National Aeronautics and Space Administration

EXPLORE EARTH

Expanding DSCOVR Data Visibility through the Atmospheric Science Data Center

Hazem Mahmoud, Ph.D.
ASDC Scientist
10/17/2024

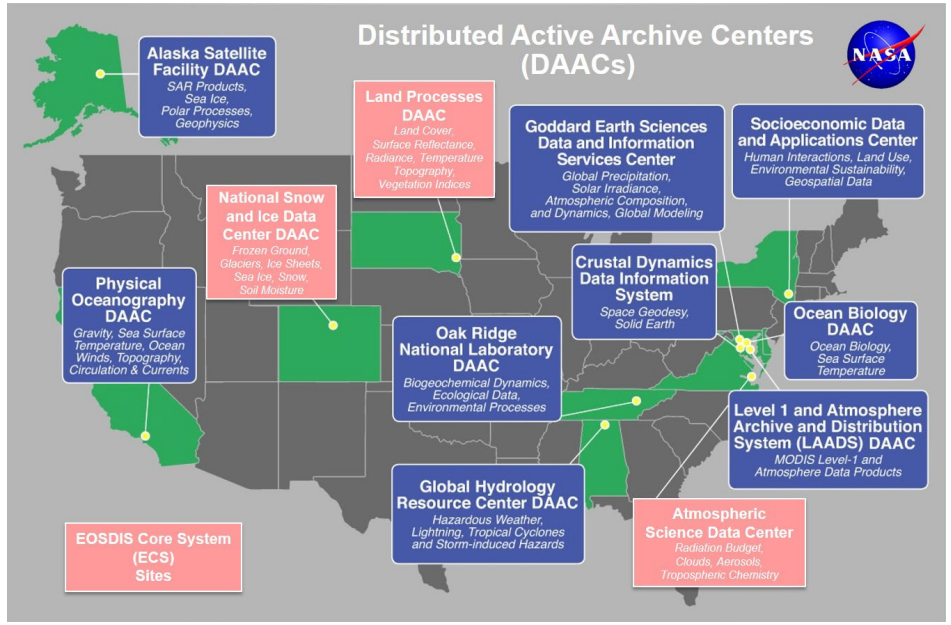
EXPLORE EARTH

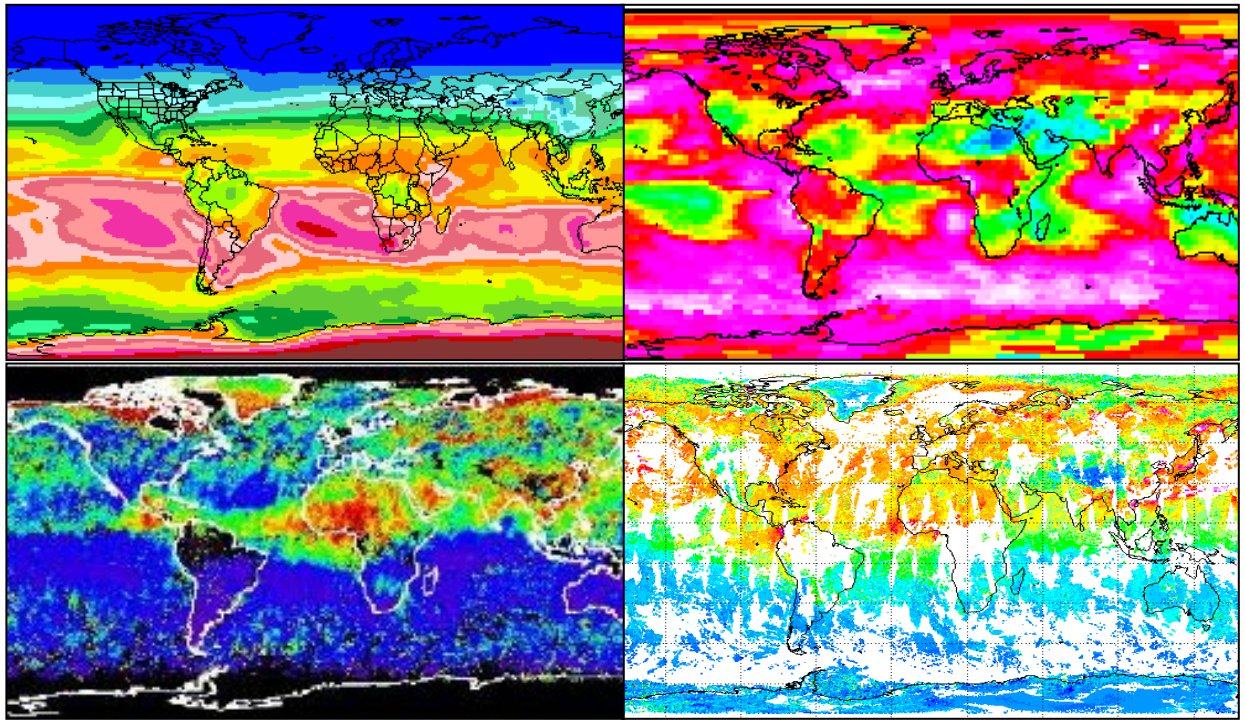
- ASDC Overview
- ASDC Data Distribution Tools and Services
- DSCOVR Data Products and Distribution Metrics
- DSCOVR data on the Cloud
- Questions

Earth System Data and Information System ***ESDIS***

EOSDIS data centers **process, archive, and distribute thousands of data products** to the global user community. The primary services provided by EOSDIS are data archive & management, distribution, information management, product generation, and user support. It is comprised of multiple components including:

- ***Distributed Active Archive Centers (DAACs)***
- Science Data Processing Segment (SDPS)
- Science Investigator-led Processing Systems (SIPS)
- Common Metadata Repository (CMR)
- Earthdata
- Global Imagery Browse Services (GIBS)
- more





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
  - 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

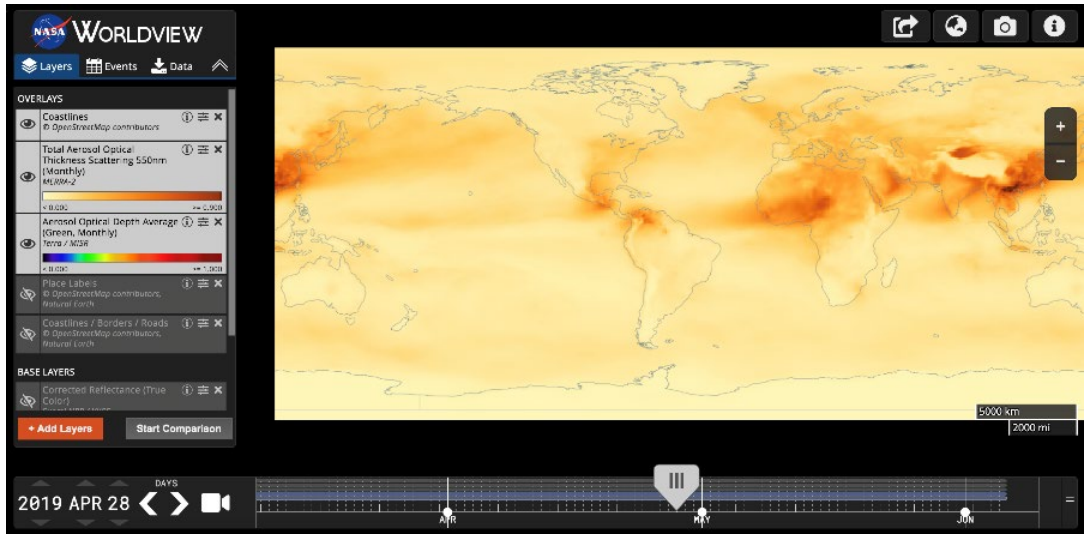
Distribute tools and services

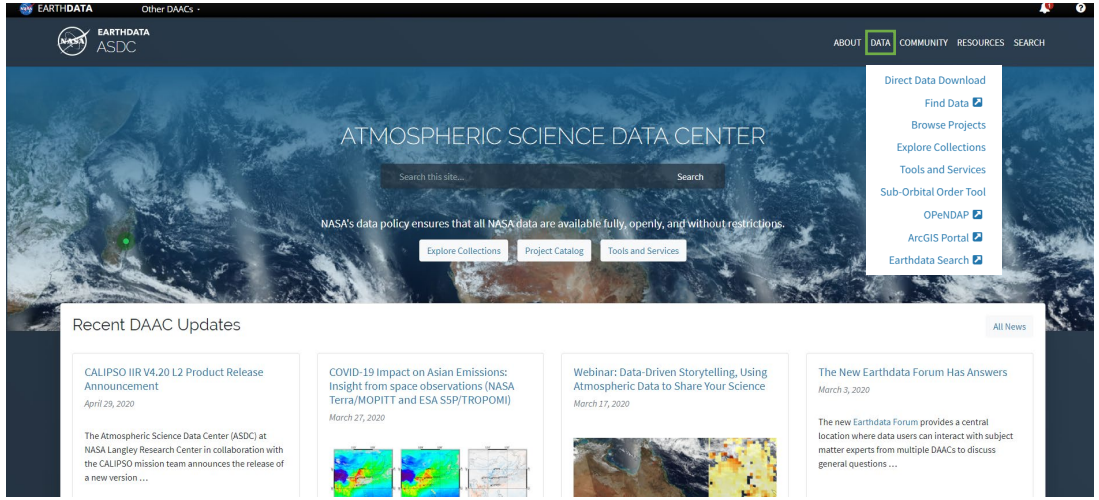
Process create higher level products

Outreach & Support research community

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
- ✓ ASDC Subsetters
  - ∘ subset ∘ aggregate





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

User Support and Other Resources

Example scripts

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

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

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

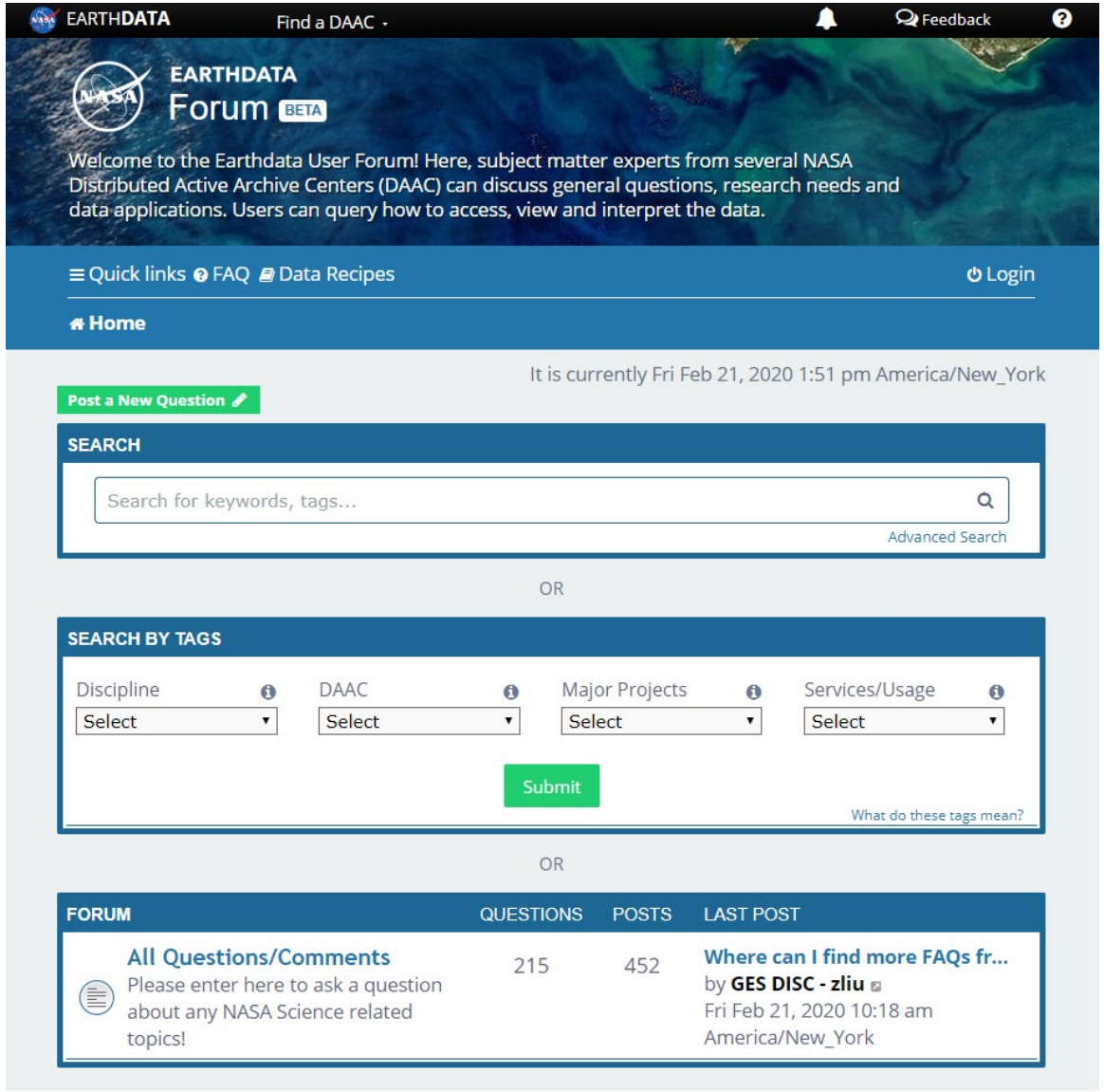
Earthdata Forum

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.

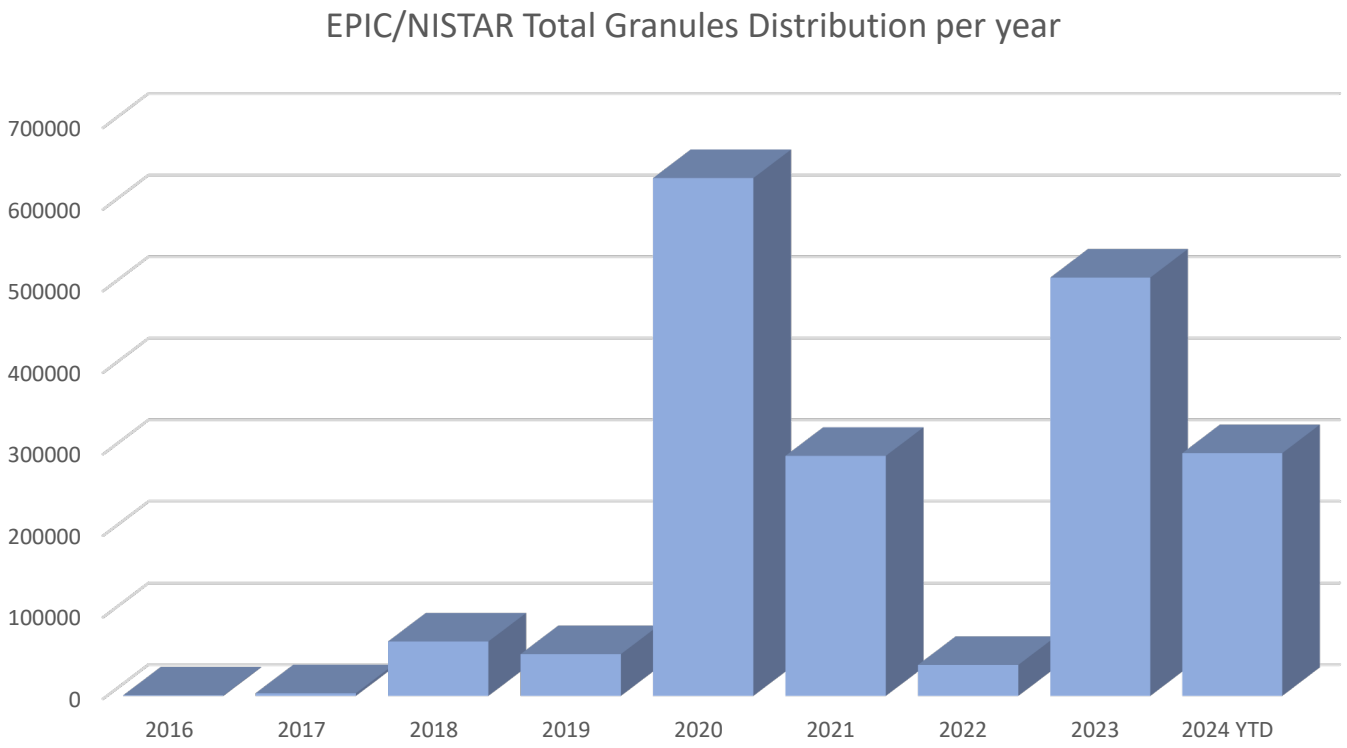


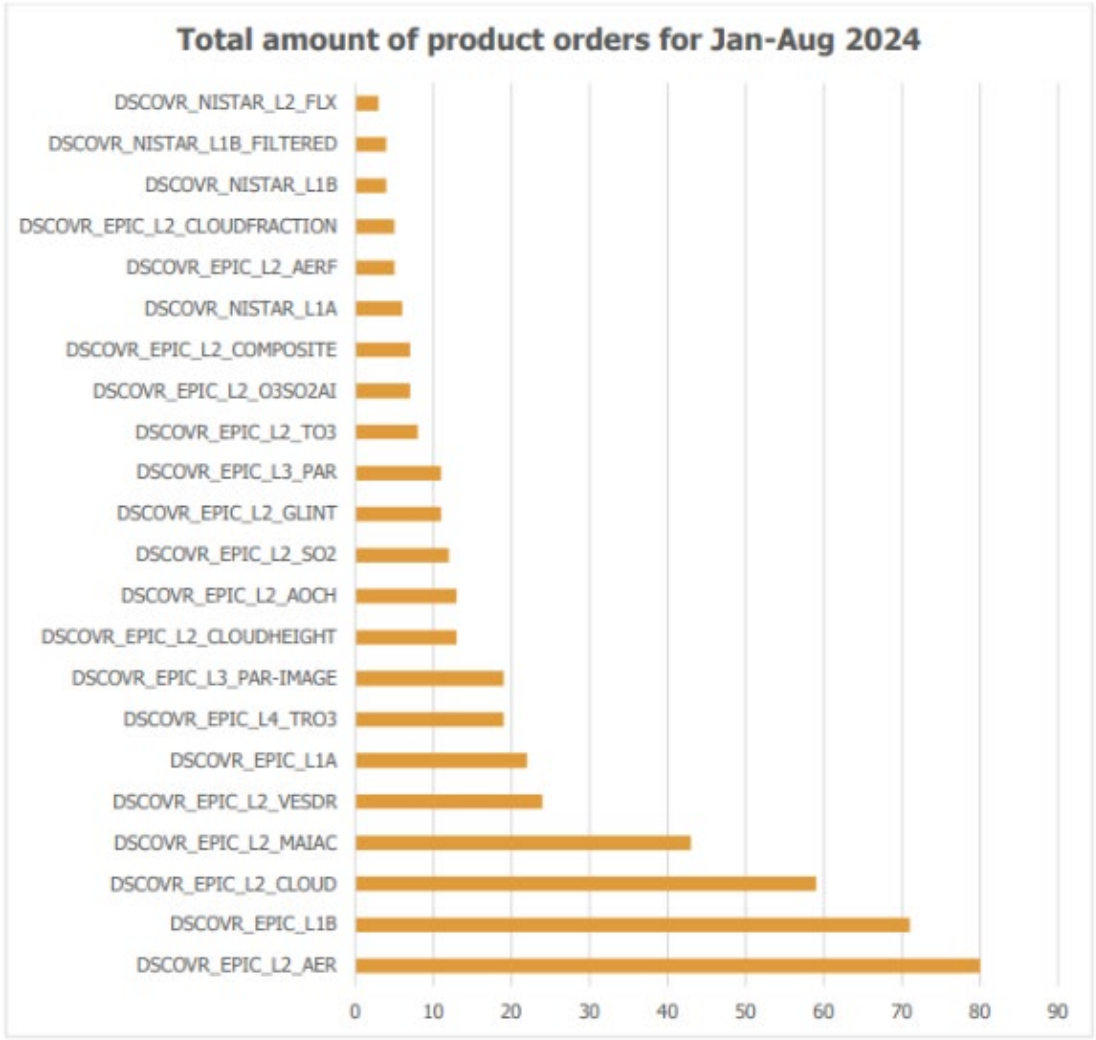
https://forum.earthdata.nasa.gov/

DSCOVR Data Products: Number of Users, Files and Size per Product for 2024

Volume downloaded:

