHDATA

Credit: [ESDS](#)

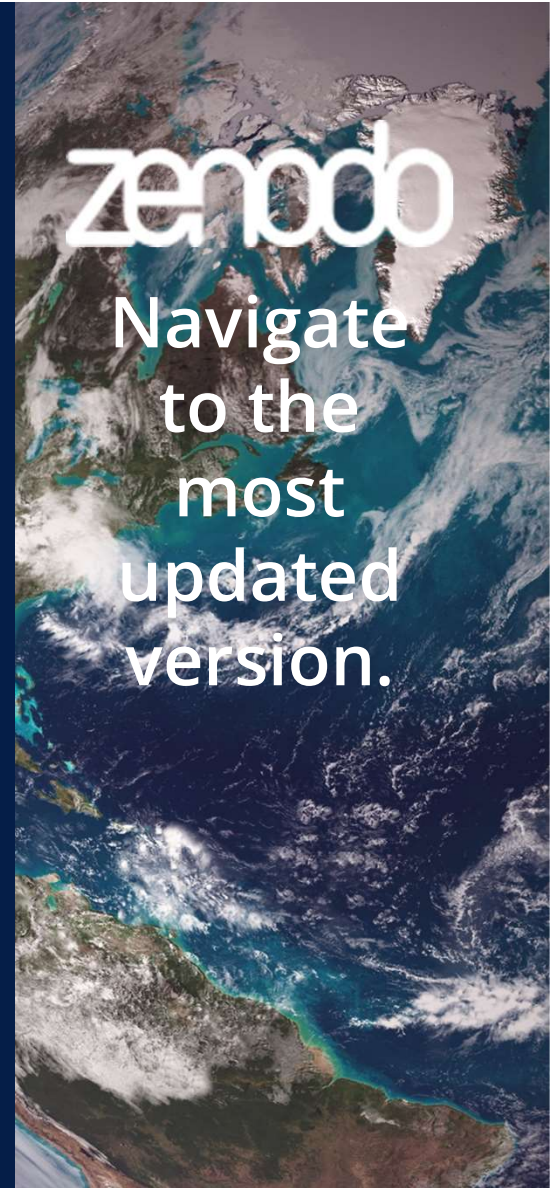
Resource Guide:

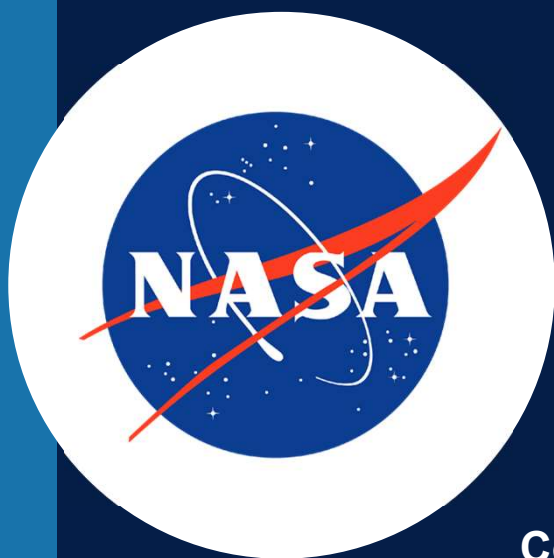
<https://zenodo.org/records/13769260>



zenodo

Navigate
to the
most
updated
version.






**Data &
Computation**



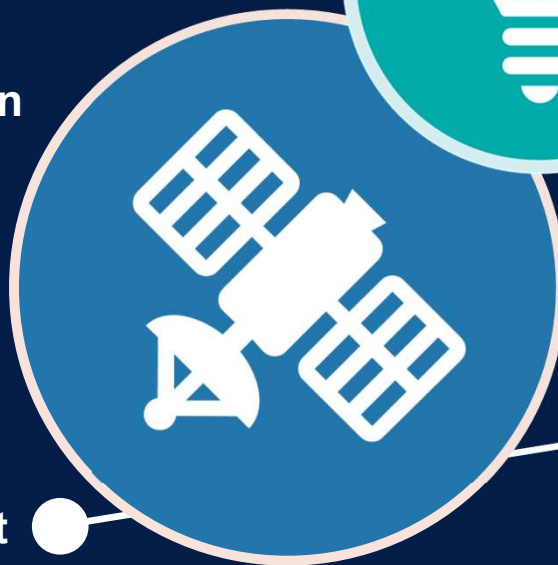
**Research &
Analysis**



Applications



Technology



Flight

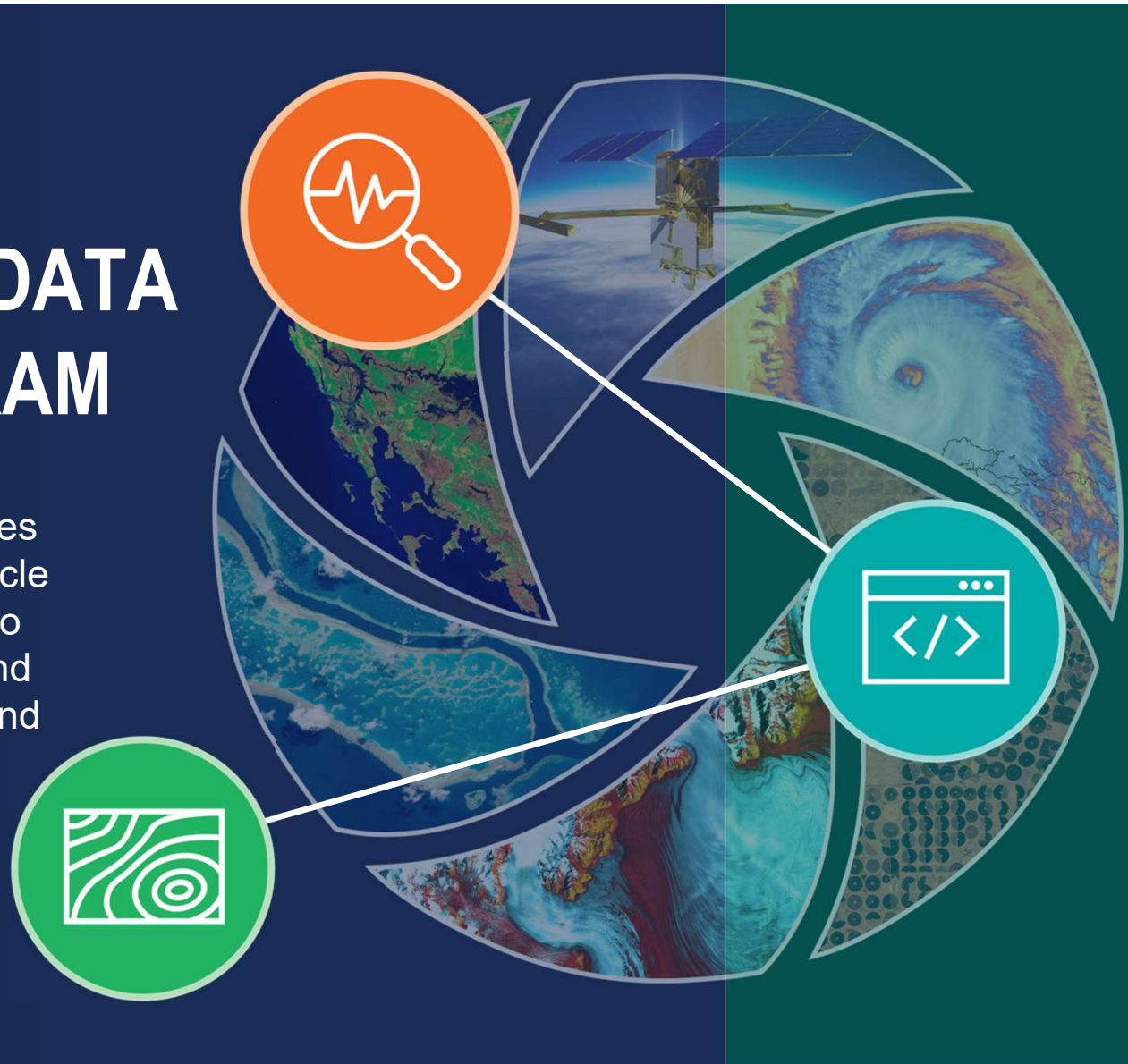
**Activating Earth System
Science takes a diverse
and mighty village!**



EARTHDATA

EARTH SCIENCE DATA SYSTEMS PROGRAM

NASA's Earth Science Data Systems (ESDS) Program oversees the entire Earth science data life cycle and facilitates unrestricted access to the data researchers, managers, and governments need to understand and protect our planet.



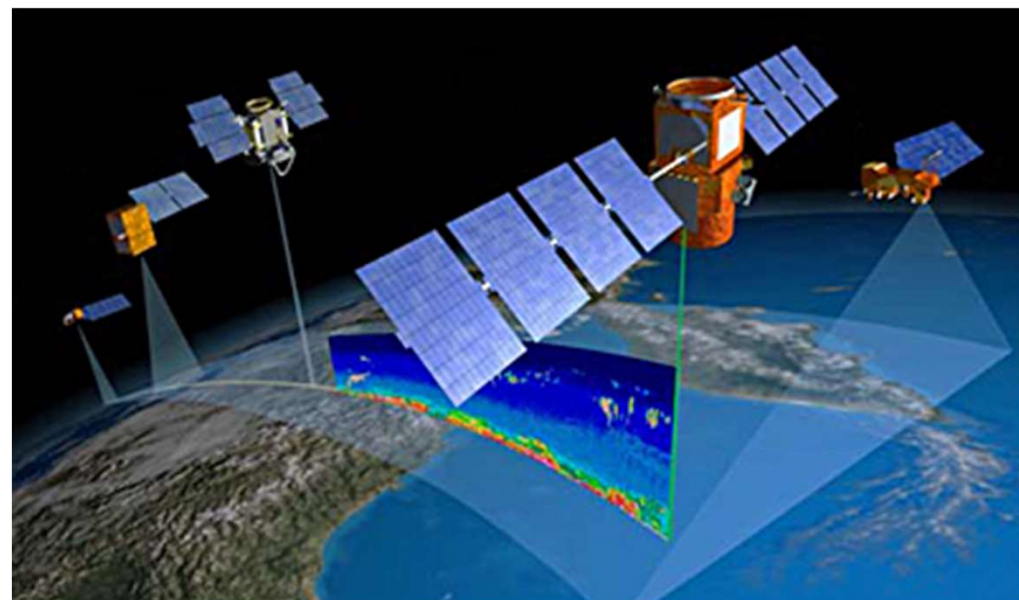
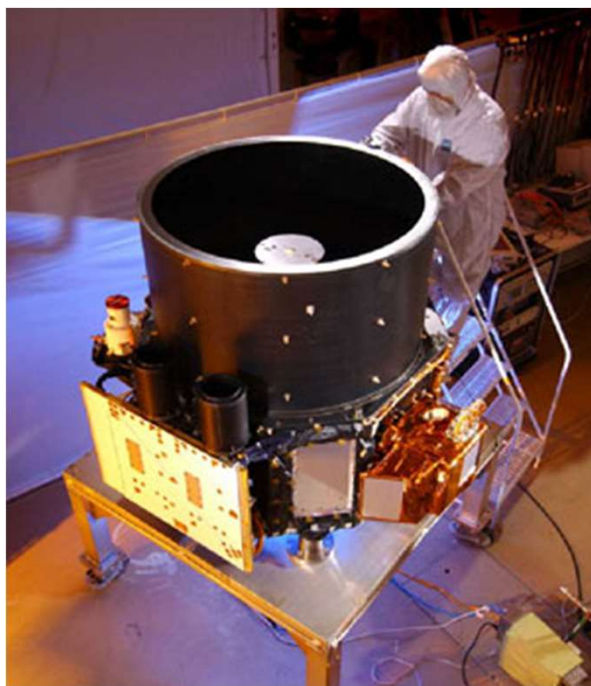
Pre Training Survey Results

Thank you!



EARTHDATA

CALIPSO (CALIOP-IRR-WFC)



EARTHDATA

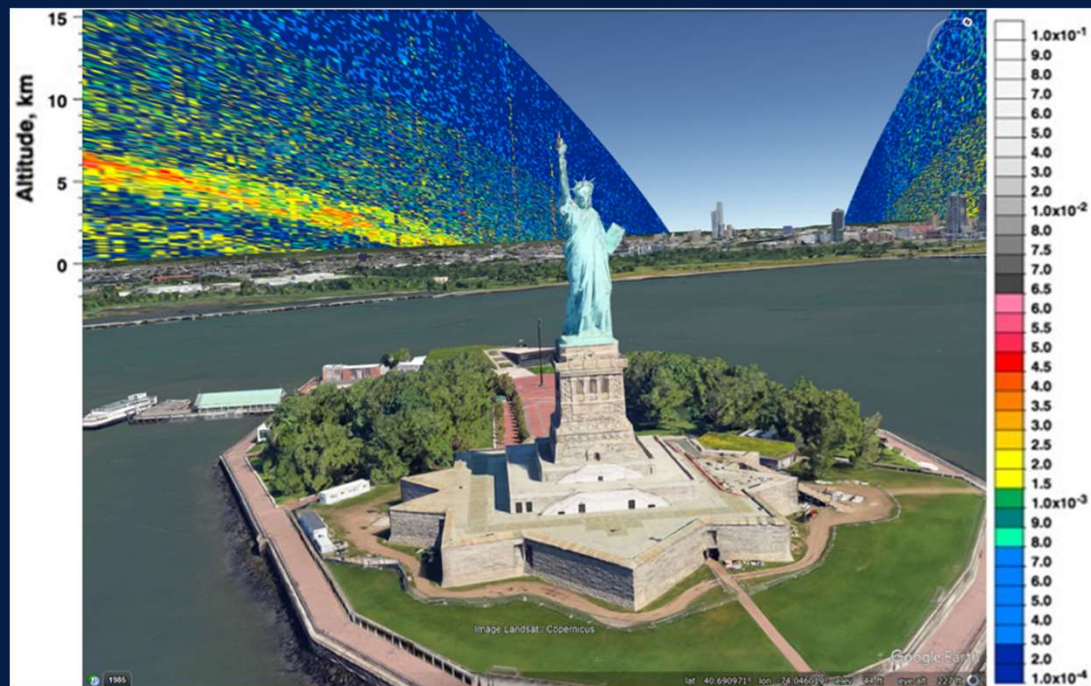
Different CALIPSO Levels / Data Products

CALIPSO data access and resources demo

- <https://asdc.larc.nasa.gov/project/CALIPSO>
- <https://forum.earthdata.nasa.gov>
- <https://subset.larc.nasa.gov/>
- <https://search.earthdata.nasa.gov/search>
- <https://www.epa.gov/hesc/rsig3d-data-inventory>
- https://github.com/nasa/ASDC_Data_and_User_Services
- https://www.hdfeos.org/zoo/index_openLaRC_Examples.php
- <https://worldview.earthdata.nasa.gov/>
- <https://software.nasa.gov/software/LAR-18710-1>



EARTHDATA





**Atmospheric
Science
Data Center**



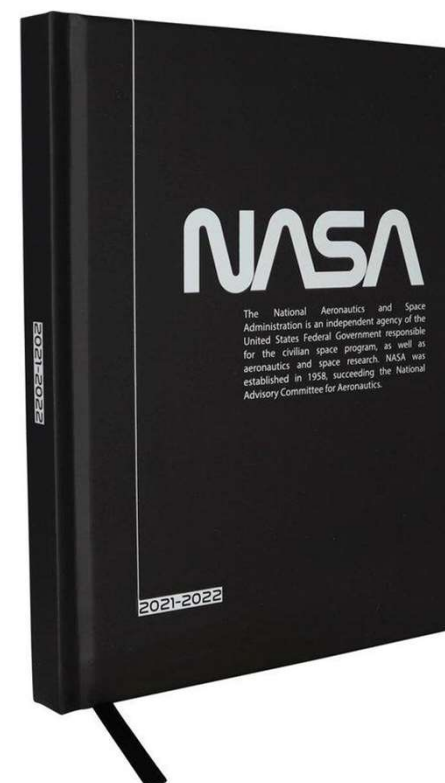
TEMPO Data For LaRC DEVELOP Participants

Dr. Hazem Mahmoud, Atmospheric Science Data Center, LaRC
Elizabeth Joyner, Earth Science Data Systems



