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# Two lightning flashes correlated with detected terrestrial gamma-ray flashes: The UPC Colombia TGF Campaign

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TGFs are intense bursts of gamma rays originated in Earth observed from space. These emissions have been correlated with lightning and thunderstorms (e.g. Cummer et al. 2005). Moreover, there is a clear correlation between lightning and TGF activity being both greater in the tropics, probably the occurrence of TGF in these areas can be related to the tropopause height (Smith et al. 2010). The AGILE satellite of the Italian Space Agency (ASI) have detected TGFs events up to 100 MeV (Tavani et al. 2011), confirming that this is the most energetic radiation on Earth. This satellite operates in the +-2.5 latitude belt over Equator. One of the interesting results (Fuschino et al. 2011) is that the TGFs/lightning occurrence ratio is different depending on the Earth region, being greater over South America.

In the framework of the future ASIM mission a campaign is conducted in the south of Colombia in order to measure VLF magnetic fields related with TGF parent lightning. A single LINET sensor was installed in October 2012 in the region of coverage of AGILE. Additional lightning data information is provided by the existing LINET network in Colombia.

Since the setup of the sensor, two AGILE TGFs events have occurred near the LINET sensor. The first one occurred in November 23rd 2012. The sub-satellite point was located 1400 km away from the LINET sensor. A VLF signal was detected within $\sim$2.5 ms, which is in agreement with other publications. The second TGF event occurred in November 19th where the sub-satellite point was 260 km away from the LINET sensor. Although this event was very close to the sensor the VLF signal detected occurred $\sim$170 ms delayed from the TGF. Because of the time differences between the TGF and VLF lightning signals, the first case appears related to the return stroke whereas the second would be related to a leader process. By using VLF signals from the double loop antenna, the direction of the received signal can be retrieved. Correlating this information with GOES satellite images it is possible to deduce the most probably active thunderstorm where the event happened. The first results suggest that the two cases reported here occurred during the developing phase of the associated thunderstorms.