

NASA Giovanni: analyze, compare, and visualize 2000+ Earth satellite and model variables without downloading data and software



2024 AGU Fall Meeting

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

ABSTRACT

Over vast oceans and remote continents, observations are often scarce and discontinuous. Satellite and model data play a critical role in research and applications. However, finding and accessing satellite and model data can be a daunting task for many, especially those outside the community.

The NASA Goddard Earth Sciences (GES) Data and Information Services Center (DISC), one of 12 NASA Science Mission Directorate Data Centers, provides Earth science data, information, and services to everyone such as researchers, application users, educators, and students. GES DISC archives and supports datasets applicable to several NASA Earth Science Focus Areas including Atmospheric Composition, Water & Energy Cycles, Carbon Cycle & Ecosystem, and Climate Variability.

To facilitate data discovery, evaluation, and exploration, GES DISC has developed the Geospatial Interactive Online Visualization ANd Analysis Infrastructure (**Giovanni**), an online tool to analyze and visualize NASA remote sensing and model data without downloading data and software. As of this writing, over 2000 Earth satellite and model variables are available in Giovanni, including several well-known NASA satellite missions (e.g., TRMM, GPM) and projects (e.g., MERRA-2, GPCP). Giovanni provides twenty-two plots that can be used to analyze, compare, and explore Earth data across different disciplines. Results can be shared with colleagues and downloaded for further analysis. Over the years, Giovanni has helped publish over 3000 referral papers.

In this presentation, we will showcase key variables and plot types in Giovanni with examples. In particular, we will present several popular precipitation products from GPM and CPCP for evaluation and comparison.

Giovanni landing page: <https://giovanni.gsfc.nasa.gov>

Login Earthdata: <https://urs.earthdata.nasa.gov/>



Giovanni The Bridge Between Data and Science v 4.4.0

High values in IMERG Early and Late in October 2024 ... [1 of 1 messages] Read More

Select Plot: Time Averaged Map

Select Date Range (UTC): YYYY - MM - dd 00 : 00 to YYYY - MM - dd 23 : 59

Select Region (Bounding Box or Shape): -180, -90, 180, 90

Select Variables: Observations (15), Disciplines (15)

Variable	Units	Source	Temp. Res.	Spat. Res.	Begin Date	End Date
Multi-satellite precipitation estimate with climatological gauge calibration - Early Run (GPM_3IMERGHE_v07)	mm/hr	GPM	Half-Hourly	0.1°	2000-06-01	2024-11-14
Multi-satellite precipitation estimate with climatological gauge calibration - Late Run (GPM_3IMERGHL_v07)	mm/hr	GPM	Half-Hourly	0.1°	2000-06-01	2024-11-14
Random Error for multi-satellite precipitation with climatological gauge calibration - Early Run (GPM_3IMERGHE_v07)	mm/hr	GPM	Half-Hourly	0.1°	2000-06-01	2024-11-14
Probability of liquid phase - Final Run (GPM_3IMERGHH_v07)	percent	GPM	Half-Hourly	0.1°	2000-06-01	2024-06-30
Random Error for multi-satellite precipitation with climatological gauge calibration - Late Run (GPM_3IMERGHL_v07)	mm/hr	GPM	Half-Hourly	0.1°	2000-06-01	2024-11-14
Quality Index for precipitation field - Final Run (GPM_3IMERGHH_v07)	index	GPM	Half-Hourly	0.1°	2000-06-01	2024-06-30
Random error for gauge-calibrated multi-satellite precipitation - Final Run (GPM_3IMERGHH_v07)	mm/hr	GPM	Half-Hourly	0.1°	2000-06-01	2024-06-30
Multi-satellite precipitation estimate with gauge calibration - Final Run (recommended for general use) (GPM_3IMERGHH_v07)	mm/hr	GPM	Half-Hourly	0.1°	2000-06-01	2024-06-30
Daily mean precipitation rate (combined microwave-IR estimate - Early Run (GPM_3IMERGDE_v07)	mm/day	GPM	Daily	0.1°	2000-06-01	2024-11-13
Daily mean precipitation rate (combined microwave-IR estimate - Late Run (GPM_3IMERGDL_v07)	mm/day	GPM	Daily	0.1°	2000-06-01	2024-11-12

