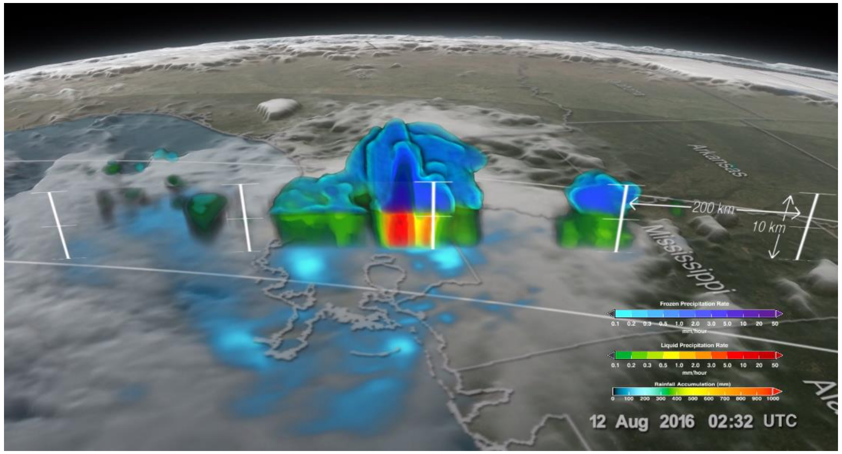
Status of the Global Precipitation Measurement (GPM) Mission Data Products and Applications



Speakers:

George Huffman george.j.huffman@nasa.gov
Dorian Janney dorian.w.janney@nasa.gov
Dalia Kirschbaum dalia.b.kirschbaum@nasa.gov
Amita Mehta amita.v.mehta@nasa.gov
Jacob Reed Jacob.reed@nasa.gov

Webinar Host:

Kristen Weaver kristen.l.weaver@nasa.gov

Background and Objective

- GPM Applications program conducts periodic webinars and in-person trainings to facilitate societally relevant decision support activities including water resources management; weather, climate and disasters monitoring; agriculture; and health

- During 2015-16 four webinars and an in-person training were conducted to describe details of GPM mission, sensors, algorithms, data products, data validation campaigns, and web portals for data access and analysis

- **The objective of the present webinar** is to provide updates about the GPM data products, data access tools, GPM E-Book for water resources and disasters applications, and examples of GPM data applications

Outline

- Brief Overview of GPM and Previous Trainings
- GPM IMERG* Data Updates
- GPM Applications
- Overview of GPM E-Book
- GPM Data Access Updates

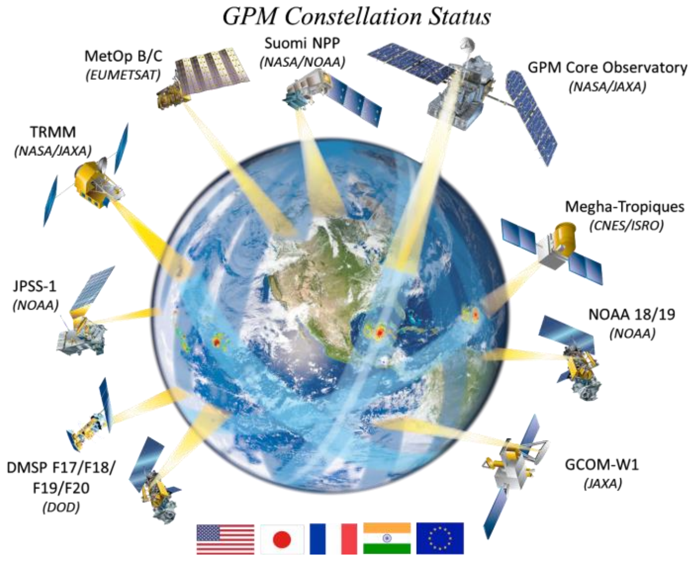
*Integrated Multi-satellitE Retrievals for GPM

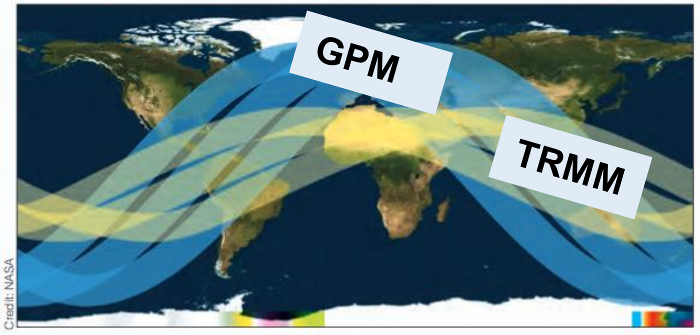
Brief Overview of GPM

- The Mission consists of the GPM Core satellite and a number of constellation satellites

- GPM Core Satellite:
  Launch- February 27th, 2014
  Altitude- 407 km
  Orbit- Non-polar covering region between 65° S to 65° N latitudes

- Sensors:
  - GPM Microwave Imager (GMI)
  - Dual-frequency Precipitation Radar(DPR)





GPM Sensors

GMI

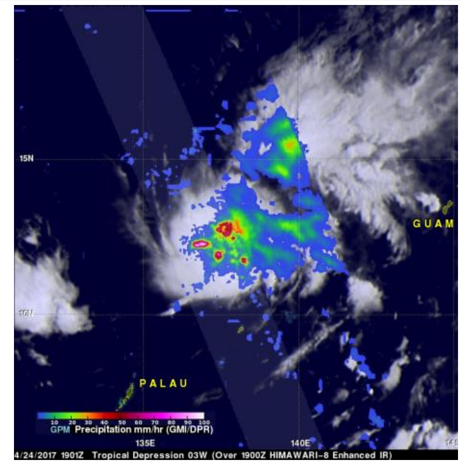
Frequencies:
10.6,18.7,23.8,36.5,89,166 & 183 GHz

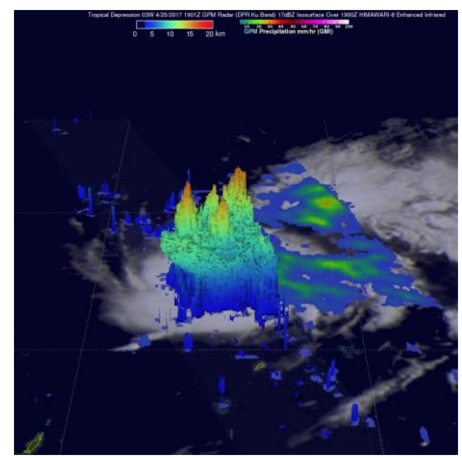
Swath width 885 km
Resolution: 19.4km x 32.2km (10 GHz) to 4.4km x 7.3km (183 GHz)

DPR

Frequencies:	**Swath**	**Resolution**
Ka 35.5 GHz	120 km	5.2 km
Ku 13.6 GHZ	245 km	

GMI/DPR View Tropical Depression 03W in Western Pacfic Ocean





4/24/2017

GPM Algorithms and Data Products

http://pmm.nasa.gov/science/precipitation-algorithms

There are 4 major algorithms used to obtain precipitation estimates from GPM observations:

• Radar Algorithm	2A-Ku, 2A-Ka, 2A-DPR
• Radiometer Algorithm	2A-GPROF
• Combined Radar+Radiometer Algorithm	2A-CMB
• Multi-Satellite Algorithm (GPM core active/passive and constellation passive microwave measurements are used)	IMERG **Widely Used for Application**

GPM: Previous Trainings

https://pmm.nasa.gov/

Click to Access

GPM: Previous Trainings

https://pmm.nasa.gov/training

Recent Training Sessions

(2015 - 2016)

- Overview of Global Precipitation Measurement (GPM) Mission, Data Products and Data Access Tools
- GPM Data Product Updates and Demonstration of Web-tools for Data Search, Analysis, Visualization, and Download
- Demonstration of Case Studies of Data Import and Analysis in GIS
- Tutorial on Using Python Scripts for Reading GPM Data

Click on the links to access webinar presentations and audio recordings

GPM Data Updates

https://pmm.nasa.gov/data-access/data-updates

- IMERG Version 4 data released in March 2017
- GPROF Version 4 was released in August 2016
- GMI, DPR, and IMERG near-real time data browser available since May 2016https://storm.pps.eosdis.nasa.gov/storm/cesium/GPMNRTView.html
- New data visualization applications:
  Global viewer
  Precipitation Applications Viewer
  STORM Event Viewer
  NASA Worldview

As of 1 May 2017 GPM V05 processing has started. The new version will be released after it has been checked by the precipitation science team

GPM Data Updates

https://pmm.nasa.gov/data-access/data-updates

- **IMERG Version 4 data released in March 2017**
- GPROF Version 4 was released in August 2016
- GMI, DPR, and IMERG near-real time data browser available since May 2016
- New data visualization applications:
  Global viewer
  Precipitation Applications Viewer
  NASA Worldview

Update on IMERG Products in Version 04

George J. Huffman

Update on IMERG Products in Version 04

George J. Huffman(1)

with David T. Bolvin(1,2), Dan Braithwaite(3), Kuolin Hsu(3), Robert Joyce(4,5), Christopher Kidd(1,6), Eric Nelkin(1,2), Soroosh Sorooshian(3), Jackson Tan(1,7), Pingping Xie(5)

(1) NASA/GSFC Earth Sciences Division – Atmospheres
(2) Science Systems and Applications, Inc.
(3) Univ. of California Irvine
(4) Innovim
(5) NOAA/NWS Climate Prediction Center
(6) Univ. of Maryland / ESSIC
(7) Univ. Space Res. Assoc.

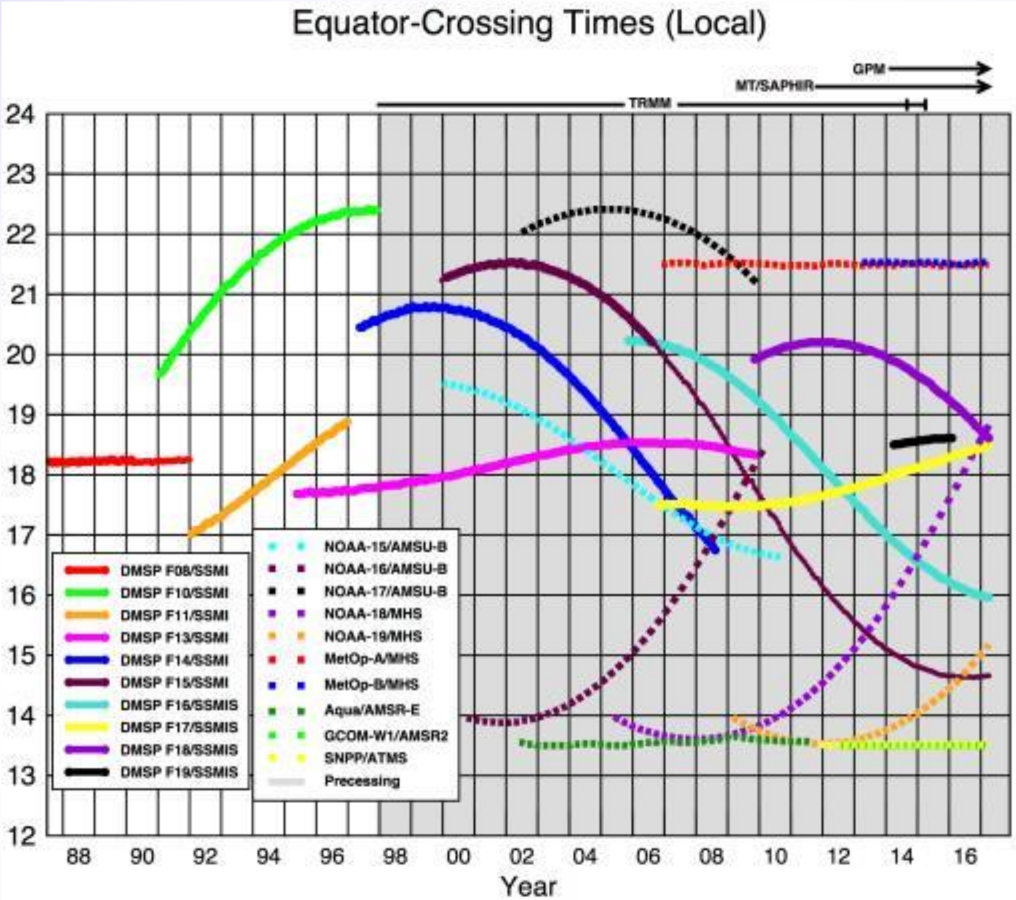
1. INTRODUCTION

Input **precip** (GPROF2017) estimates from a diverse, changing, uncoordinated set of satellites

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

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
- PPS (input data assembly, processing environment) – NASA



Ascending passes (F08 descending); satellites depicted above graph precess throughout the day.
Image by Eric Nelkin (SSAI), 25 April 2017, NASA/Goddard Space Flight Center, Greenbelt, MD.

2. IMERG DESIGN – Data Sets

Multiple runs accommodate different user requirements for latency and accuracy

- "Early" – 5(4) hr (flash flooding)
- "Late" – 15(12) hr (crop forecasting)
- "Final" – 2.5 months (research)

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

In V05

0.1° global CED grid

- merged microwave precip 90° N-S
- morphed precip 60° N-S for now
- probability of liquid precip 90° N-S

User-oriented services by archive sites

- interactive analysis (Giovanni)
- alternate formats (TIFF files, …)
- area averages

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

3. VERSION 04 IMERG – Upgrades

Use new Version 04 precip from sensors using GPROF2014v2 algorithm

Reduce Final Run latency from 3.5 to 2.5 months

- change how ancillary data are handled

Shift from static to dynamic calibration of PERSIANN-CCS by microwave precip

Extend gridders to 90° N-S

Reduce blockiness

- turn off volume adjustment in gauge analysis
- screen off-shore gauge influence
- spatially average 2BCMB-GMI calibrations

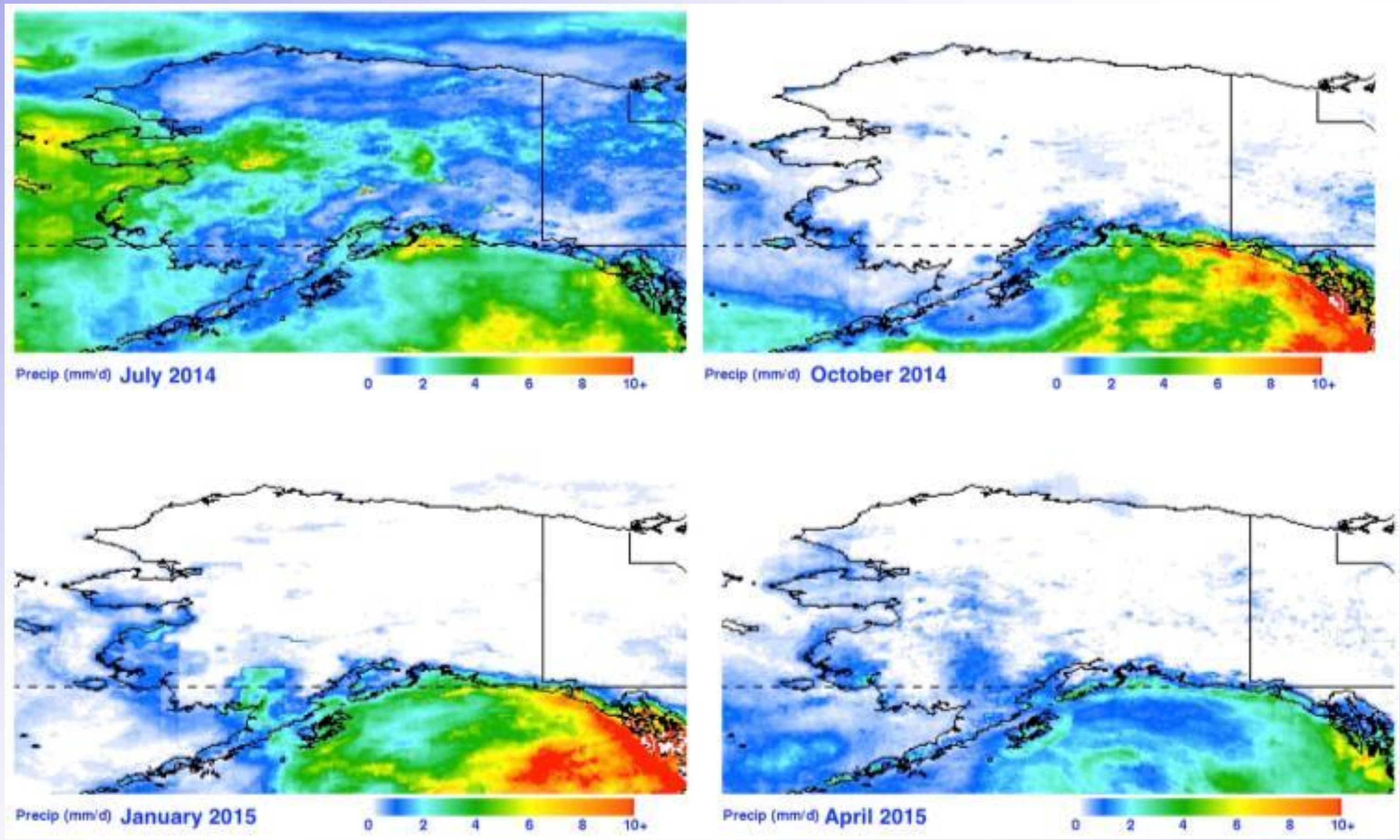
Correct bug that placed morphed values one gridbox south of actual location

- found thanks to a user's question

Adjust 2BCMB to the zonal-mean GPCP (land and ocean, except low-latitude ocean)

Calibrate all microwave sensors to 2BCMB

3. VERSION 04 IMERG – High-Latitude Seasons for Merged Microwave (HQ)



David Bolvin

Warm-season estimates appear useful at high latitudes

Input precip estimates are still deficient in snow/ice-covered surface regions

- still screening out microwave estimates in snow/ice areas and use microwave-calibrated PERSIANN-CCS estimates

3. VERSION 04 IMERG – GPM Products Are Low in the Extratropical Oceans

Ocean-only zonals for 2015

V04 GPM products are similar, by design

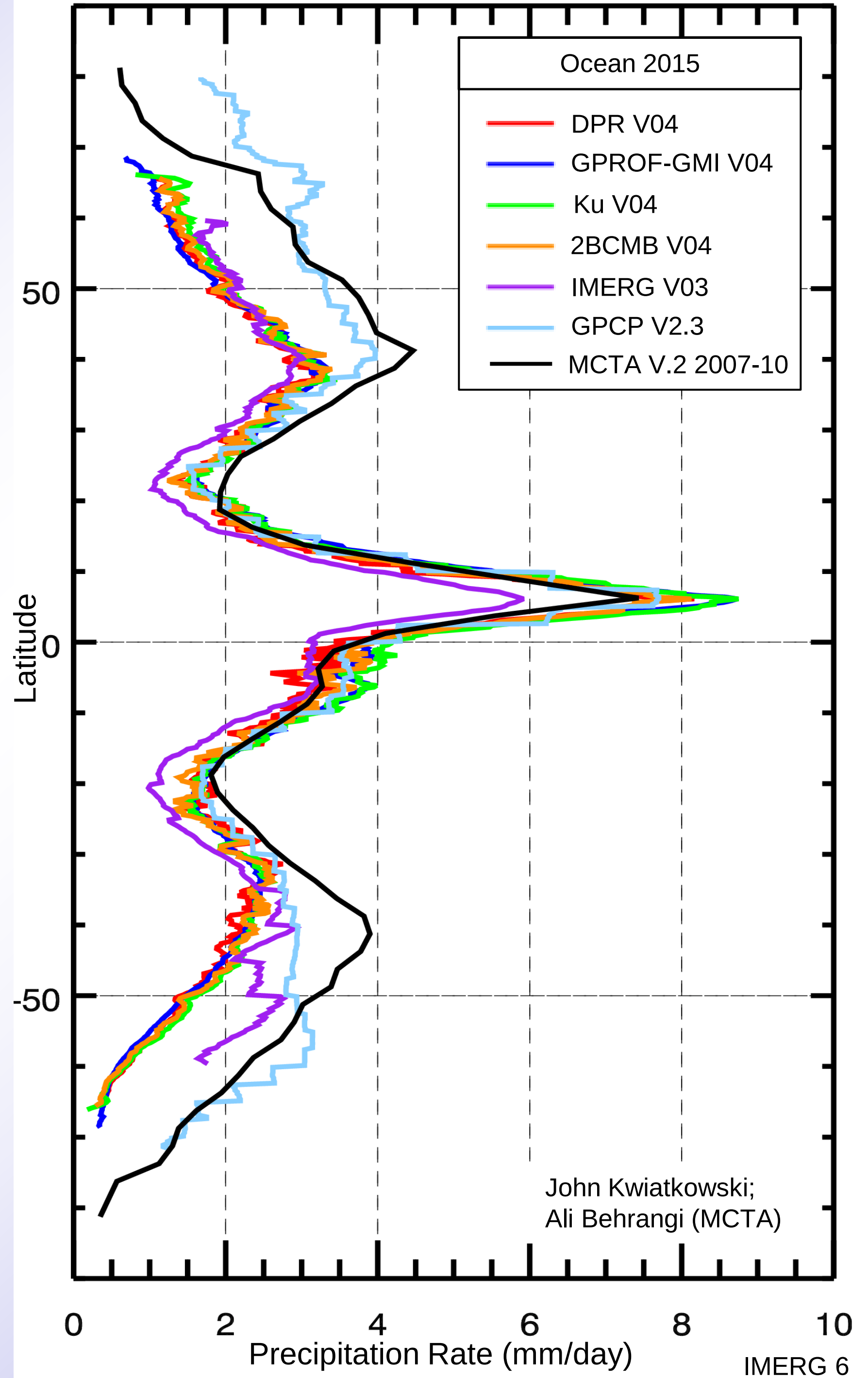
- V03 IMERG somewhat similar
  - Day 1 (pre-launch calibration)

