



**WELCOME TO  
NASA APPLIED REMOTE SENSING TRAINING  
(ARSET)  
WEBINAR SERIES**

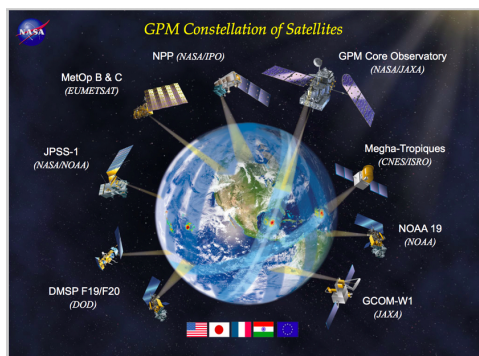
**INTRODUCTION TO GLOBAL PRECIPITATION  
MEASUREMENTS (GPM) DATA AND APPLICATIONS**

**COURSE DATES: EVERY TUESDAY, MARCH 17, 24, 31  
TIME: 8 TO 9 AM AND 1 TO 2 PM EDT**



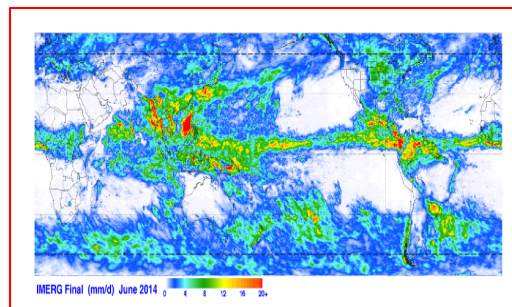
# Webinar Outline

## Week 1



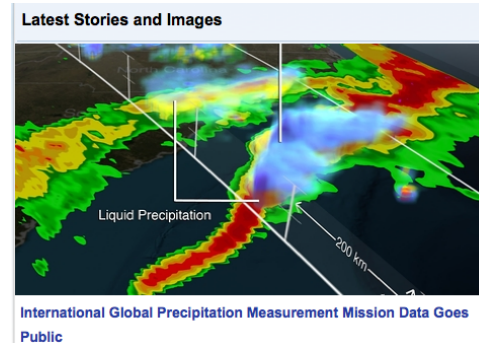
**Precipitation  
Remote Sensing  
Overview of TRMM and GPM**

## Week 3



**GPM-IMERG Data  
Demonstration of Data  
Access and GIS  
Applications**

## Week 2



**TRMM/GPM Data  
Products and Data  
Access Tools**

# ARSET Webinars Website



<http://arset.gsfc.nasa.gov>



- ARSET
- Webinars
- Workshops
- Apply for Training
- Personnel
- Links
- Upcoming Webinar



## Applied Remote Sensing Training

The goal of the NASA Applied Remote Sensing Training (ARSET) is to increase the utility of NASA earth science and model data for policy makers, regulatory agencies, and other applied science professionals in the areas of Health and Air Quality, Water Resources, Eco Forecasting, and Disaster Management.

The two primary activities of this project are webinars and in-person courses.

### Webinars (Free)

Webinars are offered throughout the year in all four application areas, generally 4-5 weeks in duration, 1 hour per week. They are intended for those new to remote sensing. For more information and to register please go to the webinars section of the website.

### In-Person Courses

ARSET in-person courses are a combination of lectures and computer hands-on activities that teach professionals how to access, interpret, and apply NASA data at regional and global scales with an emphasis on case studies. ARSET works with organizations who will host the training for groups within their geographical region, tailoring the curriculum to the needs of the projected participants. NASA does not charge an attendance fee, but attendees must make their own arrangements to travel to the course meeting location.

### Skills Taught:

- Search, access, and download of NASA data products and imagery
- Appropriate use and interpretation of satellite imagery
- Visualization and analysis of NASA imagery using NASA, EPA, and NOAA webtools and other resources such as GIS, Google Earth, Planoply, RSWI, and HREFLock

ARSET is sponsored by the Applied Sciences Program within NASA's Earth Sciences Division. We would

## ARSET

- Webinars**
- Workshops
- Apply for Training
- Personnel
- Links
- Upcoming Webinar



## Introduction to Global Precipitation Measurement (GPM) Data and Applications

Tuesday, March 17, 2015 to Tuesday, March 31, 2015

Application Area: **Disasters, Water Resources**

Keywords: **Flooding, Satellite Imagery, Tools**

Instruments/Missions: **GPM, TRMM**

[Read more](#)

Agenda: [ARSET-GPM\\_Webinar.docx.pdf](#)

GIS: True

Keywords: **Flooding, Satellite Imagery, Tools**

Instruments/Missions: **GPM, TRMM**

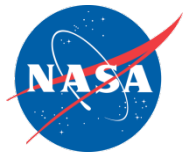
## Presentations

### Presentations and Recordings

Week	Date	Title	Presentation	Recording	Homework
1	March 17, 2015	Precipitation Remote Sensing Overview of TRMM and GPM	<a href="#">Week 1 (English)</a> <a href="#">Week 1 (Spanish)</a>		N/A
2	March 24, 2015	TRMM/GPM Data Products and Data Access Tools			N/A
3	March 31, 2015	GPM-IMERG Data Demonstration of Data Access and GIS Applications			



# Review of Weeks 1 & 2



# Remote Sensing of Precipitation

- ❑ Inferred indirectly from reflected solar radiation and emitted Infrared radiation by clouds (**Passive Remote Sensing**)
- ❑ Estimated from microwave radiation emitted or scattered by surface and precipitation particles (**Passive Remote Sensing**)
- ❑ Estimated from back-scattered microwave radiation transmitted by radars (**Active Remote Sensing**)

## TRMM

One active and two passive rain sensors

*Precipitation Radar (PR)*

*TRMM Microwave Imager (TMI)*

*Visible and Infrared Scanner (VIRS)*

## GPM

One active and one passive rain sensors

*Dual-frequency Precipitation Radar (DPR)*

*GPM Microwave Imager (GMI)*

# GPM GMI and DPR Measurements



<http://pmm.nasa.gov/GPM>

## GMI

- ❑ Higher frequency channels, not included in TMI, for improved light rain and snow detection
- ❑ Higher spatial resolutions
- ❑ Reference for constellation radiometers calibration

**GPM constellation satellites have revisit times of 1-2 hours over land**

## DPR

- ❑ Higher sensitivity to light rain and snow compared to TRMM-PR
- ❑ Better accuracy of measurements
- ❑ Better identification of liquid, ice, mixed-phase precipitation particles
- ❑ Reference standard for inter-calibration of constellation precipitation measurements

# GPM Level-2 and -3 Data Products Information



<http://pmm.nasa.gov/data-access/downloads/gpm>

Data Product Name



Data Product Documentation



Data Product Summary



Multiple Data Products Useful for Research and Applications



Level 3 | Level 2 | Level 1

Derived geophysical parameters at the same resolution and location as those of the Level 1 data.

▾ 2A-CMB: Combined GMI + DPR single orbit rainfall estimates

The GPM Combined Radar-Radiometer Algorithm performs two basic functions: first, it provides, in principle, the most accurate, high resolution estimates of surface rainfall rate and precipitation vertical distributions that can be achieved from a spaceborne platform, and it is therefore valuable for applications where information regarding instantaneous storm structure are vital. Second, a global, representative collection of combined algorithm estimates will yield a single common reference dataset that can be used to "cross-calibrate" rain rate estimates from all of the passive microwave radiometers in the GPM constellation. The cross-calibration of radiometer estimates is crucial for developing a consistent, high time-resolution precipitation record for climate science and prediction model validation applications. Full Documentation

Resolution	Region - Dates	Latency	Format	Source	DL
orbital		3 hours (RT); 40 hours (Prod)	HDF5	Prod: FTP (PPS)*	↓
			HDF5	Prod: STORM	↓
			HDF5	Mirador	↓
			OPeNDAP	OPeNDAP	
			HDF5	Prod: FTP (GES DISC)	

▸ 2A-Ku: DPR Ku-only single orbit rainfall estimates

▸ 2A-Ka: DPR Ka-only single orbit rainfall estimates

▸ 2A-DPR: DPR Ka&Ku single orbit rainfall estimates

▸ 2A-GPROF-constellation: Single-orbit rainfall estimates from each passive-microwave instrument in the GPM constellation

▸ 2A-GPROF-GMI: GMI single-orbit rainfall estimates

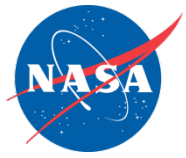
Multiple Formats and Options for Data Download

# Summary of GPM Data Access Tools



Tools	Data Products and Formats	Analysis and/or Visualization	Data Download
<p>Mirador  <a href="http://mirador.gsfc.nasa.gov">http://mirador.gsfc.nasa.gov</a></p>	<p><b>L1B, L2, and L3 GMI-GPROF            IMERG Half-hourly, Monthly</b>            Orbital and Gridded Daily, Monthly            HDF5, OPenDAP (can be converted to            ASCII, Binary, NetCDF)</p>	<p>N/A</p>	<p>Batch            Download</p>
<p>Giovanni  <a href="http://giovanni.gsfc.nasa.gov/giovanni/">http://giovanni.gsfc.nasa.gov/giovanni/</a></p>	<p><b>IMERG Half-hourly, Monthly</b>            NetCDF, GeoTIFF, PNG</p>	<p><b>Visualization:</b> Map, Time Series, Scatter Plot, Histogram  <b>Analysis:</b> Time-averaged Maps, Time Series, Scatter Plot, Map Correlations, Vertical Profiles, Time-averaged Differences</p>	<p>Download by            Select and            Click on Data            Files</p>
<p>PPS/STORM  <a href="https://storm.pps.eosdis.nasa.gov/storm">https://storm.pps.eosdis.nasa.gov/storm</a></p>	<p><b>L1B and 1C, L2, L3 GMI, DPR, GMI-DPR            Combined Data</b>, Orbital and Gridded Daily,            Monthly            IMERG Half-hourly, Monthly            HDF5, PNG</p>	<p>Map Visualization,            Interactive Latitude/Longitude            Point Data Value Display</p>	<p>FTP</p>





# **TMPA: TRMM Multi-satellite Precipitation Analysis**

## **IMERG: Integrated Multi-satellite Retrievals for GPM**

IMERG is conceptually similar to TRMM TMPA, combines GPM GMI/DPR data with the GPM constellation satellites to yield improved spatial/temporal precipitation estimates:

	<b>IMERG</b>	<b>TMPA</b>
Temporal Resolution :	30-minutes	3 hours
Spatial Resolution:	0.1°x0.1°	0.25°x0.25°
Spatial Coverage:	Global 60°S to 60°N	Global 50°S to 50°N

### **Constellation Satellites:**

GCOM-W, DMSP, Megha-Tropiques, MetOp-B, NOAA-N', NPP, NPOESS



# Week 3 Agenda

- **GPM IMERG** *Guest speaker: Dr. George Huffman (NASA-GSFC)*
- **Case Study: GPM IMERG Precipitation Data for Hurricane Arthur**  
*Brock Blevins: Demonstration of IMERG data access from Giovanni-4 and using IMERG in GIS ArcMAP*
- **Course Summary**



# GPM IMERG

Dr. George Huffman (NASA-GSFC)

[george.j.huffman@nasa.gov](mailto:george.j.huffman@nasa.gov)

# Insights on the Day-1 Integrated Multi-satellite Retrievals for GPM (IMERG) Data Sets

## The GPM Multi-Satellite Team

George J. Huffman NASA/GSFC, Chair  
David T. Bolvin SSAI and NASA/GSFC  
Dan Braithwaite Univ. of California Irvine  
Kuolin Hsu Univ. of California Irvine  
Robert Joyce Innovim and NOAA/NWS/CPC  
Chris Kidd ESSIC and NASA/GSFC  
Soroosh Sorooshian Univ. of California Irvine  
Pingping Xie NOAA/NWS/CPC

Introduction  
IMERG Design  
Examples  
Validation  
Future  
Final Comments

# 1. INTRODUCTION

A diverse, changing, uncoordinated set of input precip estimates

Goal: seek the longest, most detailed record of “global” precip

IMERG is a High-Resolution Precipitation Product

- best snapshot precipitation
- not a Climate Data Record

IMERG is a unified U.S. algorithm that takes advantage of

- KF-CMORPH – NOAA
- PERSIAN-CCS – U.C. Irvine
- TMPA – NASA
- PPS production – NASA

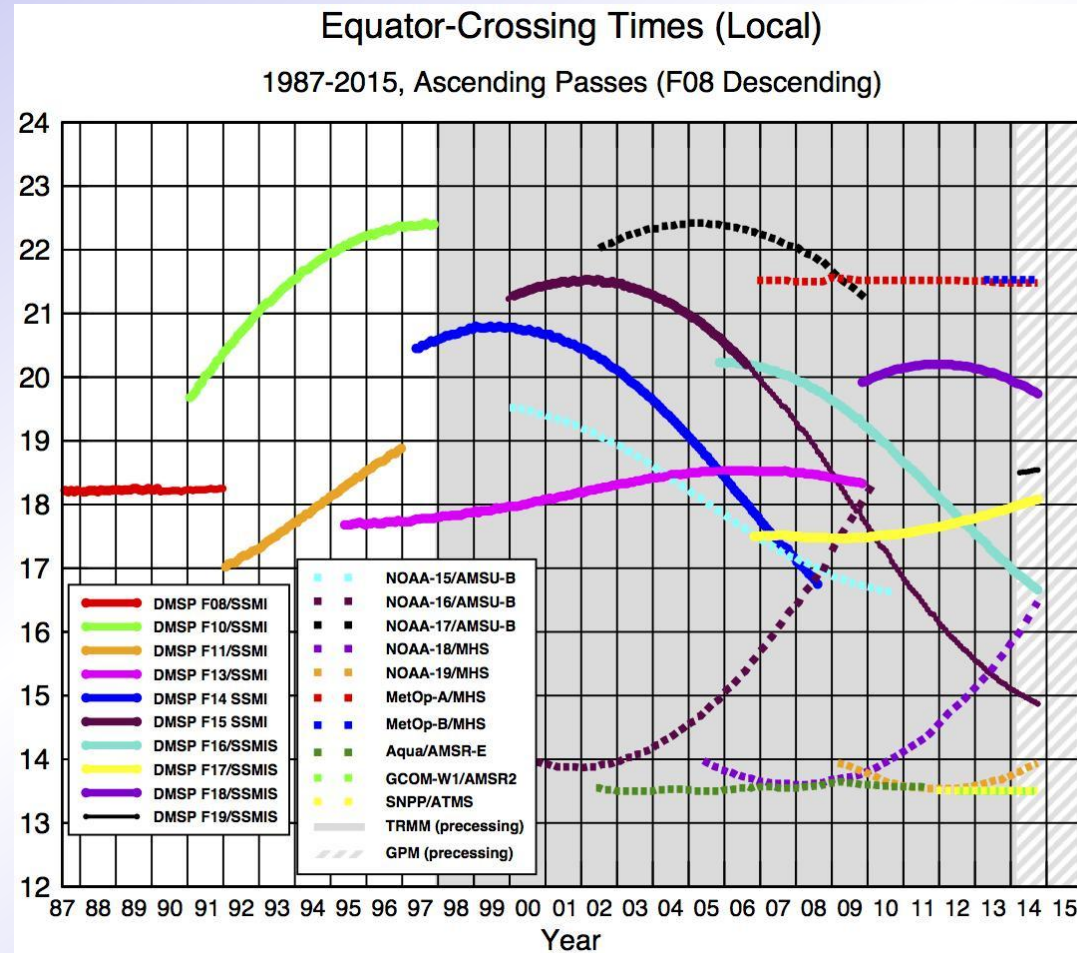


Image by Eric Nelkin (SSAI), 13 November 2014, NASA/Goddard Space Flight Center, Greenbelt, MD.

