NOAA Evaluation of GPROF for AMSR2 Operations

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I. Introduction

Validation efforts are underway to characterize and validate global rainfall calculations from the Advanced Microwave Scanning Radiometer 2 (AMSR2). AMSR2 was deployed by the Japanese Aerospace Exploration Agency (JAXA) aboard the Global Change Observation Mission – Water 1 (GCOM-W1) in May 2012. The Goddard Profiling Algorithm 2010 (GPROF2010) was updated for global rainfall retrievals and is the current NOAA operational AMSR2 precipitation product. GPROF2017 is under evaluation, modification, and testing to replace GPROF2010 for NOAA's AMSR2 operations.

NOAA Requirements - GCOM Precipitation Type/Rate

EDR Attribute	Threshold	AMSR2 EDR
Applicable conditions		Delivered under "all weather" conditions
Horizontal cell size	5 km land (89 GHz FOV); 10 km ocean (37 GHz FOV size); 5-10 km sampling	5.0 km (land); 10 km (ocean)
Mapping uncertainty, 3 sigma	< 5 km	~2.5 km
Measurement range	0 – 50 mm/hr	0 – 75 mm/hr
Measurement precision	0.05 mm/hr	0.01 mm/hr
Measurement uncertainty	2 mm/hr over ocean; 5 mm/hr over land	1.3 mm/hr (ocean) 3.6 mm/hr (land) (relative to TRMM)
Refresh	At least 90% coverage of the globe about every 20 hours (monthly average)	91% every 20 h
Precipitation type	Stratiform or convective	Convective rain rate
Latency	25 minutes	8 min

TABLE 1 – Accuracy, coverage, latency, and data requirements as set by the Joint Polar Satellite System (JPSS) for the GCOM-W mission.

II. GPROF2010 Updates

Several incremental improvements are being implemented in NOAA operations to improve the GPROF2010's accuracy and reliability.

- Updated calibration coefficients for TRMM → AMSR2
- Replace climatological snow screen with IMS daily analysis
- Replace Reynolds SST initialization with CMC
- Apply cloud-free scene POD to screen false alarms (Fig. 1)
- Increased Heidke Skill Score from 0.5 to 0.58

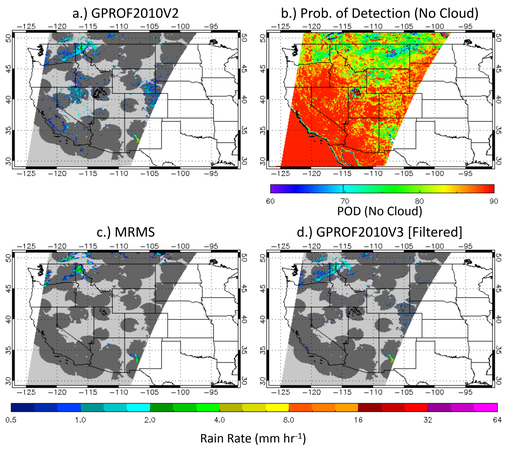

FIG. 1 – (a) Example of widespread false alarms from GPROF2010 on October 10th, 2016. (b) Probability of cloud-free detection from Turk et al. (2016) linear discriminant analysis. (c) MRMS instantaneous rain rates screened using the Radar Quality Index. (d) GPROF2010V3 using cloud-free POD to reduce false alarms.

