Day 1 for the Integrated Multi-satellitE Retrievals for GPM (IMERG) Data Sets

The GPM Multi-Satellite Team

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Introduction
IMERG Design
Examples
Future
Final Comments

1. INTRODUCTION

Goal: compute

- the longest, most detailed record of "global" precip from
- diverse, changing, input precip estimates

IMERG is a High-Resolution Precipitation Product

- best snapshot precipitation

IMERG is a unified U.S. algorithm built on

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

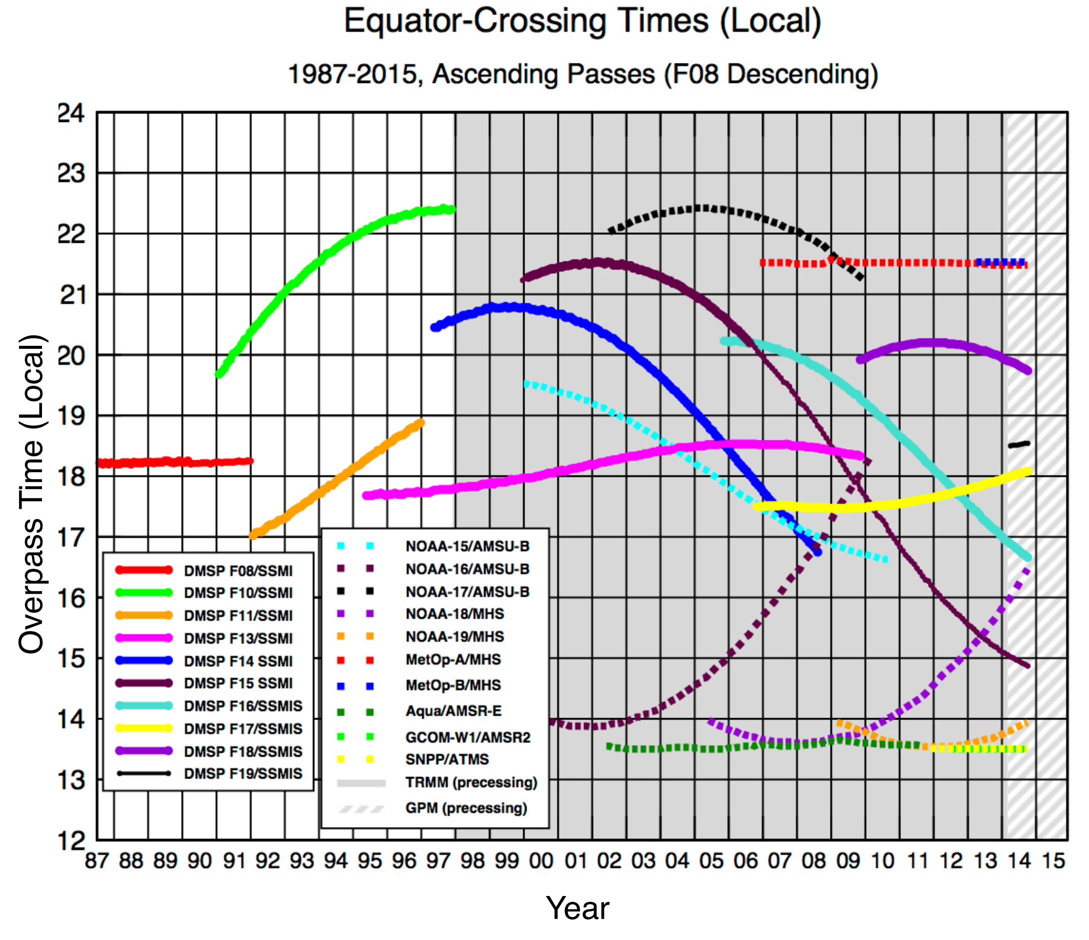


Image by Eric Nelkin (SSAI), 13 November 2014, NASA/Goddard Space Flight Center, Greenbelt, MD.

2. IMERG Data Sets

Multiple runs for different user requirements for latency and accuracy

- "early" – 4 hours (flash flooding)
- "late" – 12 hours (crop forecasting)
- "final" – 2 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

Multiple data fields in each file

User-oriented services

- interactive analysis (GIOVANNNI)
- alternate formats (KMZ, KML, TIFF WRF files, …)
- area averages (coming soon)

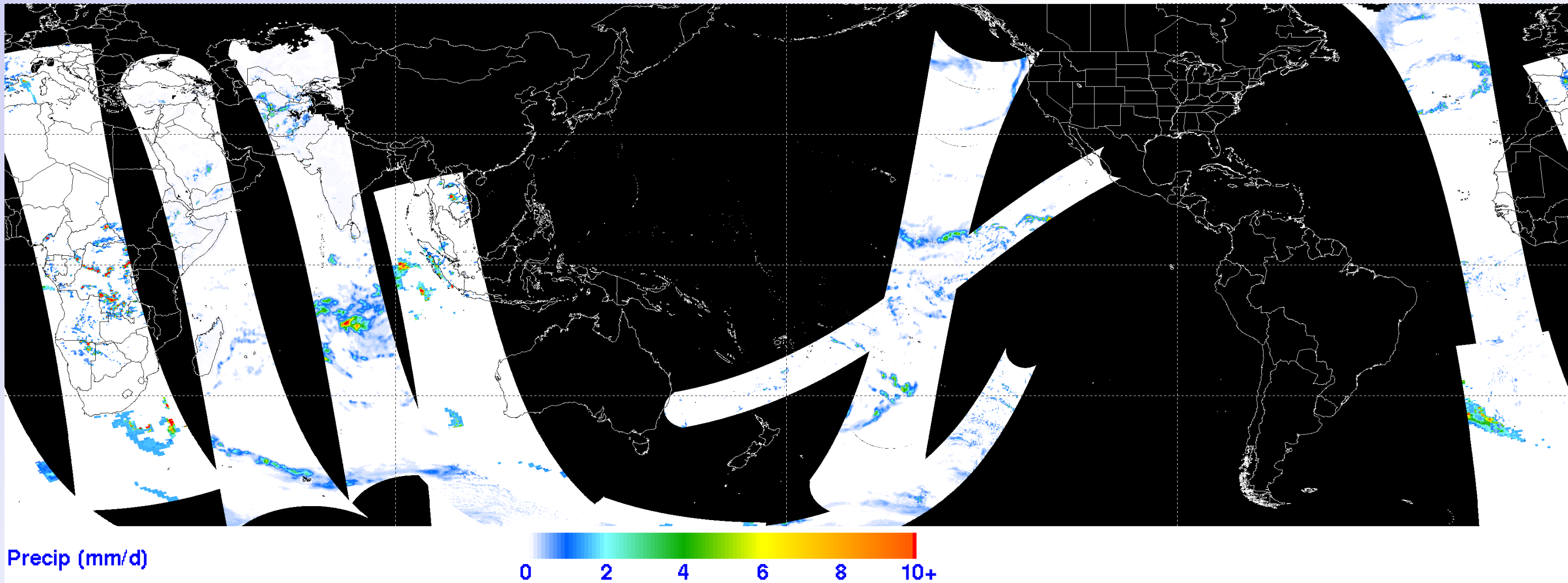
	Half-hourly data file (Early, Late, Final)
1	*Calibrated multi-satellite precipitation*
2	*Uncalibrated multi-satellite precipitation*
3	*Calibrated multi-satellite precipitation error*
4	PMW precipitation
5	PMW source identifier
6	PMW source time
7	IR precipitation
8	IR KF weight
9	*Probability of liquid-phase precipitation*
	Monthly data file (Final)
1	*Satellite-Gauge precipitation*
2	*Satellite-Gauge precipitation error*
3	Gauge relative weighting
4	*Probability of liquid-phase precipitation*