GPCP is higher in the extratropics

- new Version 2.3 of community standard
- Behrangi Multi-satellite CloudSat, TRMM, Aqua (MCTA) product confirms GPM bias
  - includes CloudSat rain, snow, mixed
  - higher than GPCP in mid-latitudes
  - roughly agrees at high latitudes

Adjust IMERG V04 to GPCP at higher latitudes with seasonal "climatology"

- known low biases in GPM products being addressed in V05
- provides reasonable IMERG bias in V04



3. VERSION 04 IMERG – GPM Product Biases Vary by Latitude

Land-only zonals for 2015

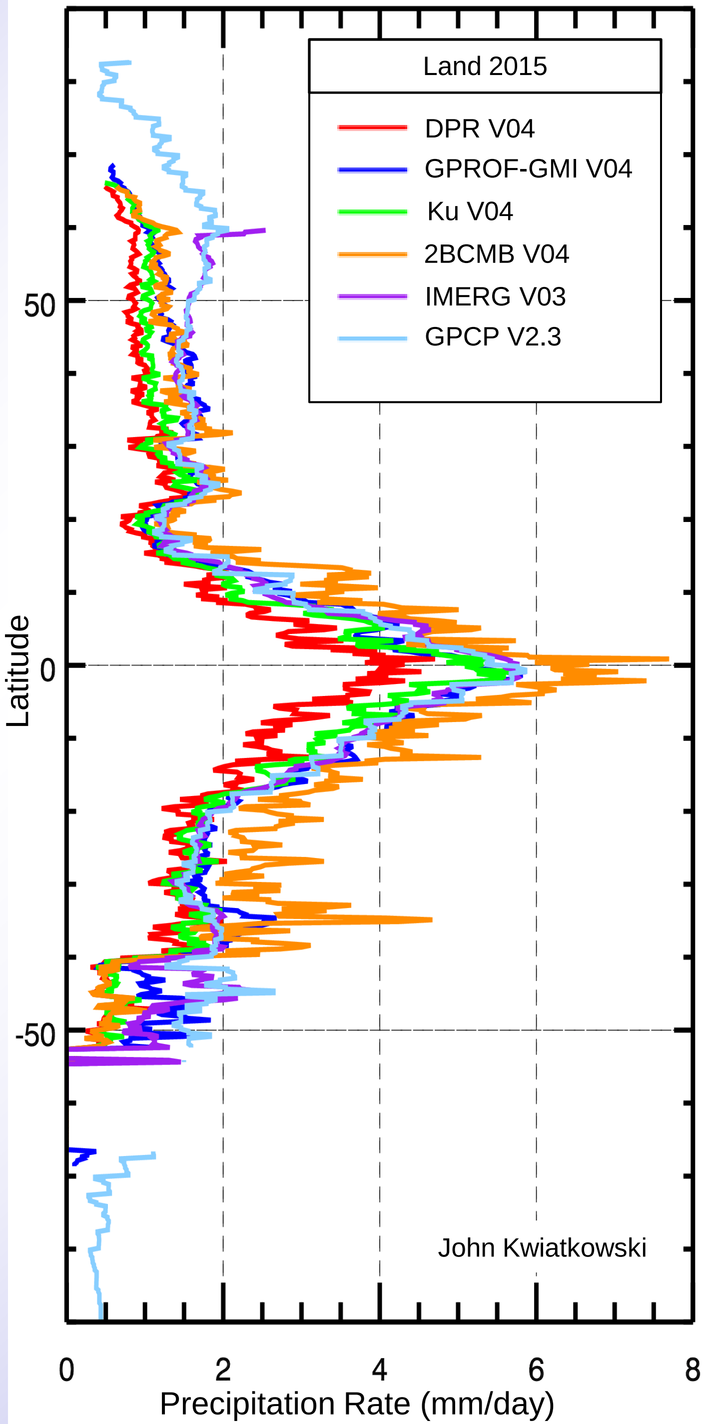
V04 GPM products tend to show more spread

GPCP is higher in the extratropics

- V03 IMERG similar (both use GPCC gauge analysis)
- MCTA n/a over land

Adjust IMERG to GPCP for V04 at all latitudes with a seasonal "climatology"

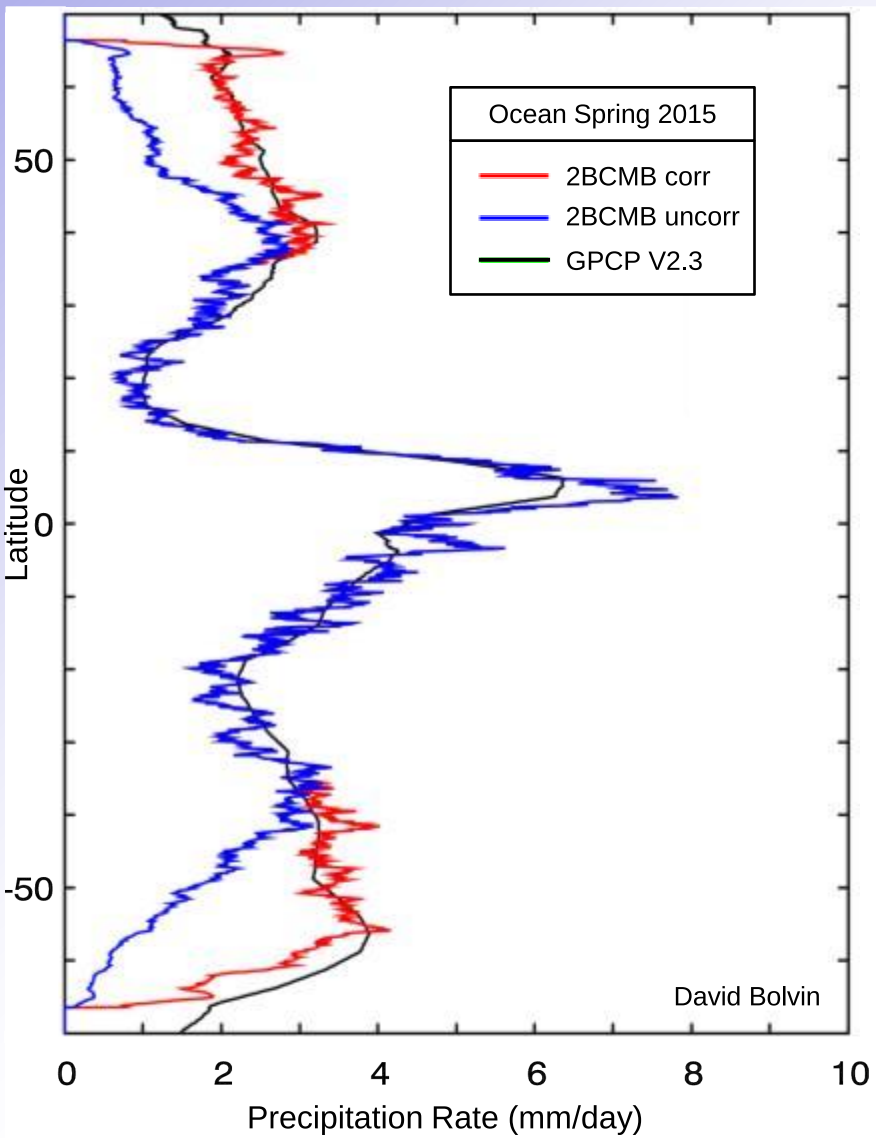
- known biases in GPM products being addressed in V05
- first cut at the adjustment to gauges that the final calibration in IMERG enforces

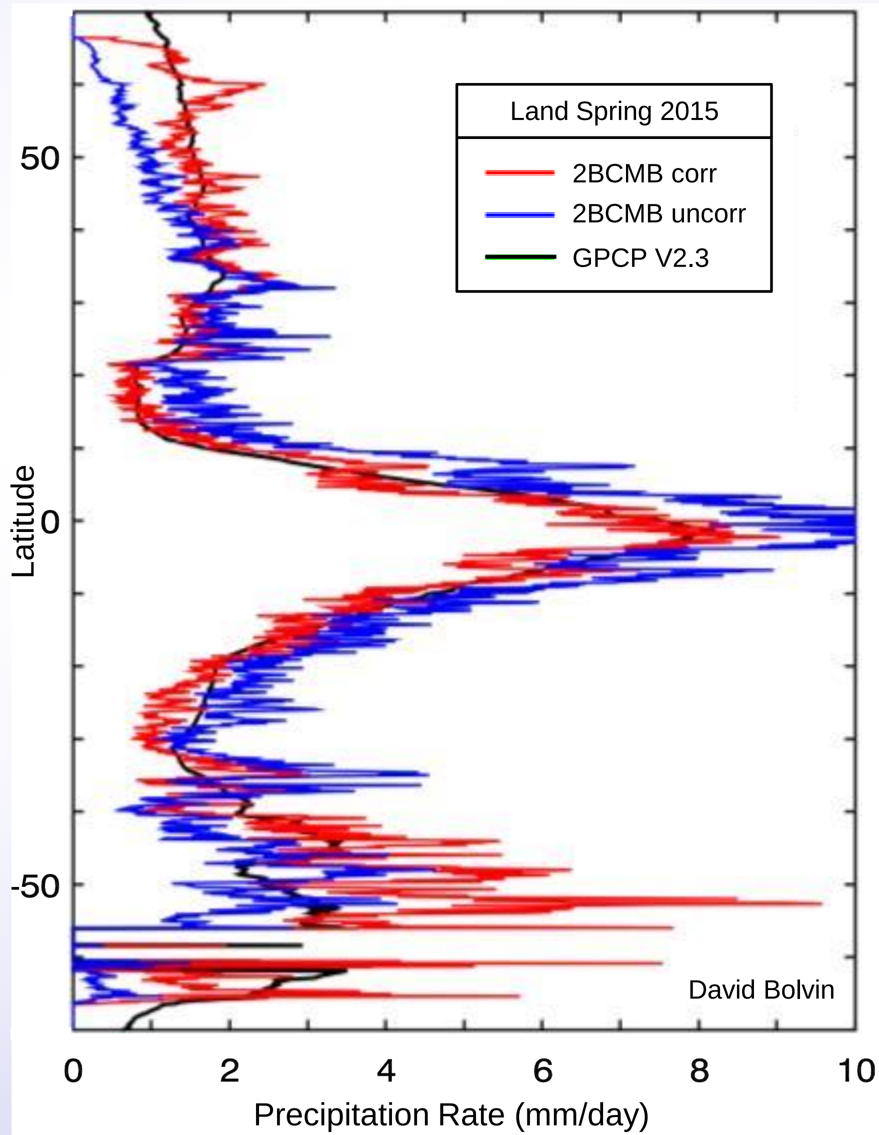


3. VERSION 04 IMERG – 2BCMB Largely Behaves as Expected for Spring 2015

Low-latitude ocean not adjusted; highest latitudes still show deficits

- regional biases are modest





4. VALIDATION – Half-Hourly IMERG Sources and MRMS over South Carolina, 2-4 October 2015

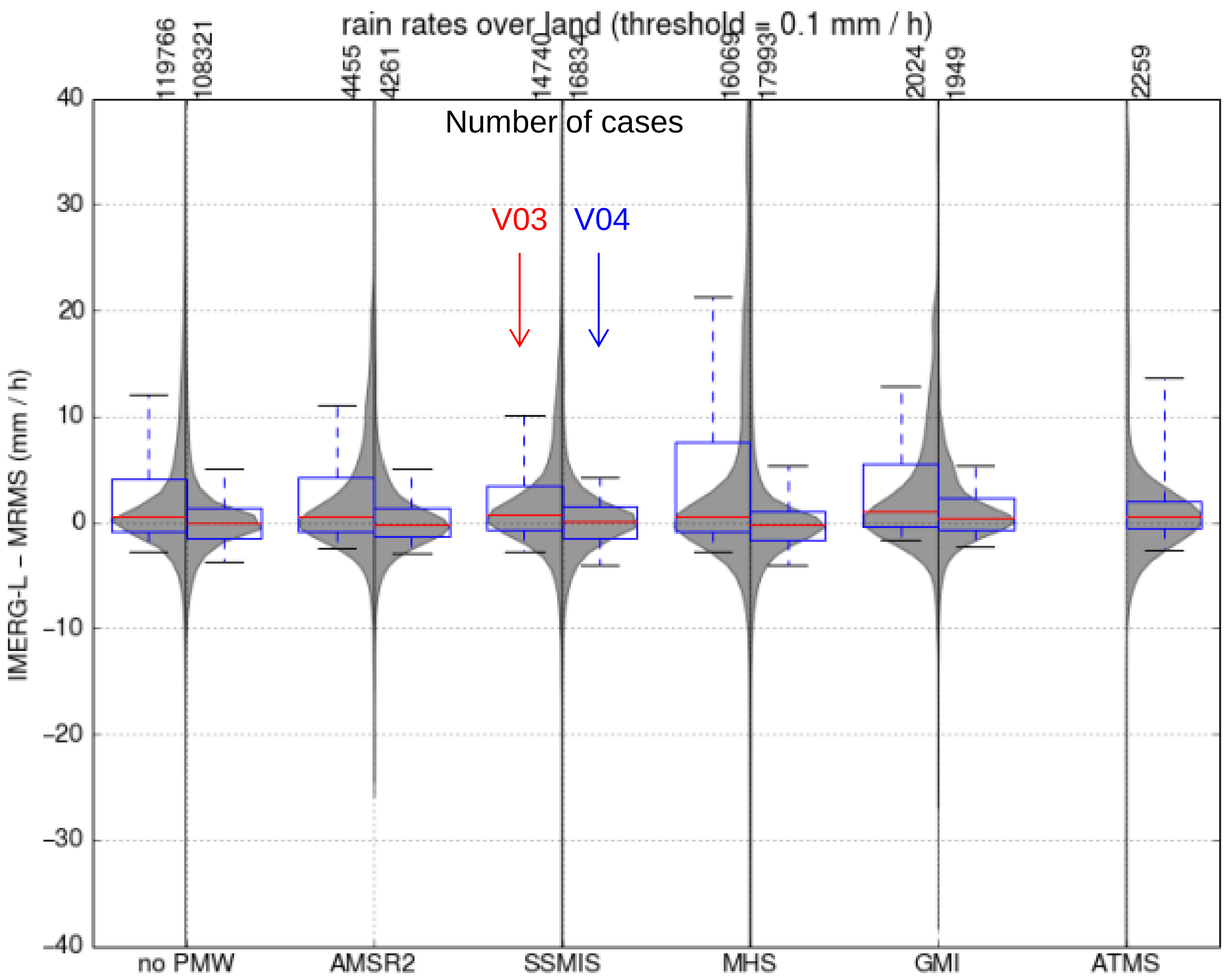
"Violin diagram" for individual sources of the half-hourly IMERG estimates

- width shows relative contribution for each difference bin
- V03(V04) on left(right)

All rainfall rates, over land

V04 is an improvement for all sensors

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



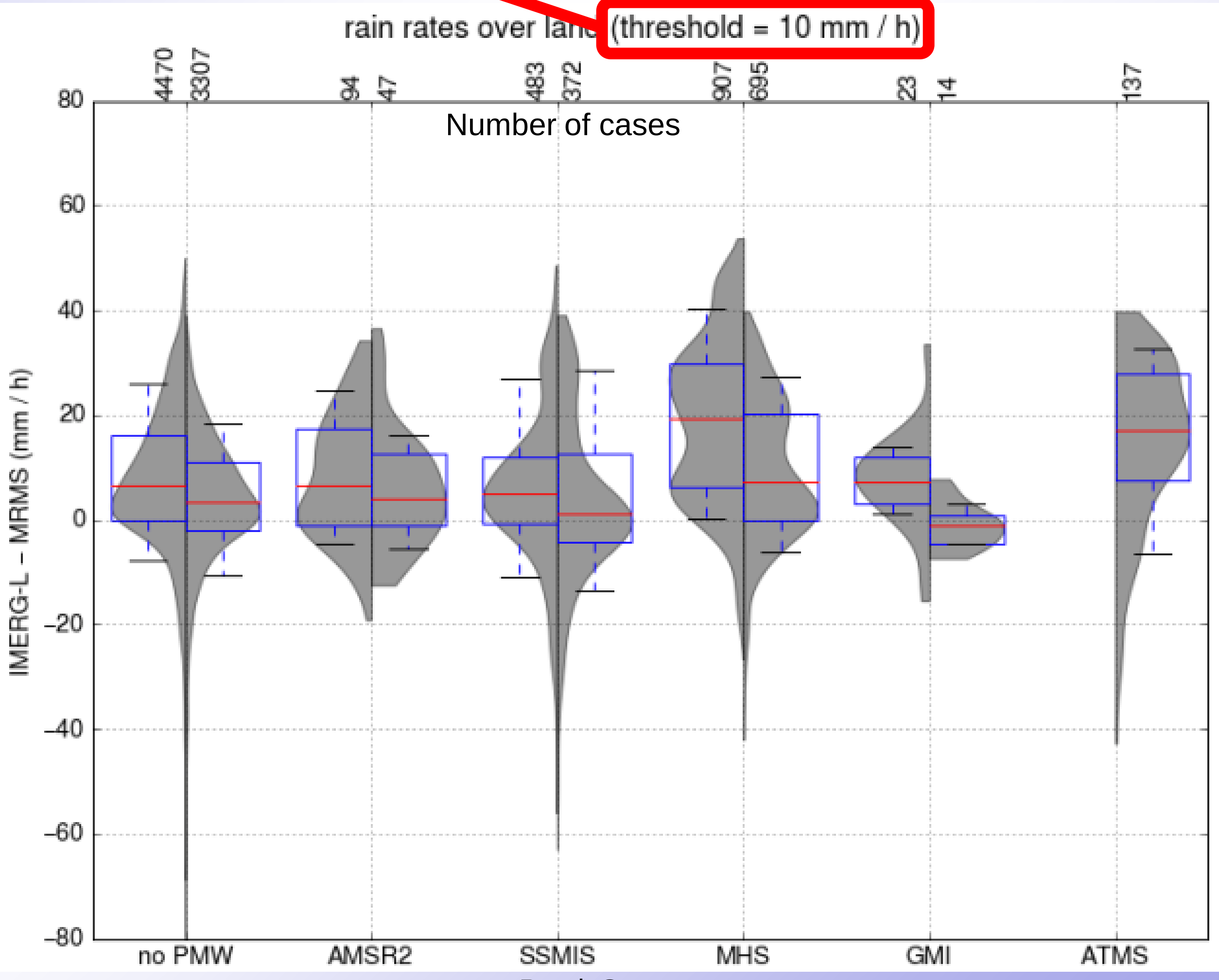
[J. Tan (UMBC; GSFC)]

PrecipSource

4. VALIDATION – Half-Hourly IMERG Sources and MRMS over South Carolina, 2-4 October 2015

This diagram focuses solely on heavy rain

- both ≥ 10 mm/h
- small sample size for AMSR2, GMI, ATMS
- V04 better than V03
- GMI and SSMIS are near zero bias
- new ATMS has issues (but low number of samples)