III. Evaluation of GPROF2017 for AMSR2

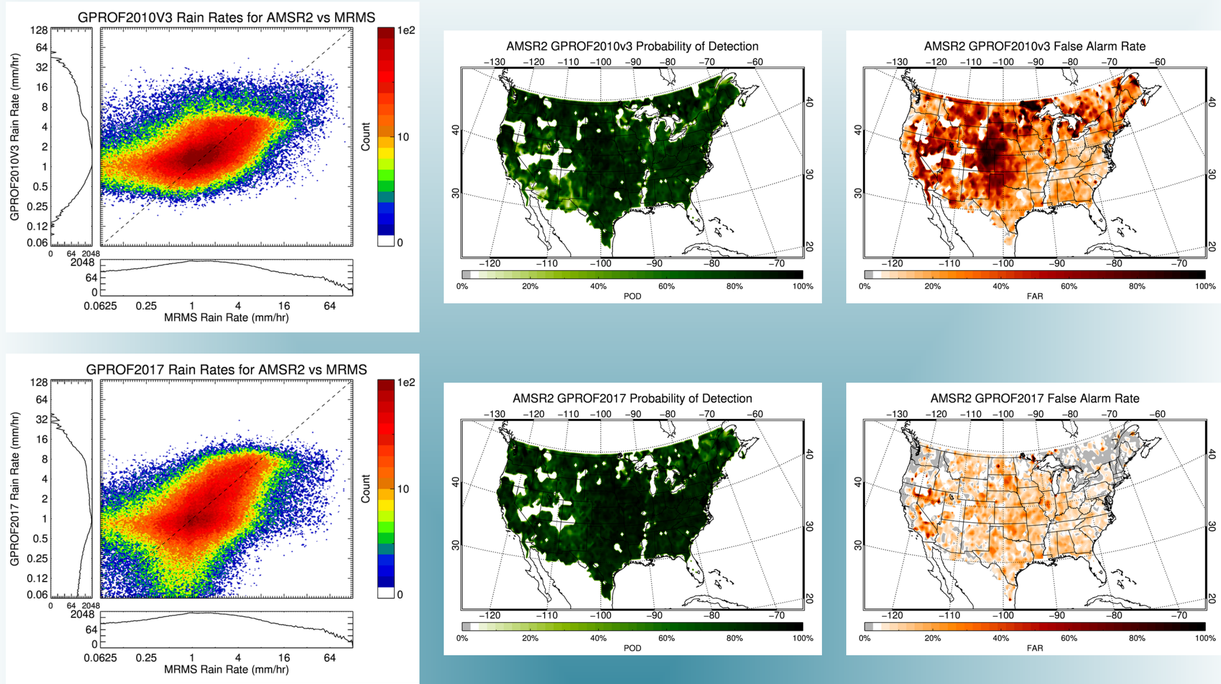

FIG. 2 – (a) Evaluation of GPROF2010V3 (top) and GPROF2017 (bottom) relative to MRMS collocated to the 89GHz FOV. Overall probability of detection (center) is comparable between the two algorithms, but False Alarm Rate (right) is dramatically better for G17 (10%) than G10 (35%).

