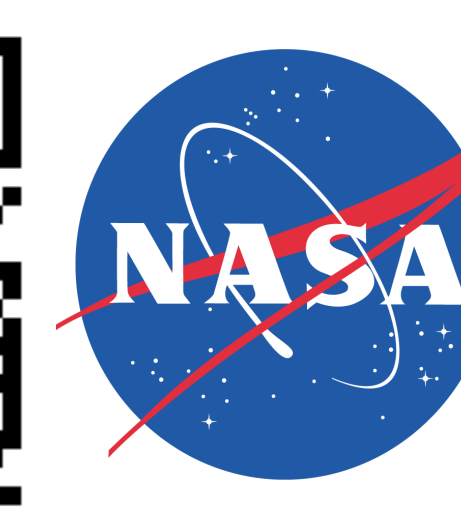


NASA Precipitation Products and Services at GES DISC



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NASA/Goddard EARTH SCIENCES DATA and INFORMATION SERVICES CENTER (GES DISC)

An Overview of GES DISC

- The GES DISC is one of the 12 NASA EOSDIS DAACs that manage, archive, and distribute Earth science data as part of NASA's Earth Science Data Information System (ESDIS) Program.
- The GES DISC is a **certified trusted repository** as a Regular Member of the International Council for Science (ICSU) World Data System (WDS).
- We provide support for the archive and distribution of data from **over 35** satellite sensors, ground measurements, field campaigns, and models, as well as refined datasets developed by science community members.
- GES DISC is a **multi-disciplinary archive**, with data in five of the six NASA Earth science focus areas: atmospheric composition, weather and atmospheric dynamics, climate variability and change, water and energy cycle, and carbon cycle.
- GES DISC archives over **5.6 PB** of data from **2500 data products**. It has disseminated over **52 PB** of data, including precipitation products from NASA satellite missions/projects (GPM, TRMM, MERRA-2, NLDAS, GLDAS, FLDAS, GPCP, MEaSUREs, etc.)
- We follow data publication process and ESDIS standards for metadata, format and citation recommendations including **Digital Object Identifiers (DOIs)**.

Measuring Demands, Deciphering Needs:

- Data distribution metrics:** Product distribution, user access, customizable by mission
- Service metrics:** Create metrics for each service to identify products, variables, and regions being subsetted
- User ticket mining by mission:** Understand our user needs, such as what is missing or needs to be improved in our data services, and determine if there are any common questions to improve outreach or user engagement
- Publication mining:** Capture, extract and provide dataset citation information from publications to science teams
- Outreach activities:** User Working Group, publications (e.g., journals, books), conferences/meetings/seminars, trainings, etc.

Help Growing the User Community: "The broad global user community drives what we do":

- Value-added products and services** based on user needs: subsetting, regridding, reformatting, data visualization and analysis, and Web services (OPeNDAP, GDS, https, THREDDS, WMS, WCS, etc.)
- User services assistance** – we work with users in research and application communities around the world to utilize the data
- Outreach activities:** social media, User Working Group, publications (e.g., journals, books), conferences/meetings/seminars, trainings, etc.

GES DISC Cloud Migration Strategy, Goals, and Status

Earthdata Strategic Goals:

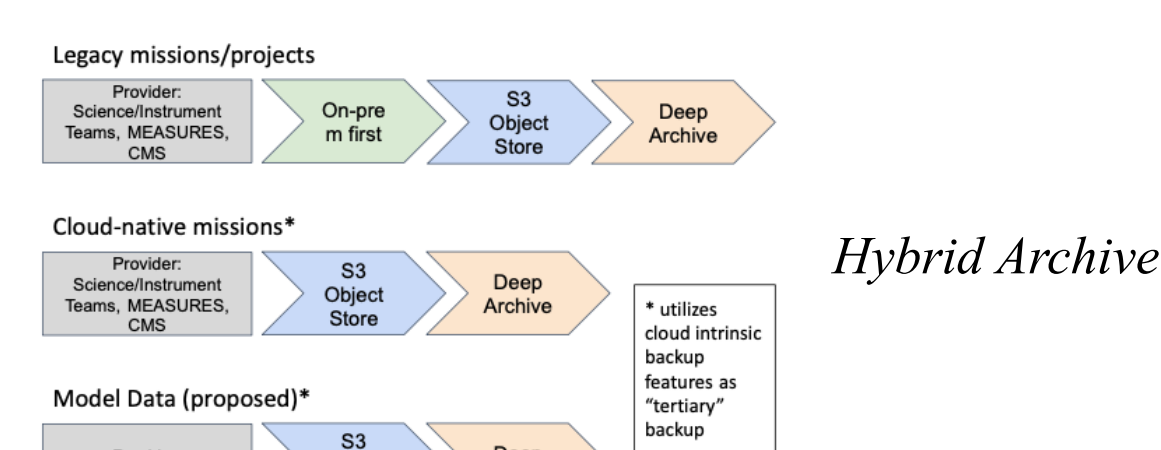
- Set the standard** for efficient production and stewardship of science-quality data.
- Advance open science** data systems for the next generation of missions, data sources, and user needs.
- Lead research and development of technology** for management and analysis of complex Earth science data.
- Leverage the diversity** of global Earth science communities to advance open science.

