

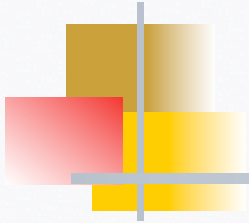
GPM's Passive Microwave Retrieval Algorithm

Christian Kummerow, Gail Skofronick-Jackson

and

Passive Microwave Team

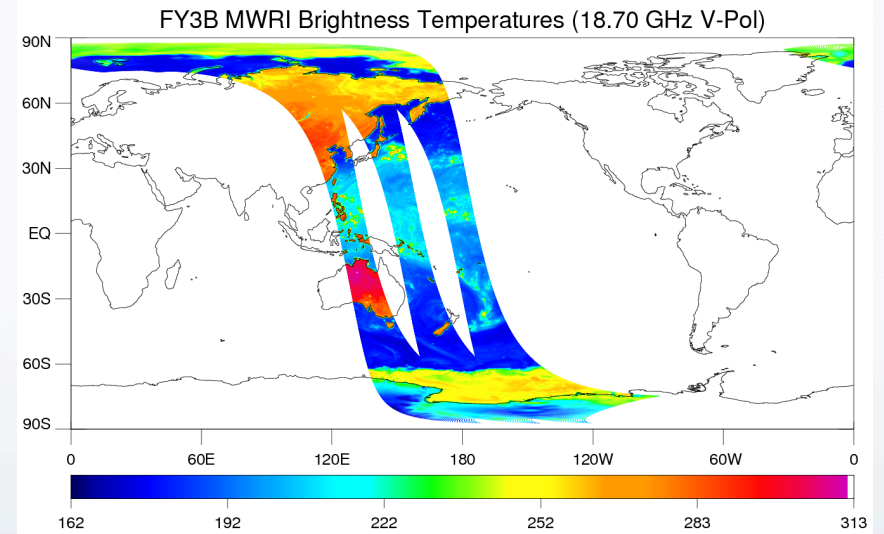
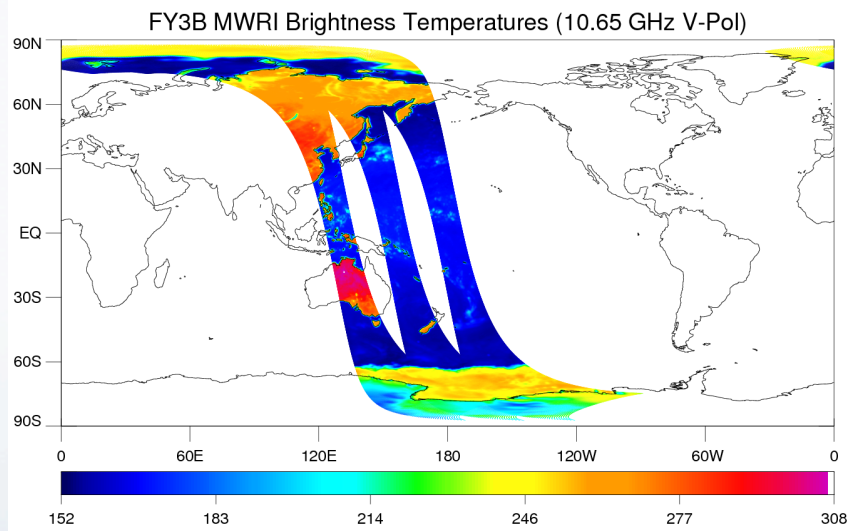
GPM Science Team Meeting
Denver, CO
Nov. 7-10, 2011