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





2023 vs. 2024


Total amount of product orders in 2023
DSCOVR_EPIC_L2_GLINT
DSCOVR_EPIC_L2_AERF
DSCOVR_NISTAR_L2_FLX
DSCOVR_NISTAR_L1A
DSCOVR_EPIC_L2_COMPOSITE
DSCOVR_EPIC_L2_CLOUDFRACTION
DSCOVR_NISTAR_L1B_FILTERED
DSCOVR_NISTAR_L1B
DSCOVR_EPIC_L2_TO3
DSCOVR_EPIC_L2_O3SO2AI
DSCOVR_EPIC_L4_TRO3
DSCOVR_EPIC_L2_SO2
DSCOVR_EPIC_L3_PAR
DSCOVR_EPIC_L2_AOCH
DSCOVR_EPIC_L3_PAR-IMAGE
DSCOVR_EPIC_L2_VESDR
DSCOVR_EPIC_L2_CLOUD
DSCOVR_EPIC_L1A
DSCOVR_EPIC_L2_MAIAC
DSCOVR_EPIC_L2_AER
DSCOVR_EPIC_L1B
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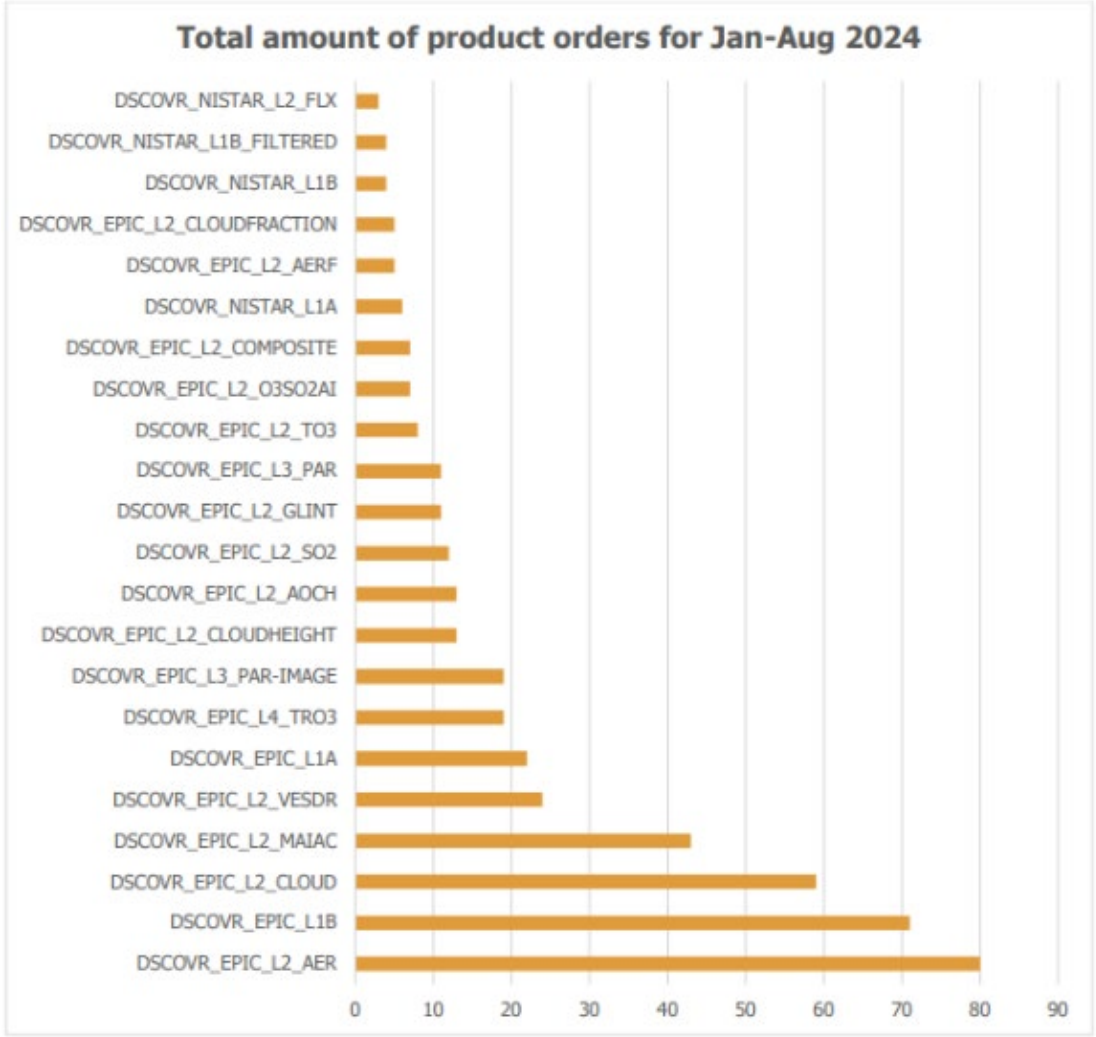
120


Total amount of product orders for Jan-Aug 2024
DSCOVR_NISTAR_L2_FLX
DSCOVR_NISTAR_L1B_FILTERED
DSCOVR_NISTAR_L1B
DSCOVR_EPIC_L2_CLOUDFRACTION
DSCOVR_EPIC_L2_AERF
DSCOVR_NISTAR_L1A
DSCOVR_EPIC_L2_COMPOSITE
DSCOVR_EPIC_L2_O3SO2AI
DSCOVR_EPIC_L2_TO3
DSCOVR_EPIC_L3_PAR
DSCOVR_EPIC_L2_GLINT
DSCOVR_EPIC_L2_SO2
DSCOVR_EPIC_L2_AOCH
DSCOVR_EPIC_L2_CLOUDHEIGHT
DSCOVR_EPIC_L3_PAR-IMAGE
DSCOVR_EPIC_L4_TRO3
DSCOVR_EPIC_L1A
DSCOVR_EPIC_L2_VESDR
DSCOVR_EPIC_L2_MAIAC
DSCOVR_EPIC_L2_CLOUD
DSCOVR_EPIC_L1B
DSCOVR_EPIC_L2_AER
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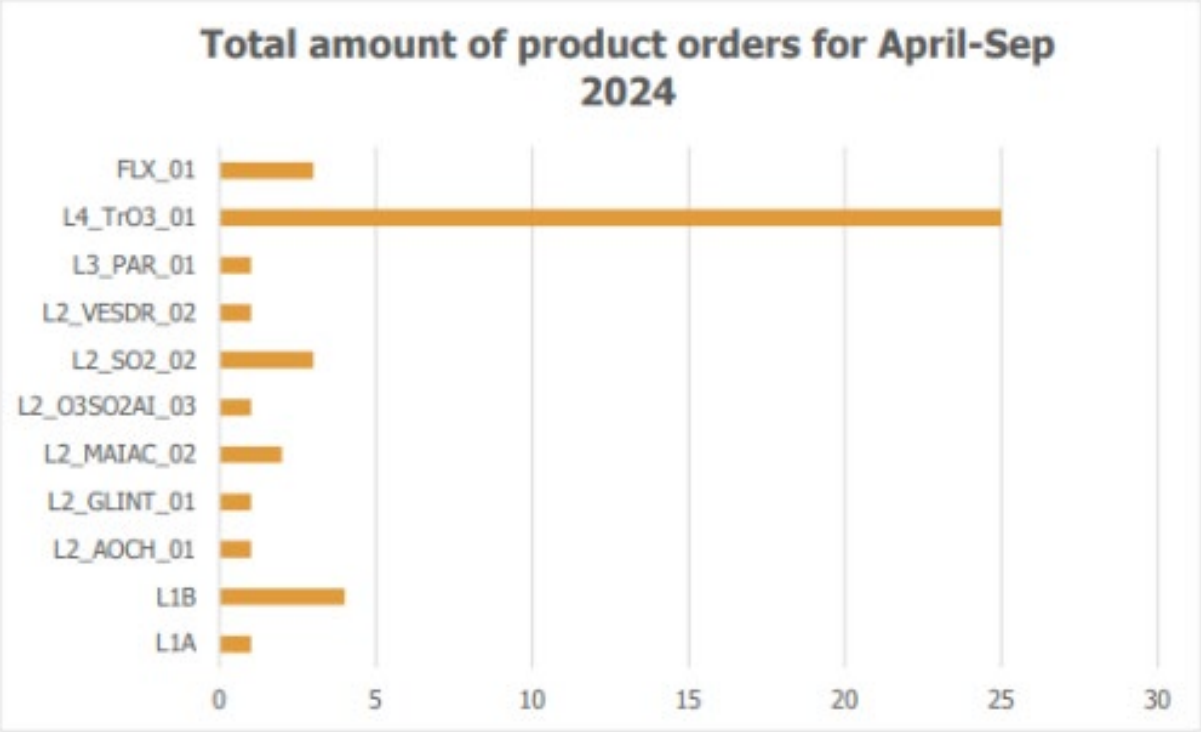
Users per Country

OPeNDAP Orders

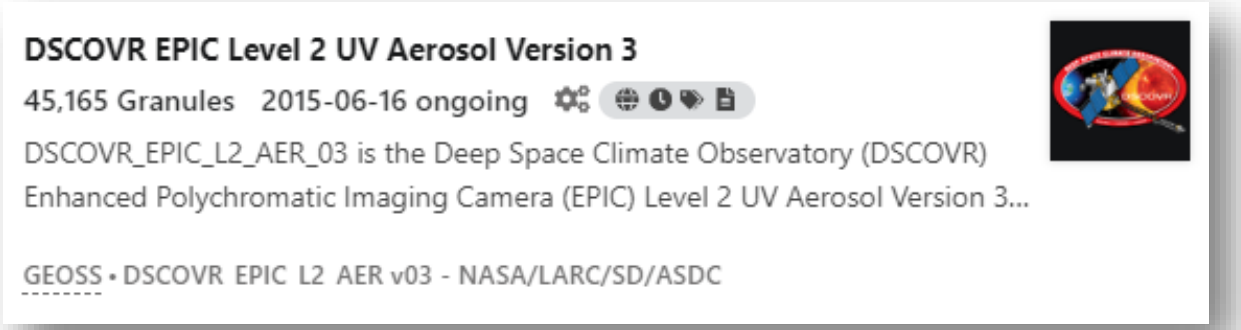


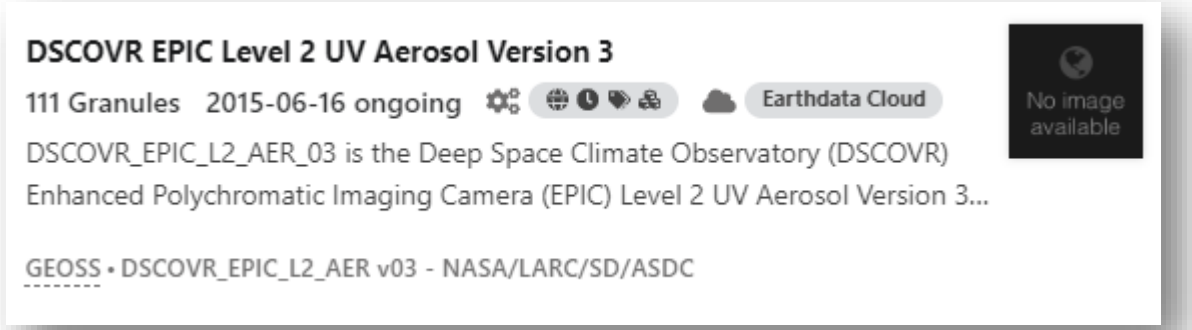
Country	#Orders 2023
United States	323
China	154
Germany	32
Finland	14
France	10
United Kingdom	9
India	9
Portugal	7
Switzerland	5
Italy	4
Korea South	4
Poland	3
Colombia	3
Bangladesh	3
Japan	3
Turkey	3
Ecuador	3
Australia	3
Russian Federation	2
Jordan	2
Brazil	2
Chile	2
Greece	2
Romania	2
Belgium	2
Iran	2
Egypt	2
Vietnam	1
Taiwan	1
Guatemala	1
Malta	1
Algeria	1
Ukraine	1
Pakistan	1
Honduras	1
Mexico	1
Philippines	1
Ethiopia	1
Namibia	1
Indonesia	1
Senegal	1
Uruguay	1

Country	# Orders Jan-Aug 2024
United States	169
China	119
Korea South	24
United Kingdom	16
India	15
France	13
Germany	11
Japan	8
Belgium	7
Finland	5
Indonesia	5
Ethiopia	5
Taiwan	4
Israel	4
Sweden	4
Singapore	3
Italy	3
Canada	2
Chile	2
Thailand	2
Venezuela	2
Argentina	2
Mexico	2
Portugal	1
Belarus	1
Uzbekistan	1
Vietnam	1
United Arab Emirates	1
Nigeria	1
Austria	1
Pakistan	1
Lebanon	1
Bolivia	1
Brazil	1
Poland	1
Australia	1
Spain	1
Kenya	1
Afghanistan	1
Czech Republic	1
Turkey	1
Tajikistan	1

DSCOVR 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
- ESDIS 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.





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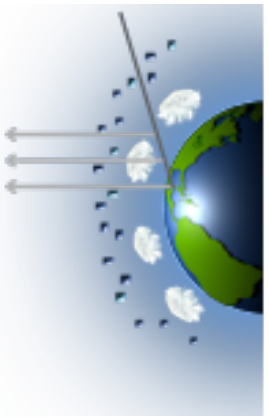
Atmospheric Science Data Center
NASA Langley Research Center
Hampton, Virginia (USA)
https://asdc.larc.nasa.gov/
Hazem.Mahmoud@nasa.gov

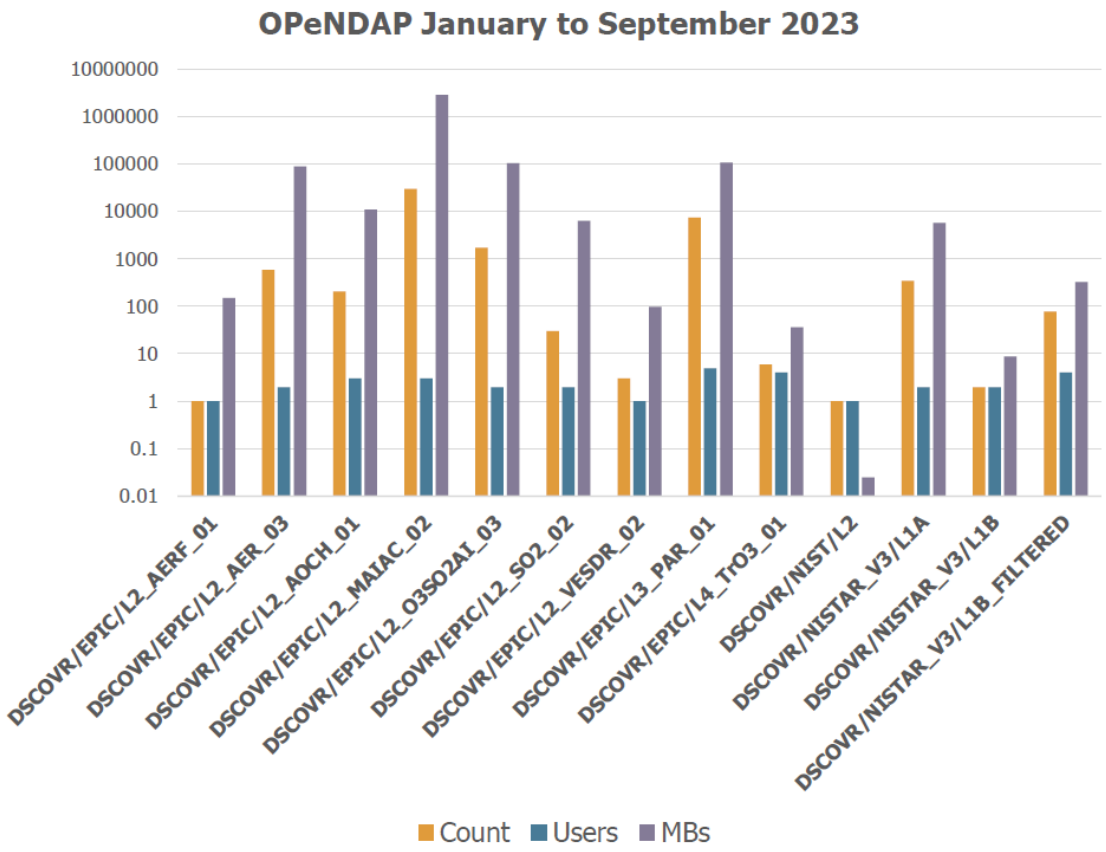


Atmospheric Science Data Center

ASDC Vision

"To be a leading provider of **atmospheric science data** products and services to the science community through **agility, innovation, and technical excellence**“

OPeNDAP


OPeNDAP January to September 2023
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DSCOVR/EPIC/L2_O3SO2AI_03
DSCOVR/EPIC/L2_SO2_02
DSCOVR/EPIC/L2_VESDR_02
DSCOVR/EPIC/L3_PAR_01
DSCOVR/EPIC/L4_TrO3_01
DSCOVR/NIST/L2
DSCOVR/NISTAR_V3/L1A
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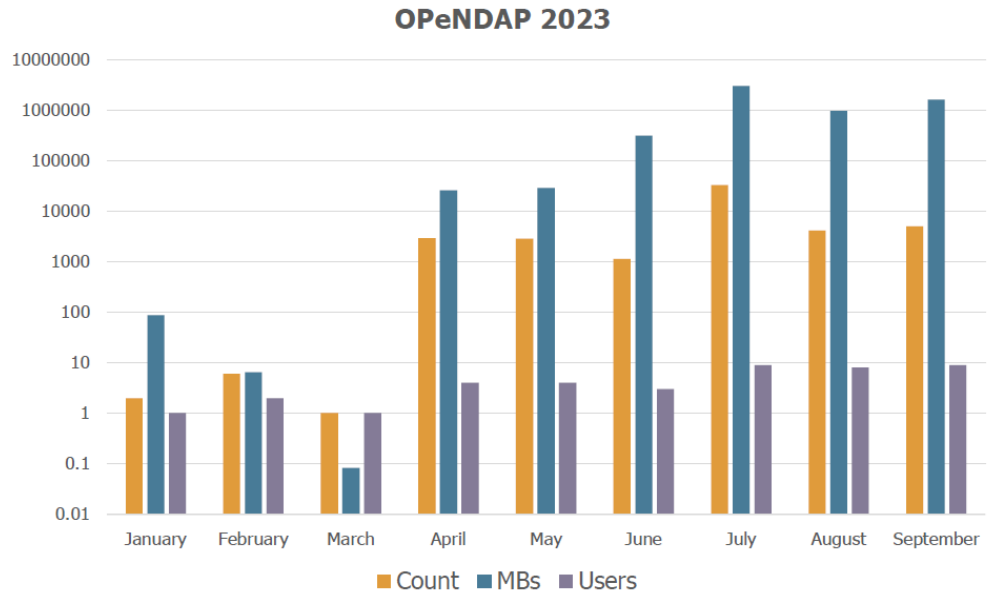
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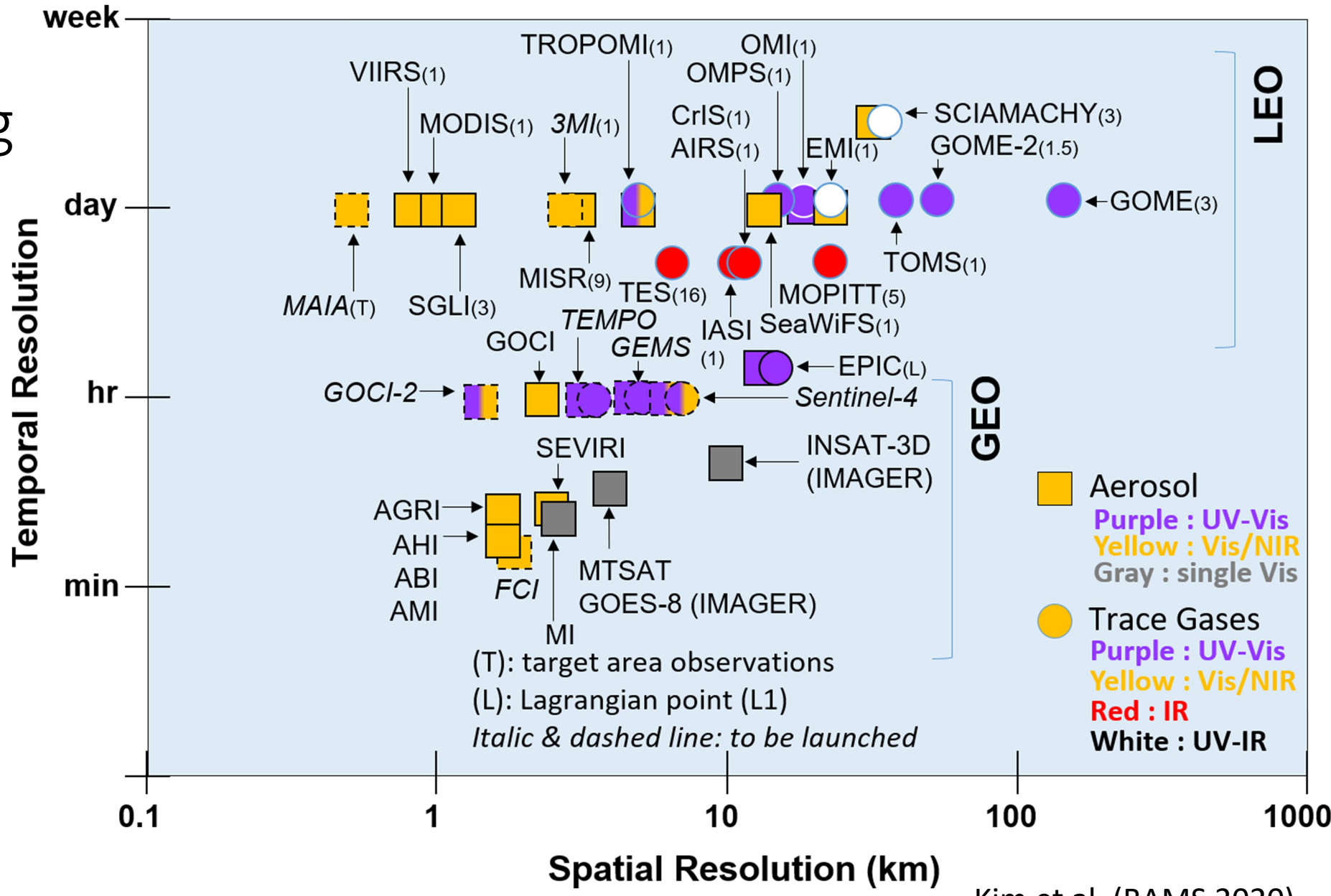
ASDC Portal for ArcGIS

- Select ASDC datasets available publicly as image services and WMS
- Incorporate data directly into web applications and desktop software
- Develop storymaps, jupyter notebooks and outreach content

https://arcgis.asdc.larc.nasa.gov

New Era of Air Quality Monitoring from Space

Development of satellite remote sensing instruments for atmospheric composition measurements with respect to temporal and spatial resolution. Numbers in parentheses for LEO instruments represent revisit time per location in days. Symbols in squares and circles represent aerosols, and AQ-related trace gases, respectively. Symbol colors represent wavelength ranges, as in the legend. For planned missions, mission names are in italics and symbol outlines are in dashed lines.