The GES DISC's overall strategy is to migrate data to cloud from on-premises with a seamless UX for users while enabling them to leverage in-place data access and minimizing risk of data loss. (~1500 collections in 2 years).

Key features:

- Prioritizing datasets having value to "early adopters" who would benefit from conducting analysis in cloud environments and demonstrate the value of cloud-based data systems;
- prioritizing suites of collections having common mission/platform/program sources and curation processes to be migrated together;
- orchestrating the above to maximize the utility of cloud resources while off-loading aging on-premises servers and minimizing on-premises data services.

Phase	Mission/project
FY22	M2T1NXSLV, GPM_3IMERGHH, Sounder (CLIMCAPS, CHIRP), NLDAS, atmospheric composition (TROPOMI, OMI, OMPS), carbon suite (OCO-2/3, ACOS, CMS), GPM/IMERG, TRMM, TROPES, MLS, TROPICS*
FY23	complete sounder (AIRS, SNPP, JPSS), complete model suite (GMAO, Hydrology/DAS), MEaSUREs, JPSS-2*, GEOS-R21C*, TSIS-2*, GeoCARB*
FY24	Remaining CMR-discoverable archive**



Resources

Introduction

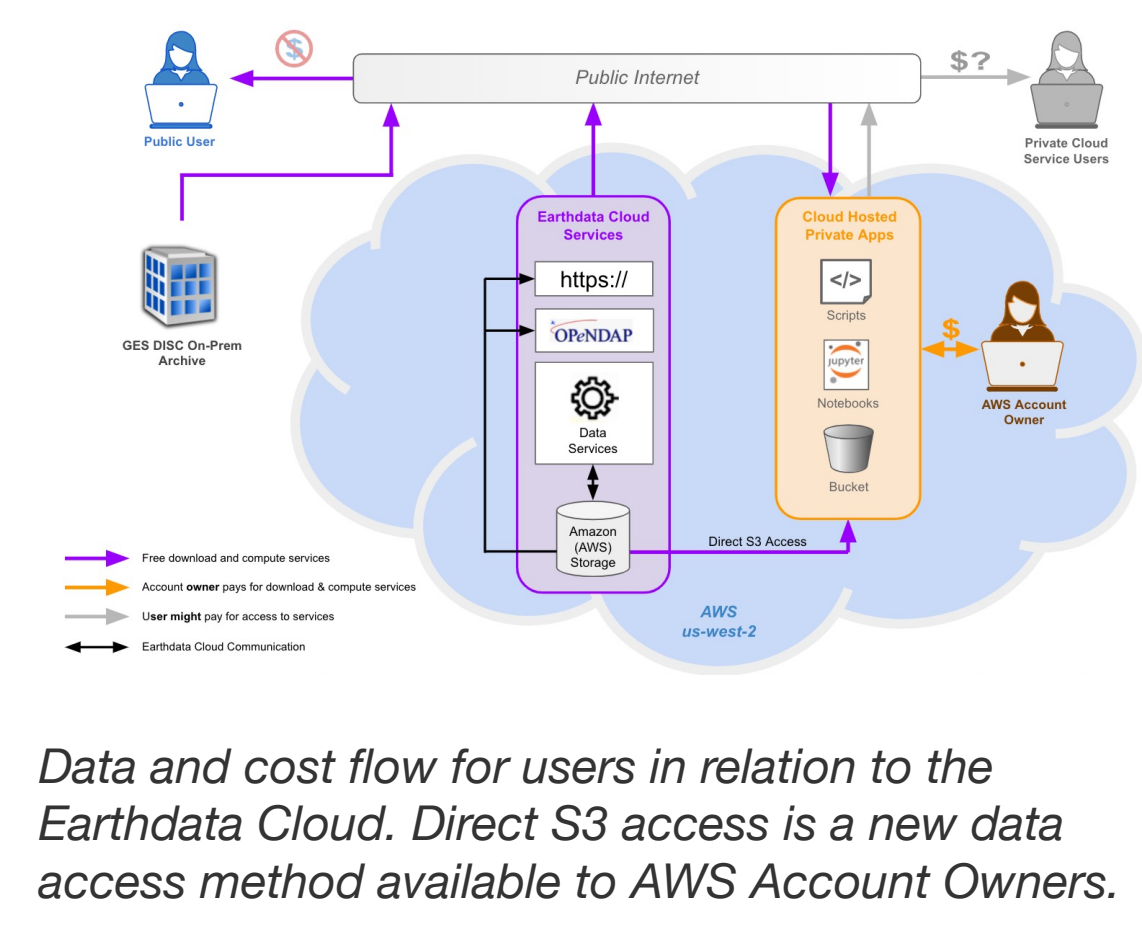
What's New
GES DISC now offers users the option to access data collections directly in the cloud through:

- Direct S3 access

Read more about what S3 access is and how to interact with GES DISC collections via S3 access in the cloud.

Migration Status
In addition to the data archive, GES DISC is also in the process of migrating services to the cloud. The following services will be migrated to the cloud soon, and any changes to access patterns will be noted in linked documentation:

- HTTPS
- OPeNDAP
- Subsetting
- Regridding
- Giovanni time series
- Time aggregation



- What to Expect**
- Accessing GES DISC data in the cloud remains free of cost to users. In compliance with NASA's open science policy, all GES DISC data and services are **freely accessible** to the public.
 - Users are responsible for their own cloud computing resources. While GES DISC data stored in and services running in the cloud are available to all users for free, users wanting to run code from inside the Earthdata Cloud (AWS us-west-2 region) are still responsible for funding and management of those resources. *Questions on cost? Refer to the AWS Pricing Calculator.*
 - Direct S3 access of GES DISC data is now available. Direct S3 access is a new option for accessing cloud-hosted data. Direct S3 access is available to users operating within the AWS us-west-2 region.
 - Familiar GES DISC services may look different for cloud-hosted data. With the migration of GES DISC data to the cloud, some services may look different compared to current on-premises services. Details on the exact changes to services are coming soon.
 - Stay up-to-date on the migration of GES DISC datasets to the cloud. GES DISC is in the process of migrating its data and services to the cloud. The status of cloud migration can be accessed through a filtered search on the GES DISC Data Collections search page.
- Benefits**
- Highlighted below are ways in which users will benefit from the data and services available in the cloud:
- Improved performance:** Quick access and subsetting of a large volume of data, compared to data and services on-premises.
 - Multiple data access methods:** A new way to access data is S3 access, which is available to users in the AWS us-west-2 region (Figure 1).
 - Multidisciplinary data access:** Find multidisciplinary NASA data in one place, the Earthdata Cloud.
 - Analysis next to data:** Users in the AWS us-west-2 region can bring their algorithms and processing software and work directly with NASA data in the cloud, expediting science discovery. Note that users are responsible for procuring cloud computing resources.
 - Expanded services:** Expanded services, such as *CMR-STAC, Harmony, and Zarr creation, are coming soon.*

Global and Regional Precipitation Products

Global Precipitation Measurement - Level 3

Geophysical parameters that have been spatially and/or temporally resampled from Level 1 or Level 2 data.

IMERG Early Run	Near real-time low-latency gridded global multi-satellite precipitation estimates
IMERG Late Run	Near real-time gridded global multi-satellite precipitation estimates with quasi-Lagrangian time interpolation
IMERG Final Run	Research-quality gridded global multi-satellite precipitation estimates with quasi-Lagrangian time interpolation, gauge data, and climatological adjustment
3B Combined	Gridded rainfall estimates from combined radar/radiometer data (GPM GMI & DPR, TRMM TMI & PR)
3A Radar	Gridded rainfall estimates from radar data (GPM DPR, TRMM PR)
3A Radiometer (GPROF)	Gridded rainfall estimates from GPM GMI, TRMM TMI, and constellation microwave radiometers

Global Precipitation Measurement - Level 2

Derived geophysical parameters at the same resolution and location as those of the Level 1 data.