Above: The Giovanni landing page. A parameter/variable-based search interface with suggestions (see below) greatly facilitates data discovery. Information (e.g., source, temporal and spatial resolution, beginning and end dates) about each variable is listed. Twenty-two plot types are available for data analysis and visualization. Different shapes are available for U.S. states, countries, land only, sea only, watersheds and world regions. Input and output data can be downloaded for further analysis using other tools (e.g., Microsoft Excel, Panoply). In short, Giovanni simplifies access to Level-3 and Level-4 variables for several popular NASA missions or projects (e.g., GPM, MERRA-2).

Variable Selection:

Select Variables: Observations (15), Disciplines (15)

Number of matching Variables: 8 of 2064

Keyword: IMERG

- Observations (15)
- Disciplines (15)
- Measurements
- Platform / Instrument
- Spatial Resolutions
- Temporal Resolutions
- Wavelengths
- Depths
- Special Features
- Portal

Giovanni Plot Types:

Select Plot: Time Averaged Map

Select Date Range (UTC): YYYY - MM - dd 00 : 00 to YYYY - MM - dd 23 : 59

Select Region (Bounding Box or Shape): -180, -90, 180, 90

Maps: Time Averaged Map, Recurring Averages, Time-Averaged Overlay Map, Accumulated, Animation

Time Series: Time Series, Area-Averaged Differences, Time Series, Area-Averaged, Homomiles, Longitude-Averaged, Cross Section, Time-Pressure, Vertical Profile

Comparisons: Map, Correlation

There are **twenty-two plots** (right) in Giovanni. Time-averaged Map and Area-averaged Time Series are the two most frequently used plots. Several plots are available to facilitate comparisons of two different precipitation variables:

- Map, Difference of Time Averaged
- Map, Correlation
- Scatter, Area Averaged (Static)
- Scatter (Interactive)
- Scatter, Time-Averaged (Interactive)
- Time Series, Area-Averaged Difference

Global and Regional Precipitation Products in Giovanni

Most Level-3 gridded precipitation data variables (e.g., IMERG, GPCP) in this presentation are available in Giovanni, along with variables from other satellite missions or projects (e.g., MERRA-2, NLDAS). IMERG Version 07 data are available.

Finding a precipitation variable is easy. The Giovanni search box provides a list of suggestions for you to choose from. For example, if you simply type in “IMERG V07,” you will have major variables of IMERG V07, including those of IMERG Early, Late, and Final.

Giovanni allows you to sort variables based on variable, units, source, temporal resolution, spatial resolution, begin date, and end date. Giovanni provides the definition of each variable and its dataset landing page that contains all related information, including data access, data DOI, ATBD, and references.

