



# Effective Access to Remote Sensing and Model Data for Agriculture from NASA GES DISC

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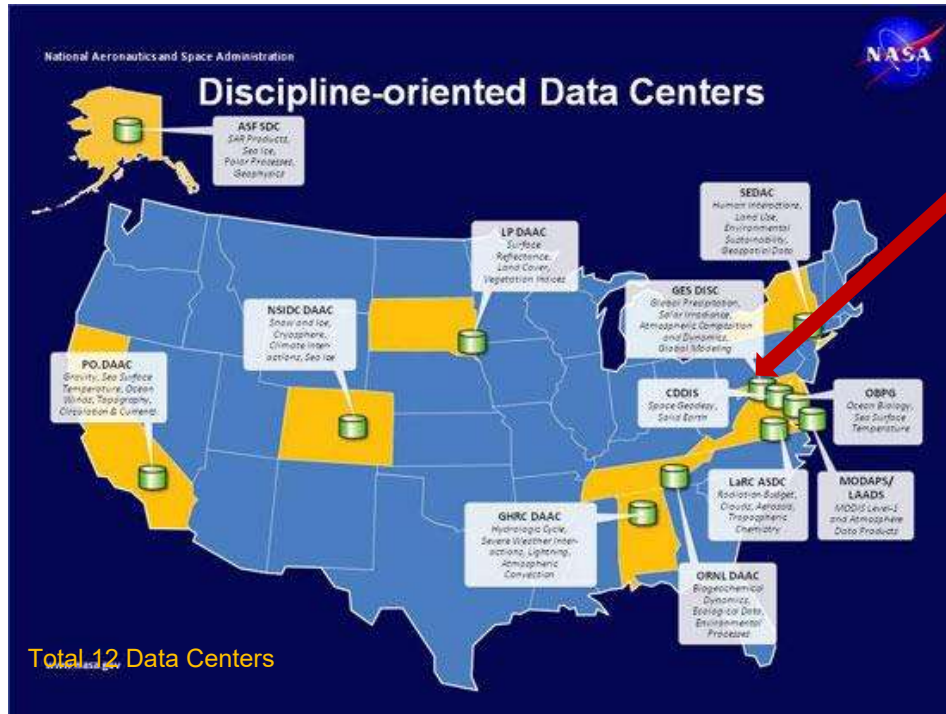
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<sup>2</sup>George Mason University

<sup>3</sup>ADNET systems Inc.



