Unlocking Atmospheric Data: A Guide to Air Quality and Sustainable Development with the Atmospheric Science Data Center

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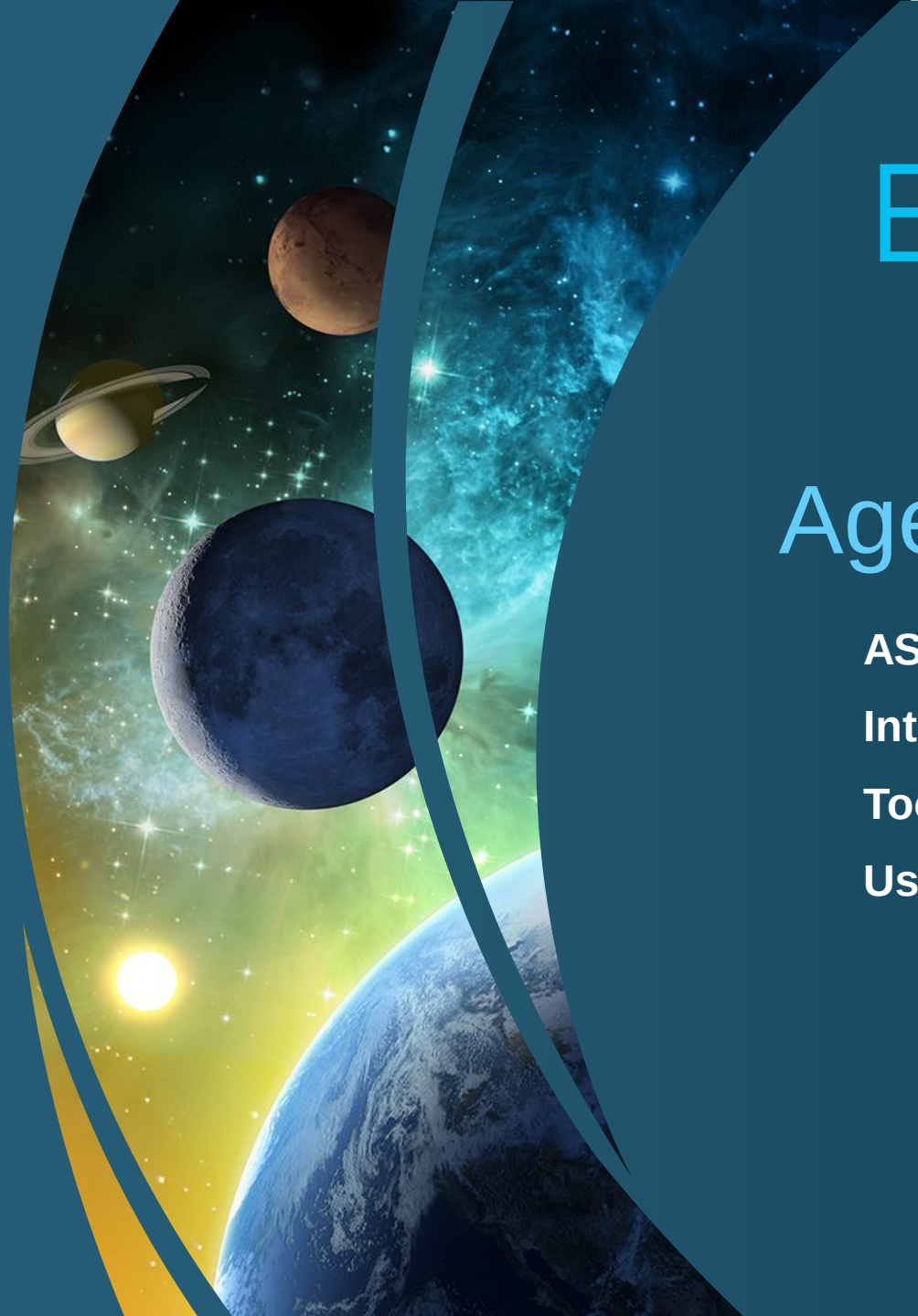
01/19/2024



EXPLORE EARTH

Agenda

- **ASDC Overview**
- **Introduction to TEMPO**
- **Tools and Services**
- **User Support**

Earth Science Data and Information System *ESDIS*

NASA's Distributed Active Archive Centers (DAACs)

A federated approach to data management

Land Process DAAC

Land Cover, Surface Reflectance, Radiance, Temperature, Topography, Vegetation Indices

Physical Oceanography DAAC

Gravity, Sea Surface Temperature, Ocean Winds, Ocean Surface Topography, Sea Surface Salinity, Ocean Circulation

National Snow and Ice Data Center DAAC

Frozen Ground, Glaciers, Ice Sheets, Sea Ice, Snow, Soil Moisture, Cryosphere, Climate Interactions

Alaska Satellite Facility DAAC

Synthetic Aperture Radar (SAR) Products

Global Hydrometeorology Resource Center DAAC

Hazardous Weather, Lightning, Tropical Cyclones, Storm-Induced Hazards

Oak Ridge National Laboratory DAAC

Biogeochemical Dynamics, Ecological Data, Environmental Processes

Atmospheric Science Data Center

Radiation Budget, Clouds, Aerosols, Tropospheric Composition

Socioeconomic Data and Applications Center

Human Interactions, Land Use, Environmental Sustainability, Geospatial Data

Ocean Biology DAAC

Ocean Color, Sea Surface Temperature, Sea Surface Salinity

Crustal Dynamics Data Information System

Space Geodesy, Solid Earth

Goddard Earth Sciences Data and Information Services Center

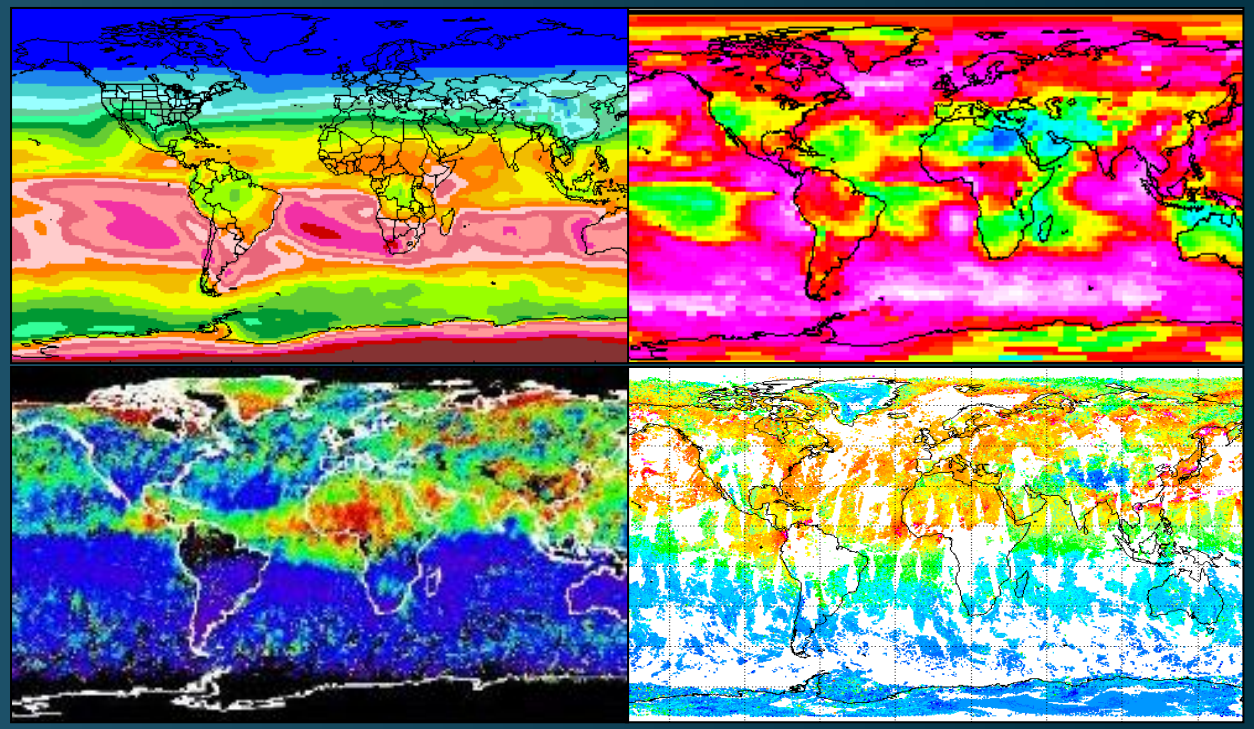
Global Precipitation, Solar Irradiance, Atmospheric Composition and Dynamics, Global Modeling