3. EXAMPLES – Data Fields from IMERG Test Data

1430-1500Z 3 April 2014

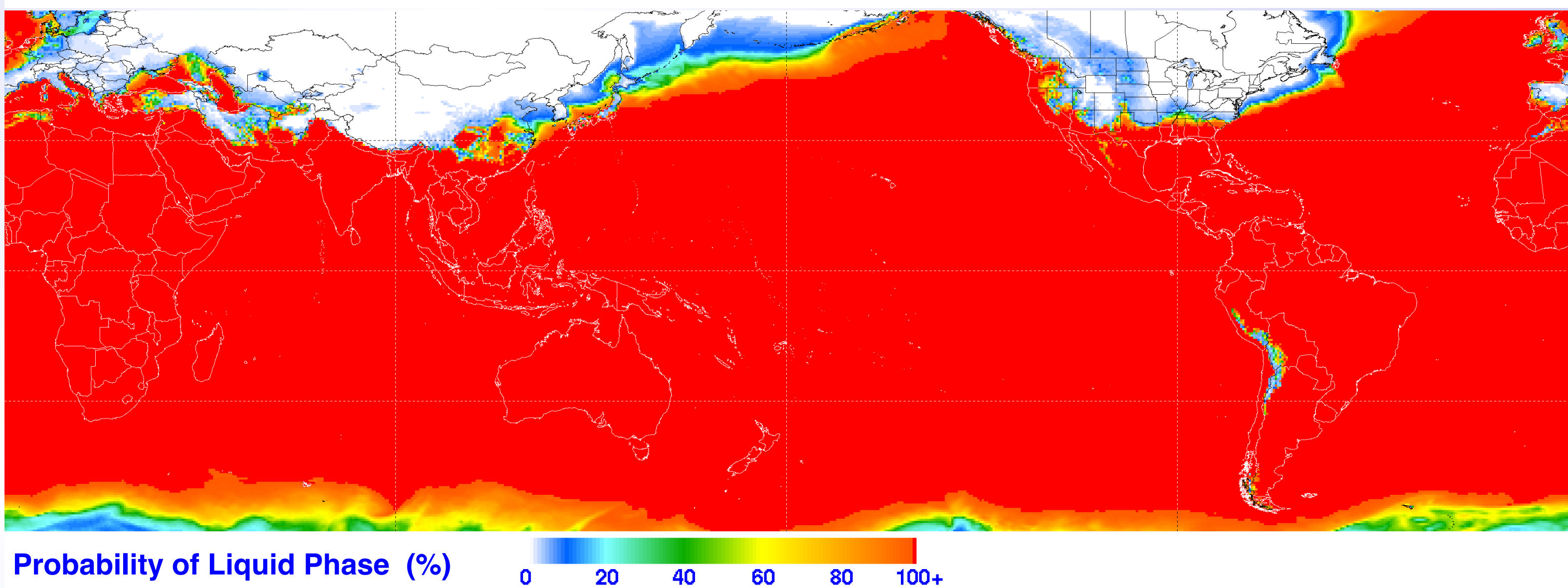
Microwave precip

data collected in the half hour, with <u>dropouts due to snow/ice</u>

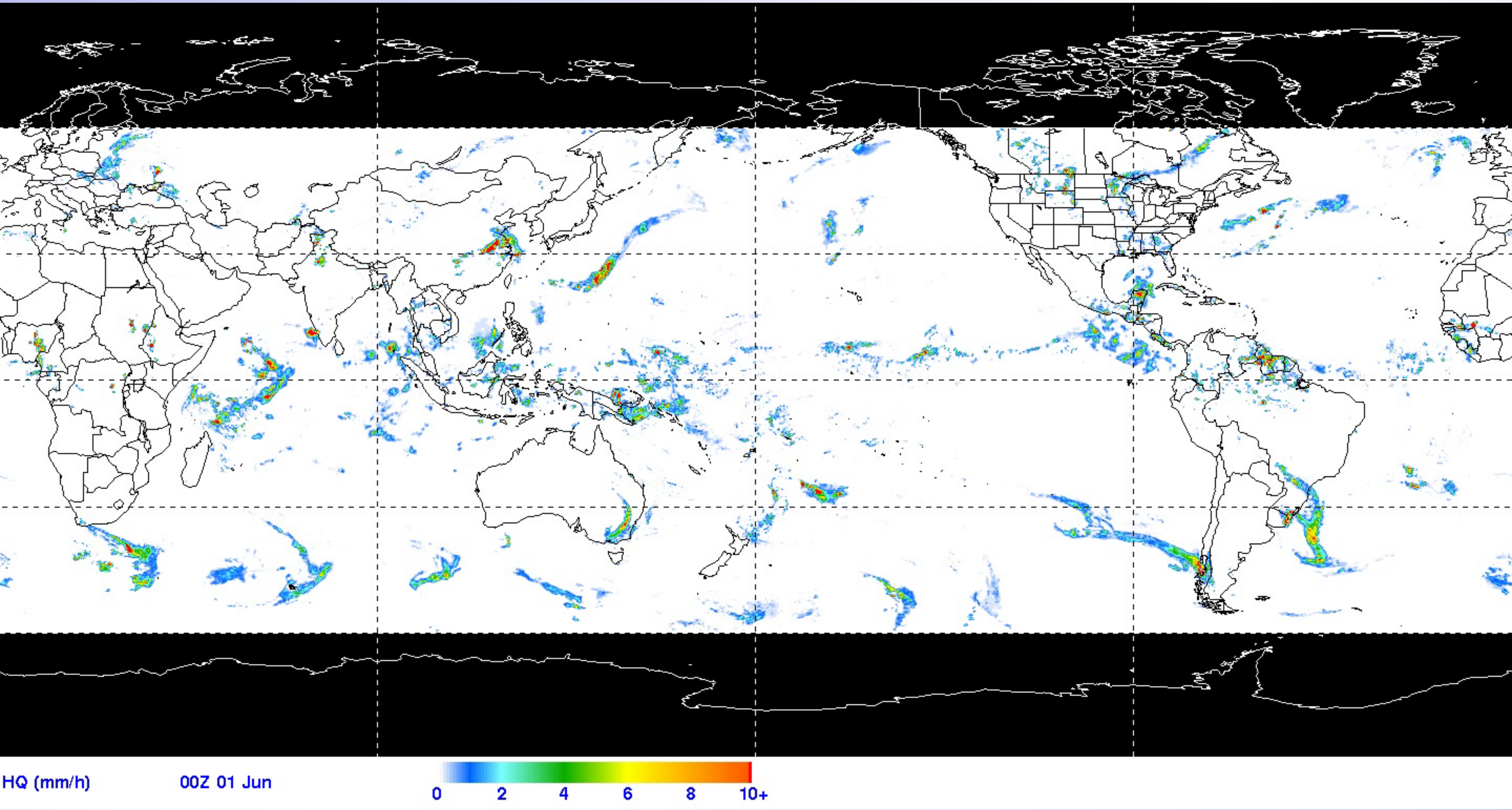


PPLP

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