2B Combined	Single-orbit rainfall estimates from combined radar/radiometer data (GPM GMI & DPR, TRMM TMI & PR)
2A Radar	Single-orbit radar rainfall estimates for GPM DPR, Ka, Ku and TRMM PR
2A Radiometer (GPROF & PRPS)	Single-orbit radiometer rainfall estimates from GPM GMI, TRMM TMI, and constellation microwave radiometers

Global Precipitation Measurement - Level 1

Level 1A: Reconstructed, unprocessed instrument data at full resolution, time referenced, and annotated with ancillary information, including radiometric and geometric calibration coefficients and georeferencing parameters (i.e., platform ephemeris), computed and appended, but not applied, to Level 0 data.

Level 1B: Radiometrically corrected and geolocated Level 1A data that have been processed to sensor units.

Level 1C: Common intercalibrated brightness temperature (TC) products using the GPM Microwave Imager (GMI) Level 1B as the reference standard.

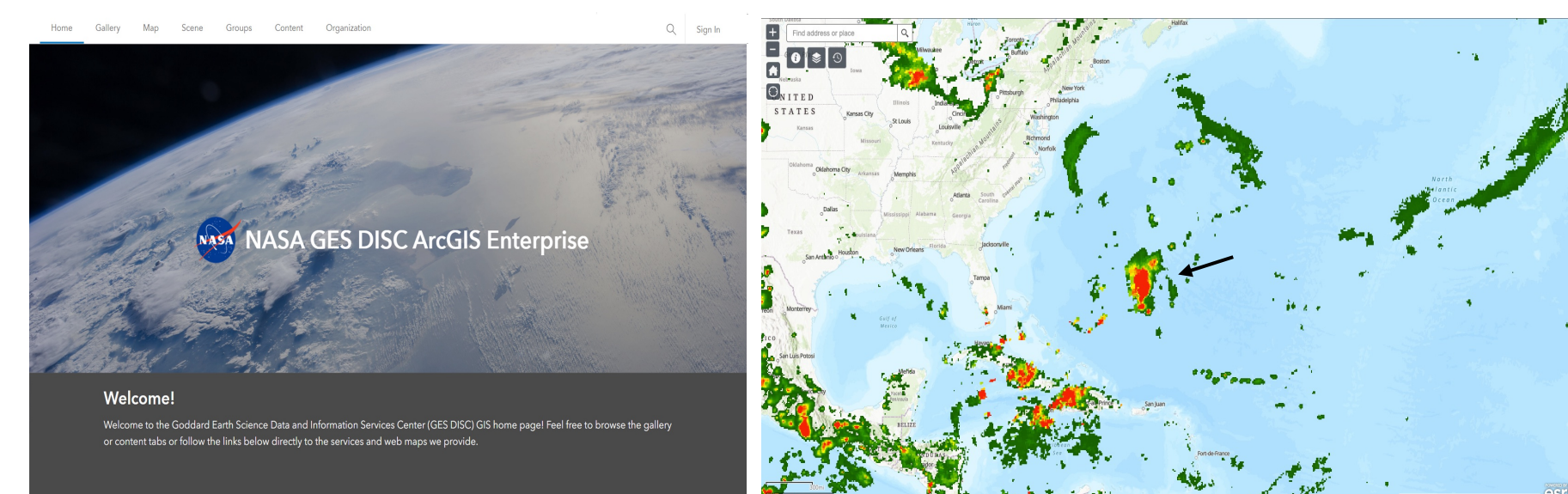
1C	Calibrated brightness temperature for GPM GMI, TRMM TMI, and constellation microwave radiometers
1B	Brightness temperatures for GPM GMI, and TRMM TMI, PR and VIRS
1A	Reconstructed, unprocessed instrument data at full resolution for GPM GMI and TRMM TMI

Data Services

In addition to the data archive, GES DISC also provides the following data services, available on each dataset landing page:

- HTTPS (online archive)
- OPeNDAP
- Subsetting
- Regridding
- Giovanni
- GrADS Data Server
- THREDDS
- Time aggregation
- User support/Help desk

ArcGIS at GES DISC



Web Maps and Apps

Top left: New GES DISC ArcGIS Enterprise Portal. *Top right:* Hurricane Fiona (arrow). Currently we offer content for the Integrated Multi-satellite Retrievals for Global Precipitation Measurement (IMERG) Early Run half-hourly product. *Bottom:* Web maps and apps.