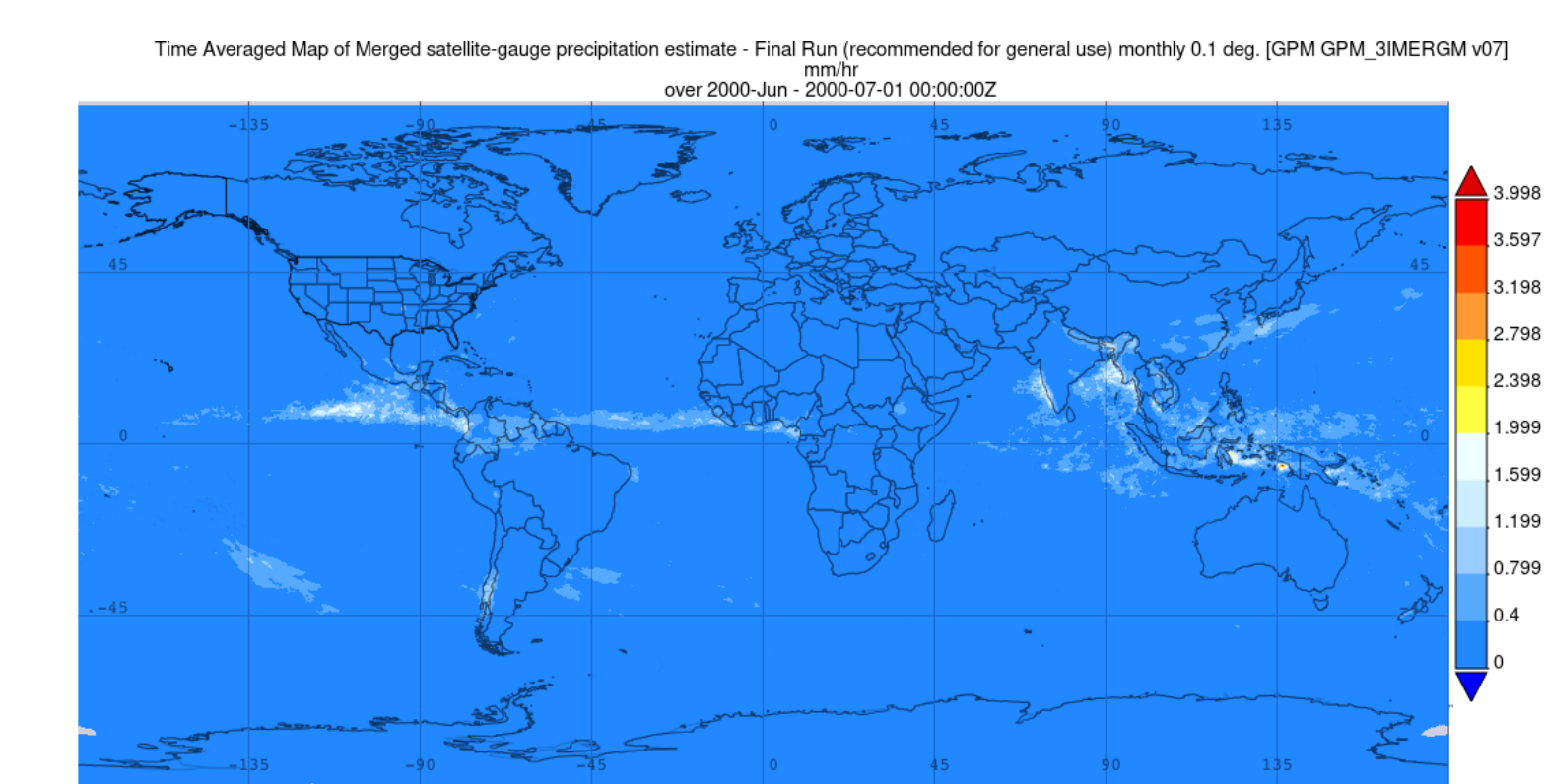
Shapefiles (right) are available:

- Countries and Areas
- Lakes and Reservoirs
- Land Only file
- Sea Only file
- U.S. States
- Watersheds
- World Regions