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

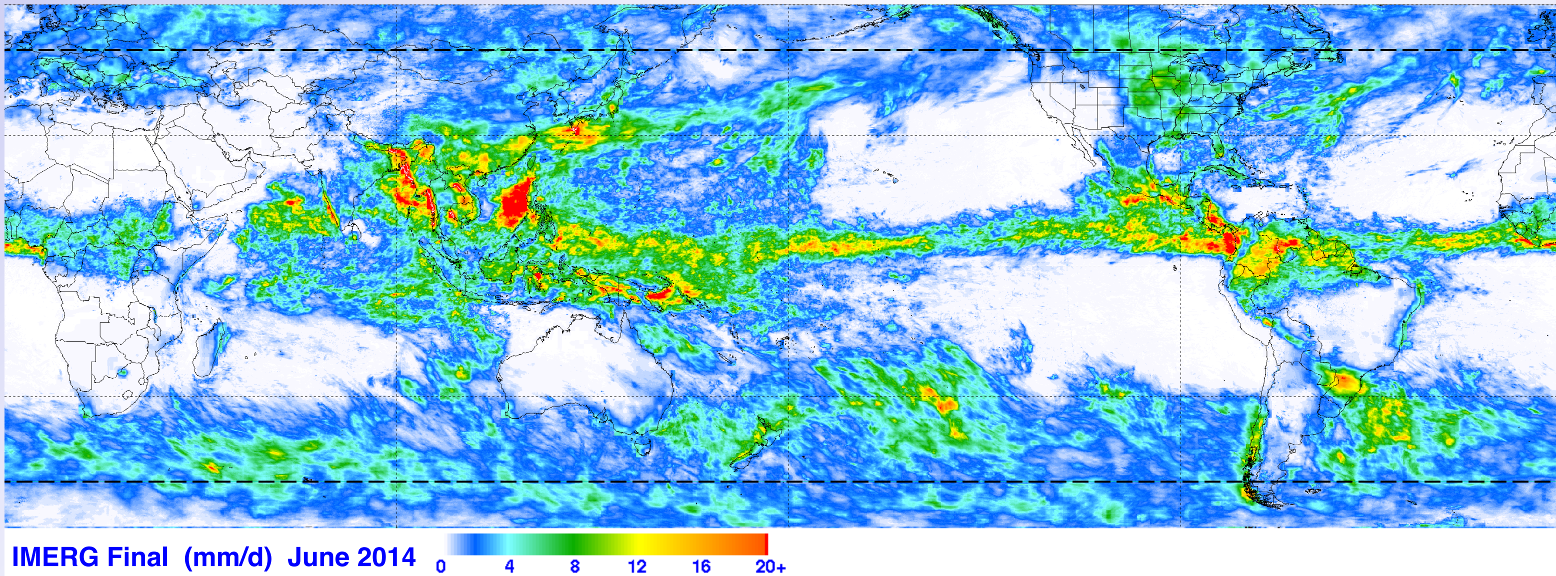


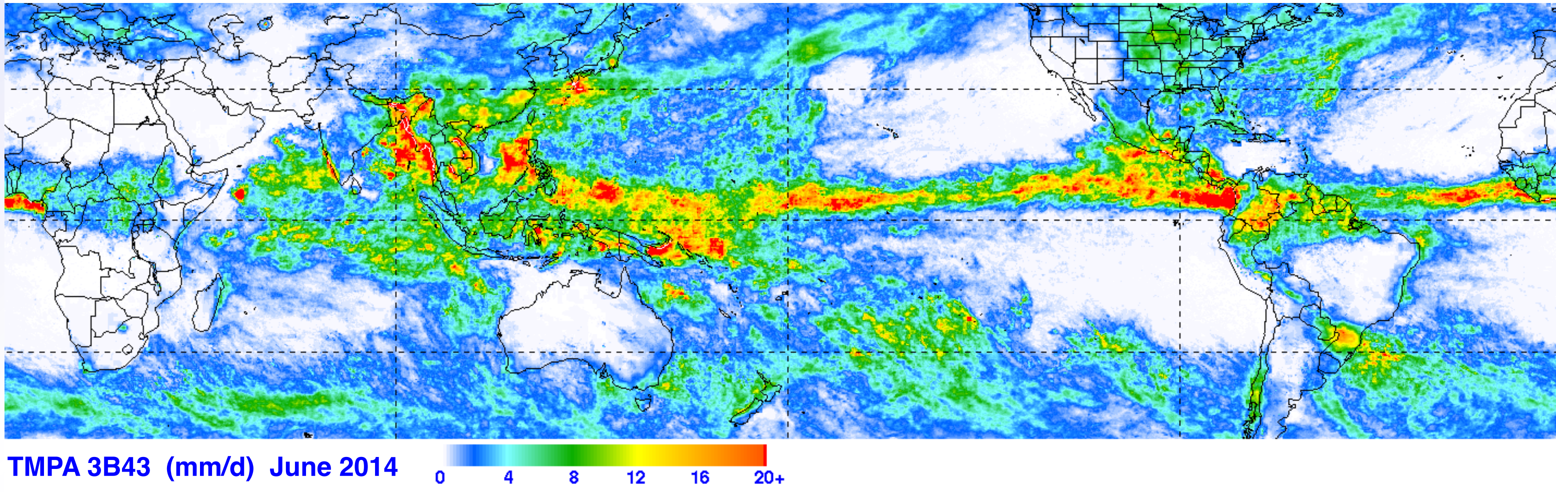
3. EXAMPLES – IMERG Final Vs. TMPA for June 2014

Same input satellites, different algorithms, different calibrator

Similar, but not identical

- features (SPCZ)
- bias (ITCZ)





