Using Large-scale Environment to Improve Passive Microwave Estimates of Heavy Precipitation

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Flood event



Hour of day

(Petković and Kummerow: J. Hydrometeorol. 2015, 16, 2501–2518.)

Global Distribution of Regional Biases of GPROF Retrieval



Total Lightning Activity [flashes km⁻² yr⁻¹] by the Lightning Imaging Sensor period 1998-2013



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(Petković and Kummerow) J. Appl. Meteor. Climatol. Online release Dec 2016.

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Separate 1° x 1° raining scenes into: *Shallow*, *Deep-Unorganized* and *Deep-Organized* systems using:

- Radar top echo height
- Convective rainfall
- Raining fraction

(Elsaesser et al. 2010, J. Climate)





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⁽Petković and Kummerow) J. Appl. Meteor. Climatol. Online release Dec 2016.

Results - Redistribution of the *a priori* Elements Weights





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Results - Improving the Quality of <u>Heavy</u> Precipitation Estimates



Precipitation Bias Improvement top 10% rainfall rate



21 % of mean rain rate bias removed

	Original	New	Reference
Mean rain rate [mm h ⁻¹]	2.87	3.11	3.89
Correlation	0.66	0.69	

Results- Improving the Quality of <u>Heavy</u> Precipitation Estimates



Results - Impact to the Overall Performance of the Retrieval



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9 Petković et al.: J. Hydrometeorol. (2017)

Summary - Conclusions

Problem:

 Passive microwave satellite rainfall retrievals over land are often biased due to limited information content of the observation vector

Hypotheses:

 Large-scale environment can compensate for lack of information by eliminating non-relevant elements of the a priori information

<u>Results</u>:

- Variability in cloud microphysics is responsible for the biases.
- Precipitation regimes (level of system organization) have distinct bias preference.
- Large-scale environment links well to precipitation regime type
- 30% 40% of the bias can be removed by implementing information on large-scale environment into the algorithm

Literature

- Petkovic, V., Christian D. Kummerow, 2014: Performance of the GPM Passive Microwave Retrieval in the Balkan Flood Event of 2014. *J. Hydrometeo. 16, 2501–2518.*
- Petković, V., Christian D. Kummerow, 2017: Understanding the Sources of Satellite Passive Microwave Rainfall Retrieval Systematic Errors Over Land. J. Appl. Meteor. Climatol., 56, 597–614.
- Petković, V., C.D. Kummerow, D.L. Randel, J.R. Pierce, and J.K. Kodros, 0: Improving the Quality of Heavy Precipitation Estimates from Satellite Passive Microwave Rainfall Retrievals. *J. Hydrometeor.*, 0, <u>https://doi.org/10.1175/JHM-D-17-0069.1</u>