Kim et al. (BAMS 2020)

Product Solutions Open Source Pricing

Search or jump to... /

nasa / ASDC_Data_and_User_Services Public

Notifications Fork 4

Code Issues Pull requests 1 Actions Projects Security Insights

main 2 branches 0 tags

Go to file Code

alexrad71 Update EPIC_l2_readme 3118559 on Aug 7 68 commits

CALIPSO	Rename CALIPSO_Ozone_Number_Density to CALIPSO/CALIPSO_Ozone...	2 months ago
DSCOVR	Update EPIC_l2_readme	last month
MAIA	Created using Colaboratory	2 months ago
MISR	Rename MISR_AOD to MISR/MISR_AOD	2 months ago
MOPITT	Rename MOP03JM_COMixingRatio to MOPITT/MOP03JM_COMixingRatio	2 months ago
TEMPO	add "open in colab" badge to TEMPO demo notebook	last month
images	Add files via upload	last year
CERES.m	Add files via upload	2 months ago
README.md	Update README.md	2 months ago

About

No description, website, or topics provided.

Readme
Activity
8 stars
3 watching
4 forks
Report repository

Releases

No releases published

Packages

alexrad71 Update EPIC_l2_readme 3118559 · last month History

Name	Last commit message	Last commit date
..		
DSCOVR_EPIC_L2_TO3	Rename DSCOVR_EPIC_L2_TO3 to DSCOVR/DSCOVR_EPIC_L2_TO3	2 months ago
DSCOVR_EPIC_L4_TrO3_vs_Pandora.py	Rename O3_EPIC_L4_vs_Pandora_final.py to DSCOVR_EPIC_L4_TrO3_vs_Pando...	last month
DSCOVR_EPIC_L4_TrO3_vs_Pandora.readme	Create DSCOVR_EPIC_L4_TrO3_vs_Pandora.readme	last month
DSCOVR_EPIC_L4_TrO3_vs_tolnet_clim_vs_pandora.py	Update DSCOVR_EPIC_L4_TrO3_vs_tolnet_clim_vs_pandora.py	last month
DSCOVR_EPIC_L4_TrO3_vs_tolnet_clim_vs_pandora.readme	Update and rename qqq to DSCOVR_EPIC_L4_TrO3_vs_tolnet_clim_vs_pandor...	last month
EPIC_l2_readme	Update EPIC_l2_readme	last month
POI_list	Add files via upload	last month
epic_l2_aer_timeseries.py	Rename epic_l2_aer_timeseries_02.py to epic_l2_aer_timeseries.py	last month
epic_l2_aer_timeseries_web.py	Rename epic_l2_aer_timeseries_web_02.py to epic_l2_aer_timeseries_web.py	last month
epic_l2_to3_timeseries.py	Rename epic_l2_to3_timeseries_02.py to epic_l2_to3_timeseries.py	last month
epic_l2_to3_timeseries_web.py	Rename epic_l2_to3_timeseries_web_02.py to epic_l2_to3_timeseries_web.py	last month

Earthdata Forum

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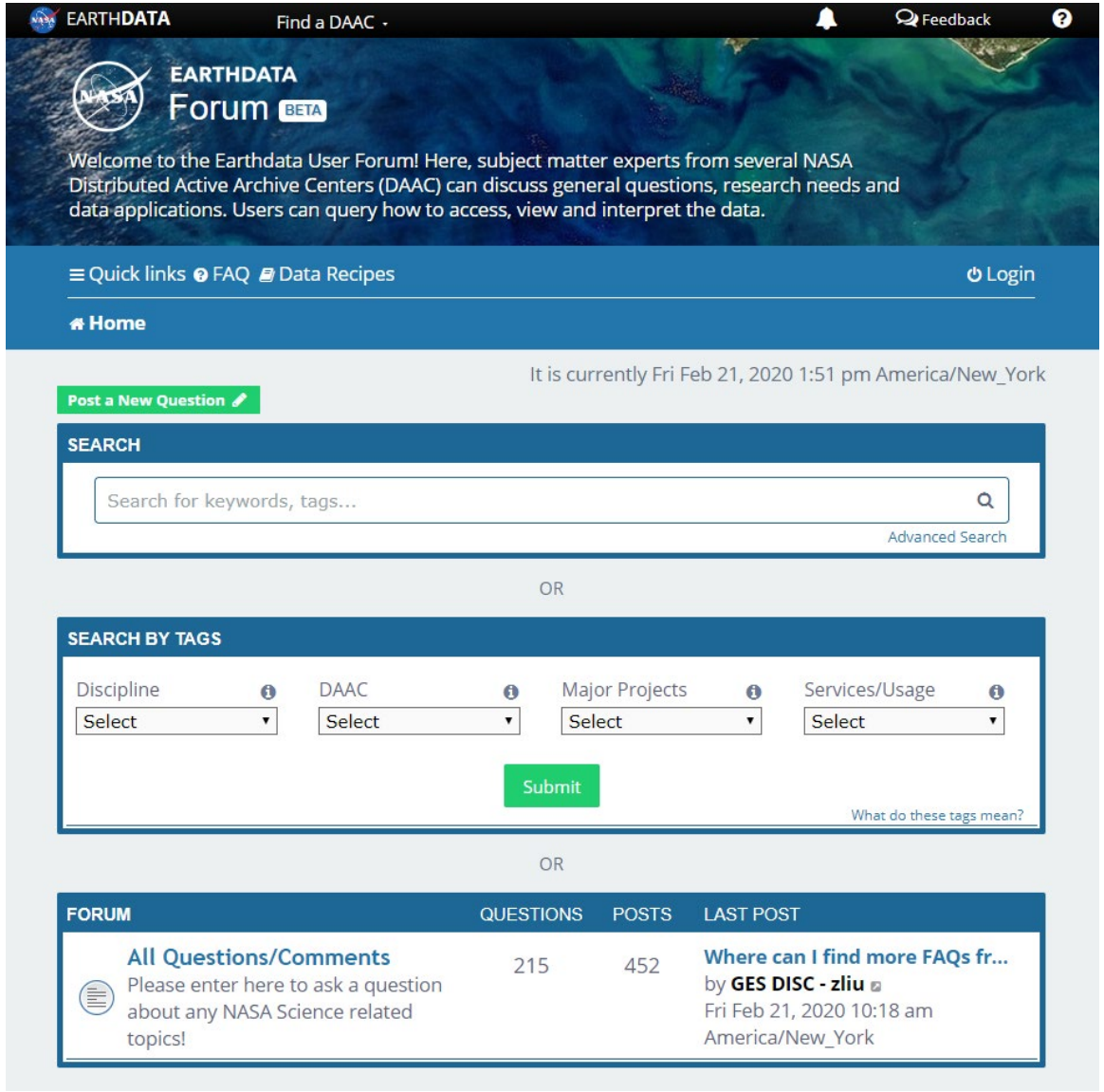

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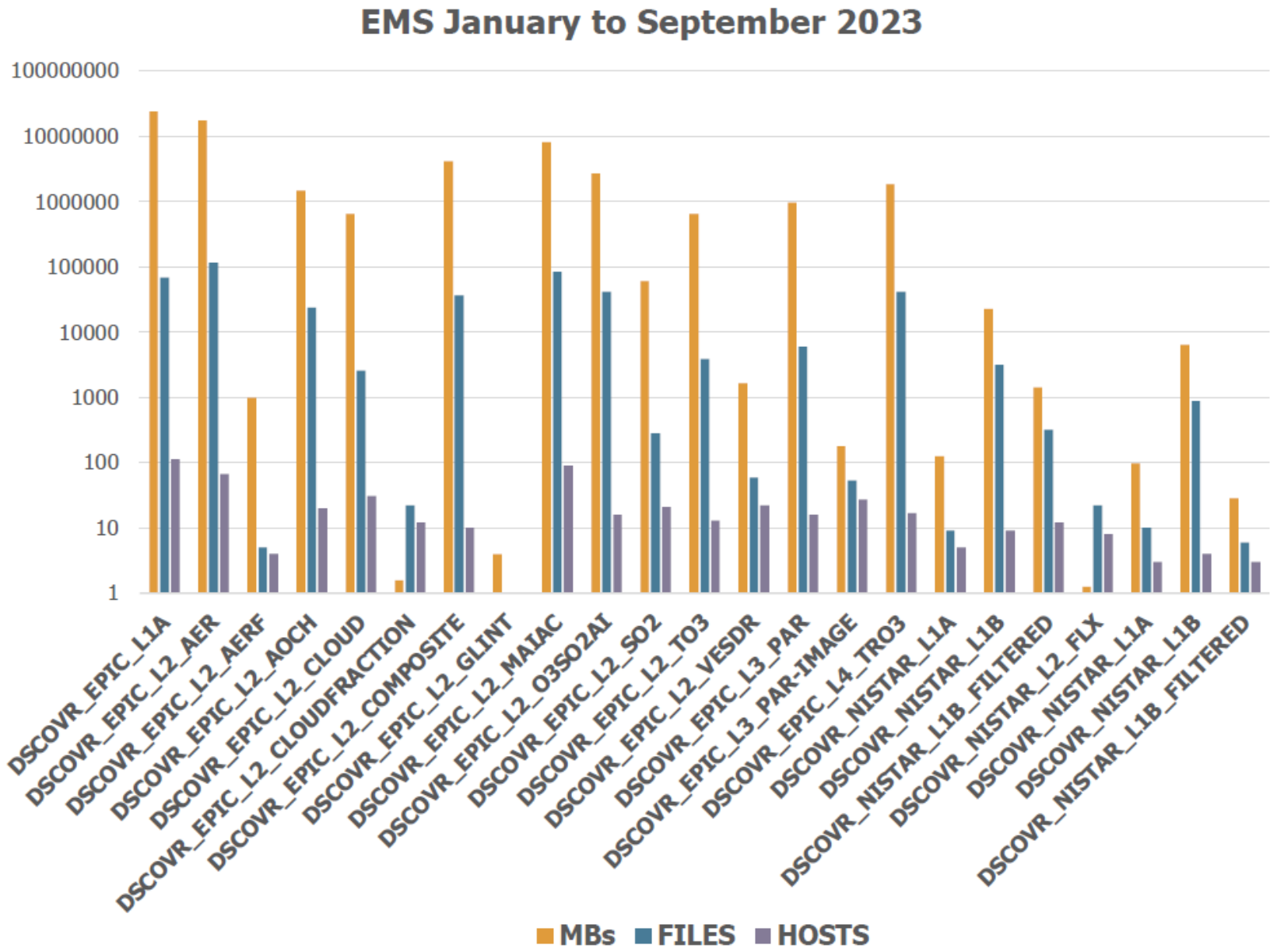
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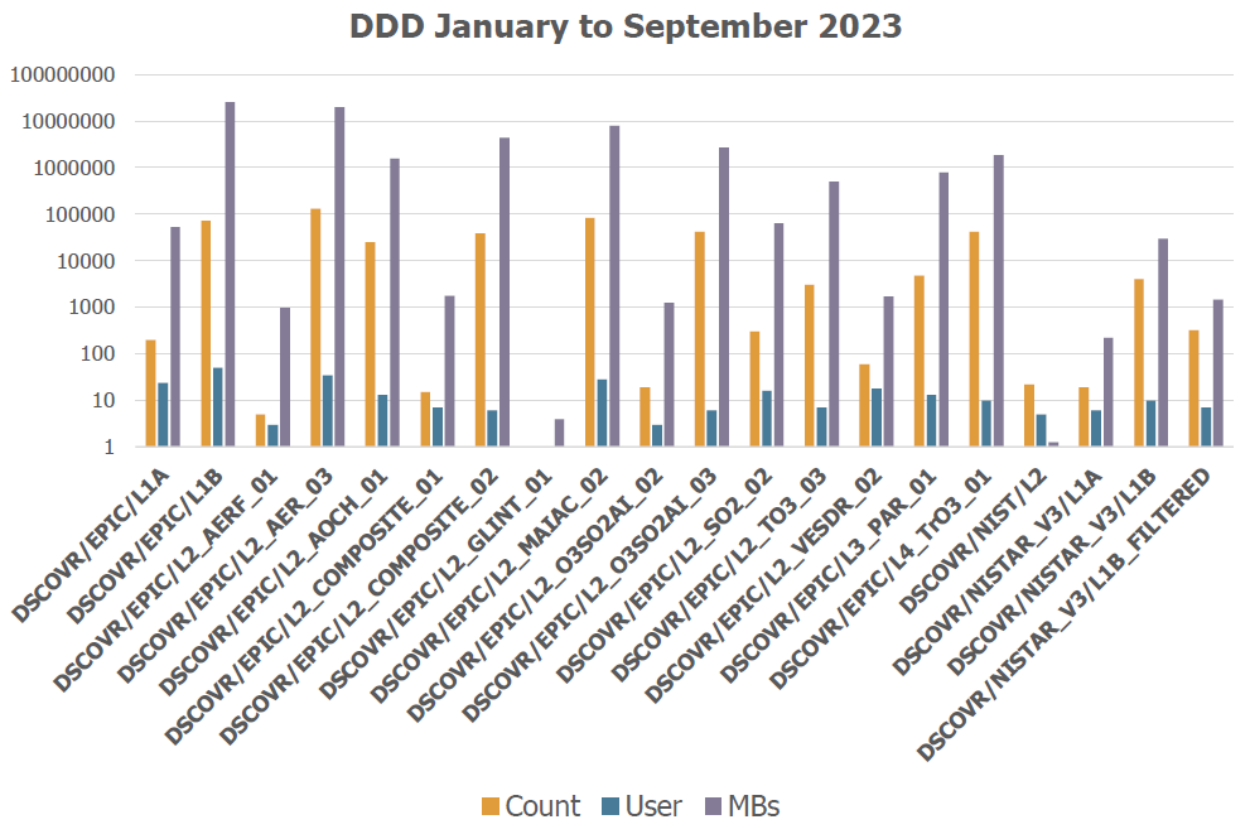
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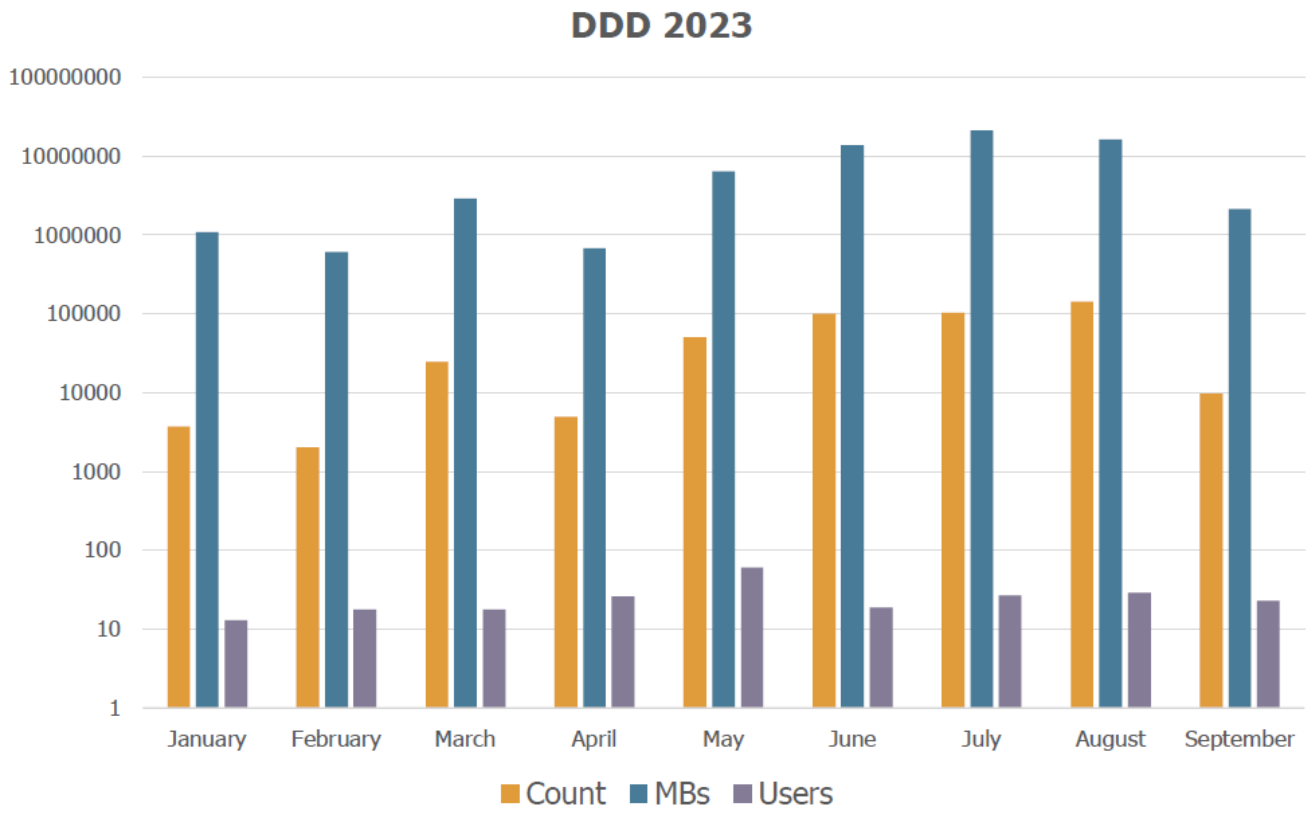
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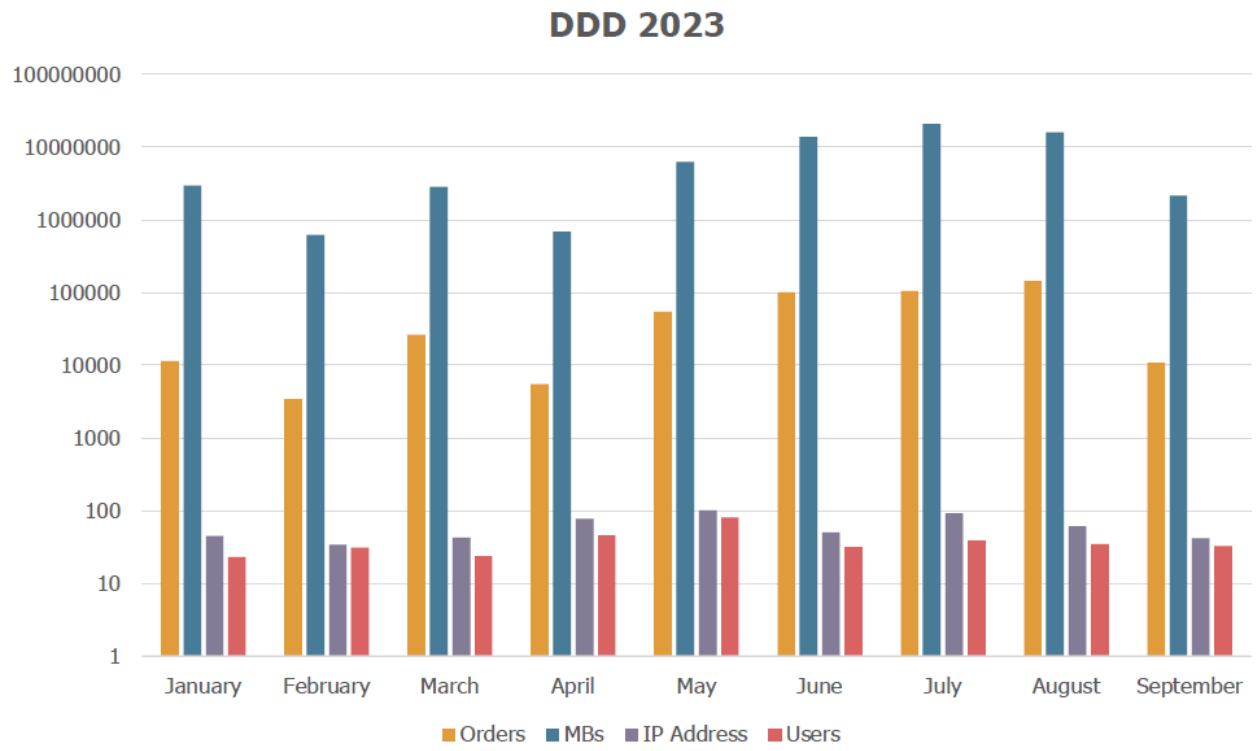
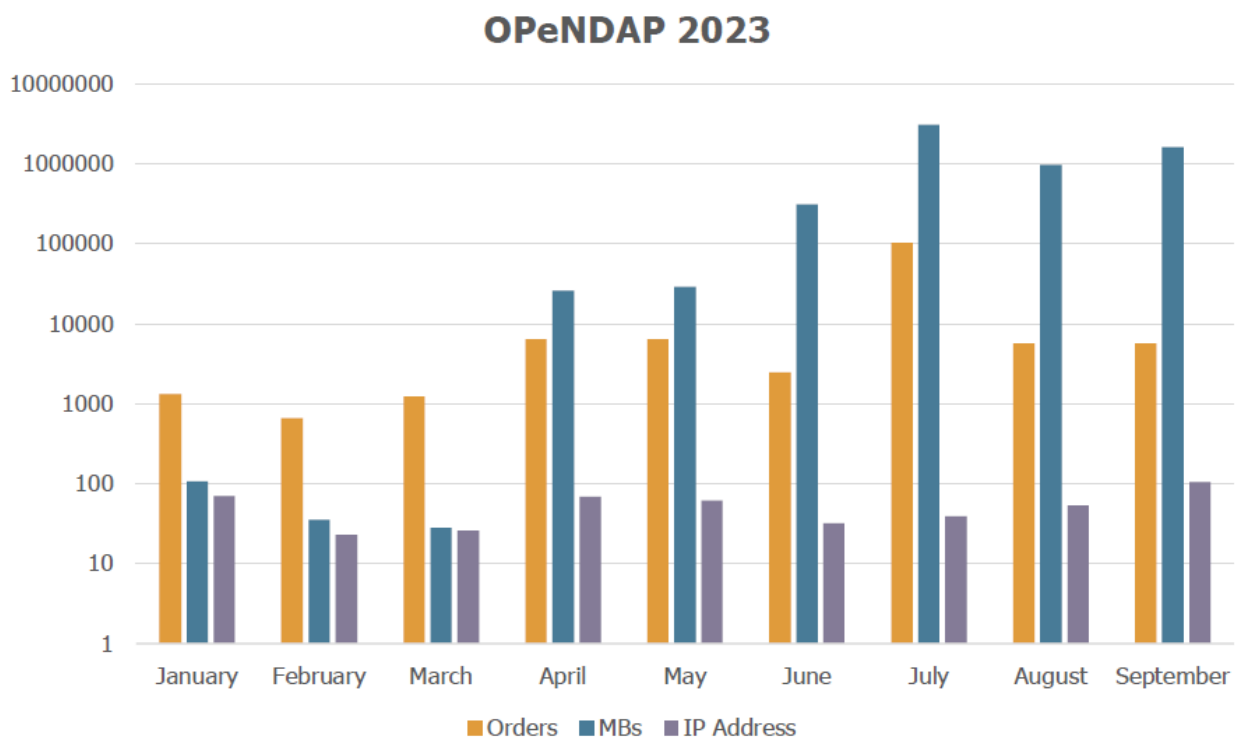
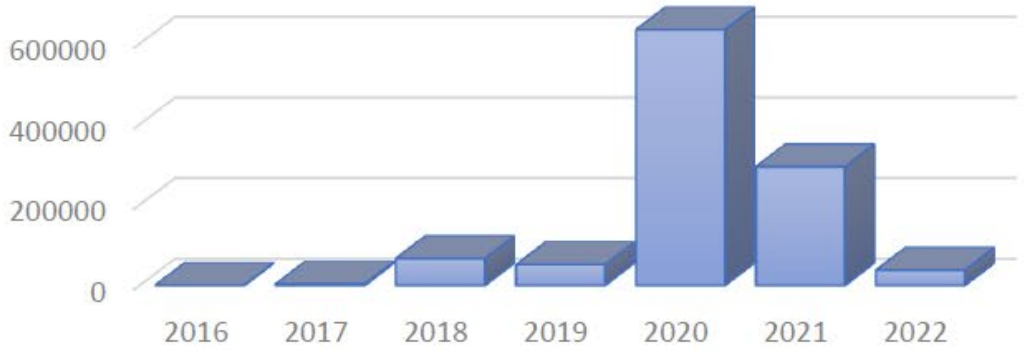
DDD vs. OPeNDAP 2023 Metrics