3. EXAMPLES – IMERG Final and TMPA vs. MRMS for 15 June 2014

Averaged to daily, 0.25° grid

- ½-hour offset for 3B42, likely not critical

Somewhat randomly chosen case with a good rain system

IMERG tends to be closer to MRMS

Changes in

- input data sets
- Lagrangian time interpolation

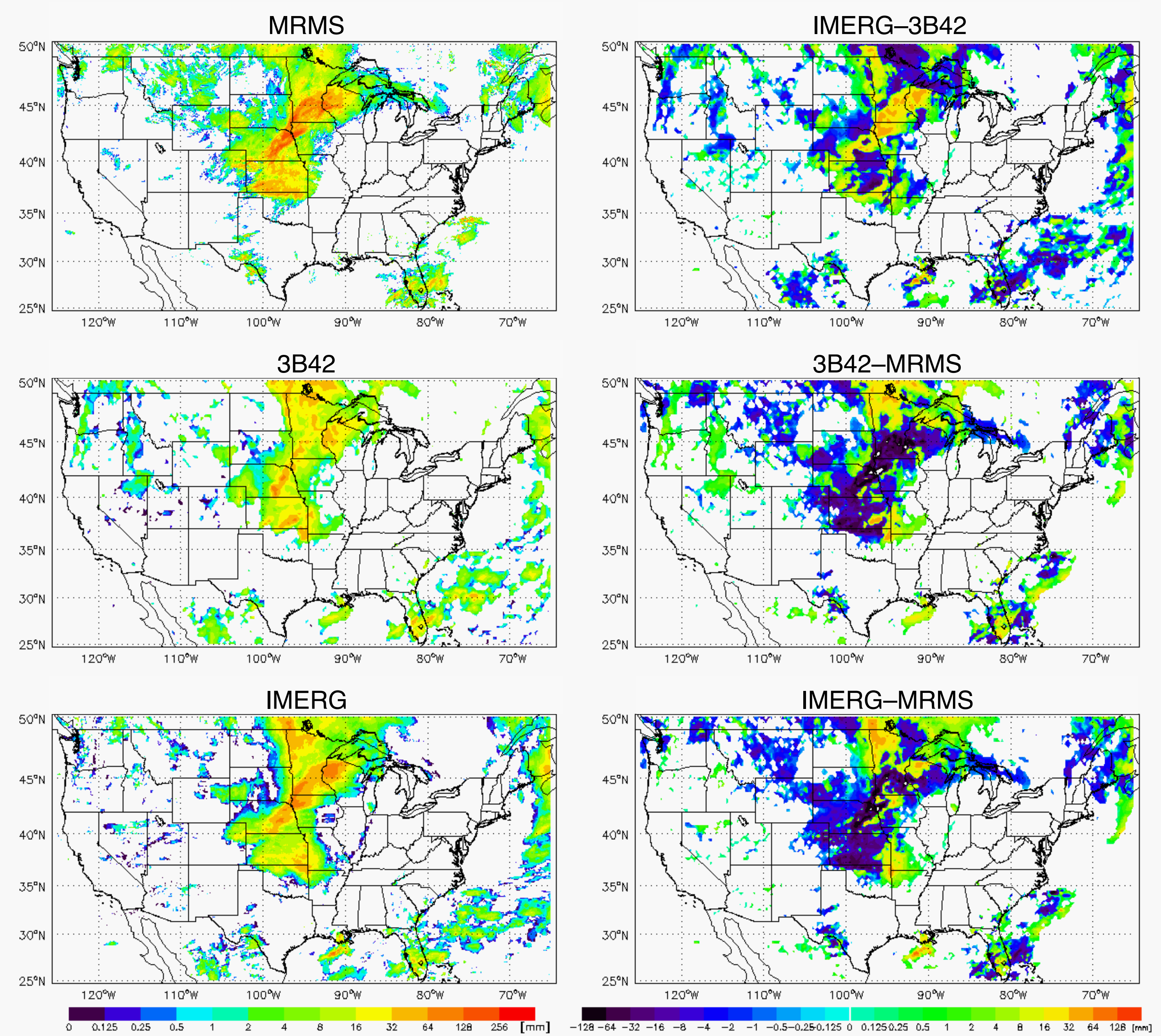


Image: J. Wang (SSAI; WFF)

3. EXAMPLES – IMERG Final and TMPA vs. MRMS PDF's for June 2014

Averaged to 3-hourly, 0.25° grid

- ½-hour offset for 3B42, likely not critical

Low and high rain rates are better

- frequency is much better
- volume is modestly better

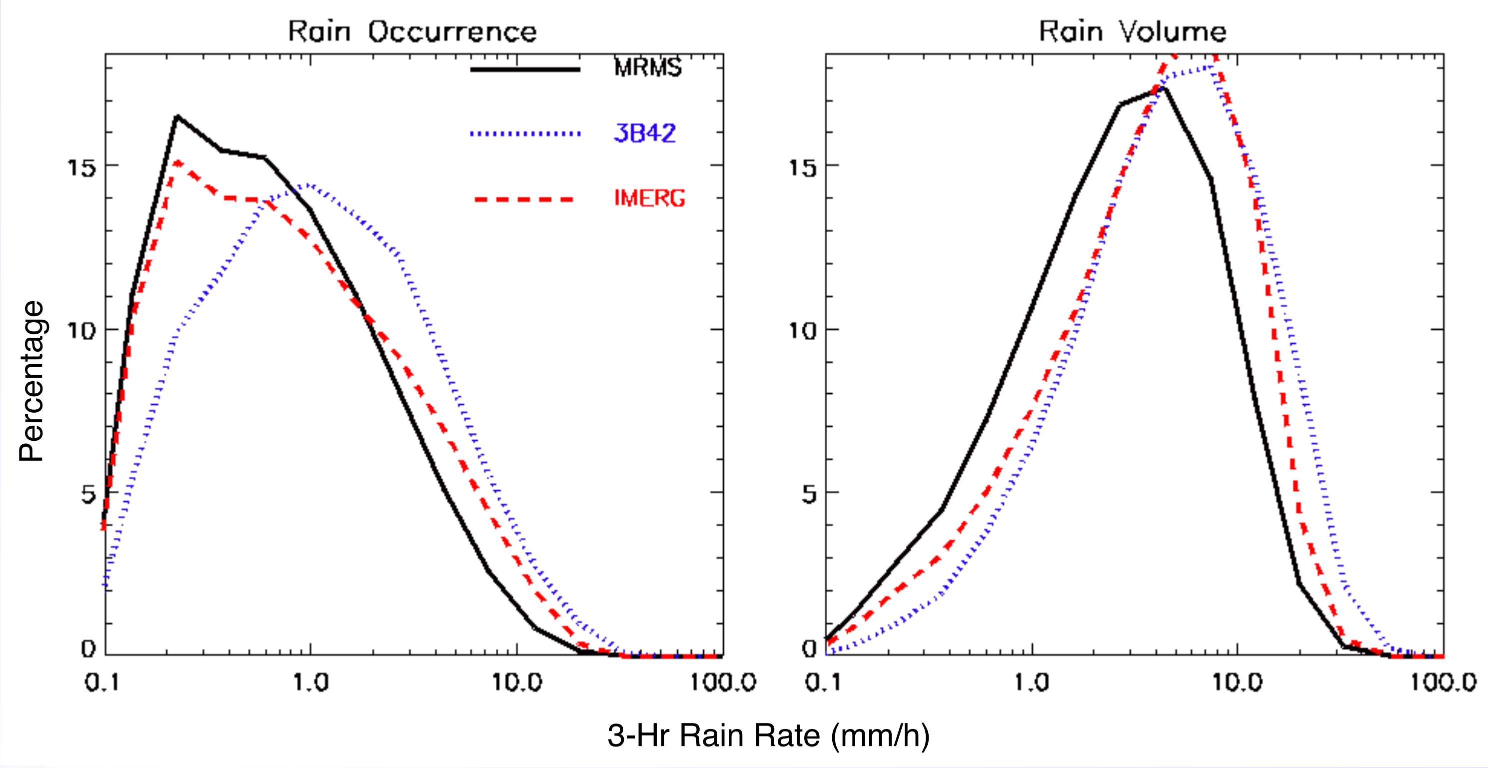


Image: J. Wang (SSAI; WFF)