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Release of Version 07 IMERG

The Global Precipitation Measurement (GPM) Project, the Precipitation Processing System (PPS), and the Goddard Earth Sciences Data and Information Services Center (GES DISC) are releasing Version 07 of the Integrated Multi-satellite Retrievals for GPM (IMERG) Final Run datasets, including the Half-hourly, the Monthly, and the Daily (produced at the GES DISC). The IMERG Version 07 near-real-time (Early and Late) products will be released in early 2024.

Since there are numerous science improvements to IMERG Version 07, as well as changes to the variable names, users are strongly encouraged to familiarize themselves with the [Data Release Notes](#).

Global Precipitation Climatology Project (GPCP)

Monthly:

Format: netCDF
 Spatial Coverage: -180.0, -90.0, 180.0, 90.0
 Temporal Coverage: 1983-01-01 to 2023-07-31
 File Size: 7 MB per file
 Data Resolution Spatial: 0.5° x 0.5°



Daily:

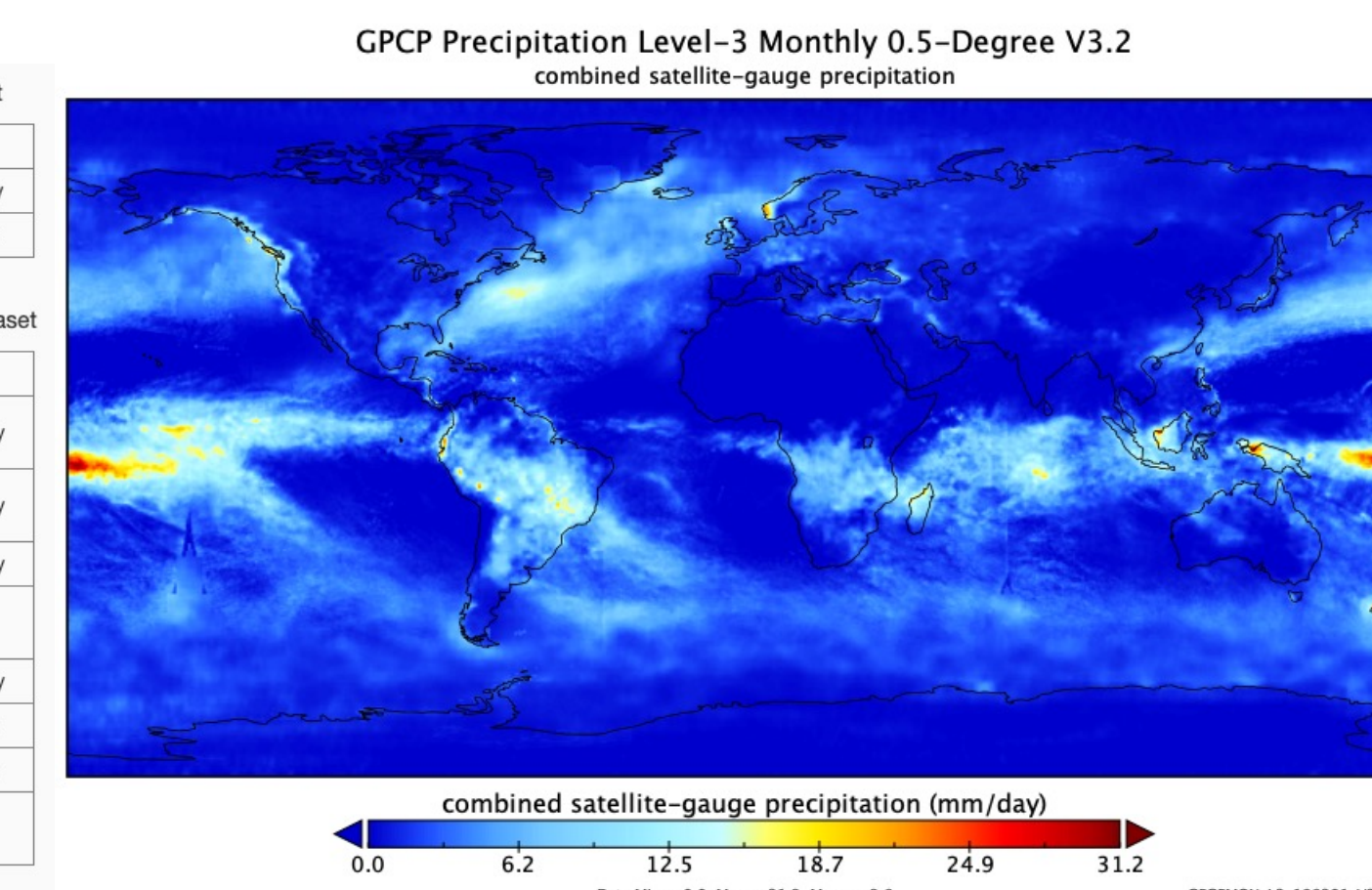
Format: netCDF
 Spatial Coverage: -180.0, -90.0, 180.0, 90.0
 Temporal Coverage: 2000-06-01 to 2021-09-30
 File Size: 1.6 MB per file
 Data Resolution Spatial: 0.5° x 0.5°