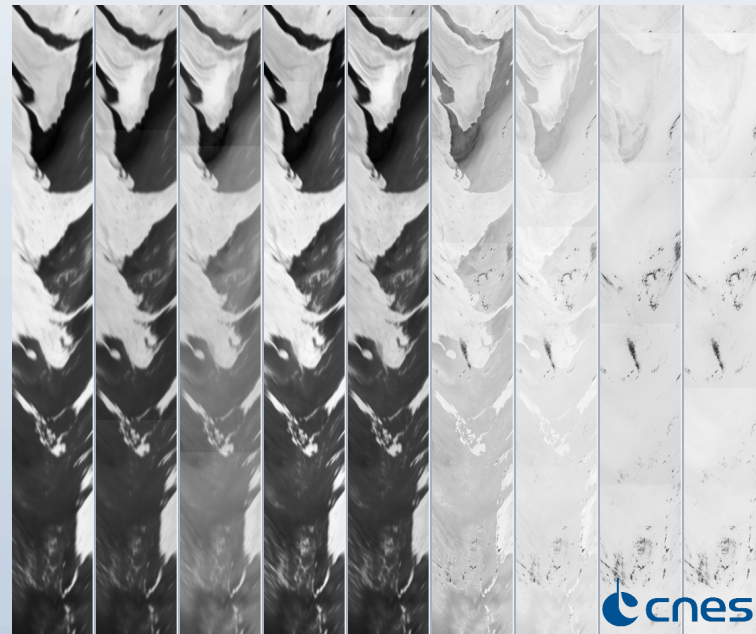
Outline

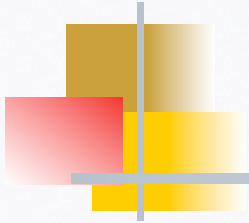
- ✧ *Algorithm General Structure (Roadmap)*
- ✧ *Progress Towards Implementation*
 - *Databases*
 - *The retrieval code*
- ✧ *Validation*
- ✧ *Delivery schedule to PPS*
- ✧ *ATBD outline and status*

FY 3B first images



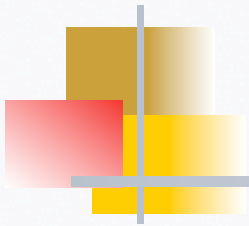
MADRAS first images





Radiometer Algorithm Road Map

- ☆ *Use a Bayesian approach for retrieving surface precipitation and its vertical structure.*
 - *A-priori databases of cloud and precipitation profiles are initially built from existing sources but transition immediately to the GPM core satellite after launch*
 - *GPM Satellite initially creates databases using DPR rainfall along with observed GMITb. Databases for other sensors are constructed from GMI observations using empirical methods.*
 - *Combined algorithm eventually replaces databases with physically consistent profiles across the radiometer spectrum. Databases for constellation radiometers are obtained through radiative transfer simulations.*
 - *Concentrate research efforts over land*