# NASA Earth Science Data Centers

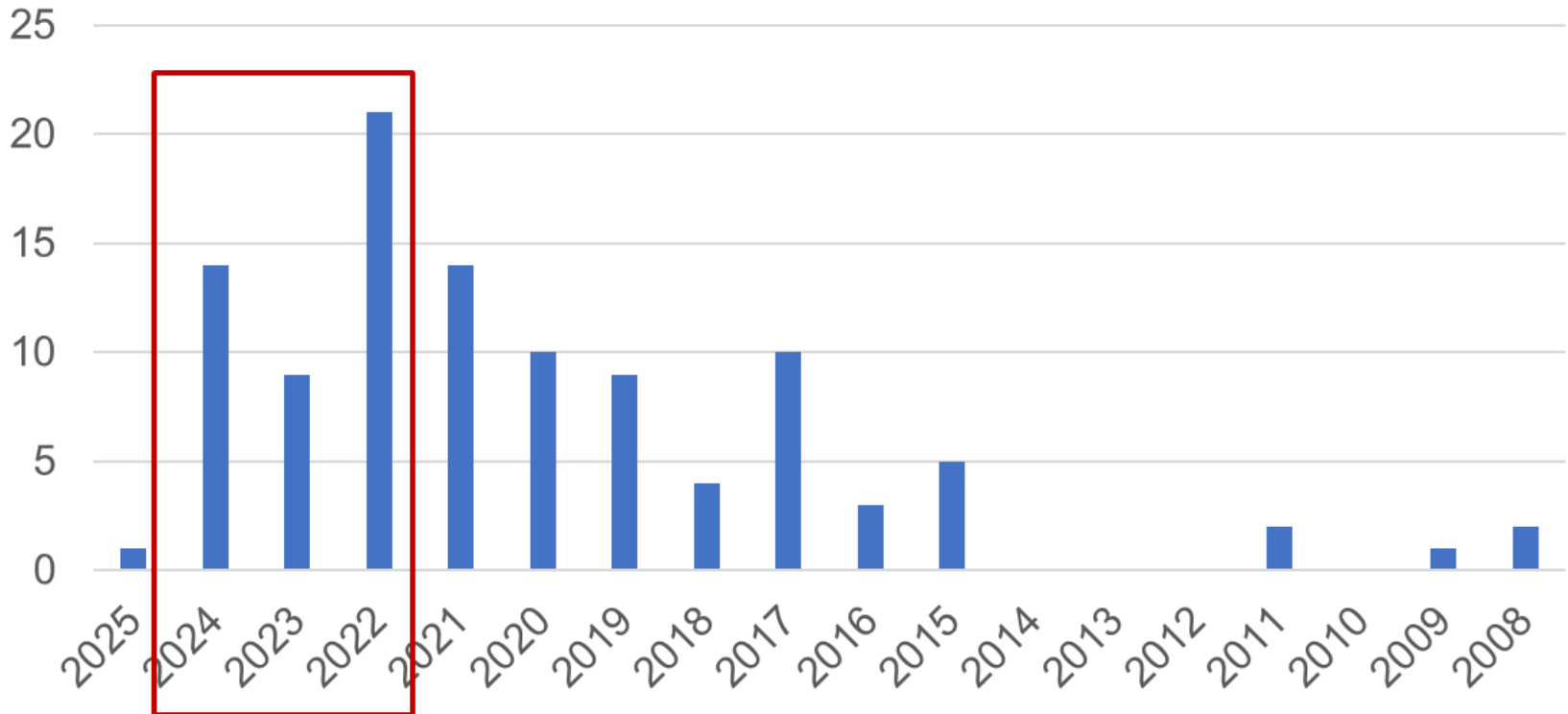


Goddard Earth Sciences Data and Information Services Center (**GES DISC**)  
> 1700 data collections

- Data are free
- Registration is required
- Data citation is highly recommended

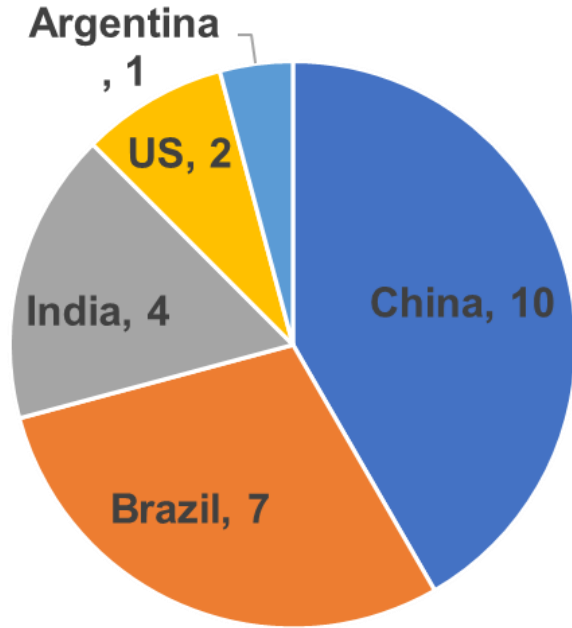


# Publications on Agriculture Applications Associated to Data at GES DISC





# Study Regions



■ China ■ Brazil ■ India ■ US ■ Argentina

study	counts
China	10
Brazil	7
India	4
US	2
Argentina	1
Nile River Basin	1
Australia	1
Ethiopia	1
Gabon	1
Japan	1
Gabon	1
Korea	1
Uzbekistan	1
vietnam	1
	33



# Summary of Data Used in Agriculture Applications:

--- Based on 2022-2024 publications related to GES DISC data

- Meteorology **near surface** data (temperature, precipitation, humidity, incoming solar radiation, wind speed, surface pressure) from **GPM/IMERG, MERRA-2, GLDAS, FLDAS**
  - Soil condition data (moisture, runoff, temperature, evaporation) from **GLDAS, FLDAS, MERRA-2**
  - Aerosol and chemistry data (O<sub>3</sub>, AOD, NO<sub>2</sub>, SO<sub>2</sub>, SO<sub>4</sub>) from **Aura/OMI, MERRA-2**
- Temporal resolutions: Sub-daily, daily, or monthly
  - Data Types: Level 3 and Level 4 gridded data





# Acronym

## Satellites:

**GPM** - The Global Precipitation Measurement

**IMERG** - The Integrated Multi-satellite Retrievals for GPM

**OMI** - Ozone Monitoring Instrument

**AIRS** - Atmospheric Infrared Sounder

## Reanalysis and Assimilation models:

**MERRA-2** - The Modern-Era Retrospective analysis for Research and Applications, Version 2

**GLDAS** - the Global Land Data Assimilation System

**FLDAS** - FLDAS is the Famine Early Warning Systems Network (FEWS NET) Land Data Assimilation System (FLDAS-Global, FLDAS-Central Asia, and FLDAS-Forecast)