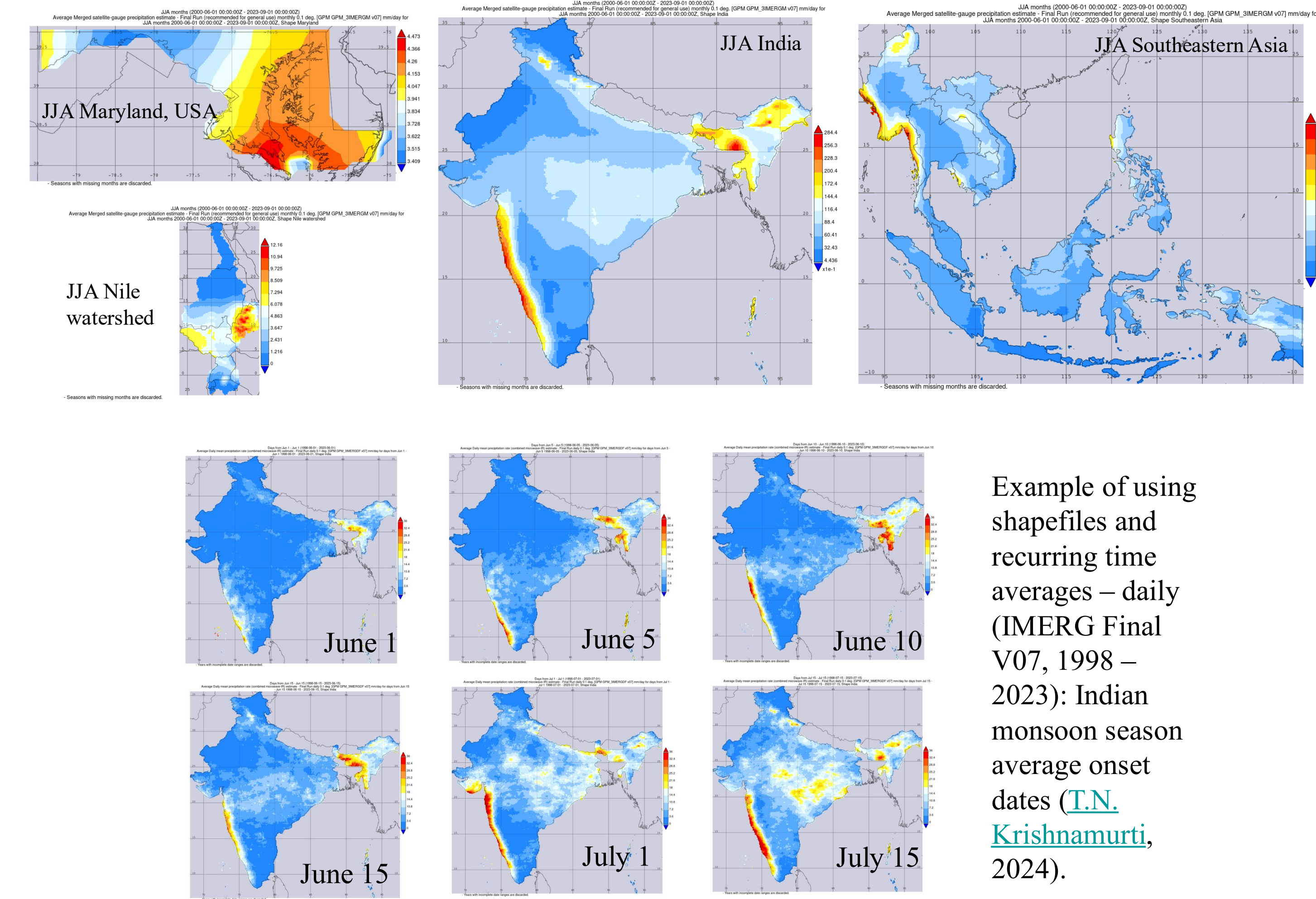
Select a Shapefile:

- Countries and Areas (source: US State Department)
- Lakes and Reservoirs (source: World Wildlife Fund)
- Land Only file (source: GES DISC)
- Sea Only file (source: GES DISC)
- US States (source: USGS/Link, US Census Bureau)
- Watersheds (source: Macro-Geographical Basins, FAO, United Nations)
- World Regions (source: ESRI)

A list of IMERG Early, Late, and Final V07 data variables.