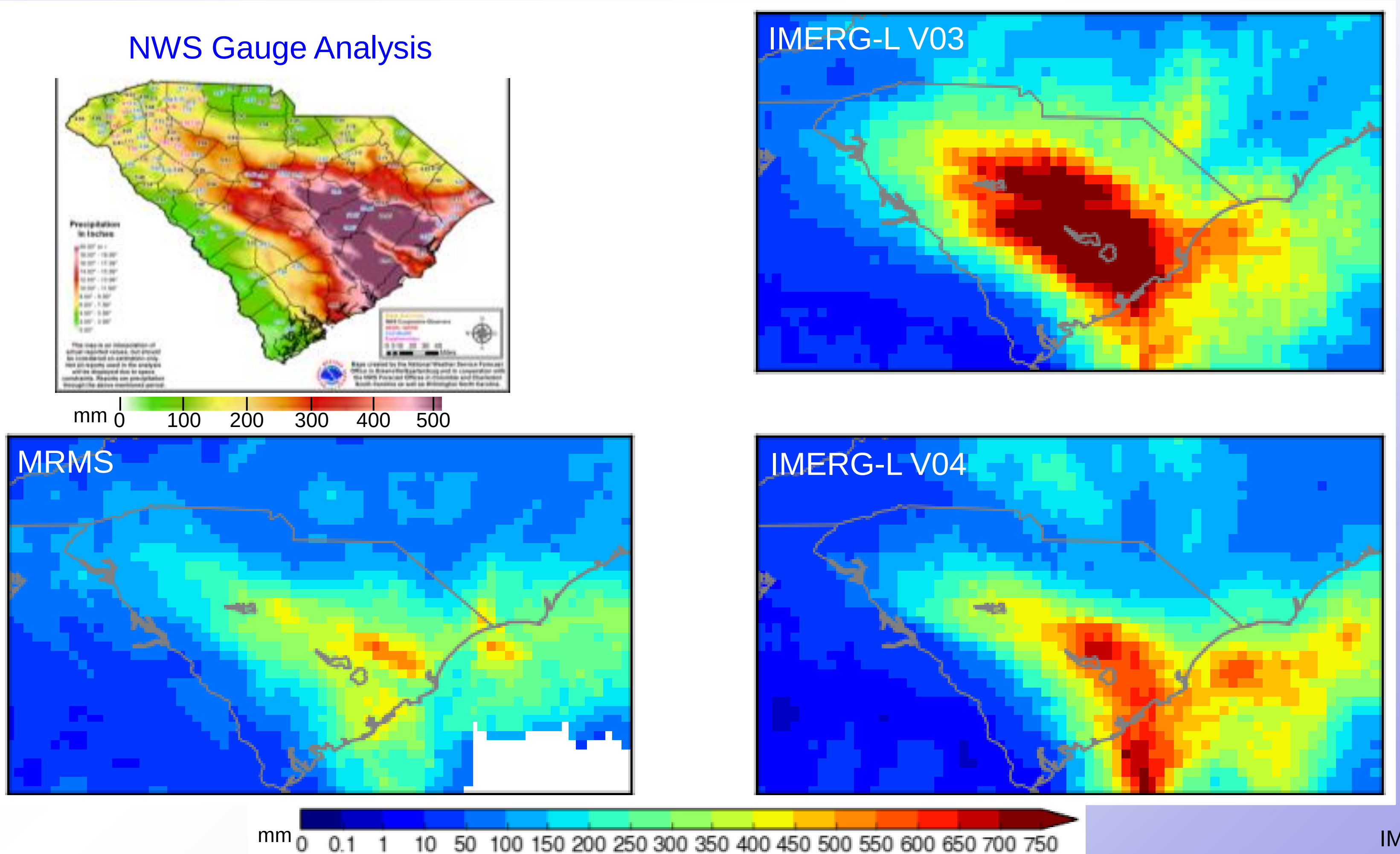


[J. Tan (UMBC; GSFC)]

4. VALIDATION – Accumulations over South Carolina, 1-5 October 2015

V04 has a much smaller overestimate than V03 compared to MRMS

- the gauge-only analysis shows more than MRMS
- both IMERG versions lack the split near the coast
- IMERG higher over the ocean, but need to consider radar range artifacts for MRMS



5. FUTURE – Version Transitions

Version 04, first-generation GPM-based IMERG archive, March 2014–present

- all data are available March 2014–December 2016
- Early and Late Run data are also available from 5 February 2017
- remainder will be filled in “soon”
- remaining months depend on data arrival

Mid-2017: Version 05 IMERG, March 2014–present

- DPR calibration change
- “minor”, but important upgrades to other algorithms
- IMERG quality flag
- no morphing outside 60° N-S

Winter 2017-18: TRMM V.8/GPM V.05 TRMM/GPM-based IMERG archive, 1998–present

Spring 2018: Legacy TMPA products retired

~2 years later: Version 06

6. FINAL COMMENTS

Version 04 IMERG addresses a number of issues uncovered in Version 03

- swaths gridded over entire globe

Versions will move quickly over the next 12 months

- GPM era being upgraded to Version 04, then 5 months later in Version 05
- TRMM-GPM eras reprocessed in Version 05 in late 2017
- TMPA to be run until Spring 2018

The future holds some “interesting” challenges, technical and institutional

george.j.huffman@nasa.gov

pmm.nasa.gov

New Users Start Here

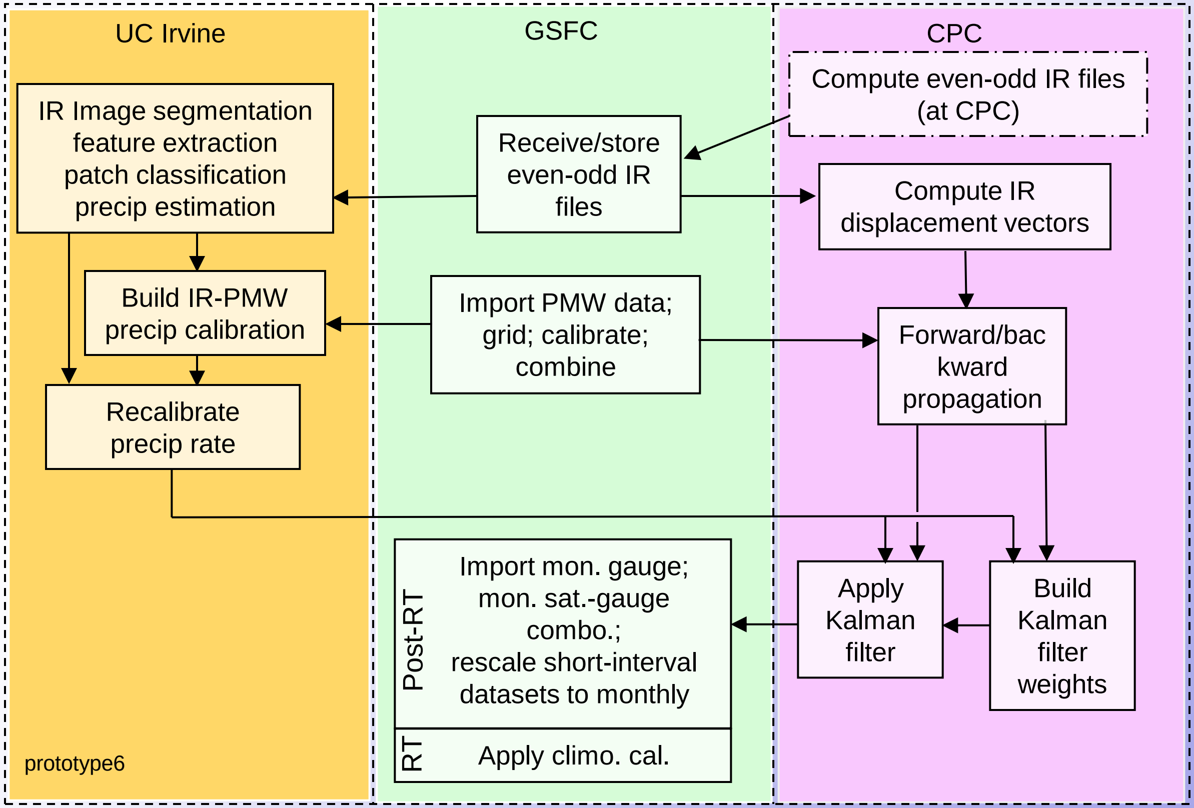
2. IMERG DESIGN – Processing

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

Institutions are shown for module origins, but

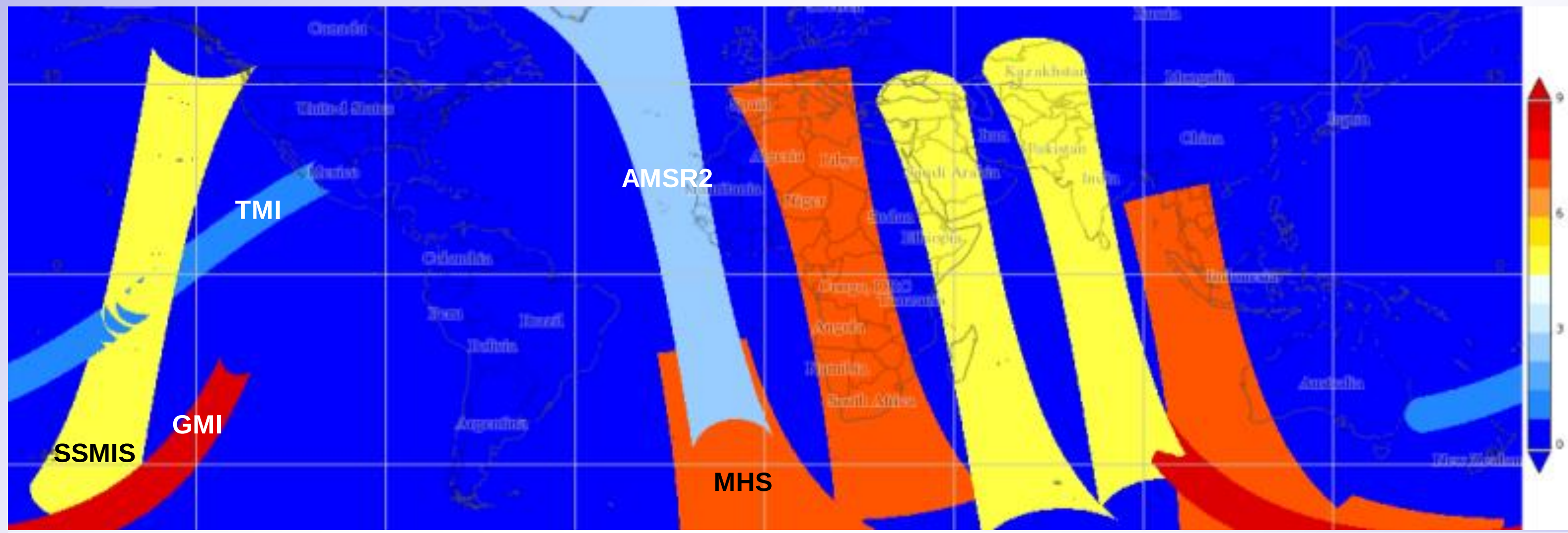
- package is an integrated system
- goal is single code system appropriate for near-real and post-real time
- "the devil is in the details"



2. IMERG DESIGN – Data Field Maps

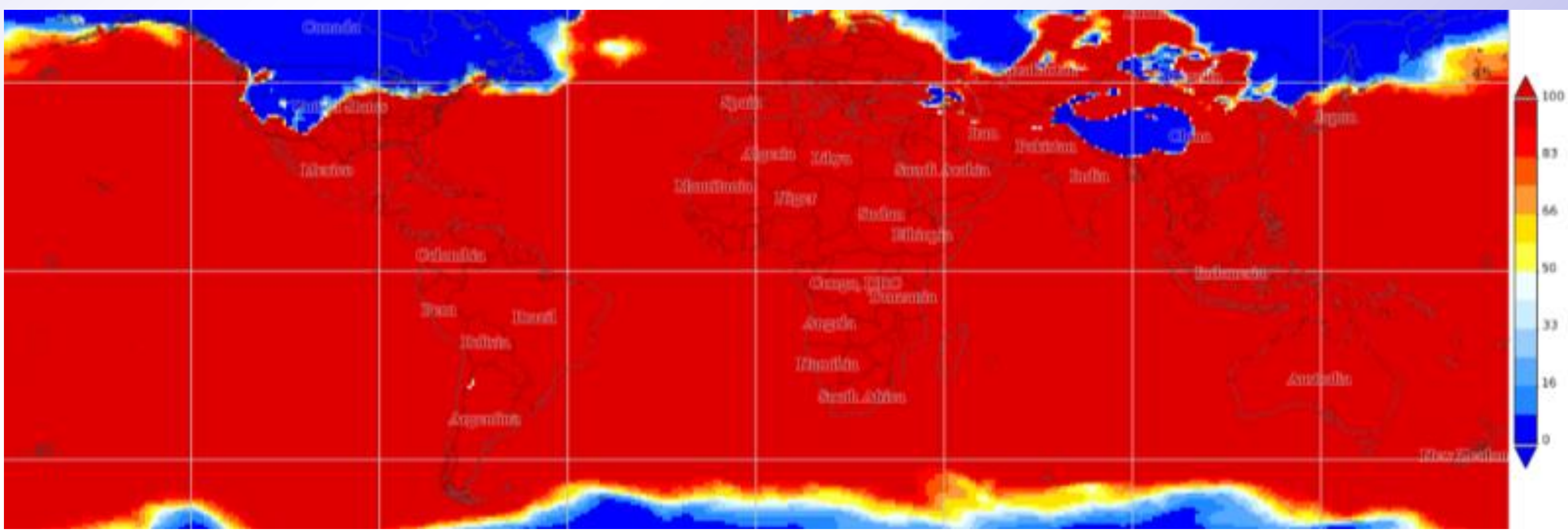
1430-1500Z 3 April 2014

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



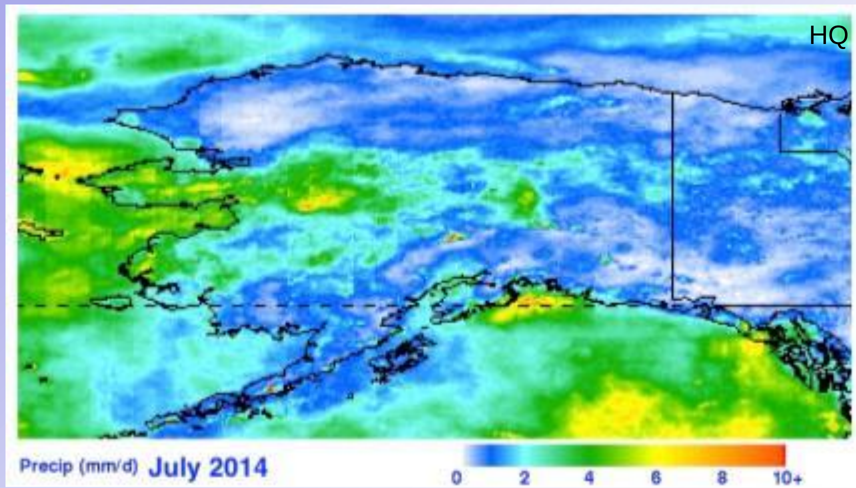
[PMW] HQprecipSource [identifier]

<u>probability</u> that precipitation <u>phase</u> is <u>liquid</u>; <u>diagnostic</u> computed from ancillary data



probabilityLiquidPrecipitation [phase] (%)

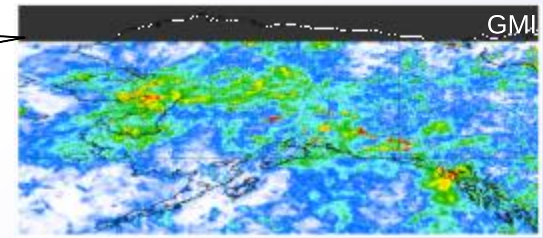
3. VERSION 04 IMERG – Individual Sensors, July 2014

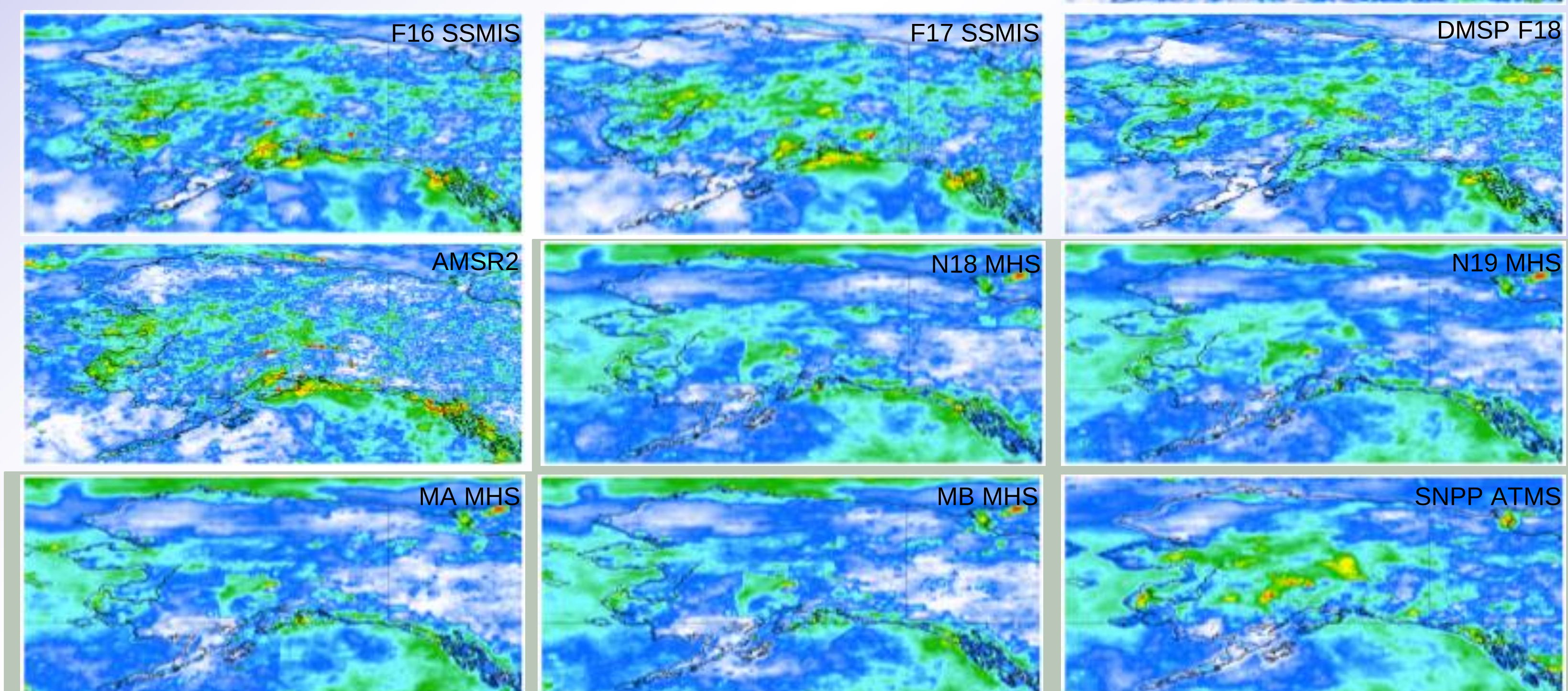


Retrievals reflect sensor types

- cross-track scanners smoother than conical scanners
- some systematic coastal issues