DSCOVR Data Products: Number of Users per Product for 2020-2022

EPIC Total Granules Distributed per Year

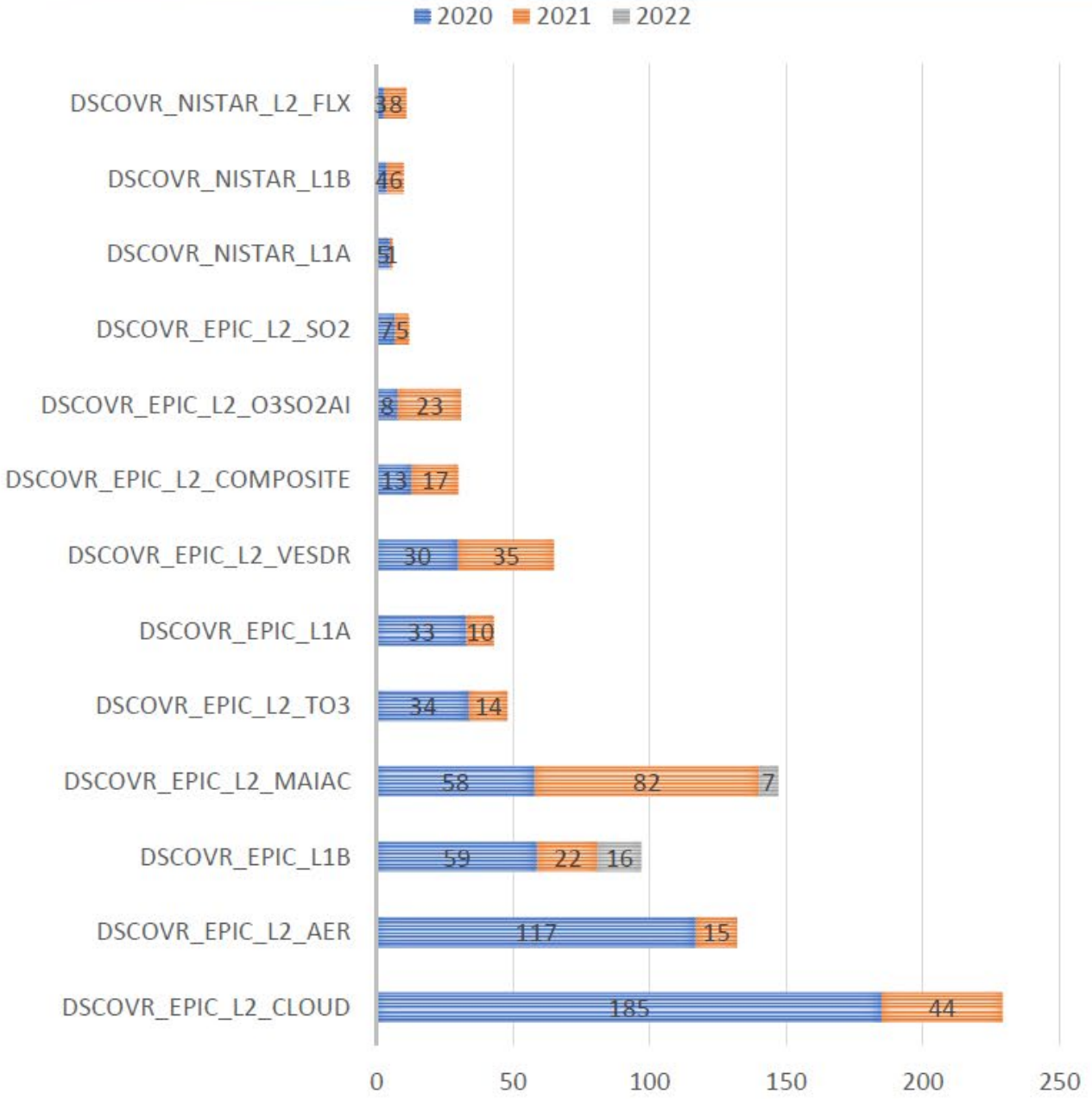


Average order size:

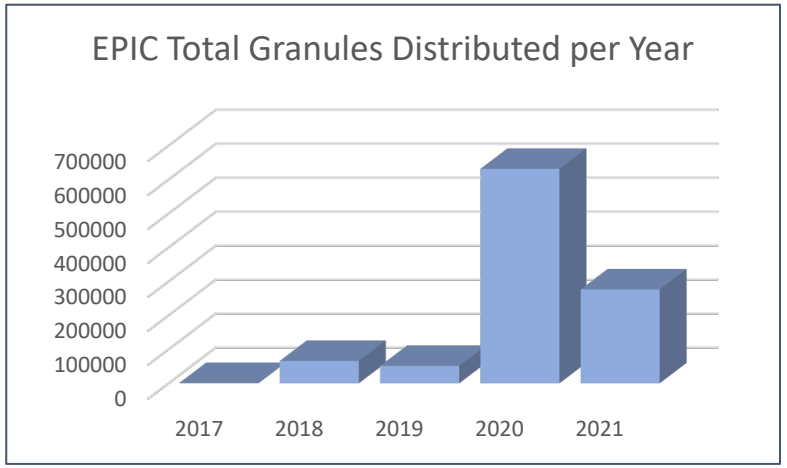
- 2020: 1143 granules, 232GB
- 2021: 1044 granules, 146GB
- 2022: 1648 granules, 448GB

RECENT UPDATES:

- DSCOVR_EPIC_L3_PAR
- DSCOVR_EPIC_L2_GLINT Geolocation Variables



DSCOVR Data Products: Number of Users per Product for 2020-2021



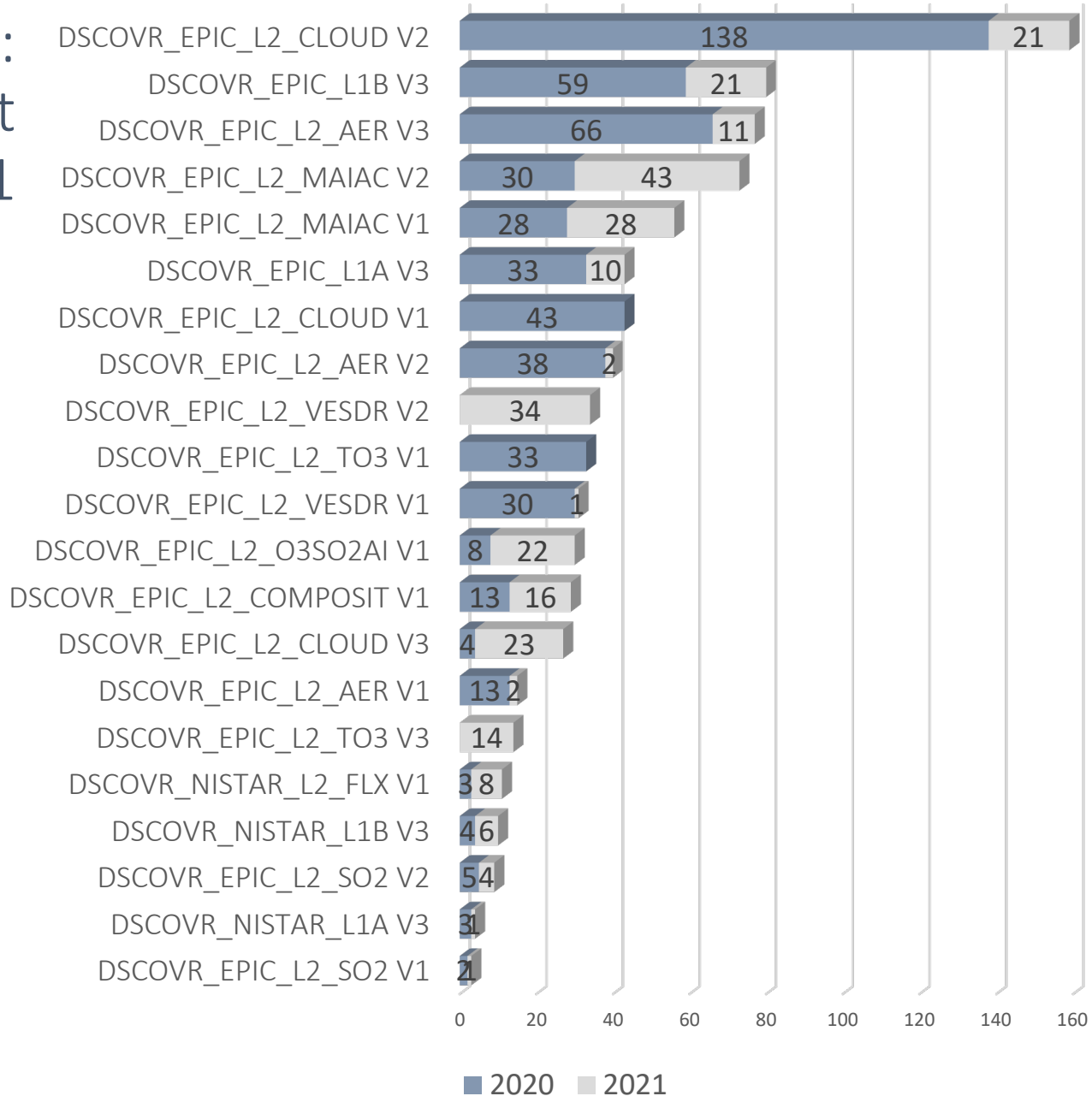
Average order size:

- 2020: 1143 granules, 232GB
- 2021: 1044 granules, 146GB

RECENT UPDATES:

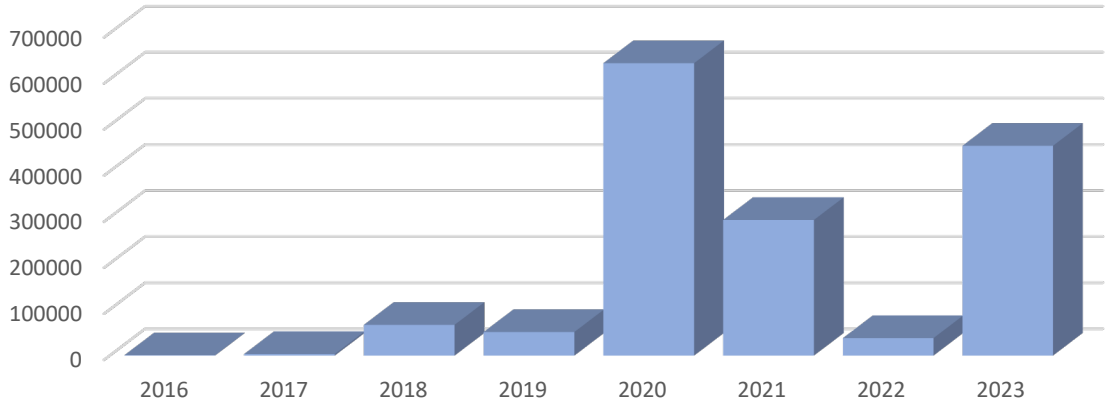
- DSCOVR_EPIC_L3_PAR
- DSCOVR_EPIC_L2_GLINT

are now orderable



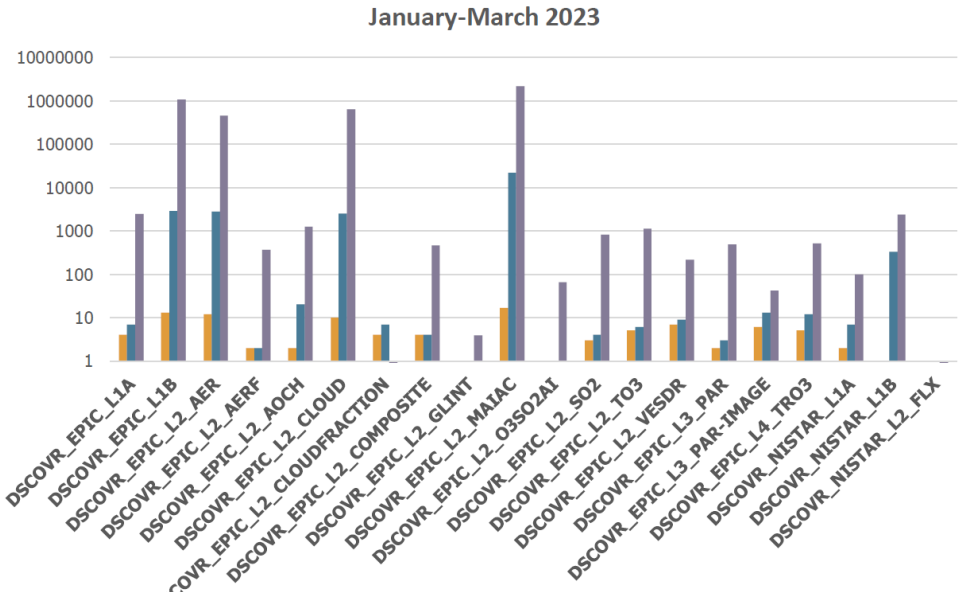
DSCOVR Data Products: Number of Users, Files and size per Product for 2023

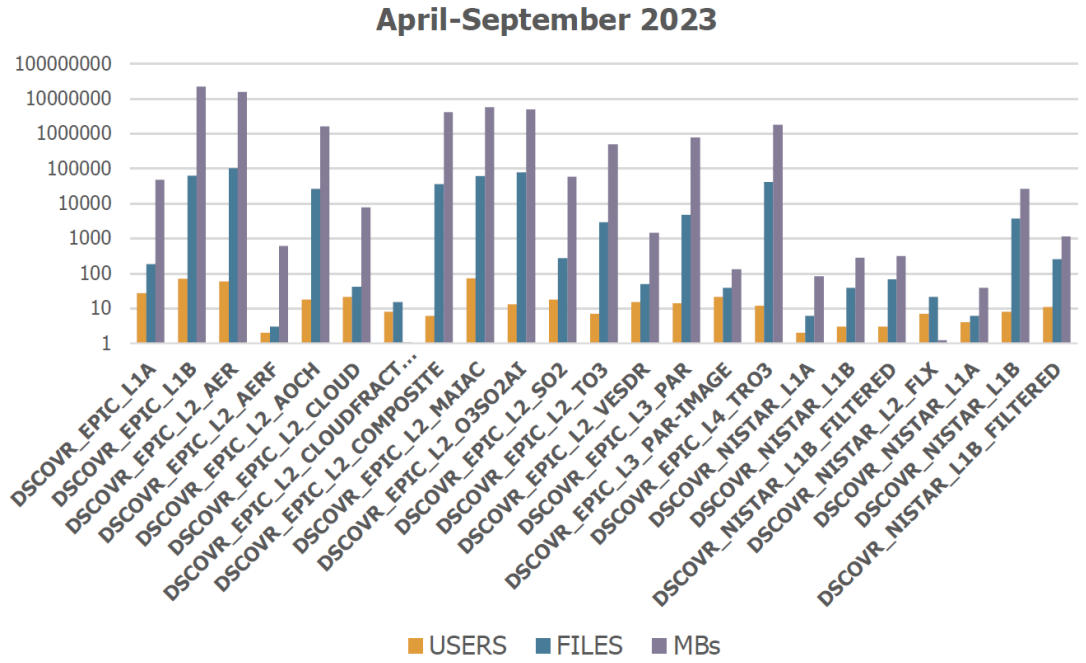
EPIC/NISTAR Total Granules Distribution per year



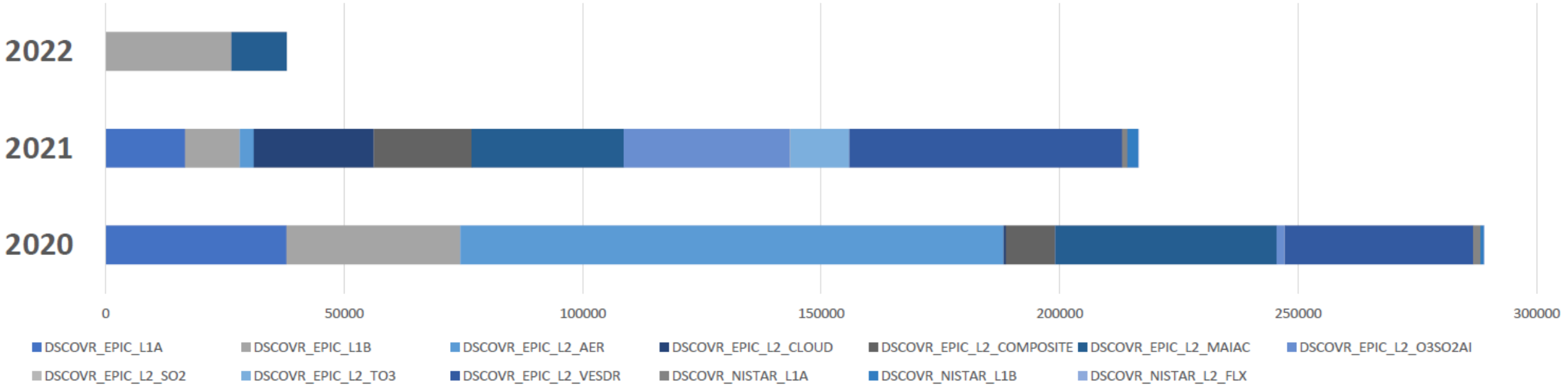
Average order size:

- 2020: 1143 granules, 232GB
- 2021: 1044 granules, 146GB
- 2022: 1648 granules, 448GB
- 2023: 1044 granules, 3.222TB