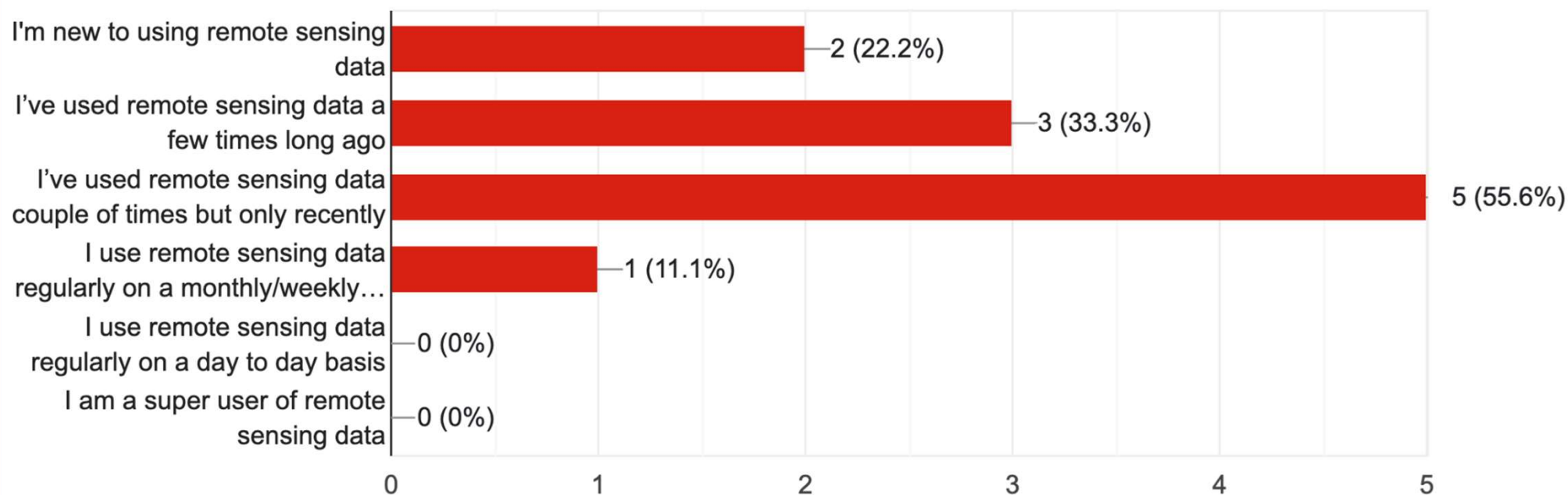
Agenda

- Welcome & Introduction
- Overview of Air Quality and Role of Aerosols
- NASA Earth fleet
- Introduction to CALIPSO & Data
 - Mission Lifecycle
- Accessing CALIPSO data:
 - Atmospheric Science Data Center
 - Data Landing Pages, Applications
 - Earthdata Resources
 - Search
 - Worldview
 - Forum
 - Air Quality Data Pathfinders
 - External Resources
 - RSIG
 - HDFEOS
- Wrap Up



2A. How often have you used NASA remote sensing data in the past? (check all that apply)

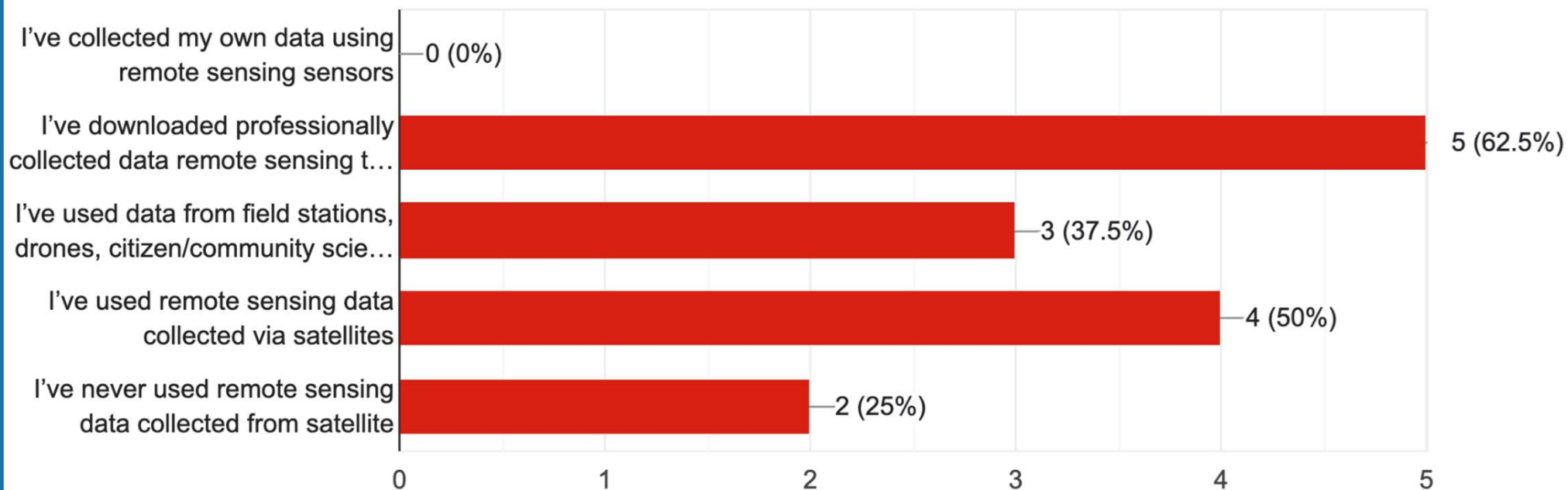
9 responses



EARTHDATA

2B. What kinds of remote sensing data have you used in the past? (check all that apply)

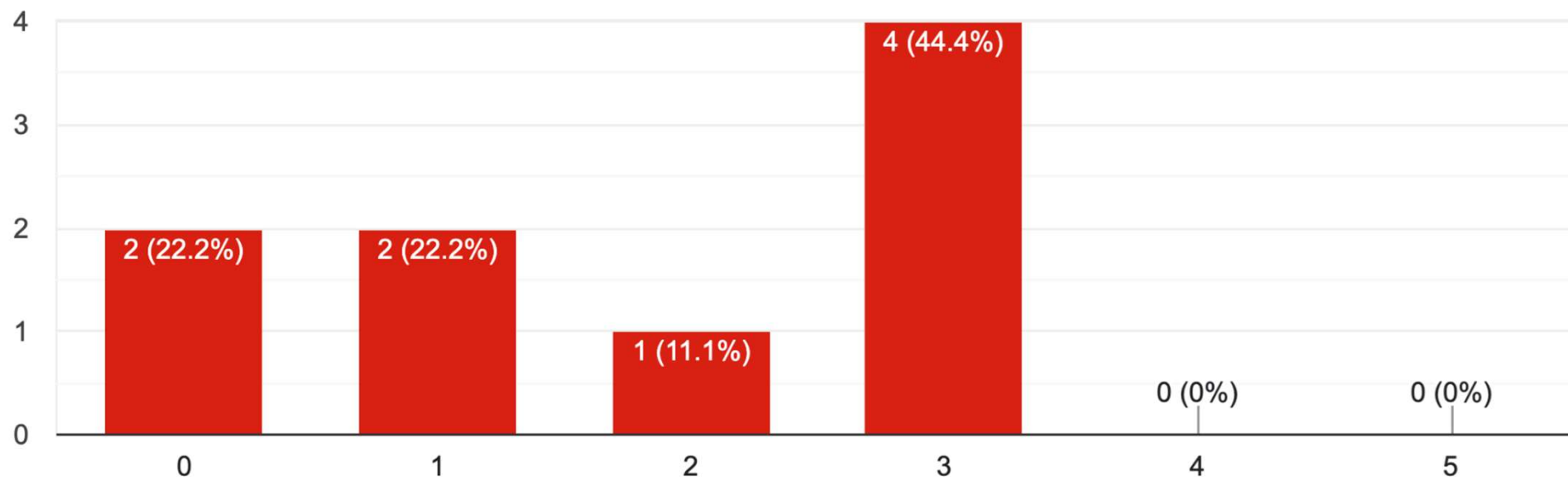
8 responses



EARTHDATA

2C. Please rank your level of familiarity using NASA Earth science data.

9 responses



No experience with
NASA Earth
Science Data

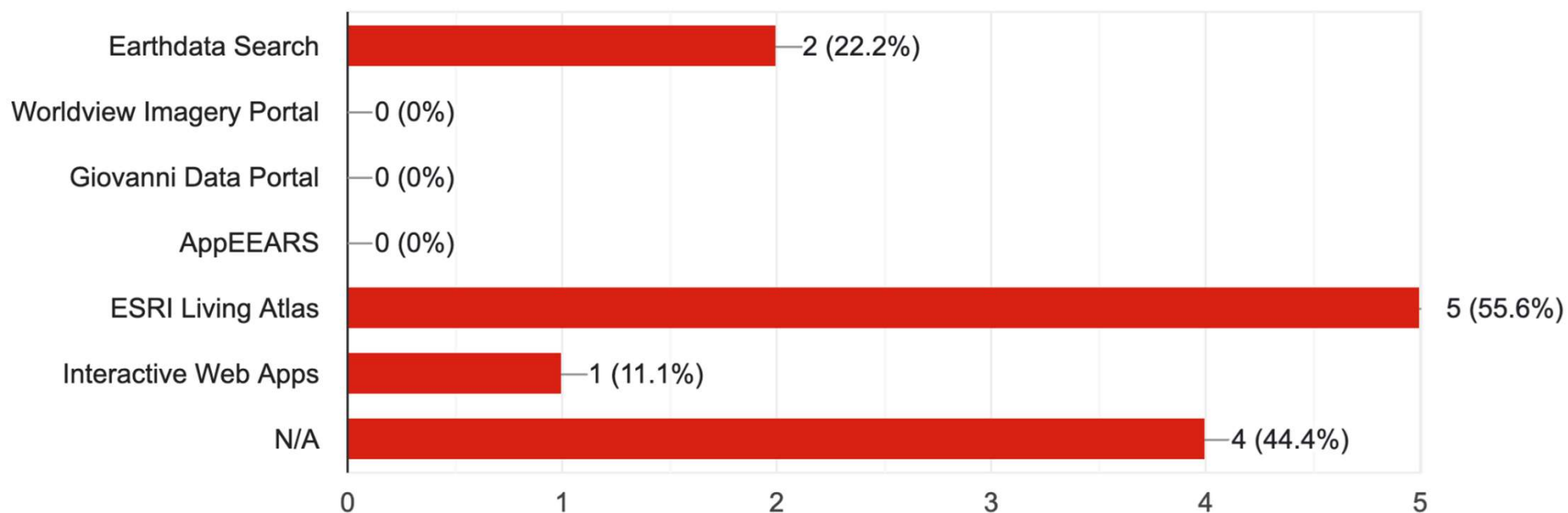
Expert- level



EARTHDATA

2E. Which of the following interfaces do you use to find NASA Earthdata? (Check all that apply.)

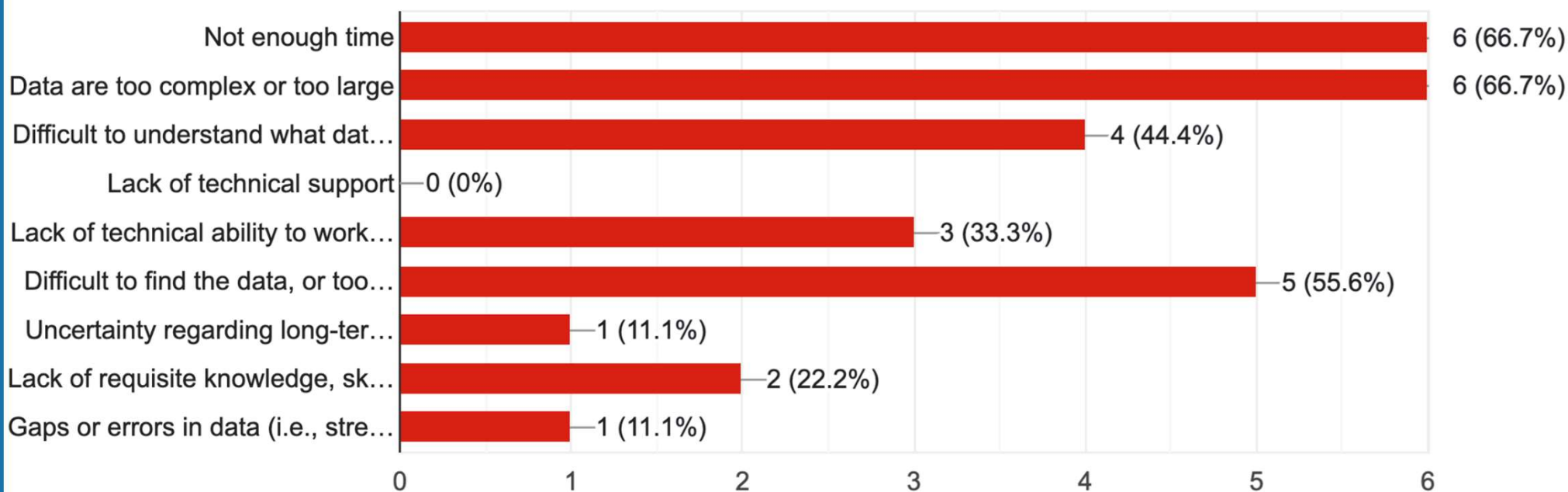
9 responses



EARTHDATA

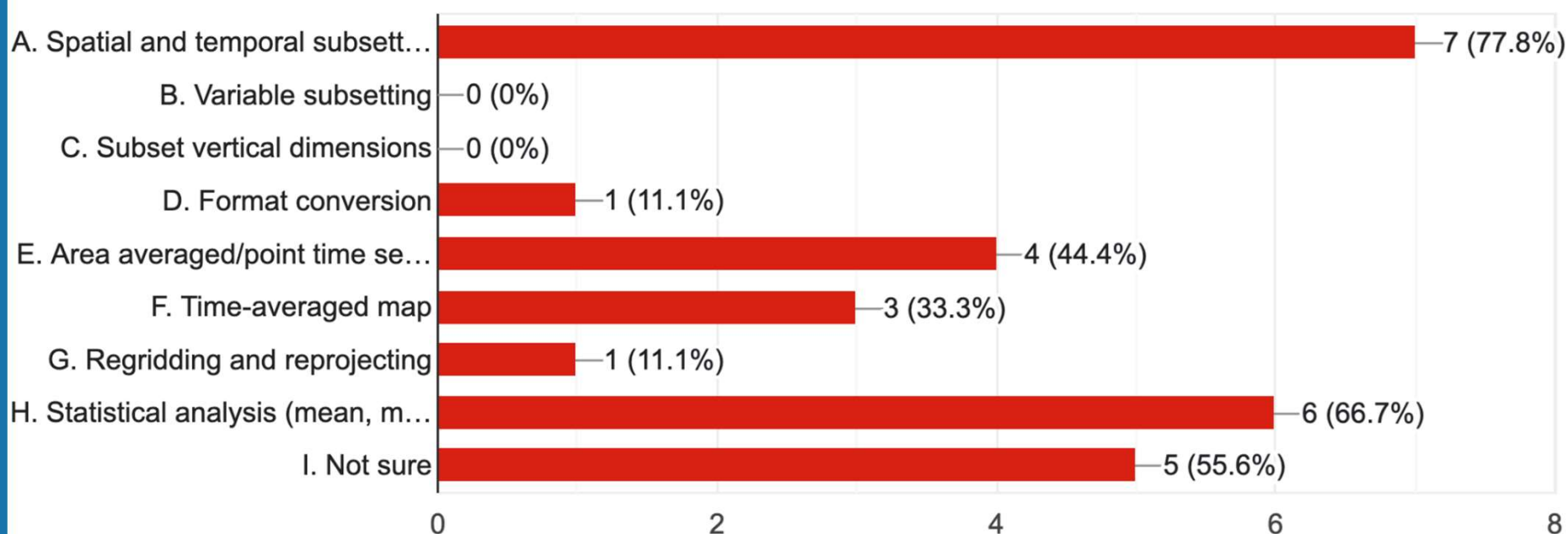
2I. What barriers to effectively using NASA Earth science data do you foresee yourself running into this term? (Select all that apply)