4. FUTURE – Transitioning from TRMM to GPM

Final Run IMERG is considered ready for delivery

- beta testing during December required a few small corrections
- currently being computed for release (April 2014–present)
- limitations remain – working to document these

Early and Late Run IMERG still pending on PPS completing the real-time system

- testing in February 2015

Early 2016: expect to compute the 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 Spring 2015
- TMI is still useful, 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
    - testing satellite climatological calibrations to continue production
    - climatological calibration over ocean is likely to cause a discontinuity
    - gauge calibration over land should continue to yield consistent results
- loss of legacy sounder estimates could raise issues for continuing TMPA

5. FINAL COMMENTS

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

IMERG will provide fine-scale estimates with three latencies for (eventually) the entire TRMM/GPM era

Final Run IMERG is on the verge of release for April 2014–present

Early and Late Run IMERG are targeted for release in late winter

The TMPA and TMPA-RT are slated to run into Summer 2016

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2. IMERG DESIGN – Processing

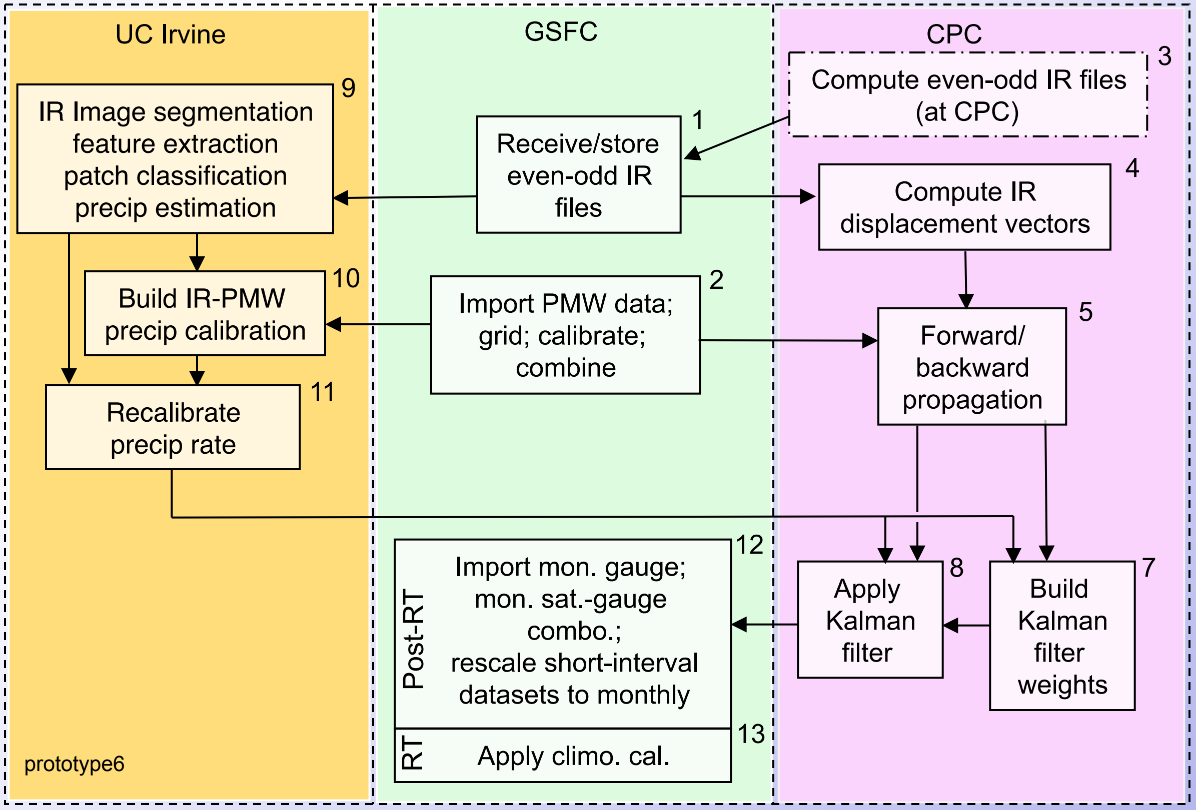
IMERG is a unified U.S. algorithm that takes advantage of

