

Terrestrial Gamma-ray Flash (TGF) Observations with Fermi GBM

Michael S. Briggs^{*1}, Oliver J. Roberts², Matthew Stanbro¹,
Eric S. Cramer¹, Robert H. Holzworth³, J. E. Grove⁴, A. Chekhtman⁵,
and Shelia McBreen⁶

¹ The University of Alabama in Huntsville, Huntsville, Alabama, USA

² USRA, Huntsville, Alabama, USA

³ University of Washington, Seattle, Washington, USA

⁴ NRL, Washington, DC, USA

⁵ George Mason University, Virginia, USA

⁶ University College Dublin, Dublin, Ireland

Over eight years, the Fermi Gamma-ray Burst Monitor has detected over four thousand Terrestrial Gamma-ray Flashes (TGFs) and at least twenty Terrestrial Electron Bursts (TEBs). This large sample is made available at the Fermi Science Support Center (<https://fermi.gsfc.nasa.gov/ssc/data/access/gbm/tgf/>) and described by Roberts et al. (JGR, submitted). In addition to the basic data for more than four thousand TGFs, data from the World Wide Lightning Network are included in the catalog. Sferic associations are found for 1554 of the TGFs, resulting in accurate localizations. For each TGF, maps of the WWLLN sferics within ± 10 minutes are provided to show the lightning activity within the vicinity.

Several results are obtained from the large GBM TGF sample. Even some very short TGFs can have extremely high fluxes that can cause saturation effects in the GBM detectors. TGFs in the Americas and Asian regions show a two-peak diurnal distribution in Local Solar Time, while African TGFs have a single peak in the afternoon. It has long been known that TGFs occur preferentially near coastline – we quantify this effect, finding TGFs concentrating near coastline with a scale of ~ 50 km and a slight preference to occur over land near coastline, compared to ocean.

An event on 2014 February 04 was observed both as a TGF and as a TEB. With this dual event we test our understanding of TGFs and TEBs: we can model the TGF observation and the TEB observation with a consistent source strength.

TGFs from tropical storms were found to occur predominately from the outer rainbands and during strengthening phases of the storms.