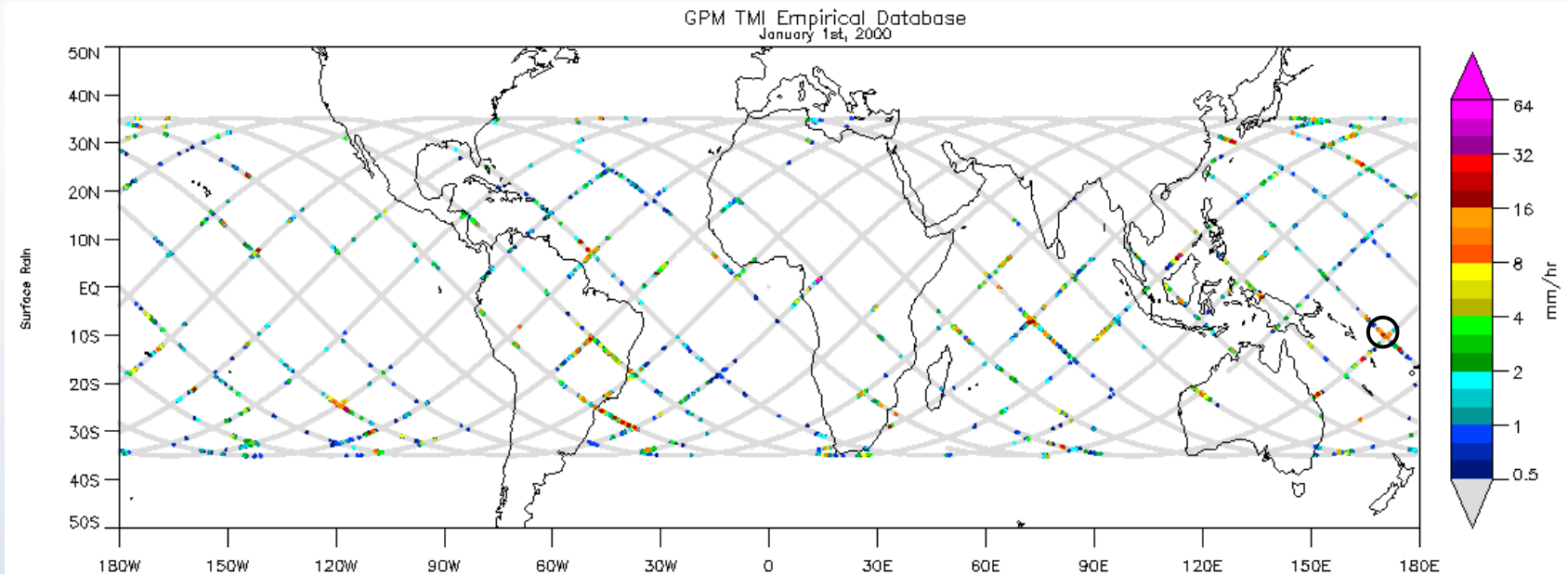


Radiometer Databases

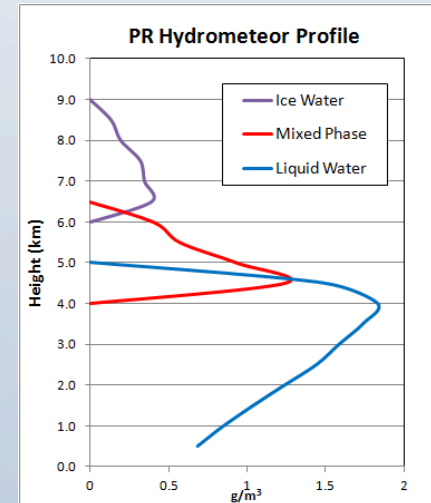
Data Source	Coverage	PI	Status
PR & TMI	Tropics	Sarah R.	Done
CloudSat & AMSR	Ocean	Mark K.	Pending
CloudSat & AMSR	Land/snow	Ralf B.	Pending
NMQ & AMSR; SSMIS	CONUS	GV Team	Pending
NMQ & MHS; AMSU	CONUS	GV Team	Pending
OPERA & AMSR	Europe	Vejko P.	Finalizing
MMF/LSM & RadXfer	Global	Karen M.	Developing
ECMWF & RadXfer	Global	Guosheng L.	Developing

PIs are asked to deliver the surface rainfall, hydrometeor vertical profiles and corresponding Tb at the original sensor resolution as well as a TMI/AMSR-E 37 GHz resolution. Details of the fields are found in Appendix A of Algorithm Roadmap.

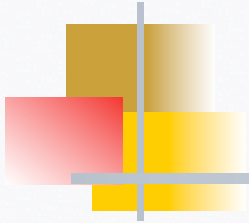
The PR & TMI database



Empirical Database (January 1st, 2000): 140,000 profiles,
8760 raining profiles (6.25%)
<R> = 0.09 mm/hr (2.16mm/day)



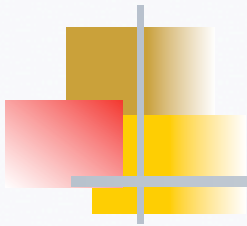
10H: 128.2
10V: 196.3
19H: 213.2
19V: 243.6
21V: 260.6
37H: 228.0
37V: 246.0
85H: 219.8
85V: 225.5



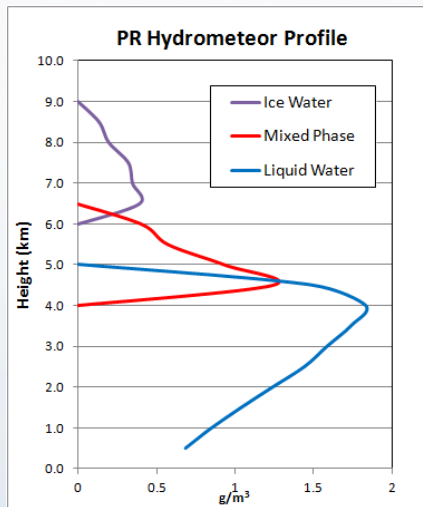
Sounding Radiometer Databases

Sounding radiometers are fundamentally different in that neither PR/TMI nor CloudSat/AMSR can be used to create observed databases. Instead, we will rely on coincident overpasses and the model derived databases.

