



Resources at GES DISC for Agriculture Studies

Jennifer Wei, Zhong Liu, Ashley Heath, Chris Battisto*,
Binita KC**

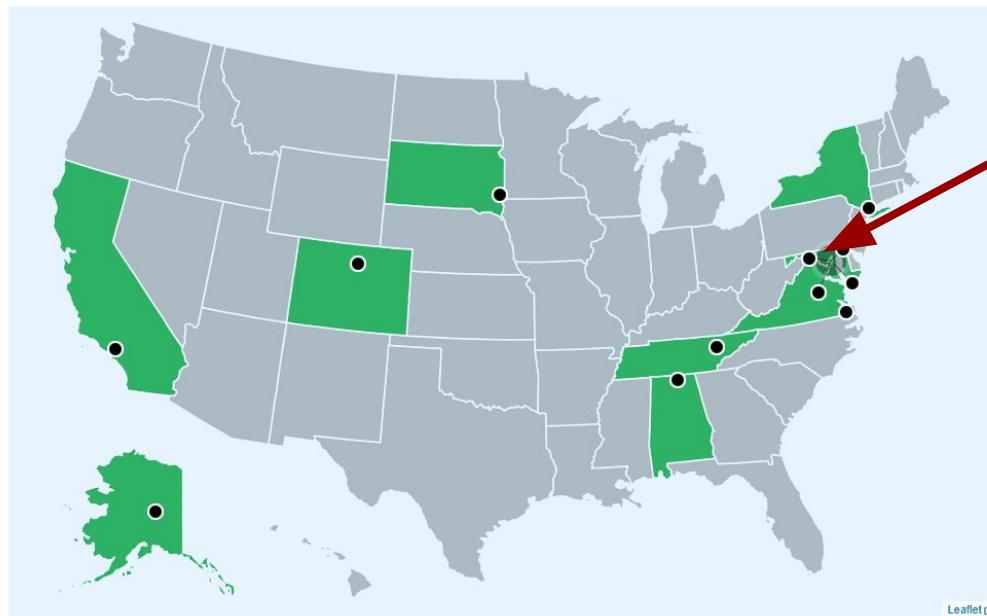


Outline

- Introduction to GES DISC (Distributed Active Archive Center- DAAC)
 - Data Holding for Agriculture study
- Resources for Agricultural studies at GES DISC
 - Data Access
 - Data Services and Tools
 - Learning resources :
 - Studying seasonality
 - Studying extreme events: Floods, Flash Floods, Heat Waves, Drought
 - Data Recipe (How-To)
- Demo and hands-on



12 NASA Distributed Active Archive Centers (DAACs)



GODDARD EARTH SCIENCES DATA AND INFORMATION SERVICES CENTER (GES DISC)

Greenbelt, MD

Atmospheric composition,
atmospheric dynamics, global
precipitation, solar irradiance



The GES DISC in a nutshell

- **Who we are**
 - GES DISC (Goddard Earth Sciences (GES) Data and Information Services Center (DISC))
 - Data are free and open to public
 - Data and Services adhere to FAIR (Findability, Accessibility, Interoperability, Reusability) data principles
- **What we do - the Bridge between Data and Science**
 - Core DAAC function and value-added services
 - Data Publication Support
- **GES DISC's value-added services**
 - Web search service
 - Level 2 Subsetter
 - Level 3/4 Regridder & Subsetter
 - Giovanni activities



The GES DISC: Who We Are

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 > **3.4 Petabytes** consisting of >**150 million data files** covering >**3000 public and restricted collections**.
- Multi-disciplinary data holdings include observations and model data of:
 - **atmospheric composition**
 - **water/energy cycles**
 - **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**.

<https://disc.gsfc.nasa.gov>



The screenshot shows the GES DISC homepage with a background image of Earth. At the top, there's a search bar and links for Feedback, Help, and Login. Below the header, the "GES DISC" logo is displayed, followed by the tagline "Atmospheric Composition, Water & Energy Cycles and Climate Variability". A central search bar has "Explore..." and "Data Collections" dropdowns, along with a search input and a magnifying glass icon. To the left, a sidebar displays statistics: Archive Size: 2,180.934 TB, Archived Data Files: 115,269,146, Files Distributed*: 2,343,875,582, and Data Volume Distributed*: 22,242.420 TB. The main content area features sections for "Projects & Missions" (Cloud Absorption Radiometer (CAR), MEASUREs, SSBUV), "Featured Gallery Images" (a map of North America showing rainfall patterns), and "News" (articles about Hurricane Florence, Copernicus Sentinel-5P TROPOMI, and GPS Radio Occultation Boundary Layer Depth Products). The footer contains links for NASA Official, Science Focus Areas, Tools, Resources, and About Us.



GES DISC data holdings (<https://disc.gsfc.nasa.gov/datasets>)

1800+ data collections being curated

Atmospheric composition missions:

- Nimbus 1-7* BUV, SBUV, TOMS
- Shuttle SBUV*
- UARS*
- Aqua AIRS
- Aura HIRDLS*, OMI, MLS
- ACOS*
- SNPP Sounder, OMPS
- JPSS-1 Sounder, OMPS
- OCO-2/3
- Copernicus Sentinel 5P
- TOVS Pathfinder*

Water cycle/precipitation missions:

- TRMM*
- GPM
- SMERGE
- TROPICS

* end-of-mission/project

Climate variability/solar missions:

- SORCE
- TCTE
- TSIS
- CAR

Model data:

- MERRA*/MERRA-2
- NLDAS, GLDAS, FLDAS, NCA-LDAS

Research-derived data:

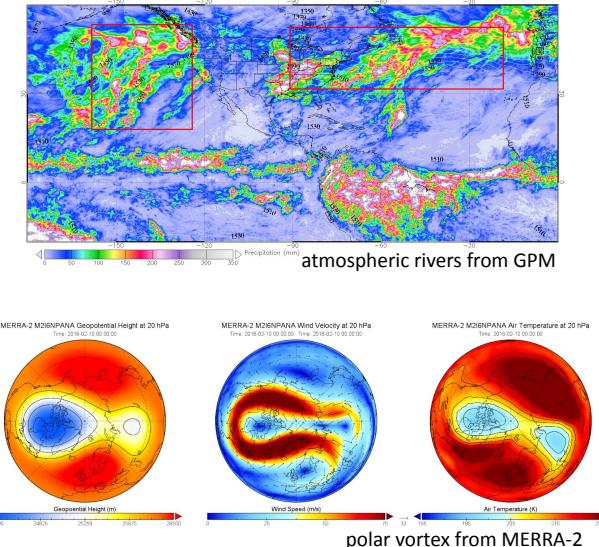
- MEASUREs
- Carbon Monitoring System

Near-real time:

- AIRS
- MLS

Recent/future assigned missions:

- GeoCarb
- JPSS-2





Agriculture related 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. 2000-present)
 - GPCP precipitation (global, daily, monthly, 0.25 deg. 1983 - 2020)
- 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 Data Pathfinders - [Agriculture and Water Resources Data Pathfinder](#)



Resources for agricultural studies at GES DISC

- Data and information access
- Data services and tools
- Learning resources:
 - Studying seasonality
 - Studying extreme events: floods, flash floods, heat waves, droughts
 - Data recipes (How-To)



Data and information access: GES DISC Portal (<https://disc.gsfc.nasa.gov>)

GES DISC
Atmospheric Composition, Water & Energy Cycles and Climate Variability

Explore... Data Collections Enter search (e.g., rainfall, GPM, TRMM_3B42) Feedback Cloud Migration Help ▾ Login My Dashboard

The GES DISC migration to the cloud is happening now. [Learn more about it!](#)

Archive Size: 3,370.369 TB
Archived Data Files: 149,675,662
Files Distributed*: 3,195,849,061

Projects & Missions

LPRM
The LPRM Level 2 (swath) and LPRM Level 3 (gridded) data products contain land surface parameters, surface soil moisture, land surface (skin...)

MeaSURES
MeaSURES: Making Earth System Data Records for Use in Research Environments, is a NASA project, solicited through Research Opportunities in ...

MERRA
The Modern-Era Retrospective analysis for Research and Applications (MERRA) is a NASA atmospheric reanalysis for the satellite era using the...

[View All Projects & Missions ...](#)

Featured Gallery Images
2018-25-05 : GPM_3IMERG-GDOL -120 -90C [View All Gallery Images...](#)

News

Look, up in the sky! It's the QBO! Data in Action, Oct 7, 2022

September/2022 global surface air temperatures and precipitation News, Oct 2, 2022

GMI Level 1B Radiance Products Collection 4 (v4.01) Public Release Data Release, Sep 20, 2022 [View All News ...](#)

Science Focus Areas
Atmospheric Composition
Water & Energy Cycles
Climate Variability

Tools
Giovanni
GIS 2
Data Rods for Hydrology
DOViz
AIRS/NRT Viewer
OGC Web Map Service

News
General
Data Release
Service Release Alerts

Resources
Earthdata Forum ▾
HowTo
Data in Action
Publications
Glossary
FAQ

About Us
Who We Are
Getting Our Data
Contact Us
User Working Group



Data and information access: GES DISC Portal (cont.)

EARTHDATA Find a DAAC ▾

GES DISC ⚠ 4 Feedback Cloud Migration Help ▾

Atmospheric Composition, Water & Energy Cycles and Climate Variability

Explore... 🔍

Data Collections Enter search (e.g., rainfall, GPM, TRMM_3B42) 📅 🗺

Browse Data by Category Visualize Data ↗ Access GIS ↗

The GES DISC migration to the cloud is happening now. [Learn more about it!](#)



Data and information access: GES DISC Portal (cont.)

Projects & Missions

LPRM

The LPRM Level 2 (swath) and LPRM Level 3 (gridded) data products contain land surface parameters, surface soil moisture, land surface (skin...

MEaSUREs

MEaSUREs: Making Earth System Data Records for Use in Research Environments, is a NASA project, solicited through Research Opportunities in ...

MERRA

The Modern-Era Retrospective analysis for Research and Applications (MERRA) is a NASA atmospheric reanalysis for the satellite era using the...

[View All Projects & Missions ...](#)

Featured Gallery Images



[View All Gallery Images ...](#)

News



Look, up in the sky! It's the QBO!
Data in Action, Oct 7, 2022



September/2022 global surface air temperatures and precipitation
News, Oct 2, 2022



OMI Level 1B Radiance Products Collection 4 (v4.01) Public Release
Data Release, Sep 20, 2022

[View All News ...](#)

Science Focus Areas

Atmospheric Composition
Water & Energy Cycles
Climate Variability

Tools

Giovanni
GIS ↗
Data Rods for Hydrology
DQViz
AIRS NRT Viewer
OGC Web Map Service
OPeNDAP and GDS

News

General
Data Release
Service Release
Alerts

Resources

Earthdata Forum ↗
HowTo
Data in Action
Publications
Glossary
FAQ
Gallery

About Us

Who We Are
Citing Our Data
Contact Us
User Working Group





Data and information access: GES DISC Portal (cont.)

The screenshot shows the GES DISC Portal homepage. At the top, there is a search bar with placeholder text "Enter search (e.g., rainfall, GPM, TRMM_3B42)" and a magnifying glass icon. To the right of the search bar are three small icons: a calendar, a map, and a search icon. Below the search bar, the word "Explore..." is displayed in large white letters. On the left side, a sidebar menu is open, showing various options under the heading "Data Collections". The options listed are: Data Documentation, Alerts, Data in Action, Data Release, FAQs, Glossary, How-To's, Image Gallery, News, Publications, Service Release, and Tools. The "Data Collections" option is currently selected, indicated by a blue background and a white icon. To the right of the sidebar, there is a callout box with two buttons: "Visualize Data" and "Access GIS". Below these buttons, a message reads: "Moving data from the archive to the cloud is happening now. Learn more about it!".



Data and information access: GES DISC Portal (cont.)

Explore...