IV. Extreme Events –Hurricane Harvey (2017)

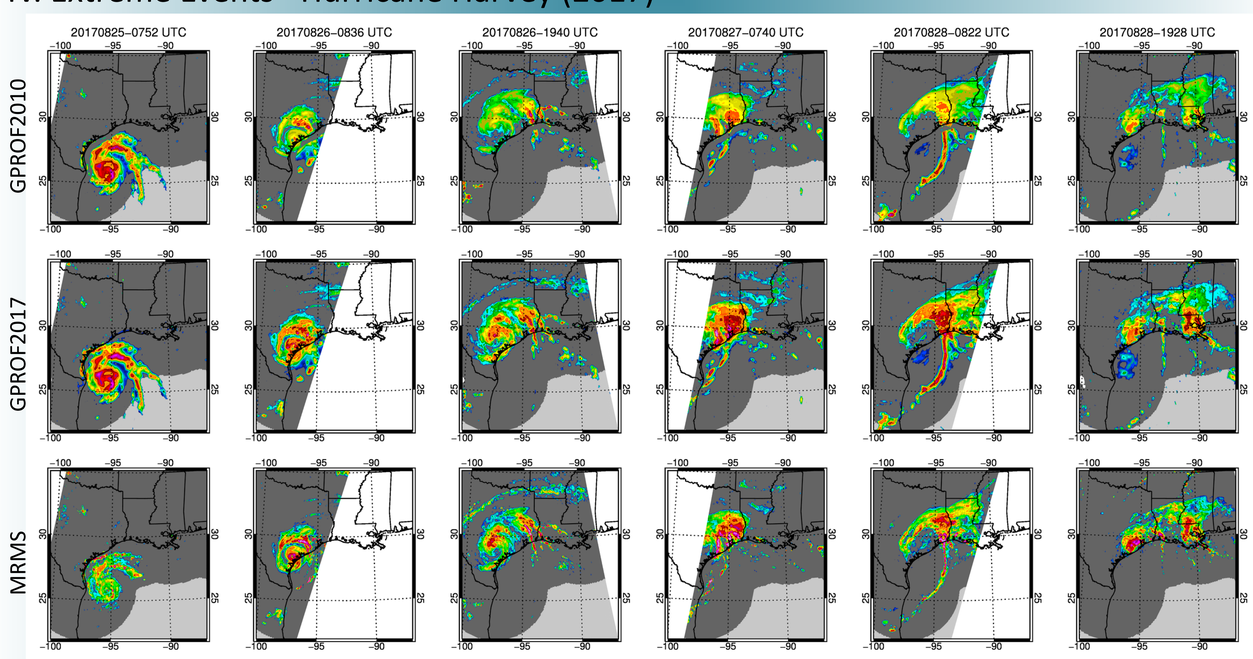

FIG. 3 – Comparisons of GPROF2010 (top), GPROF2017 (middle), and MRMS (bottom) from August 25th to August 28th as viewed by AMSR2. GPROF2010 struggles with retrievals near the coast and underestimates rain rates in warm deep convection over land.

IV. CICS-MD Swath Validation System

AMSR2 precipitation retrievals for GPROF2010 and GPROF2017 are routinely validated relative to MRMS analyses (Fig. 4). Plots are available online at http://cics.umd.edu/pmeyers/amsr2/.

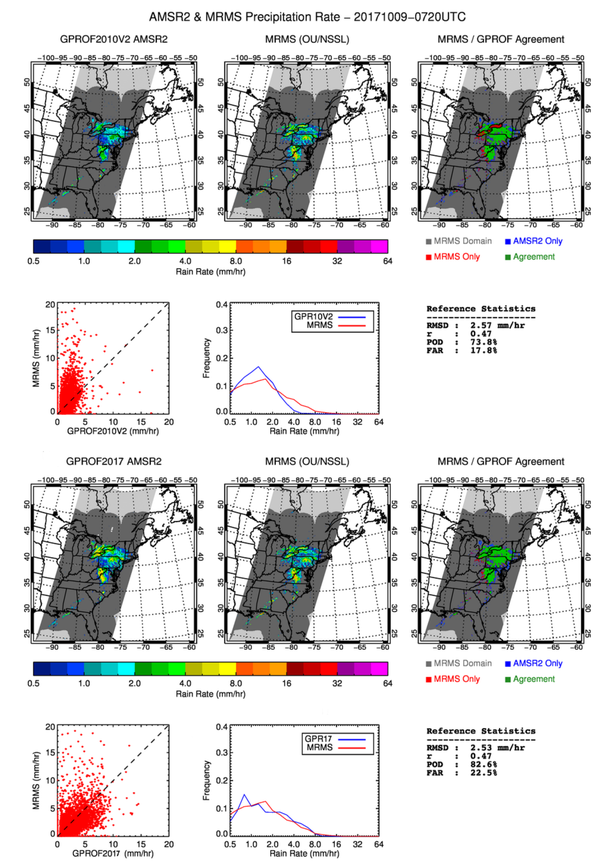

FIG. 4 – Example of routine swath validation of GPROF2010V2 (top) and GPROF2017 (bottom) for the remnants of Hurricane Nate on October 9th 2017.

Validation Statistics August 2016 – June 2017

Algorithm	POD (%)	FAR (%)	CSI (%)	RMSD (mm/h)	*r*
GPROF2010	73.1	38.1	50.4	6.55	0.40
GPROF2017	85.6	9.7	78.3	6.87	0.32

TABLE 2 - Evaluation of GPROF2010V2 and GPROF2017V5 instantaneous rain rates relative to MRMS averaged over the 89 Ghz footprint (3x5 km) for nearly 1 year of observations. GPROF2010 accuracy was undermined by poor detection of rain west of 100°W.

V. Future Directions

GPROF2017 is likely the future operational NOAA algorithm for AMSR2. It must be modified to use operationally accessible ancillary data (i.e. near surface temperature and TPW). Prior to transition, the algorithm must be tested to ensure it meets near real-time accuracy and latency requirements mandated by JPSS.

This study was supported by NOAA grant NA14NES4320003 (Cooperative Institute for Climate and Satellites-CICS) at the University of Maryland/ESSIC.