An Initial Comparison of NASA GPM Precipitation Products to NOAA Operational Products

Poster 2-57

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I. Introduction

NOAA/NESDIS generates several operational satellite derived precipitation products to serve various components of the NWS who require low latency, high temporal and spatial resolution products for weather forecasting and warning, but also longer latency, global scale products for climate monitoring and prediction.

In addition to orbital based precipitation "snap shots" (referred to as Level 2, L2 products) that are derived from both low-earth orbiting (LEO) and geostationary-earth orbiting (GEO) satellites, the L2 products are combined in numerous ways to generate "blended", mapped products (referred to as Level 3, L3).

The LEO products are primarily derived from passive microwave sensors, including AMSU/MHS, SSMIS, AMSR-2, ATMS, and most recently, NASA's Global Precipitation Measurement (GPM) GMI (which was first placed into operation in February 2014). Additionally, GPM is utilizing all possible passive microwave sensors to form a "constellation" of precipitation measurements, employing an inter-calibration method along with a common retrieval package. NOAA scientists are active participants on NASA's GPM science team and have contributed to both the L2 and L3 GPM products. NOAA is also interested in using the GPM products to support its own precipitation product line.

The purpose of this poster is to examine the GPM era products, along with some NOAA operational products, on a variety of precipitation systems over the U.S., and provide some preliminary evaluation as to the performance of the products.

II. Methodology and Results

1. L2 satellite precipitation retrievals over land were co-located with closest NMQ radar rainfall product in time and space. We inter-compared the following:

- **NASA GPM – GMI** (GPROF2014 – G14); AMSR-2 (GPROF2014) – Kummerow et al. (2015)
- **NOAA JPSS/GCOM** – AMSR-2 (GPROF2010 – G10) – Meyers et al. (2015)
- **NOAA S-NPP/ATMS** – MiRS (Boukabara et al., 2011), CICS Bayesian (prototype for GPM approach) (You et al., 2015)

2. Statistical parameters generated – correlation, bias, RMSE; PDF's of rain over the storm domain; FAR, POD and associated maps. Units in mm/hr.

Case 1 – Record Rainfall in Phoenix, AZ, September 8, 2014. Residual moisture from Pacific Ocean hurricanes, combined with summer monsoonal flow resulted in over 3" rainfall at airport; broke 119 year 24-hour record.

- G10 outperforms G14 (compare AMSR-2)
- G14 has large negative bias
- The two ATMS algorithms are comparable

STATISTIC	GMI (G14)	AMSR-2 (G10)	AMSR-2 (G14)	ATMS (MIRS)	ATMS (CICS)
BIAS	-2.46	-0.27	-1.29	-0.29	-0.17
R	0.56	0.62	0.45	0.55	0.59
RMSE	5.11	3.96	4.93	2.06	1.80
POD	0.49	0.58	0.50	0.56	0.75
FAR	0.21	0.38	0.09	0.10	0.37

Case 2 – Hurricane Arthur, US East Coast, July 3-4, 2014. Arthur became the earliest known hurricane to make landfall in NC; landfall at 03:15 UTC July 4, 100 mph winds, 972 mb.

- G14 appears to outperform G10
- Ocean NMQ data might be questionable
- ATMS algorithms are comparable

STATISTIC	GMI (G14)	AMSR-2 (G10)	AMSR-2 (G14)	ATMS (MIRS)	ATMS (CICS)
BIAS	-1.05	1.16	0.32	-0.40	-0.07
R	0.50	0.29	0.29	0.69	0.70
RMSE	5.14	6.45	6.01	2.44	2.28
POD	0.76	0.83	0.89	0.65	0.79
FAR	0.16	0.24	0.24	0.08	0.21

Case 3 – Midwest Convective Complex – June 12, 2014. Produced widespread, damaging storms, including large hail and tornadoes

- G14 and G10 comparable
- CICS slightly outperforms MiRS
- ATMS outperforms AMSR-2

STATISTIC	GMI (G14)	AMSR-2 (G10)	AMSR-2 (G14)	ATMS (MIRS)	ATMS (CICS)
BIAS	-0.33	0.93	0.72	2.68	1.97
R	0.50	0.60	0.61	0.68	0.75
RMSE	2.19	4.22	4.45	5.32	4.15
POD	0.77	0.74	0.72	0.81	0.78
FAR	0.22	0.07	0.06	0.05	0.05

III. Summary and Future Work

Three different types of weather systems over the U.S. were examined to make some initial assessment into the performance of GPM-era algorithms (G14, CICS) as compared to NOAA operational products from GCOM (G10) and S-NPP (ATMS). As expected, the different approaches perform differently under the different surface and synoptic conditions.