~69˚ N

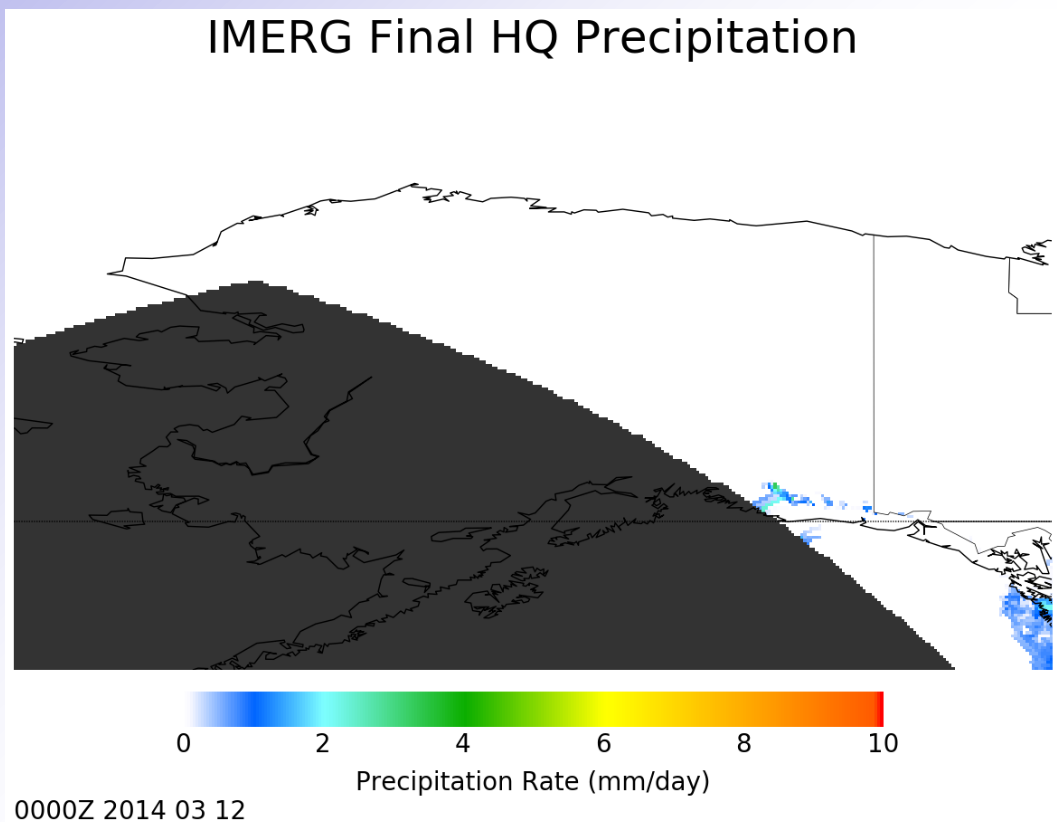


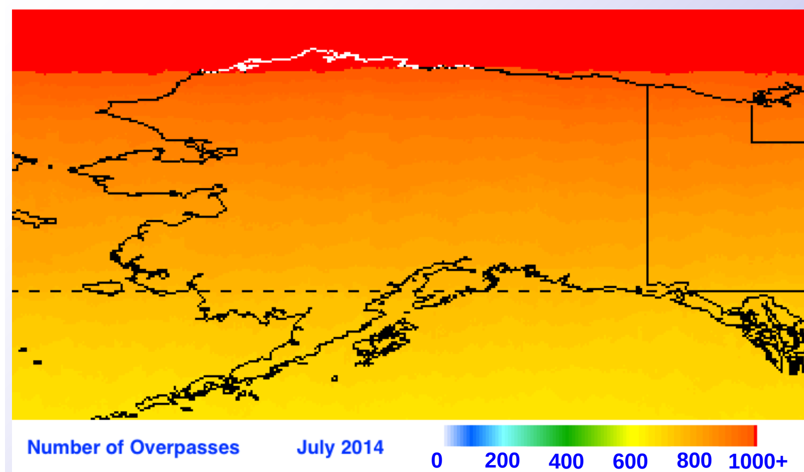


3. VERSION 04 IMERG – Individual Sensors, July 2014

Above 60˚ there is no morphing, only the half-hourly “HQ” merged microwave

- coverage is about half the times around the day, on the average
- the flashing in and out is hard to watch, but
- accumulations (say, daily) should be useful



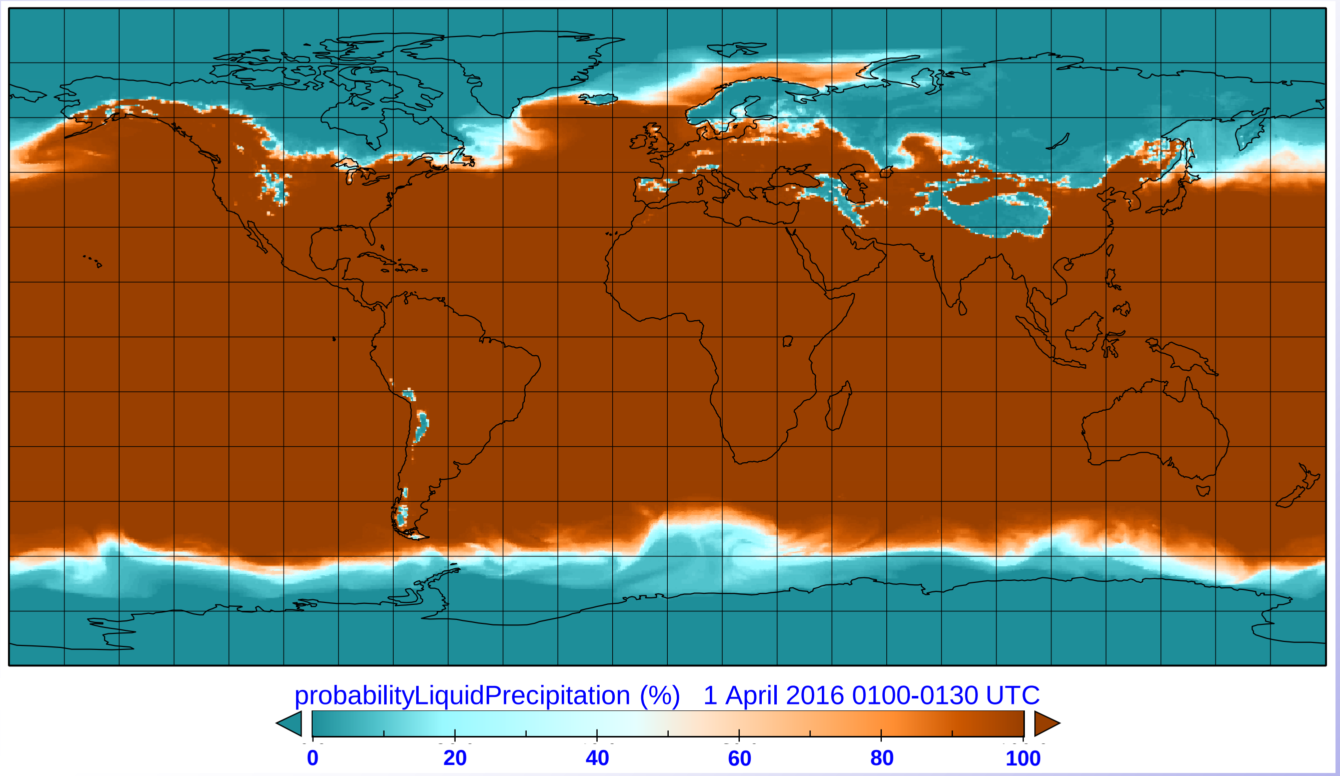


1488 half hours in the month

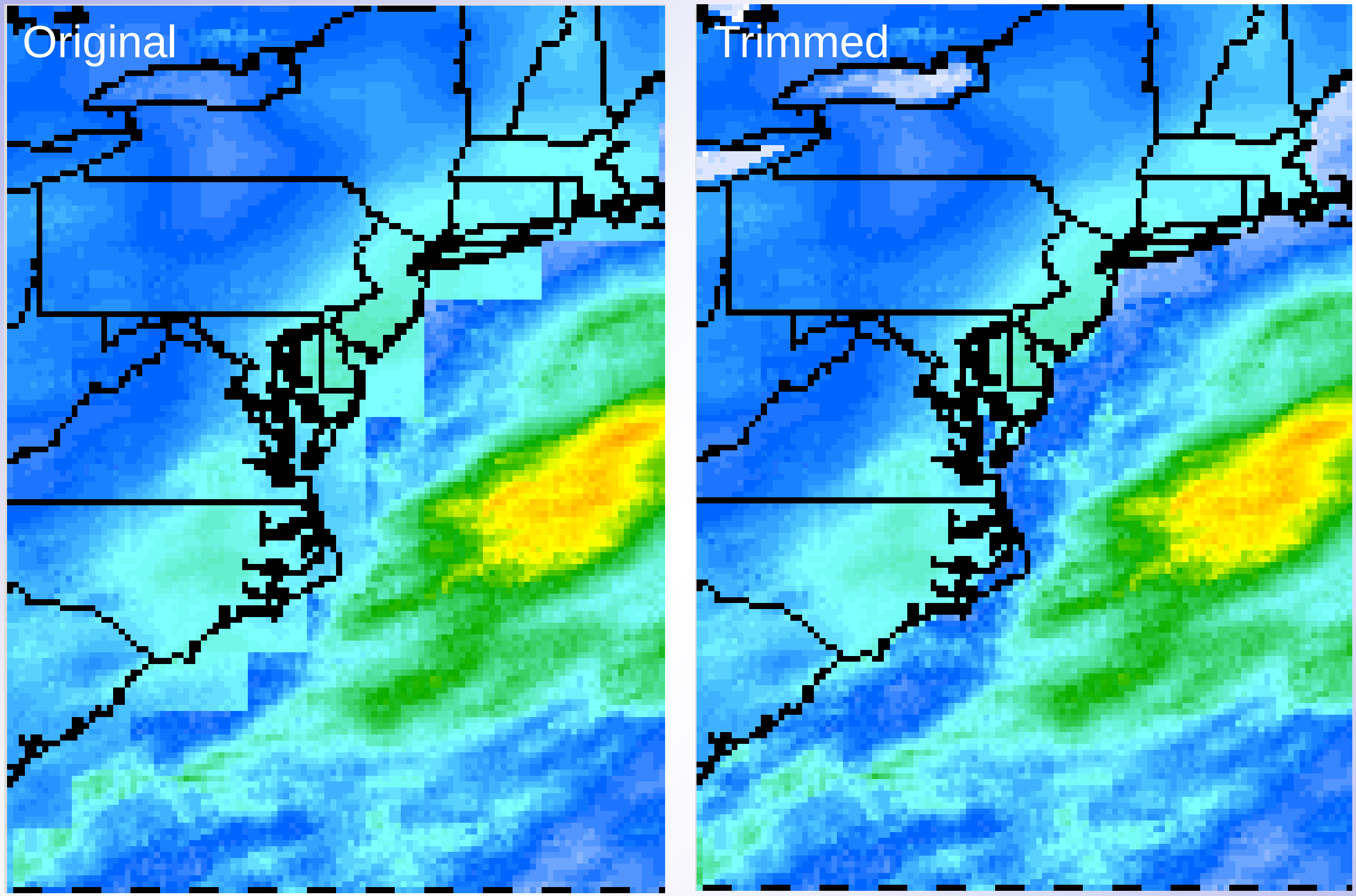
3. VERSION 04 IMERG – Precip Phase

Precip phase is available for the whole globe

- probability that the precip phase is liquid or mixed
    - mixed is rare and likely to melt, which then acts like liquid
- diagnostic based on NWP analysis of surface temperature, humidity, pressure



3. VERSION 04 IMERG – Trimming Gauge Contributions Along Coasts



January 2015

David Bolvin

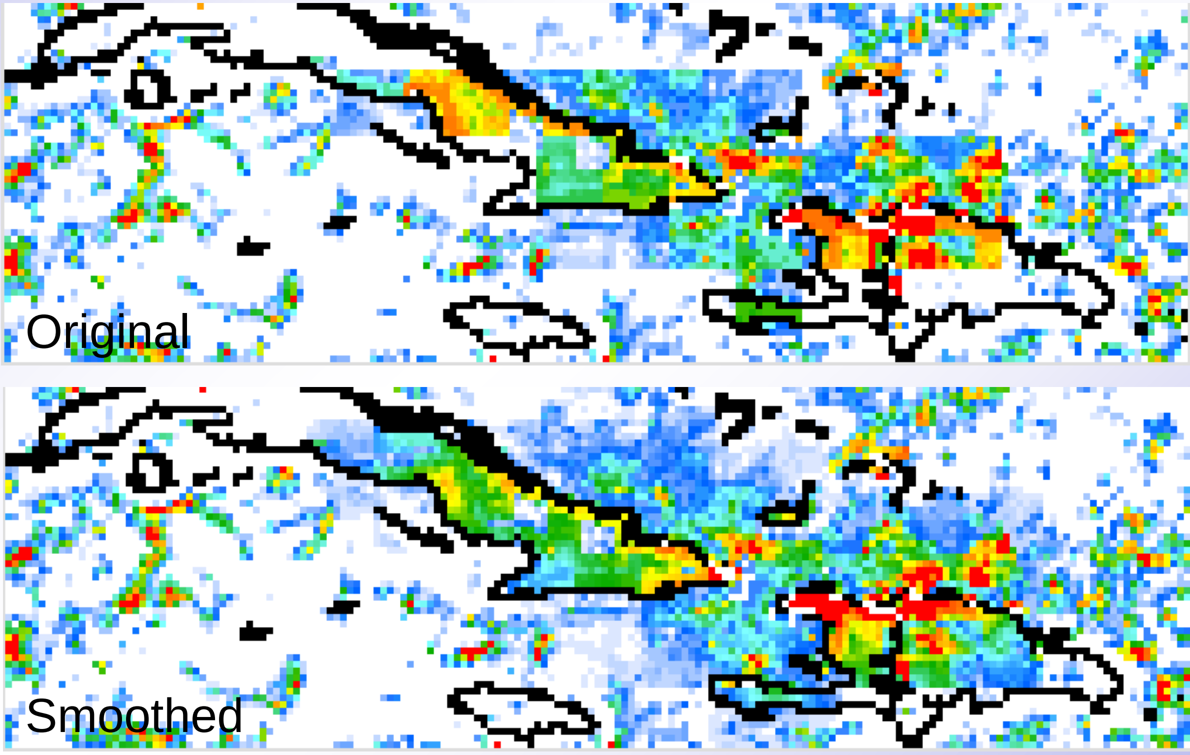
At the 0.1° IMERG resolution the 1° GPCC resolution causes unphysical blockiness along coasts where satellites and gauges disagree (Final Run)

The transition off-shore is now a jump, but perhaps should be a taper

3. VERSION 04 IMERG –2BCMB-GMI Calibration Smoothing

2BCMB-GMI calibration is a 1° x1° grid based on a 3° x3° template

- when gradients in GMI and 2BCMB are not similar, jumps between boxes are intrusive (top)
- a <u>distance-weighted</u> average of the <u>four adjacent</u> calibration values improves performance (bottom)
- all Runs



January 2015

David Bolvin

3 VALIDATION – Half-Hourly IMERG Sources and Pocamoke Fine-Scale Grid, April 2014 – March 2015

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

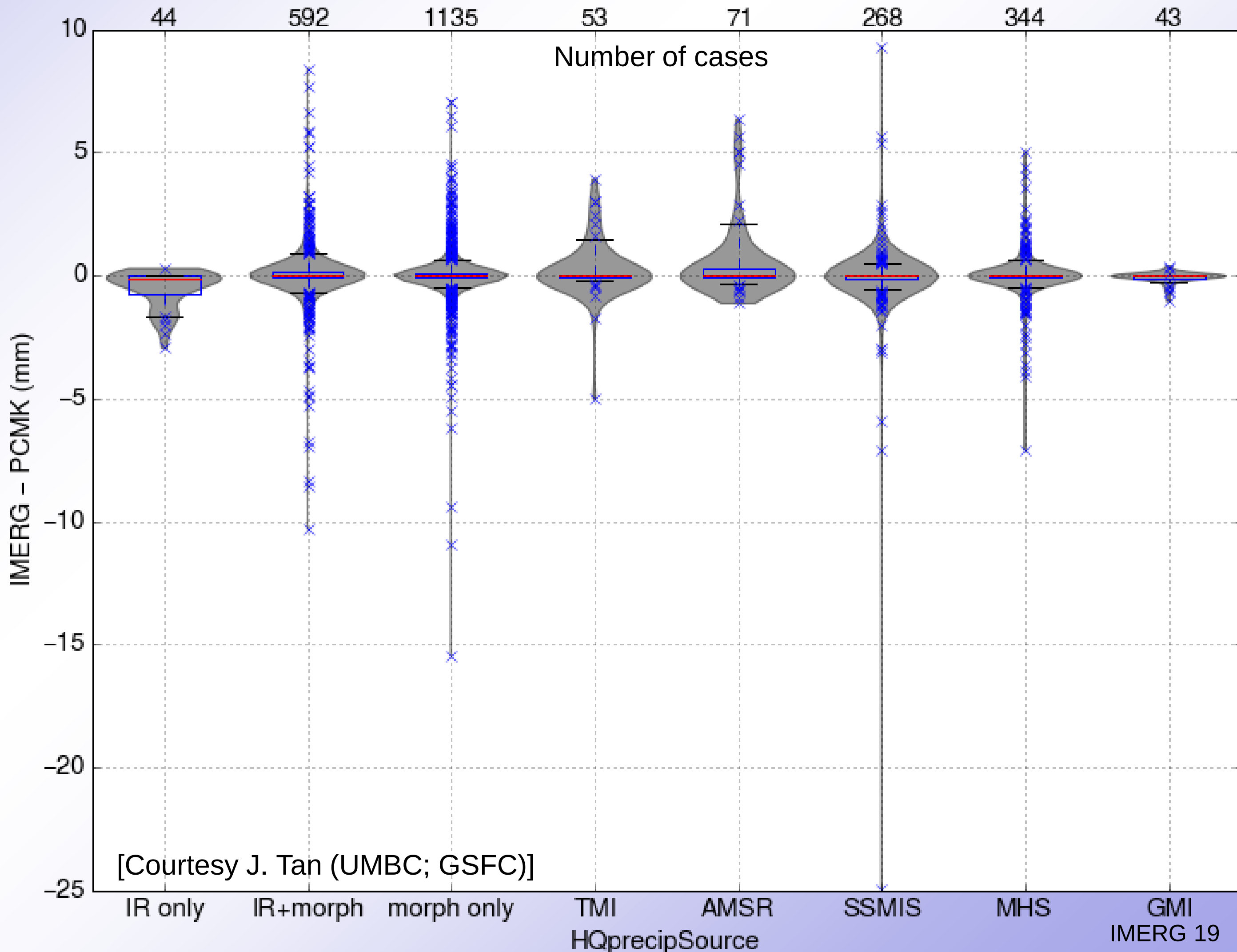
- width shows relative contribution for each difference bin

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

This is pre-launch calibration! The shift to Version 04 should give more consistency

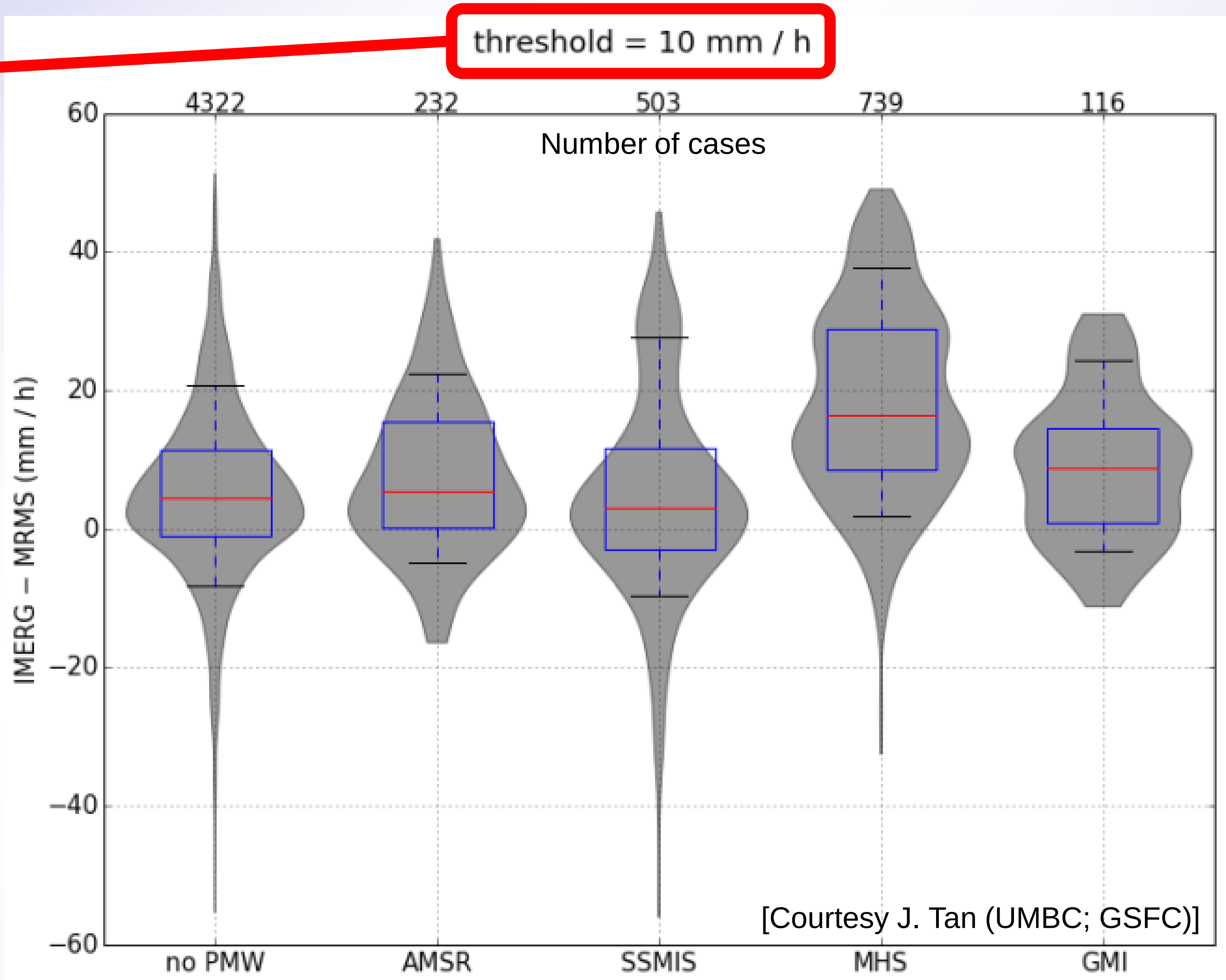


VALIDATION – Half-Hourly IMERG vs MRMS Radar/Gauge Product October 2015, South Carolina Floods