## 2. IMERG Data Sets

Multiple runs accommodate different user requirements for latency and accuracy

- “Early” – 4 hours (flash flooding)
- “Late” – 12 hours (crop forecasting)
- “Final” – 3 months (research data)

Time intervals are half-hourly and monthly (Final only)

0.1° global CED grid

- PPS will provide subsetting by parameter and location
- initial release covers 60°N-S

User-oriented services

- interactive analysis (GIOVANNI)
- alternate formats (KMZ, KML, TIFF WRF files, ...)
- area averages

	<b>Half-hourly data file (Early, Late, Final)</b>
1	<i>[multi-sat.] precipitationCal</i>
2	<i>[multi-sat.] precipitationUncal</i>
3	<i>[multi-sat. precip] randomError</i>
4	<i>[PMW] HQprecipitation</i>
5	<i>[PMW] HQprecipSource [identifier]</i>
6	<i>[PMW] HQobservationTime</i>
7	<i>IRprecipitation</i>
8	<i>IRkalmanFilterWeight</i>
9	<i>probabilityLiquidPrecipitation [phase]</i>
	<b>Monthly data file (Final)</b>
1	<i>[sat.-gauge] precipitation</i>
2	<i>[sat.-gauge precip] randomError</i>
3	<i>GaugeRelativeWeighting</i>
4	<i>probabilityLiquidPrecipitation [phase]</i>

### 3. EXAMPLES – Data Fields from IMERG Test Data (1/4)

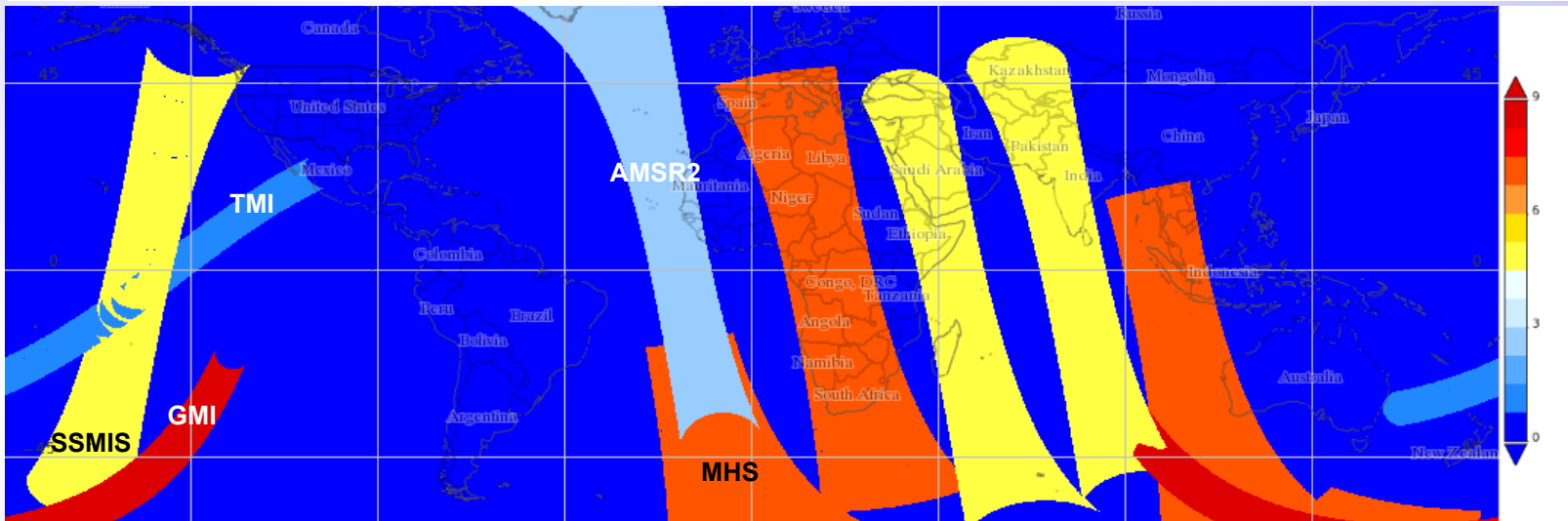
1430-1500Z 3 April 2014

PMW data collected in the half hour



[PMW] HQprecipSource [identifier] (mm/hr)

PMW sensor contributing the data, selected as imager first, then sounder, then closest to center time

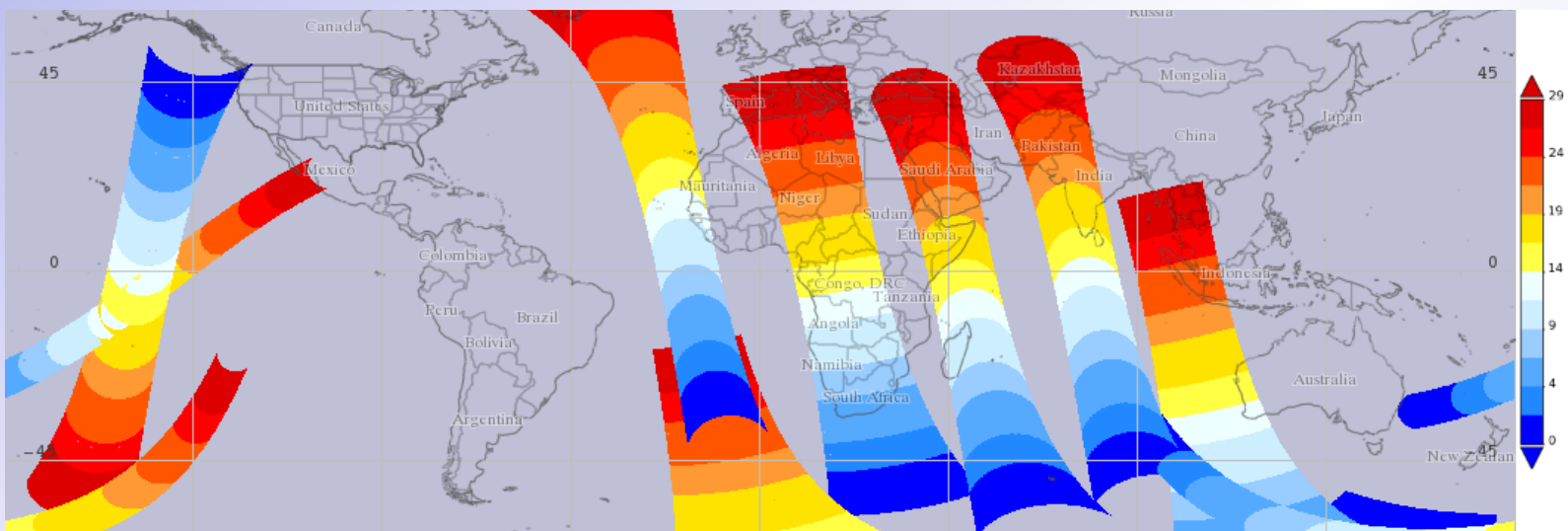


[PMW] HQprecipSource [identifier]

### 3. EXAMPLES – Data Fields from IMERG Test Data (2/4)

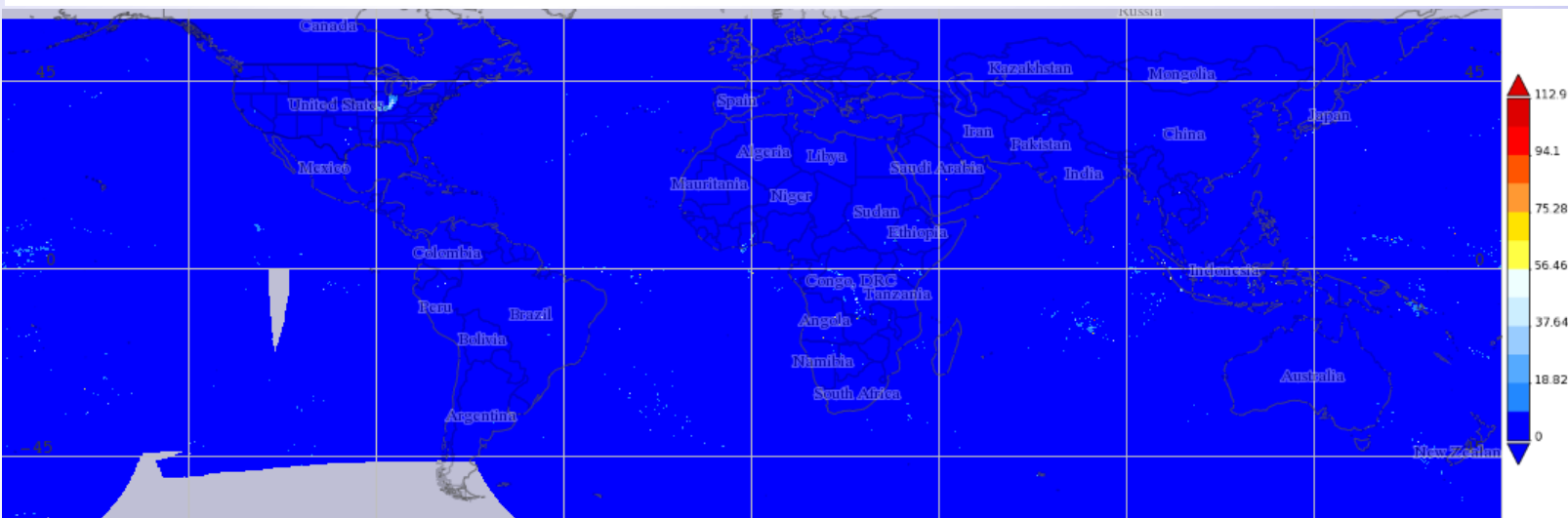
1430-1500Z 3 April 2014

PMW sensor  
observation  
time after  
start of half  
hour



[PMW] HQobservationTime (min)

precip from  
merged geo-  
IR data



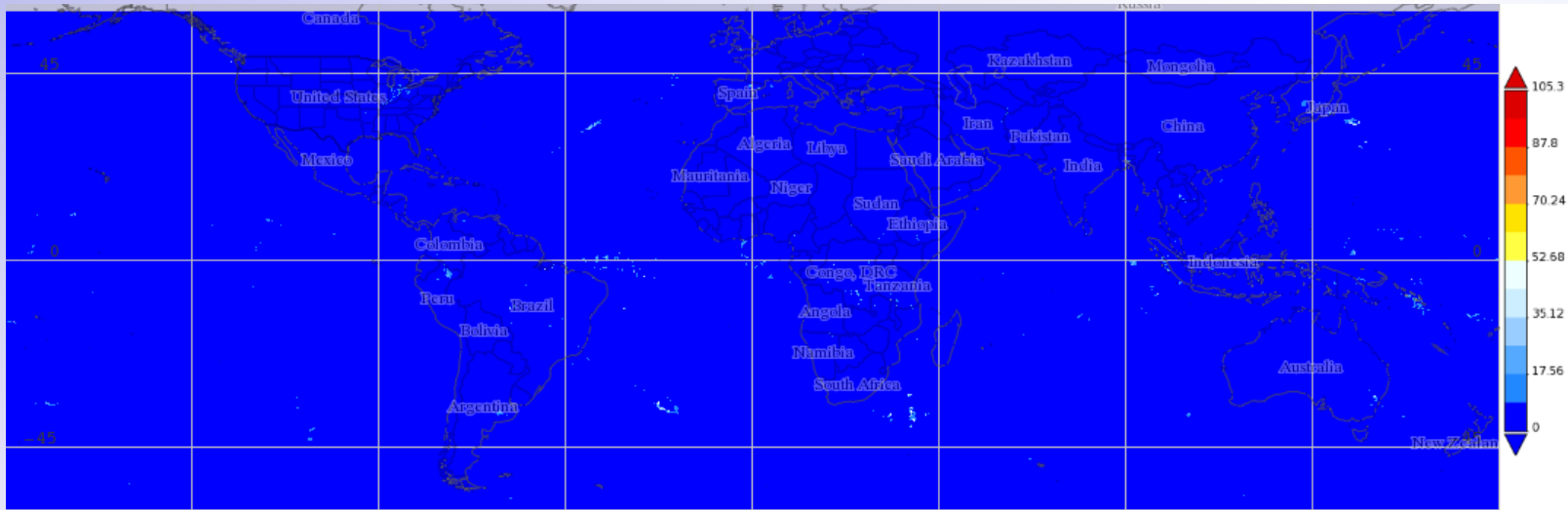
IRprecipitation (mm/hr)



### 3. EXAMPLES – Data Fields from IMERG Test Data (3/4)

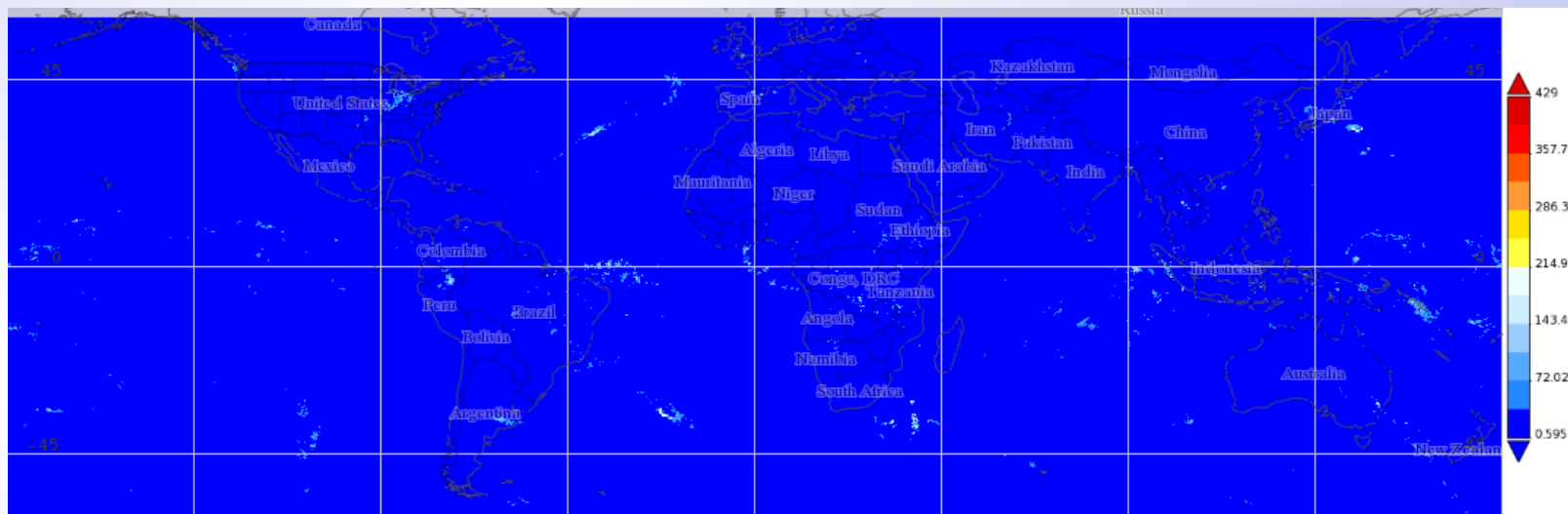
1430-1500Z 3 April 2014

“Final”  
IMERG field:  
forward and  
backward  
morphed  
microwave,  
Kalman filter  
with IR data;  
monthly  
gauge