Level 1 and Atmosphere Archive and Distribution System DAAC

MODIS Level-1 and Atmosphere Data Products

EARTHDATA

ASDC at a Glance

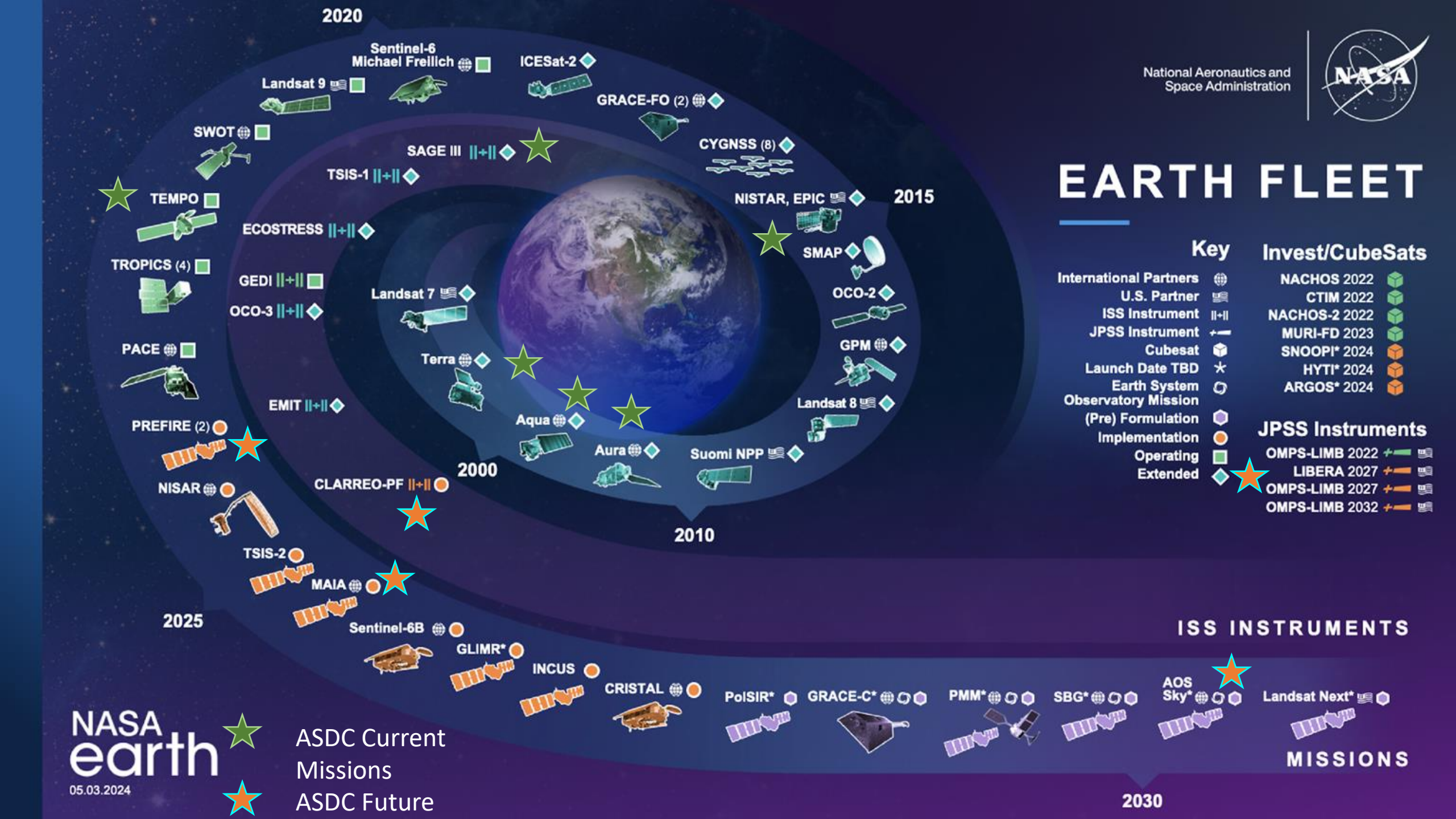


- ✓ 110+ Science projects
  - ∘ MISR ∘ MOPITT ∘ MAIA ∘ TEMPO ∘ CERES
  - ∘ TEMPO & CALIPSO → RSIG (EPA)
  - ∘ Airborne field campaigns (KORUS AQ, DISCOVER AQ, FIREX AQ)
- ✓ 1500+ unique science products
- ✓ Data usage (2022)
  - ∘ 3.5 Petabytes ∘ 160,000 users
  - ∘ 158 countries
- ✓ Data archive (2022)
  - ∘ 8+ Petabytes ∘ 168 million files (5,500 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


2020
Sentinel-6 Michael Freilich
ICESat-2
Landsat 9
GRACE-FO (2)
SWOT
CYGNSS (8)
SAGE III
TSIS-1
TEMPO
NISTAR, EPIC
2015
ECOSTRESS
SMAP
TROPICS (4)
GEDI
Landsat 7
OCO-2
OCO-3
GPM
PACE
Terra
EMIT
Landsat 8
PREFIRE (2)
Aqua
Aura
Suomi NPP
2000
CLARREO-PF
NISAR
TSIS-2
MAIA
2025
Sentinel-6B
GLIMR*
INCUS
CRISTAL
PolSIR*
GRACE-C*
PMM*
SBG*
AOS Sky*
Landsat Next*
2030
ISS INSTRUMENTS
MISSIONS
National Aeronautics and Space Administration
NASA
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
SNOOPI* 2024
HYTI* 2024
ARGOS* 2024
JPSS Instruments
OMPS-LIMB 2022
LIBERA 2027
OMPS-LIMB 2027
OMPS-LIMB 2032
NASA earth
05.03.2024
ASDC Current Missions
ASDC Future

Eyes on the Solar System - Hom

https://eyes.nasa.gov/apps/solar-system/#/home

Google Lens

EYES ON THE SOLAR SYSTEM

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Menu

Featured Stories and Events

Europa Clipper Launch

MISSION LAUNCH

OCTOBER 10TH, 2024

Asteroid and Comet Missions

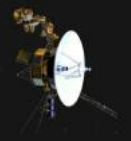
EYES ON ASTEROIDS

Entry, Descent, and Landing

PERSEVERANCE

Voyager's Grand Tour

1977 - TODAY



JUPITER

MARS

STEREO Ahead

EARTH

Juice

MERCURY

SUN

Parker Solar Probe

BioSentinel

Lucy

OSIRIS-APEX

VENUS

LIVE

OCT 02, 2024

12:57:42 PM

REAL RATE

Tropospheric **E**missions: **M**onitoring of **Po**llution

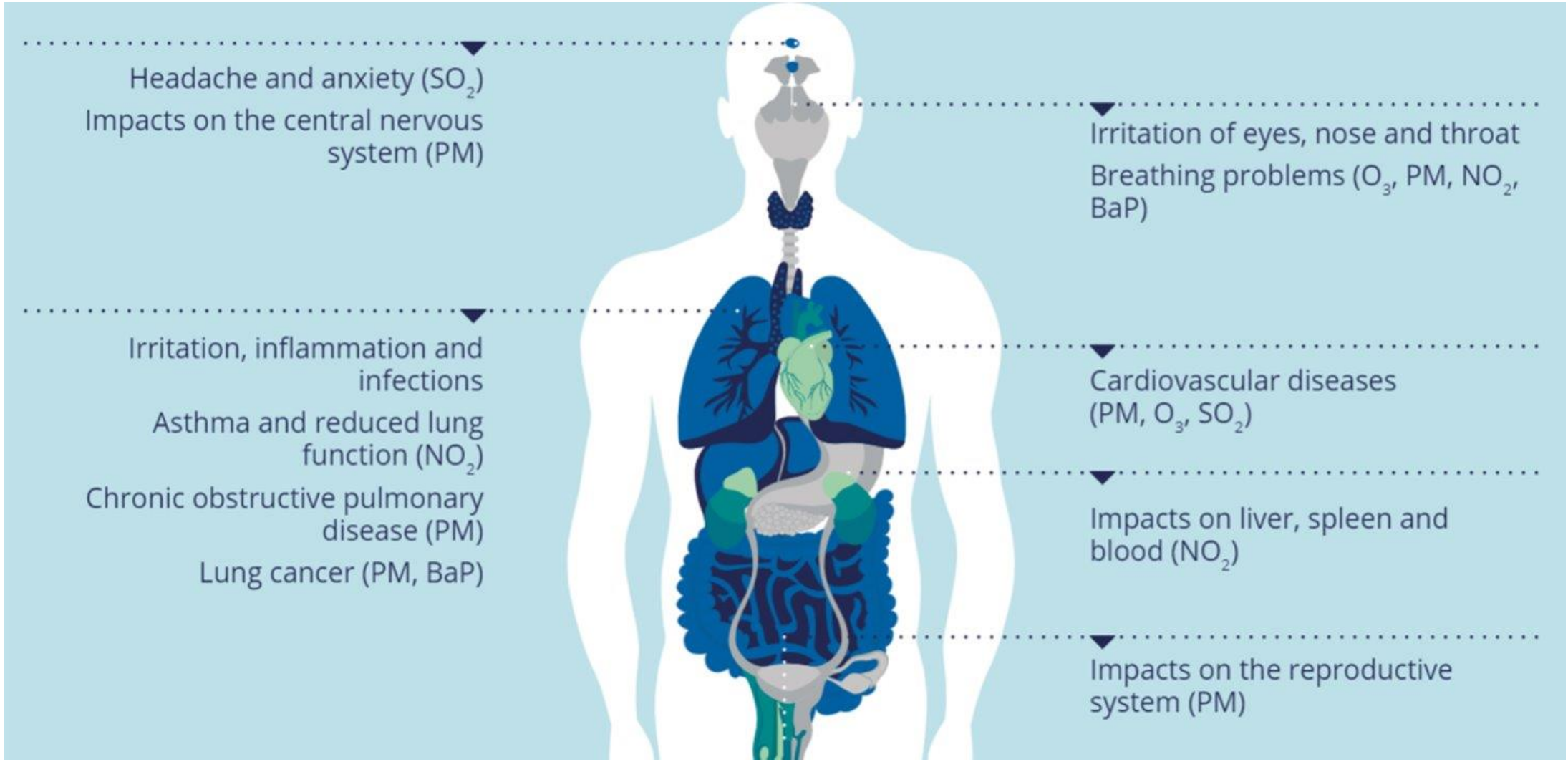
- Hourly daytime air pollution measurements over North America.
- NASA's first Earth Venture Instrument (EVI), selected in 2012.
- First Light August 2nd 2023 Mission objective is 20 months.
- **Geostationary orbit** means TEMPO can scan the continent continuously.
  - High temporal resolution
  - High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