9 responses



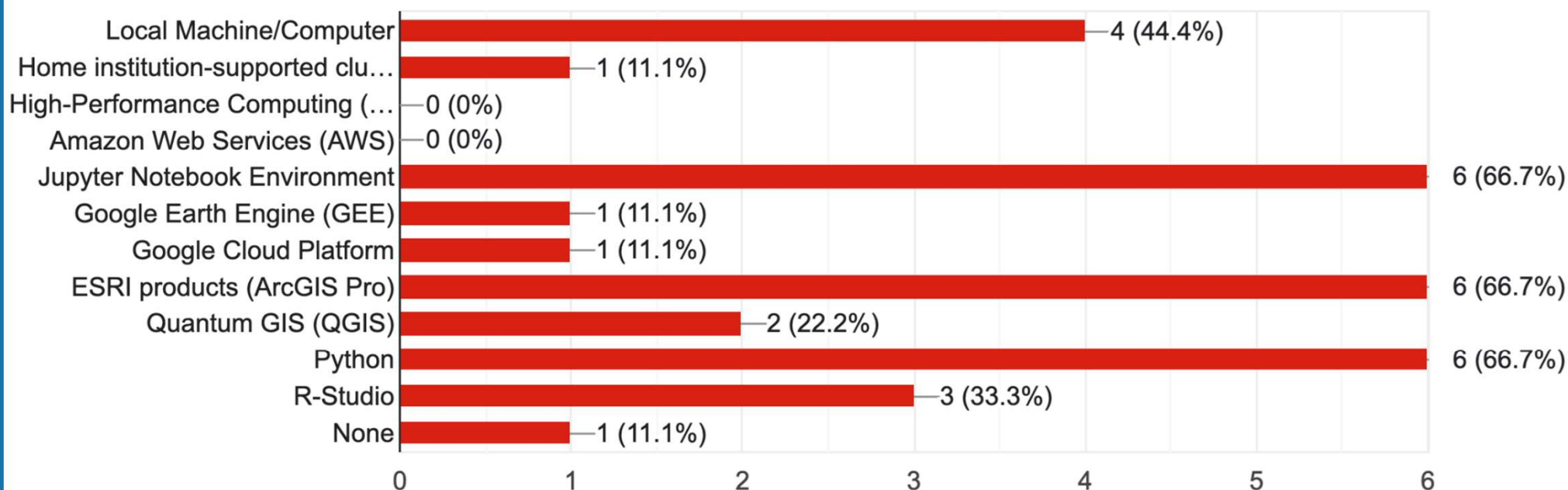
2F. What data analysis functions will you conduct in your research? If you are unsure, consult with your Lead or Science Advisor. (select all that apply)

9 responses

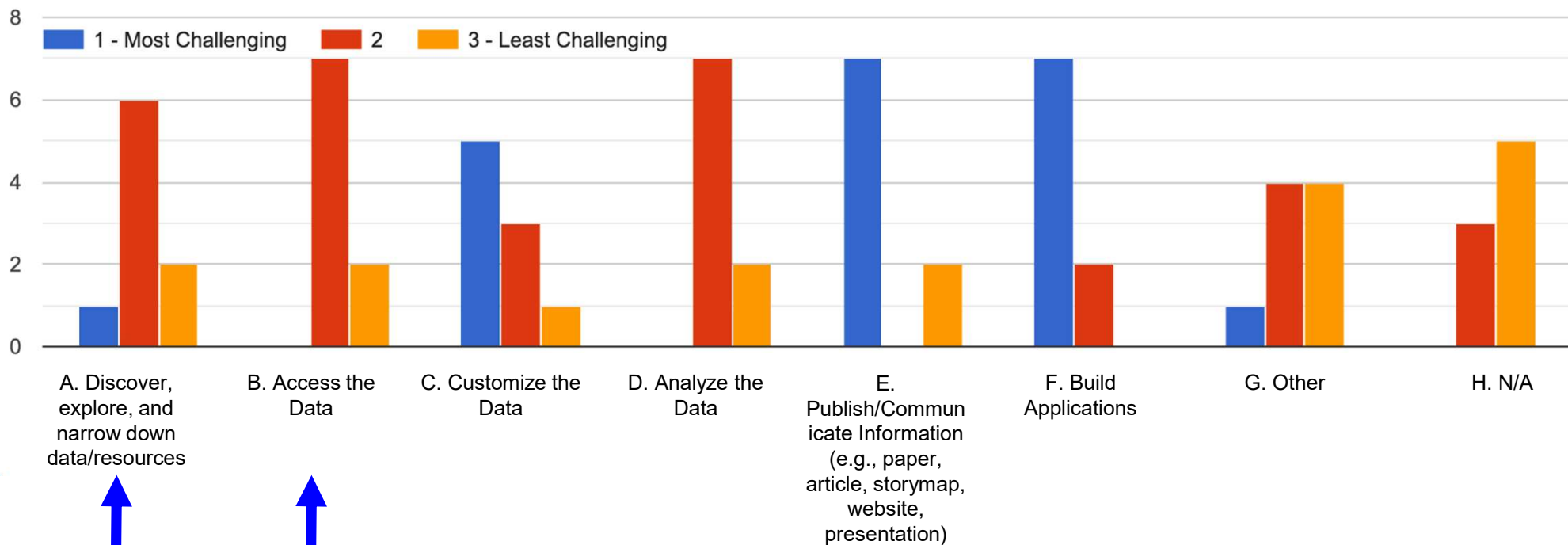


2G. Which of the following do you typically use for your data analysis and data processing workflows? (Select all that apply)

9 responses

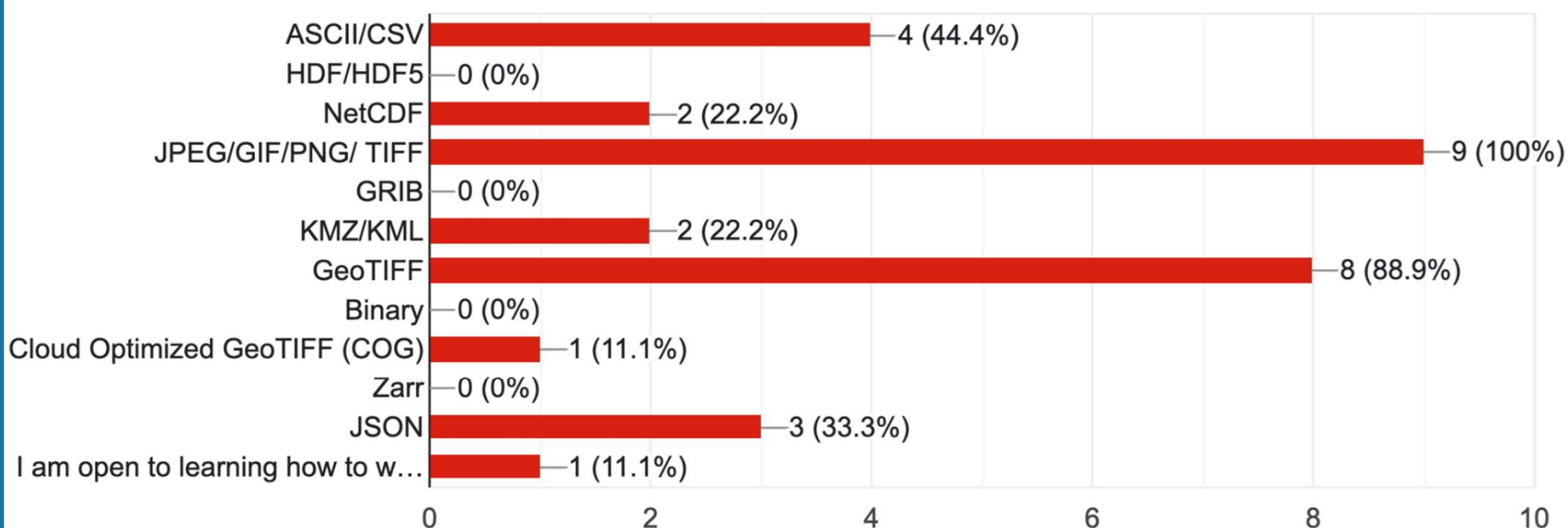


2H. Please rank the following data steps in a typical researcher's journey in the order of the challenges you experience when working with NASA Earth science data? (1-Most Challenging, 3-Least Challenging)



2J. Please indicate your preferred format(s) when working with data. If you are unsure, consult with your Lead or Science Advisor. (Select all that apply)

9 responses



A Researcher's Journey

 Indicates steps for an advanced researcher

1

Explore:

- Review literature (publications)
- Identify the major variable of interest and search for data
- Quickly visualize the primary variable and co-locate
- Find introductory information on data
- Explore available resources- tools, service
- Explore related data through publication
- Search for data and documentations cross-DAAC

2

Narrow Down:

- Determine spatial, temporal, resolution, time span, coverage, latency, processing level, platform
- Determine data quality, limitations
- Subset and download sample data

3

Access Data:

- Use services and tools
- Computing resources available
- Determine Data volume/granules needed
- Tools, software available
- Use case/tutorials

Access Data:

- Cloud access
- Web/API services
- Programmatic Chunking/Subsetting
- Metadata/Pathfinders
- Downlinking/Data logger

4

Customize Data:

- Processing to convert to grid (for non gridded)
- Data format conversion
- Regrid/reproject
- Fill missing data
- Bias correction

Customize Data:

- Cleaning-consistency checks
- Transformation and Reformatting
- Data enrichment
- Prepare data for interoperability with different systems

5

Analyze:

- Co-location
- Time series
- Change Detection
- Correlation
- Regression
- Machine learning/AI
- Trend Analysis
- Zonal mean

6

Publish/Document:

- Cite the Data (DOI), documents, service/tools
- Mention data limitations and caveats
- Data quality

7

Develop Applications

- Web/Mobile/Cloud ready
- Open Science and FAIR
- 508 compliant
- Operational support if required
- In support of data and business continuity for stakeholders
- For Internal-NASA and External stakeholders

Publish/Document:

- Publish research with data



Common NASA Tools & Their Characteristics

Freedom/Choice for Working with Data

Worldview

- Data Exploration Tool
- Easy, Intuitive Learning Curve
- Variable-first UX
- Keyword and Event search
- Parameters span a variety of Earth science disciplines
- Event search
- Pre-generated map visualizations
- Cannot Download data directly
- Imagery Only
- Level 2 & 3

GIS

- GIS Image service and OGC service-WMS/WCS
- Access to a large amount of data without the user needing to store and process the data
- Ability to view, subset and analyze the data using ArcGIS, QGIS
- Build GIS applications, webmaps, story maps
- Available for Level 3 & 4 (as of now)
- Available for high value datasets

Giovanni

- Easy-Moderate learning curve
- Designed for basic analysis (20+ types) No error bars, limited statistics, coarser resolution
- Parameters span a variety of Earth science disciplines
- Download data in a variety of formats (PNG, ASCII (csv), GeoTIFF, HDF, HDF-EOS, HDF-EOS5, HDF5, JPEG, netCDF, kmz)
- Limited to GES DISC Holdings Mostly
- Level 3 & 4
- Can be slow

AppEEARS

- Easy-Moderate learning curve
- Designed for basic analysis (20+ types) No error bars, limited statistics, coarser resolution
- Limited to GES DISC Holdings Mostly (also LAADS, LPDAAC, and OBDAAC)
- Download data in a variety of formats (CSV, GEOTIFF, NetCDF)
- Level 3 & 4
- Can be slow
- Parameters span Earth science disciplines

Earthdata Search

- Intermediate-Advanced learning curve
- Provides comprehensive access to NASA's Earth science data holdings
- Search tool only, no analytics
- Provides the data for the user to analyze as needed for science
- Offers data from all of NASA's DAACs & partners
- Variety of data formats
- Provides all levels of NASA data (1-4)
- Parameters span the Earth science disciplines

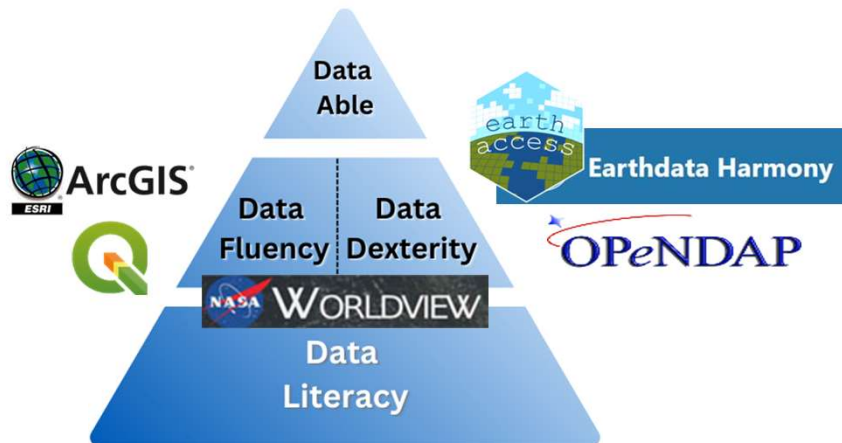
Advanced Data Skills/Knowledge Required



EARTHDATA

Where to go for TEMPO resources

Find, Customize, Visualize



User Support

- Example scripts



- Earthdata Forum
- ASDC User Support

EARTH SCIENCE DATA SYSTEMS PROGRAM

EARTH SCIENCE DATA and INFORMATION SYSTEM PROJECT

The **Earth Science Data and Information System (ESDIS) Project** manages one of the world's largest archives of Earth science data.



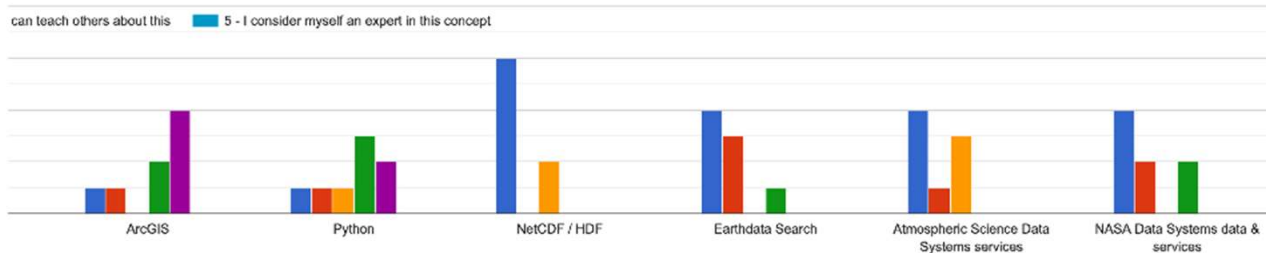
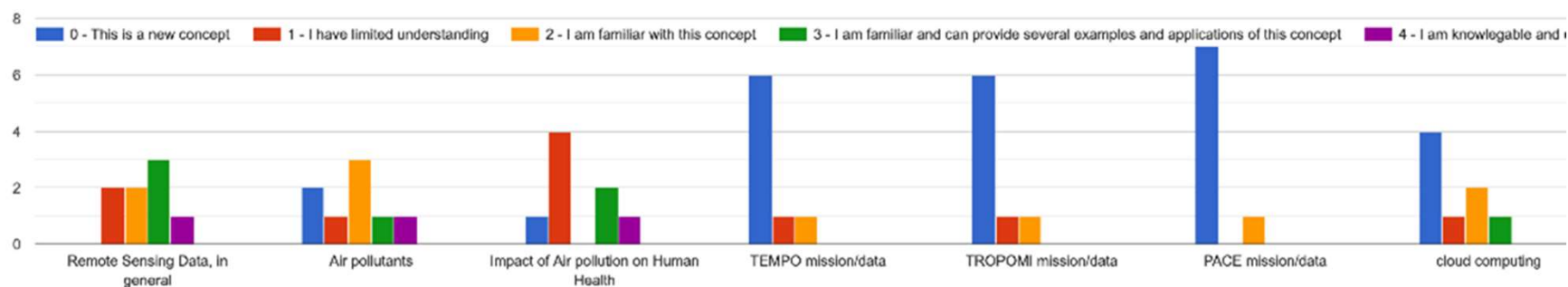
A satellite map of the world is shown in the background. A semi-transparent blue rectangular overlay covers the middle portion of the image, containing text. The text is white and includes a title, a name, and a large 'Thank you!' message.

Pre Training Survey Results & Perceived Needs

Elizabeth

Thank you!