[multi-sat.] precipitationCal (mm/hr)

estimated  
random error  
for the multi-  
satellite  
precip

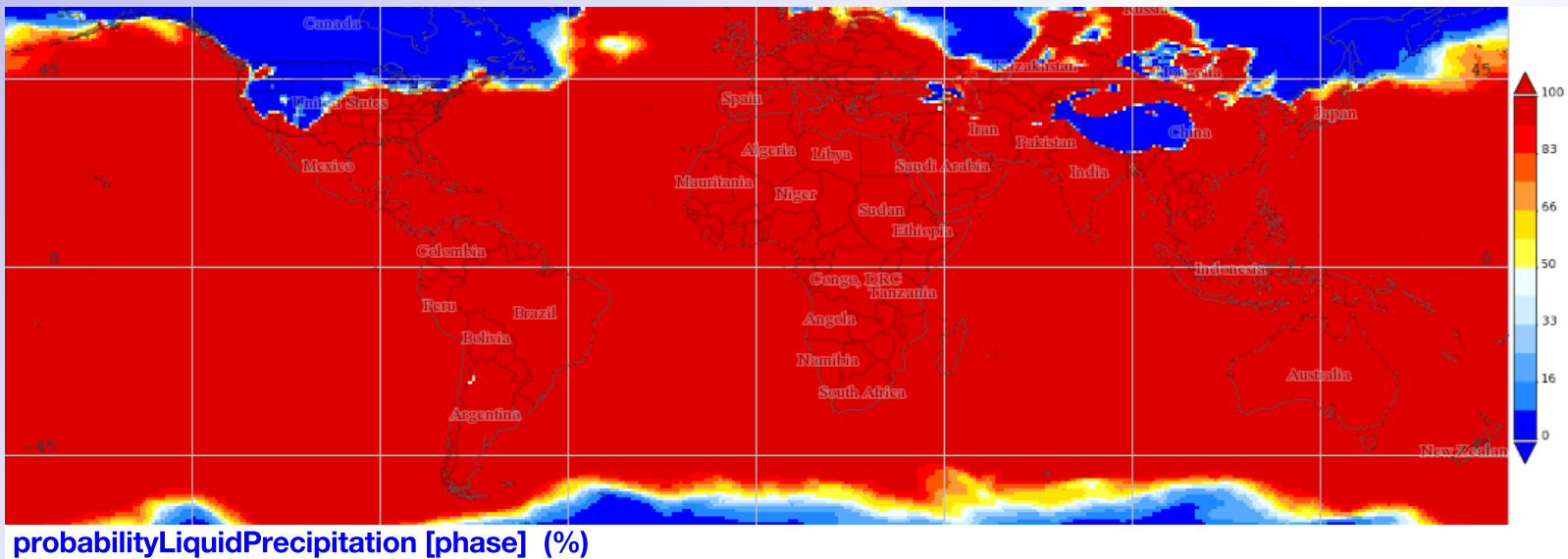


[multi-sat. precip] randomError (mm/hr)

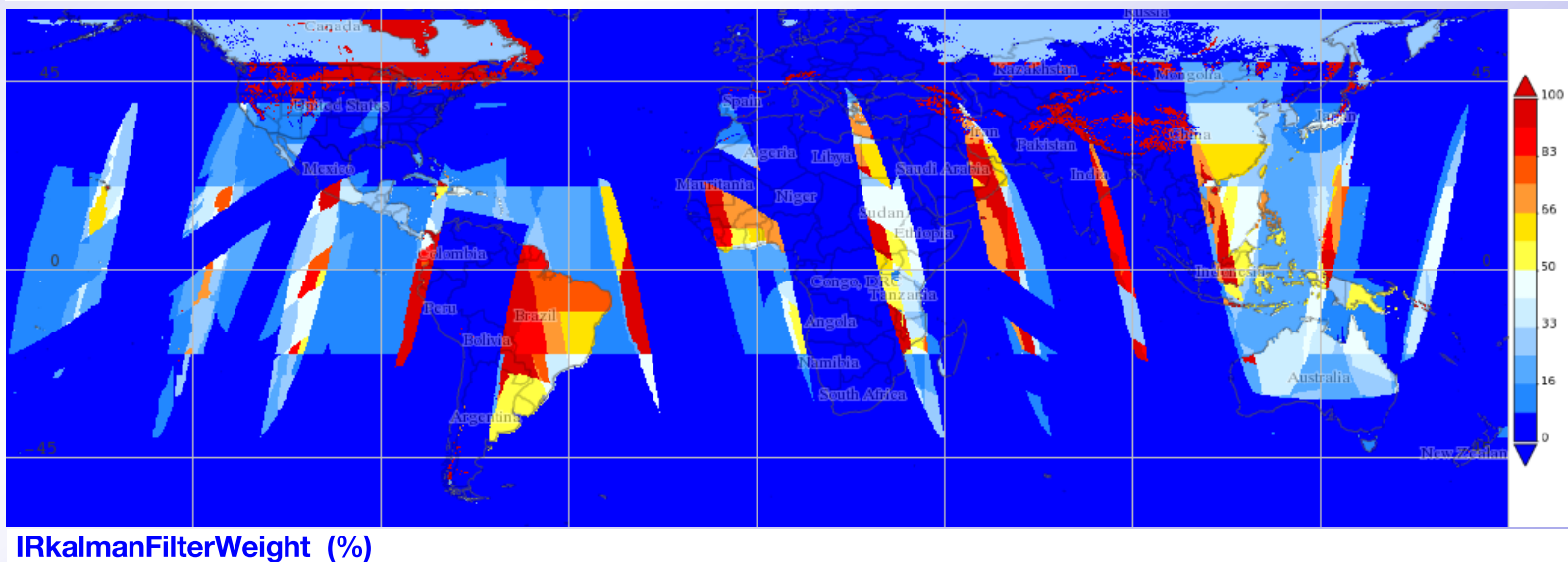
### 3. EXAMPLES – Data Fields from IMERG Test Data (4/4)

1430-1500Z 3 April 2014

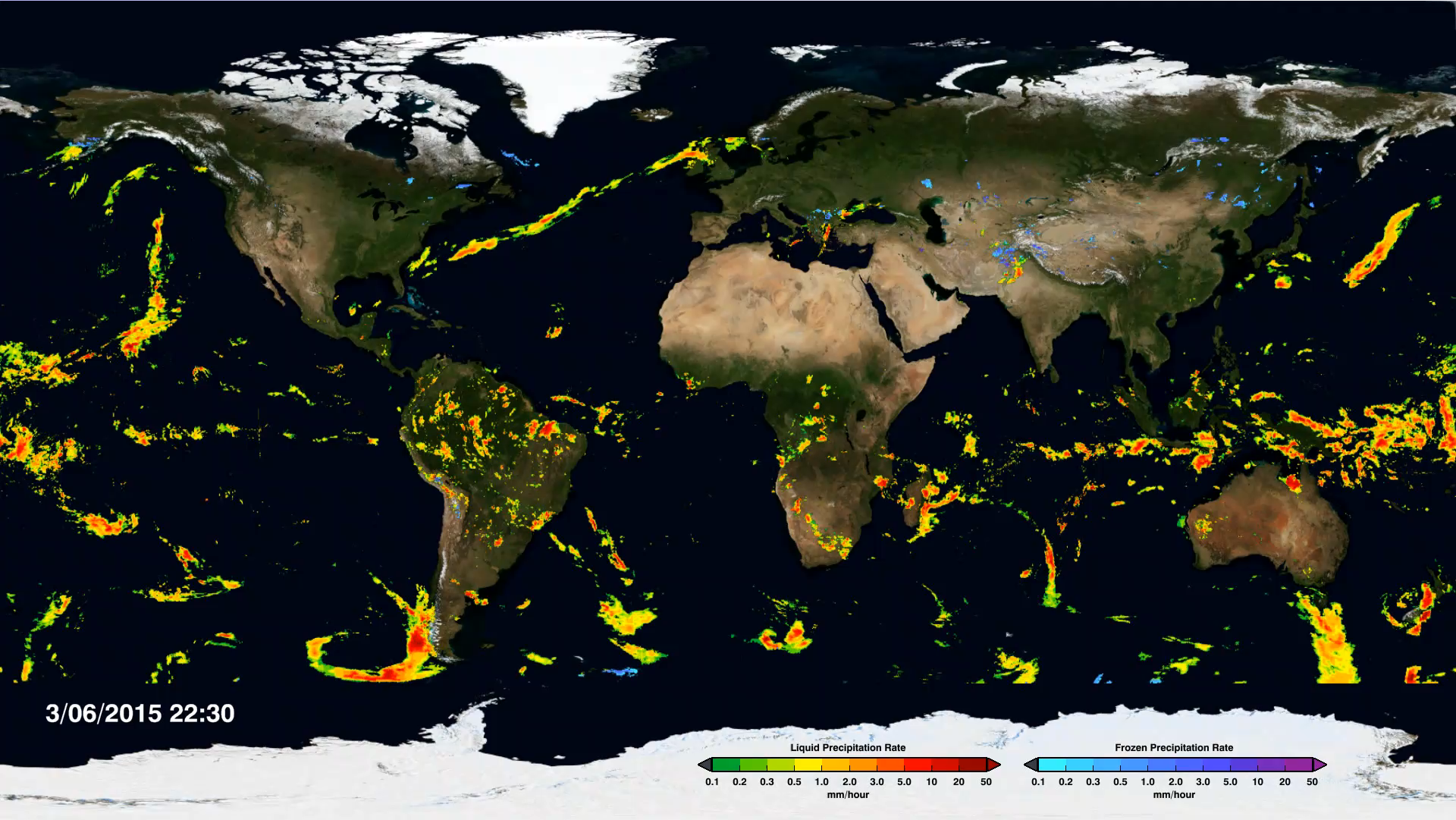
probability  
that  
precipitation  
phase is  
liquid;  
diagnostic  
computed  
from  
ancillary  
data



weighting of  
IR in the  
Kalman filter  
step



### 3. EXAMPLES – IMERG Final for 1-3 June 2014



## 4. VALIDATION – Release Notes

### “Day 1 IMERG Final Run Release Notes”

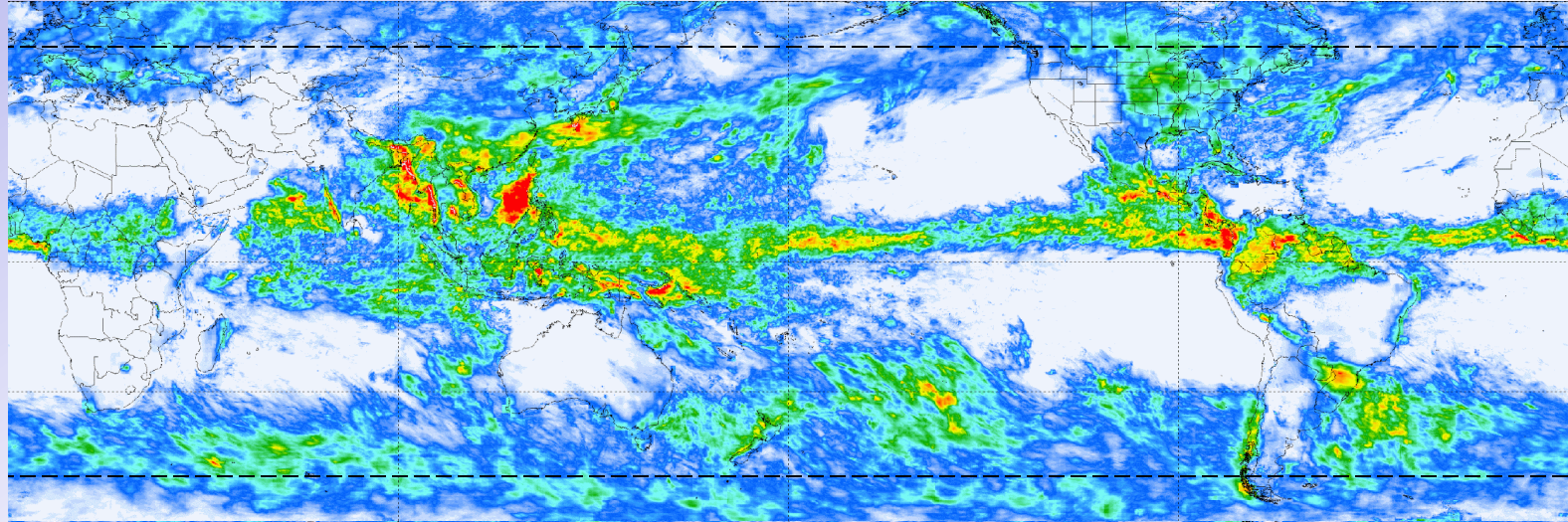
- an introduction and first cut at comparisons
- a living document
- [http://pmm.nasa.gov/sites/default/files/document\\_files/IMERG\\_FinalRun\\_Day1\\_release\\_notes.pdf](http://pmm.nasa.gov/sites/default/files/document_files/IMERG_FinalRun_Day1_release_notes.pdf)
  - this and all documents hot-linked on the IMERG data access page, accessible on the Level 3 tab on <http://pmm.nasa.gov/data-access/downloads/gpm>
- specific features, problems, behaviors
- effects due to IMERG’s structure
- cautions due to the input data
- biggest overall issue is that none of the inputs or IMERG are fully GPM-based

## 4. VALIDATION – IMERG Final Run vs. 3B43 for June 2014

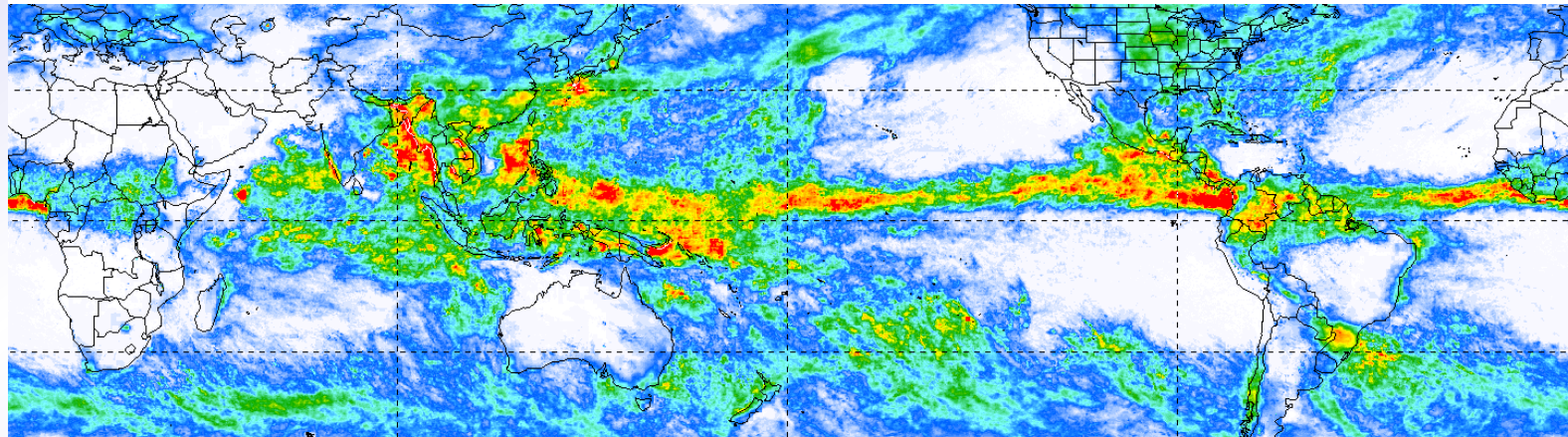
Same input satellites,  
different algorithms,  
different calibrator