We will continue to evaluate the various products as we begin to integrate the GPM products into NOAA operations, as well as continue our collaborations with NASA to improve the GPM algorithms.

IV. References

Boukabara, A., K. Garrett, W. Chen, F. Iturbide-Sanchez, C. Grassotti, C. Kongoli, R. Chen, Q. Liu, B. Yan, F. Weng, R. Ferraro, T. Kleespies and H. Meng, MiRS, 2011: An all-weather 1DVAR satellite data assimilation & retrieval system. *IEEE Trans. Geosci. Rem. Sens.*, **49**, 3249-3272.

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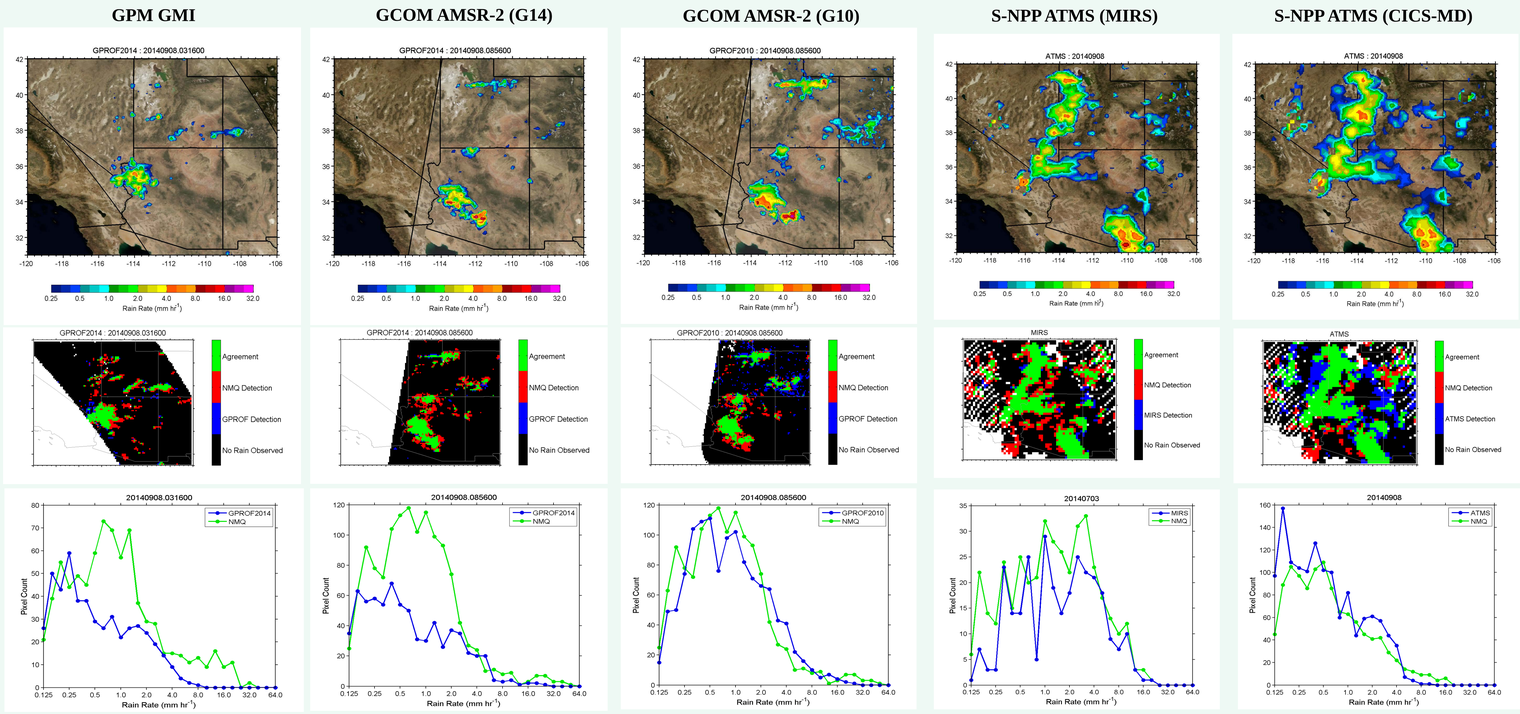
You, Y., N-Y. Wang and R. Ferraro, 2015: A Prototype Precipitation Retrieval Algorithm Over Land Using Passive Microwave Observations Stratified by Surface Condition and Precipitation Vertical Structure. *In Press, J. Geophys. Res.*