Data Source	Coverage	Status
PR & MHS; AMSU	Tropics	Pending
CloudSat & MHS; AMSU	Global Ocean	Pending
CloudSat & MHS; AMSU	Land snow	Pending
MMF/LSM & RadXfer	Global	Developing
ECMWF & RadXfer	Global	Developing



Ancillary data



10H: 128.2
10V: 196.3
19H: 213.2
19V: 243.6
21V: 260.6
37H: 228.0
37V: 246.0
85H: 219.8
85V: 225.5

Elevation ($1/10$ degree); **Std. deviation within 1 degree box**; **U & V mean slope**

Emissivity Class ($1/2$ degree global monthly climatologies of k-means clusters of self-similar emissivities)

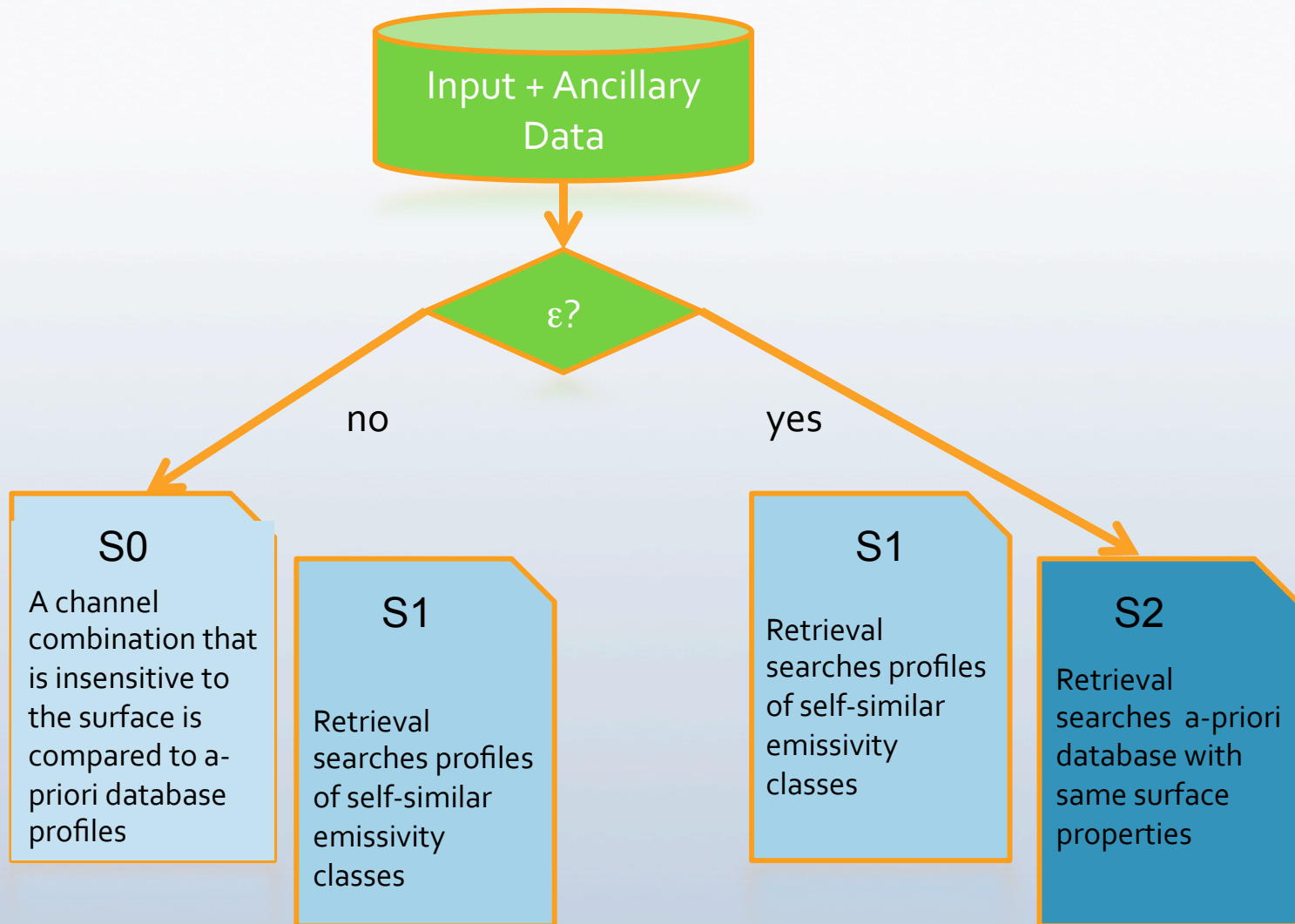
ECWMF Interim Data Product: Skin temp, 2 meter air temp, 10 meter wind speed and direction, 700 mb wind speed and direction; TPW; CLW, CIW