Credit: NASA's Scientific Visualization Studio

EARTHDATA


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

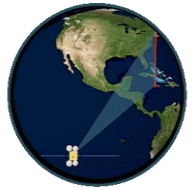
European Environment Agency 2023



EARTHDATA

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

TEMPO Data Lifecycle



Amazon EC2

> 100 Gbps

EARTHDATA CLOUD

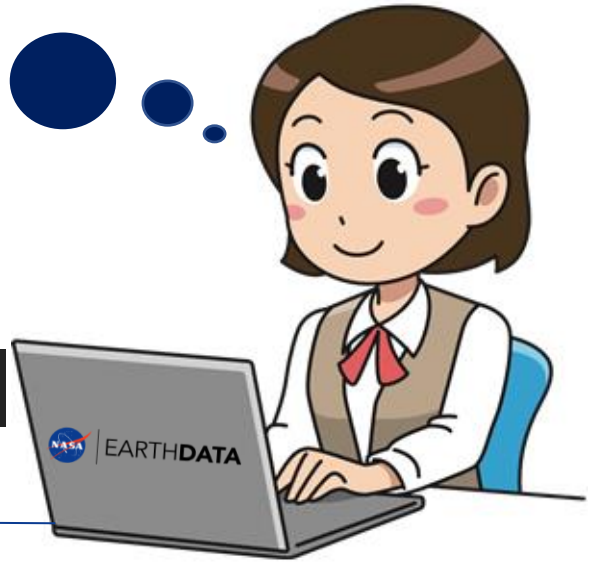
COMMON METADATA REPOSITORY

Amazon S3

NASA EARTHDATA Forum

NASA WORLDVIEW

+/- 30 Mbps



Earthdata Harmony

-SAMBAH
-HOSS

Earthdata GIS

OPeNDAP

REMOTE SENSING INFORMATION GATEWAY RSIG

NASA EDPub

Database

CUMULUS EOSDIS

Application Services

amazon web services

Networking

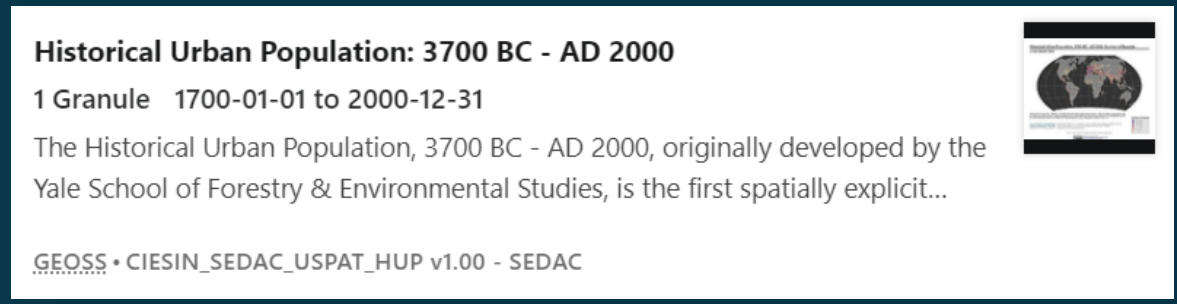
Security

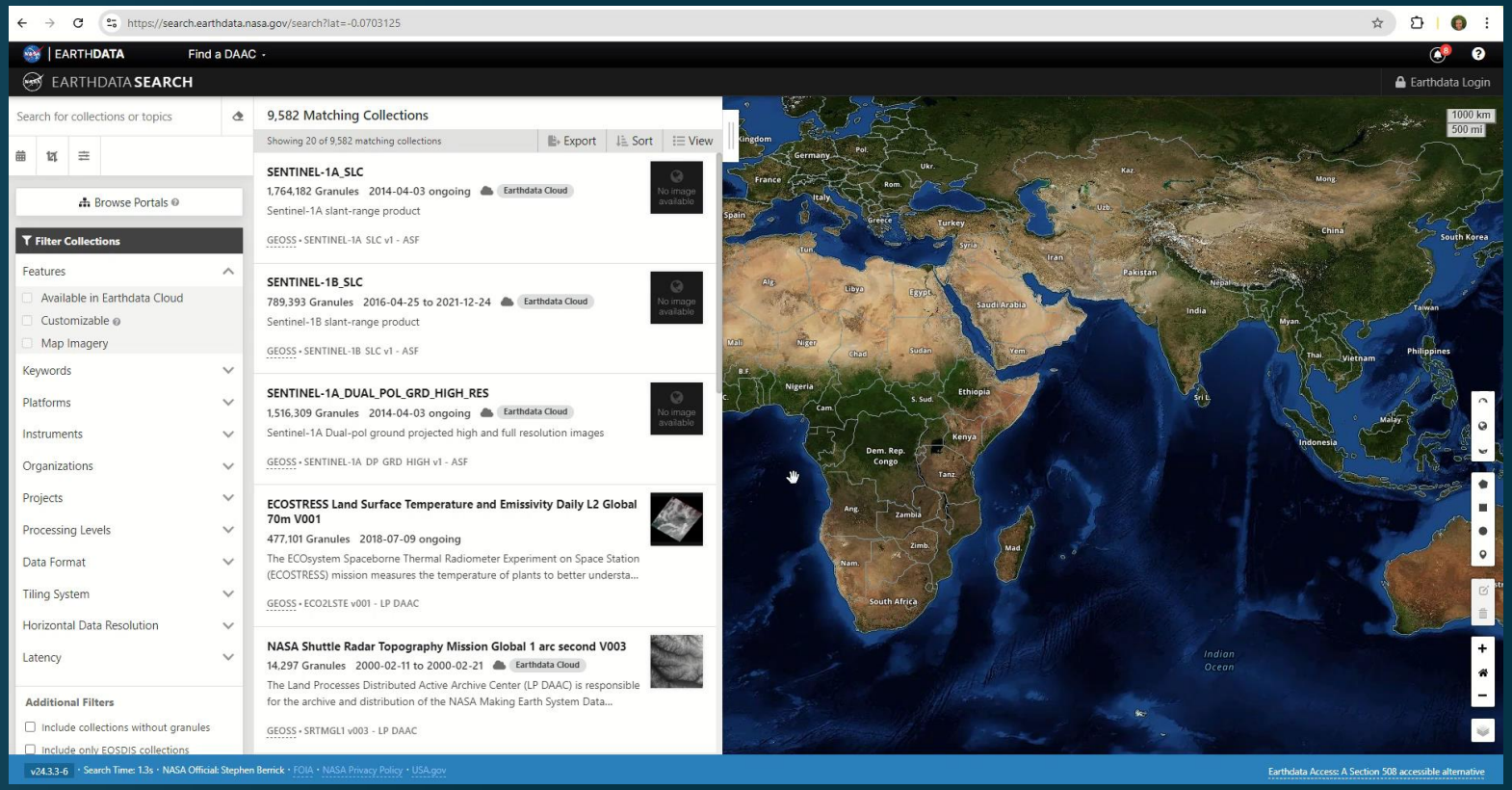
Atmospheric Science Data Center

Tools and Services

Earthdata Search

- Search and Order
  - On Premise
  - Amazon Web Services
- Subsetting & Aggregation
- Browse Imagery
- File Conversions
- Application Programming Interface (API) Access