Data Collections Enter search (e.g., rainfall, GPM, TRMM_3B42)

Browse Data by Category Visualize Data Access GIS

Features	Aerosols	Ionosphere/Magnetosphere	Sea Ice
Subject	Air Quality	Dynamics	Sea Surface Topography
Measurement	Altitude	Land Surface/Agriculture	Sensor Characteristics
Source	Atmospheric Chemistry	Indicators	Snow/Ice
Processing Level	Atmospheric Pressure	Land Use/Land Cover	Soils
Project	Atmospheric Radiation	Microwave	Solar Activity
Temporal Resolution	Atmospheric Temperature	Natural Hazards	Solar Energetic Particle Flux
Spatial Resolution	Atmospheric Water Vapor	Ocean Chemistry	Solar Energetic Particle Properties
	Atmospheric Winds	Ocean Heat Budget	Sun-Earth Interactions
	Atmospheric/Ocean Indicators	Ocean Optics	Surface Radiative Properties
	Clouds	Ocean Pressure	Surface Thermal Properties
	Ecological Dynamics	Ocean Temperature	Surface Water
	Ecosystems	Ocean Winds	Tectonics
	Frozen Ground	Paleoclimate Indicators	Topography
	Glaciers/Ice Sheets	Platform Characteristics	Ultraviolet Wavelengths
	Ground Water	Precipitation	Vegetation
	Infrared Wavelengths	Protists	Visible Wavelengths
		Public Health	
		Radar	

GESDISC



Data and information access: GES DISC Portal (cont.)

The screenshot shows the GES DISC Data Collections interface. At the top, there's a navigation bar with links for 'Data Collections' (selected), 'Feedback', 'Cloud Migration', 'Help', 'Login', and 'My Dashboard'. Below the navigation is a search bar with the query 'gpm'. A sidebar on the left contains filters for 'Features', 'Subject', 'Measurement', 'Source', 'Processing Level', 'Project', and 'Temporal Resolution'. The main content area displays a table of datasets, each with a thumbnail, title, source, version, time resolution, spatial resolution, process level, begin date, and end date. The first dataset listed is 'GPM IMERG Final Precipitation L3 Half Hourly 0.1 degree x 0.1 degree V06 (GPM_3IMERGHH 06)'.



Data Collections

Showing 1 - 25 of 129 datasets associated with **gpm** *

Refine By

Features Sort ▾

Cloud Enabled (4)

Subject Sort ▾

Atmospheric Water Vapor (121)

Microwave (17)

Precipitation (129)

Measurement Sort ▾

Brightness Temperature (17)

Precipitation Amount (7)

Precipitation Rate (7)

Rain (7)

Snow (7)

Source Sort ▾

Aqua AMSR-E (4)

DMSP 5D-2/F10 SSM/I (1)

DMSP 5D-2/F11 SSM/I (4)

DMSP 5D-2/F13 SSM/I (4)

DMSP 5D-2/F14 SSM/I (4)

[More...](#)

Processing Level Sort ▾

1 (22) 3 (73)

2 (33) 4 (1)

Project Sort ▾

GPM (129)

Temporal Resolution Sort ▾

30 minutes (2)

Want to focus your search?

- Add more keywords to your search (e.g., surface precipitation).
- Use the filters in 'Refine By'.

Dataset

Source

Version

Time Res.

Spatial Res.

Process

Level

Begin Date

End Date



GPM IMERG Final Precipitation L3 Half Hourly 0.1 degree x 0.1 degree V06 (GPM_3IMERGHH 06)

[Subset / Get Data](#)

Hover

Models
IMERG

06

30 minutes

0.1 ° x 0.1 °

3

2000-06-01

2021-09-30



GPM IMERG Final Precipitation L3 1 day 0.1 degree x 0.1 degree V06 (GPM_3IMERGDF 06)

[Subset / Get Data](#)

Hover

Models
IMERG

06

1 day

0.1 ° x 0.1 °

3

2000-06-01

2021-09-30



GPM IMERG Final Precipitation L3 1 month 0.1 degree x 0.1 degree V06 (GPM_3IMERGM 06)

[Subset / Get Data](#)

Hover

Models
IMERG

06

1 month

0.1 ° x 0.1 °

3

2000-06-01

2021-09-30



GPM IMERG Late Precipitation L3 1 day 0.1 degree x 0.1 degree V06 (GPM_3IMERGL 06)

[Subset / Get Data](#)

Hover

Models
IMERG

06

1 day

0.1 ° x 0.1 °

3

2000-06-01

2022-10-30

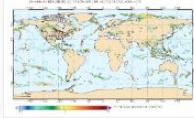


Data and information access: GES DISC Portal (cont.)

[Back to search results](#)

Global Precipitation Measurement

GPM IMERG Final Precipitation L3 Half Hourly 0.1 degree x 0.1 degree V06 (GPM_3IMERGHH)



The Integrated Multi-satellITe Retrievals for GPM (IMERG) is the unified U.S. algorithm that provides the multi-satellite precipitation product for the U.S. GPM team.

Minor Version 06B is the current version of the data set. Older versions will no longer be available and have been superseded by Version 06B.

The precipitation estimates from the various precipitation-relevant satellite passive microwave (PMW) sensors comprising the GPM constellation are computed using the 2017 version of the Goddard Profiling Algorithm (GPROF2017), then gridded, intercalibrated to the GPM Combined Ku Radar-Radiometer Algorithm (CORRA) product, and merged into half-hourly 0.1°x0.1° (roughly 10x10 km) fields. Note that CORRA is adjusted to the monthly Global Precipitation Climatology Project (GPCP) Satellite-Gauge (SG) product over high-latitude ocean and tropical land to correct known biases.

The half-hourly intercalibrated merged PMW estimates are then input to both the Climate Prediction Center (CPC) ...[more](#)

Cloud Enabled

[View Full-size Image](#)

Data Access

[Online Archive](#)

[Earthdata Search](#)

[Giovanni](#)

[Web Services ▾](#)

[Subset / Get Data](#)

[Product Summary](#)

[Data Citation](#)

[Documentation](#)

[References](#)

[Data Calendar](#)

Shortname: GPM_3IMERGHH

Longname: GPM IMERG Final Precipitation L3 Half Hourly 0.1 degree x 0.1 degree V06

DOI: 10.5067/GPM/IMERG/3B-HH/06

Version: 06

Format: HDF5

Spatial Coverage: -180.0,-90.0,180.0,90.0

Temporal Coverage: 2000-06-01 to 2021-09-30

File Size: 2.8 MB per file

Data Resolution

Spatial: 0.1 ° x 0.1 °

Temporal: 30 minutes



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



Giovanni - Data visualization and analysis without downloading data and software (more in demo and hands-on)

GIOVANNI The Bridge Between Data and Science v 4.37

Feedback Help Log out (zliu)

Select Plot
Time Averaged Map

Select Date Range (UTC)
YYYY - MM - dd 00 : 00 to YYYY - MM - dd 23 : 59
Valid Range: 1948-01-01 to 2022-11-01
Please specify a start date.