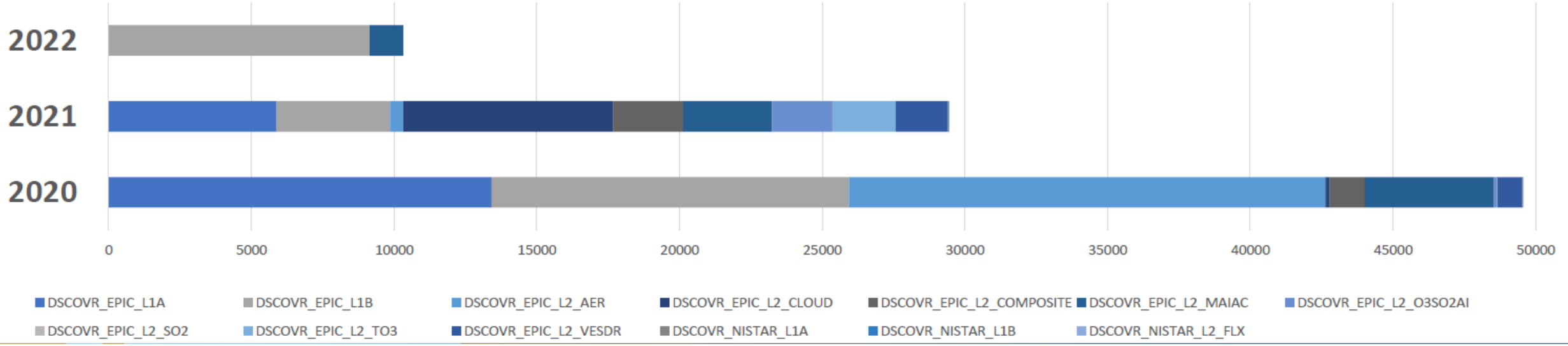


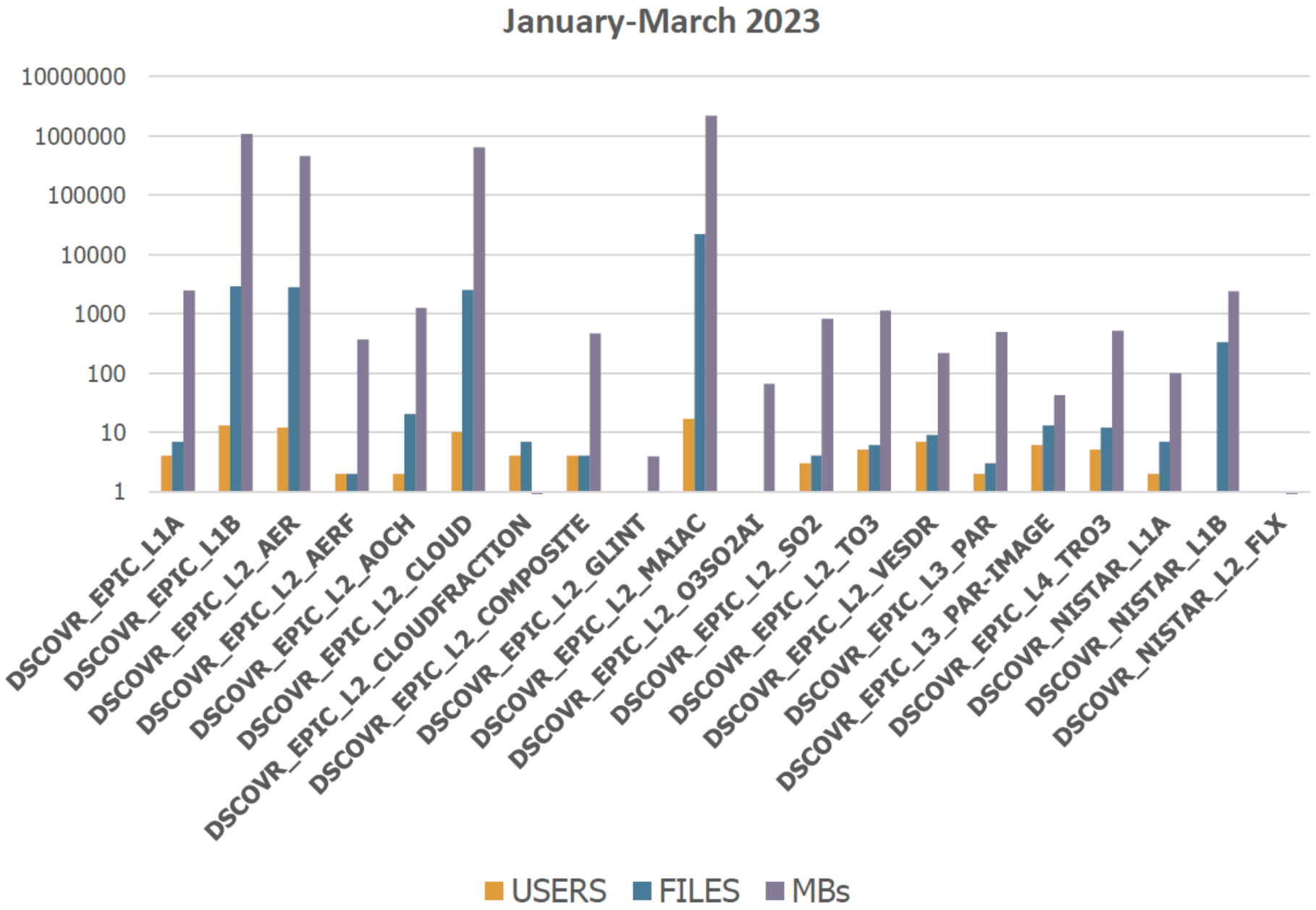


DSCOVR Distribution Volume by Granules per Year

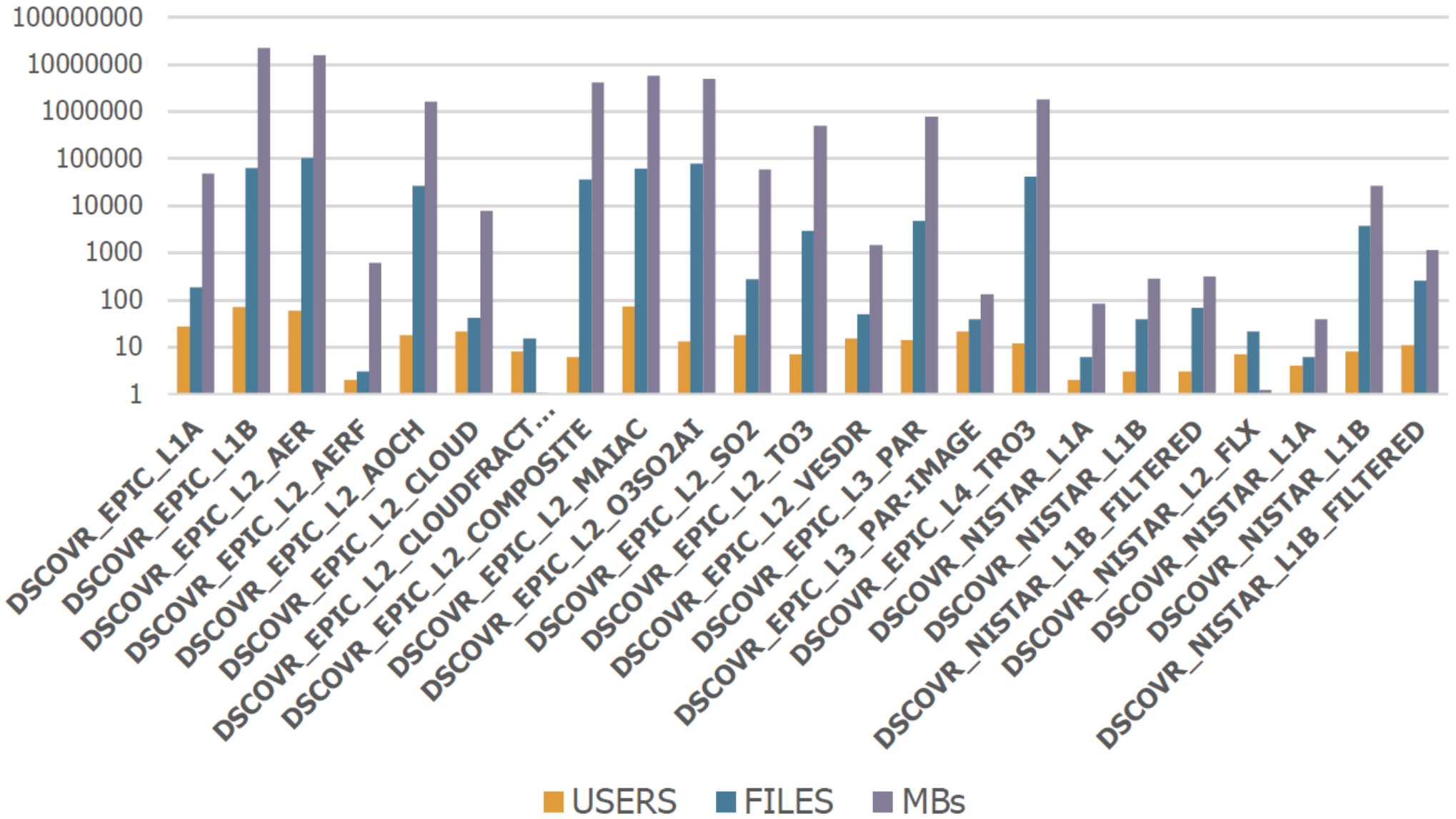


DSCOVR Distribution Volume by GB per Year

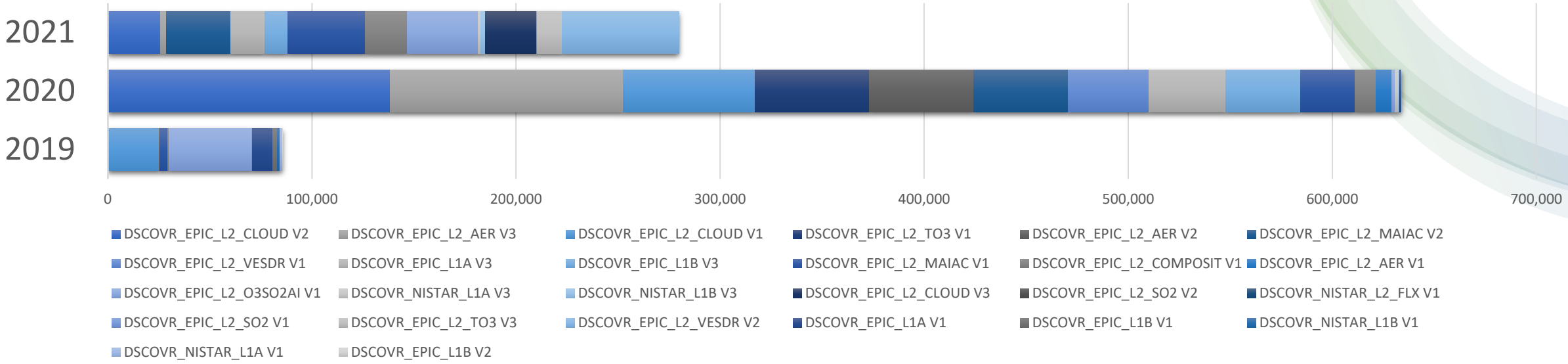



January-March 2023
10000000
1000000
100000
10000
1000
100
10
1
DSCOVR_EPIC_L1A
DSCOVR_EPIC_L1B
DSCOVR_EPIC_L2_AER
DSCOVR_EPIC_L2_AERF
DSCOVR_EPIC_L2_AOCH
DSCOVR_EPIC_L2_CLOUD
DSCOVR_EPIC_L2_CLOUDFRACTION
DSCOVR_EPIC_L2_COMPOSITE
DSCOVR_EPIC_L2_GLINT
DSCOVR_EPIC_L2_MAIAC
DSCOVR_EPIC_L2_O3SO2AI
DSCOVR_EPIC_L2_SO2
DSCOVR_EPIC_L2_TO3
DSCOVR_EPIC_L2_VESDR
DSCOVR_EPIC_L3_PAR
DSCOVR_EPIC_L3_PAR-IMAGE
DSCOVR_EPIC_L4_TRO3
DSCOVR_NISTAR_L1A
DSCOVR_NISTAR_L1B
DSCOVR_NISTAR_L2_FLX
USERS
FILES
MBs

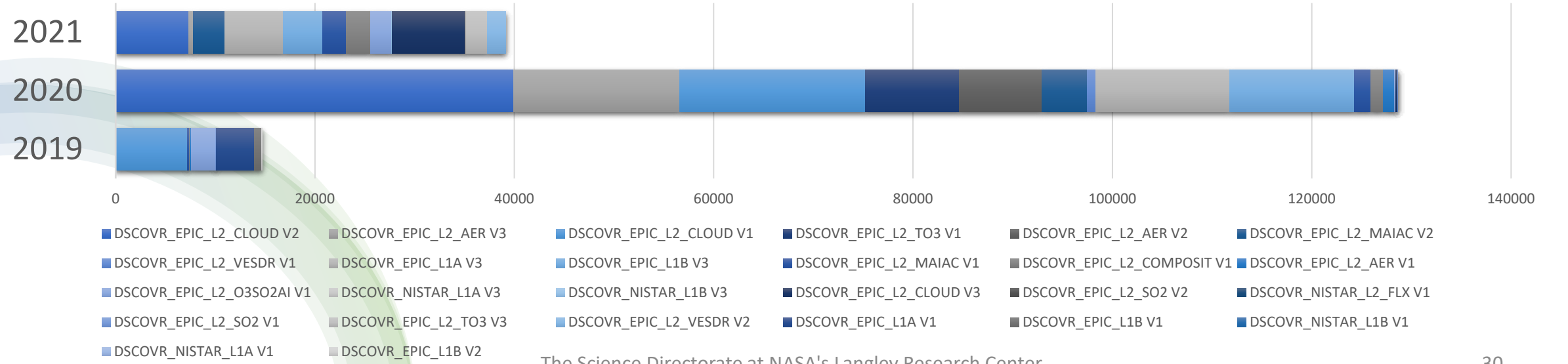
April-September 2023



DSCOVR Distribution Volume by Granules per Year



DSCOVR Distribution Volume by GB per Year



Services at the ASDC

PRE-LAUNCH

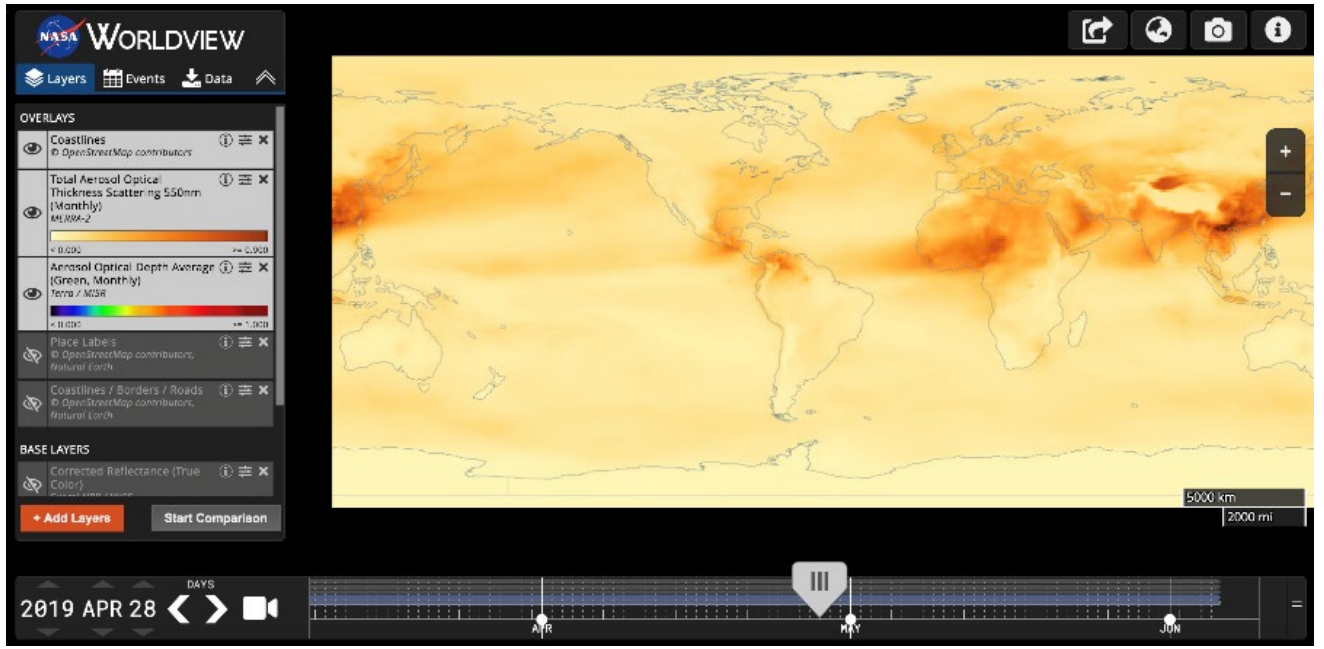
- Preparation for Ingest
  - Accurate metadata for discovery
  - Well formatted data for maximum interoperability
  - Digital Object Identifiers for each product
- Support Data Flow Testing Prior to Launch
  - Interface confidence tests
  - End-to-end ground system testing with instrument or synthetic data
- Discuss Service Options
  - Customer/Product affinities and technical capacity
  - Data Delivery Cadence

ACTIVE OPERATIONS

- Standard curation of archived data
  - Provenance and integrity
  - Up to date documentation
  - Disaster Recovery
- User Services staff to assist customers
  - Maintain FAQs, examples of scripts
  - Perform reach back to science team when necessary
  - Disseminate announcements to user community
  - Use customer feedback from annual third-party ACSI survey, contacts, and ASDC User Working Group to determine changes in services
- Subsetting and ArcGIS capabilities
  - Temporal, spatial and variable slices

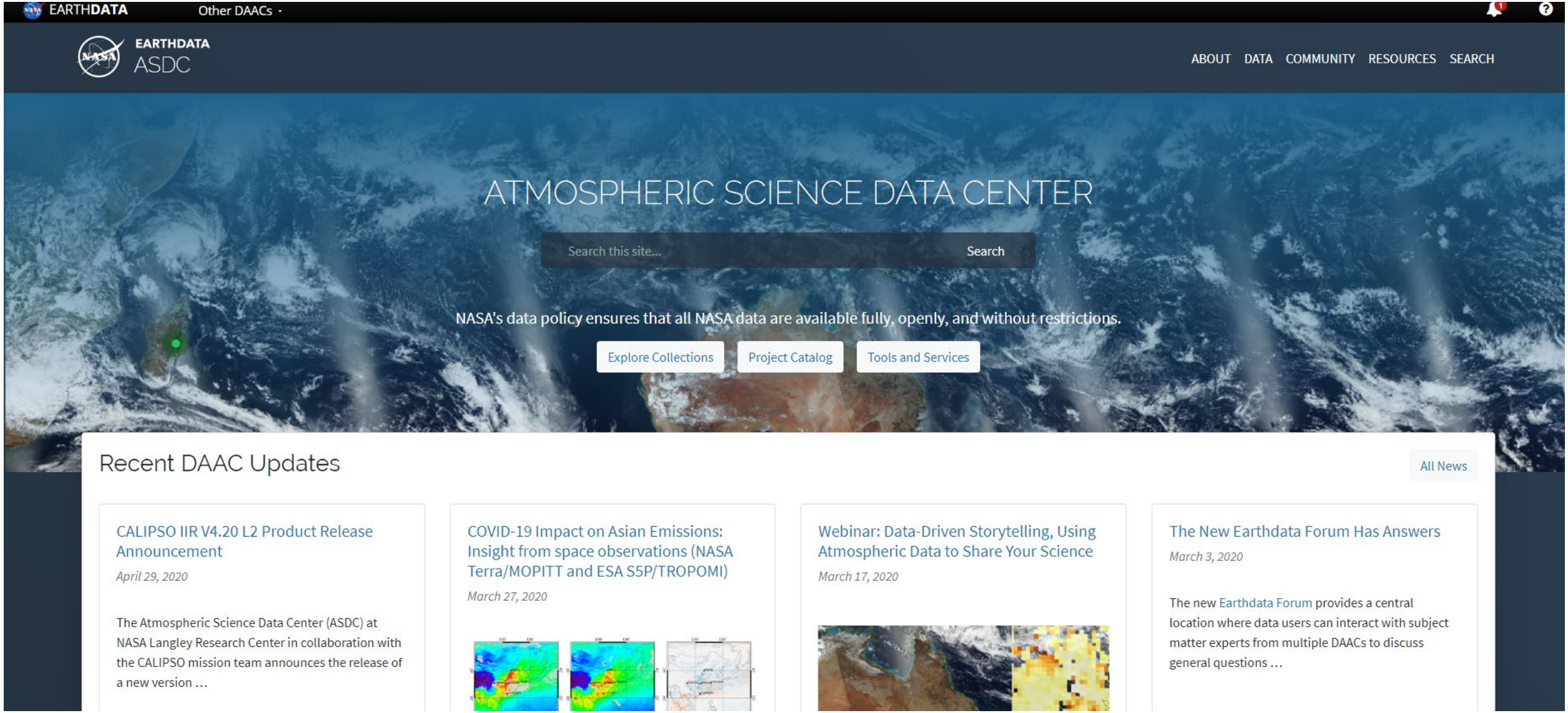
ASDC Data Distribution: Tools and Services

- ✓ NASA Earthdata Search
  - CMR Search ∘ Metadata
- ✓ NASA WorldView
  - GIBS API ∘ visualization
- ✓ OPeNDAP
  - ∘ transform ∘ subsetting
  - ∘ reformatting ∘ distribution
- ✓ HTTPS data access
  - ∘ datapool
  - ∘ permanent URL/direct access
  - ∘ enables scripts/workflow
- ✓ Example scripts
  - ∘ Python/Jupyter Notebook
  - ∘ R scripts
  - ∘ contributed tutorials/scripts



User Support and Other Resources

Earthdata Login https://urs.earthdata.nasa.gov
Earthdata Forum https://forum.earthdata.nasa.gov/
ASDC User Support support-asdc@earthdata.nasa.gov



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

ASDC in the Cloud

- ESDIS is heavily investing in commercial 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
      - SWOT and NISAR are most often cited
  - Building an AWS-native ingest and archive system called Cumulus that is intended to be used by all DAACs
  - ESDIS pays for the storage. Users pay for their own compute resources.
  - Data download will still be available free of charge
  - TEMPO, CLARREO-PF and PREFIRE are ingested on the cloud
  - User experience will not be interrupted or degraded
  - Activities are being planned in a way to avoid introducing technical and schedule risks and dependencies.
  - ASDC will work closely with ESDIS to identify risks, technical challenges and uncertainties, and proposing concepts and architectures for mitigating any issues that arise

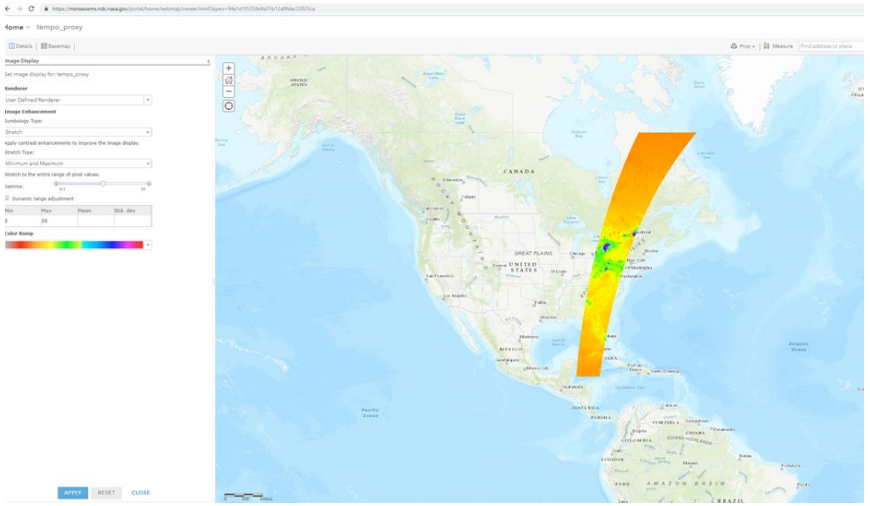
ASDC Portal for ArcGIS

- Select ASDC datasets available publicly as image services and WMS
- Incorporate data directly into web applications and desktop software
- Develop storymaps, jupyter notebooks and outreach content

https://arcgis.asdc.larc.nasa.gov

TEMPO Data Products

TEMPO file granules will be indexed by variable, date, scan, and granule correlating to the respective swath of data. Files are archived in Netcdf4 format with their respective metadata record in ODL format.



