A Self-Consistent Ensemble Approach to Propagate Estimation, Calibration, and Evolution Uncertainties through Global Precipitation Measurement Surface Precipitation Mapping

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1. Background

- There are uncertainties in the merged precipitation mapping (Level-3) products.
- Such uncertainties can be various assumptions in the production processes:

Database | Retrieval | Calibration | Rain/ No rain | Cloud propagation | etc.

Red color: considered in this study.

2. Objective

- Investigate how the various uncertainties in production process accumulate in the processing chain of Level-3 precipitation data.

3. IMERG Testbed

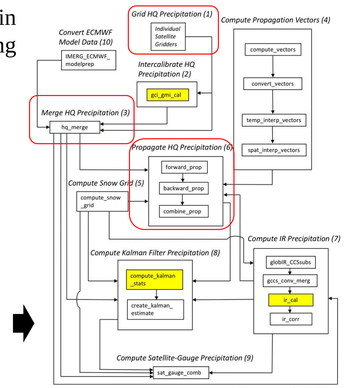
(Huffman and Bolvin, 2018)

- Can be run with user's own input data.
- Consists of selected modules (e.g., No IR-estimates, gauge adjustment)

Modules marked by red boxes are run as a part of IMERG Testbed.

*The latest version of IMERG Testbed includes Kalman filter precipitation module.

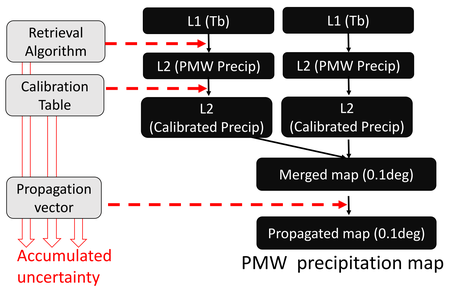
IMERG code modules



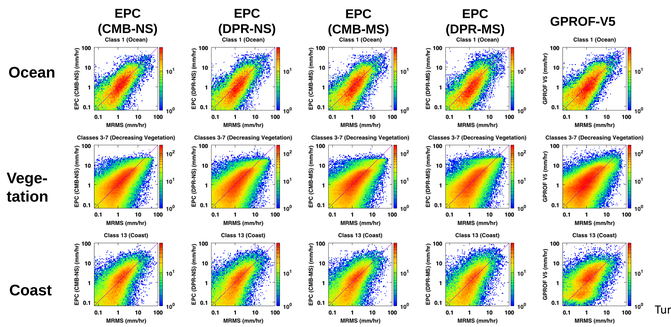
Courtesy of Huffman and Bolvin, 2018

4. Ensemble Approach

Ensemble members		
PMW precip. retrievals	GPROF (Kummerow et al., 2015)	Single algorithm, Different databases
	EPC_A (Turk et al., 2018)	
	EPC_B (")	
	EPC_C (")	
	EPC_D (")	
Calibration	No calibration	
	With calibration	
Propagation vector	Default	
	x80%	
	x120%	



Overall performance of retrievals. (vs. MRMS)



Turk et al. (2018)

5. Experimental settings

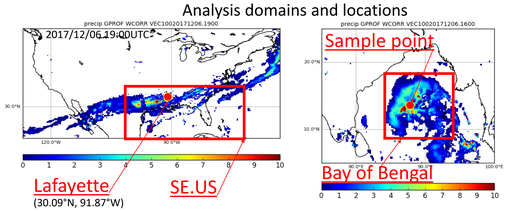
PMW sensors used in this study

Sensor	Scan
GPM/GMI	Conical
DMSP F16/SSMIS	Conical
DMSP F18/SSMIS	Conical
GCOMW/AMSR2	Conical
SNPP/ATMS	Cross-track

* GPROF L2 precip (V5) for each sensor were obtained from NASA PPS

42 hours:
Dec. 6th 00UTC – Dec. 7th 18UTC, 2017

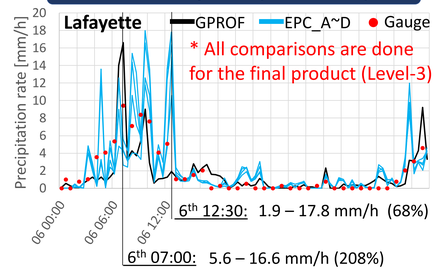
Analysis domains and locations



- Precipitation due to cold front over southern US.
- Low pressure system in Bengal Bay

6. Time series comparison (Local scale)

Retrieval spread (with calib.)