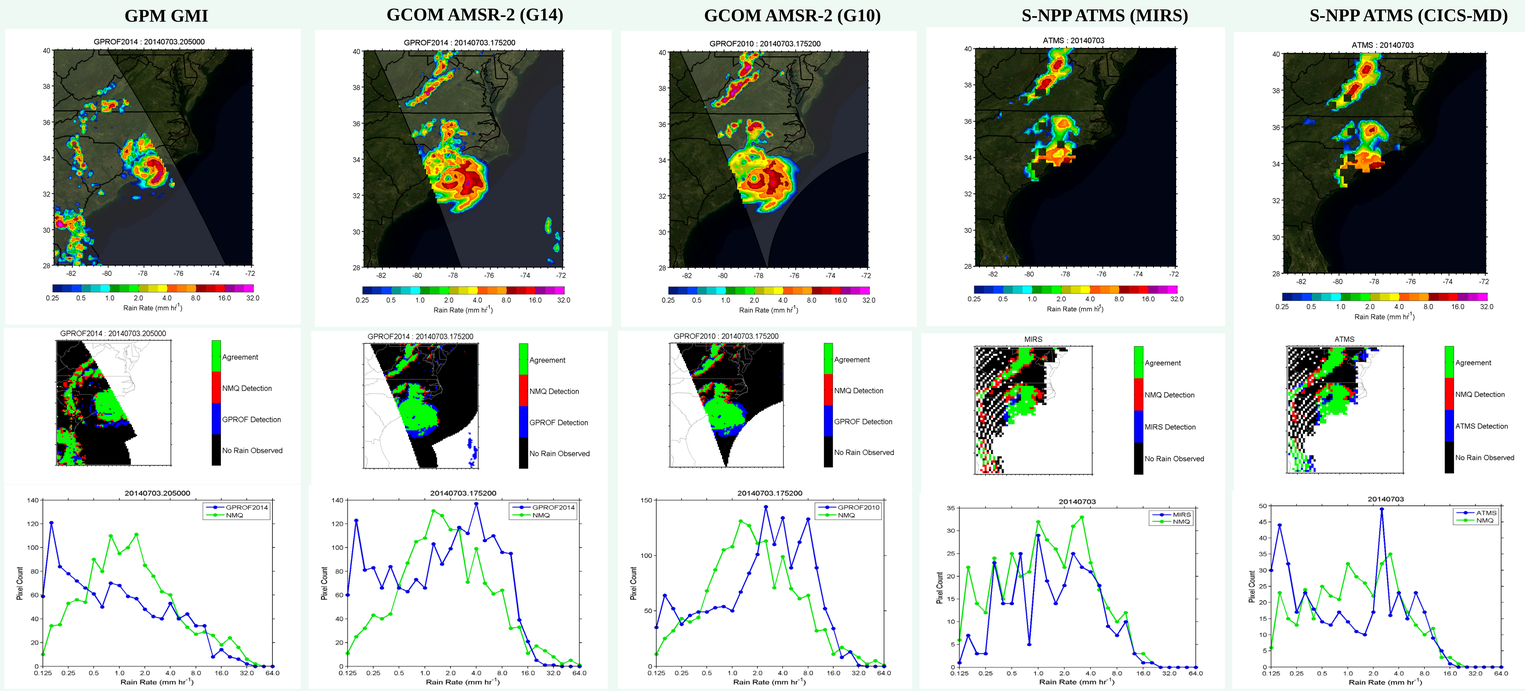
CASE 1 – Arizona Floods – September 8, 2014