Table 1. Key data fields in the MEaSUREs GPCP V3.2 daily dataset

Data Field Name	Description	Units
precip	Precipitation estimate	mm/day
probability_liquid_phase	Probability of liquid phase	percent

Table 2. Key data fields in the MEaSUREs GPCP V3.2 monthly dataset

Data Field Name	Description	Units
sat_gauge_precip	Combined satellite-gauge precipitation estimate	mm/day
sat_gauge_errvr	Combined satellite-gauge precipitation random error estimate	mm/day
satellite_precip	Satellite-only precipitation estimate	mm/day
satellite_source	Source of the contributing satellite estimate	index values
gauge_precip	Wind-loss adjusted gauge precipitation	mm/day
probability_liquid_phase	Probability of liquid phase	percent
gauge_relative_weight	Gauge relative weighting	percent
quality_index	Quality index	index values



Sample image (Jan. 1983) of the GPCP monthly product.

Other Global and Regional Precipitation Products

MERRA-2: A large collection of precipitation-related variables (e.g., total surface precipitation, convective precipitation)
 Format: netCDF

Spatial Coverage: -180.0, -90.0, 180.0, 90.0
 Temporal Coverage: 1980-01-01 to present
 Data Resolution Spatial: 0.5° x 0.625°
 Temporal: 1 hour, 3 hours, 6 hours, and 1 month



LDAS (GLDAS, NLDAS, NCA-LDAS, FEWS NET (FLDAS)): A collection of precipitation variables (e.g., total precipitation, frozen precipitation)

Format: netCDF
 Spatial Coverage: varies per collection
 Temporal Coverage: varies
 Data Resolution Spatial: varies
 Temporal: varies



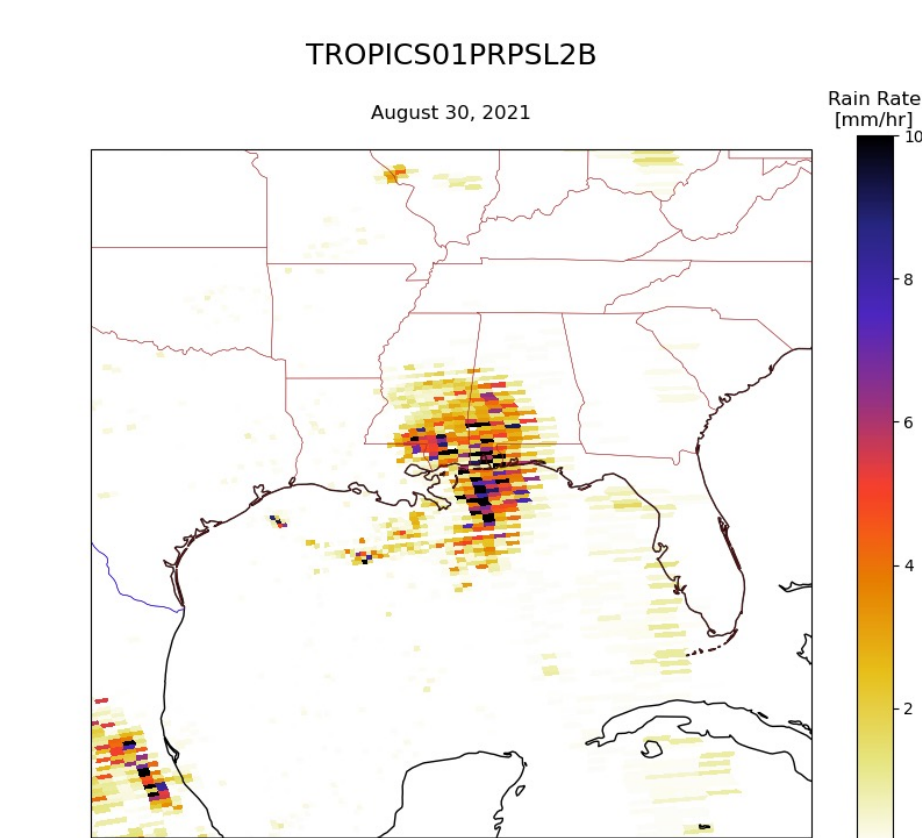
Version 1.0 Precipitation Fundamental Climate Data Record (MEaSUREs): Level-2 rain rate estimates from a number of satellites (e.g., TRMM, GPM, NIMBUS7).