Actual accumulations of rain were up to 24”

- IMERG overestimated some totals by a factor of 2

This diagram focuses solely on heavy rain



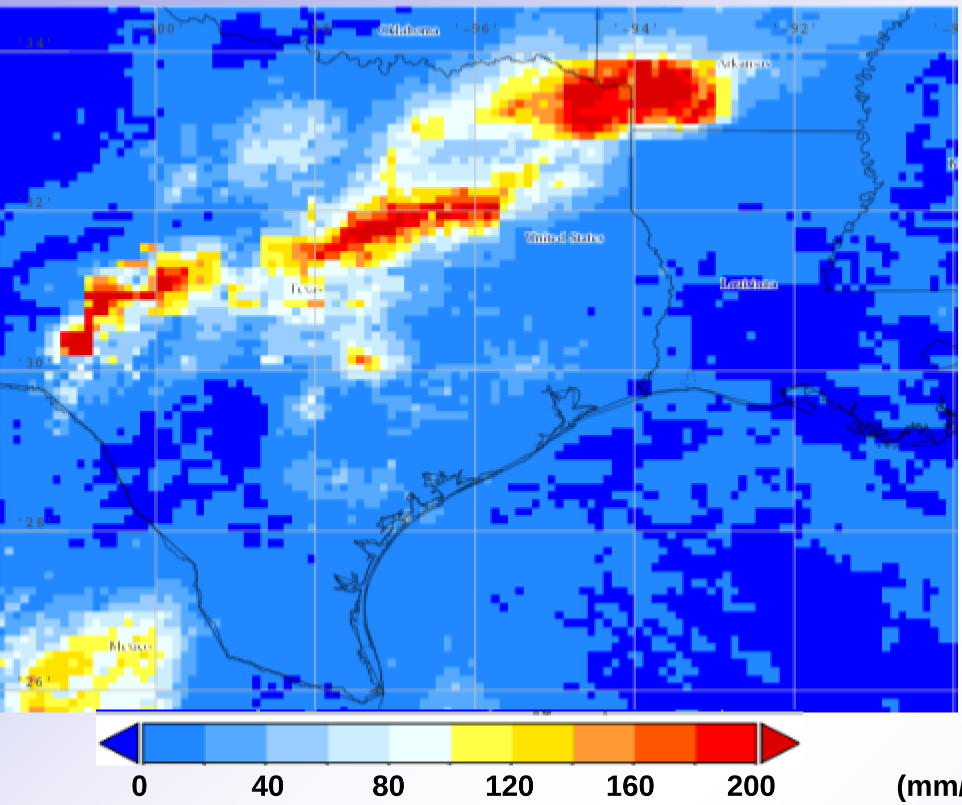
All sensors are positively biased

- MHS is particularly biased due to an IMERG error
- “no PMW” (morphed and IR) is better
- again, low number of samples

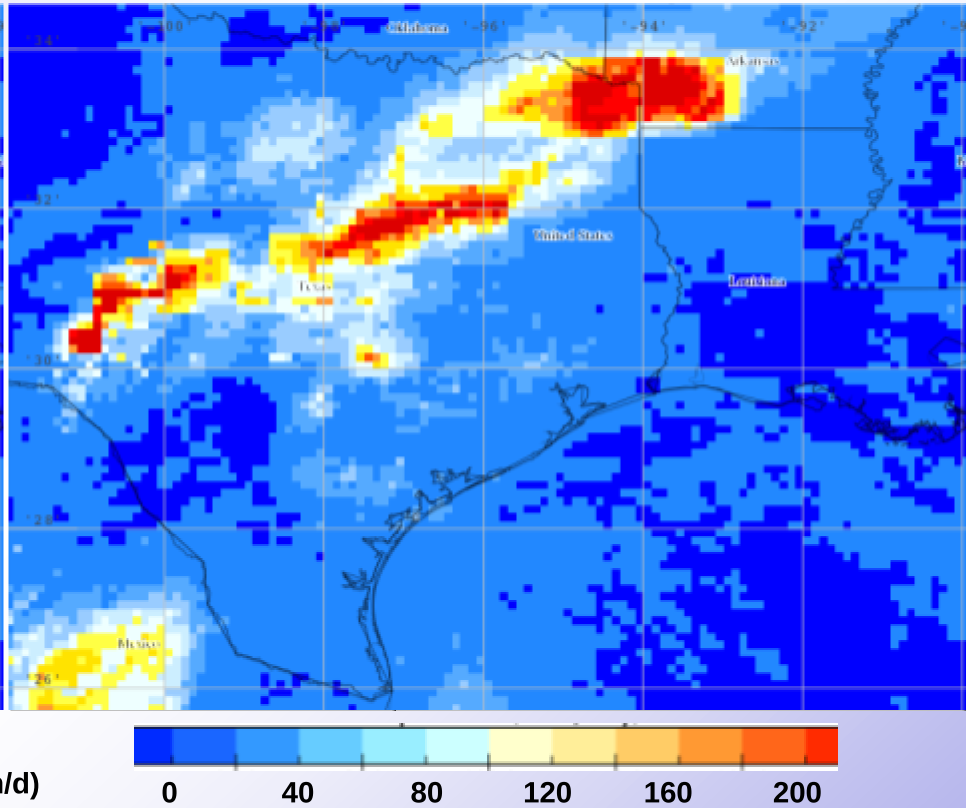
This is pre-launch calibration! The shift to Version 04 should give more consistency

4. VALIDATION – Pre-Patricia Rains in Texas, 2015 October 23/12Z–24/12Z

IMERG Early Run



CPC Gauge Analysis

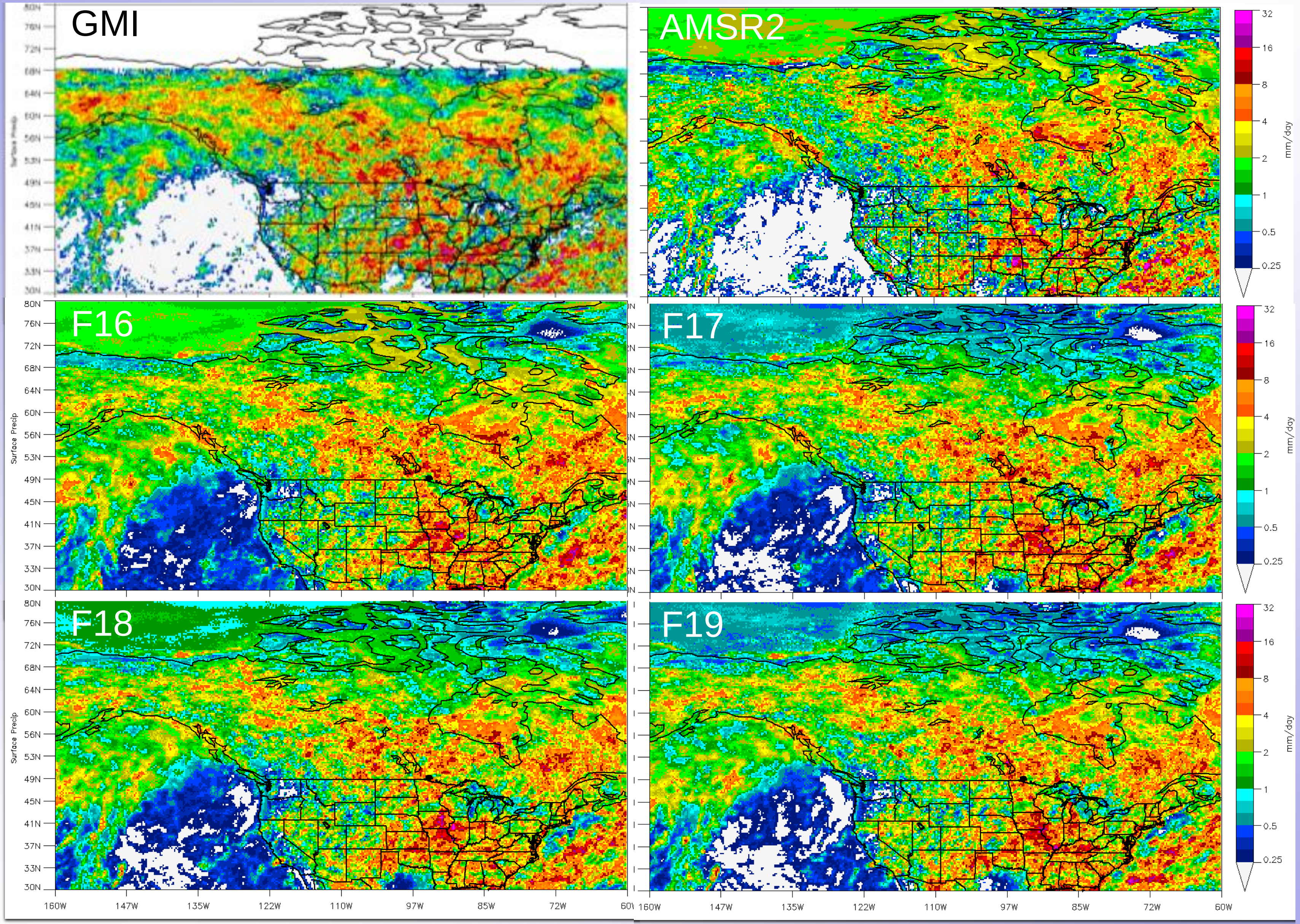


(mm/d)

General area of heavy rain is captured by IMERG, but extends further east and west

- are there sufficient gauge data to the west?

3. VERSION 04 IMERG – High Latitude GPROF2014V2, July 2015



David Randel

Input precip estimates are fairly similar across sensors, and look useful

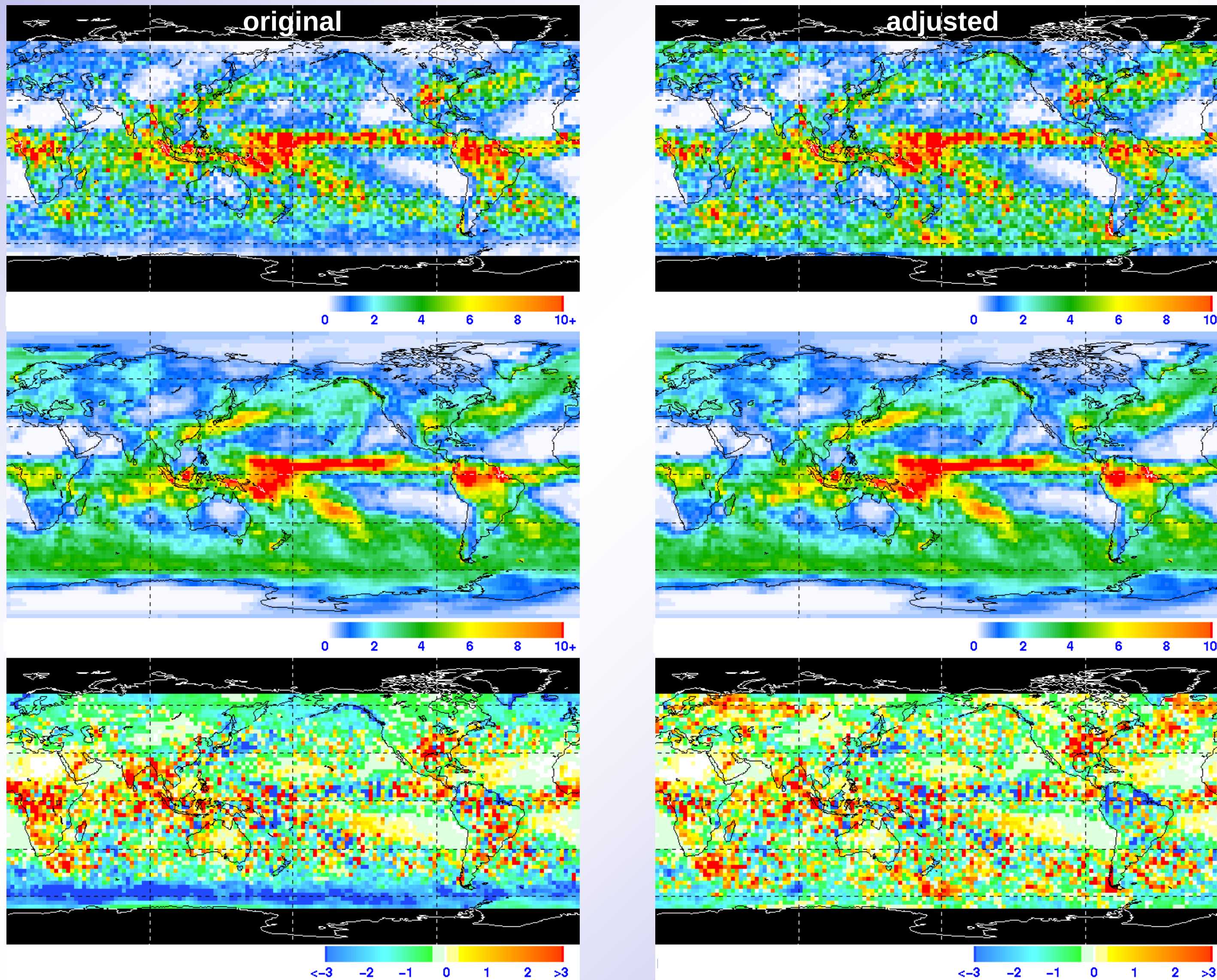
3. VERSION 04 IMERG – Regional Biases in Adjusted 2BCMB are Modest for Spring 2015

Sampling noise in 2BCMB makes direct comparison challenging

2BCMB (mm/d)

GPCP (mm/d)

[2BCMB – GPCP] (mm/d)



4. FUTURE – The Big Challenges in Multi-Satellite

Extend the analysis to the poles

Create a merged observation-model product

Orographic enhancement

Precipitation system growth and decay between satellite overpasses

Account for differences in what different sensors "see"

Estimate the fine-scale errors

- perhaps express "expert" estimate as quantiles
- then the grand challenge is aggregating the errors in space/time
- also need a "simple" quality index

Create an NWP-based assimilation system

Maintain the constellation

5. FUTURE – And Further Down the Road …

It takes a llooonng time to develop missions

Core Observatory fuel should last 10-15+ years

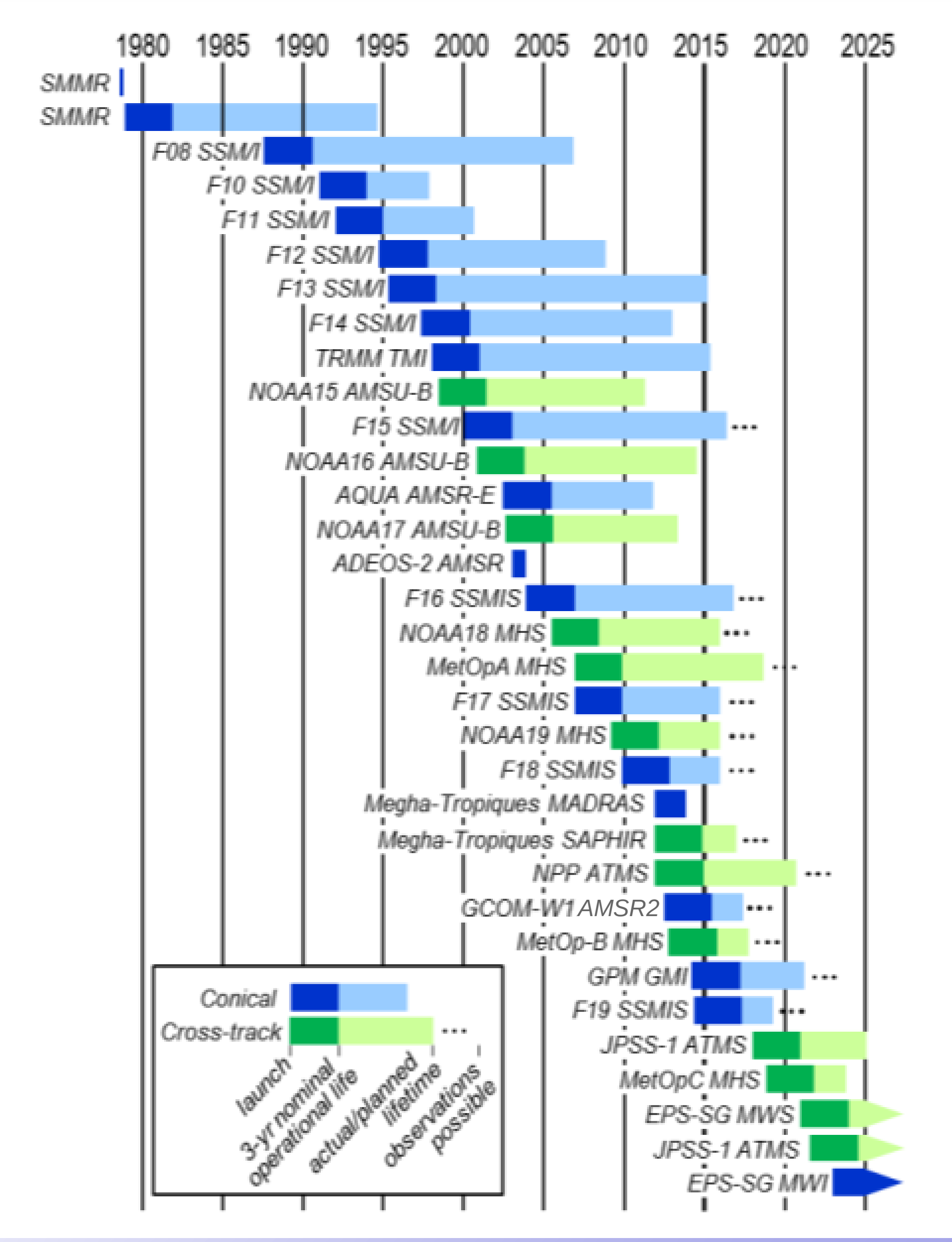
- but something could break

What will be the key research topic in 10-15 years? [Decadal Survey]

- Clouds and Precipitation Processes

Users assume that the agencies will maintain the microwave constellation and keep providing data for societal benefits

- many fewer launches planned
- need to recognize and support multi-disciplinary uses
- new generation of smaller sensors?
- alternatives of small sats or geo sats have to satisfy requirements

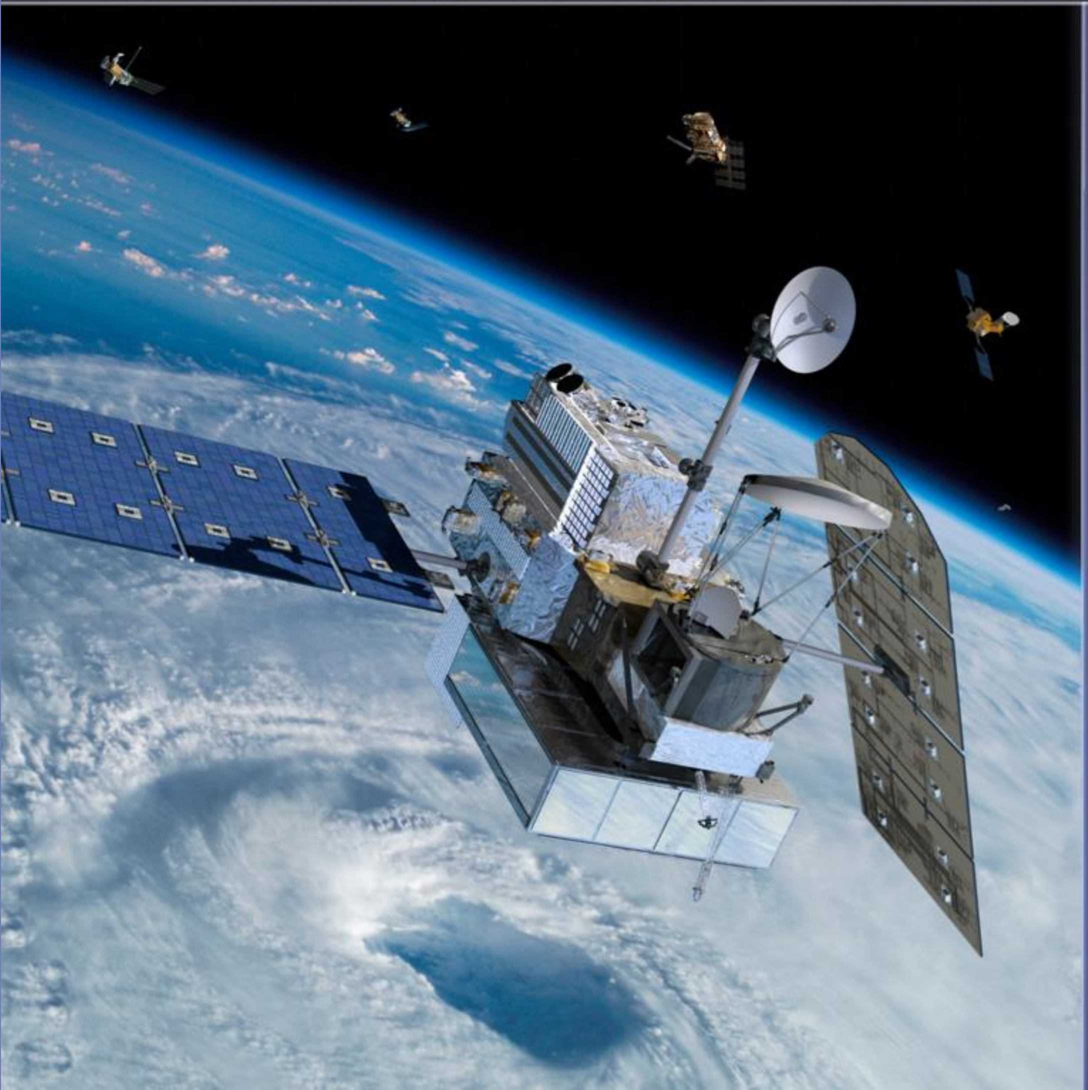


[Courtesy C. Kidd (ESSIC; GSFC)]