Rate your understanding of the following topics:



A Researcher's Journey

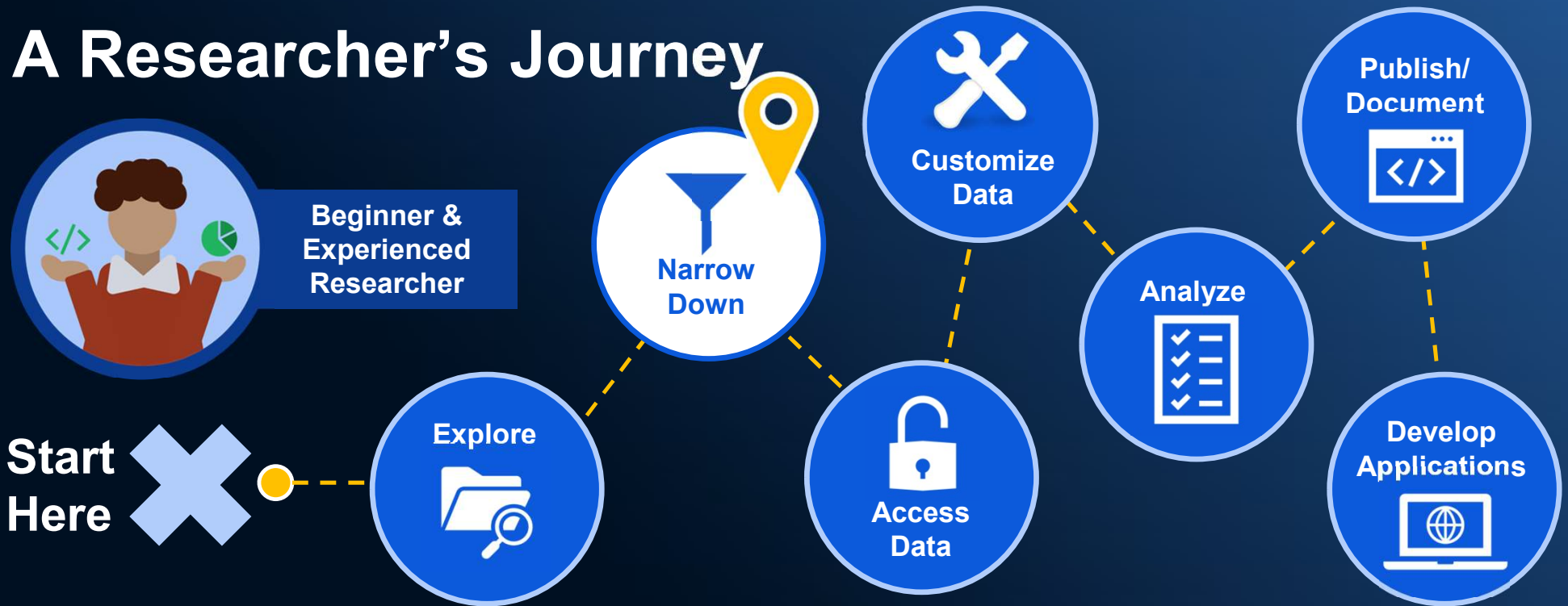


Explore



- Identify the major variable of interest and search for data
- Quickly visualize the primary variable and co-locate
- Find introductory information on data
- Explore available resources- tools, services
- Review literature (publications)
- Explore related data through publication
- Search for data and documentations cross-DAAC

A Researcher's Journey

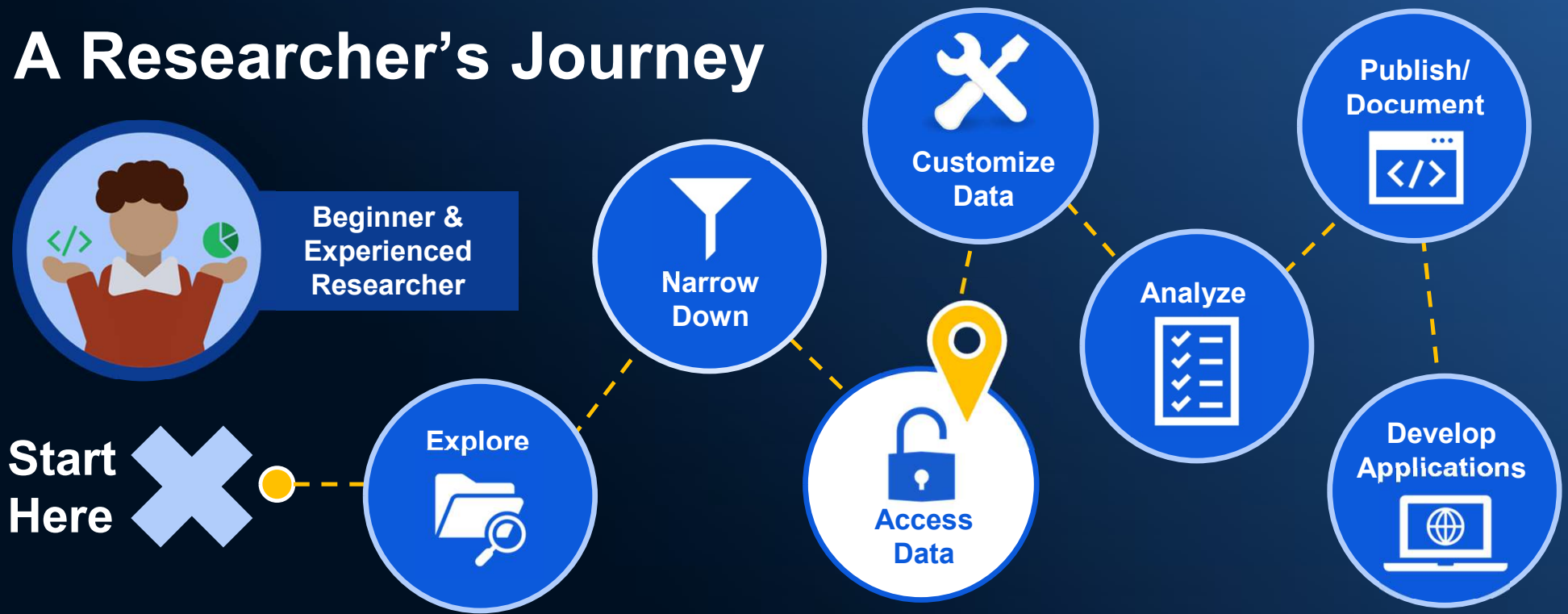


Narrow Down



- Determine spatial, temporal, resolution, time span, coverage, latency, processing level, platform
- Determine data quality, limitations
- Subset and download sample data

A Researcher's Journey



Access Data



- Use services and tools
- Computing resources available
- Determine Data volume/granules needed
- Tools, software available
- Use case/tutorials
- Cloud access
- Web/API services
- Programmatic Chunking/Subsetting
- Metadata/Pathfinders
- Downlinking/Data logger

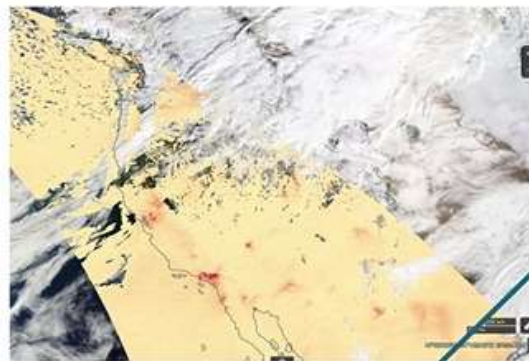
A satellite map of the world is shown in the background. A semi-transparent blue rectangular overlay covers the middle portion of the image, containing the title and the name 'Hazem'.

Overview of Air Quality and Role of Aerosols

Hazem

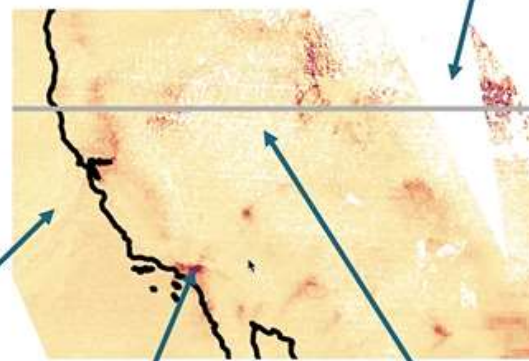
ASDC: Worldview images & thumbnails are inconsistent

Worldview



No cloud filter?

Earthdata thumbnail



High NO₂ values have been filtered out?

Looks like negative values are removed (shouldn't be)

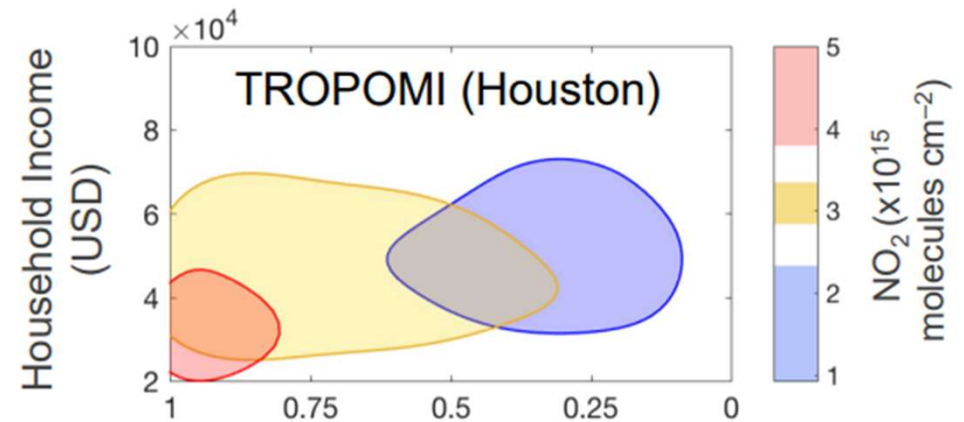
What is this?
SZA filter or
quality flags not
used?



EARTHDATA

Knowledge to Action

- Satellite data observed higher NO₂ pollution in low-income vs. high-income (Demetillo et al. 2020).
- These inequalities can be dramatically reduced with policies targeting heavy-duty diesel truck emissions.
- 2021, Executive Order 14037 targets reduction of NO_x emissions from heavy duty engines and vehicles starting 2027, making it the first update to clean air standards for this sector in more than 20 years.
- 50% of all new cars and light trucks are electric or hybrid by 2030.



National Aeronautics and
Space Administration



EARTH FLEET

INVEST/CUBESATS

- CIRIS 2023
- NACHOS 2022
- CTIM 2022
- NACHOS-2 2022
- SNOOPI* 2022
- MURI-FO* 2022
- HYTI* 2023

JPSS INSTRUMENTS

- OMPS-LIMB 2022
- LIBERA 2027
- OMPS-LIMB 2027
- OMPS-LIMB 2032

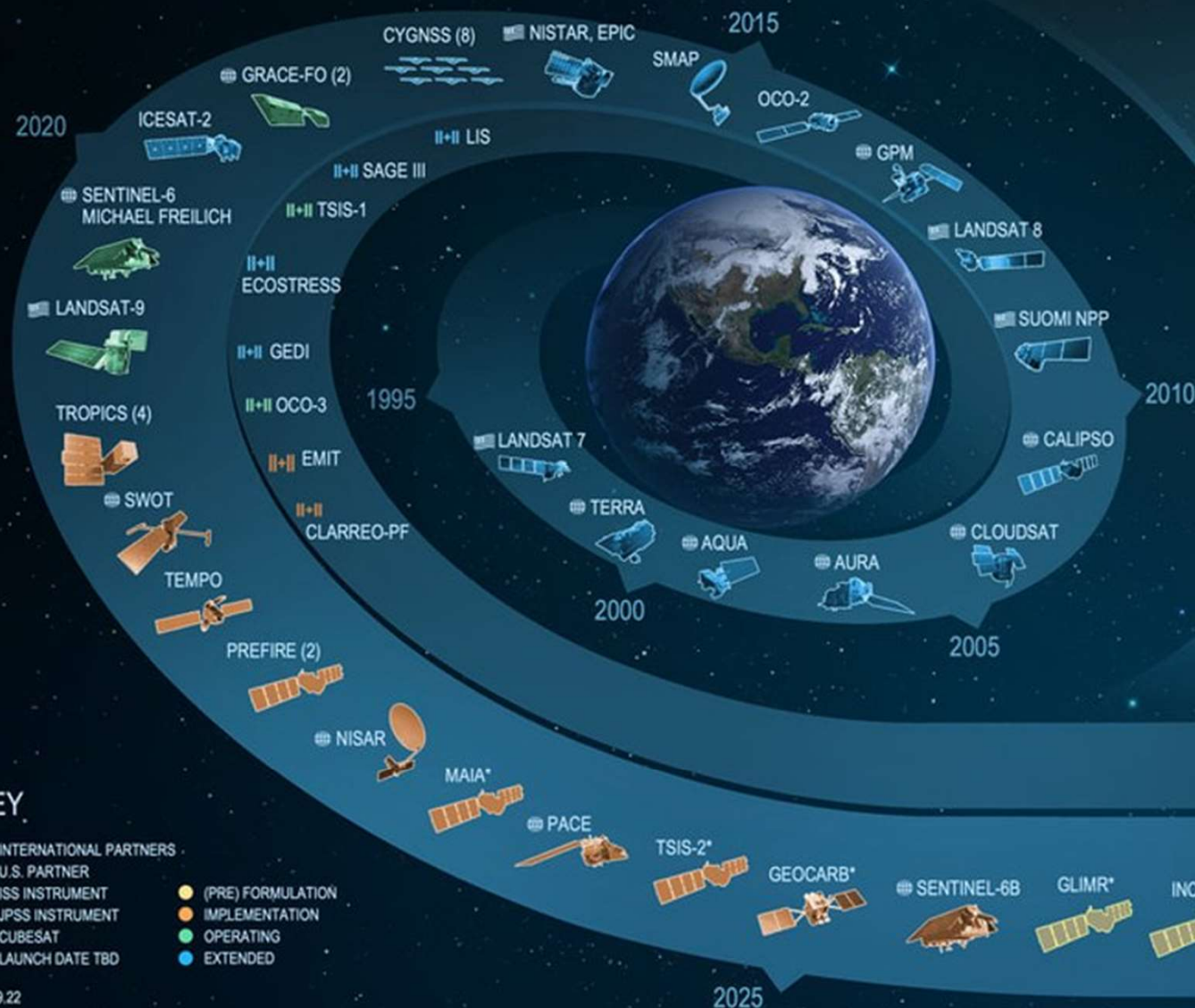
ISS INSTRUMENTS

MISSIONS

KEY

- INTERNATIONAL PARTNERS
- U.S. PARTNER
- ISS INSTRUMENT
- JPSS INSTRUMENT
- CUBESAT
- LAUNCH DATE TBD
- (PRE) FORMULATION
- IMPLEMENTATION
- OPERATING
- EXTENDED

08.29.22



Tropospheric Emissions: Monitoring of Pollution

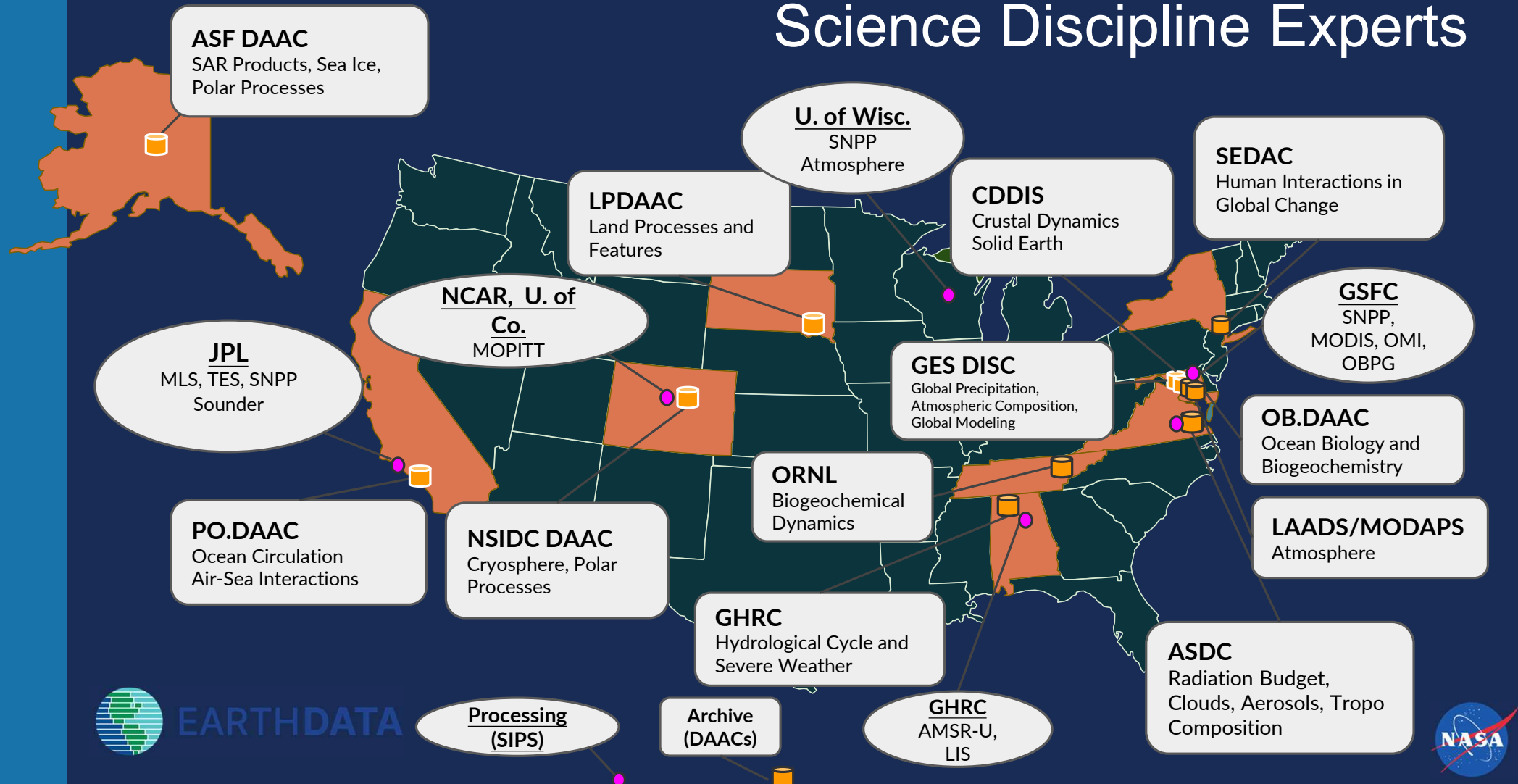
- Hourly daytime air pollution measurements over North America
- NASA's first Earth Venture Instrument (EVI), selected in 2012
- **Geostationary orbit** means TEMPO can scan the continent continuously
 - High temporal resolution
 - High spatial resolution
- Baseline data products:
 - Ozone
 - Nitrogen dioxide
 - Formaldehyde