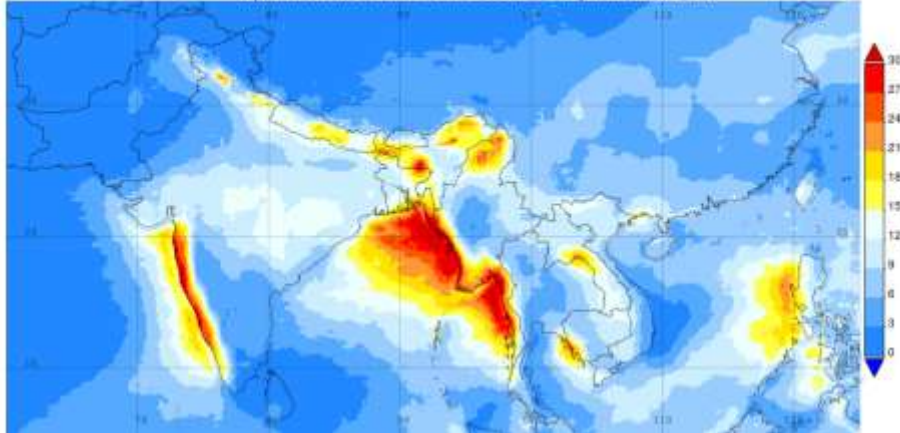




# Example Precipitation - long-term mean, July (2001-2020)

## GPM/IMERG

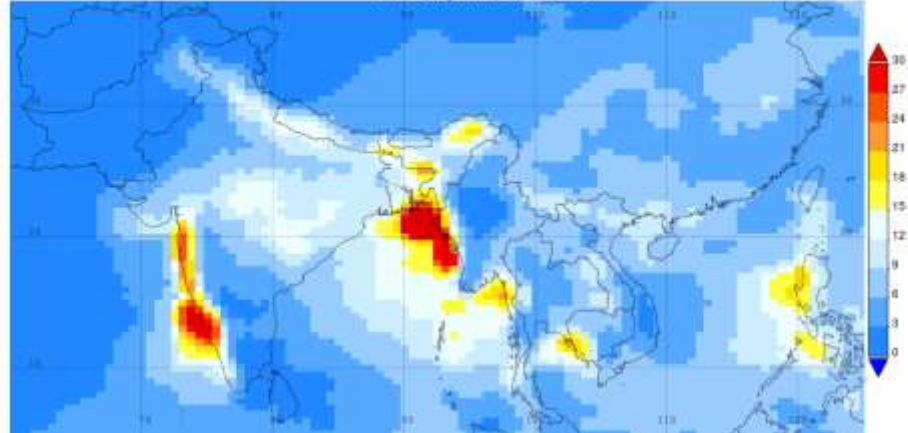
July months (2001-07-01 00:00:00Z - 2020-09-01 00:00:00Z)  
Average Merged satellite gauge precipitation estimate - Final Run (recommended for general use) monthly 0.1 deg. (GPM GPMIMERGM v07) mm/day for July months 2001-07-01 00:00:00Z - 2020-08-01 00:00:00Z. Region 60E, 5N, 125E, 38N



0.1x0.1 deg

## MERRA-2

July months (2001 - 2020)  
Average Bias corrected total surface precipitation monthly 0.5 x 0.625 deg. (MERRA-2 Reanalysis M2TMNXFLX v5.12.4) mm/day for July months 2001-Jul-2020-Jul. Region 60E, 5N, 125E, 38N