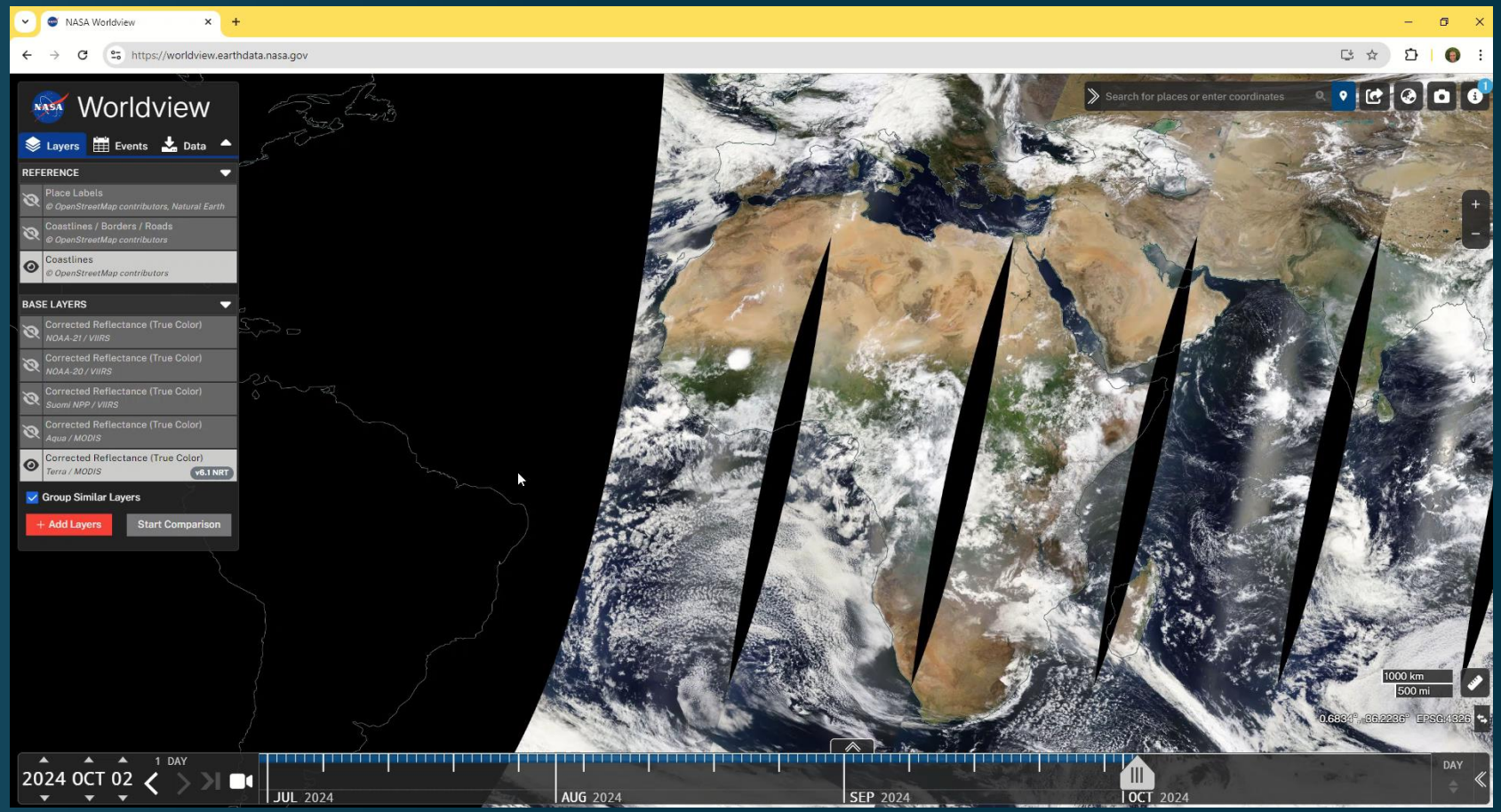




https://search.earthdata.nasa.gov

Worldview / Global Imagery Browse Service (GIBS)

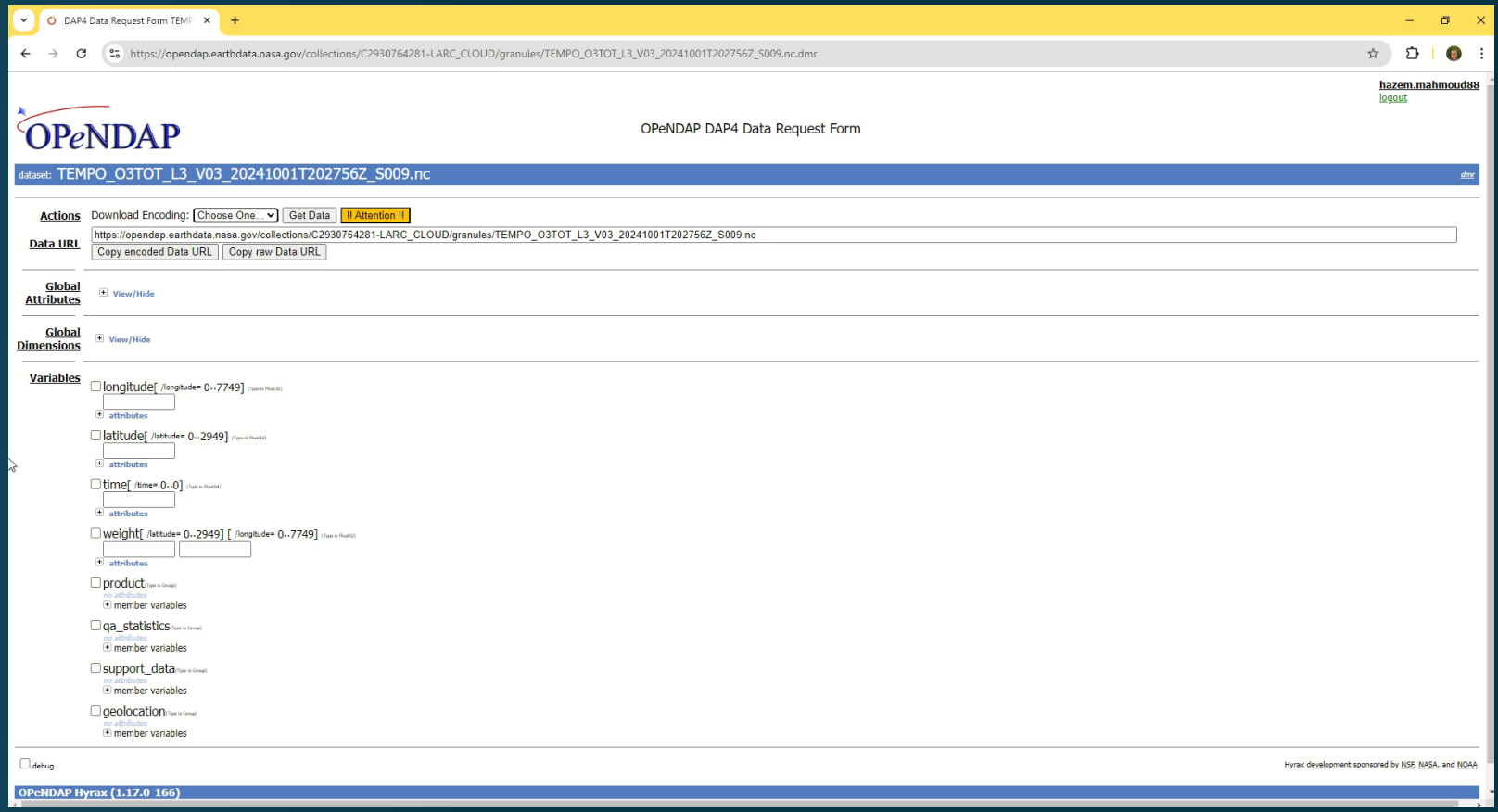
- Browse Imagery
- Animations
- Event Information
- GIBS API