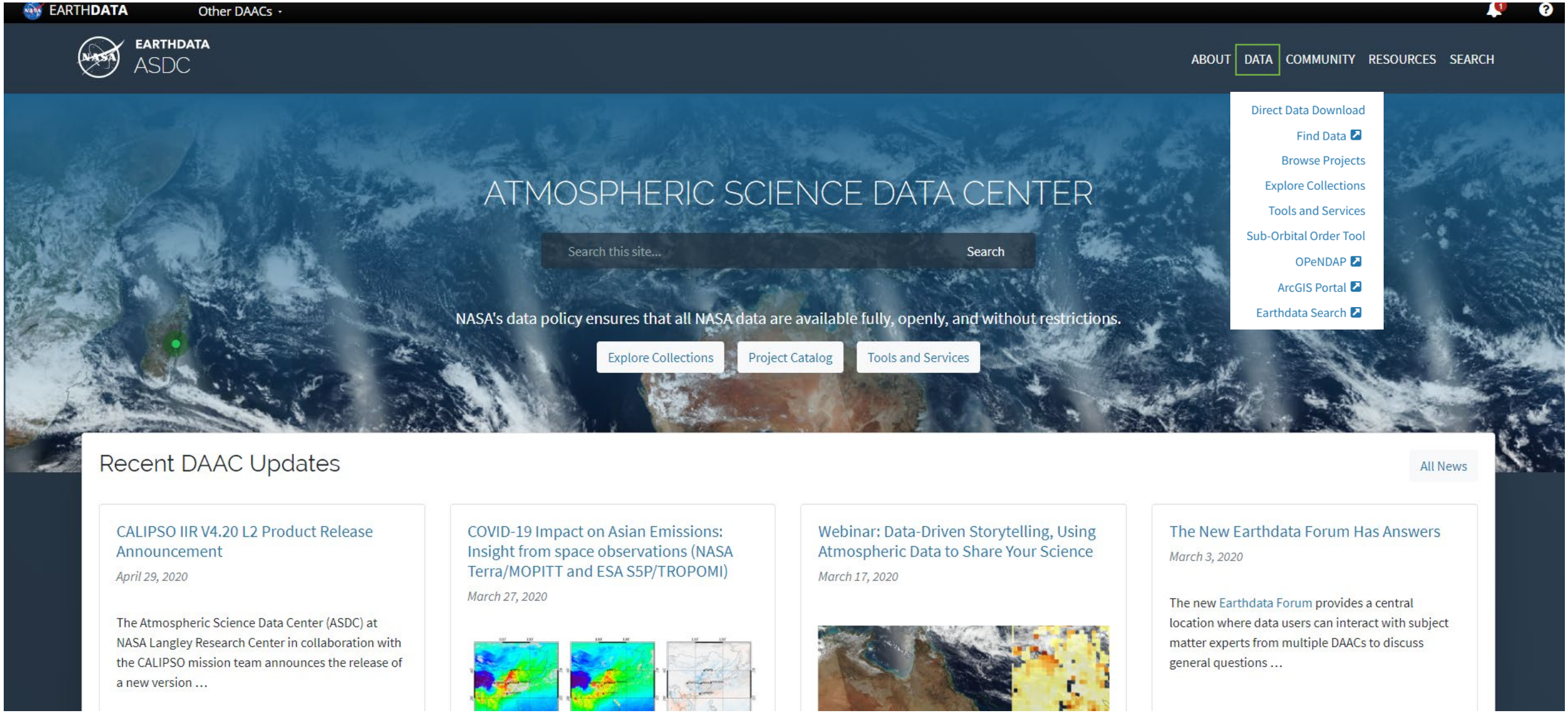
TEMPO Data Products

Level 0	radiance, irradiance, telemetry, dark frames
Level 1b	calibrated & geolocated radiance, irradiance
Level 2	derived products for total ozone, ozone vertical profile, formaldehyde, nitrogen dioxide, cloud pressure and fraction
Level 3	gridded, derived products for total ozone, ozone vertical profile, formaldehyde, nitrogen dioxide, cloud pressure and fraction

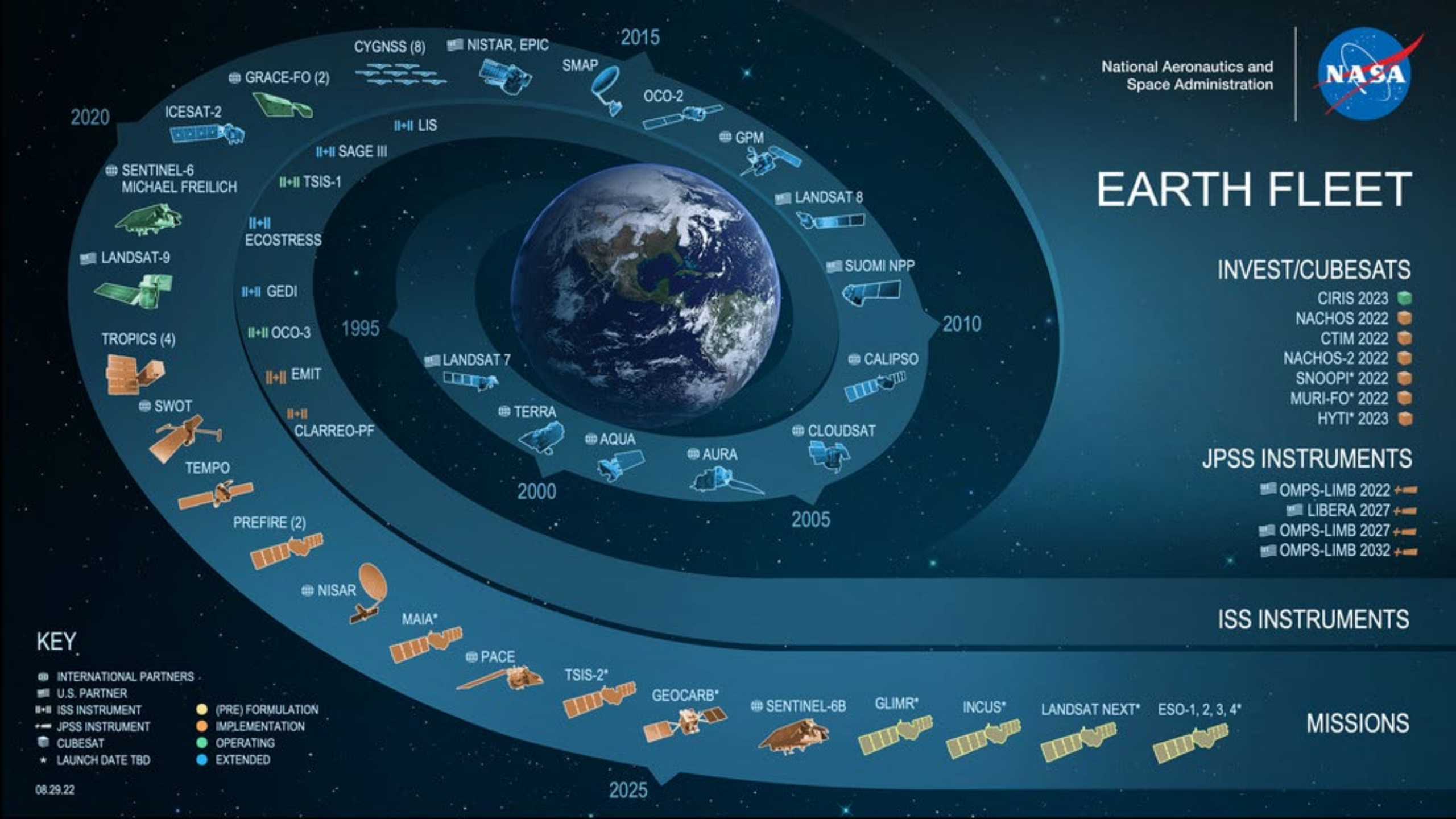
Data File Naming Convention

TEMPO_NO2_L3_V01_YYYYMMDDTHHMMSSZ_ScanIDGranuleID.nc

NO2 - this is the variable or product name contained in the file
L3 - this indicates the product level (L0, L1, L2, L3)
V01 - this denotes the version of the data file
YYYYMMDD - year, month, day
HHMMSSZ - the time in UTC
ScanID - this indicates the scan counter value
GranuleID - this indicates the granule counter value



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


National Aeronautics and Space Administration
NASA
EARTH FLEET
2015
2020
2010
1995
2000
2005
2025
CYGNSS (8)
NISTAR, EPIC
SMAP
OCO-2
GRACE-FO (2)
ICESAT-2
LIS
SAGE III
GPM
SENTINEL-6 MICHAEL FREILICH
TSIS-1
LANDSAT 8
ECOSTRESS
LANDSAT-9
SUOMI NPP
GEDI
TROPICS (4)
OCO-3
LANDSAT 7
CALIPSO
EMIT
SWOT
TERRA
CLARREO-PF
AQUA
CLOUDSAT
AURA
TEMPO
PREFIRE (2)
NISAR
MAIA*
PACE
TSIS-2*
GEOCARB*
SENTINEL-6B
GLIMR*
INCUS*
LANDSAT NEXT*
ESO-1, 2, 3, 4*
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

DSCOVR

JAN-MAR, 2023

DDD

		IP ADDRESS	USER NAME		
date_month	count	dc(UserIP)	dc(user_name)	Bytes	Megabytes
january	11470	45	23	3.10087E+12	2957218.398
february	3453	34	31	6.51581E+11	621395.7082
march	26031	43	24	3.00364E+12	2864499.062

DSCOVR

JAN-MAR, 2023

DDD

MissInProd = Mission / Instrument / Product

40,970 events (1/1/23 12:00:00.000 AM to 4/1/23 12:00:00.000 AM)

MissInProd	count	dc(UserIP)	dc(user_name)	Bytes	Megabytes
DSCOVR/EPIC/L1A	22	8	7	2585192736	2465.431915
DSCOVR/EPIC/L1B	5524	17	13	1.94407E+12	1854008.893
DSCOVR/EPIC/L2_AERF_01	11	2	2	387078599	369.1469183
DSCOVR/EPIC/L2_AER_03	5189	13	7	5.1436E+11	490532.3366
DSCOVR/EPIC/L2_AOCH_01	68	6	5	2664079202	2540.663912
DSCOVR/EPIC/L2_CLOUDFRACTION_01	21	5	2	1351782	1.289159775
DSCOVR/EPIC/L2_CLOUD_03	7236	14	12	1.99824E+12	1905672.725
DSCOVR/EPIC/L2_COMPOSITE_01	6	2	2	251113442	239.4804401
DSCOVR/EPIC/L2_COMPOSITE_02	54	9	5	484323634	461.8870106
DSCOVR/EPIC/L2_GLINT_01	4	1	1	4296971	4.097910881
DSCOVR/EPIC/L2_MAIAC_02	22156	21	9	2.29127E+12	2185122.726
DSCOVR/EPIC/L2_O3SO2AI_02	4	1	1	68246121	65.08457279
DSCOVR/EPIC/L2_O3SO2AI_03	15	4	4	137106127	130.7545919
DSCOVR/EPIC/L2_SO2_02	22	5	5	1072031030	1022.36846
DSCOVR/EPIC/L2_TO3_03	15	5	2	1164547734	1110.599264
DSCOVR/EPIC/L2_VESDR_02	23	8	7	263544158	251.3352947
DSCOVR/EPIC/L3_PAR	26	7	3	43871828	41.83943558
DSCOVR/EPIC/L3_PAR_01	7	3	3	509223873	485.633729
DSCOVR/EPIC/L4_TrO3_01	44	12	8	584138575	557.0779562
DSCOVR/NIST/L2	12	5	4	270849	0.258301735
DSCOVR/NISTAR_V3/L1A	28	5	5	105052570	100.1859379
DSCOVR/NISTAR_V3/L1B	358	2	2	2529228977	2412.060716
DSCOVR/NISTAR_V3/L1B_FILTERED	12	4	3	236962	0.225984573
public/DSCOVR/EPIC	1	1	1	144314	0.137628555

DSCOVR					
JAN-DEC, 2022					
DDD					
MissInProd = Mission / Instrument / Product					
392,777 events (1/1/22 12:00:00.000 AM to 1/1/23 12:00:00.000 AM)					
MissInProd	count	dc(UserIP)	dc(user_name)	Bytes	Megabytes
DSCOVR/EPIC/L1A	22295	68	50	8.11607E+12	7740086.243
DSCOVR/EPIC/L1B	84583	111	70	2.98259E+13	28444233.45
DSCOVR/EPIC/L2_AERF_01	81	19	13	1469808971	1401.719066
DSCOVR/EPIC/L2_AER_03	68903	96	43	9.94341E+12	9482772.749
DSCOVR/EPIC/L2_AOCH_01	40	9	6	261582835	249.4648314
DSCOVR/EPIC/L2_CLOUDFRACTION_01	42	12	8	2420174	2.308057785
DSCOVR/EPIC/L2_CLOUD_03	89462	112	77	2.5309E+13	24136544.74
DSCOVR/EPIC/L2_COMPOSITE_01	296	19	20	15132138953	14431.13227
DSCOVR/EPIC/L2_COMPOSITE_02	391	17	13	34997177943	33375.90975
DSCOVR/EPIC/L2_GLINT_01	184	45	15	182468993	174.0159922
DSCOVR/EPIC/L2_MAIAC_02	58577	56	30	5.91705E+12	5642938.549
DSCOVR/EPIC/L2_O3SO2AI_02	2616	21	22	1.75323E+11	167201.5109
DSCOVR/EPIC/L2_O3SO2AI_03	5097	23	12	3.41204E+11	325397.4498
DSCOVR/EPIC/L2_SO2_02	676	27	19	89909285509	85744.1764
DSCOVR/EPIC/L2_TO3_03	1622	26	17	3.07744E+11	293487.8645
DSCOVR/EPIC/L2_VESDR_02	48445	39	29	1.62053E+12	1545453.612
DSCOVR/EPIC/L3_PAR	105	28	17	110040593	104.9428873
DSCOVR/EPIC/L3_PAR_01	4081	38	21	6.64761E+11	633965.8204
DSCOVR/EPIC/L4_TrO3_01	450	46	24	62022519791	59149.28416
DSCOVR/NIST/L2	122	28	19	3487477	3.325917244
DSCOVR/NISTAR_V3/L1A	3118	21	21	50255965999	47927.82402
DSCOVR/NISTAR_V3/L1B	624	23	16	3935459875	3753.147006
DSCOVR/NISTAR_V3/L1B_FILTERED	150	18	16	338521567	322.839324

ASDC in the Cloud

- ESDIS is heavily investing in commercial 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
      - SWOT and NISAR are most often cited
  - Building an AWS-native ingest and archive system called Cumulus that is intended to be used by all DAACs
  - ESDIS pays for the storage. Users pay for their own compute resources.
  - Data download will still be available free of charge

ASDC in the Cloud

- ASDC engaged in a “Phase I” onboarding activity with ESDIS support
  - Period of performance is July 2020 to December 2021
  - Selected a small number of data sets from MISR, MOPITT, and CERES to ingest as part of this first phase
    - Data will still be ingested and stored at ASDC with a copy sent to AWS
  - Phase I does not include any services such as subsetting, etc.
  - Data will continue to be archived on site at ASDC for the forseeable future
- Guiding Principles
  - User experience will not be interrupted or degraded
  - Activities are being planned in a way to avoid introducing technical and schedule risks and dependencies
  - ASDC will work closely with ESDIS to identify risks, technical challenges and uncertainties, and proposing concepts and architectures for mitigating any issues that arise

DSCOVR				
JAN-MAR, 2023				
OPeNDAP		IP ADDRESS		
date_month	count	dc(clientip)	Bytes	Megabytes
january	0	0	0	0
february	0	0	0	0
march	61	4	538636	0.513683319

OPeNDAP

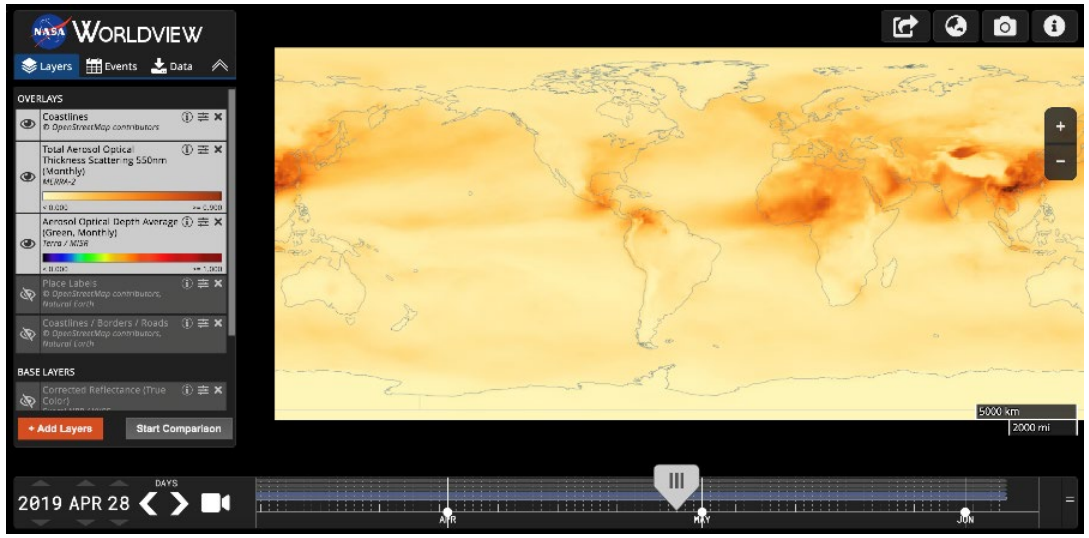
MissInProd = Mission / Instrument / Product

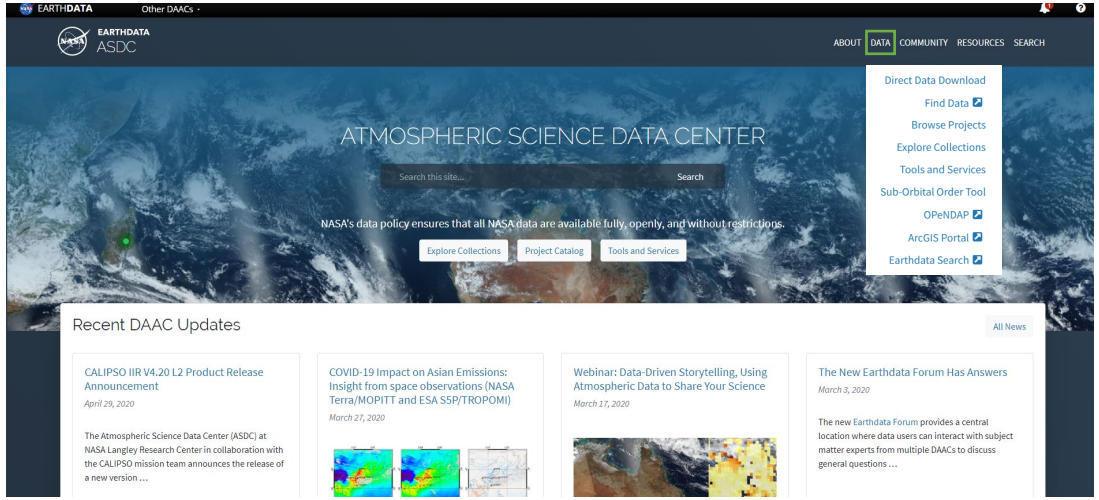
Complete 3,205 events (1/1/23 12:00:00.000 AM to 4/1/23 12:00:00.000 AM)

MissInProd	count	dc(clientip)	Bytes	Megabytes
DSCOVR/EPIC/L2_AERF_01	3	2	28182	0.02687645
DSCOVR/EPIC/L2_AER_03	8	2	3530814	3.367246628
DSCOVR/EPIC/L2_AOCH_01	13	4	94889720	90.49388885
DSCOVR/EPIC/L2_COMPOSITE_01	4	2	41728	0.039794922
DSCOVR/EPIC/L2_COMPOSITE_02	5	2	59320	0.05657196
DSCOVR/EPIC/L2_GLINT_01	5	2	64110	0.06114006
DSCOVR/EPIC/L2_MAIAC_02	14	3	7797299	7.436083794
DSCOVR/EPIC/L2_O3SO2AI_02	1	1	12669	0.0120821
DSCOVR/EPIC/L2_O3SO2AI_03	5	3	67420	0.064296722
DSCOVR/EPIC/L2_SO2_02	11	3	528550	0.50406456
DSCOVR/EPIC/L2_TO3_03	2	2	26928	0.025680542
DSCOVR/EPIC/L2_VESDR_02	1	1	11844	0.011295319
DSCOVR/EPIC/L3_PAR_01	2	2	26113	0.024903297
DSCOVR/EPIC/L4_TrO3_01	18	5	5637401	5.376244545

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
- ✓ ASDC Subsetters
  - ∘ subset ∘ aggregate