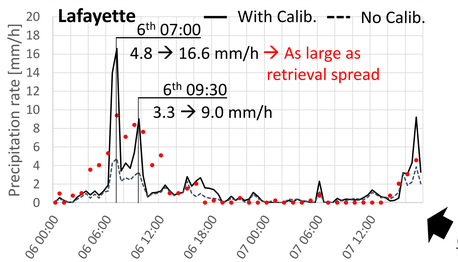


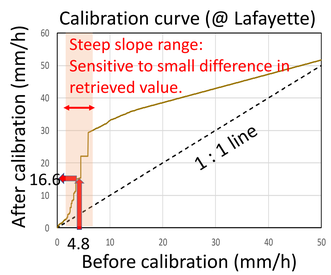
@ Local / 0.5-hourly scale:

- More than 200% spread
- Even a choice of reference database (EPC's database) leads to significant spread.

*10.6 – 17.8 mm/h (Only for EPCs)

Calibration effect (with/no calib.)

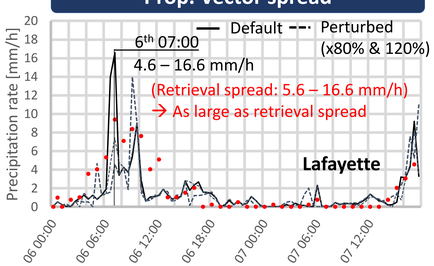




@ Local / 0.5-hourly scale:

- As large as retrieval spread for precipitation peaks

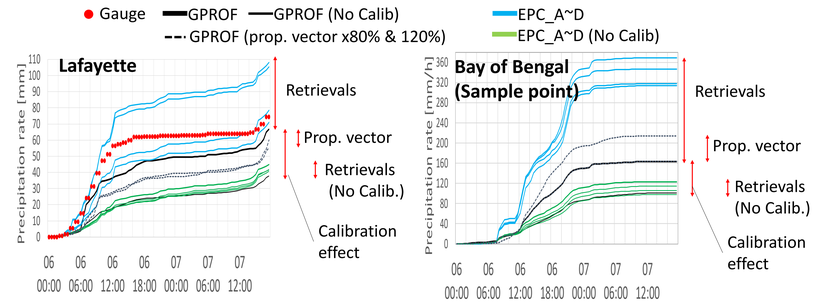
Prop. Vector spread



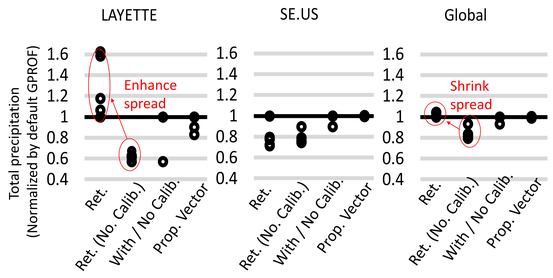
@ Local / 0.5-hourly scale:

- As large as retrieval spread for precipitation peaks
- Some shifts in peak timing

7. Time evolution of accumulated precipitation



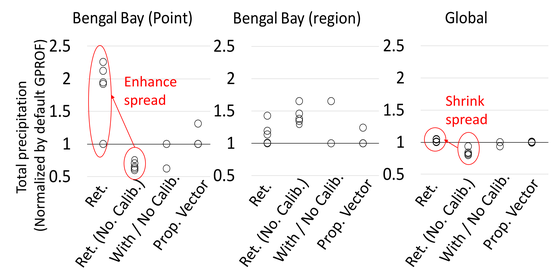
8. Total precipitation in different spatial scales



Calibration effect:

[Local scale]
→Enhance retrieval spread

[Large scale]
→Shrink retrieval spread



Prop. vector spread:

[Local scale]
→ Large

[Large scale]
→ Small

9. Conclusions

Relative importance of uncertainties due to each process is a function of spatial/temporal scales

- Relatively large uncertainties due to retrieval choice persist across scales.
- Calibration effect has as large impact as retrieval choice.
- Calibration process enhances (shrinks) the retrieval spread in local (large) spatial scales.
- Uncertainty due to propagation vector is larger in smaller/shorter spatiotemporal scales.