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

Select Variables
Observations
 Observation (11)

Disciplines
 Hydrology (11)
Measurements
Platform / Instrument
Spatial Resolutions
Temporal Resolutions
Portal

Number of matching Variables: 11 of 2011 Total Variable(s) included in Plot: 0
Please select at least 1 variable

Keyword: imerg

Variable	Units	Source	Temp.Res.	Spat.Res.	Begin Date	End Date
Multi-satellite precipitation estimate with climatological gauge calibration - Early Run (GPM_3IMERGHHE v06)	mm/hr	GPM	Half-Hourly	0.1 °	2000-06-01	2022-11-01
Multi-satellite precipitation estimate with climatological gauge calibration - Late Run (GPM_3IMERGHHL v06)	mm/hr	GPM	Half-Hourly	0.1 °	2000-06-01	2022-10-31
Multi-satellite precipitation estimate with gauge calibration - Final Run (recommended for general use) (GPM_3IMERGH v06)	mm/hr	GPM	Half-Hourly	0.1 °	2000-06-01	2021-09-30
Random Error for multi-satellite precipitation with climatological gauge calibration - Late Run (GPM_3IMERGHL v06)	mm/hr	GPM	Half-Hourly	0.1 °	2000-06-01	2022-10-31
Random error for gauge-calibrated multi-satellite precipitation - Final Run (GPM_3IMERGHH v06)	mm/hr	GPM	Half-Hourly	0.1 °	2000-06-01	2021-09-30
Random Error for multi-satellite precipitation with climatological gauge calibration - Early Run (GPM_3IMERGHHE v06)	mm/hr	GPM	Half-Hourly	0.1 °	2000-06-01	2022-11-01
Daily accumulated precipitation (combined microwave-IR) estimate - Final Run (GPM_3IMERGDF v06)	mm	GPM	Daily	0.1 °	2000-06-01	2021-09-30
Daily accumulated precipitation (combined microwave-IR) estimate - Early Run (GPM_3IMERGDE v06)	mm	GPM	Daily	0.1 °	2000-06-01	2022-10-30
Daily accumulated precipitation (combined microwave-IR) estimate - Late Run (GPM_3IMERGDL v06)	mm	GPM	Daily	0.1 °	2000-06-01	2022-10-30
Merged satellite-gauge precipitation estimate - Final Run (recommended for general use) (GPM_3IMERGM v06)	mm/hr	GPM	Monthly	0.1 °	2000-06-01	2021-09-30
Random error for merged satellite-gauge precipitation - Final Run (GPM_3IMERGM v06)	mm/hr	GPM	Monthly	0.1 °	2000-06-01	2021-09-30

GES
Responsible NASA Official: Angela Li
Web Curator: M. Hegde

Privacy Powered By ▲ Contact Us

Reset Plot Data Go to Results



User services

- FAQs, How-To (recipes), Glossary, etc.
- Social media (Twitter, 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 recipe (How-To)



Studying the Seasonality

Temporal resolution: Interannual, Season, *Monthly, Daily*

Areal coverage: *Regional to continental scale*

Time period: *Annual to decadal*

Data Variables:

Soil moisture, soil temperature, ET, LAI, Precipitation (rainfall, accumulated rainfall), snow depth, snowmelt, runoff, soil moisture, surface temperature, wind, humidity, ground temperature, evaporation

Monthly Data Products	Source	Product Name	Variable name	Resolution	Coverage
	MERRA-2	M2SMNXEDI	Extreme precipitation indices for flood (RX5Day, RX1Day, R99p, R95p, R90p, CWD)	Monthly, 0.625x0.5 deg	1980.01 - global
	MERRA-2	M2TMNXFLX	Total precipitation (PRECTOTCORR)	Monthly, 0.625x0.5 deg	1980.01 - global
	IMERG	GPM_3IMERGM	precipitation, randomError	Monthly, 0.1 deg.	2000.06 - Global
	GPCP	GPCPMON	combined satellite-gauge precipitation, combined satellite-gauge precipitation random error	Monthly, 0.5 deg.	1983.01 - Global
	NLDAS	NLDAS_NOAH0125_M_2.0	Frozen precipitation, Liquid precipitation (rainfall), Surface runoff, Subsurface runoff, Snowmelt, Snow depth, Soil moisture (various depths), Root zone soil moisture, Potential Evapotranspiration, Evaporation, Streamflow	Monthly, 0.125 deg.	1979.01 – North America
	NLDAS	NLDAS_MOS0125_M_2.0	Frozen precipitation, Liquid precipitation, Total evapotranspiration, Surface runoff, Subsurface runoff, Snowmelt, Snow depth, Soil moisture (various depths), Transpiration, Evaporation, Streamflow	Monthly, 0.125 deg.	1979.01 – North America
	NLDAS	NLDAS_VIC0125_M_2.0	Frozen precipitation, liquid precipitation, Total evapotranspiration, Surface runoff, Subsurface runoff, Snowmelt, Snow depth, Soil moisture (various depths), Root zone soil moisture, Transpiration, Streamflow	Monthly, 0.125 deg	1979.01 – North America
	GLDAS	GLDAS_CLSM10_M_2.1	Total precipitation rate, Snow precipitation rate, Rain precipitation rate, Evapotranspiration, Storm surface runoff, Baseflow-groundwater runoff, Snow melt, Snow depth, Root zone soil moisture, Surface soil moisture, Transpiration	Monthly, 1.0 degree	2000.01 - Global
	GLDAS	GLDAS_NOAH025_M_2.1 GLDAS_NOAH10_M_2.1	Snow precipitation rate, Rain precipitation rate, Evapotranspiration, Storm surface runoff, Baseflow-groundwater runoff, Snow melt, Snow depth, Soil moisture (various depths), Evaporation, Transpiration, Total precipitation rate, Root zone soil moisture	Monthly, 0.25 degree, 1.0 degree	2000.01 - Global
	GLDAS	GLDAS_VIC10_M_2.1	Snow precipitation rate, Rain precipitation rate, Evapotranspiration, Storm surface runoff, Baseflow-groundwater runoff, Snow melt, Snow depth, Soil moisture (various depths), Transpiration, Evaporation, Root zone soil moisture, Total precipitation rate	Monthly, 1.0 degree	2000.01 - Global



