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A Process-Based Validation of GPM IMERG and Its Sources Using a Mesoscale Rain Gauge Network in the West African Forest Zone

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Using a two-year dataset (2016–17) from 17 one-minute rain gauges located in the moist forest region of Ghana, the performance of the Integrated Multisatellite Retrievals for GPM, version 6b (IMERG), is evaluated based on a subdaily time scale, down to the level of the underlying passive microwave (PMW) and infrared (IR) sources. Additionally, the spaceborne cloud product Cloud Property Dataset Using SEVIRI, edition 2 (CLAAS-2), available every 15 minutes, is used to link IMERG rainfall to cloud-top properties. Several important issues are identified: 1) IMERG's proneness to low-intensity false alarms, accounting for more than a fifth of total rainfall; 2) IMERG's overestimation of the rainfall amount from frequently occurring weak convective events, while that of relatively rare but strong mesoscale convective systems is underestimated, resulting in an error compensation; and 3) a decrease of skill during the little dry season in July and August, known to feature enhanced low-level cloudiness and warm rain. These findings are related to 1) a general oversensitivity for clouds with low ice and liquid water path and a particular oversensitivity for low cloud optical thickness, a problem which is slightly reduced for direct PMW overpasses; 2) a pronounced negative bias for high rain intensities, strongest when IR data are included; and 3) a large fraction of missed events linked with rainfall out of warm clouds, which are inherently misinterpreted by IMERG and its sources. This paper emphasizes the potential of validating spaceborne rainfall products with high-resolution rain gauges on a subdaily time scale, particularly for the understudied West African region.