- 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 GSMaP

Institutions are shown for module origins, but

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

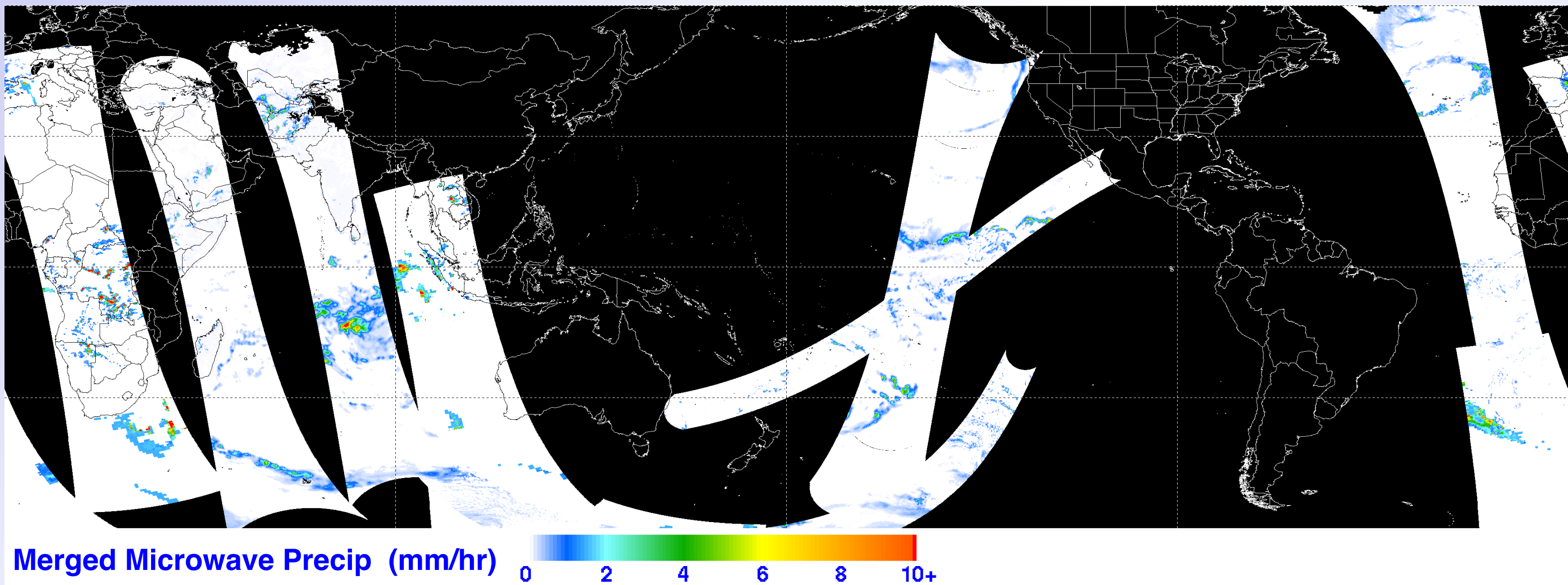


3. EXAMPLES – Data Fields from IMERG Test Data (1/4)

1430-1500Z 3 April 2014

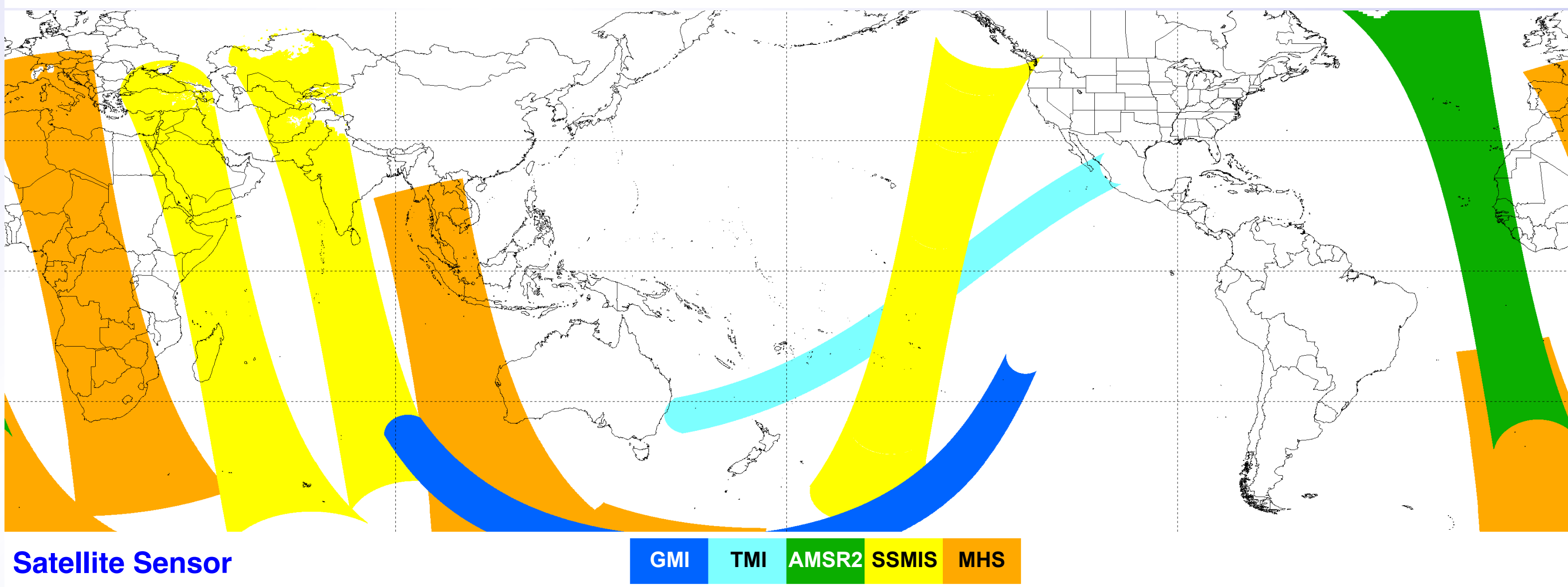
Microwave precip

data collected in the half hour, with <u>dropouts due to snow/ice</u>



Source microwave sensor contributing the data;