Studying extreme events - floods

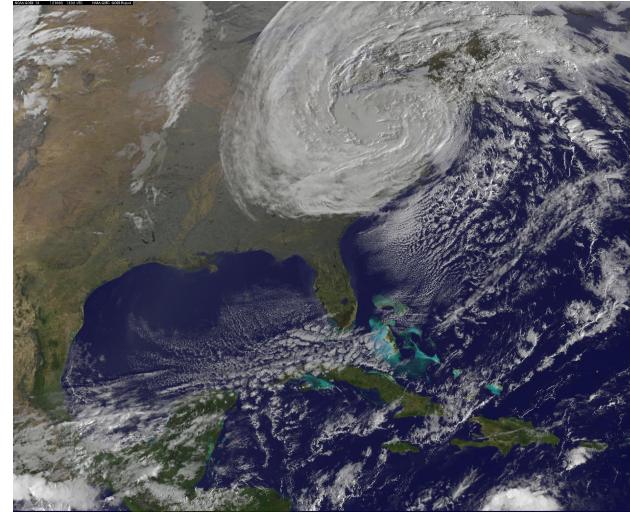
Seasonal Floods

Temporal resolution: *Daily*

Areal coverage: *Regional to local scale*

Time period: *Annual, monthly*

(annual /decadal for trend analysis)



GOES image of Hurricane Sandy
(October 30, 2012). Sandy was one of the
most expensive storm events in U.S.
history.

Data Variables:

Precipitation (rainfall, accumulated rainfall), wind speed, wind direction, soil moisture, surface temperature, humidity



Daily Data Products

Source	Product Name	Variable name	Resolution	Coverage
MERRA-2	M2SDNXSLV	Maximum precipitation rate during the period (TPRECMAX)	Daily, 0.625x0.5 deg	1980.01 - global
IMERG	GPM_3IMERGDF	precipitationCal, randomError	Daily, 0.1 deg	2000.06- global
IMERG	GPM_3IMERGDE	precipitationCal, randomError	Daily, 0.1 deg.	2000.06 - Global
IMERG	GPM_3IMERGDL	precipitationCal, randomError	Daily, 0.1 deg	2000.06 - Global
GPCP	GPCPDAY	combined satellite-gauge precipitation, combined satellite-gauge precipitation random error	Daily, 0.5 deg.	1983.01 - Global
GLDAS	GLDAS_CLSM025_DA1_D_2.2	Evaporation, Evapotranspiration, Storm surface runoff, Baseflow-groundwater runoff, Snow melt, Snow depth, Soil moisture, Transpiration	Daiily, 0.25 degree	2000.01 - Global



Studying extreme events - floods

Flash Flooding

Temporal resolution: *Daily, 3-hourly, hourly*

Areal coverage: *Watershed and local scale*

Time period: *Monthly, daily*

(annual/decadal for trend analysis)

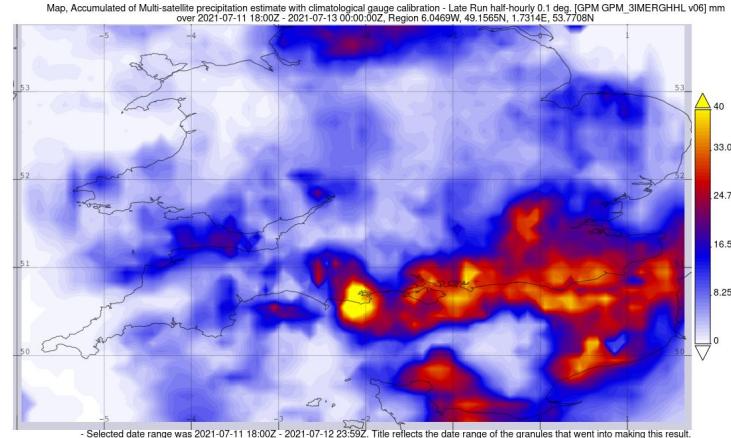


Image of IMERG accumulated rainfall data created with NASA Giovanni for rain and flash flood event in southern England and London, July 11-13, 2021, from the News article "[Heavy rains lead to London floods](#)".

Data Variables:

Precipitation (rainfall, accumulated rainfall), wind speed, wind direction, soil moisture, surface temperature, humidity



3-Hourly, Hourly, and Half-Hourly Data Products

Source	Product Name	Variable name	Resolution	Coverage
MERRA-2	M2T1NXFLX	Total precipitation (PRECTOTCORR)	Hourly,.625x 0.5 deg	1980.01 - global
IMERG	GPM_3IMERGHH	precipitationCal, randomError	Half-hourly, 0.1 deg.	2000.06 - Global
IMERG	GPM_3IMERGHHE	precipitationCal, randomError	Half-hourly, 0.1 deg.	2000.06 - Global
IMERG	GPM_3IMERGHHL	precipitationCal, randomError	Half-hourly, 0.1 deg	2000.06 - Global
NLDAS	NLDAS_NOAH0125_H_2.0	Frozen precipitation, Liquid precipitation (rainfall), Surface runoff, Subsurface runoff, Snowmelt, Snow depth, Soil moisture (various depths), Root zone soil moisture, Potential Evapotranspiration, Evaporation, Streamflow	Hourly, 0.125 deg.	1979.01 – North America
NLDAS	NLDAS_MOS0125_H_2.0	Frozen precipitation, Liquid precipitation, Total evapotranspiration, Surface runoff, Subsurface runoff, Snowmelt, Snow depth, Soil moisture (various depths), Transpiration, Evaporation, Streamflow	Hourly, 0.125 deg.	1979.01 – North America
NLDAS	NLDAS_VIC0125_H_2.0	Frozen precipitation, liquid precipitation, Total evapotranspiration, Surface runoff, Subsurface runoff, Snowmelt, Snow depth, Soil moisture (various depths), Root zone soil moisture, Transpiration, Streamflow	Hourly, 0.125 deg	1979.01 – North America
GLDAS	GLDAS_CLSM10_3H_2.1	Total precipitation rate, Snow precipitation rate, Rain precipitation rate, Evapotranspiration, Storm surface runoff, Baseflow-groundwater runoff, Snow melt, Snow depth, Root zone soil moisture, Surface soil moisture, Transpiration	3-Hourly, 1.0 degree	2000.01 - Global
GLDAS	GLDAS_NOAH025_3H_2.1 GLDAS_NOAH10_3H_2.1	Snow precipitation rate, Rain precipitation rate, Evapotranspiration, Storm surface runoff, Baseflow-groundwater runoff, Snow melt, Snow depth, Soil moisture (various depths), Evaporation, Transpiration, Total precipitation rate, Root zone soil moisture	3-Hourly, 0.25 degree, 1.0 degree	2000.01 - Global
GLDAS	GLDAS_VIC10_3H_2.1	Snow precipitation rate, Rain precipitation rate, Evapotranspiration, Storm surface runoff, Baseflow-groundwater runoff, Snow melt, Snow depth, Soil moisture (various depths), Transpiration, Evaporation, Root zone soil moisture, Total precipitation rate	3-Hourly, 1.0 degree	2000.01 - Global