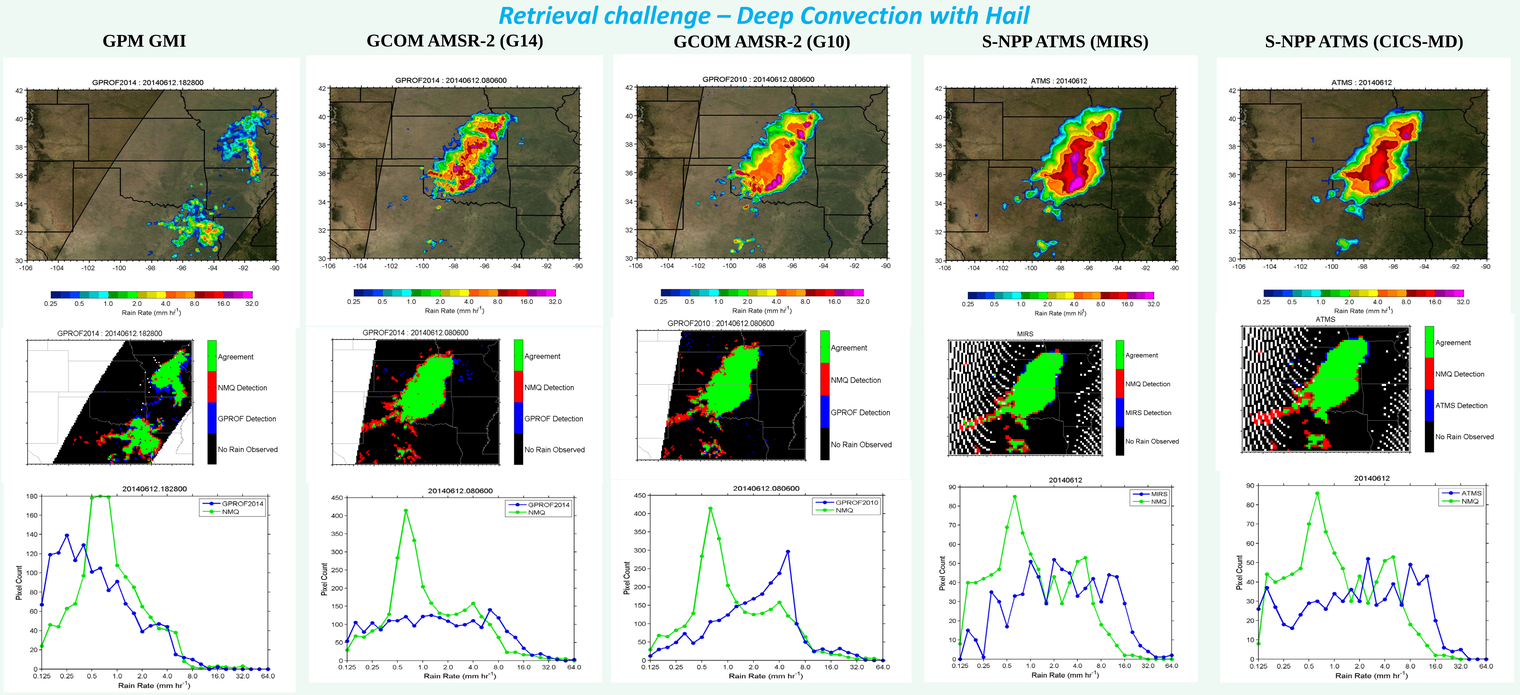
Retrieval challenge – Monsoonal flow over arid region



CASE 2 – Hurricane Arthur – July 3, 2014

Retrieval challenge – Tropical Precipitation/"Warm" rain processes & tropical DSD



CASE 3– Midwest Convective Complex – June 12, 2014

Retrieval challenge – Deep Convection with Hail