Similar features, but not identical

- features (SPCZ)
- bias (ITCZ)



IMERG Final (mm/d) June 2014



TMPA 3B43 (mm/d) June 2014

# 4. VALIDATION – Daily 0.25° IMERG, 3B42, MRMS for 15 June 2014

MRMS = NOAA Multi-Radar Multi-Sensor

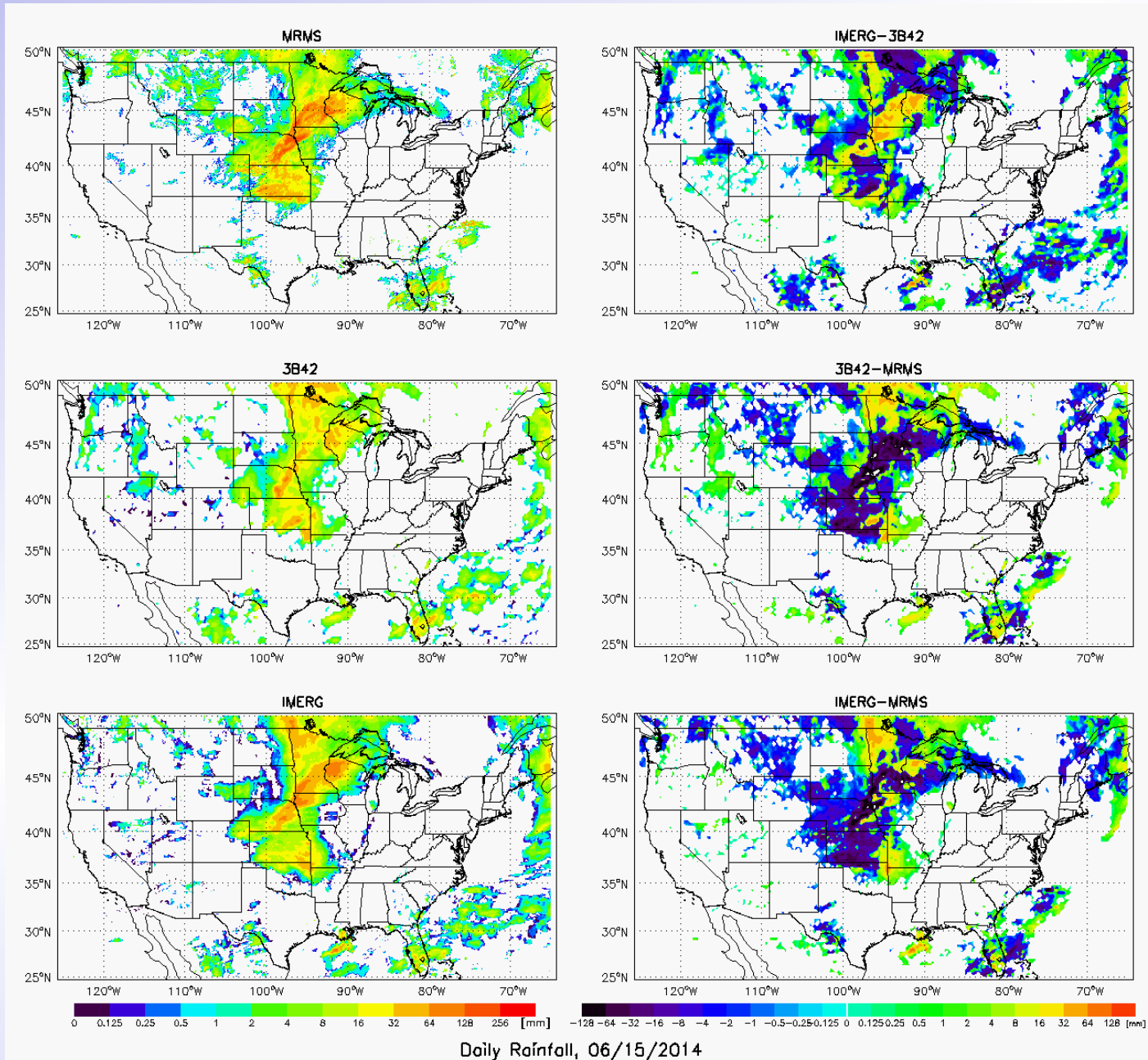
IMERG better

- Wisconsin to Nebraska
- Idaho, Nevada

IMERG worse

- N. Minnesota

Radar stops just off-shore; satellite doesn't



[Courtesy J. Wang (SSAI; NASA/GSFC 612)]

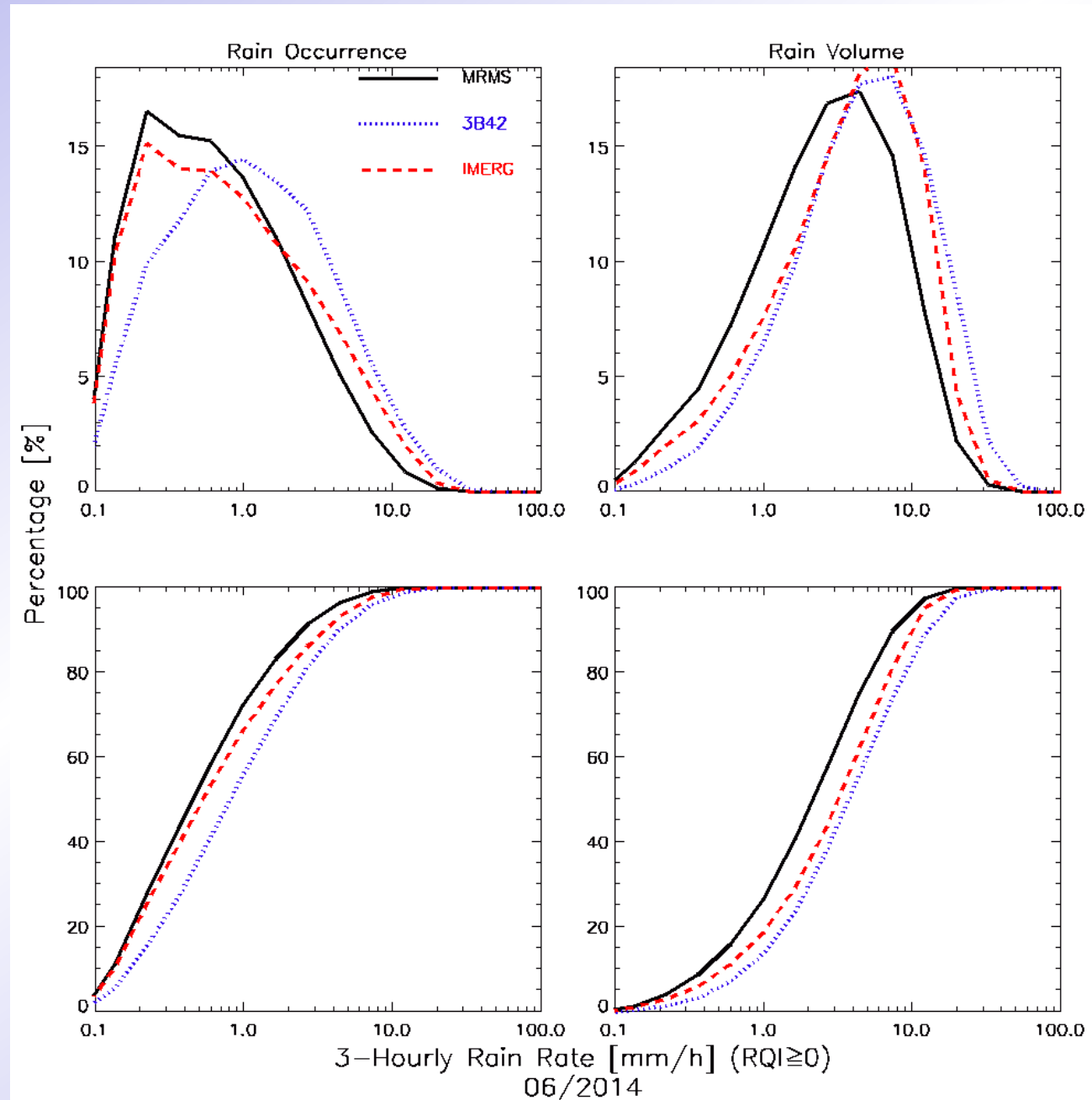
#### 4. VALIDATION – 3-Hourly, 0.25° IMERG, 3B42, MRMS for 15 June 2014

IMERG better than 3B42  
for precip occurrence

IMERG performs modestly  
better for precip volume

Note: Original footprint  
GPROF retrievals below  
0.1 mm/hr are thresholded  
to zero

- how this affects  
IMERG depends on the  
resolution of the input  
sensor and  
subsequent averaging  
(here 0.25°)



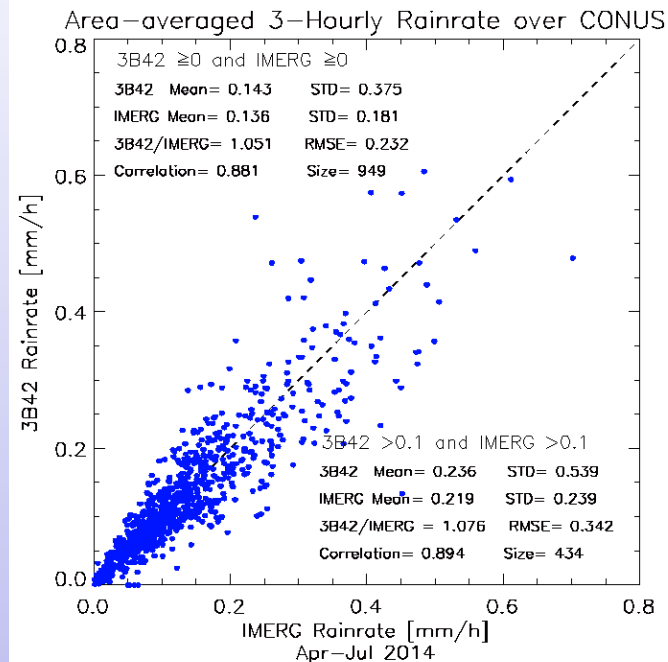
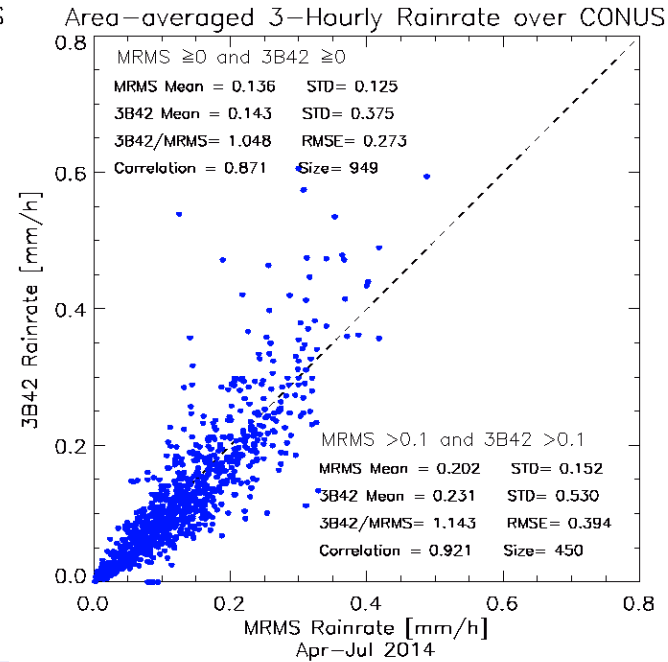
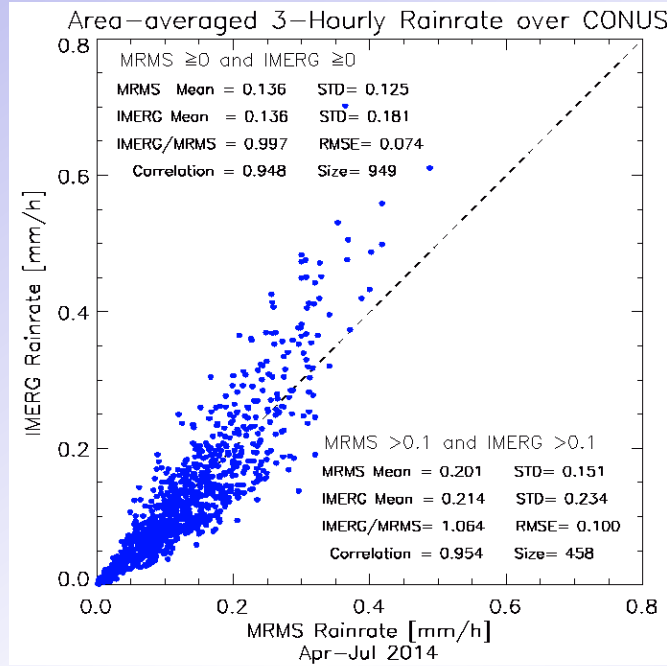
# 4. VALIDATION – 3-Hourly, CONUS-avg. IMERG, 3B42, MRMS for April–July

2014

IMERG better for bias and RMSE

IMERG and 3B42 trend high at high rates

At this spatial scale, error is roughly multiplicative



[Courtesy J. Wang (SSAI; NASA/GSFC 612)]