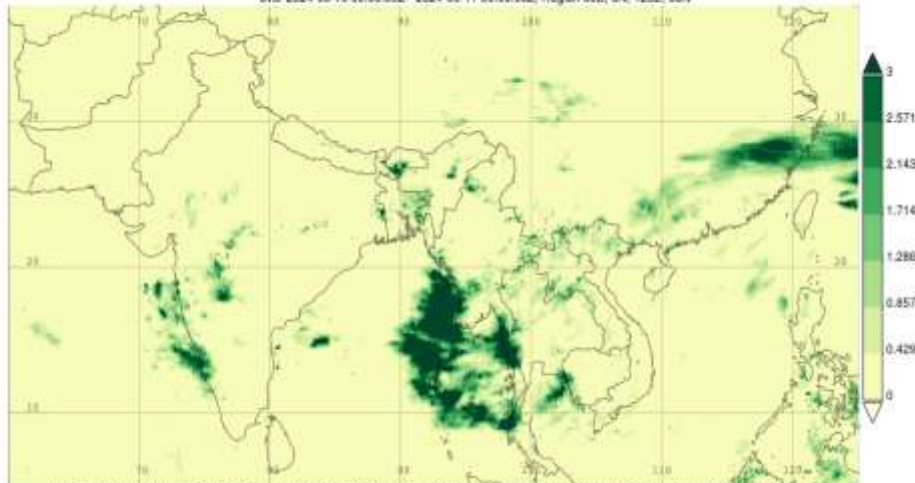
0.5x0.625 deg



# Example Precipitation - 2024.06.10

## GPM/IMERG

Time Averaged Map of Multi-satellite precipitation estimate with gauge calibration - Final Run (recommended for general use) half-hourly 0.1 deg. [GPM GPM 3IMERGHH v07] mm/hr over 2024-06-10 00:00:00Z - 2024-06-11 00:00:00Z, Region 60E, 5N, 125E, 38N

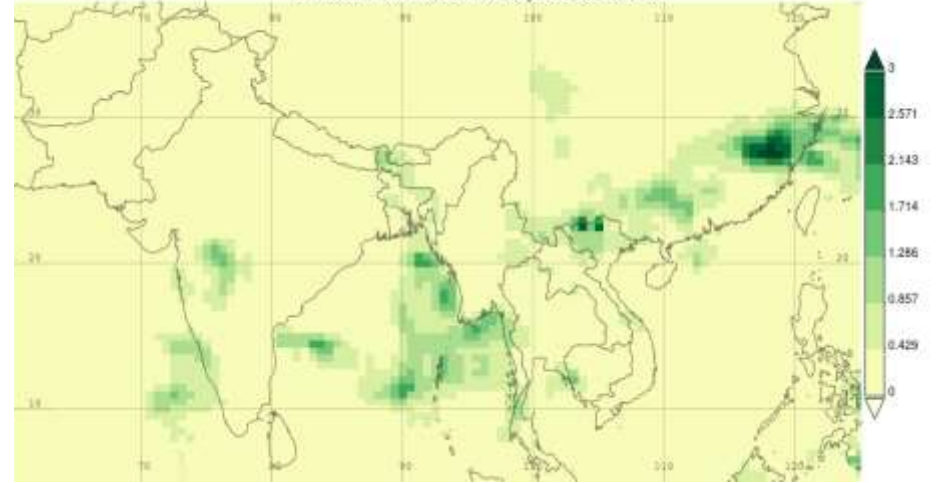


- Selected date range was 2024-06-10 00:00Z - 2024-06-10 23:59Z. Title reflects the date range of the granules that went into making this result.

0.1x0.1 deg

## MERRA-2

Time Averaged Map of Bias corrected total surface precipitation, time average hourly 0.5 x 0.625 deg. [MERRA-2 Reanalysis M2T1NXFLX v5.12.4] mm/hr over 2024-06-10 00Z - 2024-06-10 23Z, Region 60E, 5N, 125E, 38N



0.5x0.625 deg



# Data for Agriculture Applications – precipitation from satellite observations

Project	Product shortName	Resolution	Coverage	Latency
<b>GPM/IMERG</b> (Final products)	GPM_3IMERGHH_07	30-min; 0.1x0.1 deg	1998.01 – present; global	~ 3.5 month
	GPM_3IMERGDF_07	1-day; 0.1x0.1 deg	1998.01 – present; global	~ 3.5 month
	GPM_3IMERGM_07	1-month; 0.1x0.1 deg	1998.01 – present; global	~ 3.5 month
<b>GPM/IMERG</b> (early and late products)	GPM_3IMERGHHE_07	30 min, 0.1x0.1 deg	1998.01 - present, global	~ 4 hours
	GPM_3IMERGHHL_07	30 min, 0.1x0.1 deg	1998.01 - present, global	~ 14 hours
<b>MEaSURES/GPCP</b>	GPCPDAY_3.3	1-day; 0.5x0.5 deg	1998.01- present; global	~ 1 year
	GPCPMON_3.3	1-month; 0.5x0.5 deg	1983.01-present; global	~ 1 year