[View TEMPO Simulation](#)

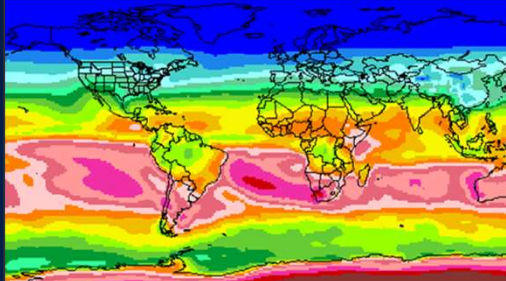


Credit: NASA's Scientific Visualization Studio

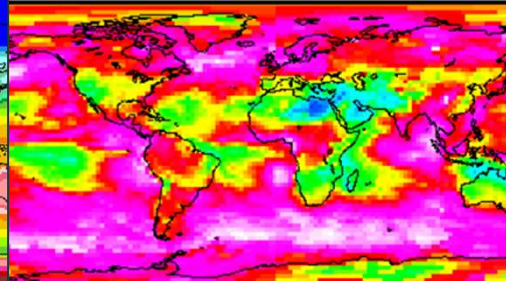
Data are Produced and Managed by Science Discipline Experts



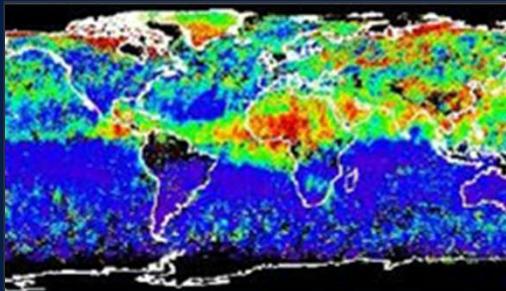
RADIATION BUDGET



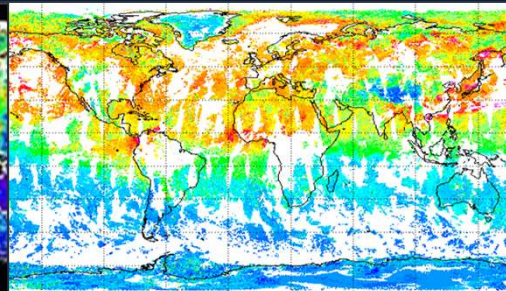
CLOUDS



AEROSOLS



TROPOSPHERIC COMPOSITION



ASDC at a glance

- ✓ 100+ Science projects
 - MISR ◦ MOPITT ◦ MAIA ◦ TEMPO ◦ CERES
 - CALIPSO → RSIG (EPA)
 - Airborne field campaigns
(**KORUS AQ, DISCOVER AQ, FIREX AQ**)
- ✓ 1100+ unique science products
- ✓ Data usage
 - 2,061 Terabytes ◦ 160,000 users
 - 158 countries
- ✓ Data archive
 - 5.8 Petabytes ◦ 141 million files (4,400 TB)
on high-speed disks
- ✓ Data in cloud (ongoing)
 - Data and services in the cloud
 - Scalable infrastructure

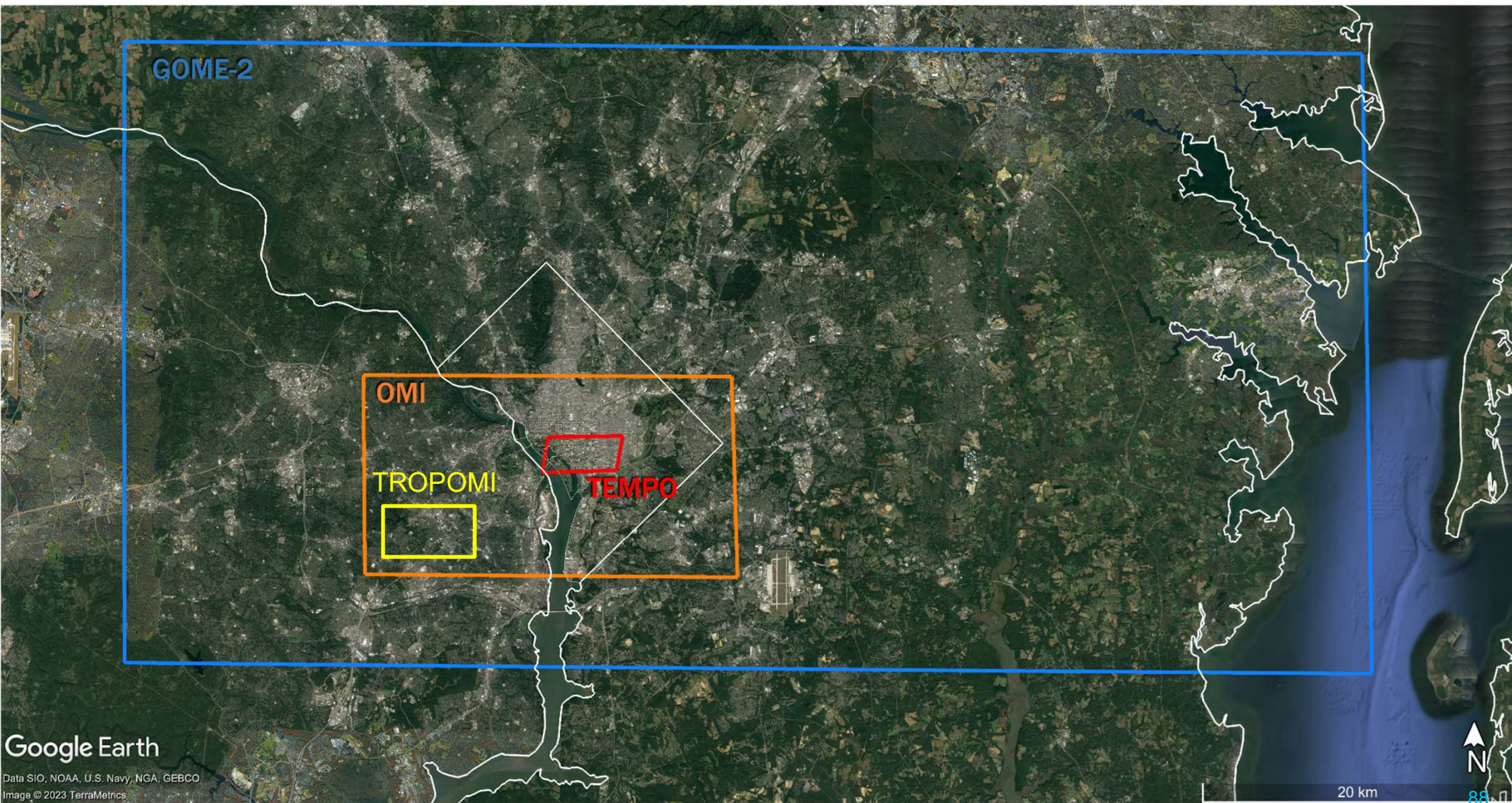
Primary Functions of ASDC

- Ingest receive data from data provider
- Archive preservation & provenance
- Distribute tools and services
- Process create higher level products
- Outreach & Support research community



EARTHDATA





GOME-2

OMI

TROPOMI

TEMPO

Google Earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2023 TerraMetrics

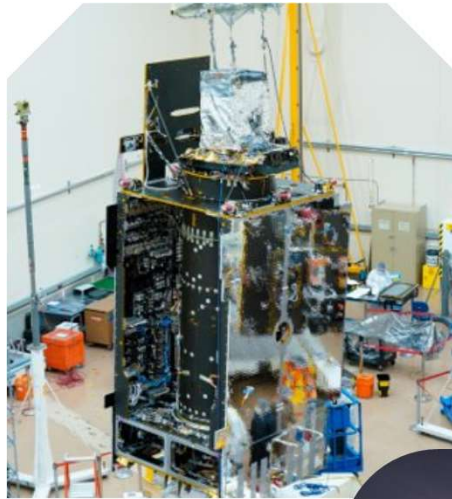
20 km



TEMPO

- Geostationary orbit at altitude of ~36,000 km (~22,000 mi)
- First Light August 2nd 2023
- Mission objective is 20 months

TEMPO launched aboard a SpaceX Falcon 9 vehicle on April 7, 2023



Air quality measurements

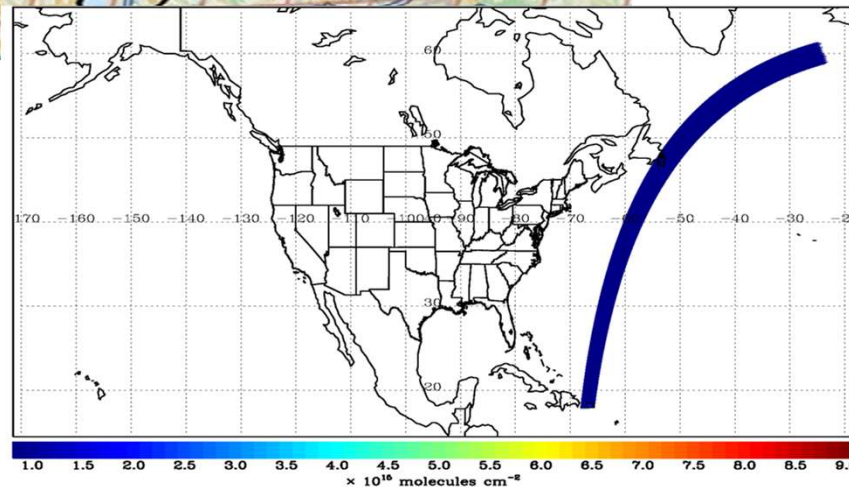


UV/Visible spectrometer view
of North America

Measures ozone, nitrogen
dioxide, formaldehyde,
aerosols, and other pollutants

Resolution:

- Hourly (~10 mins for special studies)
- Approximately 2 km N/S × 4.75 km E/W



Available Data Services

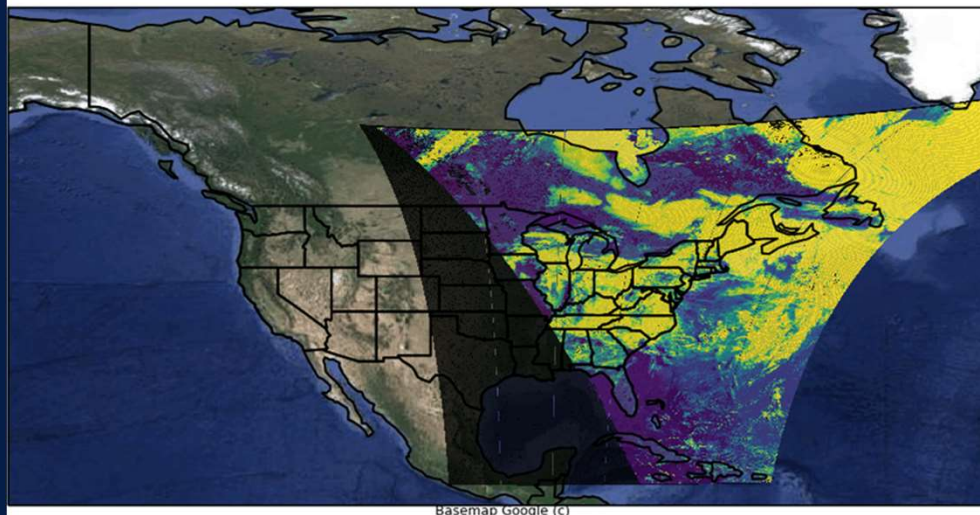
Tool and Service Availability	Level 1	Level 2	Level 3
Available in Earthdata Search (EDS)	Yes	Yes	Yes
Subsetting (temporal, spatial bounding box, variable)	No	Yes	Yes
Worldview Imagery	No	Yes (Selected Variables)	Yes (Selected Variables)
Concatenation/Aggregation	No	Yes	No
ArcGIS Image Service *image services	No	No	Yes*
RSIG	No	Yes	Yes



One day of HCHO retrievals: filtering data

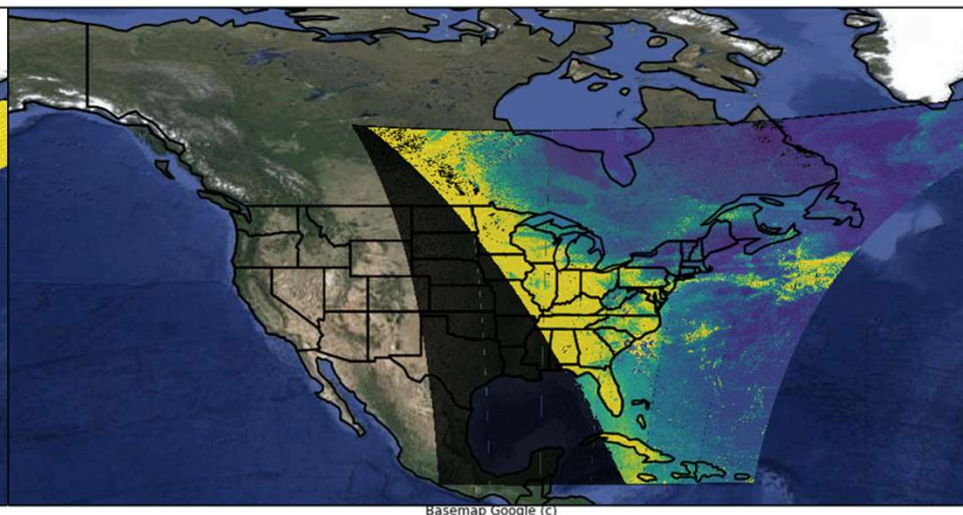
To perform qualitative studies it is essential to perform quality control on the data; multiple variables in the level 2 and level 3 files (main_data_quality_flag, cloud_fraction, vertical_column_uncertainty, snow_ice_fraction...) provide suitable information to filter data depending on the user's application.