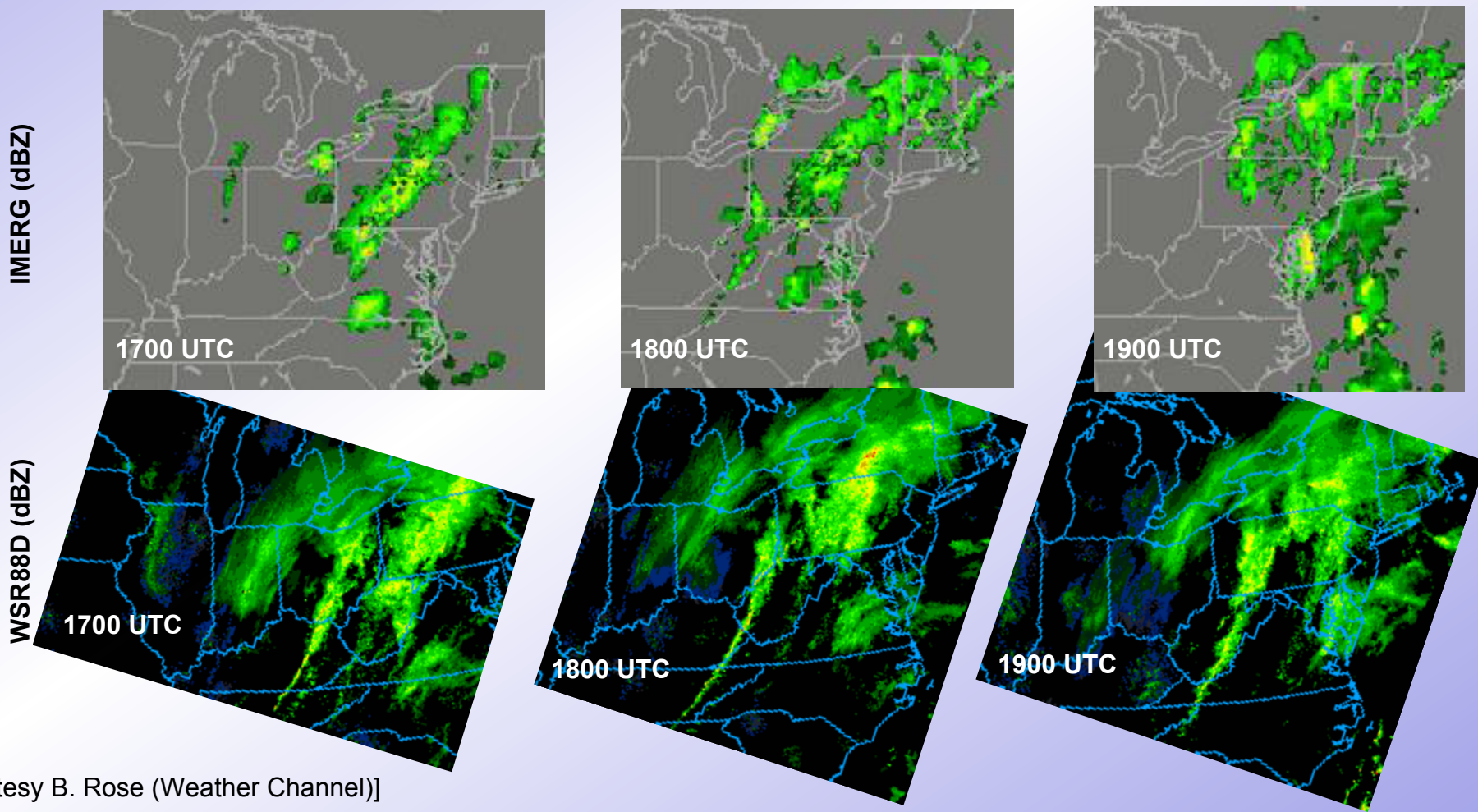


#### 4. VALIDATION – Snow in IMERG, NWS WSR88D, 12 March 2014

IMERG converted to dBZ, WSR88D in dBZ; both original resolution

Hang-back line in radar missing in IMERG

2-5” of snow with near-blizzard conditions at Cleveland, Ohio around 1900 UTC

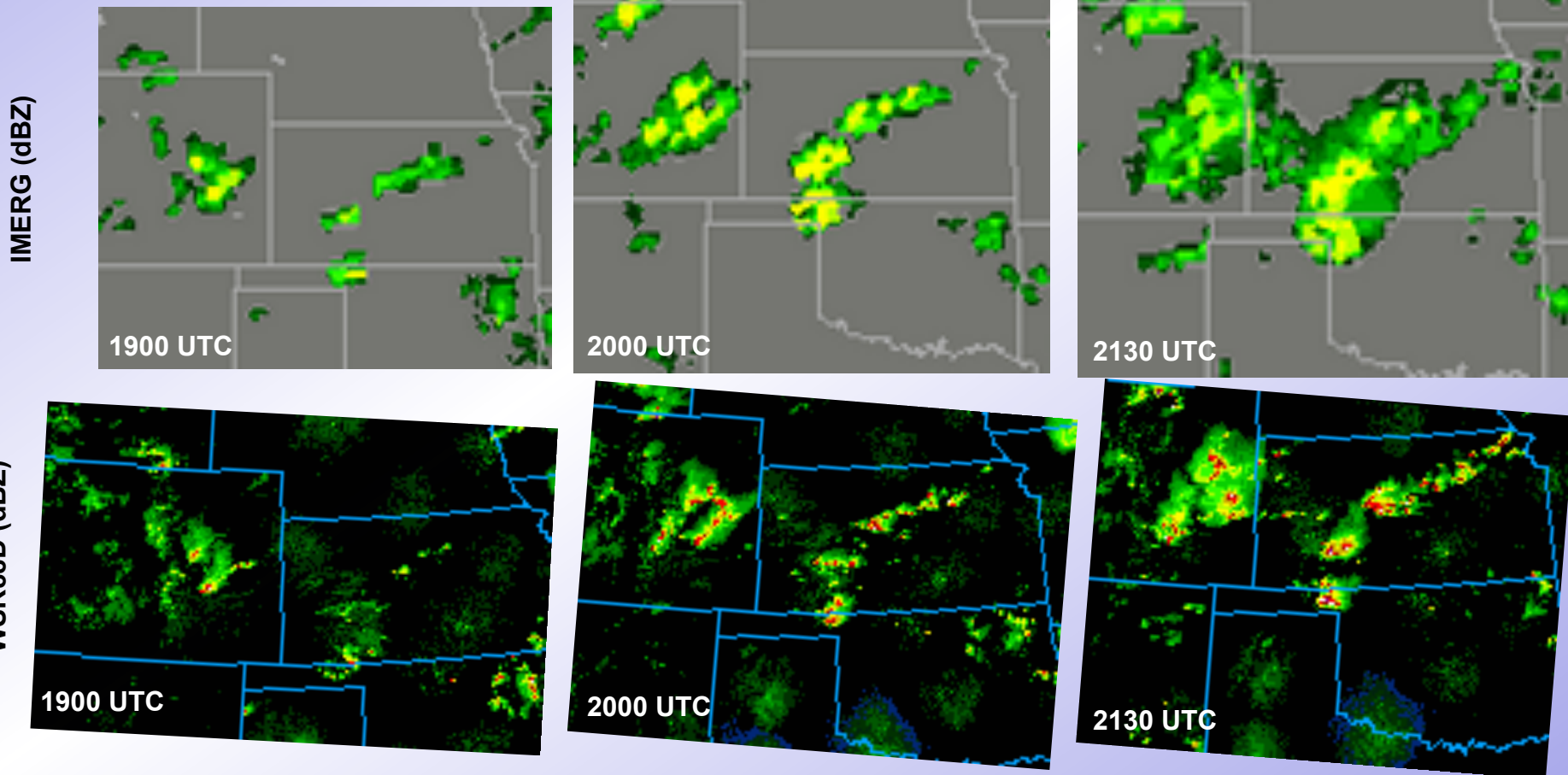


#### 4. VALIDATION – Supercells in IMERG, NWS WSR88D, 22 July 2014

IMERG converted to dBZ, WSR88D in dBZ; both original resolution

IMERG has good placement of supercells

Anvils more prominent in IMERG, lower maximum values (resolution?)



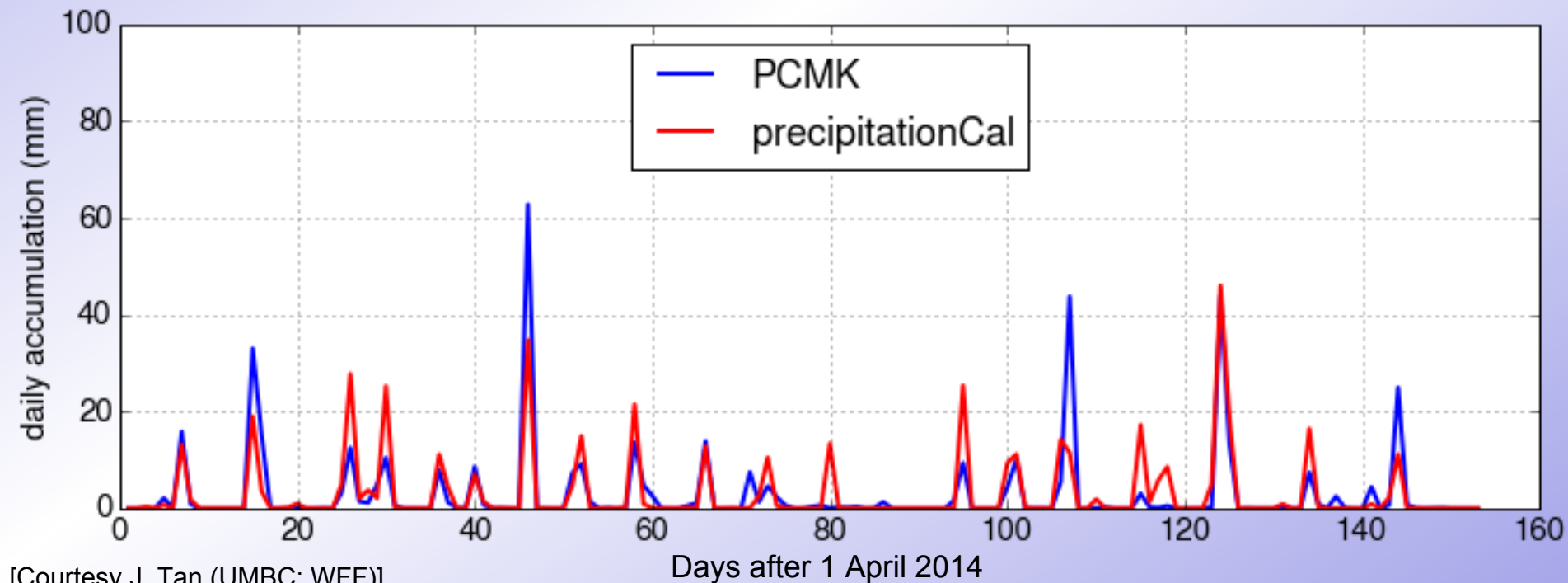
[Courtesy B. Rose (Weather Channel)]

#### 4. VALIDATION – Daily IMERG and Pocamoke Fine-Scale Grid, April-August 2014

23 surface gauges in a 6x5 km region near Wallops Island, Virginia

Excellent correlation for most events (warm season)

Both over- and under-estimates for largest events



#### 4. VALIDATION – Half-Hourly IMERG Sources and Pocamoke Fine-Scale Grid, April-August 2014

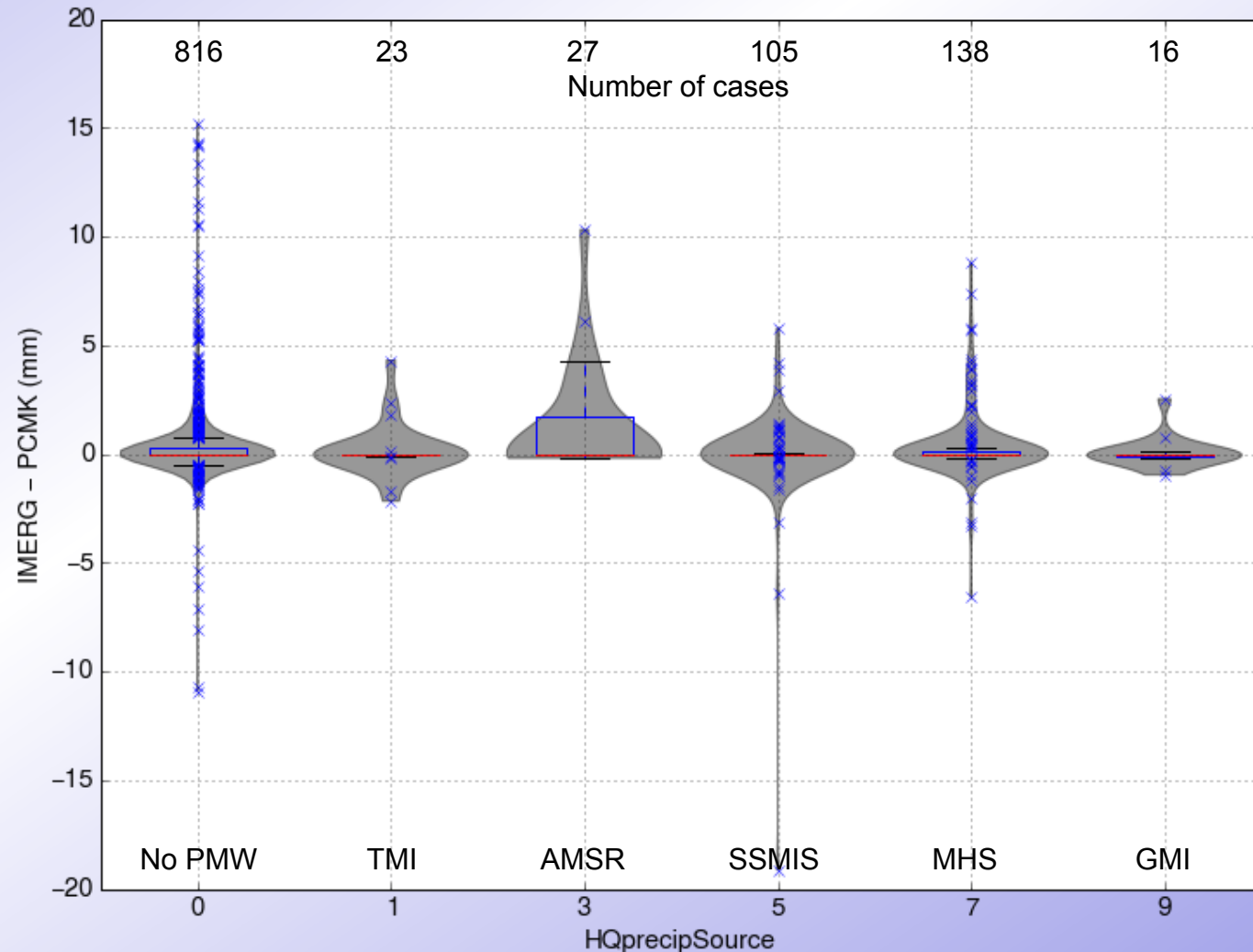
“Violin diagram” for individual sources of the half-hourly IMERG estimates

- width shows relative contribution for each difference bin

GMI is best; AMSR and SSMIS less so

The extra scatter for no-PMW (interpolated) is partly driven by the large number of cases

No-PMW (interpolated) data are competitive with the skill for most of the sensors



## 5. FUTURE – Transitioning from TRMM to GPM

IMERG is becoming available

- Final Run for mid-March to October 2014 (having a fight with November)
- Late Run in Beta Test, starting from 7 March 2015
- Early Run in Alpha Test

Early 2016: first-generation GPM-based IMERG archive, March 2014–present

Early 2017: first-generation TRMM/GPM-based IMERG archive, 1998–present

What happens to TMPA now that the TRMM satellite has run out of fuel?

