EGU2020-10077
https://doi.org/10.5194/egusphere-egu2020-10077
EGU General Assembly 2020

Using FERMI TGF observation data to show an enhanced likelihood of TGF origin at the edges of stormcloud lightning clusters

Paul Connell
University of Valencia, Image Processing Laboratory, Astronomy and Space Physics, Valencia, Spain (paul.connell@uv.es)

In designing the MXGS coded mask imager on the ASIM mission to the ISS many simulations of its performance were made using a model of TGF origin as a RREA in a vertical electric ffield at about 15 km altitude. One consequence was the prediction that imaging scatter background from high energy photons would be 15-20% of CZT detector counts, decreasing with TGF off-axis observation angle.

Analysis of the linear image reconstruction model shows the maximum scatter background to be 40% in some cases, with sources at the same off-axis angle having both small and large scatter background. The obvious reason to explain this asymmetry is that a TGF beam is not primarily vertical, but at large angles, and provokes an inference about TGF origin.

The phenomenon can be explained by TGF origin at the tips of lightning leader channels, resulting in a wide range of random beam angles, or in the macro electric ffield of the induced negative shfielding charge above a stormcloud. This charge might begin as concentrated near the top-centre of a stormcloud but should slowly spread out to form a torus-like charge with the greatest electric field on the circular boundary of the torus, over a range of angles from vertical to horizontal to downward - with many TGFs absorbed or expanding spherically as a low energy Compton Scatter Remant.

In this scenario the TGF would originate near the upper radial edge of the cloud, but not within it, either by lightning leader electron injection or electron positron injection from a cosmic ray shower, posing the question if this location of origin can be observed.

We made a study of over 6000 TGF locations from FERMI-WWLLN observations where the centroid centrepoint of the nearest lightning cluster to the TGF was located, allowing for wind drift, its RMSQ cluster radius determined, and its distance vector from the cluster centrepoint. If the cluster would represent stormcloud location and area, then the macro E-field scenario of TGF origin should result in an annular distribution of the TGF-WWLLN vector location, but convolved with the lightning location error distribution. We present the results here, showing there is indeed a significant increase in TGF origin at the outer boundary of stormcloud lightning clusters.