Studying extreme events - heat waves

Heat Waves

Temporal resolution: *Daily, 3-hourly, hourly*

Areal coverage: *Watershed and local scale*

Time period: *Monthly, daily
(annual/decadal for trend analysis)*

Data Variables:

Precipitation (rainfall, accumulated rainfall), wind speed, wind direction, soil moisture, surface temperature, humidity



Studying extreme events - droughts

Droughts

Temporal resolution: *Daily, 3-hourly, hourly*

Areal coverage: *Watershed and local scale*

Time period: *Monthly, daily
(annual/decadal for trend analysis)*

Data Variables:

Precipitation (rainfall, accumulated rainfall), wind speed, wind direction, soil moisture, surface temperature, humidity



How-To guides (Jupyter Notebooks)

Find a DAAC ·

GES DISC · How-To's · rainfall

Atmospheric Composition Water & Energy/Cycles and Climate Variability

Feedback · Cloud Migration · Help · Login · My Dashboard

How-To's Showing 1 - 25 of 27 how-to's associated with rainfall

Sort by: Relevance

Refine By

Data Tools: Sort ·

- ArcGIS (1)
- Jupyter Notebook (1)
- MDaaS (1)
- Pandas (1)

Data Types: Sort ·

- CSV (1)
- JSON (1)
- Swath (1)

Data Formats: Sort ·

- HDF (2)
- NetCDF (1)
- NetcDF (1)

Tags: Sort ·

- 3h03 (1)
- AlgorithmS (1)
- ARIS (1)
- ArcGIS (1)
- Cloud Cover (1)
- Cloud (1)
- More...

How to find the max precipitation value of a Region of Interest (ROI) using an ArcGIS Image service (Jupyter Notebook)

Download the companion Jupyter Notebook

Related Data Collections (1)

How To Read IMERG Data Using Python

Download the companion Jupyter Notebook

Related Data Collections (1)

How to view GPM IMERG data using Giovanni

How to view level 2 GPM DPR data in Panoply

How To Plot Horizontal and Vertical Slices of Swath Data with Python Using GPM_ZADPR

Download the companion Jupyter Notebook

Related Data Collections (1)

How to Read Data in netCDF Format with R

Related Data Collections (1)

How to Display a Shapefile-based

Related Data Collections (1)

How to Import Gridded Data in NetCDF

Related Data Collections (1)

How to convert a netCDF file to a

Related Data Collections (12)

How to Create Hovmöller Plots with

How to subset and download THRE

[GES DISC Search: Showing 1 - 25 of 27 how-to's associated with rainfall](#)

Find a DAAC ·

GES DISC · How-To's · rainfall

Atmospheric Composition Water & Energy/Cycles and Climate Variability

Feedback · Cloud Migration · Help ·

How to find the max precipitation value of a Region of Interest (ROI) using an ArcGIS image service (Jupyter Notebook)

Download the companion Jupyter Notebook

Overview:

The goal of this tutorial is to inform the user on how to find the maximum precipitation rate (mm/hr) using an ArcGIS image service as data input, via a Jupyter Notebook (JN). The ArcGIS image service used in the notebook is the "GPM_IMERGHHE_06 (ImageServer)" ArcGIS REST service (Huffman et al., 2016).

Example:

For this example, we are using "GPM IMERG Early Precipitation Rate" data as the input to find the max precipitation value of a ROI for a specific time range. The NASA GES DISC ArcGIS Enterprise landing page hosts the mapping interfaces of this data through a web map, web app, Web Mapping Service (WMS), and direct image service link. Hurricane Ida is the weather event determining the time, and location of the analysis. The current date and time, and geographic ranges are specifically set in the JN for a ~115 sq-km area in Manville, NJ, USA, during the heavy rainfall impacts on the Northeastern United States from Hurricane Ida remnants between August 29th, 2021, at 12:00 AM EST and September 3rd, 2021, at 12:00 AM EST, using the GPM_IMERGHHE6 ArcGIS Image Service as the data source. However, any date and time ranges can be applied by editing the JN code included in this documentation. See Figure 1 below for a visualization of the GPM IMERG Web Map when Hurricane Ida's heavy rainfall impacts pass over the ROI on September 1st, 2021, at 6:30 PM EST, at a precipitation rate of 54.50 mm/hr.

Figure 1 shows a GPM IMERG Early Precipitation Rate Web Map (GPM_IMERGHHE6 precipitationRate) for the region around Manville, NJ, USA, on September 1st, 2021, at 6:30 PM EST. The map displays a color-coded precipitation intensity, with a legend indicating rates up to 220 mm/hr. A callout box highlights a peak precipitation rate of 54.50 mm hr over the Manville area.