GPM Applications

Dalia Kirschbaum

The Global Precipitation Measurement (GPM) Mission Applications Examples



Dalia Kirschbaum

GPM Deputy Project Scientist for Applications

Dalia.b.Kirschbaum@nasa.gov

www.nasa.gov/gpm

Twitter: NASA_Rain

Facebook: NASA.Rain

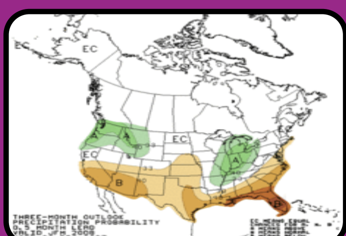
Societal Benefit Areas

Extreme Events and Disasters

- Landslides
- Floods
- Tropical cyclones
- Re-insurance

Water Resources and Agriculture

- Famine Early Warning System
- Drought
- Water Resource management
- Agriculture



Weather, Climate & Land Surface Modeling

- Numerical Weather Prediction
- Land System Modeling
- Global Climate Modeling

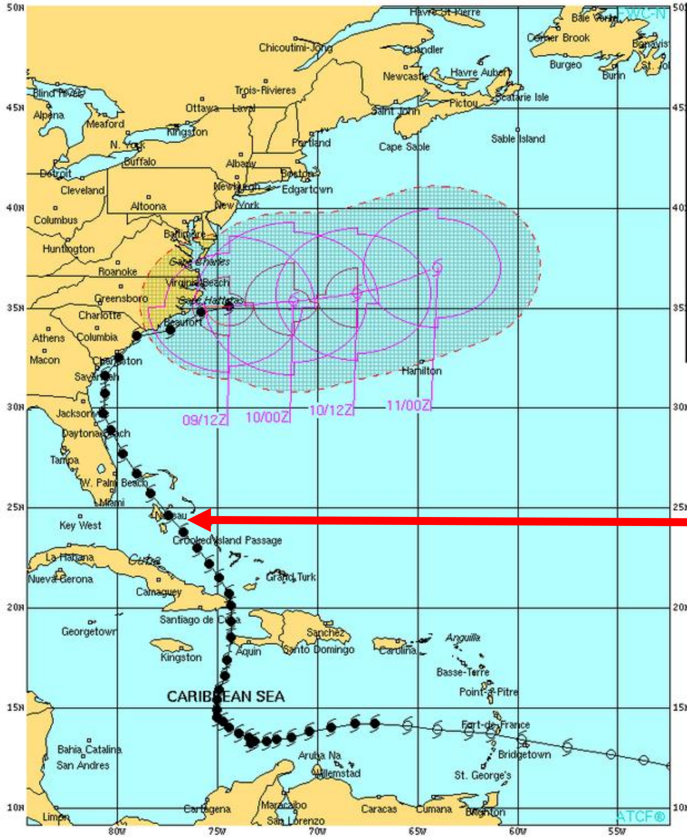
Public Health and Ecology

- Disease tracking
- Animal migration
- Food Security

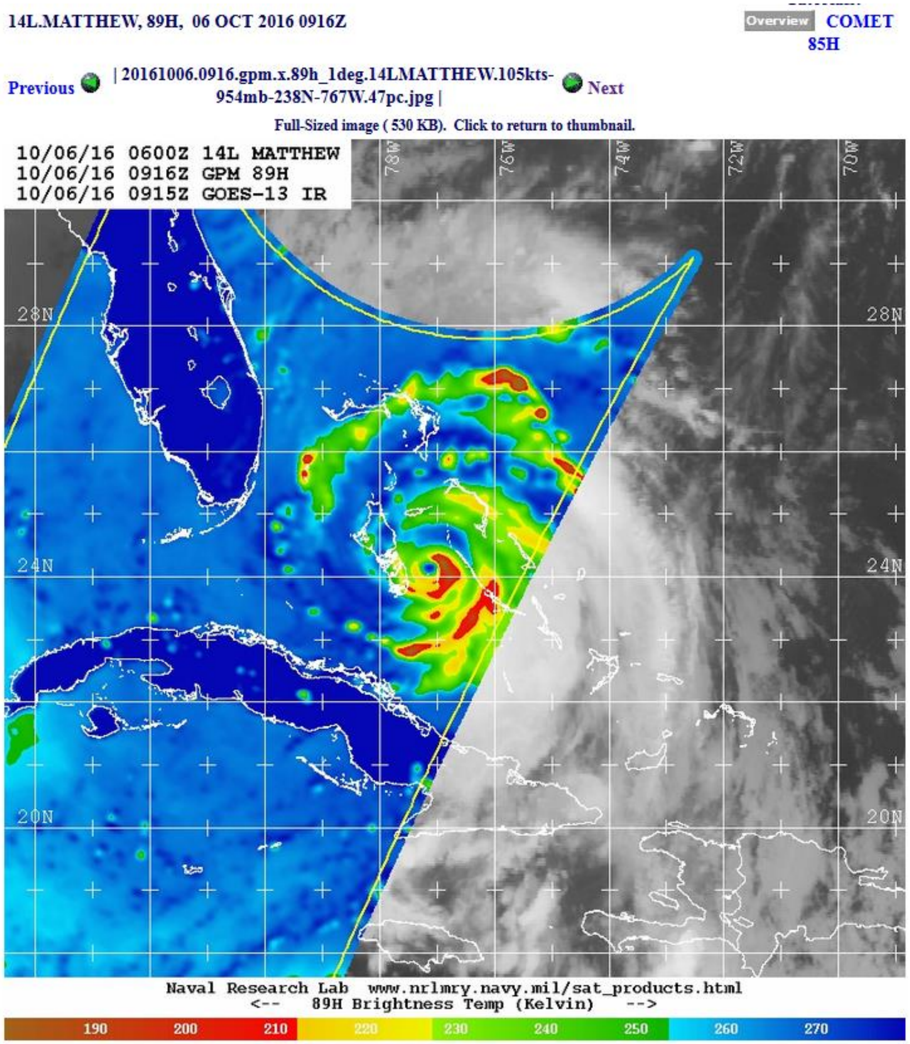
GLOBAL PRECIPITATION MEASUREMENT

GPM Data used for Operational Tropical Cyclone Tracking

The Naval Research Lab (NRL) routinely uses GPM Microwave Imager (GMI) data along with other sensors in their Automated Tropical Cyclone Forecasting System for improved storm track prediction. The NRL's forecasts are used by weather prediction and disaster response organizations around the world.

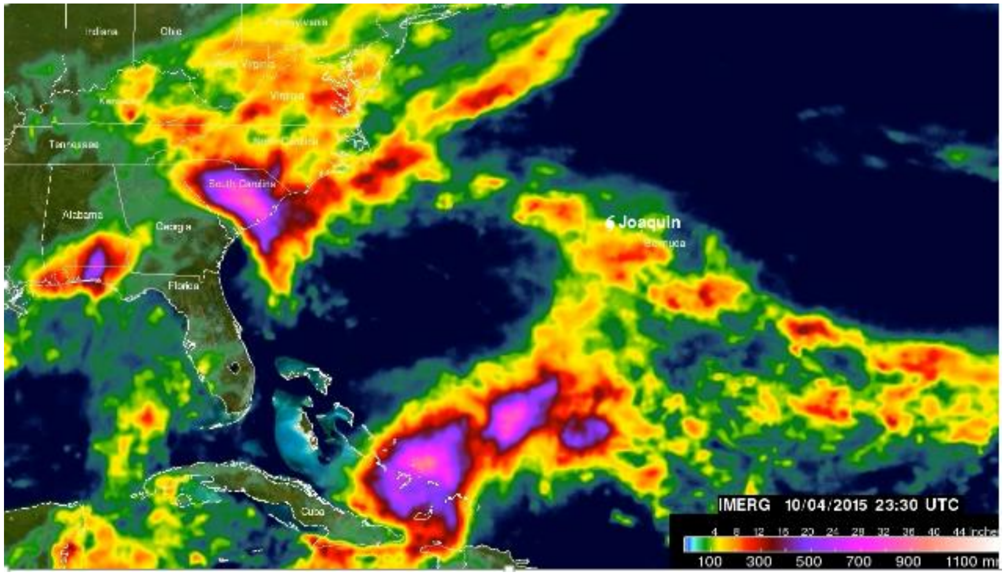


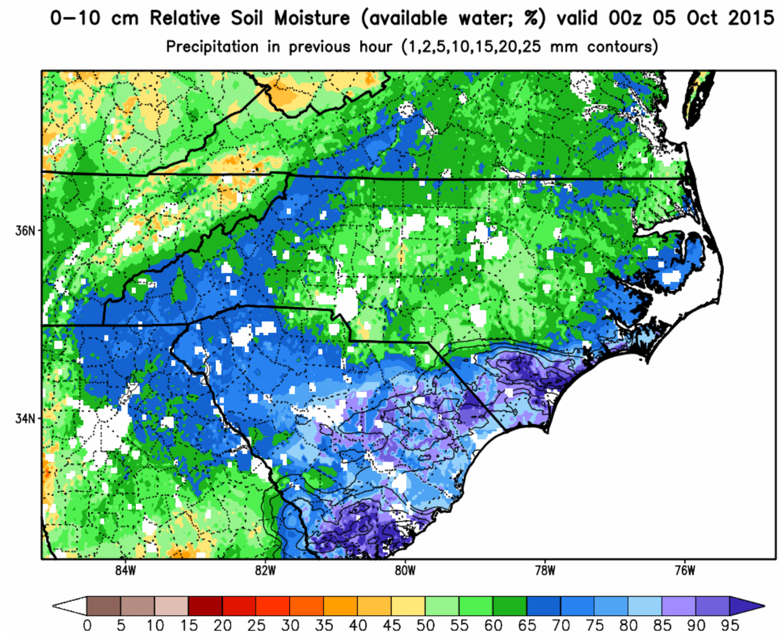
Hurricane Matthew affecting Nassau in the Bahamas as a Category 4 storm on 10/6/2016



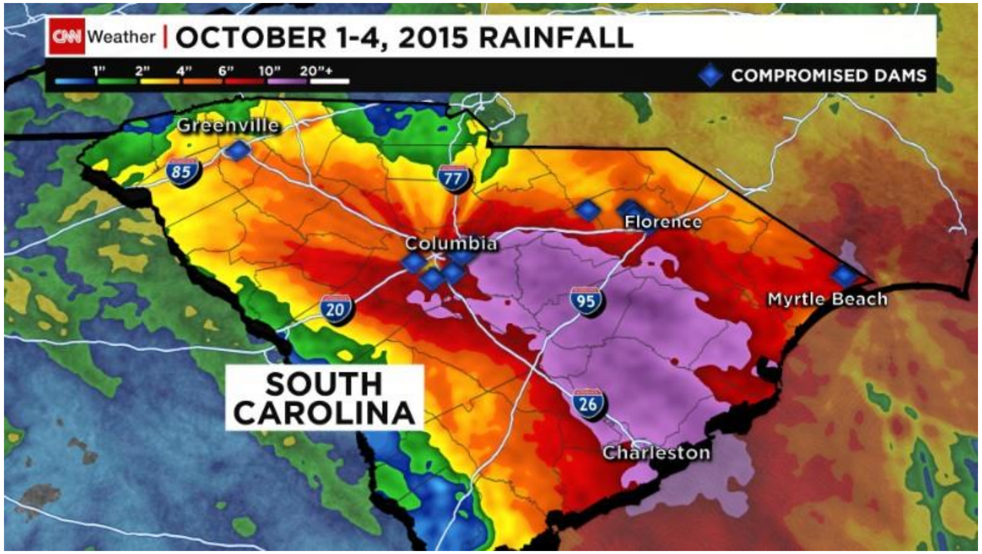
http://www.nrlmry.navy.mil

South Carolina Storms, October 2015



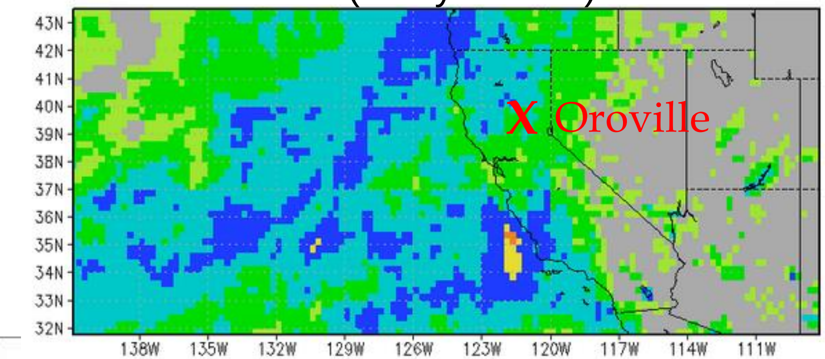


NASA's Land Information System routinely assimilates GPM data as a forcing input for their regional and global instances. The example shows heavy rainfall for a major South Carolina rainfall event in October, 2015. Forecasters are provided this data in near real-time by SPoRT at MSFC and the data are actively being assessed with feedback provided by partners in NWS forecast offices.

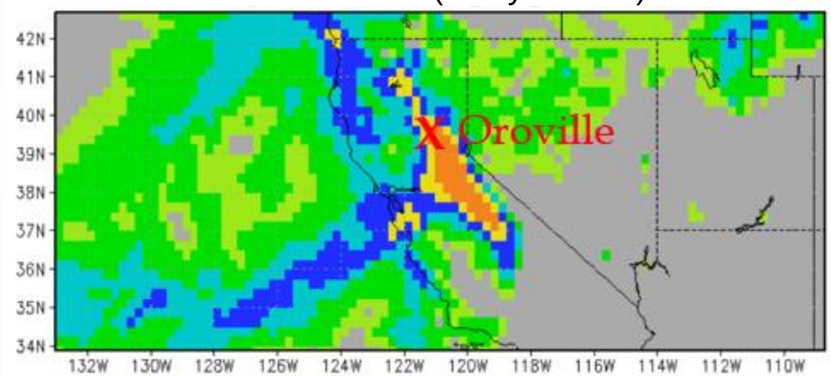


GPM used for Flood Estimation for Oroville Dam, February 2017

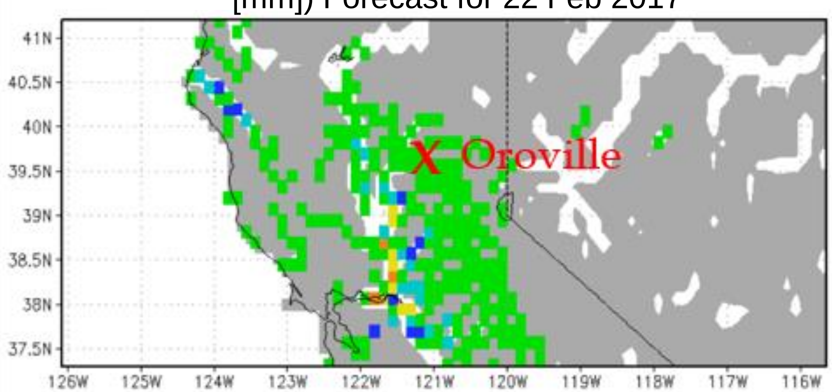
IMERG Rainfall (7-day accum.) 21 Feb 2017



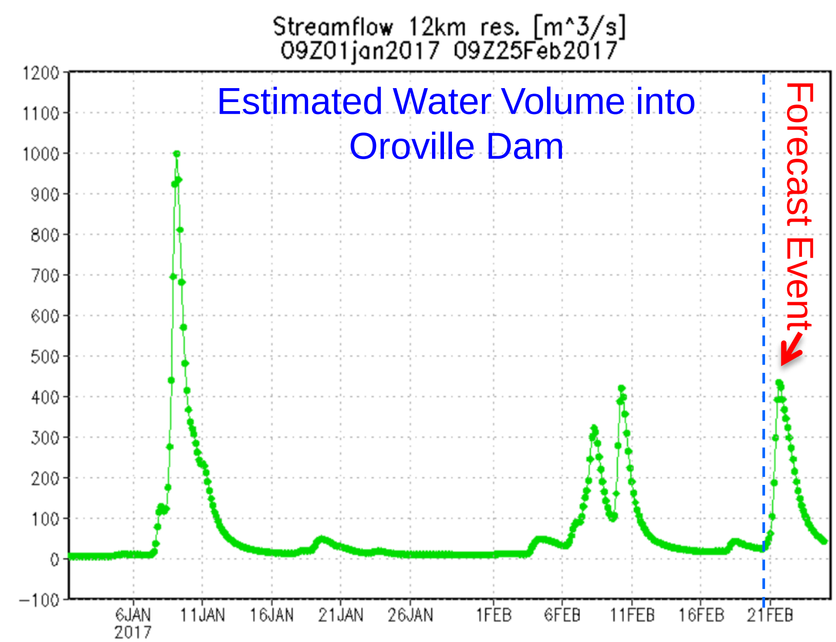
GEOS-5 Rainfall Forecast (3-day accum.) 22 Feb 2017



Flood Detection/Intensity (depth above threshold [mm]) Forecast for 22 Feb 2017



The Global Flood Monitoring System (GFMS) uses GPM to detect potential flooding conditions and estimate intensity. This system also uses GEOS-5 forecast to estimate streamflow within affected areas. Top left shows the 7-day IMERG rainfall totals over California ending on 21 Feb. 2017. Top middle plot shows forecasted 3-day rainfall from the GEOS-5 model near the Oroville Dam area. Bottom left plot shows the forecasted flood detection/intensity for 22 Feb. 2017, forecasts over northern California are estimated to be over 200 mm for the 22 Feb. 2017 (bottom).

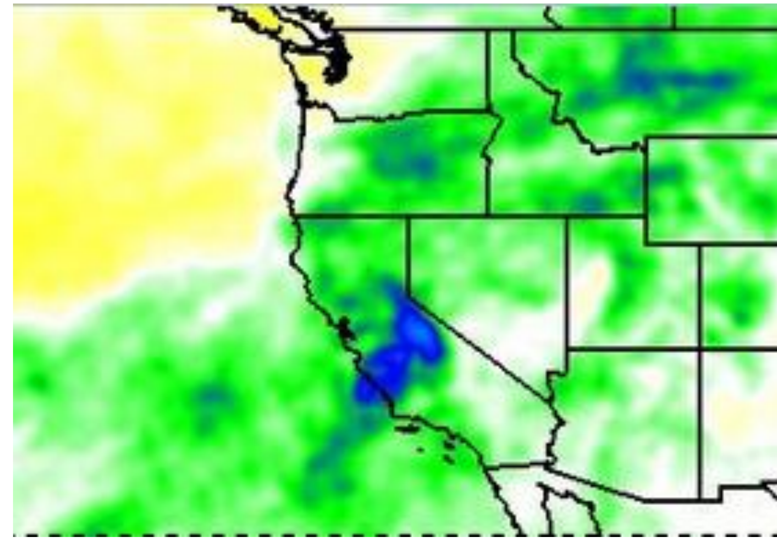


GPM Observes Pineapple Express rainfall, causing flooding in California January, 2017

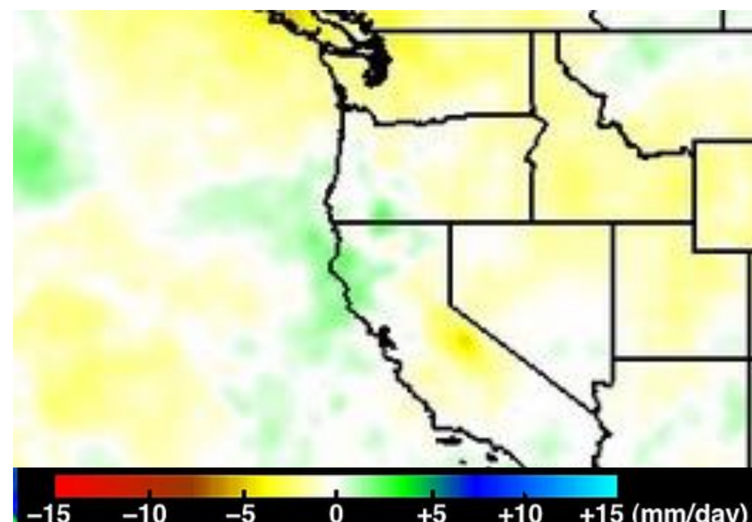
An atmospheric river (“Pineapple Express”) delivered over 5 inches of rainfall in parts of California in early January, 2017 (bottom) as viewed by GPM’s IMERG data. The 30-day rainfall anomalies ending Jan. 10th show TRMM Multi-satellite Precipitation Analysis from 2017 (top right) and 2016 (bottom, right).