https://worldview.nasa.gov

OPeNDAP

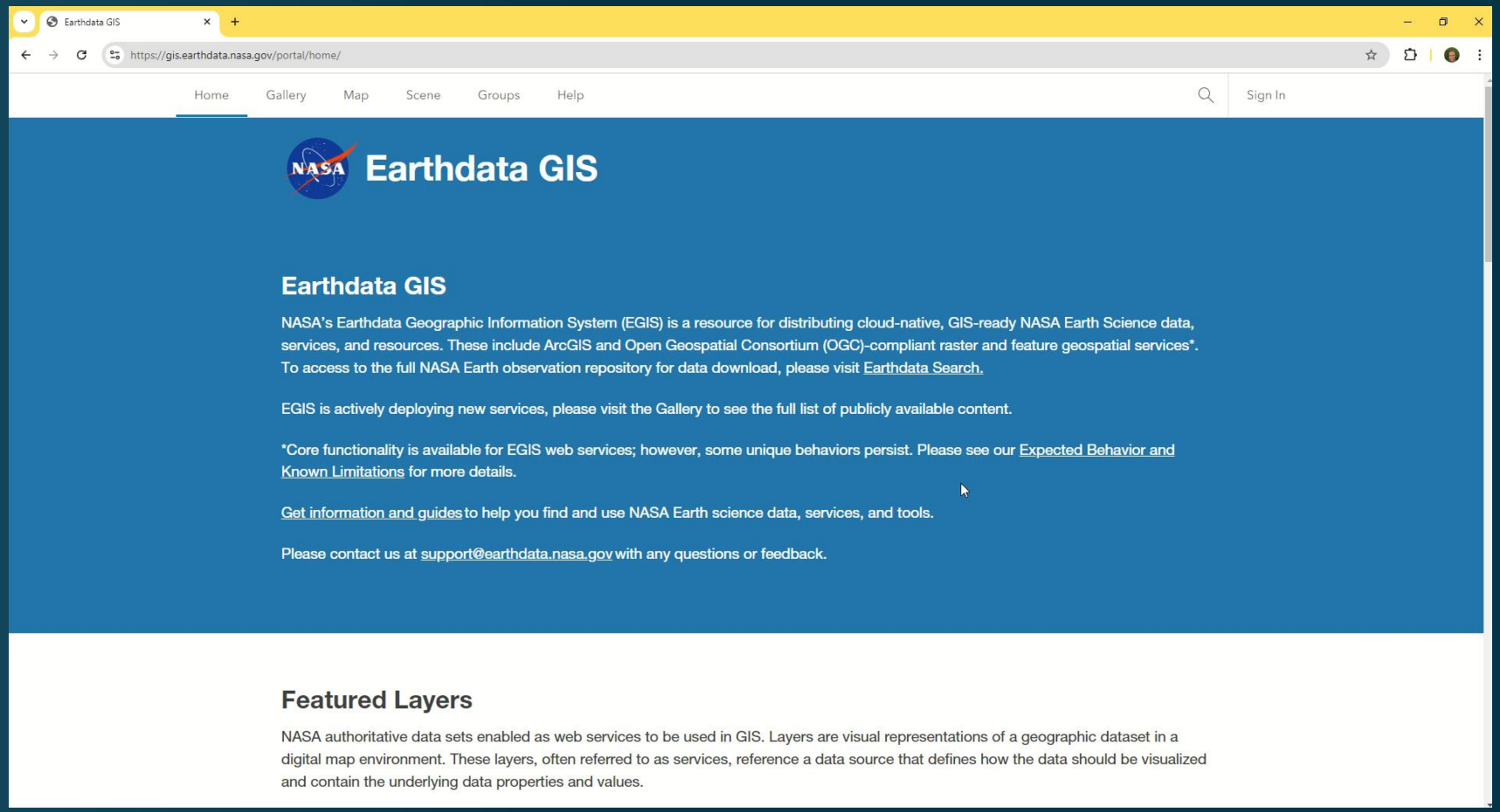
- API Access
- Subsetting & Aggregation
- File Conversions



https://opendap.earthdata.nasa.gov

ArcGIS Enterprise in the Earthdata Cloud

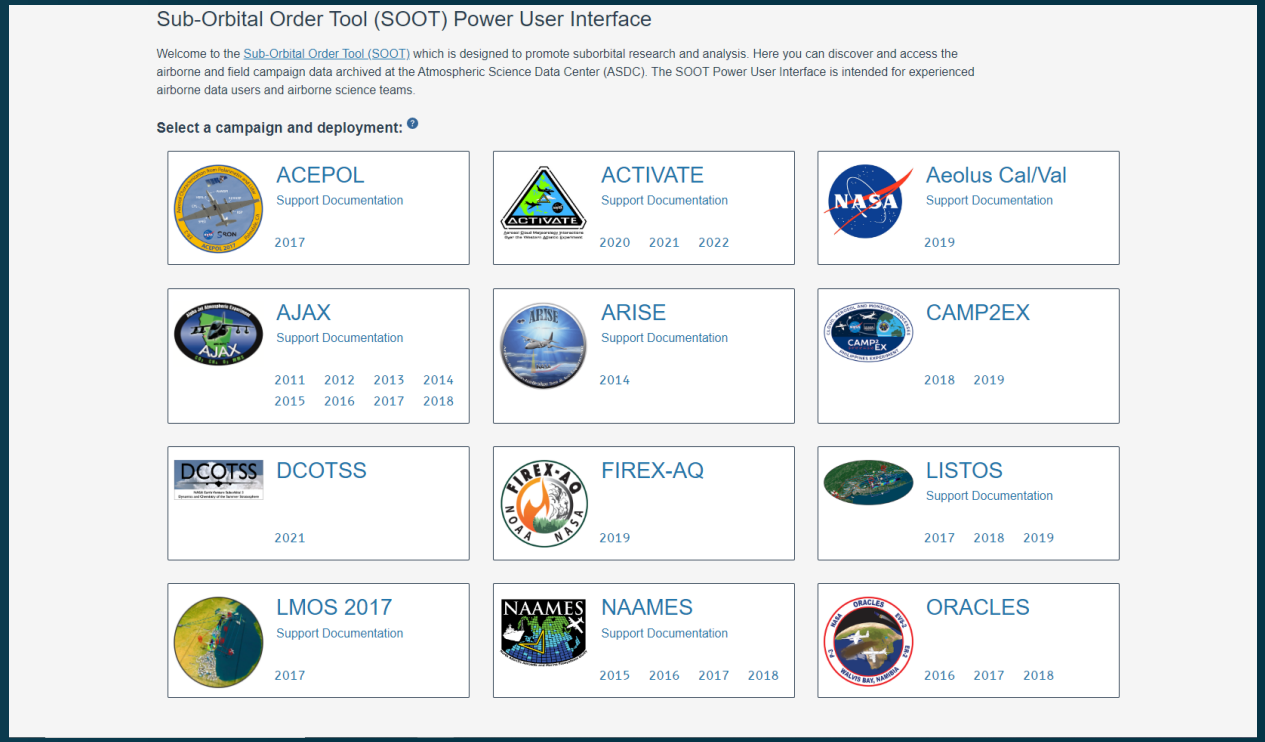
- Geospatial Services
- Maps
- StoryMaps
- Applications



https://gis.earthdata.nasa.gov

Sub-Orbital Order Tool (SOOT)

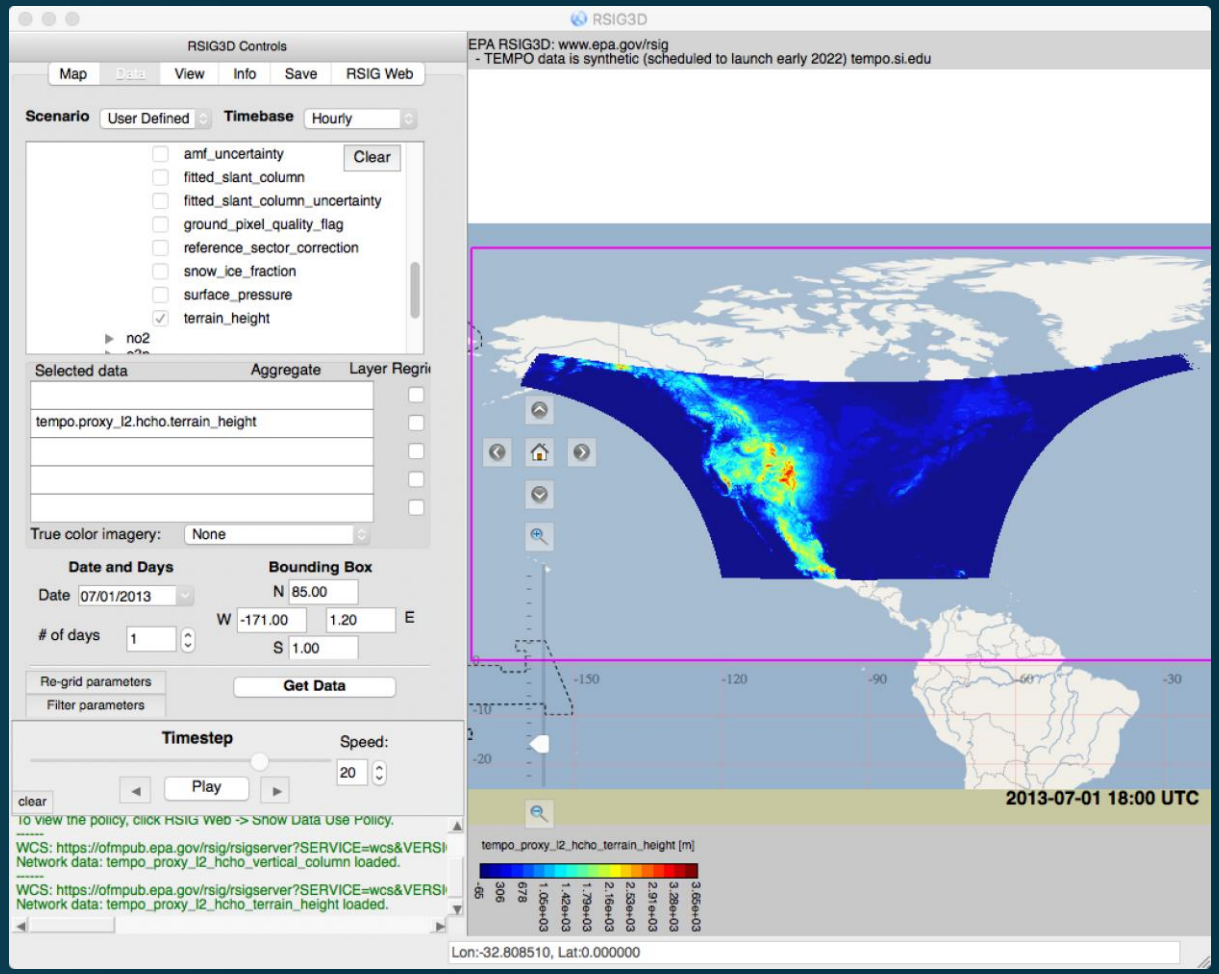
- Search and Access Sub-Orbital Data
- Merge to Common Time Scale
- Supports general and power users