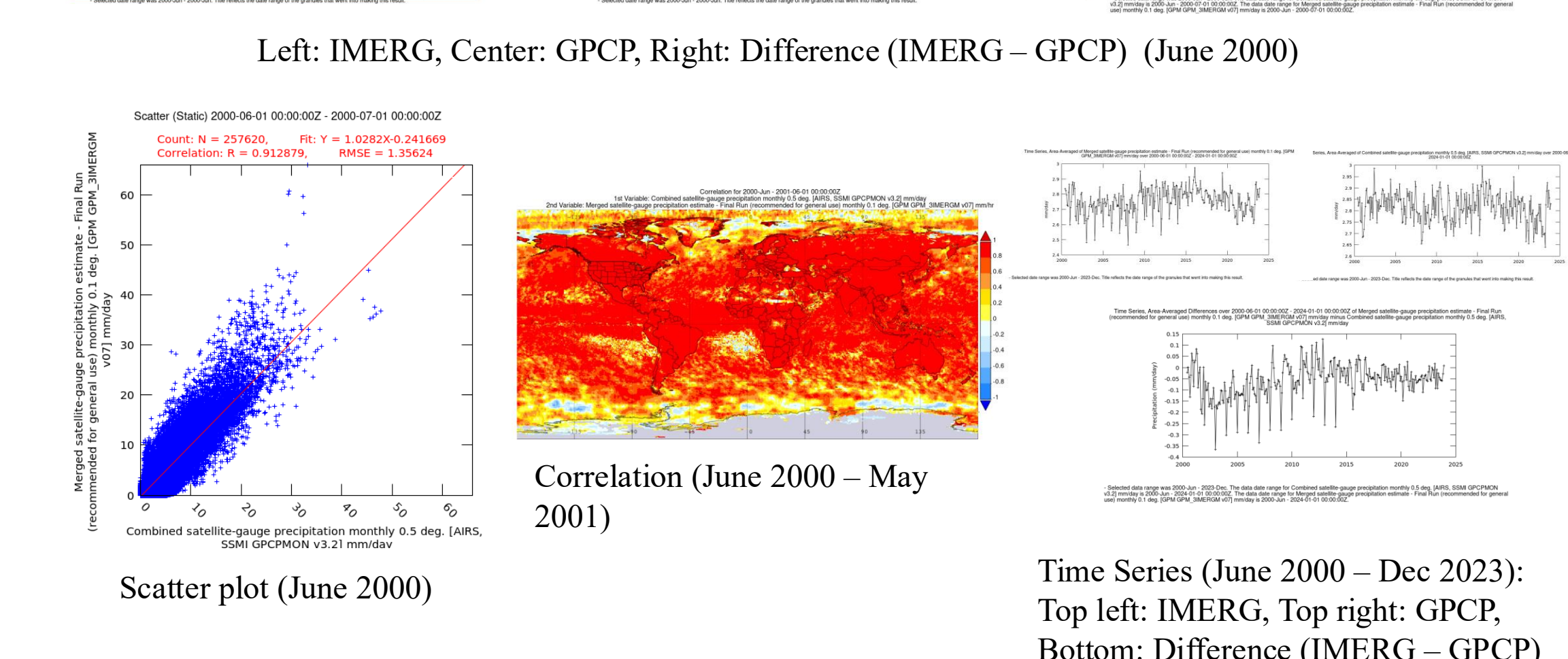
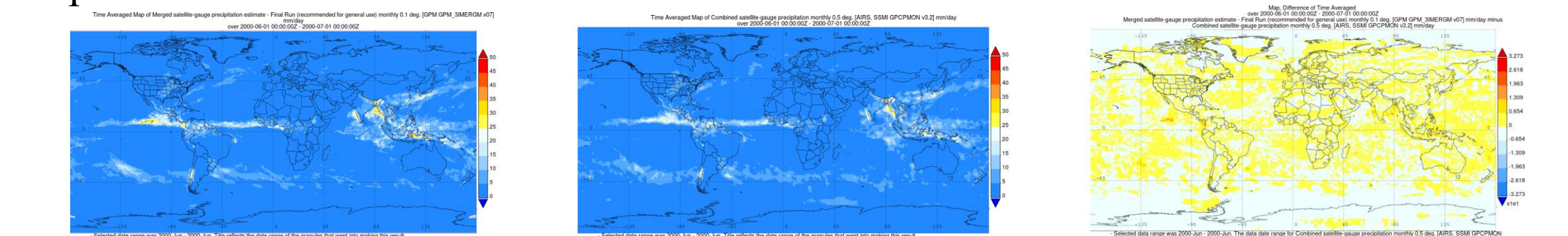
Samples (IMERG Final V07 monthly (2000 – 2024))



Example of using shapefiles and recurring time averages – daily (IMERG Final V07, 1998 – 2023); Indian monsoon season average onset dates (T.N. Krishnamurti, 2024).

