# Online Visualization and Analysis of NASA Satellite-Based Global and Regional Precipitation Products through Giovanni

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

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## Abstract

Observational data are essential for Earth science research and applications. Traditional ground-based observations suffer from many limitations (e.g. costly deployment). As a result, data are often sparse and inconsistent, especially over vast oceans that cover nearly 71% of the Earth's surface, and for remote continents.

Precipitation is one of the important physical parameters in the global hydrological cycle and other disciplines. Each year, severe floods and droughts happen in different parts of the world and cause significant damage to the economy, as well as human casualties (e.g. Hurricane Katrina, the Dust Bowl). Accurate and timely precipitation observations and predictions are important for research and applications. However, ground-based precipitation observations are quite limited, especially in remote and mountainous regions. Since the satellite era began, satellite-based precipitation products have gained popularity in Earth science research, applications, and education.

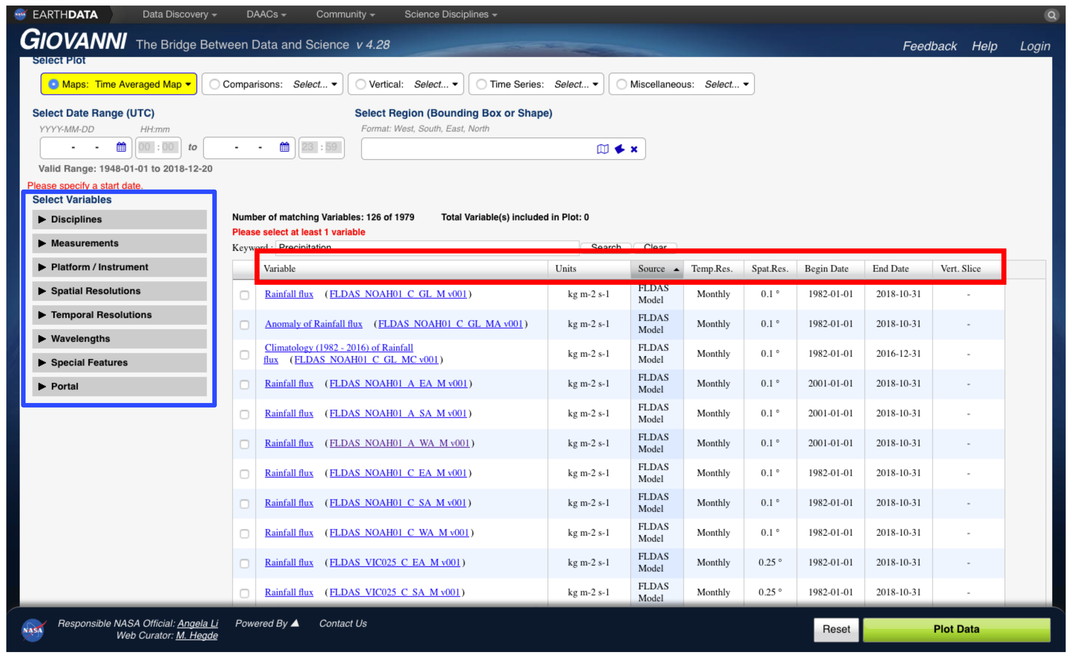
Accessing satellite products can be a daunting task to many users, especially those who do not have prior experience or knowledge with satellite data. Recognizing this obstacle, the NASA Goddard Earth Sciences and Data and Information Services Center (GES DISC), home to data archives for the NASA-JAXA Tropical Rainfall Measuring Mission (TRMM) and Global Precipitation Measurement (GPM), has developed data services including an online visualization and analysis tool, Giovanni (the Geospatial Interactive Online Visualization ANd aNalysis Infrastructure), enabling users at different levels to access, explore, and evaluate NASA satellite-based data products without downloading either data and software, or requiring coding.

Currently, global and regional precipitation products from different satellite missions (TRMM, GPM) and projects (e.g. the Modern Era Retrospective-analysis for Research and Applications Version 2 (MERRA-2), and the North American Land Data Assimilation System (NLDAS)), ranging from half-hourly to monthly temporal resolution, are available in Giovanni.

There are over 1900 variables in Giovanni, covering measurements in precipitation, hydrology, atmospheric dynamics, atmospheric chemistry, etc. In this poster presentation, we will provide a live demonstration of Giovanni and its latest development, including precipitation-related variables, and new basic features such as polar projections. The session will also provide a Q&A opportunity for attendees.

***Giovanni***

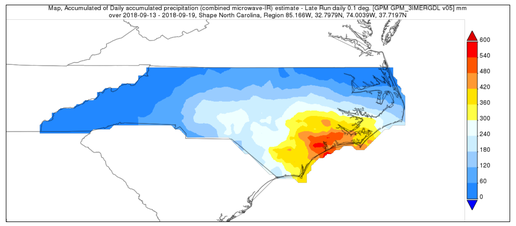
(https://giovanni.gsfc.nasa.gov/)




***Above***: The landing page of Giovanni (the Geospatial Interactive Online Visualization ANd aNalysis Infrastructure), developed by the NASA GES DISC, provides online data analysis and visualization for over 1900 variables including global and regional satellite-based precipitation variables.

*Red box at left:* To help locate a variable of interest, Giovanni provides different options. Search results can be sorted by variable names, units, source, temporal resolution, spatial resolution, begin date, end date, and vertical slice (if available).