Format: netCDF
 Spatial Coverage: varies per collection
 Temporal Coverage: varies
 Data Resolution Spatial: varies
 Temporal: varies



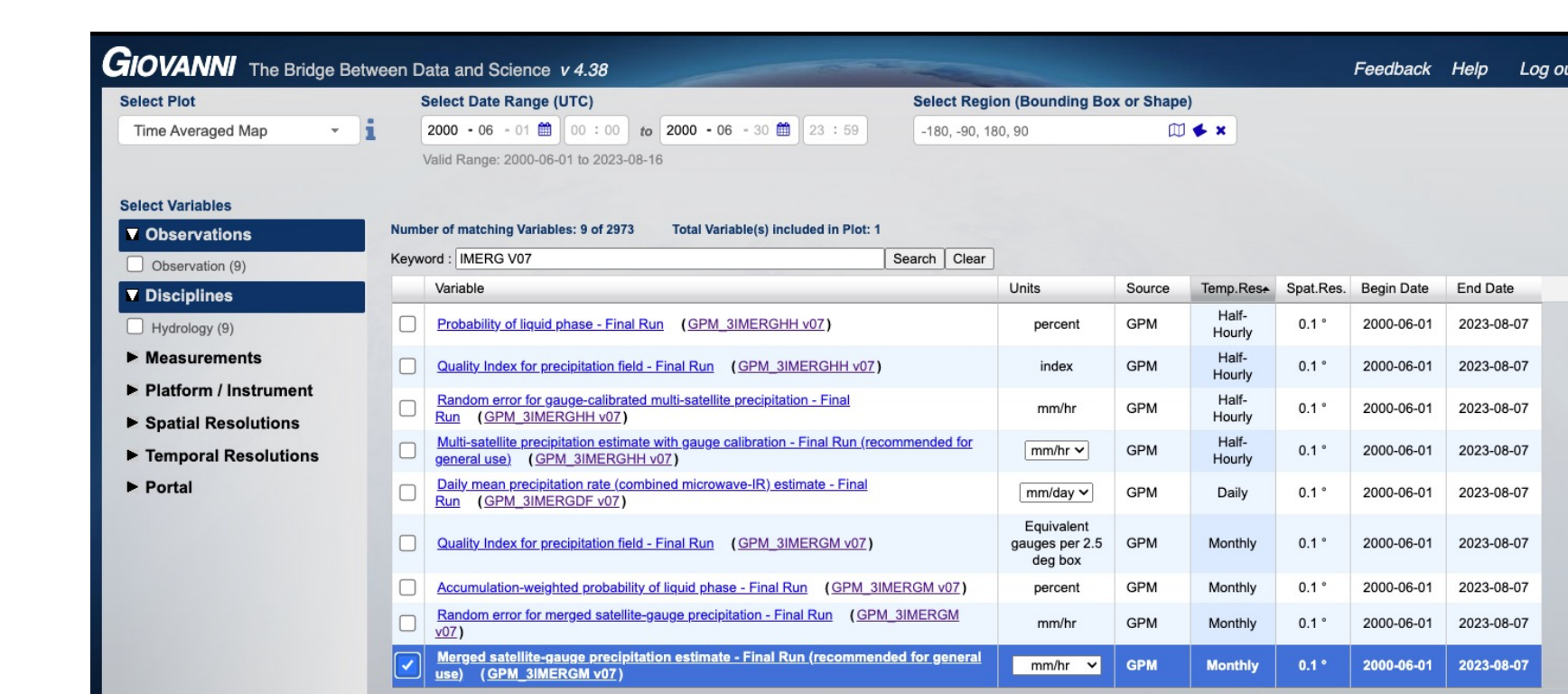
TROPICS Pathfinder Products:

Format: netCDF
 Spatial Coverage: -180.0, -90.0, 180.0, 90.0
 Temporal Coverage: 2021-08-08 to 2021-11-15
 Data Resolution Spatial: varies
 Temporal: 97 minutes

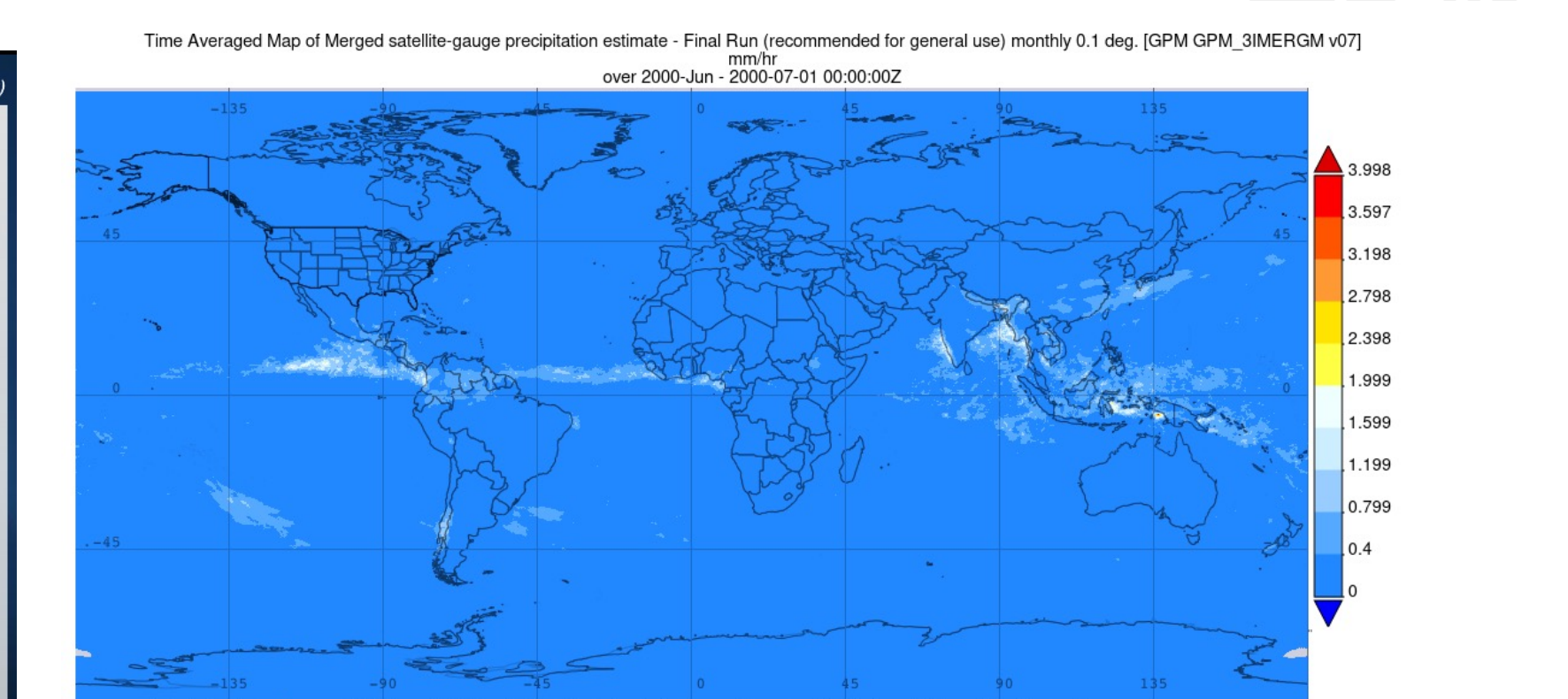


Giovanni – Online Visualization without Downloading Data and Software

Most Level-3 gridded precipitation data (e.g., IMERG, GPCP) in this presentation are available in Giovanni, along with variables from other satellite missions or projects. IMERG Version 07 data are being added to Giovanni.



IMERG Version 07 data have been added to Giovanni.



A sample (Jun 2000) of IMERG Version 07 monthly data.