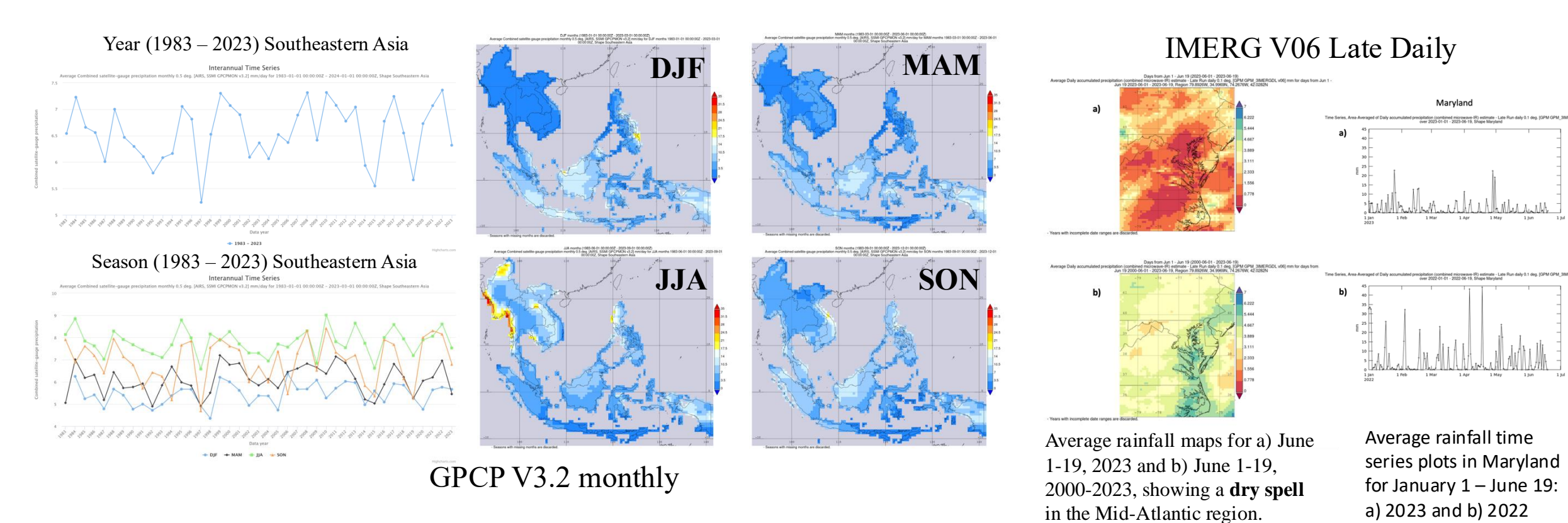
Product Comparison

One can use Giovanni to compare two products. In this example, we use two monthly products: GPCP V3.2 and IMERG Final Run V07.



Climatology

Climatology-like maps and time series are available: day, month, season, and year.



Supporting NASA’s Earth System Observatory (ESO)

Addressing, Mitigating Climate Change

NASA will design a new set of Earth-focused missions to provide key information to guide efforts related to climate change, natural hazard mitigation, fighting forest fires, and improving real-time agricultural processes. Each uniquely designed satellite in the **Earth System Observatory** will complement the others, working in tandem to create a 3D, holistic view of Earth, from bedrock to atmosphere.

Areas of focus for core of the observatory include (precipitation related):

- Aerosols:** Answering the critical question of how aerosols affect the global energy balance, a key source of uncertainty in predicting climate change.
- Cloud, Convection, and Precipitation:** Tackling the largest sources of uncertainty in future projections of climate change, air quality forecasting, and prediction of severe weather.

Proposed New Services to Support ESO

New, enterprise-level data services need to be developed for supporting ESO.

- Co-incident data search and visualization services (e.g., TRMM-GPM matchup) for satellites, in-situ instruments, and model data, which is imperative for a wide range of research activities such as case studies, algorithm development, product validation.
- Co-location data services (e.g., same grids, projections) to enable direct comparison of data products in different spatial and temporal resolutions.
- Improving other data search capabilities (e.g., parameter, criteria, and shapefile-based data search).
- Improving data services (e.g., criteria and shapefile-based subsetting, customized data products or analysis-ready data (ARD)).
- Improving data visualization capabilities (e.g., more data products, integrated visualizations from different sources from satellites, in-situ observations, and model data.
- Enabling data integration and AI/ML (e.g., the FAIR compliance).

Suggestions or subscription to our mailing list: gsfc-dl-help-disc@mail.nasa.gov



Areas of focus for ESO



ESO mission data will be openly available, cloud-based, and designed for collaborative research.