selected as imager first, then sounder

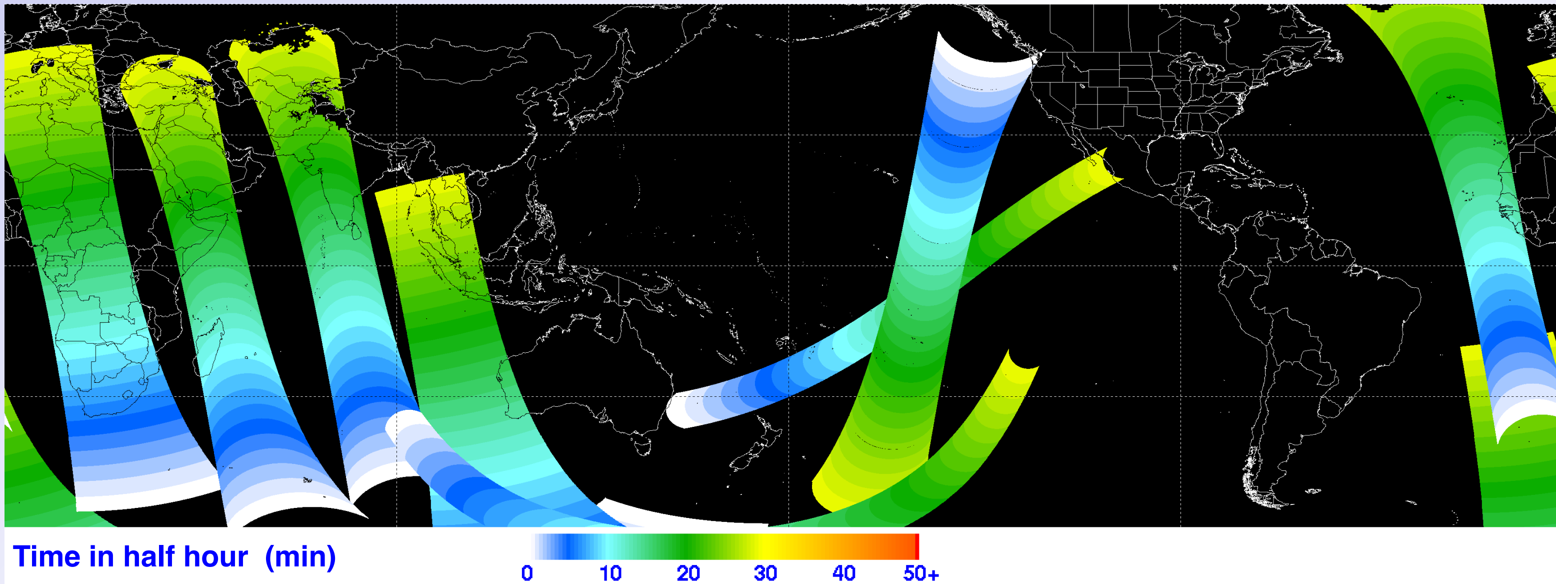


3. EXAMPLES – Data Fields from IMERG Test Data (2/4)

1430-1500Z 3 April 2014

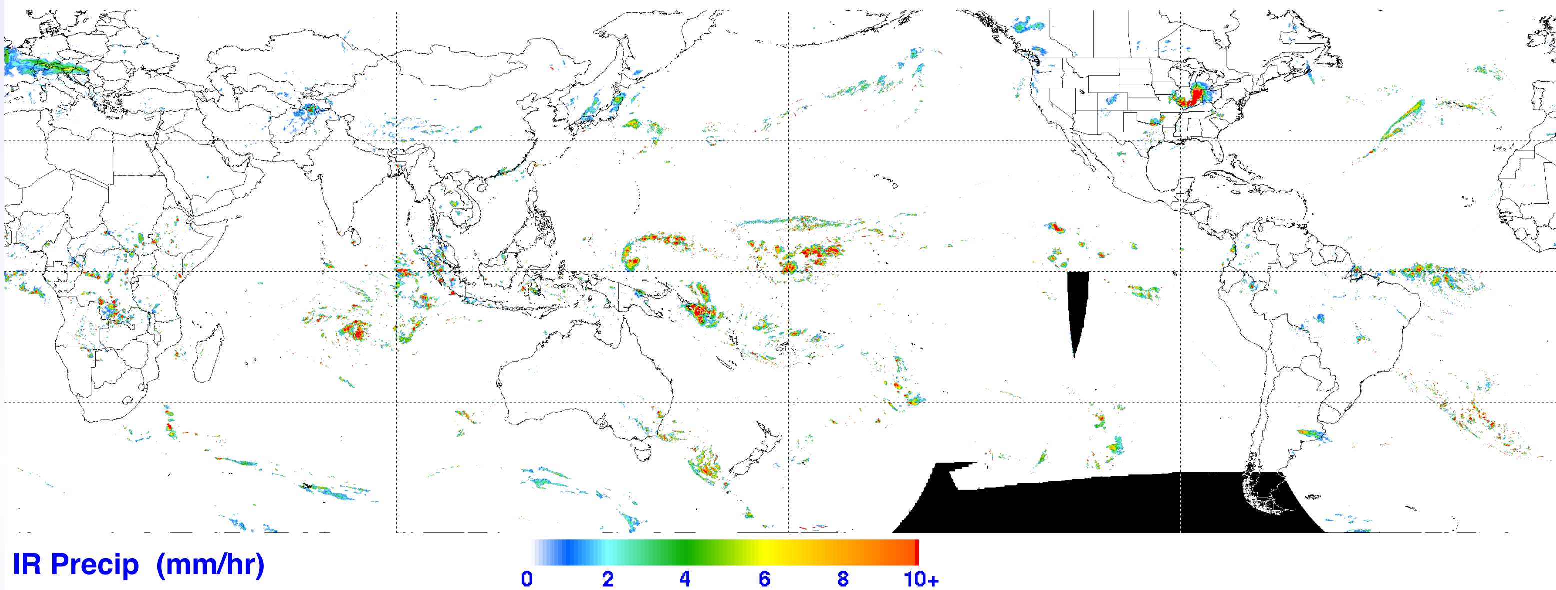
Time

time after start of half hour



IR Precip

precip from merged geo-IR data

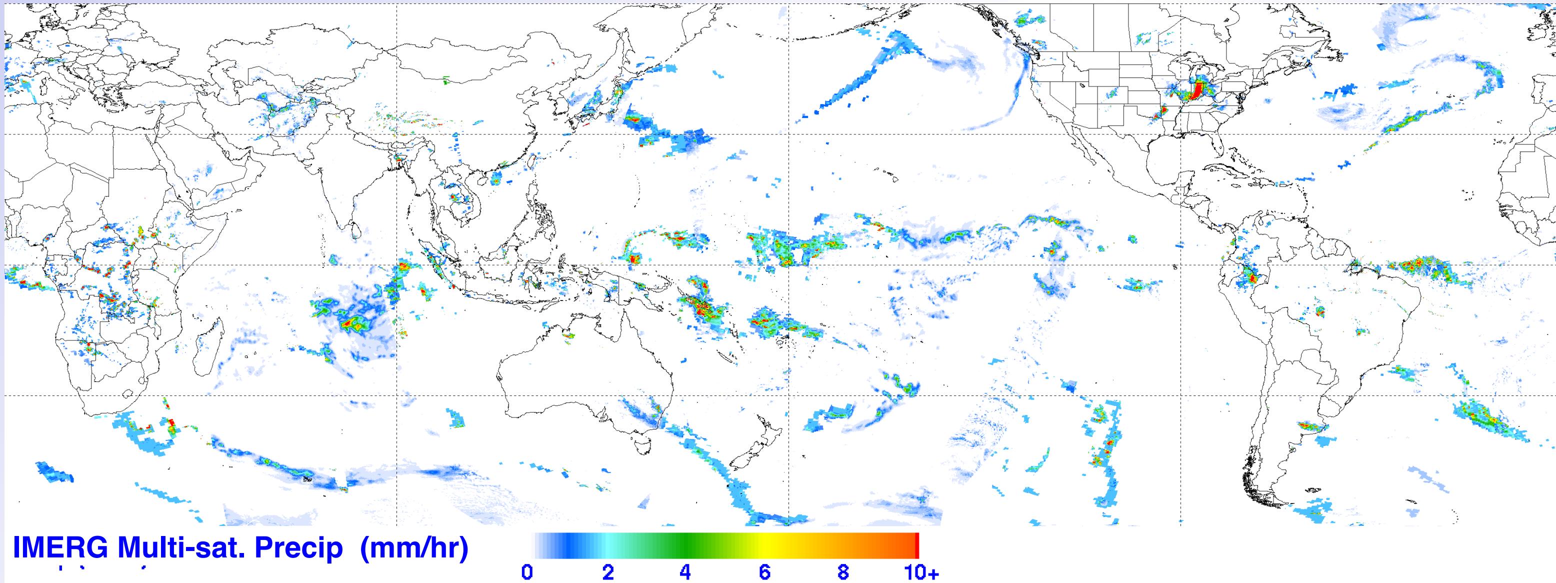


3. EXAMPLES – Data Fields from IMERG Test Data (3/4)

1430-1500Z 3 April 2014

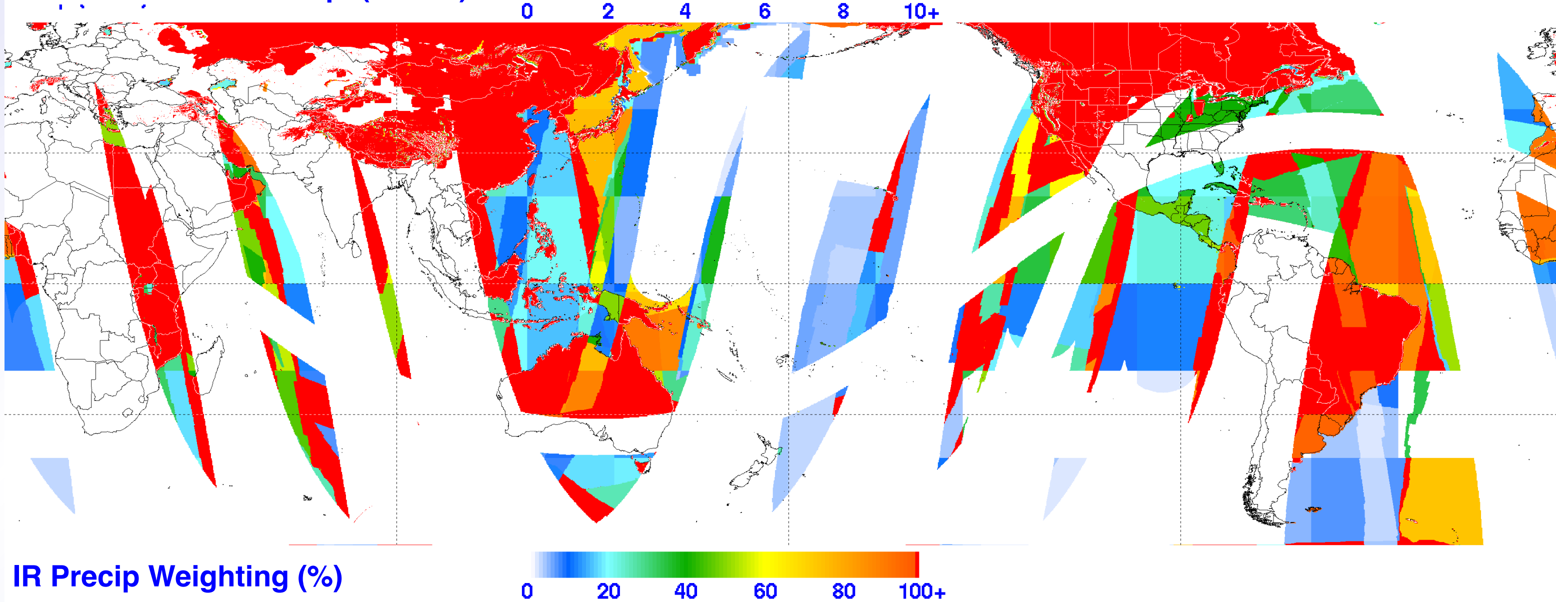
IMERG

“<u>Early</u>” IMERG field: <u>forward morphed</u> microwave, Kalman filter with IR data



IR Weighting

weighting of IR in the Kalman filter step

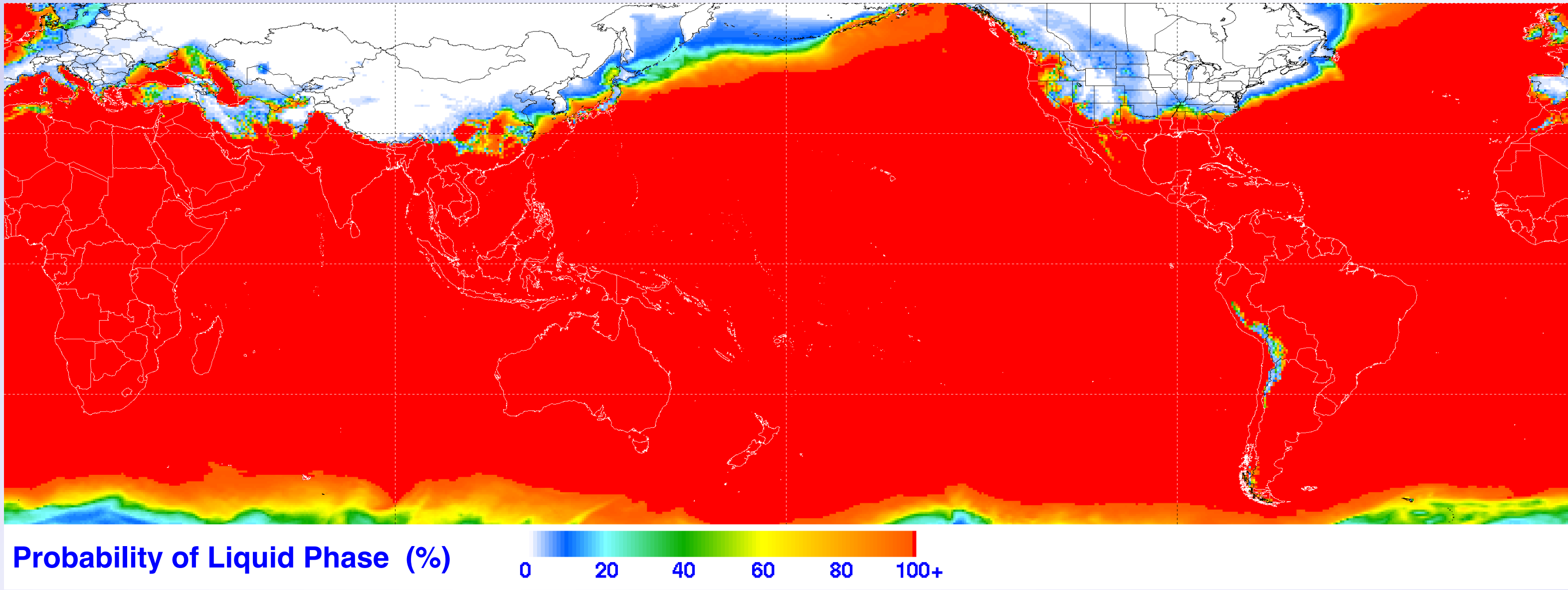


3. EXAMPLES – Data Fields from IMERG Test Data (4/4)

1430-1500Z 3 April 2014

PPLP

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