Image credit: Hal Pierce, SSAI/GSFC

Rainfall anomalies, Jan 10th, 2017

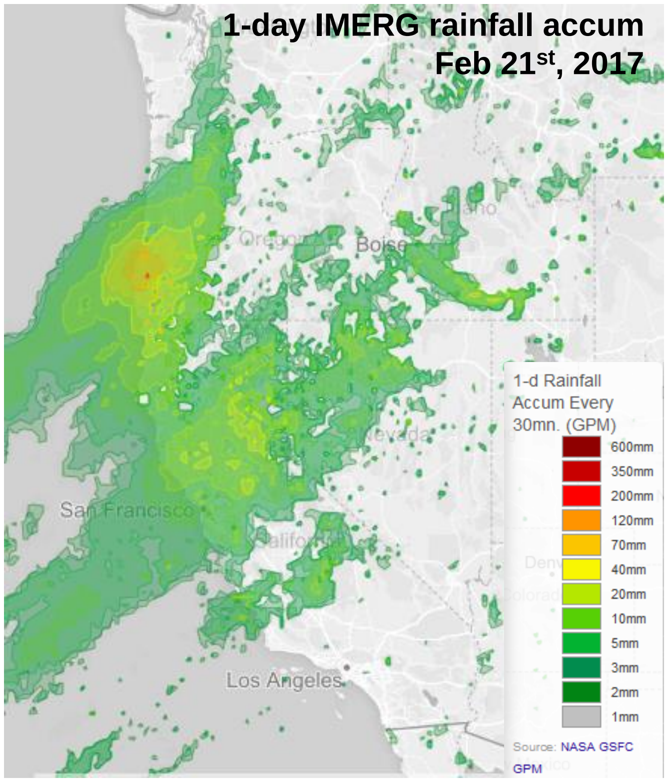


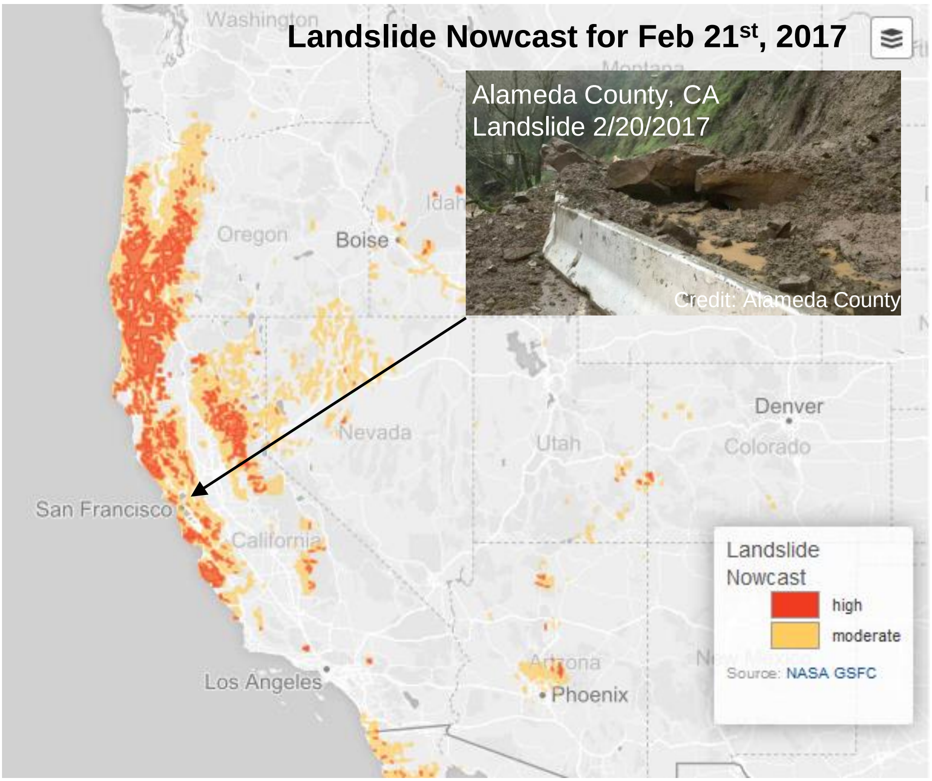
Rainfall anomalies, Jan 10th, 2016



Global Landslide Nowcasting for California, February 2017

A global landslide nowcast model provides situational awareness of landslide hazards for a wide range of users. The model uses IMERG near real-time data with a global susceptibility map to identify locations with landslide potential.



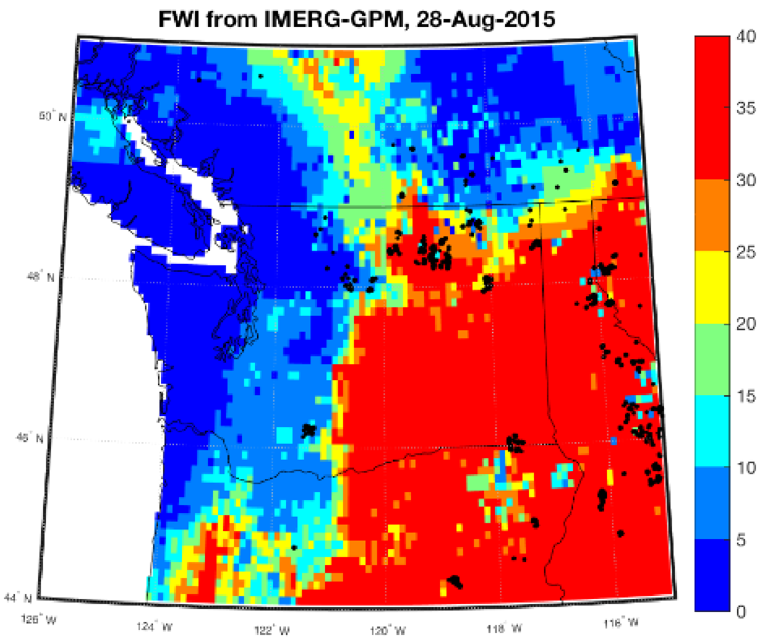


1-day IMERG rainfall accumulation (left) for the U.S. West Coast and corresponding landslide nowcasts (right) are shown for Feb. 21st, 2017 results are updated every 30 minutes

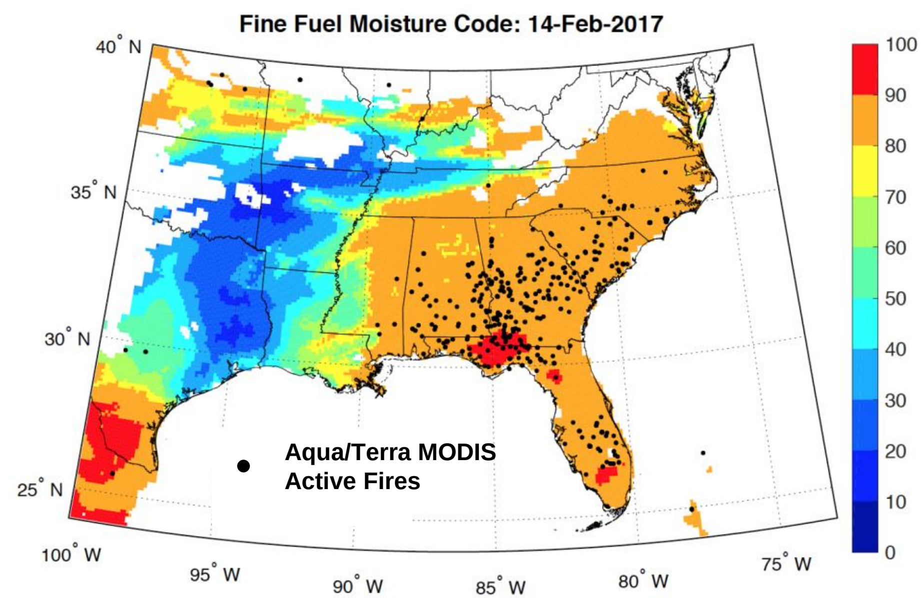
Kirschbaum/Stanley https://pmm.nasa.gov/precip-apps

Global Fire Weather Data and Forecasting

The Fire Weather Index System is the most widely used fire danger rating system in the world. The Global Fire WEather Database (GFWED) developed at NASA GISS integrates different weather factors influencing the likelihood of a vegetation fire starting and spreading. GPM IMERG and other data are incorporated in different versions of the GFWED and are used by fire management agencies around the world.



The Fire Weather Index tracks the potential for extreme fire behavior, seen here with Aqua & Terra MODIS active fires, using GPM IMERG for Aug 2015 record-breaking Pacific Northwest wildfires (Field, Engel Marlier, Lettenmaier)

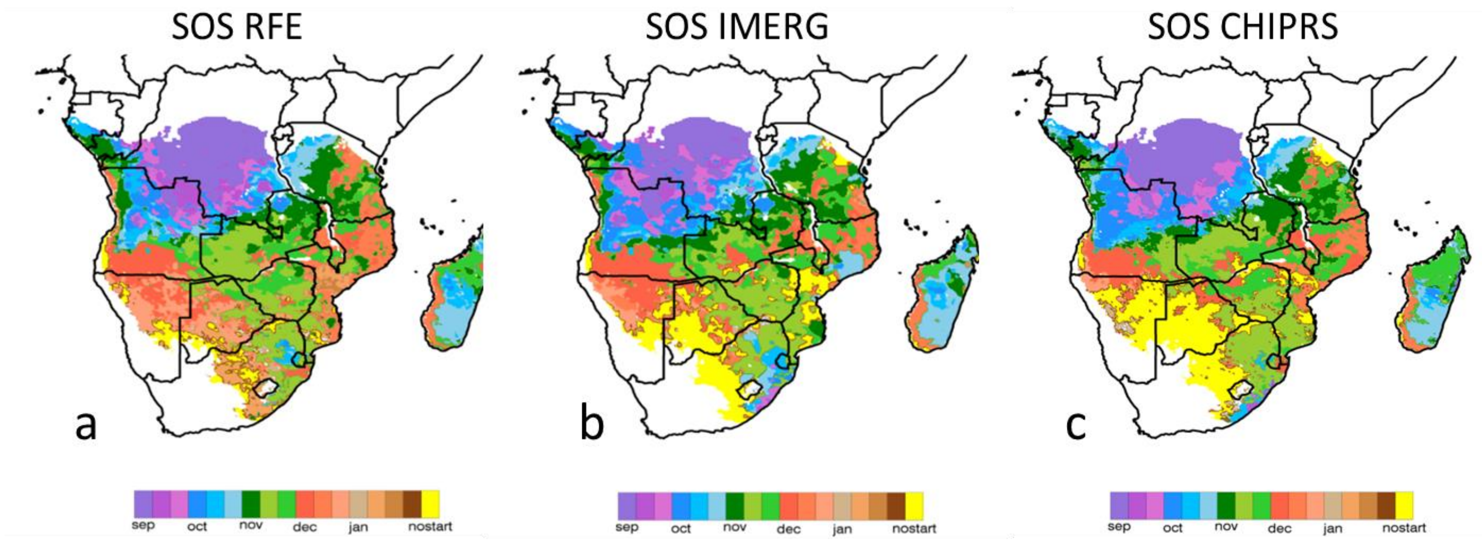


The Fine Fuel Moisture Code tracks the potential for fire starts, such as these predominantly agricultural and forest plantation prescribed fires in the southeast US.

R. Field/NASA GISS

Agricultural Monitoring

IMERG Estimates are compared with routine rainfall sources for Remote Agricultural Drought Monitoring within the Famine Early Warning System Data Assimilation System



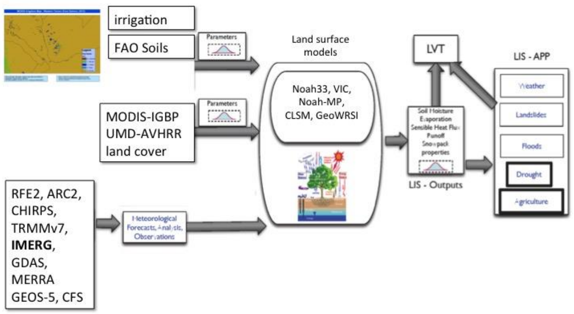
Start-of-season (SOS) for the 2015-16 Southern Africa growing season, computed with three different satellite derived rainfall estimates

Contribution from McNally et al.

Kirschbaum et al. 2016, BAMS

"While the IMERG product's spatial resolution, temporal latency and, for this example, agreement with the CHIRPS shows great promise, its utility for **FEWS NET will be better assessed when a longer time series is available**."

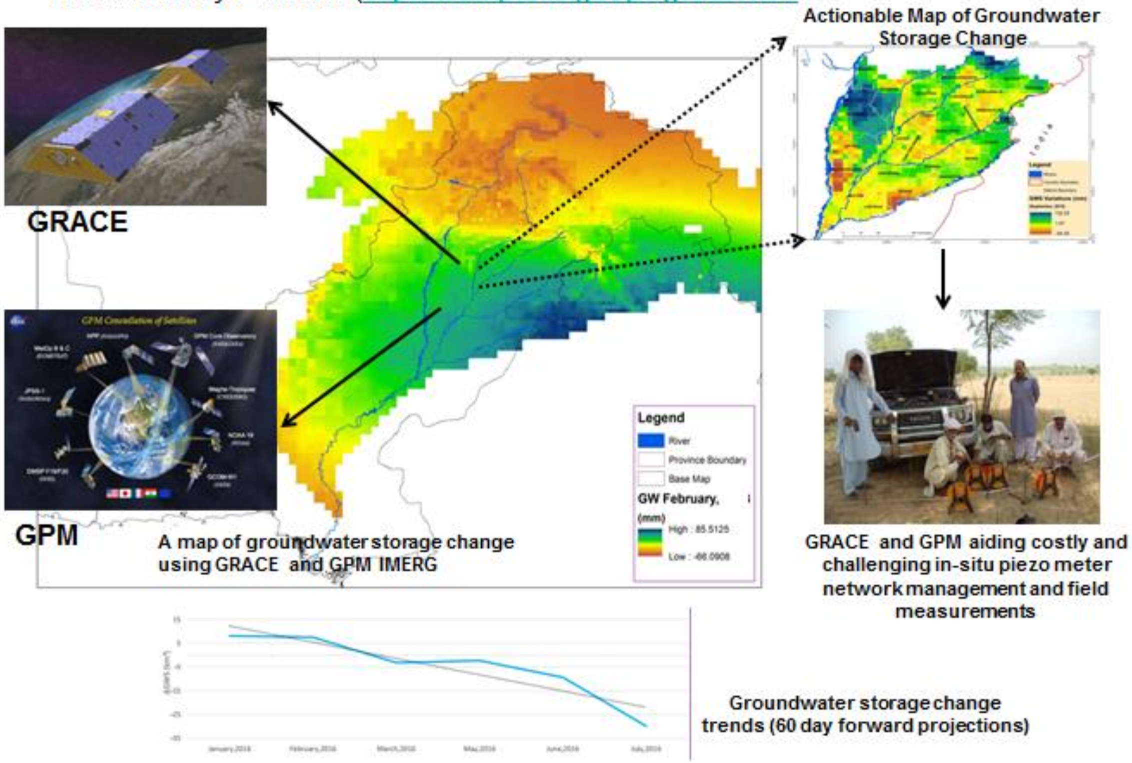
NASA Land Information System (LIS)
FEWS NET Land Data Assimilation System (FLDAS)



Satellite data used to empower National Water Agencies of Pakistan and Nepal

Over 10,000 farmers in the Indus basin receive information on water resources in their area on their cell phone

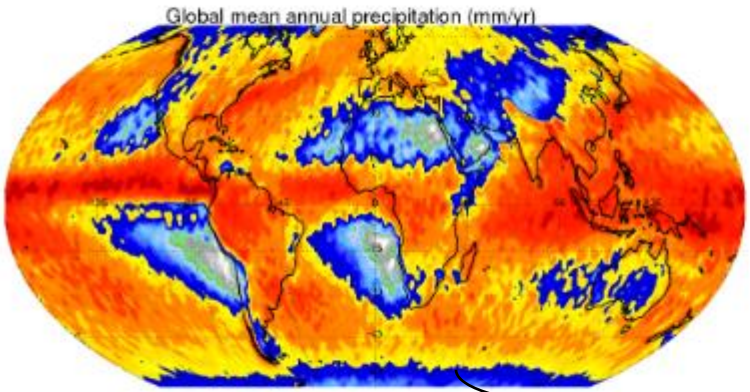
Operationalization of GRACE and GPM for Seasonal Groundwater Management in Pakistan by PCRWR (http://www.pcrwr.gov.pk/grace.html

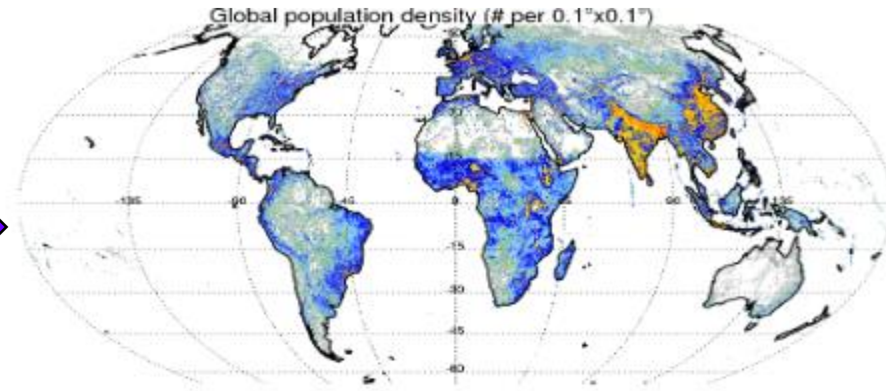


"Dear farmer friend, we would like to inform you that your wheat crop does not need irrigation due to sufficient rainfall during the past week."

