GBM TERRESTRIAL GAMMA-RAY FLASHES (TGFS) AND LIGHTNING

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A new data mode of the Fermi Gamma-ray Burst Monitor (GBM) and new analysis techniques detect TGFs at an unprecedented rate. Individual photon data are now telemetered to the ground, enabling a search of the data for TGFs at high temporal resolution. Initially this enhanced data was available only for selected portions of the orbit; since 2012 November 26 the new data mode is continuous. When Fermi is located over thunderstorm active regions, 0.4 TGFs are detected per hour. The new TGF sample includes both fainter and shorter TGFs than previously detected. Correlating the gamma-ray detections of the new, extended GBM TGF sample with sferics detected with the World Wide Lightning Location Network (WWLLN), several patterns were identified. There are two temporal groups, nearly simultaneous associations (fraction of a millisecond separation) and less associated (up to milliseconds separation). The TGF-WWLLN events that are nearly simultaneous exhibit a strong anti-correlation between gamma-ray duration and GBM-WWLLN association rate. We interpret these observations to indicate that the radio detections of the nearly simultaneous group are due to the currents of the TGFs, while the radio signals from the other group are lightning strokes related to the TGFs. Comparisons are also made to the lightning observations of the Lightning Imaging Sensor (LIS), using the LIS annualized maps that correct for exposure. With GBM's lowered TGF threshold, the ratio between TGFs and LIS lightning flashes is 1:2600. As previously found with other TGF instruments, there are regional variations in this ratio. A model-independent correction of the GBM TGF measurements for instrumental effects obtains a TGF fluence (time-integrated intensity) distribution that is consistent with a power law.