MERRA Data Product: Skin temp, 2 meter air temp, 10 meter wind speed and direction, 700 mb wind speed and direction; TPW; CLW, CIW

GANAL Data Products: Skin temp, 2 meter air temp, 10 meter wind speed and direction, 700 mb wind speed and direction; TPW; CLW, CIW

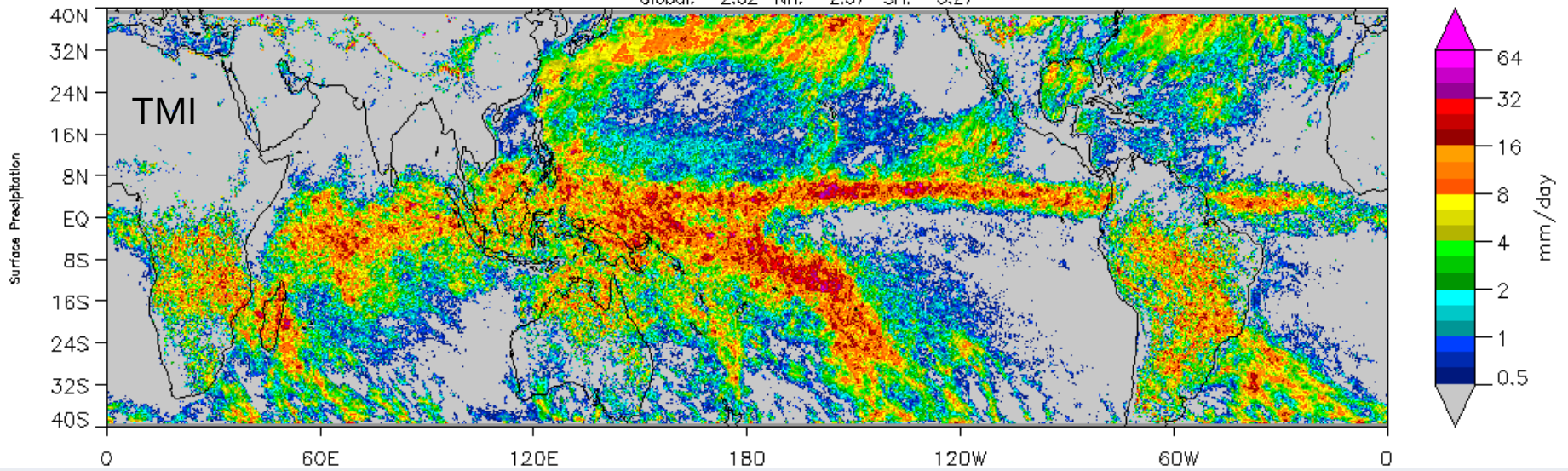
MODIS IGBP Surface Classification ($1/20$ of degree global grids, annual climatologies for 2004-2006).