[GES DISC How-To's: How to find the max precipitation value of a Region of Interest \(ROI\) using an ArcGIS image service \(Jupyter Notebook\)](#)



How-To guides

EARTHDATA Find a DAAC ▾

GES DISC [How-To's](#) rainfall  

Atmospheric Composition, Water & Energy Cycles and Climate Variability

Feedback Cloud Migration Help ▾  My Dashboard

[Back to how-to's](#)

How to Access MERRA-2 Data using OPeNDAP with Python3 and Calculate Daily/Weekly/Monthly Statistics from Hourly Data

 [Download the companion Jupyter Notebook](#)

Overview:
This How-To uses Python3 to demonstrate how to remotely access the MERRA-2 hourly files using an OPeNDAP URL, and how to analyze data - such as resampling hourly files into daily, weekly, and monthly files and calculating their corresponding statistics, e.g., mean, sum, and maximum.

Example:
This Python3 example code demonstrates how to remotely access a dataset archived in GES DISC using the Open-source Project for a Network Data Access Protocol (OPeNDAP) web service. In this example we use the Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2) aerosol diagnostics collection M2TINXAER.5.12.4. This collection is 1-hourly time-averaged single-level global aerosol assimilation and archived in daily files with 24 hourly time slices in each file (481 MB per file/day and 14.6 GB per month). For this demonstration we only read one-month of data (January 2020 including 31 days or files) remotely using the OPeNDAP URL. We also demonstrate how to calculate the daily/weekly/monthly statistics from the hourly data and how to visualize the evolution of Australian bushfire in January 2020. Figures 1 and 2 are the example images generated by the Python code below, in which the total aerosol extinction (AOT) is plotted as an indicator of the aerosol loading in atmosphere.

Sample Images:

Total Aerosol Extinction AOT [550 nm](1) weekly_max

time = 2020-01-05 time = 2020-01-12 time = 2020-01-19

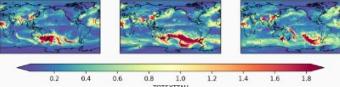
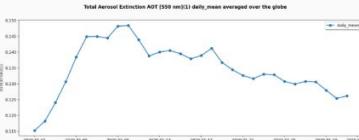


Figure 1 The evolution of weekly maxima of the MERRA-2 hourly AOT in the first three weeks of 2020. Note that it is calendar week from Monday to Sunday of each week. The date in the subtitle is labeled as the last day (Sunday) of that week.

Total Aerosol Extinction AOT [550 nm](1) daily_mean averaged over the globe



[GES DISC How-To's: How to Access MERRA-2 Data using OPeNDAP with Python3 and Calculate Daily/Weekly/Monthly Statistics from Hourly Data](#)

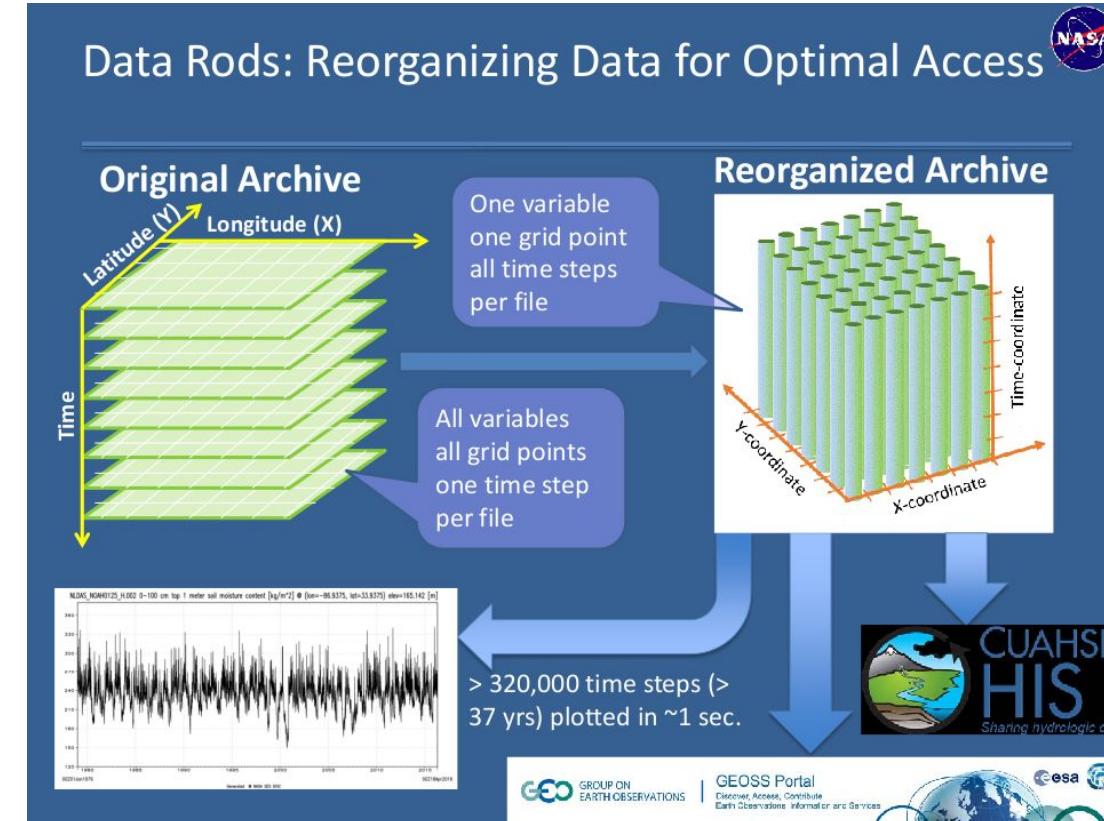


Demo 1: Use Giovanni to find, analyze and visualize variables

- A walkthrough: <https://giovanni.gsfc.nasa.gov>
- Global precipitation products: IMERG (Hurricane Katrina)
https://giovanni.gsfc.nasa.gov/giovanni/#service=TmAvMp&starttime=2005-08-29T12:00:00Z&endtime=2005-08-29T12:00:59Z&data=GPM_3IMERGHHE_06_precipitationCal
- Global Precipitation Climatology Project (recurring averages for Jun, Jul, and Aug):
https://giovanni.gsfc.nasa.gov/giovanni/#service=QuCI&months=06,07,08&starttime=1983-01-01T00:00:00Z&endtime=2020-12-31T23:59:59Z&shape=state_dept_counties_2017/shp_232&&data=GPCPMON_3_2_sat_gauge_precip
- An example: NLDAS soil moisture content (0-10 cm)
https://giovanni.gsfc.nasa.gov/giovanni/#service=TmAvMp&starttime=1979-01-01T00:00:00Z&endtime=1979-01-31T23:59:59Z&data=NLDAS_NOAH0125_M_2_0_SoilM_0_10cm



Hydrology Data Rods Time Series





Hydrology Data Rods Time Series

Projects & Missions

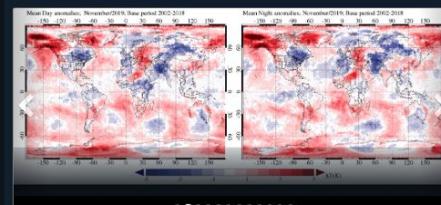
LPRM
The LPRM Level 2 (swath) and LPRM Level 3 (gridded) data products contain land surface parameters, surface soil moisture, land surface (skin)...