- TRMM will be shut down in April 2015
- TMI has been useful throughout, but PR products stopped 8 October 2014
- TMPA-RT uses climatological calibration, so continues to run “as is”
- production TMPA partly depends on PR for calibration
  - production switches to climatological calibration with October 2014
  - performance is being scrutinized
  - gauge calibration over land should continue to yield consistent results
  - climatological calibration over ocean is likely to cause a discontinuity
- loss of legacy sounder estimates could raise issues for continuing TMPA

## 6. FINAL COMMENTS

The U.S. Day-1 GPM multi-satellite precipitation algorithm is constructed as a unified U.S. algorithm

IMERG is becoming available

- Final Run for mid-March to October 2014 (having a fight with November)
- Late Run in Beta Test, starting from 7 March 2015
- Early Run in Alpha Test
- GPM era reprocessed in early 2016
- TRMM-GPM eras reprocessed in early 2017
- TMPA to be run until mid-2017

Even the Day-1 datasets are typically an improvement over TMPA

- There is no substitute for seeing how particular IMERG runs work for your application

[george.j.huffman@nasa.gov](mailto:george.j.huffman@nasa.gov)

[pmm.nasa.gov](http://pmm.nasa.gov)

## **Reserve Slides**

## 2. IMERG DESIGN – Processing

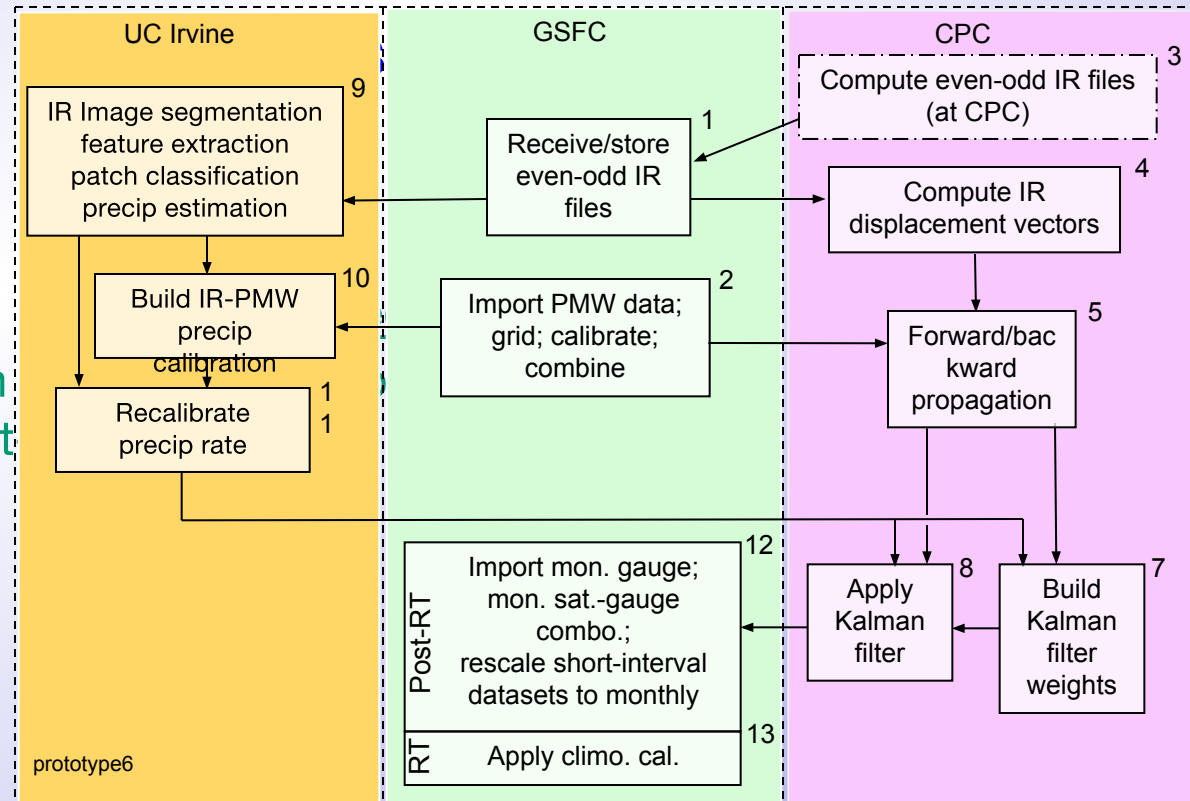
IMERG is a unified U.S. algorithm that takes advantage of

- Kalman Filter CMORPH (lagrangian time interpolation) – NOAA
- PERSIANN with Cloud Classification System (IR) – U.C. Irvine
- TMPA (inter-satellite calibration, gauge combination) – NASA
- all three have received PMM support
- PPS (input data assembly, processing environment) – NASA

The Japanese counterpart is

Institutions are shown for module origins, but

- package will be an
- goal is single code system
- real and post
- “the devil is in the details”

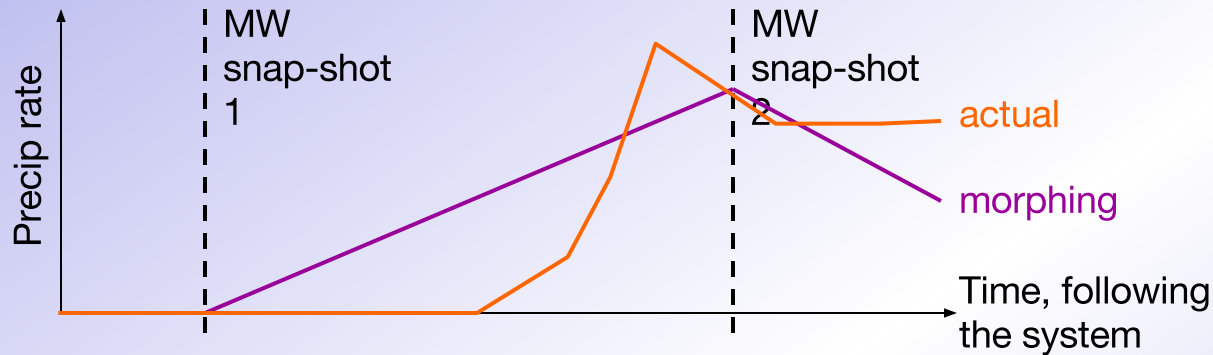




## 4. FUTURE – Where do we need help? (1/2)

We need a better treatment for (precipitation system) cloud growth and decay

- current morphing is linear interpolation between microwave snapshots



- how do we use more-frequent GEO data to capture short-interval variations?

### Orographic enhancement and suppression

- that happens in the liquid phase
- is missed by current microwave algorithms
- because they only quantitatively detect solid hydrometeors (using scattering channels) over land
- “obvious” choices are hard:
  - compute quantitative results for liquid phase (use emission channels)
  - model moisture convergence and precipitation with ancillary data

# Live Demonstration of IMERG Access and GIS Analysis



<http://giovanni.gsfc.nasa.gov/giovanni/>

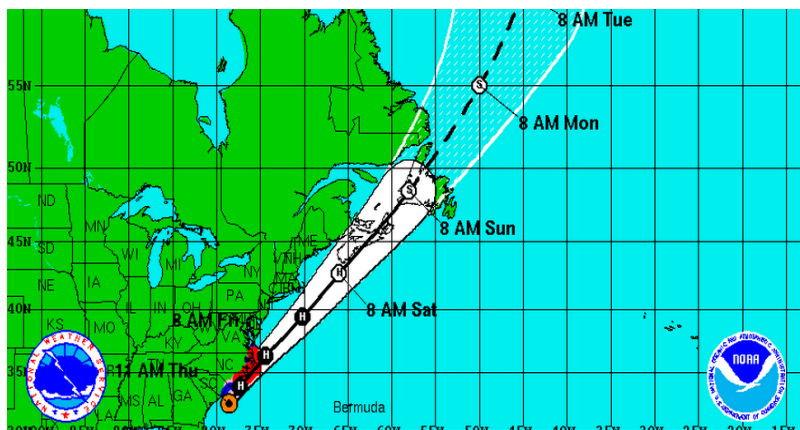


# Hurricane Arthur (1-5 July 2014)



**Hurricane Arthur, formed off southern Florida on July 1, 2014, and is moving north toward the Outer Banks on 4<sup>th</sup> of July.**

**Arthur continued to move northward to mid- and high-latitudes causing heavy rains over New England and Atlantic Coast of Canada**



Reference, National Hurricane Center  
(2014, July 2)

# GPM Data Access - Giovanni Version 4 data portal



<http://giovanni.gsfc.nasa.gov/giovanni/>

## Giovanni Home page

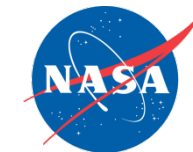
The screenshot shows the Giovanni data portal interface. At the top, there is a navigation bar with 'EARTHDATA' and several dropdown menus: 'Data Discovery', 'Data Centers', 'Community', and 'Science Disciplines'. Below this is the 'GIOVANNI' logo and the tagline 'The Bridge Between Data and Science v 4.12', along with links for 'Release Notes', 'Browser Compatibility', and 'Known Issues'. A yellow banner at the top left reads 'GOCART data no longer available... [1 of 1 messages] Read More'. The main content area is divided into several sections. On the left, there are 'Select Date Range' and 'Select Variables' sections. The 'Select Variables' section has two expandable categories: 'Disciplines' and 'Measurements'. The 'Maps Choices' section is highlighted with a red box and contains several options: 'Time-Averaged' (selected), 'Animated', 'User-Defined Climatology', 'Accumulated', and 'Difference of Time Averaged'. Each option has a 'Details...' link. On the right, there is a 'Shapefile' section with 'Show Map' and 'Show Shapes' buttons, and a 'Variable(s) included in Plot: 0' section with 'Search' and 'Clear' buttons. At the bottom right, there are 'Help', 'Reset', 'Feedback', and 'Plot Data' buttons. A yellow box on the right side of the page is labeled 'Analysis/Plot Options' and contains the text 'Dropdown Menu options' and 'Choose Time-Averaged'. A yellow arrow points from this box to the 'Time-Averaged' option in the 'Maps Choices' section.

**Analysis/Plot Options**

**Dropdown Menu options**

**Choose Time-Averaged**

# Giovanni Version 4



<http://giovanni.gsfc.nasa.gov/giovanni/>

**Select Date Range (UTC)**  
YYYY-MM-DD HH:mm to YYYY-MM-DD HH:mm  
2014 -07 -01 04 : 00 to 2014 -09 -30 23 : 59

**Select Region (Bounding Box or Shapefile)**  
Format: West, South, East, North  
-180, -50, 180, 50

Pick a start date

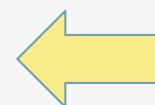
2014 07 - Jul

Su	Mo	Tu	We	Th	Fr	Sa
29	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9

Pick an end date

2014 07 - Jul

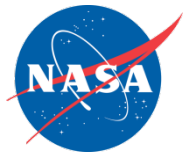
Su	Mo	Tu	We	Th	Fr	Sa
29	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9



**Temporal Search**  
Click calendar to choose the date range of interest

- Air Temperature (15)
- Albedo (8)
- Altitude (4)

# Giovanni Version 4



<http://giovanni.gsfc.nasa.gov/giovanni/>

**GIOVANNI** The Bridge Between Data and Science v 4.12 [Release Notes](#) [Browser Compatibility](#) [Known Issues](#)

**GOCART data no longer available...** [1 of 1 messages] [Read More](#)

Select Plot

Maps: Time-Averaged  Comparisons: Select...  Time Series: Select...  Vertical: Select...  Miscellaneous: Select...

Select Date Range (UTC)

YYYY-MM-DD HH:mm

2014 -07 -01 04 : 00 to 2014 -07 -07 04 : 00 -180, -50, 180, 50 Show Map

Valid Range: 1979-01-01 to 2015-03-16

Select Variables

**Disciplines**

- Aerosols (117)
- Atmospheric Chemistry (18)
- Atmospheric Dynamics (64)
- Hydrology (114)
- Water and Energy Cycle (120)

**Measurements**

- Aerosol Index (1)
- Air Pressure (6)
- Air Temperature (15)
- Albedo (8)
- Altitude (4)

Number of matching:   
Please select at least 1   
Keyword:

Select Region (Bounding Box or Shapefile)

Format: West, South, East, North

-180, -50, 180, 50

Show Map

Shape Files

- Countries**
- US States

Shape

- Afghanistan
- Albania
- Algeria
- American Samoa
- Andorra
- Angola
- Anguilla

Done Clear Shape Selection

Help Reset Feedback

**Spatial Search**

You can manually enter the latitude/longitude of your region

OR

Click **Show Shapes** to select shapefiles for various Countries or US States

# Giovanni Version 4



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**GIOVANNI** The Bridge Between Data and Science v 4.12 [Release Notes](#) [Browser Compatibility](#) [Known Issues](#)

GOCART data no longer available... [1 of 1 messages] [Read More](#)

Select Plot

Maps: Time-Averaged  Comparisons: Select...  Time Series: Select...  Vertical: Select...  Miscellaneous: Select...