The Retrieval Algorithm

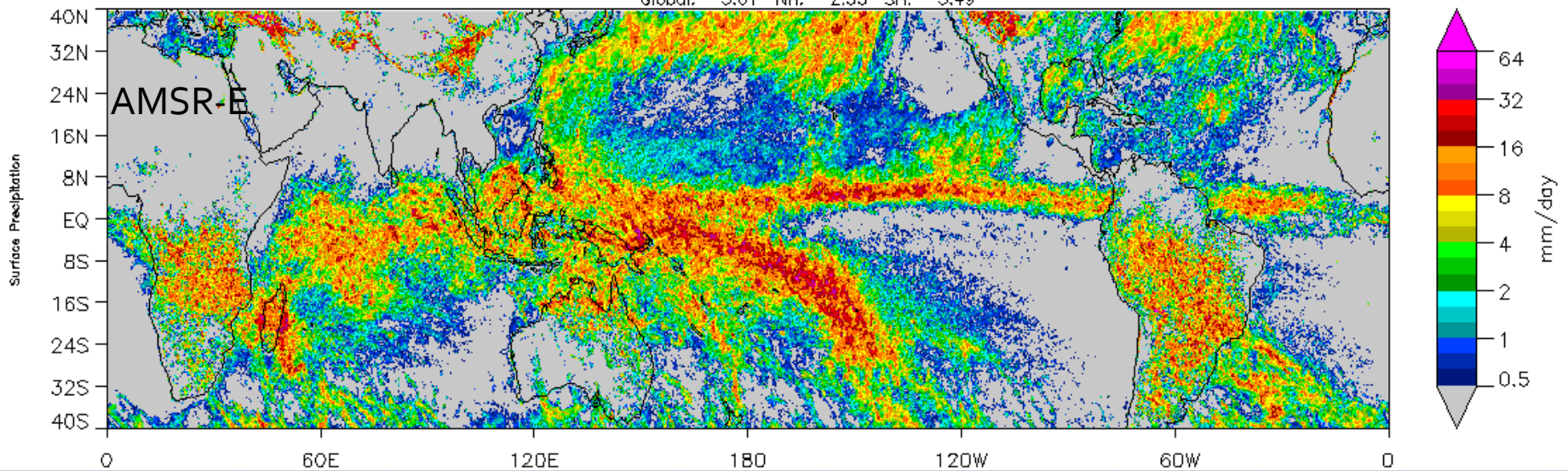


Jan 2007

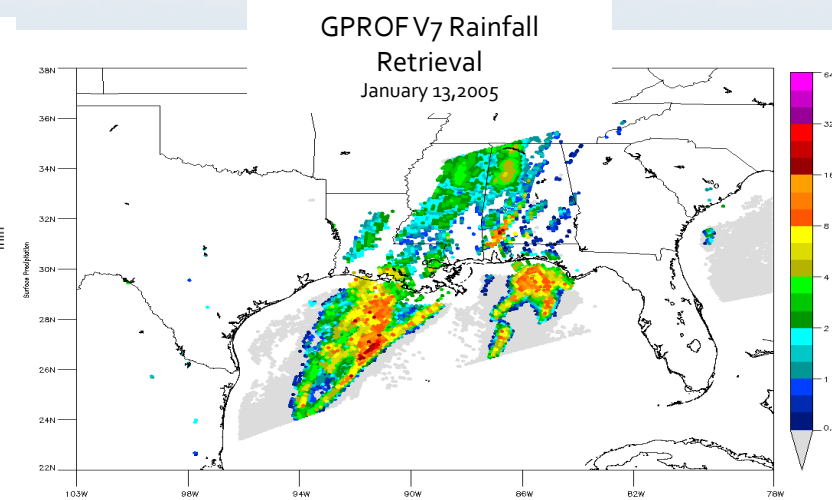
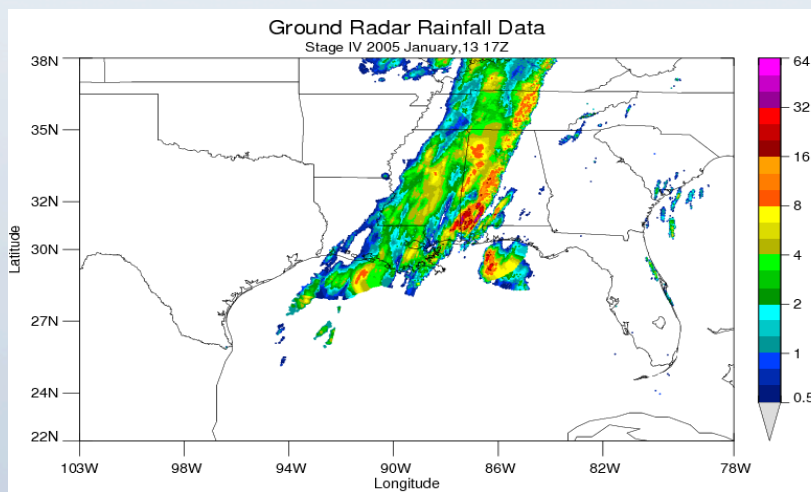
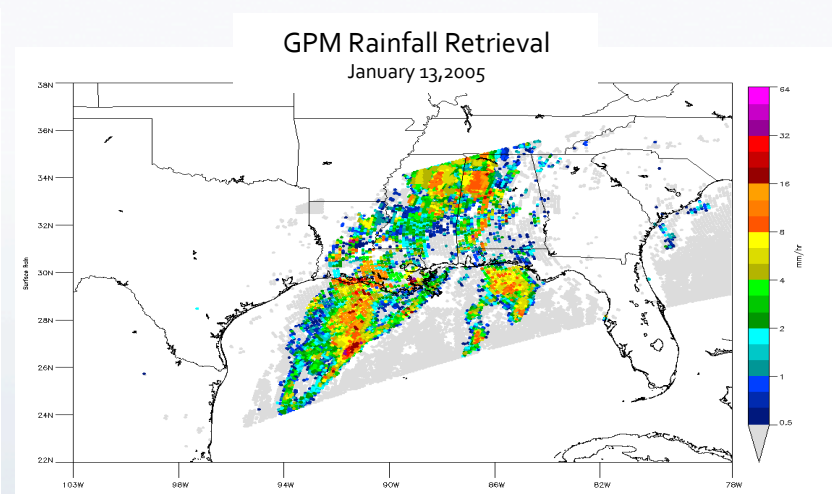
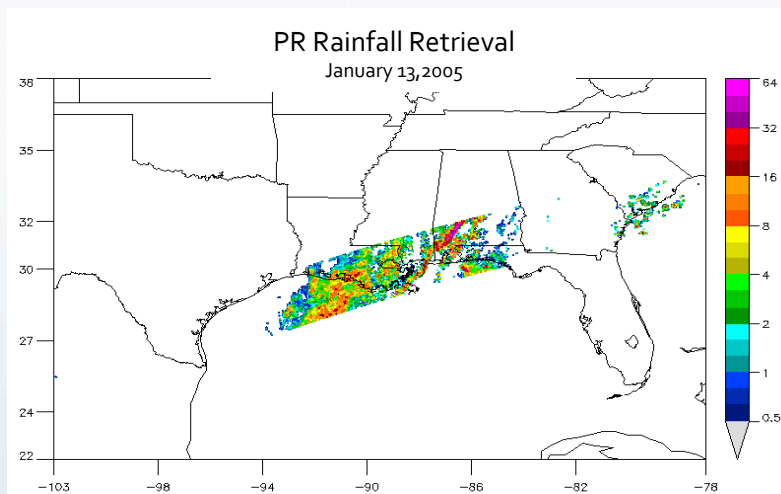
GPROF 2D10 TRMM TMI January 2007 Days: 1-31
Global: 2.82 NH: 2.37 SH: 3.27



