Improving Geostationary Satellite Rainfall Estimates Using Lightning Information: Underlying Statistical Relationships

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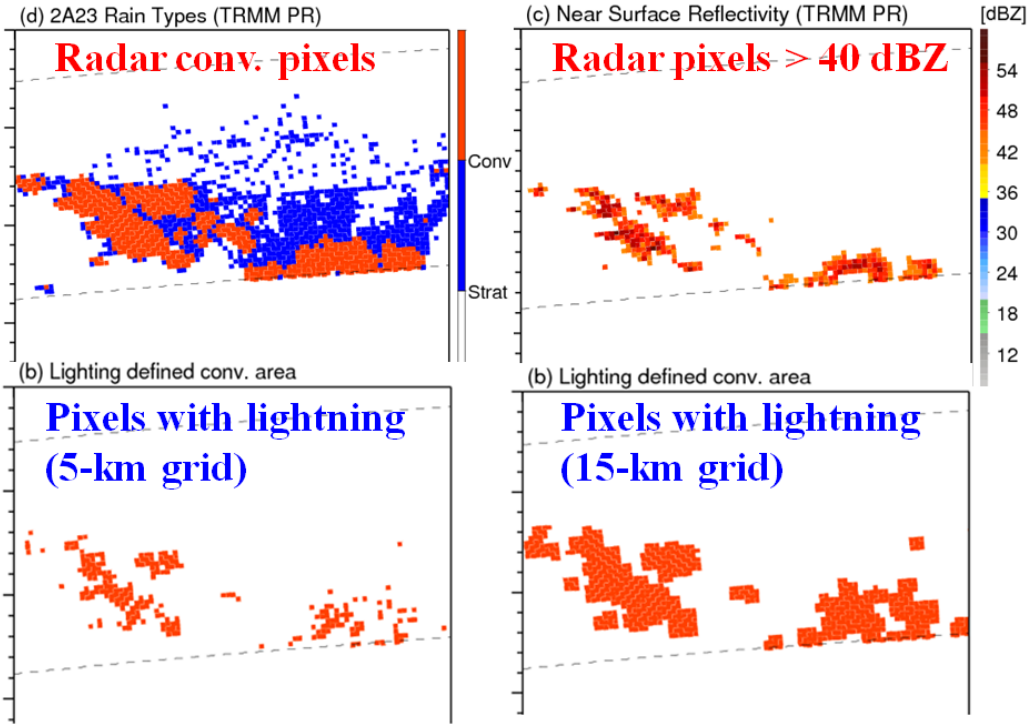
NOAA's GOES-R satellite (to be launched in 2016) will have first ever Geosynchronous Lightning Mapper (GLM). This study is using TRMM data to develop the basis and eventually the algorithms to combine GOES-R Infrared (IR), GLM data and microwave calibrator to provide an improved geosynchronous rainfall product for use in identifying heavy rain events and improve flood warnings.

In fact, numerous observations and studies point close relationship between convective rainfall and lightning occurrence, especially for continental summer storms. This paper examines lightning-rainfall relationships through 13 years of TRMM measurements on storm scale and pixel by pixel. Results show that lightning occurrence successfully identifies convective cores in over 90% of the storms over USA (100,000 samples). Lightning occurrence also discriminates convectively intense storms (seen by radar) from extremely cold clouds (seen by IR). Further results show that area of lightning flashes (or lightning flash frequency) is strongly related to convective rain area, especially for stronger cores (higher reflectivities as indicated by TRMM radar). However, linear correlations between lightning flashrate and rainfall rate (or radar echo) are not found on the pixel scale (5-km). Coarser pixel scale (e.g., 20km) is suggested in linking lightning flashrate and rainfall rate. Above relations will be used in development of GOES-R rain algorithm. An initial lightning-enhanced GOES-R rainfall estimate scheme will be develop to: 1) eliminate intensely convective rainfall falsely defined by the IR retrievals; 2) better identify convective cores when masked by anvil debris; 3) provide information on convective core size and volume rainfall rate.

Convective Area vs. Lightning Flash Area



Convective Core Size vs. Lightning Flash Area