MEaSUREs
MEaSUREs: Making Earth System Data Records for Use in Research Environments, is a NASA project, solicited through Research Opportunities in...

MERRA
The Modern-Era Retrospective analysis for Research and Applications (MERRA) is a NASA atmospheric reanalysis for the satellite era using the...

[View All Projects & Missions ...](#)

Featured Gallery Images



[View All Gallery Images ...](#)

New



Science Focus Areas

Atmospheric Composition
Water & Energy Cycles
Climate Variability

Tools

Giovanni
GIS
[Data Rods for Hydrology](#)
DQViz
AIRS NRT Viewer
OGC Web Map Service
OPeNDAP and GDS

News

General
Data Release
Service Release
Alerts

Resources

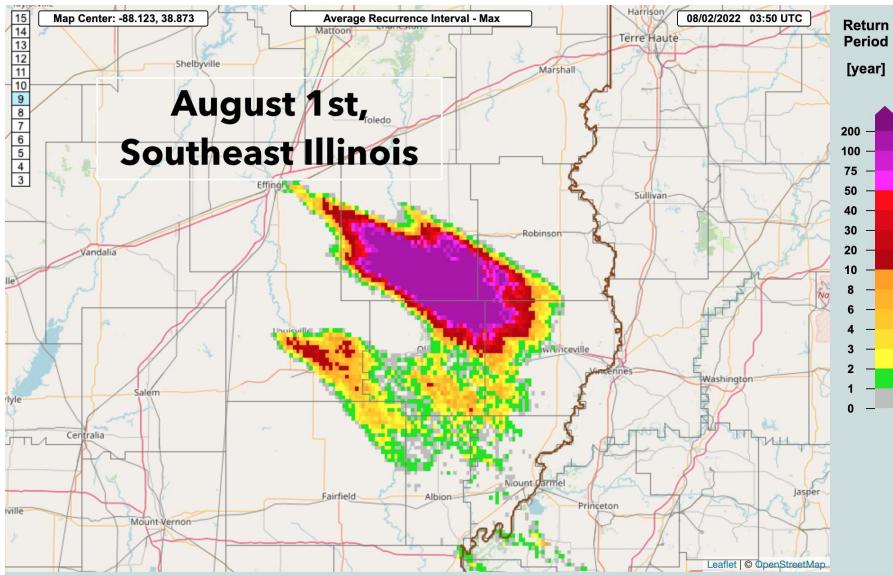
Earthdata Forum
HowTo
Data in Action
Publications
Glossary
FAQ
Gallery

NLDAS Primary Forcing Data L4 Hourly 0.125 x 0.125 degree V002 ([NLDAS_FORA0125_H](#))

Data Product	Short Name	Description	Unit	Sample URL
APCPsfc	Precipitation hourly total	kg/m ²	plot	asc2
DLWRFsfc	Surface DW longwave radiation flux	W/m ²	plot	asc2
DSWRFsfc	Surface DW shortwave radiation flux	W/m ²	plot	asc2
PEVAPsfc	Potential evaporation	kg/m ²	plot	asc2
SPFH2m	2-m above ground specific humidity	kg/kg	plot	asc2
TMP2m	2-m above ground temperature	K	plot	asc2
UGRD10m	10-m above ground zonal wind	m/s	plot	asc2
VGRD10m	10-m above ground meridional wind	m/s	plot	asc2



Demo 2 - Southeast Illinois Floods Use Case



Kaylan Patel (@WxPatel)



Hydrology Data Rods Time Series API



Generate Time Series over Newton Grid

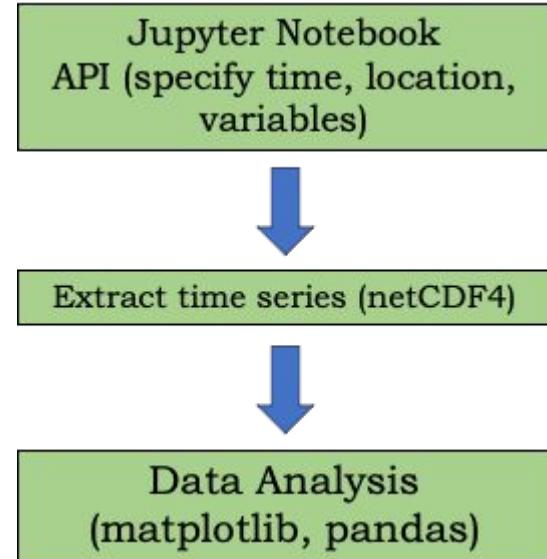
- **Generate Time Series over Newton Grid**

- **Variables**

- Precipitation Hourly Total:
[\(NLDAS:NLDAS FORA0125 H.002:APCPsfc\)](#)
- Hourly 0-100cm Soil Moisture Content:
[\(NLDAS:NLDAS NOAH0125 H.002:SOILM0-100cm\)](#)

- **Time**

- 2022-07-01 to 2022-09-01





Google Colab Notebook Link

[https://colab.research.google.com/drive/1v1iSQrDID1b1Bm
miOlj80UtbB9C4tzHZ?usp=sharing](https://colab.research.google.com/drive/1v1iSQrDID1b1Bm miOlj80UtbB9C4tzHZ?usp=sharing)



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”
- Comments and suggestions: gsfc-dl-help-disc@mail.nasa.gov