Select Date Range (UTC)

YYYY-MM-DD HH:mm  
2014 -07 -01 04:00 to 2014 -07 -07 04:00 -180, -50, 180, 50

Valid Range: 1979-01-01 to 2015-03-16

Select Variables

▼ Disciplines

- Aerosols (117)
- Atmospheric Chemistry (18)
- Atmospheric Dynamics (64)
- Hydrology (114)
- Water and Energy Cycle (120)

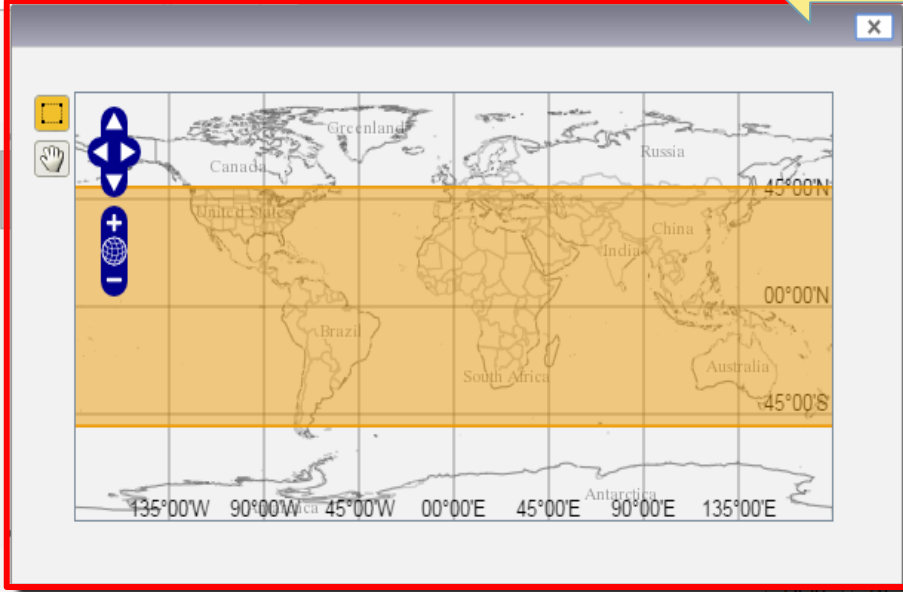
▼ Measurements

- Aerosol Index (1)
- Air Pressure (6)
- Air Temperature (15)
- Albedo (8)
- Altitude (4)

Select Region (Bounding Box or Shapefile)

Format: West, South, East, North

Show Map



**Spatial Search**

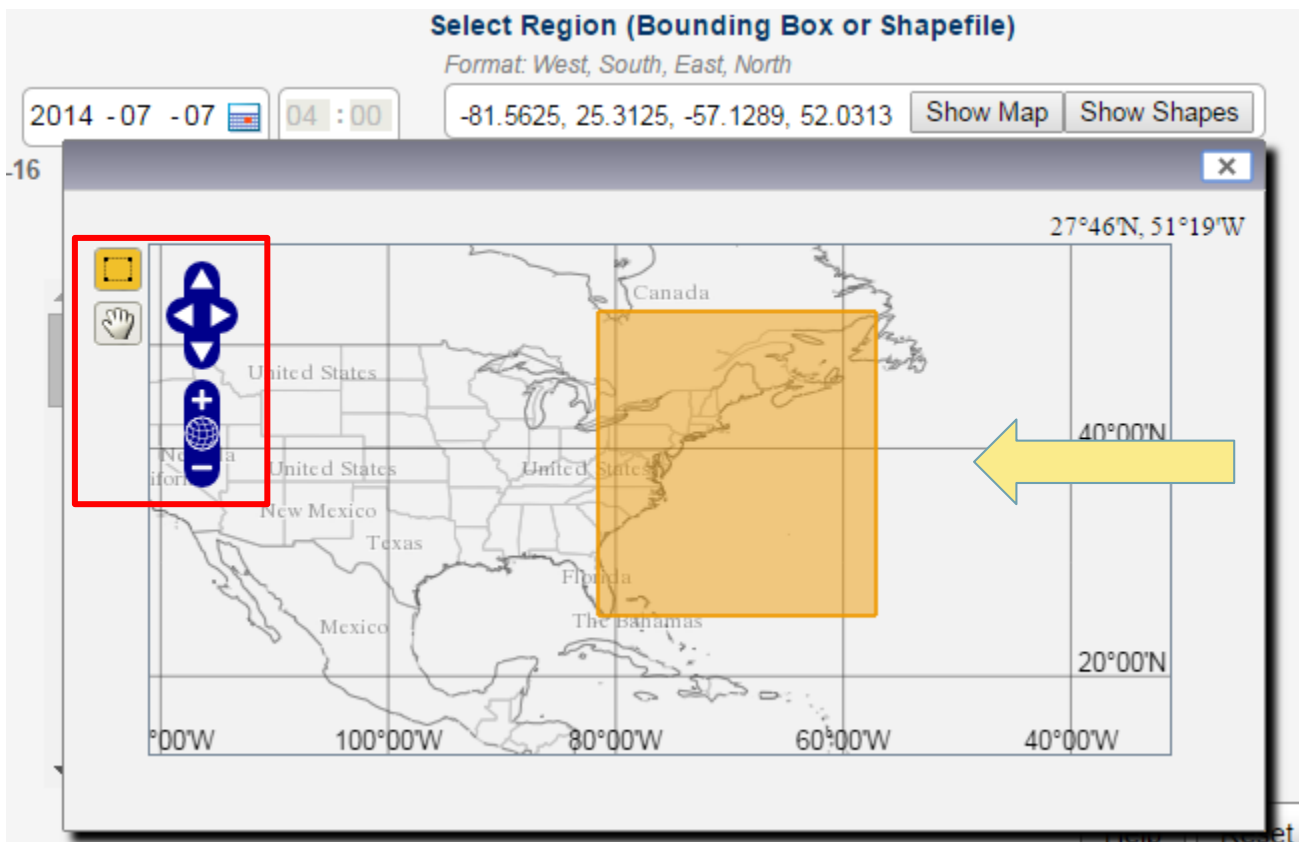
Alternatively, you can

Click **Show Map** to select a bounding box for your region of interest

# Giovanni Version 4



<http://giovanni.gsfc.nasa.gov/giovanni/>

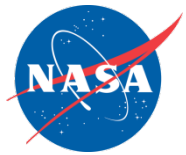


## Spatial Search

Using the interactive map tools, zoom into your region of interest and select your bounding box for data retrieval



# Giovanni Version 4

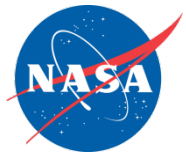


<http://giovanni.gsfc.nasa.gov/giovanni/>

The screenshot shows the GIOVANNI web interface with the following elements:

- Navigation:** EARTHDATA, Data Discovery, Data Centers, Community, Science Disciplines.
- Header:** GIOVANNI The Bridge Between Data and Science v 4.12 [Release Notes](#) [Browser Compatibility](#) [Known Issues](#)
- Alert:** GOCART data no longer available... [1 of 1 messages] [Read More](#)
- Select Plot:** Radio buttons for Maps: Time-Averaged (selected), Comparisons, Time Series, Vertical, and Miscellaneous.
- Select Date Range (UTC):** Input fields for YYYY-MM-DD and HH:mm, with a valid range of 1979-01-01 to 2015-03-13.
- Select Region (Bounding Box or Shapefile):** Input field for coordinates (-180, -90, 180, 90) and buttons for Show Map and Show Shapes.
- Select Variables:** A list of variables categorized under Disciplines and Measurements. A red box highlights this section.
- Search:** A text input field for a keyword (highlighted with a red box), a Search button, and a Clear button. Above it, it shows "Number of matching Variables: 0 of 331" and "Total Variable(s) included in Plot:".
- Annotations:** A yellow box on the right contains the text: "Either type the variable 'precipitation' in the Keyword search OR Navigate through the Select Variables list". Yellow arrows point from this box to the keyword search field and the Select Variables list.
- Footer:** Help, Reset, Feedback, and a large green Plot Data button.

# Giovanni Version 4



<http://giovanni.gsfc.nasa.gov/giovanni/>

## Select Variables

### Disciplines

- Aerosols (117)
- Atmospheric Chemistry (18)
- Atmospheric Dynamics (64)
- Hydrology (114)
- Water and Energy Cycle (120)

### Measurements

### Platform / Instrument

### Wavelengths

### Depths

Number of matching Variables: 114 of 331

Total Variable(s) included in Plot: 0

Please select at least 1 variable

Keyword :

Search

Clear

	Variable Name	Source	Temp. Res.	Spat. Res.	Begin Date	End Date	Vert. Slice
<input type="checkbox"/>	<a href="#">Precipitation Rate (TRMM_3B42_daily v6)</a>	TRMM	Daily	0.25 °	1997-12-31	2011-06-30	-
<input type="checkbox"/>	<a href="#">Precipitation Rate (TRMM_3B42_daily v7)</a>	TRMM	Daily	0.25 °	1997-12-31	2014-10-31	-
<input type="checkbox"/>	<a href="#">Precipitation Total (NLDAS_FORA0125_H v002)</a>	NLDAS Model	Hourly	0.125 °	1979-01-01	2015-03-12	-
<input type="checkbox"/>	<a href="#">Evapotranspiration Total (NLDAS_NOAH0125_H v002)</a>	NLDAS Model	Hourly	0.125 °	1979-01-02	2015-03-12	-
	<a href="#">Soil Moisture Content Layer 1 (0 10</a>						

## Select Variables

### Measurements

- Precipitation (13)

### Platform / Instrument

- GLDAS Model (27)
- GPM (13)
- NLDAS Model (70)
- TRMM (4)

### Spatial Resolutions

### Temporal Resolutions

### Portal

Help

Reset

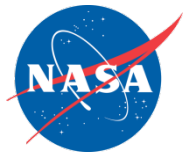
Feedback

Plot Data

## Navigate through the Select Variables list

Check boxes next to the various **Disciplines** (Hydrology), **Measurements** (Precipitation), **Platform / Instrument (GPM)** to narrow down your search for the desired variables

# Giovanni Version 4



<http://giovanni.gsfc.nasa.gov/giovanni/>

## Select Variables

Hydrology (9)

### Measurements

Precipitation (9)

### Platform / Instrument

GPM (9)

### Spatial Resolutions

### Temporal Resolutions

half-hourly (9)

monthly (4)

### Portal

Number of matching Variables: 9 of 331

Total Variable(s) included in Plot: 1

Keyword :

Search Clear

	Variable Name	Source	Temp. Res.	Spat. Res.	Begin Date	End Date	Vert. Slice
<input type="checkbox"/>	<a href="#">Instantaneous Precipitation - UnCalibrated (GPM_3IMERGHH v03)</a>	GPM	Half-Hourly	0.1 °	2014-03-12	2014-11-30	-
<input checked="" type="checkbox"/>	<a href="#">Instantaneous Precipitation - Calibrated (GPM_3IMERGHH v03)</a>	GPM	Half-Hourly	0.1 °	2014-03-12	2014-11-30	-
<input type="checkbox"/>	<a href="#">Instantaneous Precipitation - UnCalibrated (GPM_3IMERGHH v03)</a>	GPM	Half-Hourly	0.1 °	2014-03-12	2014-11-30	-
<input type="checkbox"/>	<a href="#">Calibrated-precipitation random error (GPM_3IMERGHH v03)</a>	GPM	Half-Hourly	0.1 °	2014-03-12	2014-11-30	-

Help

Reset

Feedback

Plot Data

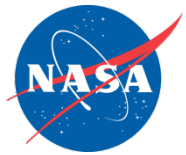
Scroll down and select

**Instantaneous Precipitation - Calibrated (GPM\_3IMERGHH v03)**  
**Half-Hourly Temporal Resolution**



Click  
**Plot Data**

# Giovanni Version 4

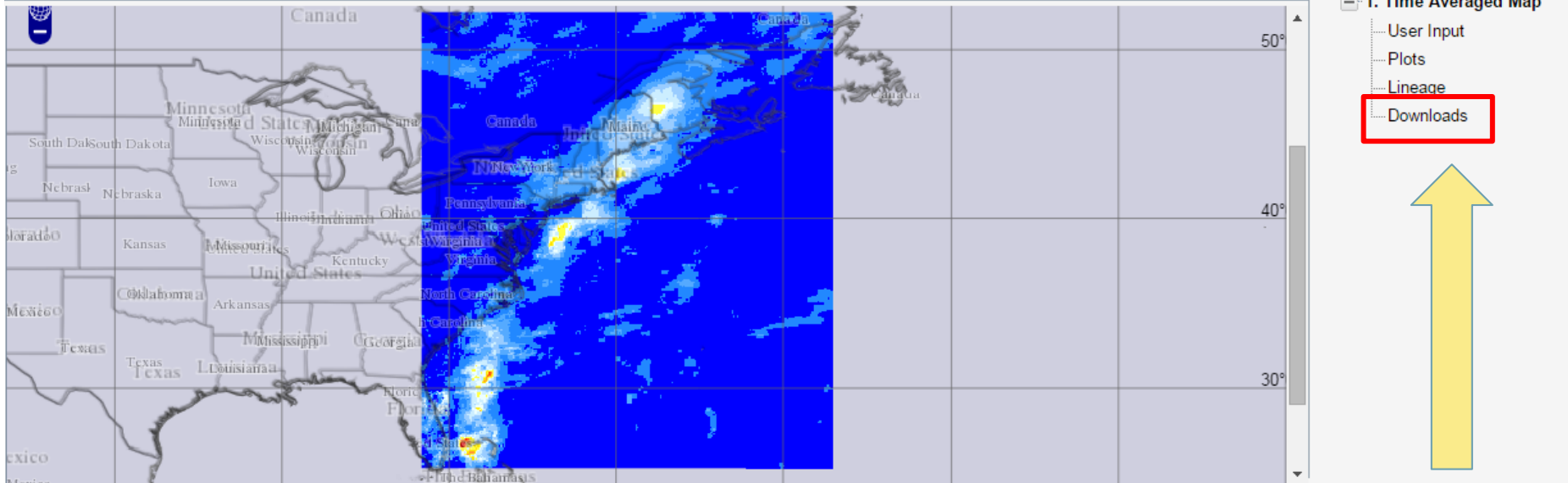


<http://giovanni.gsfc.nasa.gov/giovanni/>

A Time Averaged Map will be generated with precipitation displayed in mm/hr from July 1, 2017 - July 7, 2014 for our region

Time Averaged Map of Instantaneous Precipitation - Calibrated half-hourly 0.1 deg. [GPM GPM\_3IMERGHH v03] mm/hr over 2014-07-01 04:00Z - 2014-07-07 04:29Z, Region 81.5625W, 25.3125N, 57.1289W, 52.0313N

## 1. Time Averaged Map



Click Downloads to display links to data files ready for downloading.

***\*You may also use the time averaged map or an animated maps to narrow down specific half-hourly periods to download.***

# Giovanni Version 4



<http://giovanni.gsfc.nasa.gov/giovanni/>

You can download the data files in either NetCDF, GeoTIFF or PNG formats.  
NetCDF format is easily imported into ArcMap.  
Click the link to download to your desired location on your computer.

**GIOVANNI** The Bridge Between Data and Science v 4.12 [Release Notes](#) [Browser Compatibility](#) [Known Issues](#)

GOCART data no longer available... [1 of 1 messages] [Read More](#)

## 1. Time Averaged Map

Click on file links to download. Files contain data portrayed in the plot images.

