Global Meteorological Datasets at NASA GES DISC

2025 AGU Fall Meeting

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

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Introduction

Meteorological information plays an important role in research and applications such as flooding, heatwaves, agricultural sustainability, food security, environmental conditions and monitoring, etc. However, finding and accessing current and historical meteorological data can be a challenging task for those who are not familiar with Earth data, their archives, and services. Furthermore, meteorological datasets are provided by different organizations (e.g., NOAA, NASA, WMO, and ECMWF). Accessing and integrating data from different data portals can be another challenge. At NASA Goddard Earth Sciences (GES) Data and Information Services Center (DISC), we archive and distribute global and regional meteorological data collections to support research, applications, and education. For example, several popular global meteorological data collections are available, including NASA's Integrated Multi-satellitE Retrievals for GPM (IMERG), the Global Precipitation Climatology Project (GPCP), and the Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2).

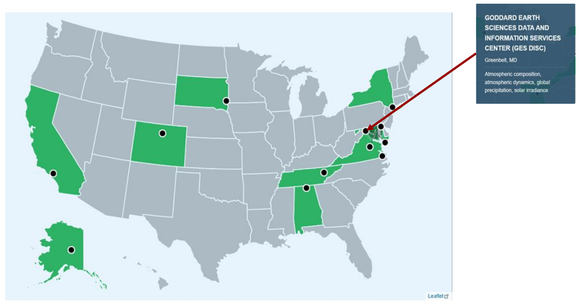
Over the years, GES DISC has developed data services (e.g., data subsetting, format conversion) and support for users around the world to facilitate their research and applications. In particular, the Geospatial Interactive Online Visualization ANd aNalysis Infrastructure (Giovanni) is a user-friendly, interactive online tool for accessing, analyzing, and visualizing a large collection of NASA satellite mission and project datasets, including global meteorological data collections, without downloading data and software. Giovanni currently offers over 2000 data variables and more than 20 plot types. Several near-real-time data products are available. Users can download analysis results in different formats (e.g., ASCII, netCDF, GeoTIFF). A list of shapefiles (e.g., countries, states, major watersheds, and tribal lands) is also available.

In this presentation, we will first introduce the NASA Earth satellite and model data holdings and services at GES DISC, applicable to several NASA Earth Science Focus Areas, including Atmospheric Composition, Water & Energy Cycles, and Climate Variability. We will introduce Giovanni and examples of using it in meteorological research and applications.

1. NASA Goddard Earth Sciences (GES) Data and Information Services Center (DISC)

The Goddard Earth Sciences Data and Information Services Center (GES DISC) is one of the 12 **NASA Distributed Active Archive Centers (DAACs)** that manages, archives and distributes data as part of NASA's Earth Observation Systems Data and Information System (EOSDIS). We provide the support for the **archive and distribution** of the data from a range of **satellite observations, models, ground measurements, and field campaigns**.

- Archives total volume > **7.4 Petabytes** consisting of ~**250 million data files** covering >**3000 public and restricted collections**.
- Multi-disciplinary data holdings include observations and model data of:
  - **atmospheric composition**
  - **weather, water/energy cycles**
  - **carbon cycle, climate variability**
- Through various available tools and services, the GES DISC provides users with **multi-sensor and model visual comparisons** and data access for a number of **projects spanning several disciplines**.



12 NASA Distributed Active Archive Centers (DAACs) in the United States (https://www.earthdata.nasa.gov/centers)

Data Services and Tools:
- Dataset and information search
- Subsetting (spatial and parameter)
- Format conversion (netCDF, ASCII)
- Time series (Data Rods)
- Machine to machine (OPeNDAP, https, THREDDS, GDS)
- GIS support (in-house GIS specialists)
- Online visualization and analysis (explore and evaluate datasets without downloading software and data) – Giovanni

User Services:
- FAQs, How-Tos (recipes), Glossary, etc.
- Social media (YouTube, User Forum)
- Help desk (phone, email, online feedback)
- Training materials (ARSET => Applied Remote Sensing Training)

Learning Resources:
- Studying seasonality
- Studying extreme events: floods, flash floods, heat waves, droughts
- Data recipes (How-Tos)

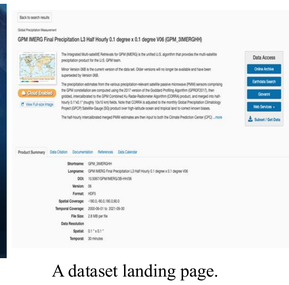
Information:
- Data information and services: https://disc.gsfc.nasa.gov/ Search for: TRMM (GPM, TRMM, IMERG, NLDAS, GLDAS, FLDAS, MERRA)
- Giovanni: https://giovanni.gsfc.nasa.gov or Google search "NASA giovanni" Search for "GPM", "NLDAS", "MERRA", "GLDAS", "FLDAS"
- NASA Applied Remote Sensing Training (**ARSET**): https://appliedsciences.nasa.gov/what-we-do/capacity-building/arset
- Cloud migration: https://disc.gsfc.nasa.gov/information/documents?title=Migrating%20to%20the%20Cloud
- Comments and suggestions: gsfc-dl-help-disc@mail.nasa.gov



The GES DISC portal: https://disc.gsfc.nasa.gov



Data and information access from the GES DISC portal.



A dataset landing page.

The GES DISC Migration to the Cloud is Happening Now:
GES DISC is moving its data archive to the cloud! In compliance with NASA's open science policy, all GES DISC data and services continue to be **free** to all users.

