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The intensity distribution of Terrestrial Gamma-ray Flashes from the ALOFT flight campaign

Anders Fuglestad[1] and the ALOFT team[*]
[1]Department of Physics and Technology, University of Bergen, Bergen, Norway
[*]A full list of authors appears at the end of the abstract

In July 2023, the Airborne Lightning Observatory for FEGS and TGFs (ALOFT) flight campaign took place using a NASA ER-2 research aircraft flying over the Gulf of Mexico and the Caribbean Sea. The campaign consisted of about 60 flight hours at a cruise altitude of 20 km, using live telemetry to target gamma-ray glowing thunderclouds.

The payload consisted of several instruments including gamma-ray detectors with a dynamic range spanning four orders of magnitude in flux, an imaging array of optical photometers, electric field change meters, radiometers, and radar systems. In addition to several ground stations measuring very low frequency, low frequency, and very high frequency radio signals.

96 TGFs were detected by ALOFT. For 44 of these events, it was possible to get an estimate of the location of the source using both correlated optical pulses and lightning detection networks.

With the estimate of the source location and the gamma-ray observation from ALOFT. Monte Carlo simulations were used to get an estimate of the source intensity of the TGFs.

Based on the results it was determined that the vast majority of the 44 TGFs investigated have source intensities below the threshold needed to be observed from current satellite instruments, which indicates a large population of low intensity TGFs that has gone previously undetected. These results contribute to the open debate on the rarity of TGFs.

ALOFT team: N. Østgaard 1, T. Lang 2, M. Marisaldi 1, J. E. Grove 4, M. Quick 2, H. Christian 3, C. Schultz 2, R. Blakeslee 2, I. Adams 6, R. Kroodsma 6, G. Heymsfield 6, A. Mezentsev 1, D. Sarria 1, I. Bjørg Engeland 1, A. Fuglestad 1, N. Lehtinen 1, K. Ullaland 1, S. Yang 1, B. Hasan Qureshi 1, J. Søndergaard 1, B. Husa 1, D. Walker 3, D. Shy 4, M. Bateman 3, D. Mach 13, P. Bitzer 3, M. Fullekrug 7, M. Cohen 8, M. Stanley 9, S. Cummer 10, J. Montanya 11, M. Pazos 12, C. Velosa 5, O. van der Velde 11, Y. Pu 10, P. Krehbiel 9, J. A. Roncancio 11, J. A. Lopez 11, M. Urbani 11, A. Santos 5