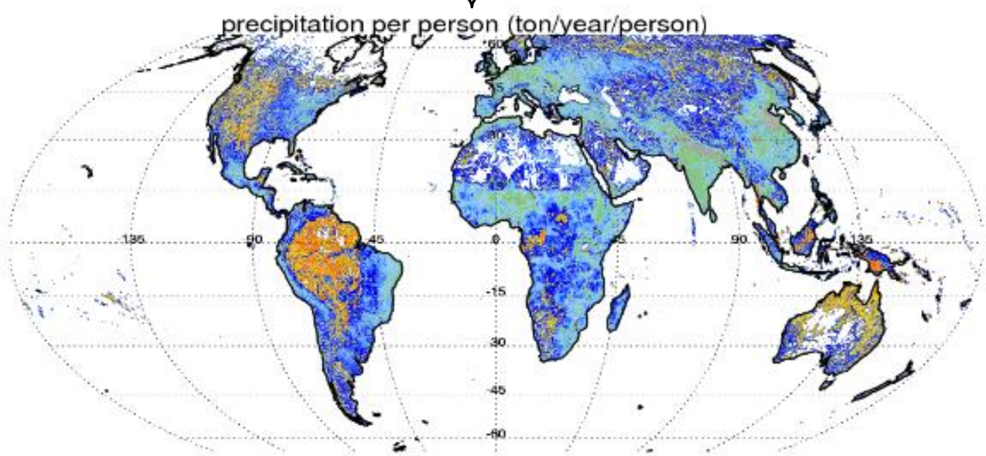
Hossain/U Washington

Food-Water-Energy Nexus





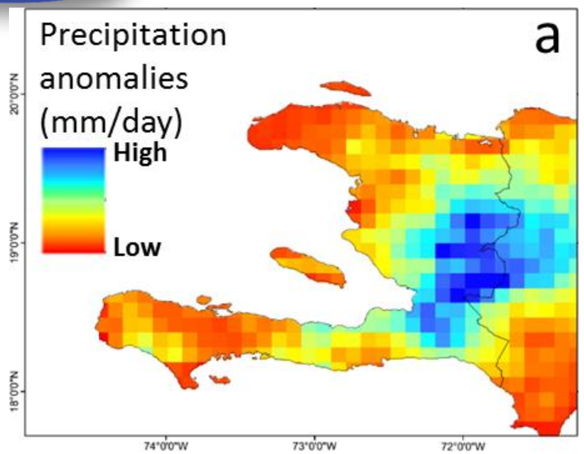
Global Precipitation Per Person



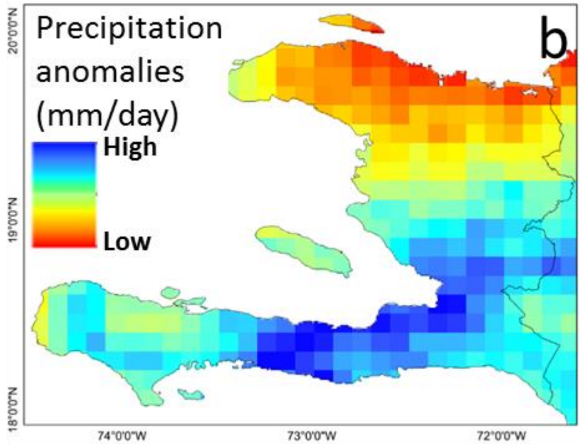
Global 2030 projections estimate increased demands for food (50%), water (30%) and energy (40%). Accurate, global estimates of precipitation will help better quantify the vulnerability of urban areas to these systemic changes and better characterize hydroclimate variability of extreme events.

M. Shepherd/C. Liu

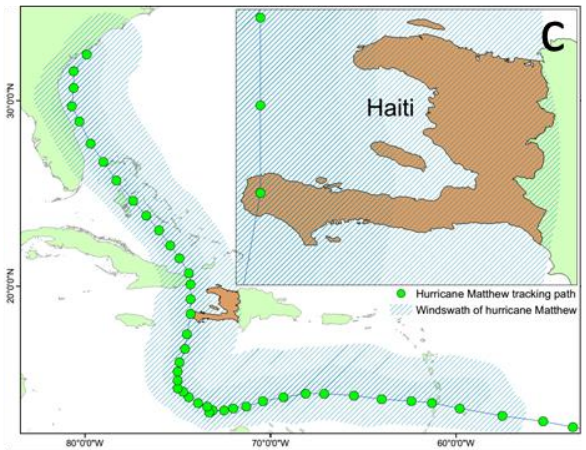
GPM used to estimate Cholera Risk after Hurricane Matthew, October 2016



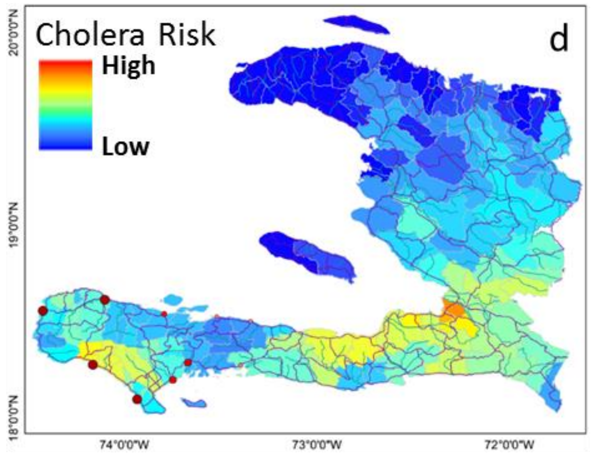
September precipitation anomalies



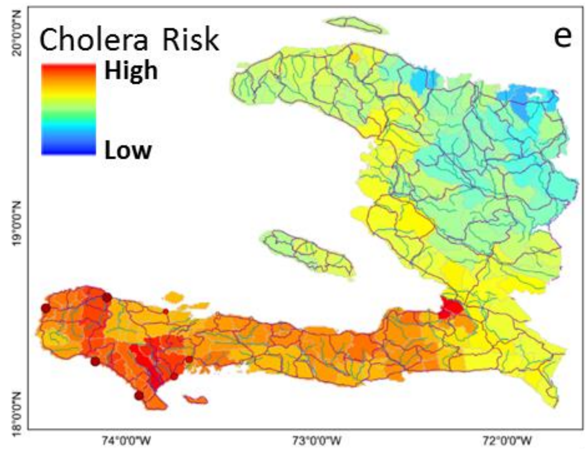
(Sept1-Oct13) precipitation anomalies



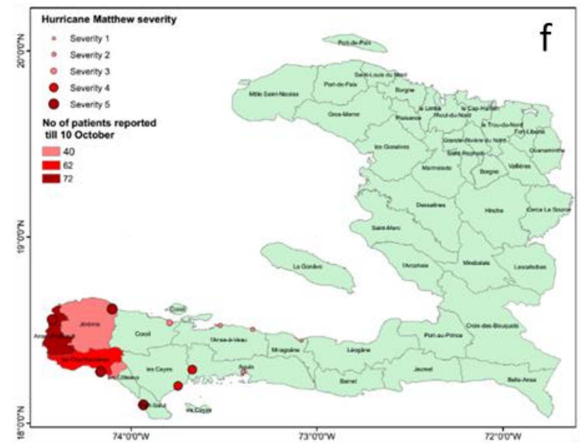
Hurricane Matthew track over Haiti



Cholera risk map based on pre hurricane hydro-climatic condition



Cholera risk map based on 2 weeks post hurricane hydro-climatic condition



Cholera condition in Haiti until 10 October

GPM IMERG data was used along with air temperature anomalies and population to compute maps of estimated cholera risk in Haiti following the passage of Hurricane Matthew 1-2 October, 2016. Plots show a) IMERG precipitation anomalies prior to and b) following Hurricane Matthew; c) track forecast for Matthew over Haiti, d) shows a Cholera risk map based on pre-hurricane hydroclimatic conditions, e) updated Cholera risk map 2 weeks after Hurricane Matthew, and f) reported cases of Cholera as of 10 Oct 2016.

For more information on the TRMM and GPM Missions:

http://gpm.nasa.gov

www.nasa.gov/gpm

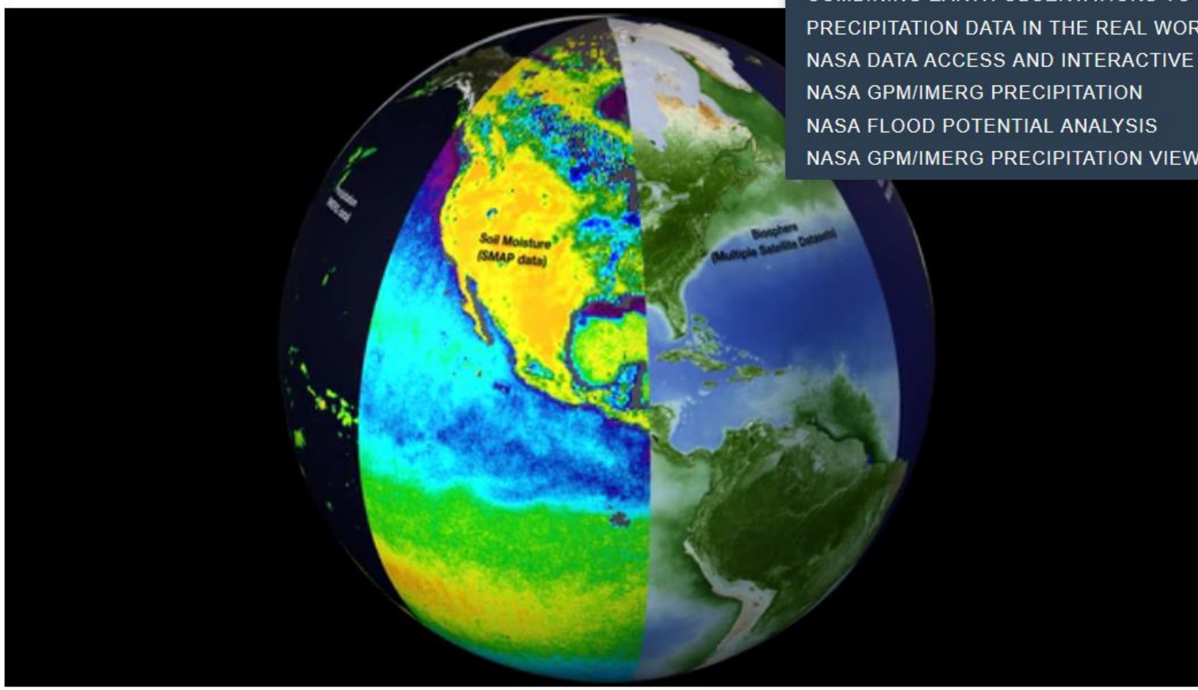
Twitter: NASA_Rain   Facebook: NASA.Rain

GPM E-Book

http://www.appsolutelydigital.com/Nasa/index.html

Dorian Janney

EARTH OBSERVATIONS OF WATER RESOURCES E-BOOK



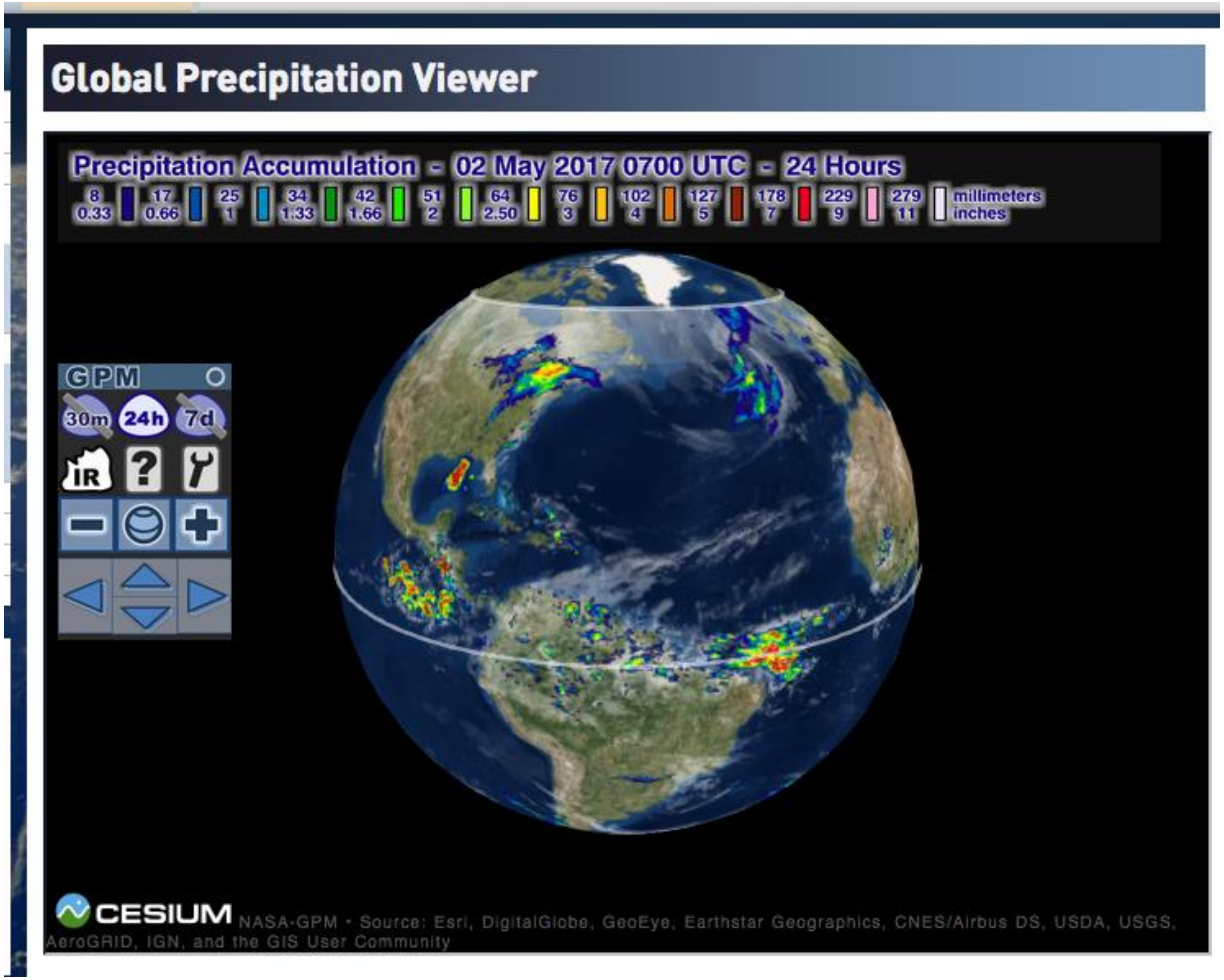
WORLD BANK GROUP
Environment & Natural Resources

GPM Data Access and Visualization Updates

Jacob Reed & Amita Mehta

Global Precipitation Viewer

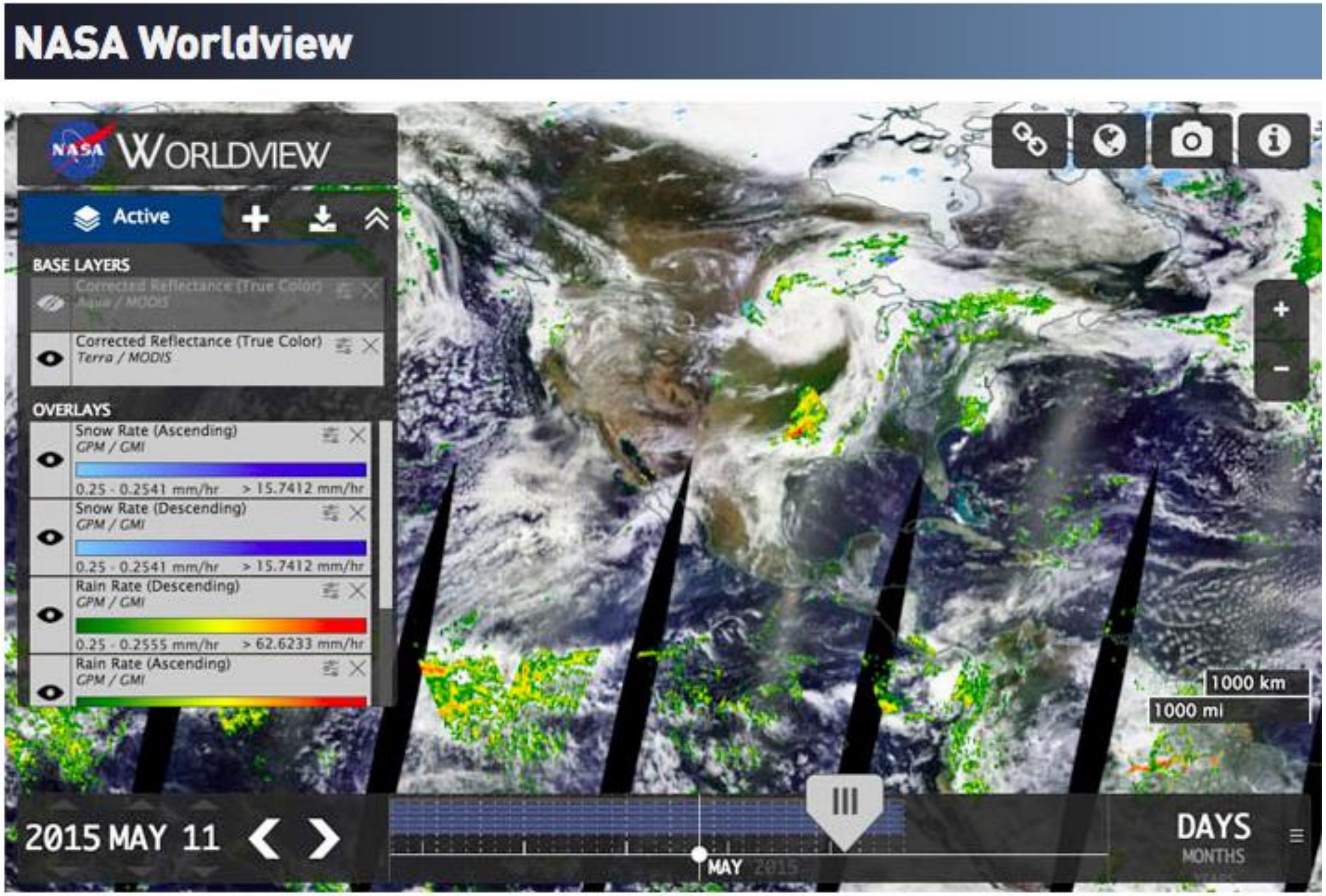
https://pmm.nasa.gov/data-access/global-viewer



Real Time IMERG Precipitation Data: 30m, 24hour, 7day

NASA Worldview

https://pmm.nasa.gov/data-access/worldview



Near-Real Time and Archived GMI Rain Rates

Precipitation and Applications Viewer

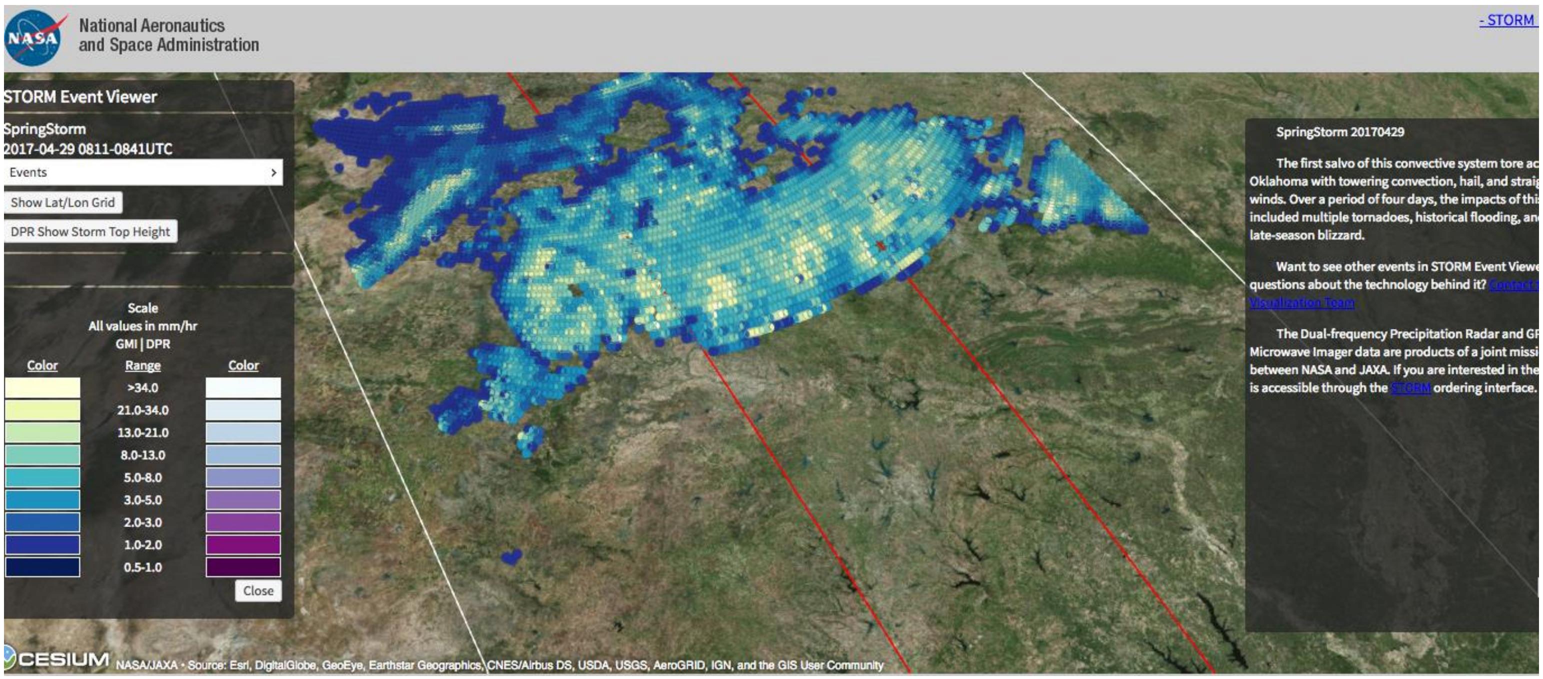
https://pmm.nasa.gov/precip-apps

Select Region

Select Data Product

Precipitation Storm Event Viewer

https://storm.pps.eosdis.nasa.gov/storm/cesium/EventViewer.html



Thank You!

Amita Mehta (amita.v.mehta@nasa.gov)