# Data for Agriculture Applications – precipitation from assimilation and reanalysis models

Project	Product shortName	Resolution	Coverage	Latency
<b>FLDAS</b>	FLDAS_NOAH01_C_GL_M_001	1-month; 0.1x0.1 deg;	1982.01 - present; global	~ 1-month
<b>GLDAS</b>	GLDAS_CLSM025_DA1_D_2.2	1-day; 0.25x0.25 deg	2003.02 - present; global	~ 2 month
	GLDAS_NOAH025_3H_2.1	3-hour; 0.25x0.25 deg	2000.01- present; global	~ 3 month
	GLDAS_NOAH025_M_2.1	1-month; 0.25x0.25 deg	2000.01- present; global	~ 3 month
<b>MERRA-2</b>	M2T1NXFLX_5.12.4	1-hour; 0.5x0.625 deg	1980-present, global	~ 1 month
	M2TMNXFLX_5.12.4	1-month; 0.5x0.625 deg	1980 - present; global	~ 1 month





# How to Find and Access the Data?

- ❑ Checking curated data list for agriculture applications in the Appendix
- ❑ Searching GES DISC data portal <https://disc.gsfc.nasa.gov/>
- ❑ Searching NASA earth science data portal: <https://search.earthdata.nasa.gov/>
- ❑ Post question at forum: <https://forum.earthdata.nasa.gov/> or ask question to the help desk ([gsfc-dl-help-disc@mail.nasa.gov](mailto:gsfc-dl-help-disc@mail.nasa.gov) )

## Dataset Landing Page

M2T1NXSLV\_5.12.4 <https://doi.org/10.5067/VJAFPLI1CSIV>

The second Modern-Era Retrospective analysis for Research and Applications  
MERRA-2 tavg1\_2d\_slv\_Nx: 2d,1-Hourly,Time-Averaged,Single-Level,Assimilation,Single-Level Diagnostics  
V5.12.4 (M2T1NXSLV)

Cloud Enabled

[View Full-size Image](#)

M2T1NXSLV (or tavg1\_2d\_slv\_Nx) is an hourly time-averaged 2-dimensional data collection in Modern-Era Retrospective analysis for Research and Applications

Data Access

- Online Archive
- Earthdata Search
- Giovanni
- Web Services ▾
- [Subset / Get Data](#)

Product Summary Variables **Data Citation** **Documentation** References



# Data Tools – Obtaining Subsetted Data

Data Access

- Online Archive
- Earthdata Search
- Giovanni
- Web Services ▾
- ↓ Subset / Get Data**

Download Method:  Get File Subsets using OPeNDAP

Get Original Files  
Generate unmodified file links directly from the archive.

Get File Subsets using OPeNDAP   
Generate file links supporting geo-spatial search and crop and selection of variables and...

Get File Subsets using the GES DISC Subsetter   
Generate file links supporting geo-spatial search and crop, selection of variables, and reg...

Method Options


Refine Date Range: 1998-01-01 to 2024-12-31

Refine Region:  -127.393, 22.828, -73.956, 50.441

-127.393,22.828,-73.956,50.441

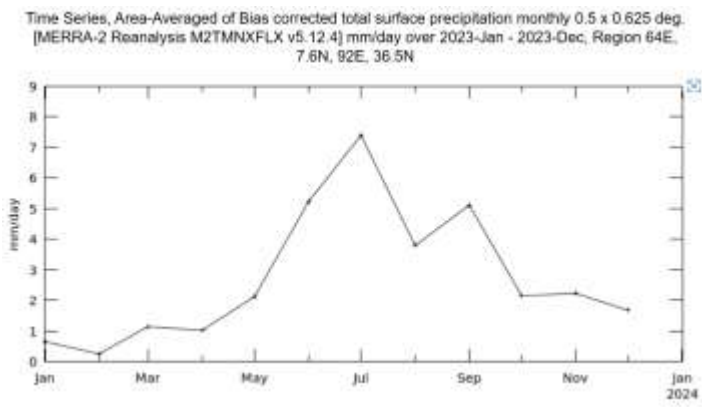
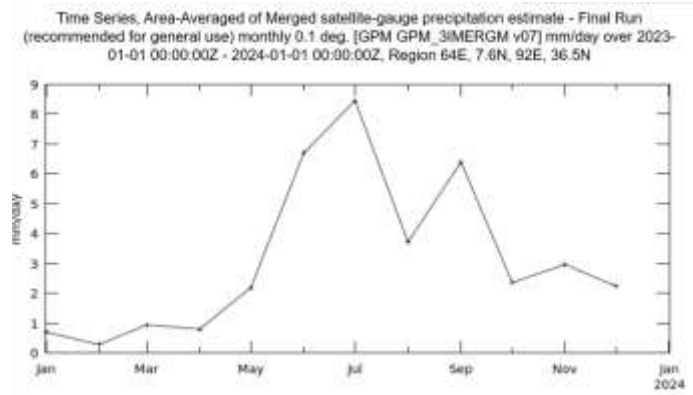
## User Guides:

- [How to use the \*\*Level 3\*\* and \*\*4\*\* Subsetter and Regridder](#)
- [How to Use the Web Services \*\*API\*\* for \*\*Subsetting\*\* MERRA-2 Data](#)
- [How to Access \*\*M2T1NXSLV\*\* Cloud OPeNDAP Granules using Python](#)





# Data Tools – Obtaining Time Series Data



## User Guides:

- [How to Access the "Giovanni in the Cloud: Time Series" Service Using Python](#)
- [How to Obtain a Time Series at a Single Point using TDS](#)
- [How to Access the Hydrology Data Rods Time Series API Using Python](#)





# Data Tools – Online Visualization

**GIOVANNI** The Bridge Between Data and Science v4.40

Feedback Help Log out (shen5089)

Giovanni unavailable during maintenance period, Wednesday, June 11, 2025 15:00 UTC ... [1 of 2 messages] [Send Message](#)

Select Plot: Time Series, Area-Averaged

Select Date Range (UTC): 2023 - 01 - 01 to 2023 - 12 - 31

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

Comparisons: Map, Correlation

Time Series, Area-Averaged (Static)  
Scatter (Interactive)  
Scatter (Static)  
Scatter, Time-Averaged (Interactive)  
Time Series  
Time Series, Area-Averaged Differences  
Time Series, Area-Averaged  
**Time Series, Longitude-Averaged**  
Time Series, Latitude-Averaged

Time Series, Recurring Averages

Miscellaneous: Histogram, Zonal Mean

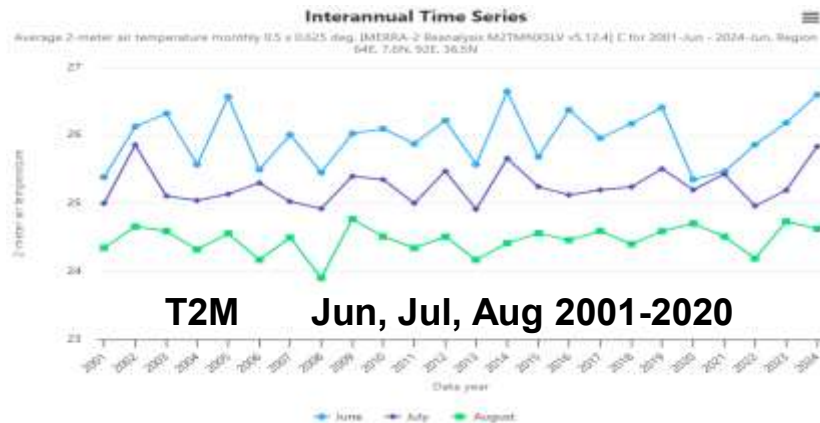
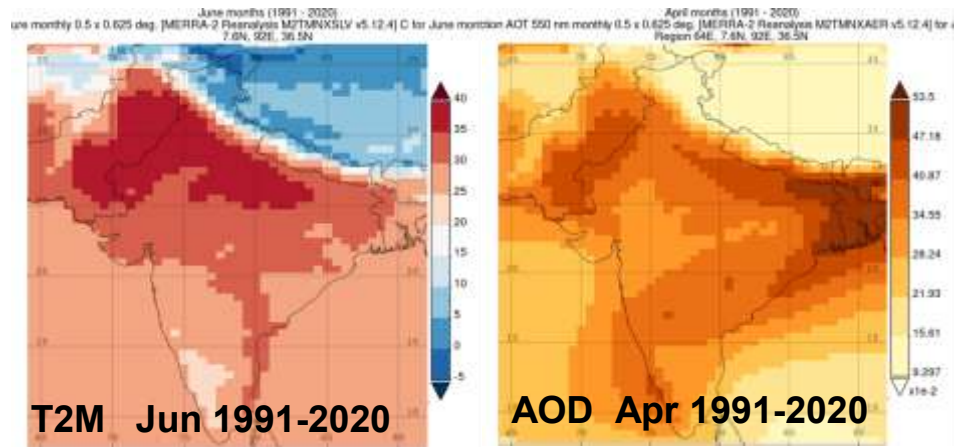
Vertical: Cross Section, Latitude-Pressure, Cross Section, Longitude-Pressure, Cross Section, Time-Pressure, Vertical Profile