**NetCDF Format:**  
[timeAvgMap.GPM\\_3IMERGHH\\_03\\_precipitationCal.20140701-20140707.81W\\_25N\\_57W\\_52N.nc](#)

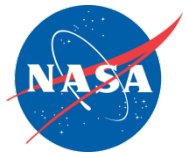
**Images (GeoTIFF):**  
[timeAvgMap.GPM\\_3IMERGHH\\_03\\_precipitationCal.20140701-20140707.81W\\_25N\\_57W\\_52N.geotiff](#)

**Images (PNG):**  
[timeAvgMap.GPM\\_3IMERGHH\\_03\\_precipitationCal.20140701-20140707.81W\\_25N\\_57W\\_52N.png](#)

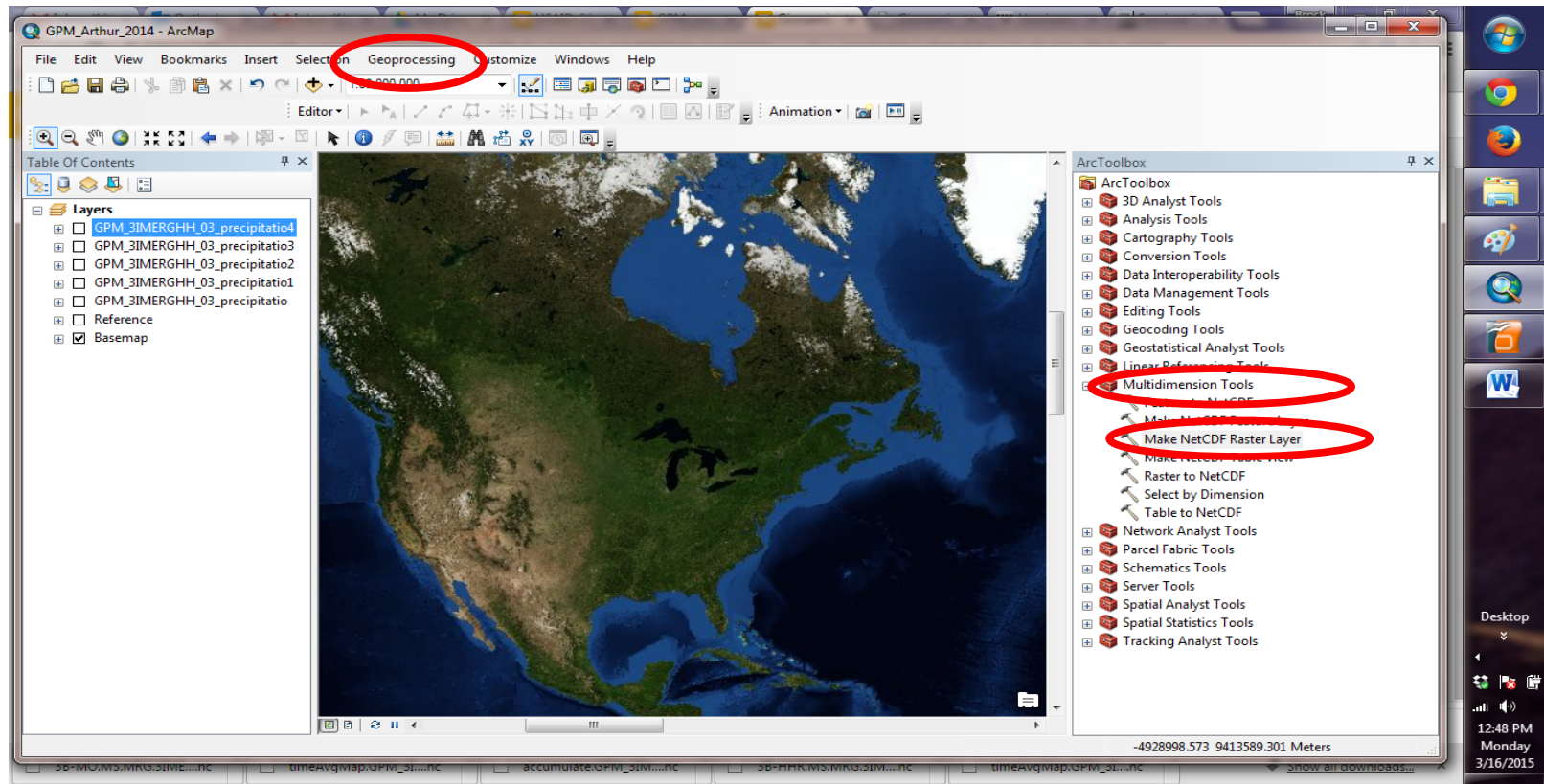
**History**

- 1. Time Averaged Map
  - User Input
  - Plots
  - Lineage
  - Downloads

[Acknowledgment Policy](#) [Help](#) [Feedback](#) [Back to Data Selection](#)



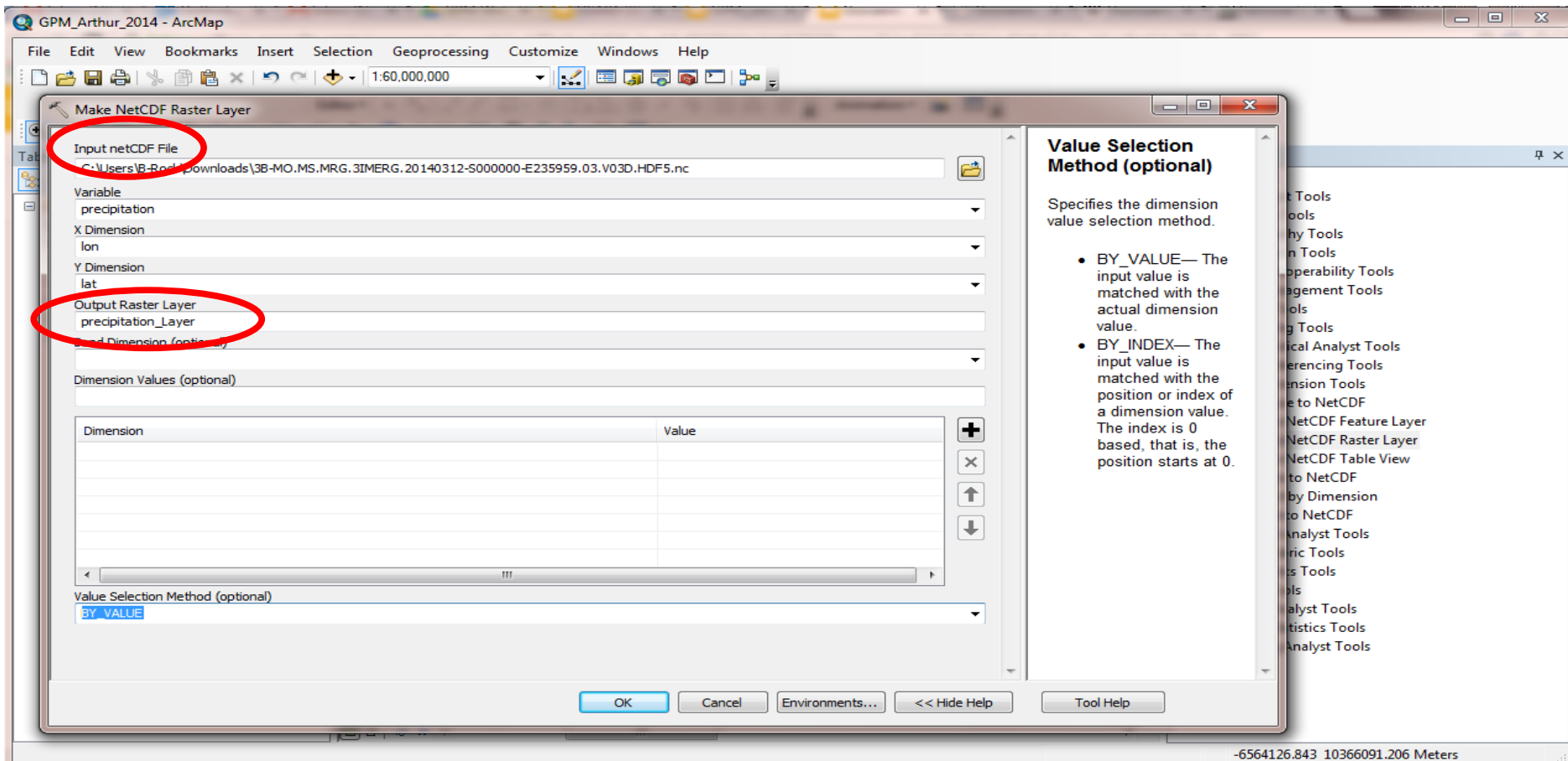
# Import into GIS (ArcMAP)



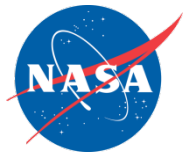
Import TRMM precipitation data - Under the Geoprocessing Tab, Open the ArcToolbox. Open the Multidimensional toolbox, choose the **Make NetCDF Raster Layer** tool



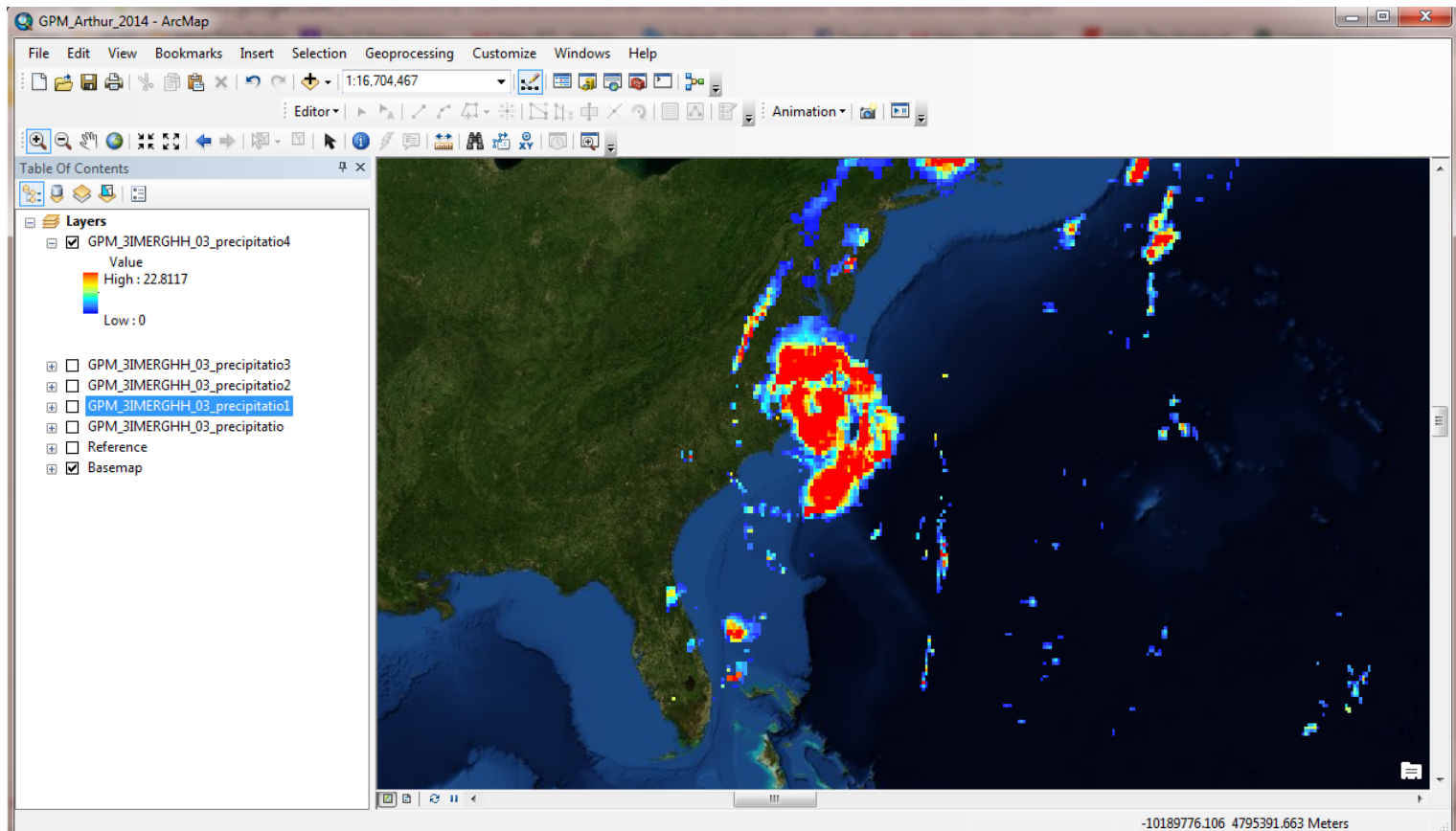
# Import into GIS (ArcMAP)



For the input field, **Input netCDF File**: Navigate to and click on the previously downloaded GPM precipitation file. The remaining fields will fill in accordingly, KEEP the default values. You may change the output file name if you choose. Click OK.



# Import into GIS (ArcMAP)



The result will be in raster format in ArcMAP. Raster files are ideal for spatial analysis tools





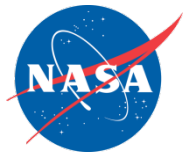
# Common GIS Data Layers

Rivers/Basins	USGS HydroSHEDS	<a href="http://hydrosheds.cr.usgs.gov/">http://hydrosheds.cr.usgs.gov/</a>
Population	NASA Socioeconomic Data and Applications Center (SEDAC)	<a href="http://sedac.ciesin.columbia.edu/">http://sedac.ciesin.columbia.edu/</a>
Elevation	Consortium for Spatial Information (CGIAR-CSI)	<a href="http://srtm.csi.cgiar.org/">http://srtm.csi.cgiar.org/</a>
Reservoirs	NASA Socioeconomic Data and Applications Center (SEDAC)	<a href="http://sedac.ciesin.columbia.edu/">http://sedac.ciesin.columbia.edu/</a>
Soil Type	ISRIC - World Soil Information	<a href="http://www.isric.org/">http://www.isric.org/</a>
Dams	NASA Socioeconomic Data and Applications Center (SEDAC)	<a href="http://sedac.ciesin.columbia.edu/">http://sedac.ciesin.columbia.edu/</a>
Infrastructure	See various local/state/regional GIS data sites	
Land Use	Waterbase	<a href="http://www.waterbase.org">http://www.waterbase.org</a>



# Course Summary

# NASA Remote Sensing Observations of Precipitation



- Tropical Rainfall Measuring Mission (TRMM) launched in November 1997 and Global Precipitation Measurement (GPM) mission launched in February 2014 provide high-quality precipitation measurements useful for various applications
- GPM Level-2 precipitation from GMI/DPR are available at high resolution (**5 km**) between 65°S to 65° N – 16 orbits per day, no continuous spatial coverage
- Integrated Multi-satellite Retrievals for GPM (IMERG), using GPM core satellite and constellation satellites, provides **half-hourly, 0.1°x0.1°** precipitation between 60°S to 60°N -- **will be available in near-real time with 4-hour data latency and will extend research quality TRMM Multi-satellite Precipitation Analysis Data useful for climate applications**
- Several web-based tools (PPS/STORM, Mirador, Giovanni) make it easy to access, analyze, visualize, and download freely available GPM and TRMM precipitation products

# NASA Remote Sensing Observations of Precipitation Trade Offs



- ❑ It is difficult to obtain extremely high spatial and temporal resolution at the same time – *high frequency, high resolution data can not be obtained globally due to sensors' swath widths and satellite orbital configuration*
- ❑ Various levels of data from individual sensors and derived data products from multiple sensors and satellites are available in various data formats – **selection depends on the applications**
- ❑ Data applications may require additional *in situ* measurements, processing, and analysis
- ❑ Regional validation is highly commended



# Concluding Remarks

- NASA Applied Sciences Program offers 'research to application' opportunities through competitive grants/proposals program (<http://nspires.nasaprs.com/external/>)
- NASA DEVELOP program offers opportunities to utilize NASA data products for specific environmental application involving student liaisons (<http://develop.larc.nasa.gov/>)

**ARSET** can provide advanced on-line and/or in-person trainings focused on specific environmental applications and geographic regions upon request in Air Quality, Land Management, Water Resources and Disasters Management (<http://arset.gsfc.nasa.gov/training>)

# Homework Assignment



**Homework Assignment Link**  
**Due by April 30, 2015**



# Important Information

## Who can request the Certificate of Completion?

Those who attended all 3 live sessions and submit the completed homework assignment by April 30, 2015

Send request to Marines Martins for the Certificate

Email: [marines.martins@ssaiha.com](mailto:marines.martins@ssaiha.com)

# Upcoming Training



## NASA Remote Sensing Observations and Tools for Flood Management

webinar sessions on  
June 8, 15, 22, and 29 June 2015



# ARSET ListServ



**For information on upcoming courses and program updates sign up to the listserv**

<https://lists.nasa.gov/mailman/listinfo/arset>



# Thank You!

**Amita Mehta**

**email: [amita.v.mehta@nasa.gov](mailto:amita.v.mehta@nasa.gov)**