2024-05-09 10:41:07 to 2024-05-09 11:14:16; SCAN S001



Cloud fraction

2024-05-09 10:41:07 to 2024-05-09 11:14:16; SCAN S001



Vertical column uncertainty

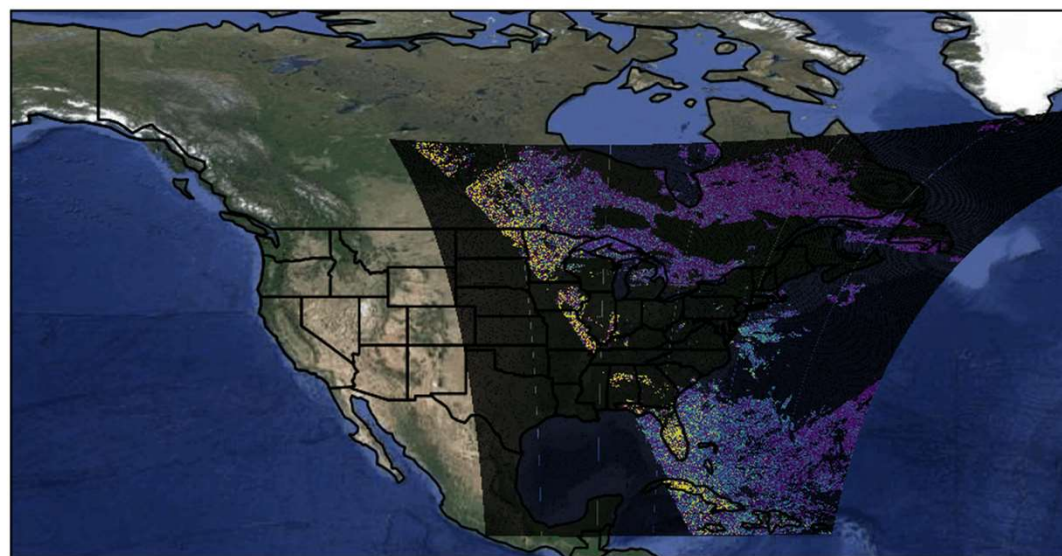


EARTHDATA

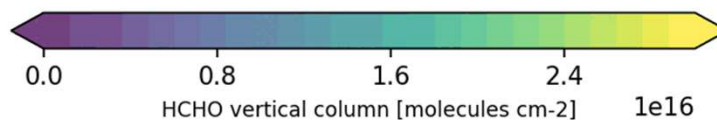
The Science Directorate at NASA's Langley Research Center

One day of HCHO retrievals showing data only with cloud fraction < 0.25

2024-05-09 10:41:07 to 2024-05-09 11:14:16; SCAN S001

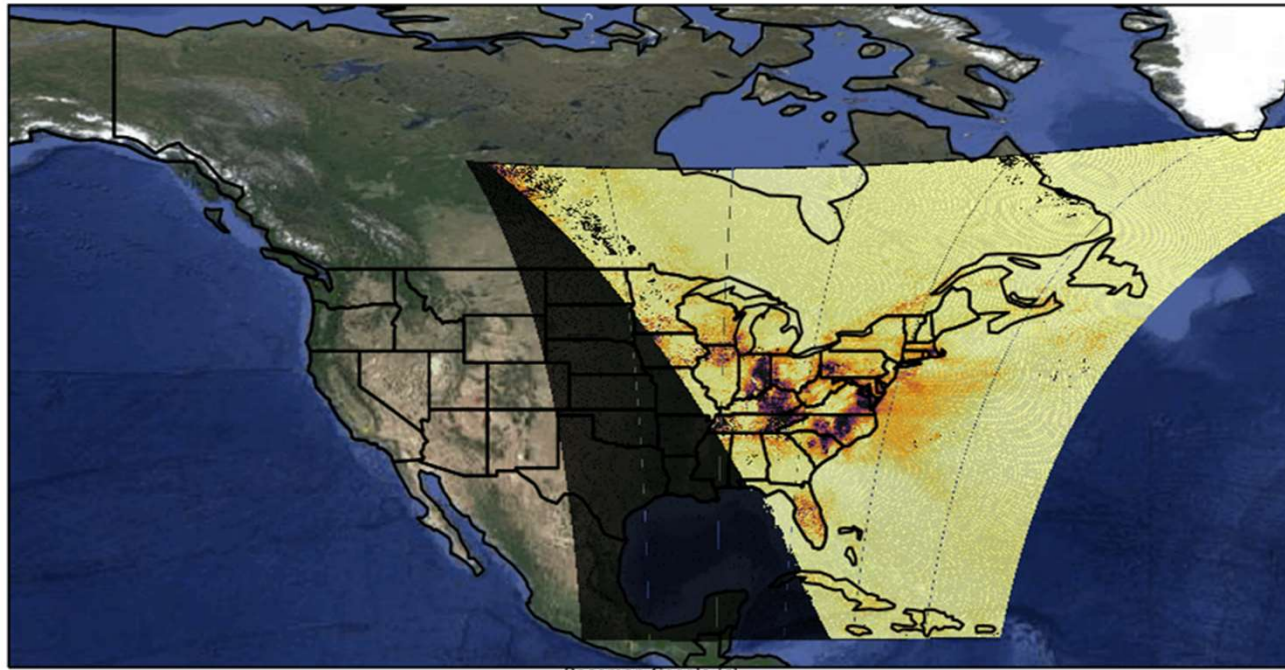


Basemap Google (c)



One day of NO₂ retrievals (unfiltered)

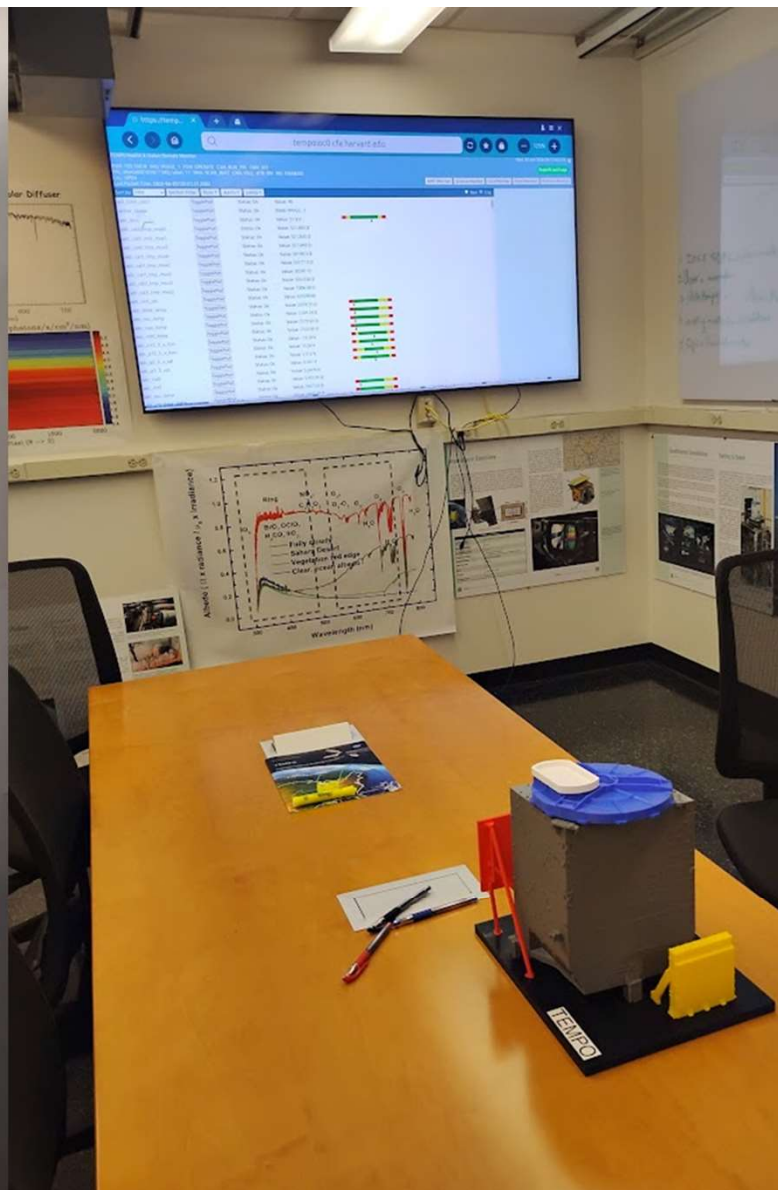
2024-05-09 10:41:07 to 2024-05-09 11:14:16; SCAN S001



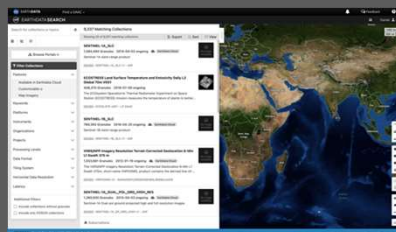
Basemap Google (c)

As mentioned previously it is important to filter data using the criteria described in the user guides

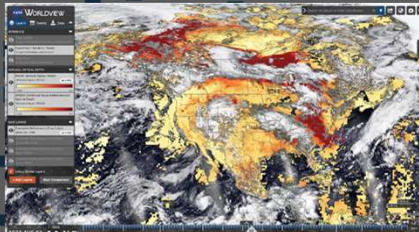




Three places to highlight for data exploring:



Earthdata Search



Worldview



earthaccess



OPeNDAP



Amazon S3



Database



CUMULUS
EOSDIS

Application Services



Networking



Security



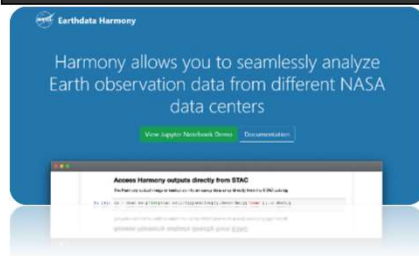
Atmospheric
Science
Data Center



Additional Resources

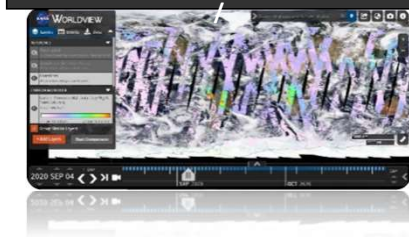
Harmony Services

<https://harmony.earthdata.nasa.gov/>



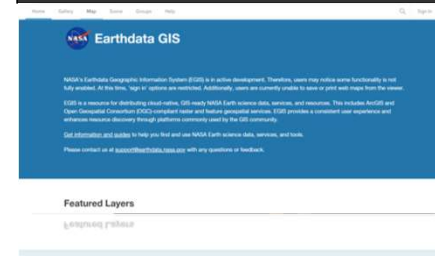
Worldview

<https://worldview.earthdata.nasa.gov>



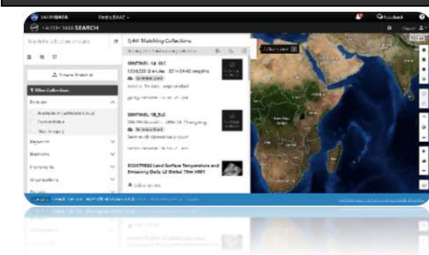
Earthdata GIS EGIS

<https://gis.earthdata.nasa.gov/portal/>



Earthdata Search

<https://search.earthdata.nasa.gov/search>



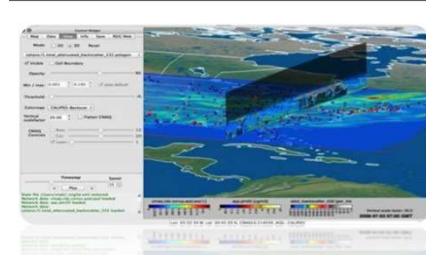
OPeNDAP

<https://opendap.earthdata.nasa.gov/>

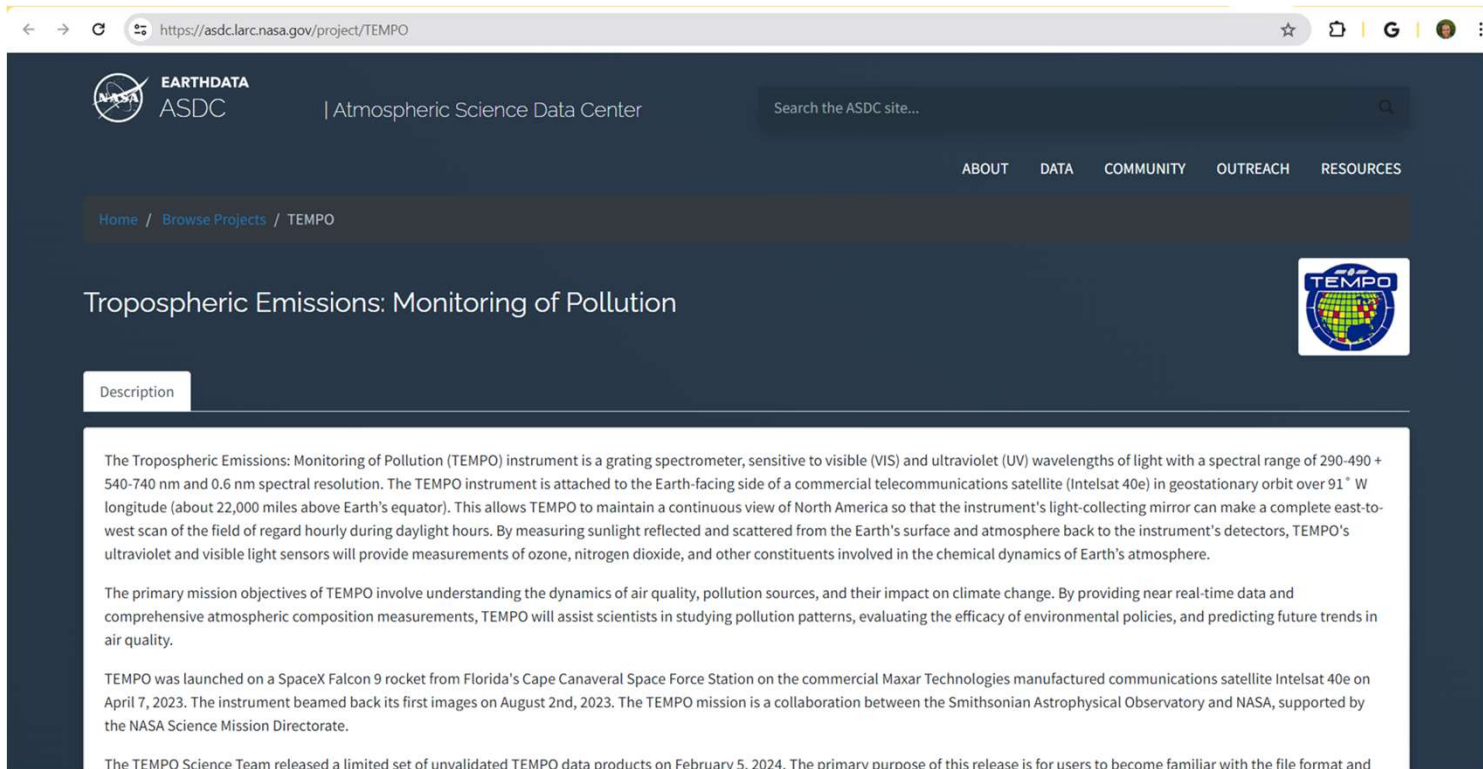


Remote Sensing Information Gateway

<https://www.epa.gov/hesc/rsig3d-data-inventory>

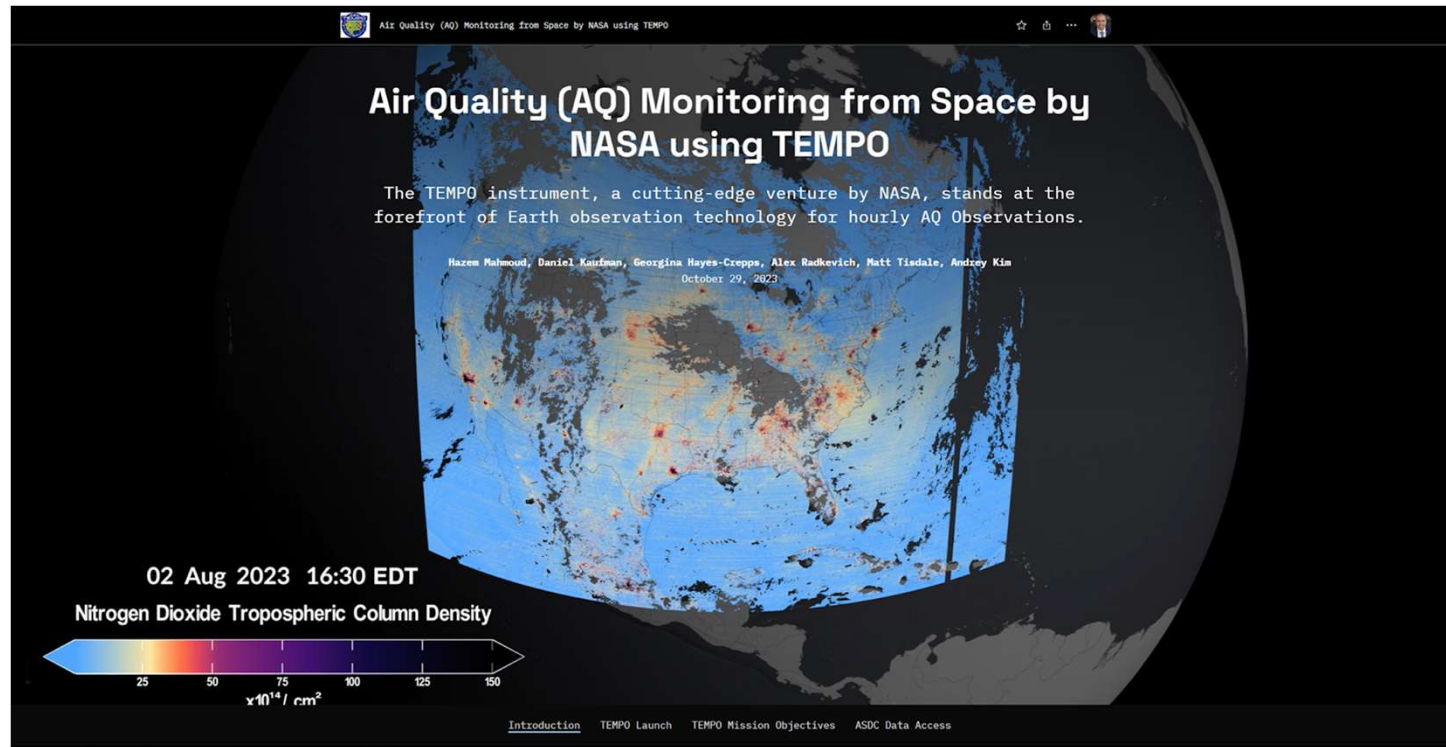


ASDC Webpage



The screenshot shows a web browser window with the URL <https://asdc.larc.nasa.gov/project/TEMPO>. The page header includes the NASA EarthData ASDC logo and the text "Atmospheric Science Data Center". A search bar is located on the right side of the header. Below the header, there is a navigation menu with links: ABOUT, DATA, COMMUNITY, OUTREACH, and RESOURCES. The main content area features a breadcrumb trail: Home / Browse Projects / TEMPO. The title of the page is "Tropospheric Emissions: Monitoring of Pollution". To the right of the title is a small circular logo with the word "TEMPO" and a globe. Below the title, there is a "Description" tab. The description text reads: "The Tropospheric Emissions: Monitoring of Pollution (TEMPO) instrument is a grating spectrometer, sensitive to visible (VIS) and ultraviolet (UV) wavelengths of light with a spectral range of 290-490 + 540-740 nm and 0.6 nm spectral resolution. The TEMPO instrument is attached to the Earth-facing side of a commercial telecommunications satellite (Intelsat 40e) in geostationary orbit over 91° W longitude (about 22,000 miles above Earth's equator). This allows TEMPO to maintain a continuous view of North America so that the instrument's light-collecting mirror can make a complete east-to-west scan of the field of regard hourly during daylight hours. By measuring sunlight reflected and scattered from the Earth's surface and atmosphere back to the instrument's detectors, TEMPO's ultraviolet and visible light sensors will provide measurements of ozone, nitrogen dioxide, and other constituents involved in the chemical dynamics of Earth's atmosphere. The primary mission objectives of TEMPO involve understanding the dynamics of air quality, pollution sources, and their impact on climate change. By providing near real-time data and comprehensive atmospheric composition measurements, TEMPO will assist scientists in studying pollution patterns, evaluating the efficacy of environmental policies, and predicting future trends in air quality. TEMPO was launched on a SpaceX Falcon 9 rocket from Florida's Cape Canaveral Space Force Station on the commercial Maxar Technologies manufactured communications satellite Intelsat 40e on April 7, 2023. The instrument beamed back its first images on August 2nd, 2023. The TEMPO mission is a collaboration between the Smithsonian Astrophysical Observatory and NASA, supported by the NASA Science Mission Directorate. The TEMPO Science Team released a limited set of unvalidated TEMPO data products on February 5, 2024. The primary purpose of this release is for users to become familiar with the file format and

TEMPO Storymap



<https://storymaps.arcgis.com/stories/01e82aefbc8b4d7a951fe089c818bc00>

A satellite map of the Earth, showing North America, Europe, and Africa. The map is centered on the Atlantic Ocean, with the Americas on the left and Europe and Africa on the right. The landmasses are shown in shades of green and brown, while the oceans are dark blue. A semi-transparent blue banner is overlaid on the map, containing the title and speaker information.

Earthdata Forum & Q & A - TEMPO/TROPOMI + Activity

Elizabeth

Whoa - Wait a minute... Earthdata Forum

- *Ask questions* with subject-matter experts from many of NASA's Distributed Active Archive Centers (DAACs)
- *Communicate with other users* about data applications and research needs
- *Explore FAQ's and posts* from users like you with the searchable interface

Resources:

[NASA Earthdata Forum Quick Video Guide:](#)
[How to Post a New Question](#)



**EARTHDATA
Forum**

Welcome to the Earthdata User Forum! Here, subject matter experts from several NASA Distributed Active Archive Centers (DAAC) can discuss general questions, research needs and data applications. Users can query how to access, view and interpret the data.

[Quick links](#) [FAQ](#) [Data Recipes](#) [Login](#)

[Home](#)

It is currently Wed Feb 24, 2021 4:20 pm America/New_York

[Post a New Question](#)

SEARCH

[Advanced Search](#)

OR

SEARCH BY TAGS

Discipline	DAAC	Major Projects	Services/Usage
Ocean	OB DAAC	CZCS	SeaDAS
Submit			

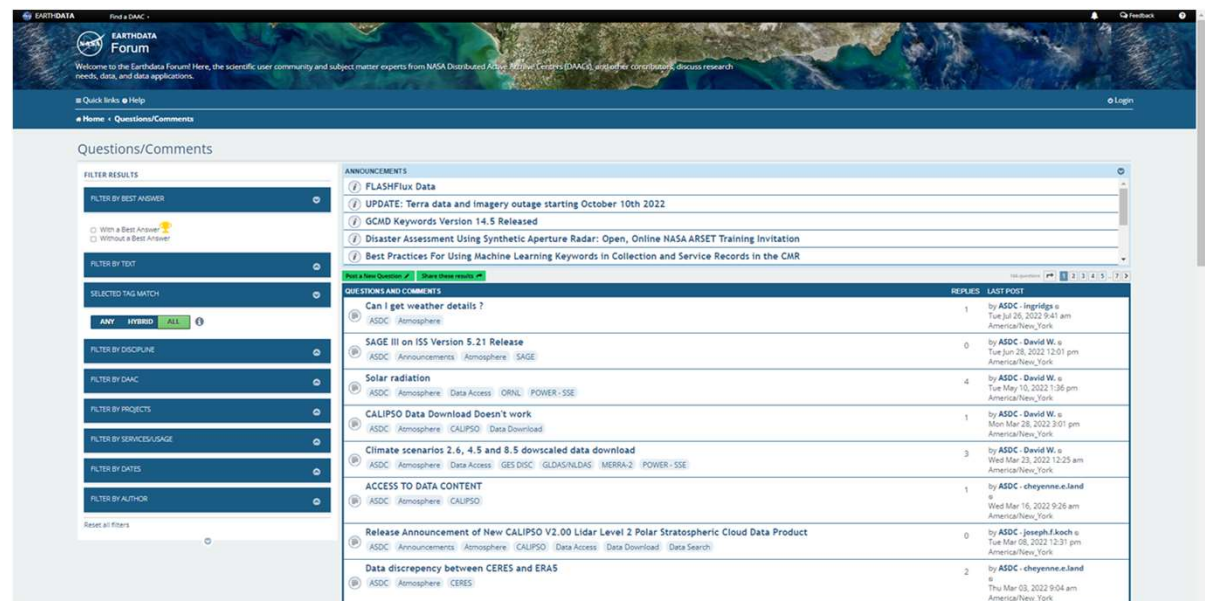
[What do these tags mean?](#)

OR

FORUM	QUESTIONS	POSTS	LAST POST
All Questions/Comments Please enter here to ask a question about any NASA Science related topics!	1828	7010	Re: MISR L1B2E data access af... by adamk0 Wed Feb 24, 2021 11:53 am America/New_York

Earthdata Forum

- View Existing Questions/Answers
- Ask New Questions to Subject Matter Experts
- Science and Technical Support



<https://forum.earthdata.nasa.gov>

Earthdata Forum - Home

forum.earthdata.nasa.gov

forum.earthdata.nasa.gov

EARTHDATA Find a DAAC

Welcome to the Earthdata Forum! Here, the scientific user community and subject matter experts from NASA Distributed Active Archive Centers (DAACs), and other contributors, discuss research needs, data, and data applications.

Quick links Help Login

Home

It is currently Sun Apr 23, 2023 9:18 pm America/New_York

Post a New Question

Search

ATL08

Discipline Select DAAC Select Major Projects Select Services/Usage Select

Selected Tags: NSIDC ICESat/ICESat-2

Submit

What do these tags mean?

Forum	Questions	Posts	Last post
Questions/Comments Use this Forum to find information on, or ask a question about, NASA Earth Science data.	3467	13446	(resolved) MOD03 CMR concept ... by earthengine_urs  Sun Apr 23, 2023 12:30 pm America/New_York



EARTHDATA

Activity

1. Log into Earthdata Forum.
2. Search for TEMPO, TROPOMI and PACE questions (existing) and/or post your own question
3. Share your findings with the group

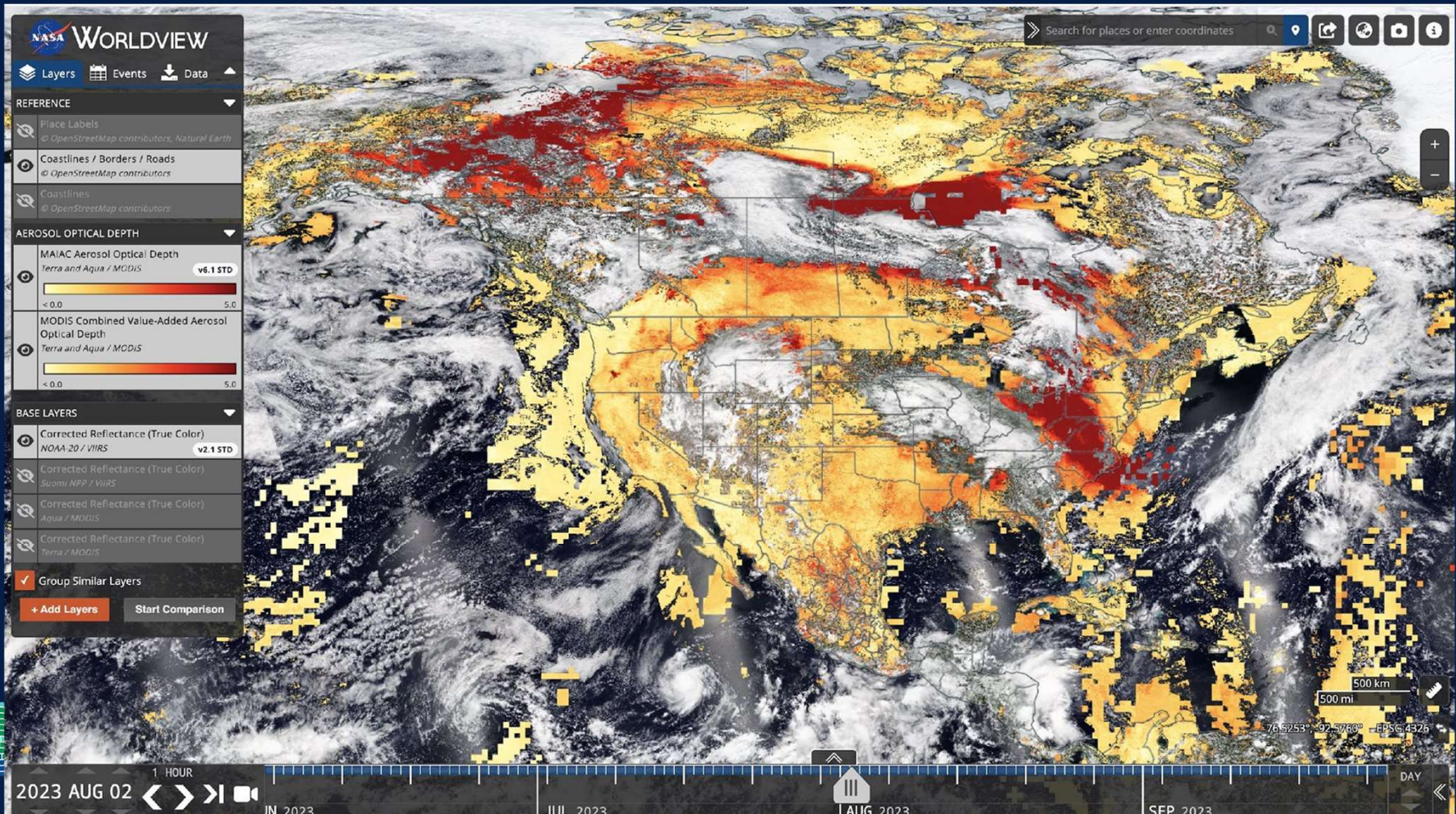
A satellite image of Earth from space, showing North America, Europe, and Africa. The image is split horizontally by a blue semi-transparent band containing text. The top half shows North America and Europe, while the bottom half shows Africa and parts of South America. The blue band is wider on the left side, where the text is located.

Viewing TEMPO data in NASA Worldview

Hazem / demo

How to retrieve images/rasters?

worldview.earthdata.nasa.gov

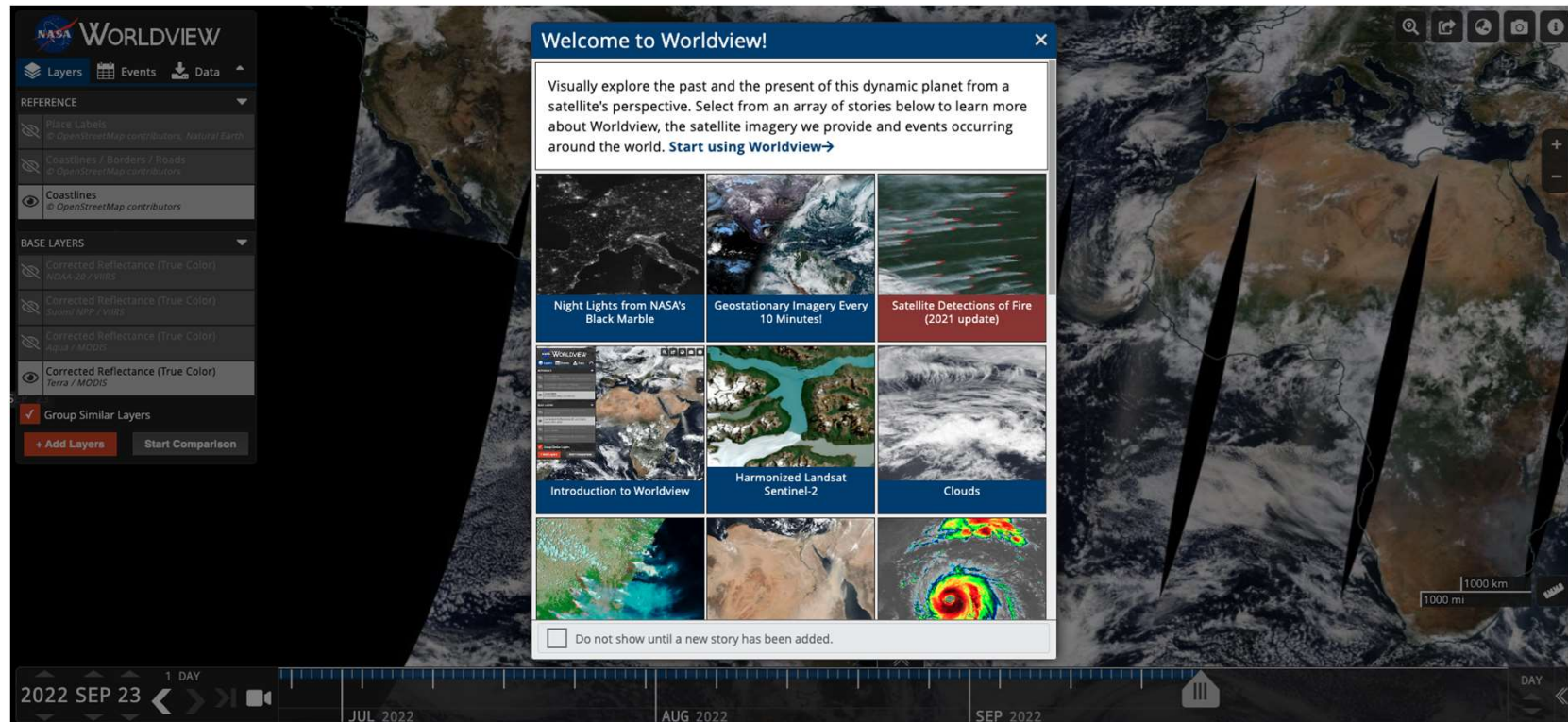


NASA Imagery for Visualizers



- **Worldview** is an **open source** web mapping application
- **Global Imagery Browse Services (GIBS)** is a **set of services** - fast and open access to 1000+ NASA imagery products