Start Date: 1980-01-01 End Date: 2025-06-30

Map: MERRA-2 Reanalysis M2TMXKSLV v5.12.4 [C] for June months ADT 550 re monthly 0.5 x 0.625 deg. 7.6N, 92E, 36.5N

Map: MERRA-2 Reanalysis M2TMXKSLV v5.12.4 [C] for April months (1991 - 2020) re monthly 0.5 x 0.625 deg. 64E, 7.6N, 92E, 36.5N

Reset Plot Data Go to Results





# Why and Where I can find the data DOI

- Data DOI is **permanent and unique** references to data products
  - Each data DOI links to a public **dataset landing page**
  - The data DOIs allow researchers to publish citations for **the exact data** used in their research
- 
- Data DOI is **stored in data file** as a metadata
  - Data DOI is **on the dataset landing page**
  - Copy the description in **“Data Citation”** tab on the dataset landing page

Product Summary   Variables   **Data Citation**   Documentation   References   Data Calendar

**To cite the data in publications:**  
Global Modeling and Assimilation Office (GMAO) (2015), MERRA-2 tavg1\_2d\_slv\_Nx: 2d,1-Hourly,Time-Averaged,Single-Level,Assimilation,Single-Level Diagnostics V5.12.4, Greenbelt, MD, USA, Goddard Earth Sciences Data and Information Services Center (GES DISC), Accessed: **[Data Access Date]**, 10.5067/VJAFPL1CSIV



# How to Cite the data

**Data DOI:** <https://doi.org/10.5067/VJAFPLI1CSIV>

**In article body :** .... GMAO (2025)

**In references:**

Global Modeling and Assimilation Office (GMAO) (2015), MERRA-2 tavg1\_2d\_slv\_Nx: 2d,1-Hourly,Time-Averaged,Single-Level,Assimilation,Single-Level Diagnostics V5.12.4, Greenbelt, MD, USA, Goddard Earth Sciences Data and Information Services Center (GES DISC), Accessed: Jan 12 2023, <https://doi.org/10.5067/VJAFPLI1CSIV>

**Data DOI:** <https://doi.org/10.5067/GPM/IMERG/3B-HH/07>

**In article body :** .... Huffman, et al (2023)

**In Reference:**

Huffman, G.J., E.F. Stocker, D.T. Bolvin, E.J. Nelkin, Jackson Tan (2023), GPM IMERG Final Precipitation L3 Half Hourly 0.1 degree x 0.1 degree V07, Greenbelt, MD, Goddard Earth Sciences Data and Information Services Center (GES DISC), Accessed: May 20 2024, <https://doi.org/10.5067/GPM/IMERG/3B-HH/07>





## **Appendix : Data at GES DISC for Agriculture Applications**



# Data for Agriculture Applications – precipitation from satellite observations

Project	Product shortName	Resolution	Coverage	Latency
<b>GPM/IMERG</b> (Final products)	GPM_3IMERGHH_07	30-min; 0.1x0.1 deg	1998.01 – present; global	~ 3.5 month
	GPM_3IMERGDF_07	1-day; 0.1x0.1 deg	1998.01 – present; global	~ 3.5 month
	GPM_3IMERGM_07	1-month; 0.1x0.1 deg	1998.01 – present; global	~ 3.5 month
<b>GPM/IMERG</b> (early and late products)	GPM_3IMERGHHE_07	30 min, 0.1x0.1 deg	1998.01 - present, global	~ 4 hours
	GPM_3IMERGHHL_07	30 min, 0.1x0.1 deg	1998.01 - present, global	~ 14 hours
<b>MEaSURES/GPCP</b>	GPCPDAY_3.3	1-day; 0.5x0.5 deg	1998.01- present; global	~ 1 year
	GPCPMON_3.3	1-month; 0.5x0.5 deg	1983.01-present; global	~ 1 year



# Data for Agriculture Applications – precipitation from assimilation and reanalysis models

Project	Product shortName	Resolution	Coverage	Latency
<b>FLDAS</b>	FLDAS_NOAH01_C_GL_M_001	1-month; 0.1x0.1 deg;	1982.01 - present; global	~ 1-month
<b>GLDAS</b>	GLDAS_CLSM025_DA1_D_2.2	1-day; 0.25x0.25 deg	2003.02 - present; global	~ 2 month
	GLDAS_NOAH025_3H_2.1	3-hour; 0.25x0.25 deg	2000.01- present; global	~ 3 month
	GLDAS_NOAH025_M_2.1	1-month; 0.25x0.25 deg	2000.01- present; global	~ 3 month
<b>MERRA-2</b>	M2T1NXFLX_5.12.4	1-hour; 0.5x0.625 deg	1980-present, global	~ 1 month
	M2TMNXFLX_5.12.4	1-month; 0.5x0.625 deg	1980 - present; global	~ 1 month