GPROF 2D10 EOS-AQUA AMSR-E January 2007 Days: 1-31
Global: 3.01 NH: 2.53 SH: 3.49



The first retrieval from GPROF 2014





Pre-launch Validation Plan

☆ *Tropical Oceans*

- *TRMM & GPROF2010*
- *Kwajalein*

☆ *Extratropical Oceans*

- *Alaska WSR-88*

☆ *Tropical Land*

- *TRMM*
- *NMQ*

☆ *Extratropical Land*

- *NMQ w. and w/o snow on ground from NSIDC*



Post-launch Validation

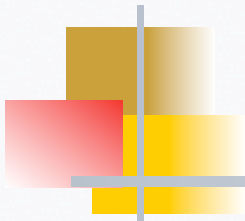
- ☆ *Use use primarily the DPR and Combined algorithm to validate constellation radiometer precipitation by comparing statistics of coincident overpasses to draw out error statistics*
- ☆ *Team members to engage in PI-based research of algorithm deficiencies, error characterization and improvements.*



Delivery Schedule

Initial ATBD developed	Nov. 2010
Initial test Algorithm delivered to PPS	Nov. 2010
Research code available to all PIs Anonymous ftp from rain.atmos.colostate.edu cd pub/GPM/ Contact Dave Randel (drandel@atmos.colostate.edu)	Nov. 7, 2011
Retrieval code with appropriate (if not complete) science routines delivered to PPS	Nov. 2011
Improvement of research code	2012
Delivery of At-launch code ¹ to PPS	Nov. 2012
Continued Science Improvement	2013

¹ At-launch code refers to GMI code. Other radiometers will remain in research environment and be transferred to operations when complete. CSU/PPS transfer is well tested with current personnel.



The ATBD

<http://rain.atmos.colostate.edu/ATBD>

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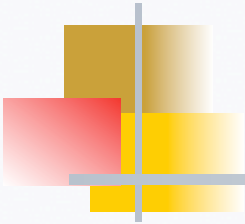
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5.1 ASSUMPTIONS

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The ATBD

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APPENDIX A: GPM CORE AND CONSTELLATION SATELITES

- A.1 GPM Core Satellite
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APPENDIX B: PI PROFILE FORMATS

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