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

User Support and Other Resources

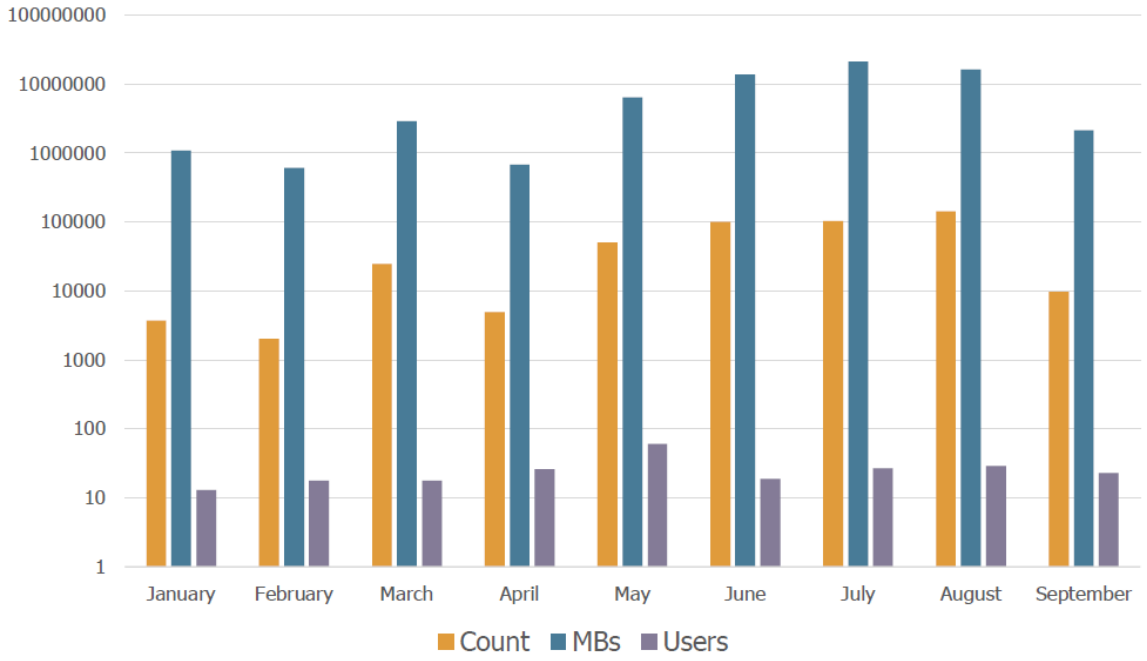
Example scripts

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

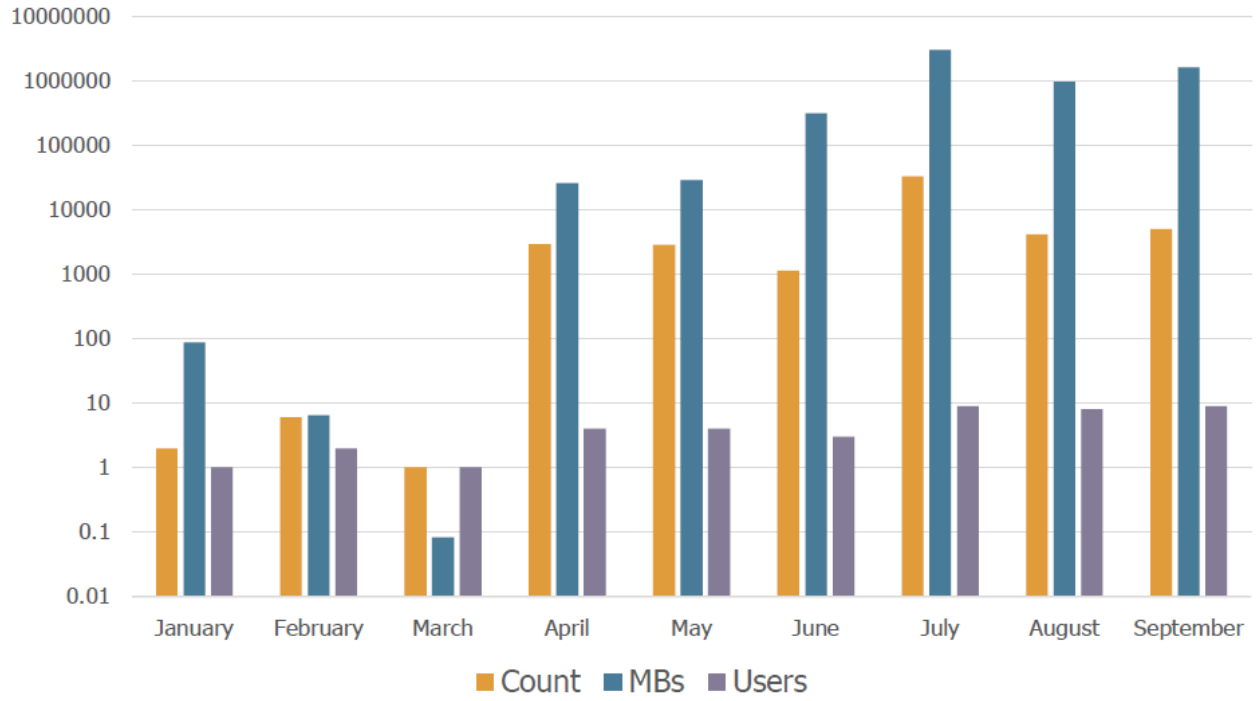
Earthdata Forum https://forum.earthdata.nasa.gov/

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

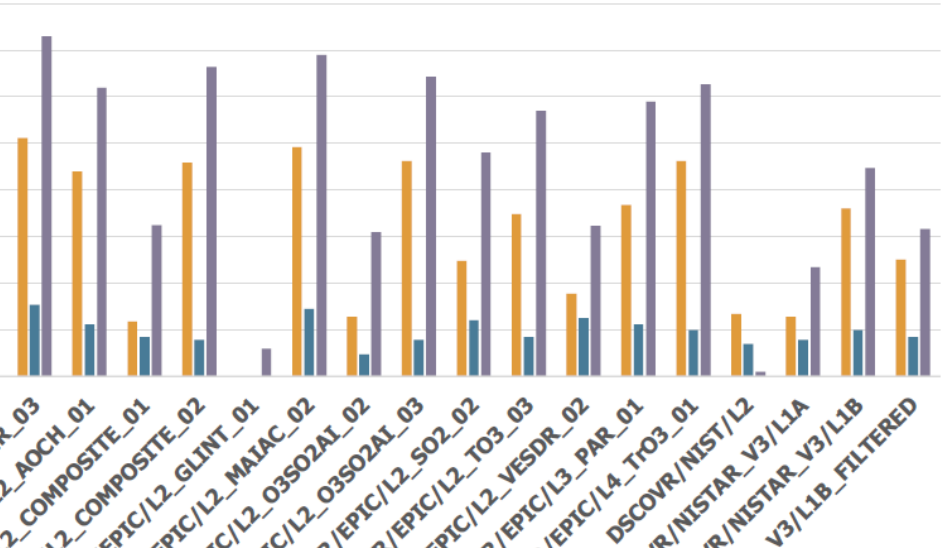
DDD 2023



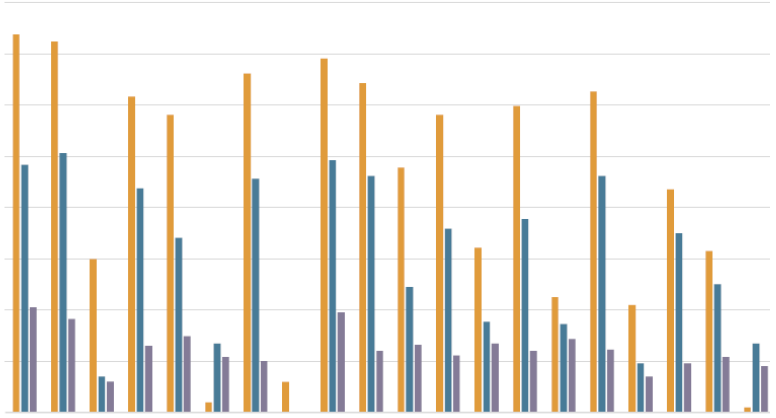
OPeNDAP 2023



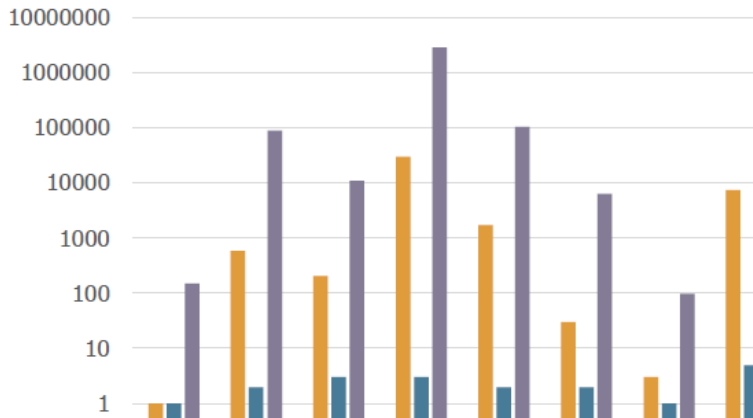
DDD January to September 2023

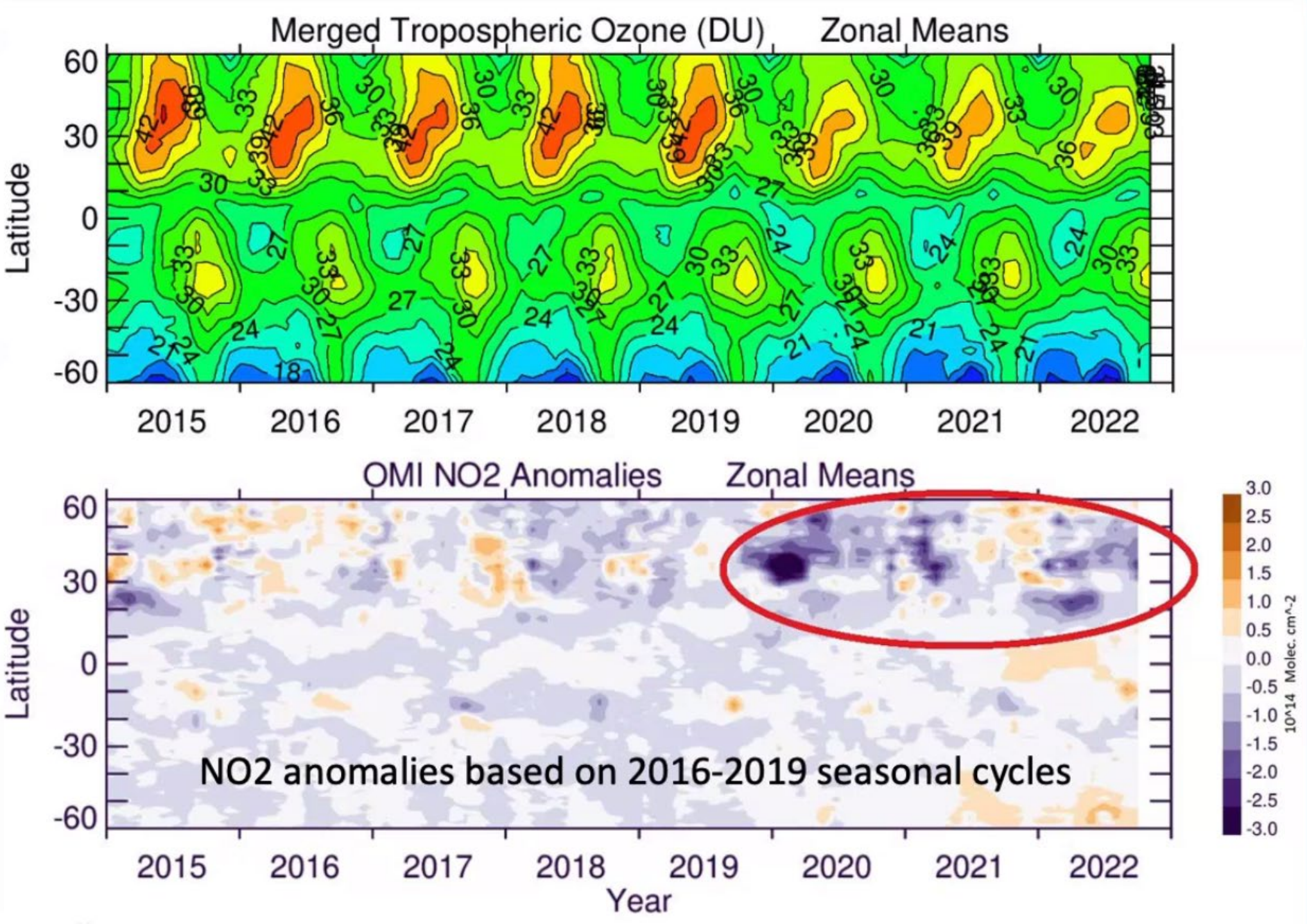


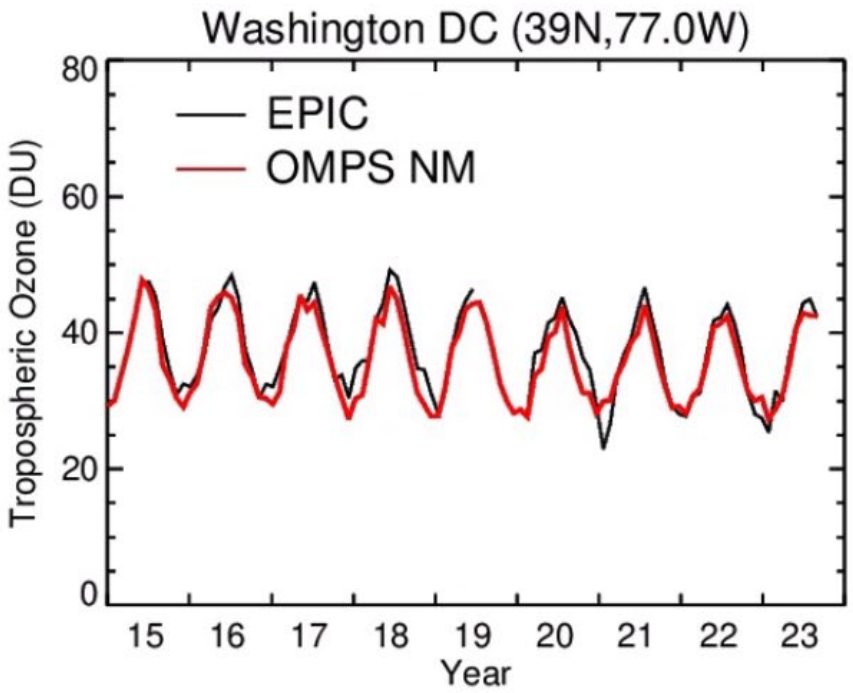
EMS January to September 2023

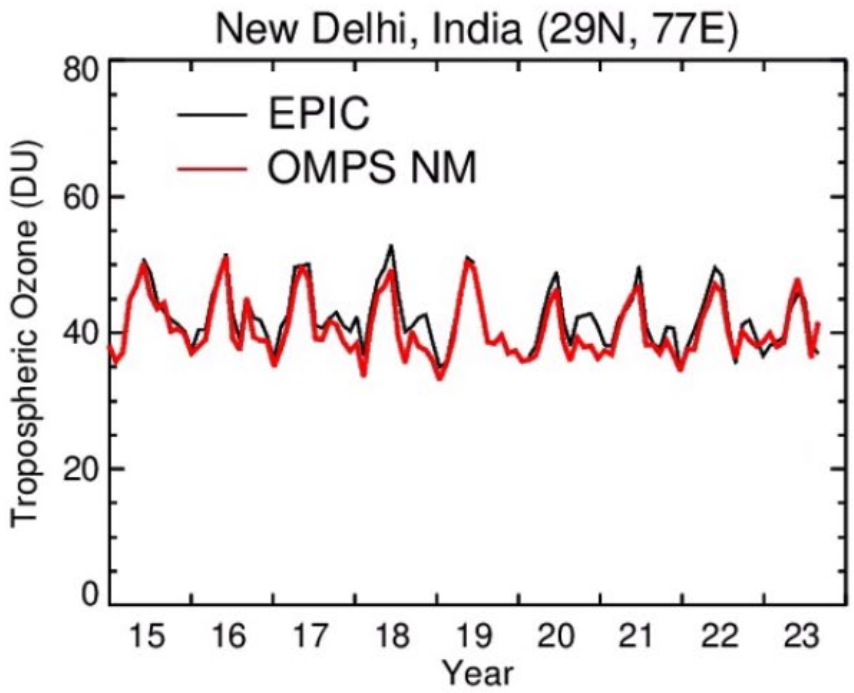


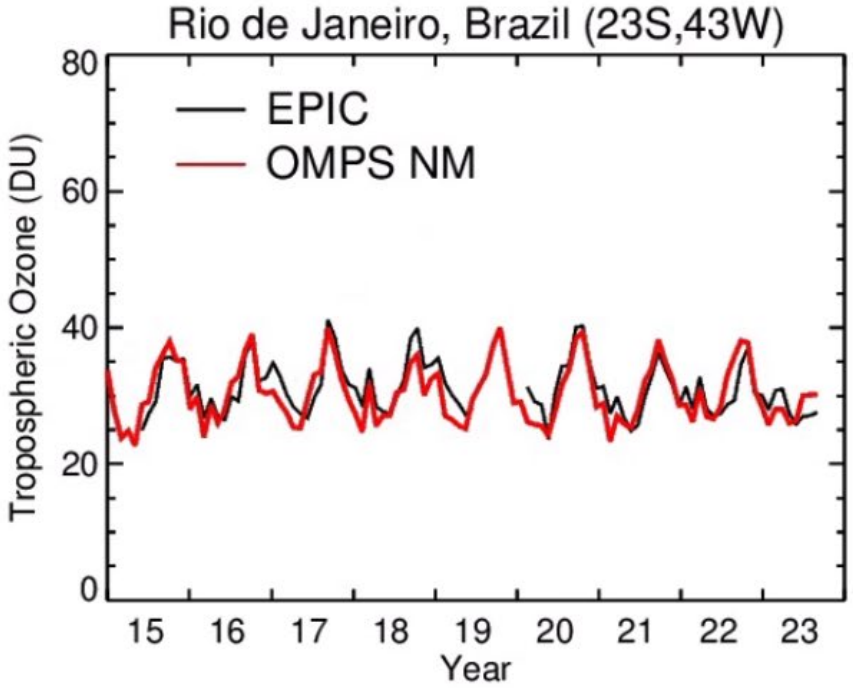
OPeNDAP January to Septem

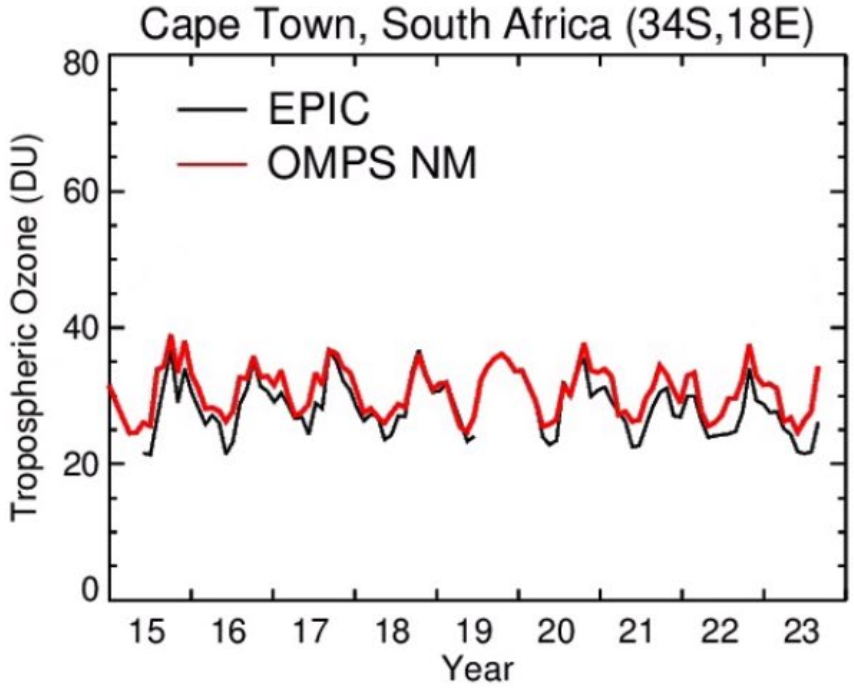



Merged Tropospheric Ozone (DU) Zonal Means
Latitude
60
30
0
-30
-60
2015
2016
2017
2018
2019
2020
2021
2022
OMI NO2 Anomalies Zonal Means
NO2 anomalies based on 2016-2019 seasonal cycles
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
10^14 Molec. cm^-2
Year


Washington DC (39N,77.0W)
EPIC
OMPS NM
Tropospheric Ozone (DU)
0
20
40
60
80
15
16
17
18
19
20
21
22
23
Year