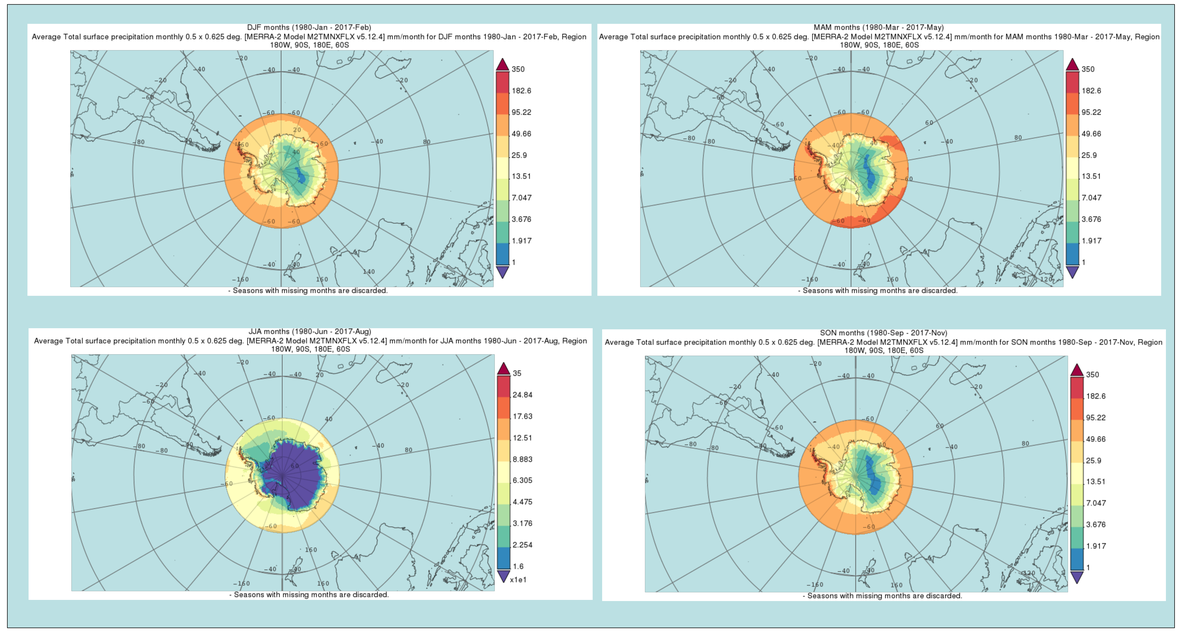
*Blue box at left:* One can also sort variables based on disciplines, measurements, or platform/instrument (e.g. TRMM, GPM, MERRA-2, NLDAS), etc.




Map of accumulated (September 13–19, 2018) IMERG-Late rainfall data product (in mm) for North Carolina, with extreme values due to Hurricane Florence.

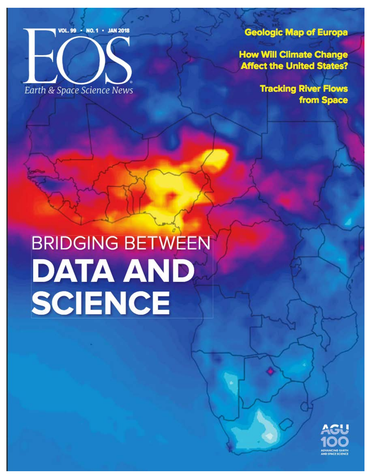
## *Giovanni Update:*

- Polar projections (North and South) are now available.
- Earthdata login is required for downloading data.
- The User-Defined Climatology / Quasi-Climatology map has been renamed "Monthly and Seasonal Averages".
- GeoTIFF downloads contain real data.
- Giovanni handles granules which have neither a time dimension or time information embedded in the global attributes.
- Vector plots have been restored.
- New features were added in most plot options.
- Both search and overall performance have been improved.




Seasonal averages (1980–2017, in mm/month) of MERRA-2 surface total precipitation (*prectot*) over the Antarctic: DJF (top left), MAM (top right), JJA (bottom left), and SON (bottom right).

## *Further Reading about Giovanni*



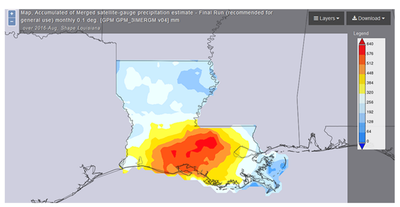




Fig. 4. Accumulated rainfall (millimeters) from GPM Integrated Multisatellite Retrievals (IMERG) Final Run (version 4), showing a record-breaking flood event in Louisiana in August 2016. Credit: Giovanni

Cross sections, applicable to 3-D data sets from NASA's Atmospheric Infrared Sounder (AIRS) instrument and Modern-Era Retrospective Analysis for Research and Applications (MERRA) data analysis program, include latitude–pressure, longitude–pressure, time–pressure (Figure 6), and vertical profile.

For data comparison, Giovanni has built-in processing code for data sets that require measurement unit conversion and regridding. Commonly used comparison functions include map and time series differences, as well as correlation maps and *X*–*Y* scatterplots (area averaged or time averaged). Zonal means and histogram distributions can also be plotted.

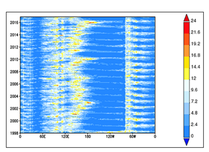


Fig. 5. Hovmöller diagram of TMPA monthly precipitation (millimeters per day) in the tropical region (5°S–5°N) showing El Niño–Southern Oscillation events between 1998 and 2016. Credit: Giovanni

An article describing Giovanni was featured on the cover of AGU *Eos* (January 2018 issue). This article included IMERG (the Integrated Multi-satellitE Retrievals for GPM) data examples.

**Precipitation products:** https://disc.gsfc.nasa.gov/datasets?keywords=precipitation **Giovanni:** https://giovanni.gsfc.nasa.gov/ **GES DISC:** https://disc.gsfc.nasa.gov ***Suggestions or subscription to our mailing list:*** gsfc-help-disc@lists.nasa.gov