https://asdc.larc.nasa.gov/soot/power-user

EPA Remote Sensing Information Gateway (RSIG)

- Visualization (2D/3D) & Animations
- Subsetting to CMAQ Modeling Grids
- File Conversions
- API Access

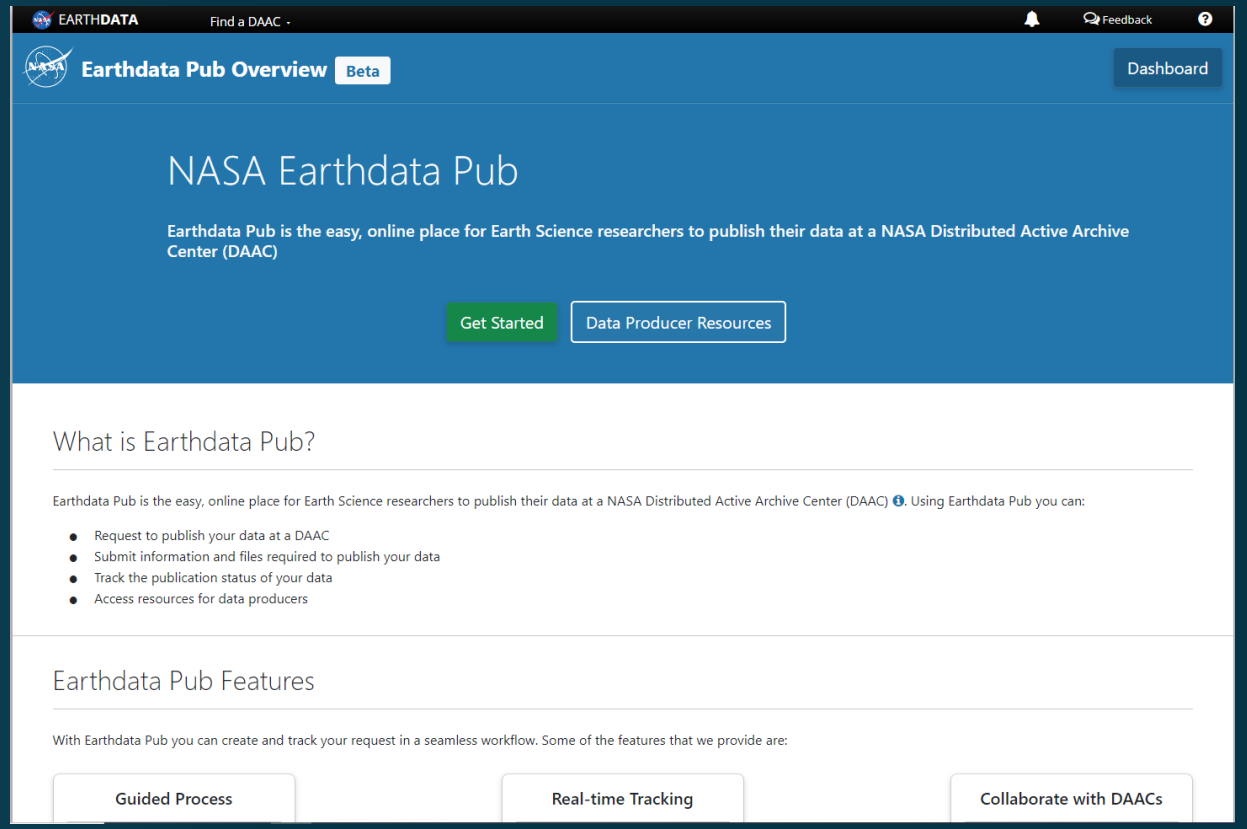


https://www.epa.gov/hesc/remote-sensing-information-gateway

User Support

Earthdata Pub

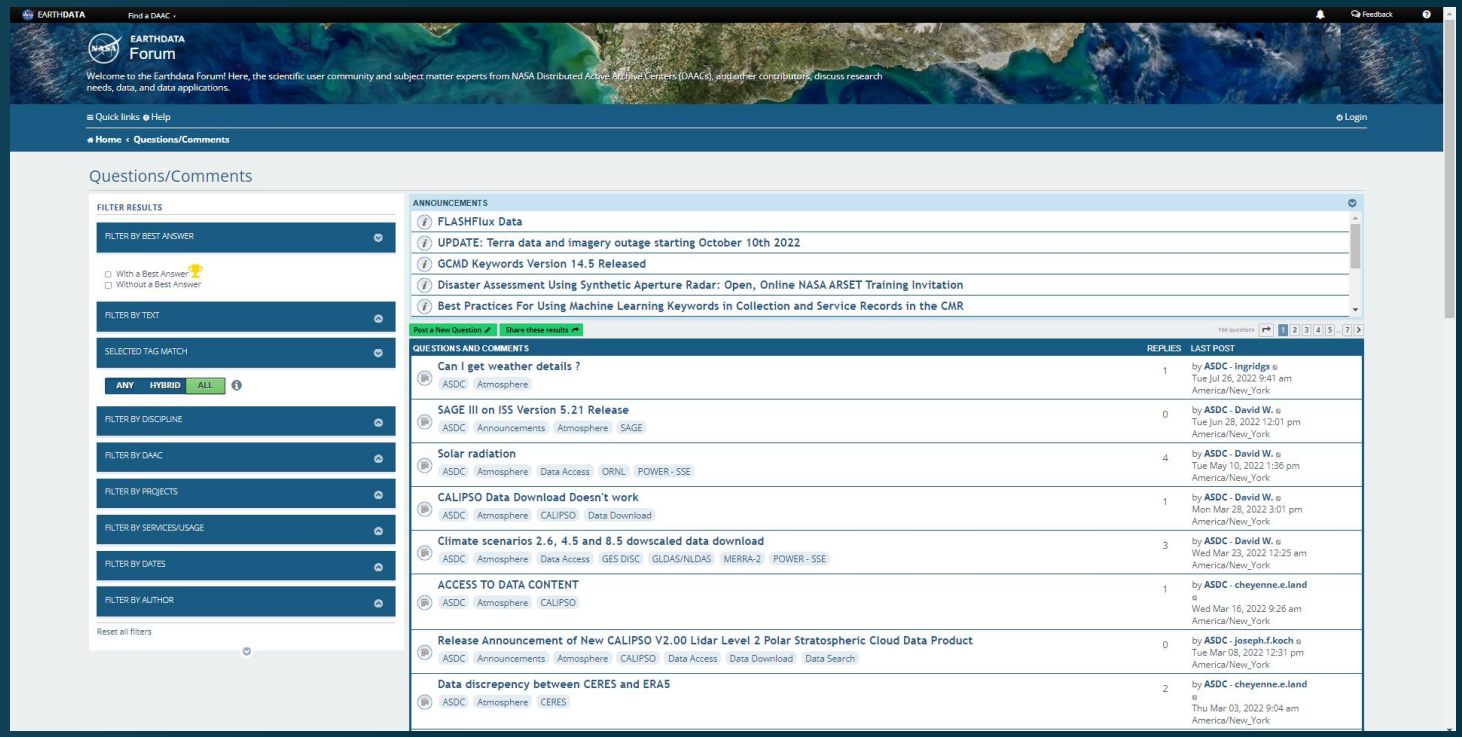
- Request to publish your data at a DAAC
- Submit information and files required to publish your data
- Track the publication status of your data
- Access resources for data producers