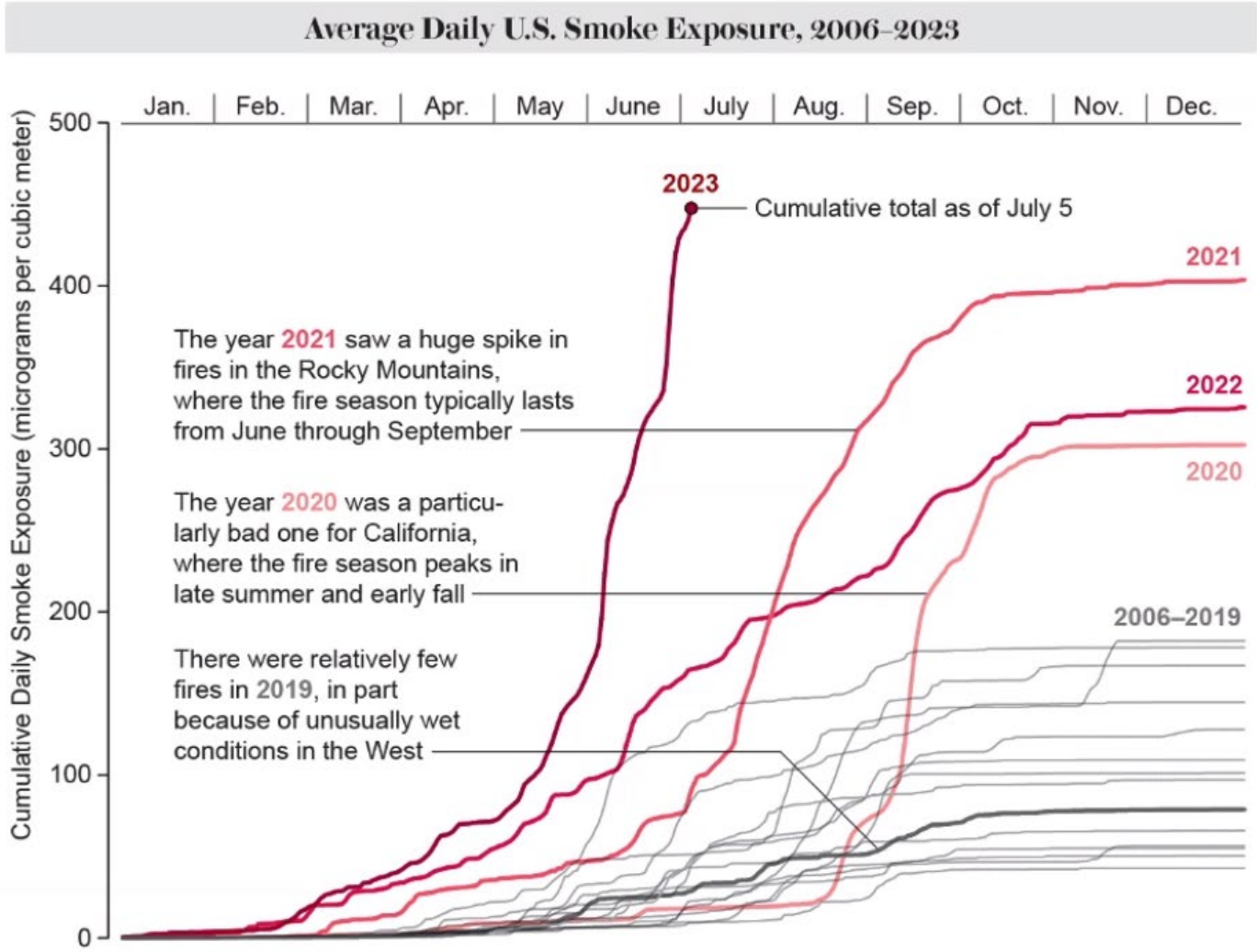

New Delhi, India (29N, 77E)
EPIC
OMPS NM
Tropospheric Ozone (DU)
0
20
40
60
80
15
16
17
18
19
20
21
22
23
Year


Rio de Janeiro, Brazil (23S,43W)
EPIC
OMPS NM
Tropospheric Ozone (DU)
0
20
40
60
80
15
16
17
18
19
20
21
22
23
Year


Cape Town, South Africa (34S,18E)
EPIC
OMPS NM
Tropospheric Ozone (DU)
0
20
40
60
80
15
16
17
18
19
20
21
22
23
Year

MAIAC AOD product will soon be released on EDS. This product differentiate between smoke and dust

Increasing cumulative daily smoke exposure in recent years



Credit: Amanda Montañez;
Source: Environmental Change and Human Outcomes Lab (ECHOLab), Stanford University

ABSTRACT. Observing the Earth from the Moon's surface has important scientific and technical advantages. The apparent librational movement of the Earth in the Moon's sky complicates observations of the Earth. The angular diameter of the Earth as seen from the Moon's surface is 1.8–2.0°, depending on the Earth–Moon distance. The libration of the Moon in latitude reaches an amplitude of 6.68° and has a main period of 27.21 d. The libration of the Moon in longitude, reaching an amplitude of 7.9°, has a period of 27.55 d. This causes the center of the Earth to move in the Moon's sky in a rectangle measuring 13.4°× 15.8°. The trajectory of the Earth's motion in this rectangle has a period of 6 years (or 2190.34 d).

[1]. Gorkavyi, N., Carn, S., DeLand, M., Knyazikhin, Y., Krotkov ,N., Marshak A., Myneni, R. and Vasilkov, A.: Earth Imaging From the Surface of the Moon With a DSCOVR/EPIC-Type Camera. *Front. Remote Sens.* 2:724074. doi: 10.3389/frsen.2021.724074, 2021.

[2]. Gorkavyi, N., Krotkov, N., and Marshak, A.: Earth observations from the Moon's surface: dependence on lunar libration, *Atmos. Meas. Tech.*, 16, 1527–1537, https://doi.org/10.5194/amt-16-1527-2023, 2023. **Cumulative views and downloads: >8500.**

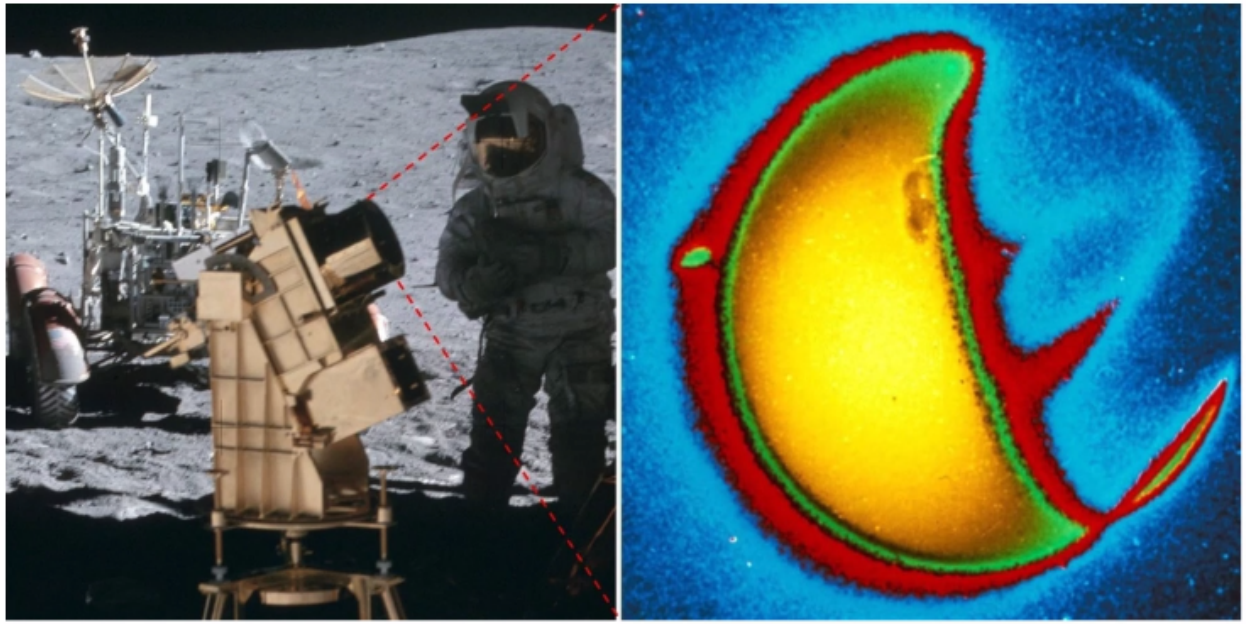


Figure 1. (from [2]) **Left:** a far-ultraviolet camera and spectrograph was operated on the lunar surface during the **Apollo 16 mission**, April 1972 (credits: NASA, Apollo 16).
Right: the Earth, photographed in far-ultraviolet light (1304 angstroms) by astronaut John W. Young. Credits: George Carruthers (NRL) and Thornton Page (JSC), Far UV Camera, NASA, Apollo 16; based on the image AS16-123-19657 (Mason, 2019).

2

View from EPIC
(12 October 2015)

Earth observations from the Moon's surface compared to L1 observations:

Scientific advantages
1. Smaller distance (~4 times)
2. Richer phase angles (0°-180°)
3. Night side and twilight zone of the Earth

Technical benefits
1. Orbital stability
2. Possibility for repair
3. Robust connection with the Earth

View from LRO
(12 October 2015)

"Use the Moon as a platform for Earth-observing studies . . . The observations from the Moon will have higher resolution than would similar observations made from L1. Myriad science investigations targeting topics such as lightning, Earth's albedo, atmosphere, and exosphere . . . , the oceans, infrared emission, and radar interferometry may be accomplished from the surface of the Moon. The Moon also offers a unique vantage point for full-disk observations . . ."
(Artemis III Science, 2020).

5

STM Feedback and way forward

~30 in person and ~ 30 online with international attendees and international questions. AWS curiosity

The Science team is very glad to see the poster and asked how can we get PANDORA and AERONET on EDS?

99% Scientific presentations, Geophysical Retrievals, Geolocation. ASDC had the only poster.

The Science team recommended to have a 10-15 time slot to present this great work in addition to the poster for side discussions.

Can we get Data usage metrics vs. Publications/Citation?

EPIC DSCOVR has a global coverage. Can we present metrics for usage per country?

MAIAC AOD product will soon be released on EDS. This product with differentiate Aerosols between smoke and dust.

The Science teams are not familiar with OPeNDAP. ASDC needs to develop a code for Facilitating OPeNDAP usage.

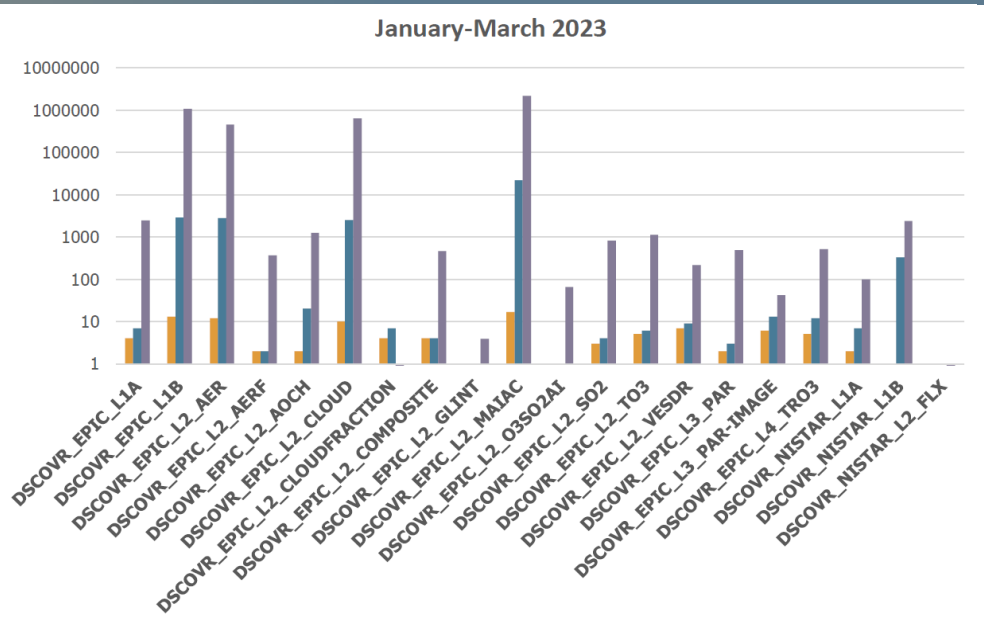
It will be a great to have EPIC DSCOVR on ASDC ArcGIS Portal, especially ozone/Aerosol products.

This will help TEMPO users to use ASDC products for extended trends.

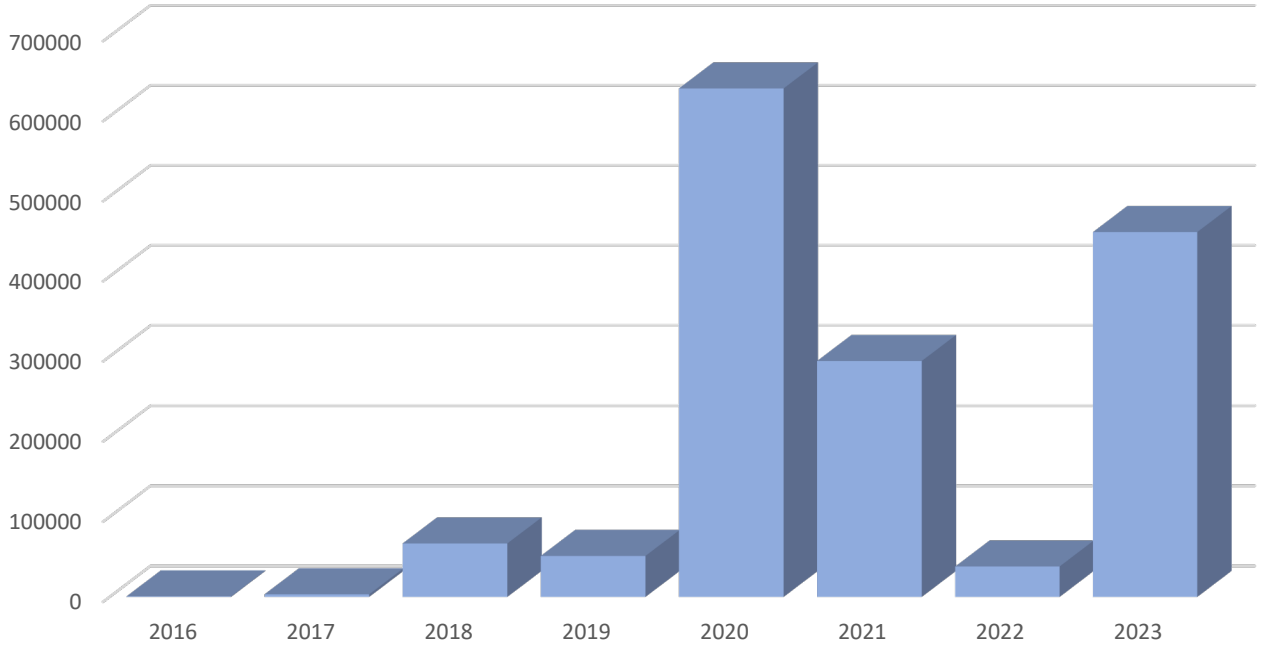
Poster

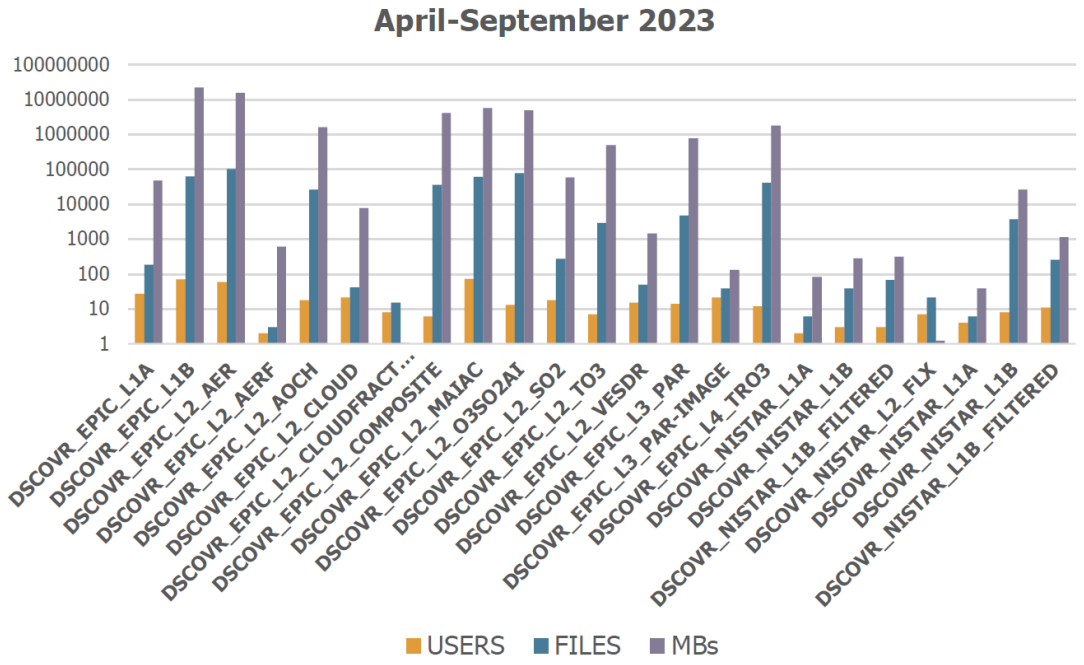
DSCOVR Data Products: Number of Users, Files and Size per Product for 2023

30,748 files from January to March
424,592 files from April to September

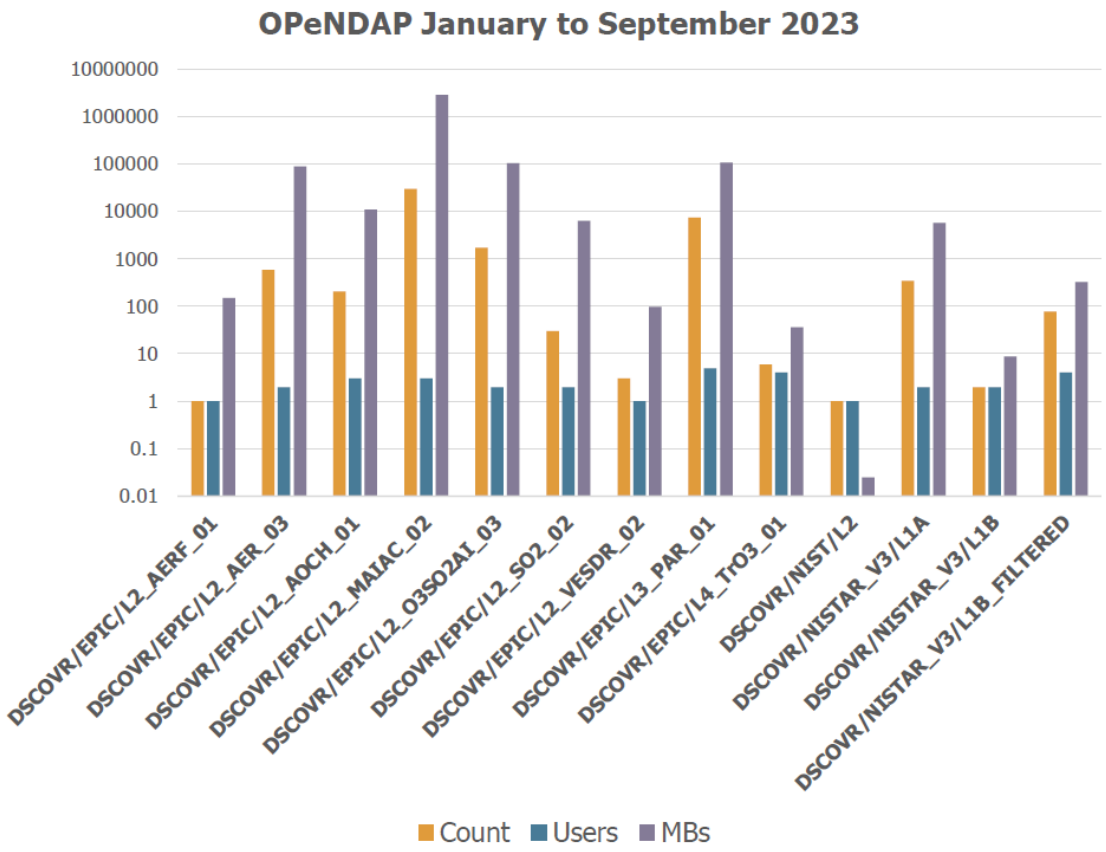


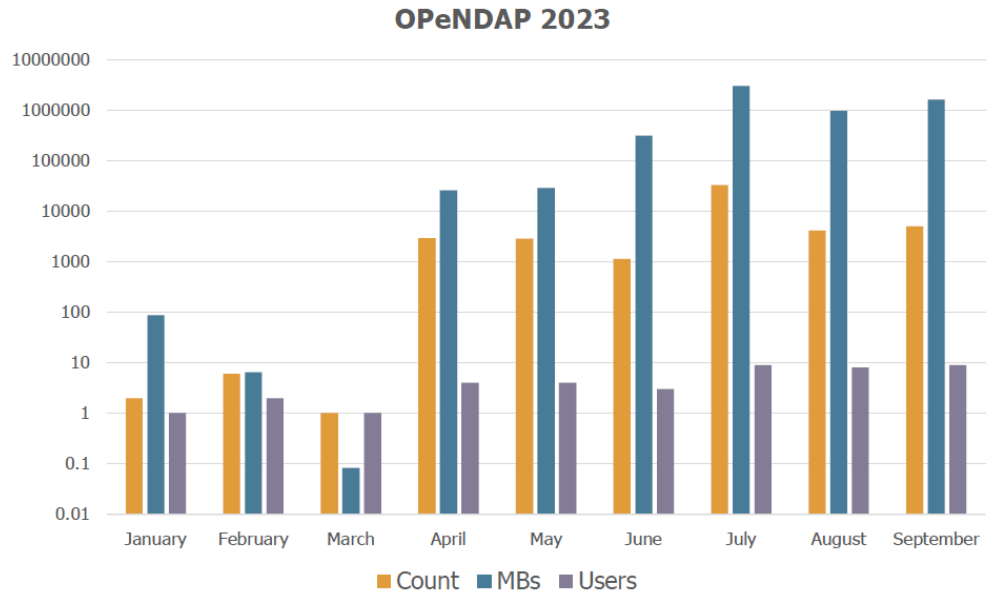
EPIC/NISTAR Total Granules Distribution per year





OPeNDAP


OPeNDAP January to September 2023
10000000
1000000
100000
10000
1000
100
10
1
0.1
0.01
DSCOVR/EPIC/L2_AERF_01
DSCOVR/EPIC/L2_AER_03
DSCOVR/EPIC/L2_AOCH_01
DSCOVR/EPIC/L2_MAIAC_02
DSCOVR/EPIC/L2_O3SO2AI_03
DSCOVR/EPIC/L2_SO2_02
DSCOVR/EPIC/L2_VESDR_02
DSCOVR/EPIC/L3_PAR_01
DSCOVR/EPIC/L4_TrO3_01
DSCOVR/NIST/L2
DSCOVR/NISTAR_V3/L1A
DSCOVR/NISTAR_V3/L1B
DSCOVR/NISTAR_V3/L1B_FILTERED
Count
Users
MBs


OPeNDAP 2023
10000000
1000000
100000
10000
1000
100
10
1
0.1
0.01
January
February
March
April
May
June
July
August
September
Count
MBs
Users