4. FUTURE – Where do we need help?

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

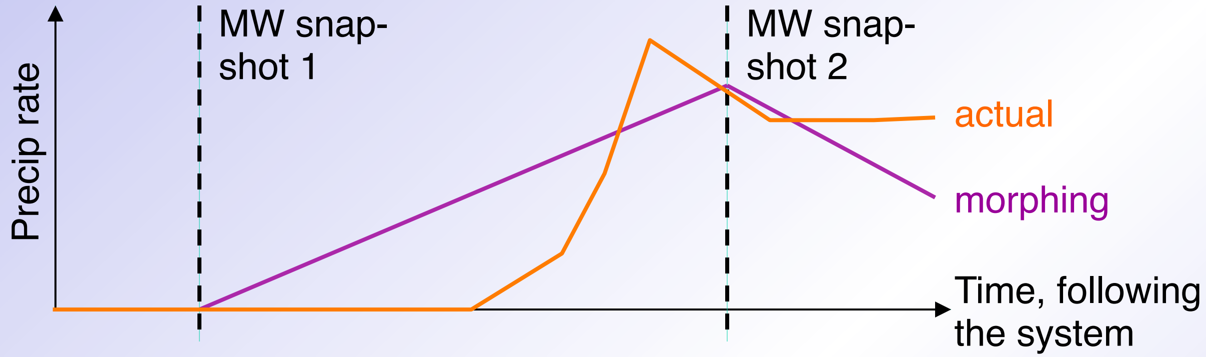
Error estimation is a major issue

- combined-satellite errors are an amalgamation of errors from
    - input retrievals
    - sampling
    - combination algorithm
- monthly random error estimate is reasonable
- monthly bias has some draft concepts
- short-interval error is a work in progress (Maggioni et al. 2014)
- user requirements tend to be fuzzy
    - cdf or quantiles seem like a natural approach
    - how to do this compactly?
    - likely need to have "expert" and "simple" estimates
- the grand challenge is aggregating errors in space and time

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