https://pub.earthdata.nasa.gov/

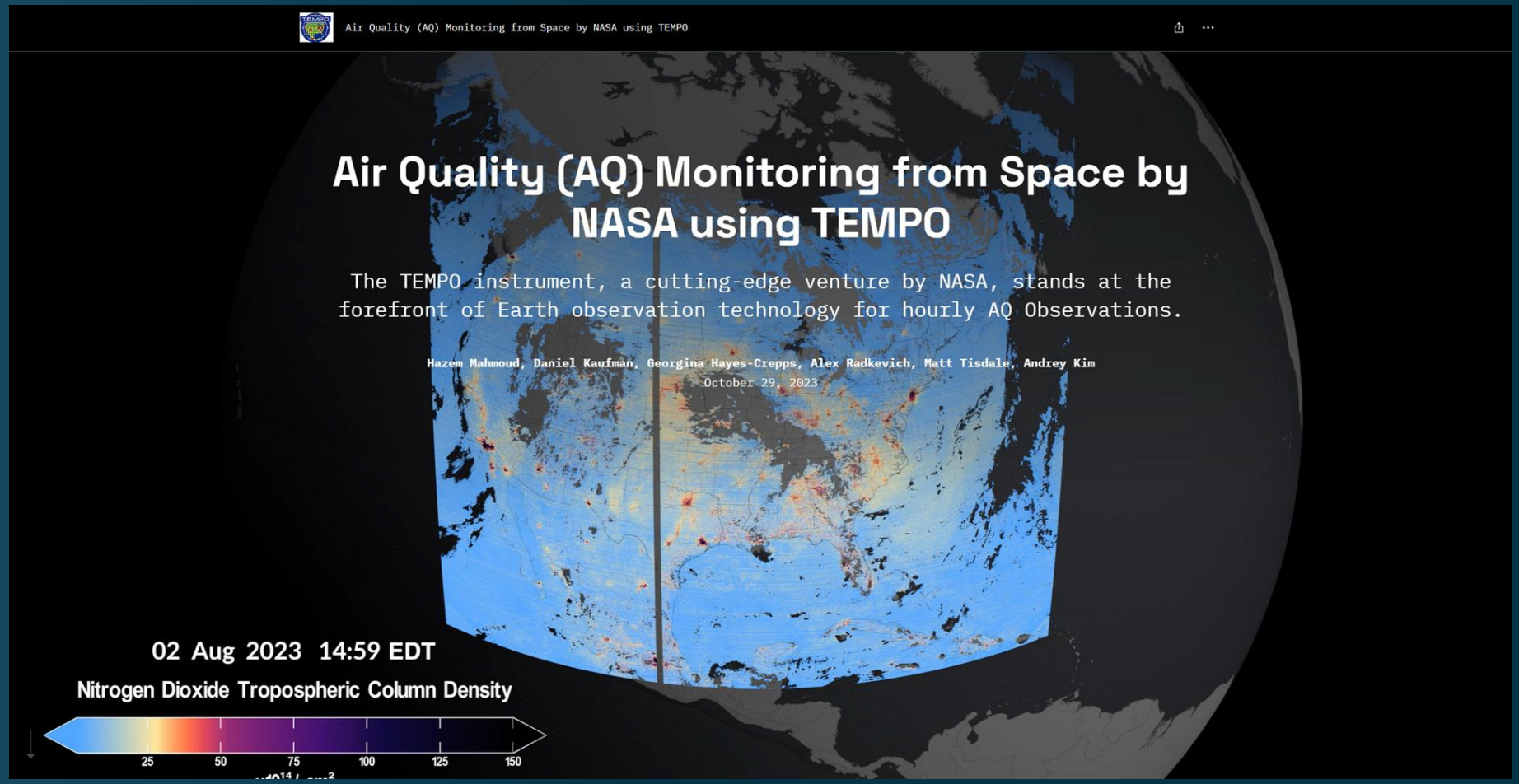
Earthdata Forum

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



https://forum.earthdata.nasa.gov

TEMPO Storymap



https://storymaps.arcgis.com/stories/01e82aefbc8b4d7a951fe089c818bc0c

Science Directorate

Atmospheric Science Data Center (ASDC)

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10/03/2024

www.airnow.gov

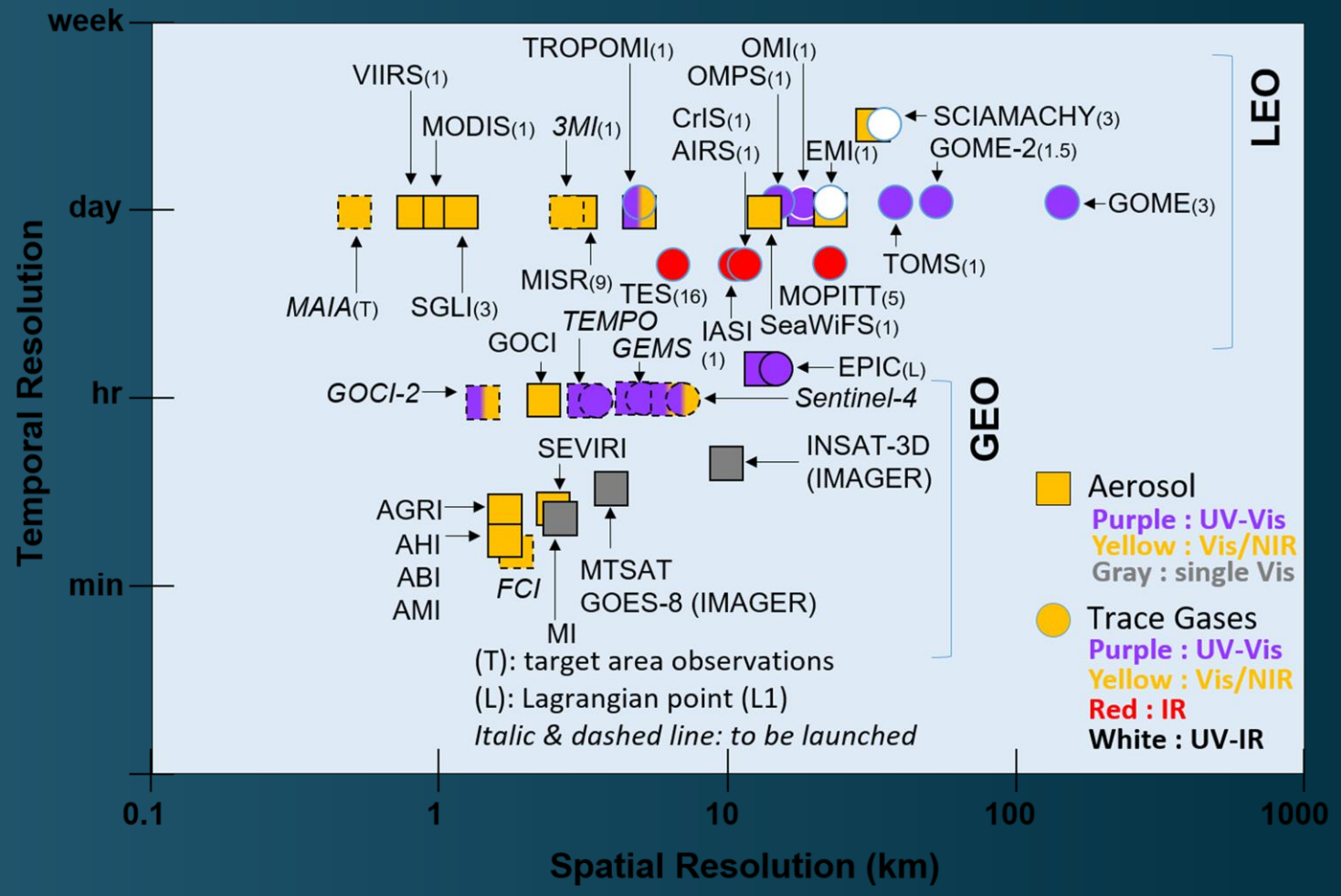
AQI by EPA

AQI Basics for Ozone and Particle Pollution

Daily AQI Color	Levels of Concern	Values of Index	Description of Air Quality
Green	Good	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Yellow	Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very Unhealthy	201 to 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

Pollutant	Averaging Time	2005 AQGs	2021 AQGs
$PM_{2.5}$, $\mu g/m^3$	Annual	10	5
	24-hour[a]	25	15
PM_{10}, $\mu g/m^3$	Annual	20	15
	24-hour[a]	50	45
O_3, $\mu g/m^3$	Peak season[b]	-	60
	8-hour[a]	100	100
NO_2, $\mu g/m^3$	Annual	40	10
	24-hour[a]	-	25
SO_2, $\mu g/m^3$	24-hour[a]	20	40
CO, mg/m^3	24-hour[a]	-	4

AQ from Space



Kim et al. (BAMS 2020)

ASDC Data and User Services

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.