# Data for Agriculture Applications – Aerosol and Chemistry

Project	Products shortName	Variables	Resolution	Coverage	Latency
<b>Aura (satellite)</b>	OMAEROe_003	AOD	1-day; 0.25x0.25 deg	2004.10-present, global	~ 2 days
	OMDOAO3e_003 OMTO3e_003	O3 (total)	1-day; 0.25x0.25 deg	2004.10-present, global	
	OMNO2d_004	NO2	1-day; 0.25x0.25 deg	2004.10-present, global	
	OMSO2e_003	O2	1-day; 0.25x0.25 deg	2004.10-present, global	
<b>AIRS (satellite)</b>	AIRS3STD_7.0	O3 profile	1-day 1x1 deg	2022.09 - present, global	~ 2 days
<b>MERRA-2 (reanalysis model)</b>	M2T1NXAER_5.12.4	Ozone, SO4	1-hour; 0.5x0.625 deg	1980-present; global	~ 1 month
	M2TMNXAER_5.12.4	Ozone, SO4	1-month; 0.5x0.625 deg	1980-present; global	
	M2T3NVASM_5.12.4	Ozone	3-hour; 0.5x0.625 deg	1980-present; global	





# GES DISC Data for Agriculture Applications – MERRA-2 Reanalysis

**Global; 0.5x0.625 deg; 1980-present; latency ~ 1 month**

Products – subdaily (monthly)	Description	Variables
M2T1NXSLV_5.12.4 (M2TMNXSLV_5.12.4)	Assimilation, Single-Level Meteorology Diagnostics	T2M, T10M, U10M, V10M, U50M, V50M, QV2M, QV10M, Q850, Q250
M2SDNXSLV_5.12.4 (M2SMNXSLV_5.12.4)	Daily Statistics, Assimilation, Single-Level Diagnostics	T2Mmean, T2mmin, T2Mmax
M2T1NXAER_5.12.4 (M2TMNXAER_5.12.4)	Assimilation, Single-Level Aerosol Diagnostics	SO4, AOD
M2T1NXFLX_5.12.4 (M2TMNXFLX_5.12.4)	Assimilation, Single-Level Surface Flux Diagnostics	Precipitation, wind speed
M2T1NXLND_5.12.4 (M2TMNXLND_5.12.4)	Assimilation, Single-Level Land Surface Diagnostics	soil moisture, soil temperature, soil evaporation, greenness fraction, leaf area index
M2T1NXRAD_5.12.4 (M2TMNXRAD_5.12.4)	Assimilation, Single-Level Radiation Diagnostics	surface albedo, solar incoming radiation, cloud fraction
M2I3NVASM_5.12.4 (n/a)	Assimilation, Model-Level Meteorological Fields	T, QV, ozone





## Data for Agriculture Applications from Land Assimilation Model

Project	Products – shortName	Variable name	Coverage and Resolution	Latency
<b>FLDAS</b>	FLDAS_NOAH01_C_GL_M_001	Temperature, moisture, wind speed, humidity	1982.01 – present; global 1 month; 0.1x0.1 deg	~ 1 month
<b>GLDAS</b>	GLDAS_CLSM025_DA1_D_2.2	ground water	2003.02 – present, global 1-day; 0.25x0.25 deg;	
	GLDAS_NOAH025_3H_2.1	Tair, Esoil, Evap, GwRunoff, PotEvap, Qair, Runoff, SoilMoi, SoilTmp, SurPre, SurPre, SurTemp, Tvet, wind, radiation, humidity, wind speed	2000.01-present; global 3-hour; ; 0.25x0.25 deg;	
	GLDAS_NOAH025_M_2.1	Tair, Esoil, Evap, GwRunoff, PotEvap, Qair, Runoff, SoilMoi, SoilTmp, SurPre, SurPre, SurTemp, Tvet, wind, radiation, humidity, wind speed	2000.01-present; global 1-month; ; 0.25x0.25 deg;	





# Thanks!

## Questions??

Online Helps: FAQs and How-tos at <https://disc.gsfc.nasa.gov/>

GES DISC at the Earthdata User Forum: <https://forum.earthdata.nasa.gov/>

GES DISC Help Desk at [gsfc-dl-help-disc@mail.nasa.gov](mailto:gsfc-dl-help-disc@mail.nasa.gov)