Quick Worldview Demo



Hands On Activity: Worldview

Location: LA, California

Instrument: TEMPO

Data: NO2 L3 Troposphere / HCHO L3 / O3

Time: June 16, 2024

Visualization: Animation

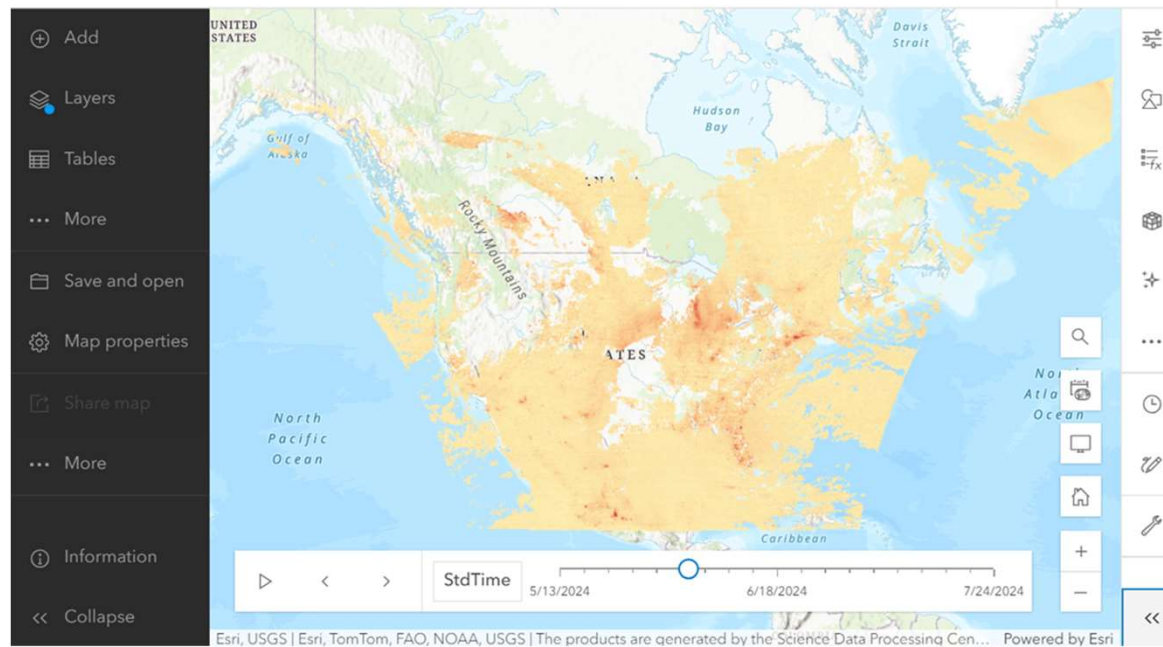


A satellite map of the world is shown in the background. A semi-transparent blue rectangular overlay covers the middle portion of the image, containing the title and name. The overlay is wider than it is tall, extending across most of the image's width.

TEMPO data in Earthdata GIS (EGIS)

Hazem

Quick EGIS Demo



gis.earthdata.nasa.gov

[EJScreen \(epa.gov\)](https://epa.gov)

A satellite map of the world is shown in the background. A semi-transparent blue rectangular overlay covers the middle portion of the image, containing the title and presenter's name. The map shows the Americas, Europe, and parts of Africa and Asia.

Locating PACE-TEMPO- TROPOMI data in Earthdata Search

Hazem

Where do I find data online?

Earthdata Search
(search.earthdata.nasa.gov)

Unified search and discovery interface for all of NASA's Earth Science data, with pre-processing and transformation services for select datasets



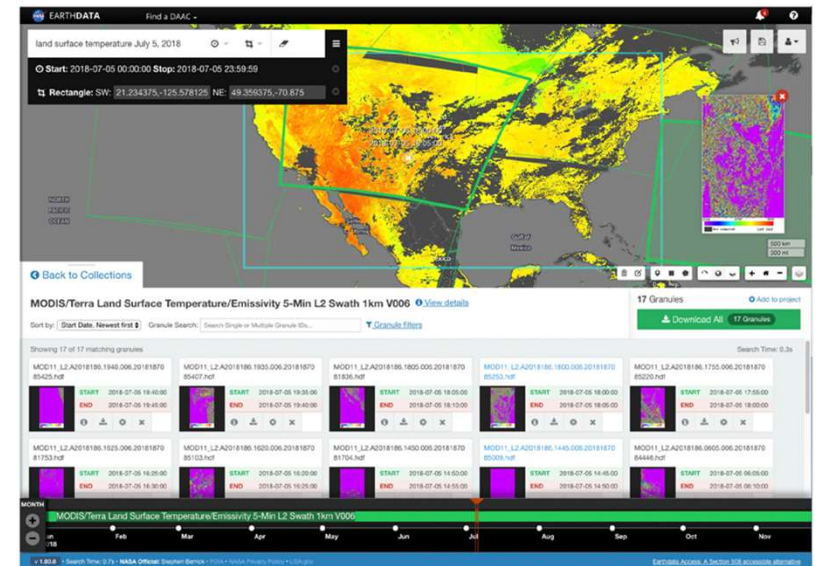
A screenshot of the Earthdata Search web application. The interface is dark-themed. At the top, there's a header with the NASA logo, "EARTHDATA", and a search bar. Below the header, the main content area is divided into a left sidebar and a main results pane. The sidebar contains a "Filter Granules" section with a "Clear Filters" button, a "Granule Search" section with a "Granule ID(s)" input field, a "Temporal" section with "Start" and "End" date pickers, and a "Data Access" section with checkboxes for "Find only granules that have browse images" and "Find only granules that are available online". The main results pane shows "Search Results (16 Collections)" for the query "TEMPO NO2 tropospheric, stratospheric, and total columns". It displays "Showing 20 of 10,237 matching granules". The results are presented in a grid of six cards, each showing a granule ID, start/end times, and download options. At the bottom of the results pane, there's a "Download All" button with a count of "10,237". To the right of the results pane is a map of the United States and surrounding regions, with a green rectangular box indicating the search area. The map includes a scale bar (500 km, 300 mi) and a "Feedback" button.

NASA Earthdata Search

Data discovery and data access tool that allows for the discovery of more than 50,000 Earth Observation data collections.

Allows users to:

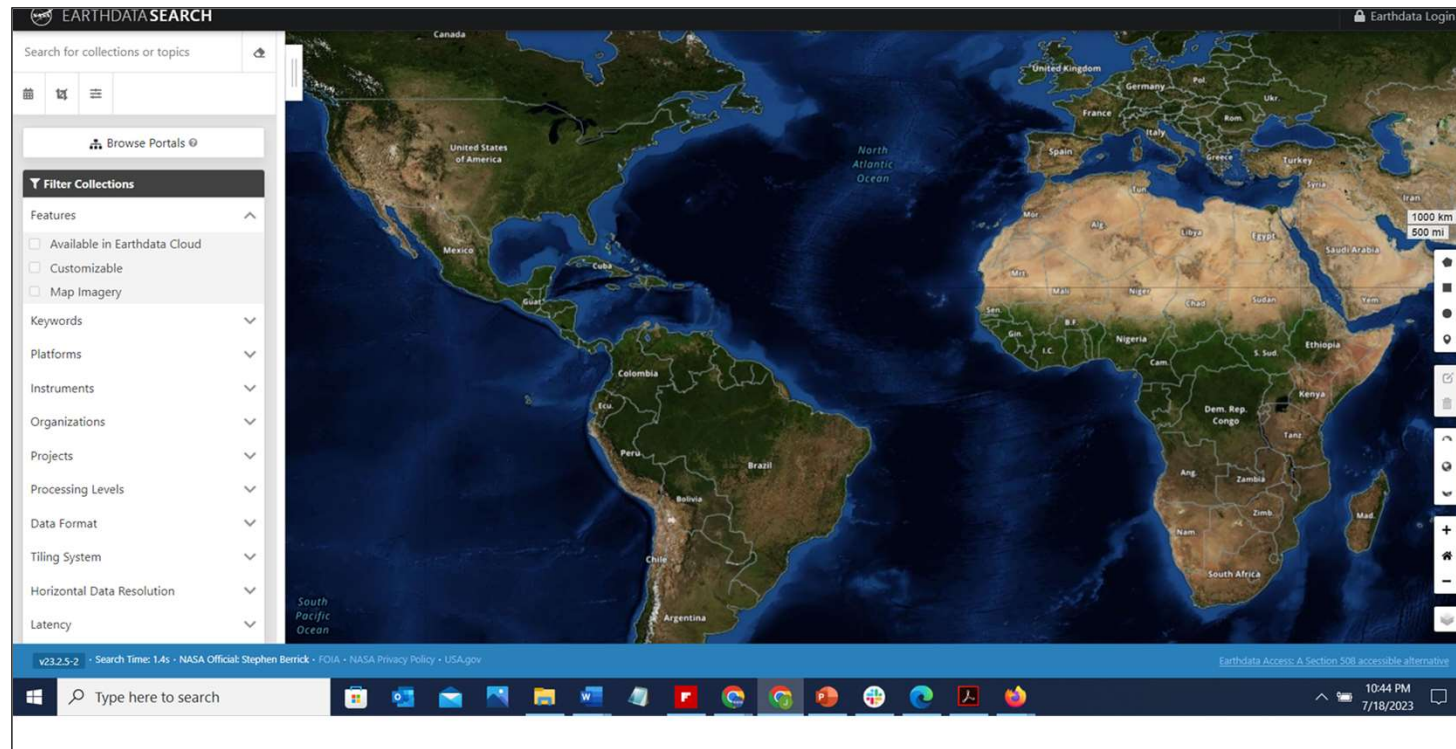
- Access data collections
- Search for data files by date and spatial area
- Preview browse images
- Download or submit requests for data files
- Customize select data collections



<https://search.earthdata.nasa.gov>



Quick Earthdata Search Demo



<https://search.earthdata.nasa.gov>

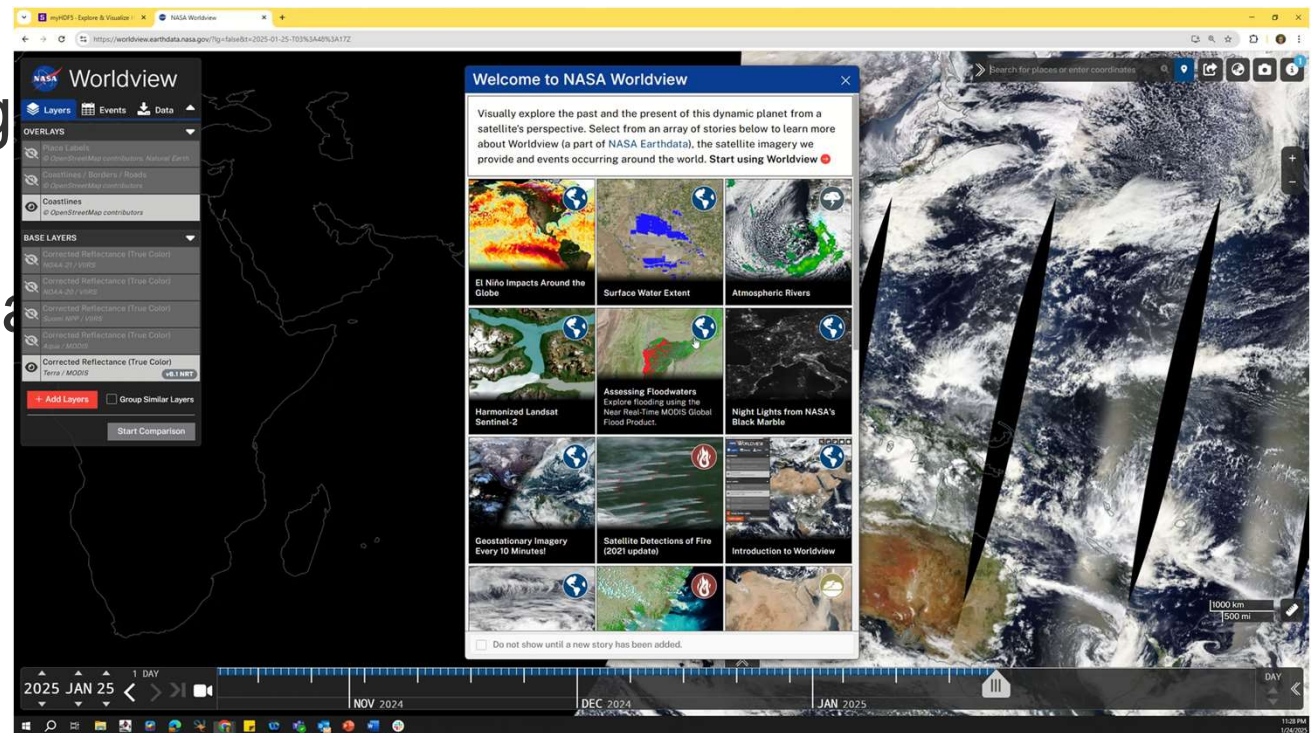
A satellite map of the world is shown in the background. A semi-transparent blue rectangular overlay covers the middle portion of the image. Inside this blue area, there is white text on the left and a vertical white line on the right, followed by more white text.

Welcome, Introductions,
Demo of EPA's RSIG -
Installed in advance

Hazem / demo RSIG

Worldview / Global Imagery Browse Service (GIBS)

- Browse Imagery
- Animations
- Event Information
- GIBS API



A satellite map of the world is shown in the background. A semi-transparent blue rectangular overlay covers the middle portion of the image, from the top of the Atlantic Ocean down to the bottom of the Indian Ocean. The text is placed within this blue area.

ASDC Github for Data and User Services

Hazem

TEMPO	Add files via upload	4 months ago
TOLNet	Add files via upload	last week
images	Add files via upload	2 years ago
README.md	Update README.md	2 weeks ago
ncompare-example-usage.ipynb	add URLs for two example MOPITT data files	10 months ago

README

ASDC_Data_Tutorials_and_User_Services

This GitHub page serves as a comprehensive resource for end users seeking tutorials on various missions conducted by the Atmospheric Science Data Center (ASDC). The page's primary objective is to provide step-by-step guidance and instructions on utilizing the NASA missions archived and distributed by ASDC DAAC. By offering these tutorials, the page aims to enhance the knowledge and proficiency of end users, enabling them to leverage the valuable resources made available by ASDC effectively. This GitHub page facilitates the seamless transfer of expertise from ASDC to end users, fostering a collaborative environment that drives innovation and progress in space-related endeavors.



EARTHDATA

https://github.com/nasa/ASDC_Data_and_User_Services/tree/main/TEMPO

How about programmatic access?



Python library for NASA

```
1 import earthaccess
2
3 earthaccess.login(strategy="netrc")
4
5 results = earthaccess.search_data(
6     count=2,
7     short_name="ATL08",
8     bounding_box=(-92.86, 16.26, -91.58, 16.97),
9 )
10
11 earthaccess.download(results, "./research/")
12
```

- Line 3: earthaccess handles authentication with NASA EDL.
- Line 5: earthaccess abstracts NASA's search API (CMR) into a *pythonic* module.
- Line 11: earthaccess can download or open data for both cloud and on-prem hosted datasets.



A satellite map of the world is shown, with a semi-transparent blue overlay covering the middle portion. The overlay contains white text and a vertical line. The text reads "Just in Time Solutions for your Research Journey" on the left and "Elizabeth" on the right, separated by a vertical line.

Just in Time Solutions for your Research Journey

Elizabeth



EARTHDATA

Engage with us | Start here at earthdata.nasa.gov



Get Started Guide

An introduction to resources and tools



Data Pathfinders

To guide users through the process of selecting & using datasets



Backgrounders

Informational articles providing a deeper explanation of key topics



Webinars & Tutorials

Step-by-step instructions for working with NASA Earth Science resources



Data Stories

Articles, Data Chats, Data User Profiles

Who is this Data Pathfinder Designed For?



Users who don't
know where to start
with NASA data



Users who need data
for a specific time,
date, or place



Users who are short
on time and need
quick insights



Users who
have questions
about data



EARTHDATA



EARTHDATA

[Air Quality Data Pathfinder](#)

Summary

- Hourly daytime air pollution measurements over North America
- Baseline data products:
 - Ozone
 - Nitrogen dioxide
 - Formaldehyde

TEMPO data can be accessed via Earthdata Search, Worldview, RSIG, EGIS, and programmatically

ESDS and ESDIS have resources to help support your work.



Credit: NASA's Scientific Visualization Studio



Post Survey

