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## A Prototype IMERG Error Modeling Framework based on GPM DPR Observations and its Global Validation

**Zhe Li**<sup>1</sup>, Daniel Wright<sup>1</sup>, Samantha Hartke<sup>1</sup>, Dalia Kirschbaum<sup>2</sup>, Sana Khan<sup>2,3</sup>, Viviana Maggioni<sup>4</sup>, and Pierre-Emmanuel Kirstetter<sup>5,6</sup>

<sup>1</sup>Department of Civil and Environmental Engineering, University of Wisconsin–Madison, Madison, Wisconsin, USA

<sup>2</sup>NASA Goddard Space Flight Center, Greenbelt, Maryland, USA

<sup>3</sup>Earth System Science Interdisciplinary Center, College Park, Maryland, USA

<sup>4</sup>Civil, Infrastructure and Environmental Engineering Department, George Mason University, Fairfax, Virginia, USA

<sup>5</sup>School of Meteorology, University of Oklahoma, Norman, OK, USA

<sup>6</sup>NOAA National Severe Storm Laboratory, Norman, OK, USA

The potential of global high-resolution near-realtime multi-sensor merged satellite precipitation products such as NASA's 30-minute, 0.1° Integrated Multi-satellitE Retrievals for Global Precipitation Mission (IMERG) to monitor, characterize and model the water cycle has been widely recognized. Despite continuing improvements in the coverage, accuracy, and resolution of these products, their usefulness in real-world applications is still limited by the lack of insight into errors in estimated precipitation and the ability to properly quantify errors in ways that benefit various end users. A fundamental limitation is the lack of reliable “ground truth” data (e.g., rain gauges or ground weather radars)—such reference observations are lacking in precisely the places (complex terrain, ungauged areas, and developing countries) that could benefit most from satellite products. Moreover, error characterization of satellite precipitation products poses a unique challenge due to the “mixed” discrete and continuous distribution of errors, a challenge that is increasingly important to address as satellite precipitation products advance to higher resolutions.

In this work, we propose to use the instantaneous swath-based data products from the Dual-frequency Precipitation Radar (DPR) aboard the GPM core observatory as an alternative reference to replace ground observations—which could facilitate IMERG global error estimation at its native resolution. We compare two DPR-based products, 2ADPR and 2BCMB, against the Multi-Radar/Multi-Sensor (MRMS) data over the contiguous United States (CONUS). We then select 2BCMB to train a mixed discrete-continuous error model based on the Censored Shifted Gamma Distribution (CSGD) to estimate IMERG errors. This error model is evaluated and compared against an alternative CSGD model trained on MRMS data in the CONUS during 2014-2019. Using NASA's MERRA-2 reanalysis products, we also demonstrate how IMERG errors can be further constrained by including ancillary information as covariates within the error model. This error modeling framework will be further examined at several ground validation sites around the globe (e.g., WegenerNet, AMMA-CATCH among others) to evaluate its robustness under different climatic, land cover, and DPR sampling conditions.