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

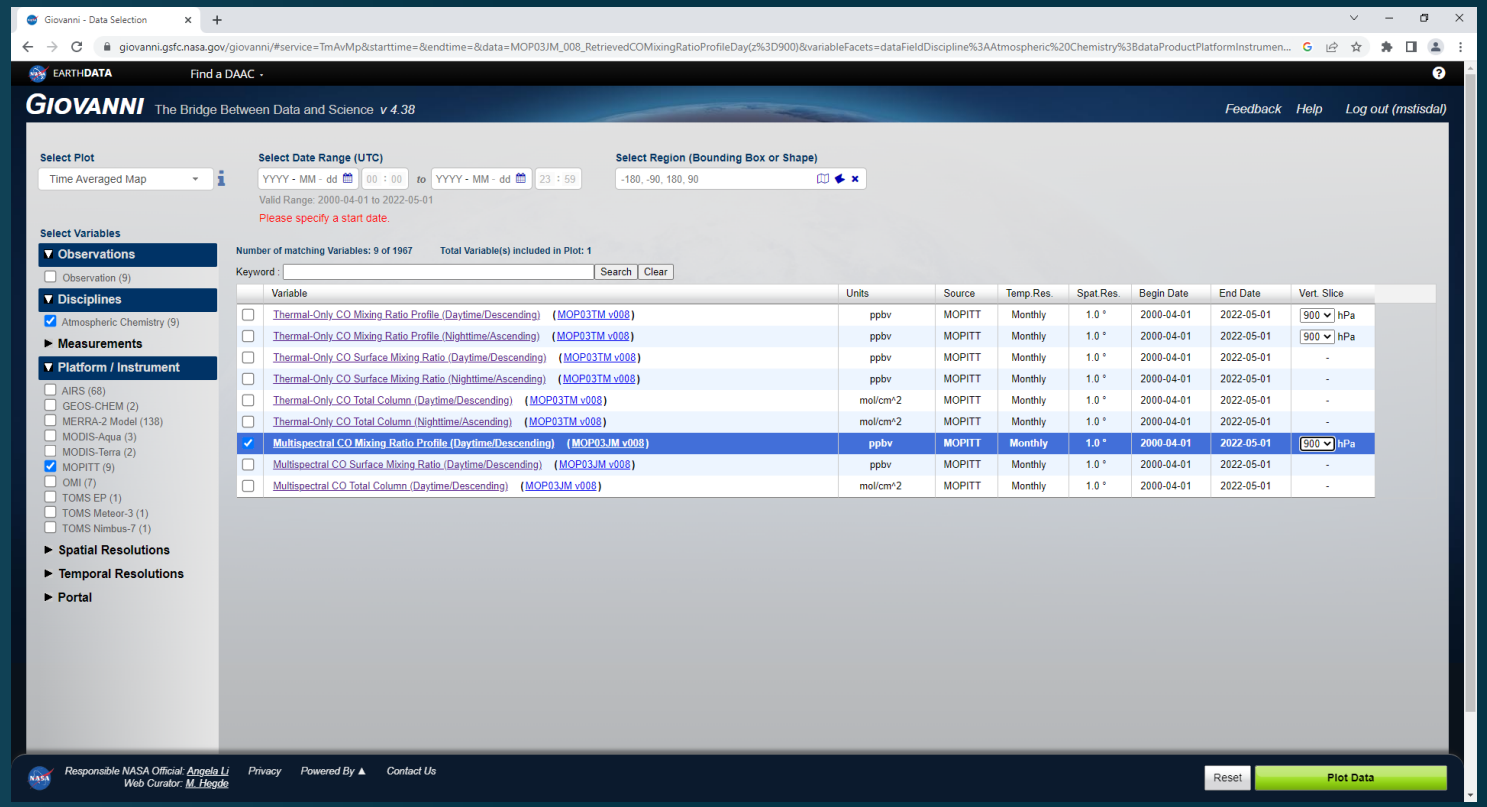
Earthdata Website

- Data Tools
- Data Recipes
- Data Pathfinders
- Webinars and Tutorials

https://www.earthdata.nasa.gov/

Giovanni

- Time Series
- Time Averaged Maps
- Comparisons
- Vertical Cross Sections



https://giovanni.earthdata.nasa.gov

https://19january2021snapshot.epa.gov/ozone-layer-protection/basic-ozone-layer-science_.html

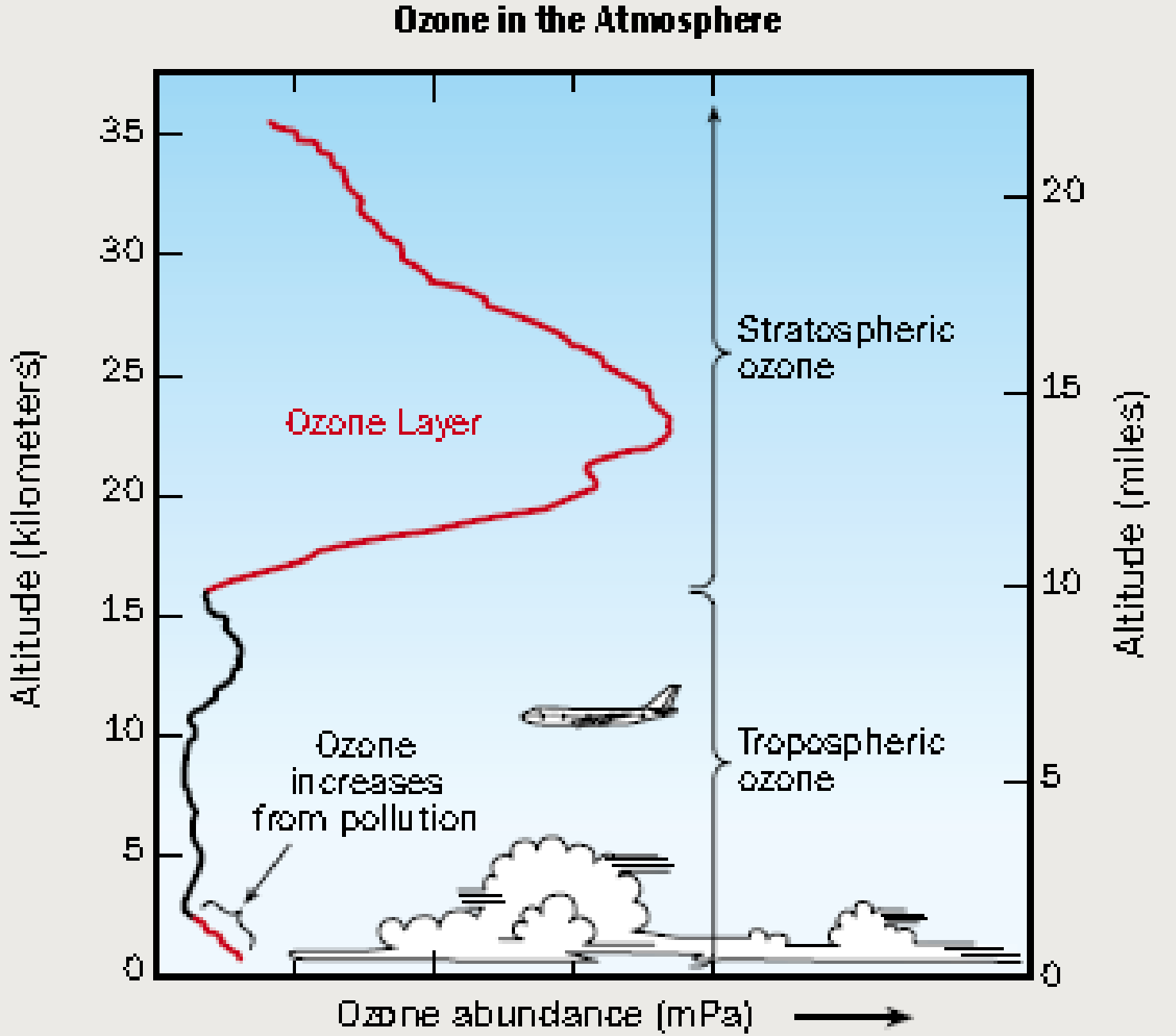


Figure Q1-2 Ozone in the atmosphere. Ozone is present throughout the troposphere and stratosphere. This profile shows schematically how ozone changes with altitude in the tropics. Most ozone resides in the stratospheric "ozone layer." The vertical extent or thickness of this layer varies from region to region and with season over the globe (see Q4). Increases in ozone occur near the surface as a result of pollution from human activities.

What's different about TEMPO compared to other satellite instruments measuring air quality?

- TEMPO is geostationary v. polar-orbiting satellites (e.g., OMI, TROPOMI)
  - Limited Field of Regard (FOR): greater North America, not global coverage
  - Higher temporal & spatial resolution than polar-orbiting
  - More data: scans east-to-west during daylight hours (~18 scans per day)
  - Scans follow available daylight so they don't all start over the East coast
  - **Note: Granule #s don't correspond to specific geographic areas**—granules are used to divide a scan into more manageable file sizes (e.g., Scan 001 Granule 01 in the morning may start over East coast, but Scan 016 Granule 01 in the evening may start over central US)