An information page is available to provide resources intended to guide users in understanding, discovering, accessing, and using GES DISC data and services residing in the Earthdata Cloud. You can find information on the latest status of data and services in the cloud, step-by-step guidance on accessing datasets from the Earthdata Cloud through tutorials listed in the How-To section, and questions related to accessing data and services in the cloud in the FAQ section.

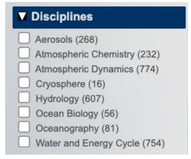
2. Global Meteorological Datasets at GES DISC

- **Global Precipitation Measurement (GPM) mission and Global Precipitation Climatology Project (GPCP)**
  - Integrated Multi-satellite Retrievals for Global Precipitation Measurement (GPM) (IMERG) (global, half-hourly, daily and monthly, 0.1 deg., 1998 – present, latencies: Early – 4 hours, Late – 12 hours, and Final - 3-months)
  - GPCP precipitation (global, daily, monthly, 0.25 deg. 1983 - 2024)
- **Land data assimilation systems** (NLDAS (hourly and monthly, 0.125 deg., 1979-present), GLDAS (3-hourly and monthly, 0.25 deg. 1948-2014, 2000-present), FLDAS (daily and monthly, 0.01 deg. (daily) and 0.1 deg. (monthly), 2000-present)
  - Soil moisture, ET, LAI, Runoff
  - Soil temperature, air temperature
  - Precipitation (total, liquid, frozen, SWE)
  - Solar Radiation, wind
- **Modern-Era Retrospective analysis for Research and Applications version 2 (MERRA-2)** (global, hourly and monthly, 0.5 x 0.625 deg. 1980-present)
  - Soil moisture, evaporation, surface skin temperature, air temperature, precipitation, solar radiation, wind, runoff, etc.

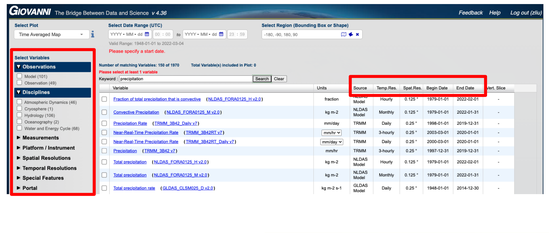
Additional resources (datasets/tools/limitations): NASA Earthdata (https://www.earthdata.nasa.gov/)

3. Explore, Compare, and Evaluate Global Meteorological Datasets with Giovanni

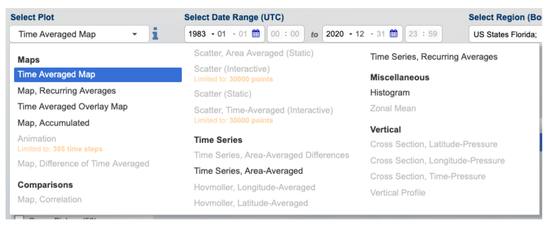
The Geospatial Interactive Online Visualization ANd aNalysis Infrastructure (Giovanni) provides the means to perform 22 visualizations on ~2000 variables from six different DAACs. With Giovanni's assistance, researchers around the world have published more than 3,000 peer-reviewed papers in a wide range of Earth science disciplines and other areas.



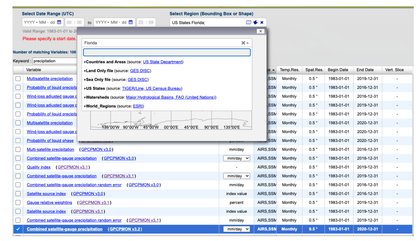
Select variables in different disciplines.



Facets and sorting to filter out unwanted variables.



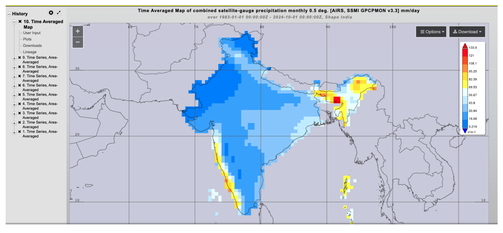
22 visualizations allow users to explore, compare and evaluate similar variables from different sources (e.g., remote sensing, modeling).



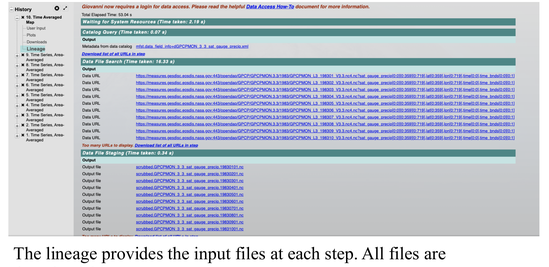
Different shapes (e.g., countries, watersheds, land/sea masks).



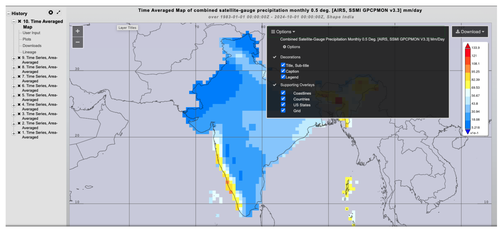
An example to plot the average map of the Global Precipitation Climatology Project (GPCP) monthly precipitation variable in India.



The output map shows that the GPCP precipitation is unevenly distributed in India.



The lineage provides the input files at each step. All files are downloadable.



Map customization (e.g., title, caption, legend, color bar).



Download files in different formats (e.g., NetCDF, PNG).