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# Using Space-based Lightning Observations to Enhance Geostationary Satellite Rainfall Estimation

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It is widely recognized and accepted that spaceborne lightning observations provide a wealth of information regarding the dynamical and microphysical characteristics of convection. Lightning information also has great potential for improving the estimation of convective rainfall. The recent launches of spaceborne lightning mapper such as Global Lightning Mapper (GLM) onboard the GOES-16, the Lightning Imaging Sensor (LIS) to the ISS, and the Lightning Mapping Imager (LMI) on the Chinese FY-4 satellite provide excellent opportunities to apply lightning observations for enhancing satellite rainfall estimation. We have quantified the relationships between lightning, convective rain volume, cold cloud coverage, and bulk precipitation microphysics for both tropical and mid-latitude convection (warm season) based on longer-term observations from the Tropical Rainfall Measuring Mission (TRMM). These statistical relationships have been used to enhance an IR technique (CST) and develop an IR-lightning-combined rainfall estimation algorithm (called CST-L). The application of the CST-L algorithm to an independent TRMM IR and lightning database showed significant improvement compared to IR-only rainfall estimation when validated by passive microwave and precipitation radar rainfall estimates. CST-L significantly improves the classification of convective rain areas, reduces false alarms of heavy precipitation, and better represents rainfall variability. The CST-L algorithm has been applied to the IR and lightning observations from the state-of-the-art GOES-16 ABI and GLM. Preliminary results of CST-L applied to ABI/GLM also show significant improvements against IR-only rainfall product. CST-L will be further refined by including environmental variables such as wind shear between 850 and 200 hPa, CAPE, and total precipitable water (850-500 hPa) as derived from reanalysis data. Our updated CST-L algorithm will be statistically validated against rain estimates from GPM, ground-based radar, and the operational GOES-16 rainfall product. This effort will make the geosynchronous satellite precipitation information uniquely important, providing more accurate (and highly time resolved) precipitation estimates for supplementing ground-based and orbital satellite-based estimates, especially in remote mountainous areas and over the open oceans.