Geophysical Research Abstracts
Vol. 21, EGU2019-7858-1, 2019
EGU General Assembly 2019
© Author(s) 2019. CC Attribution 4.0 license.

High-Energy Atmospheric Phenomena observed in "lightning hole" proximity.

Pavlo Kochkin (1), Chris Skeie (1), Alte I. de Boer (6), Michiel Bardet (6), Allasia Cedric (7), Franck Flourens (7), Hugh Christian (3), Eric Grove (4), Mason Quick (4), Samer Nussirat (3), Eric Wulf (4), Shiming Yang (1), Georgi Genov (1), Kjetil Ullaland (1), Martino Marisaldi (1), Nikolai Lehtinen (1), Andrey Mezentsev (1), David Sarria (1), Lex van Deursen (2), and Nikolai Østgaard (1)

(1) University of Bergen, Bergen, Norway (pavlo.kochkin@uib.no), (6) The Netherlands Aerospace Centre, Amsterdam, Netherlands, (7) Airbus, Toulouse, France, (3) University of Alabama, Huntsville, Alabama, US, (4) U.S. Naval Research Laboratory, Washington DC, US, (2) Eindhoven University of Technology, Eindhoven, Netherlands

A "lightning hole" is a region with depleted in-cloud lightning activity surrounded by relatively high lightning discharge rate from all sides. Lightning holes have been observed in regions of strong updrafts and are spatially associated with overshooting cloud tops. What makes them difficult to detect is their relatively short lifetime (a few tens of minutes) and horizontal displacement caused by side winds. The phenomenon became evident only recently after development of Lightning Mapping Arrays (LMAs). Such antenna arrays operate at higher frequencies thus are more sensitive to in-cloud discharges than classical VLF Lightning detection networks.

In this work we analyse the data obtained during two in-flight experimental campaigns. One was conducted in Colorado with an ER-2 NASA's aircraft flying at 20 km altitude in 2017. Another campaign was held in Northern Australia with an A340 test aircraft flying at 12 km cruise altitude in 2016. Both aircraft had gamma-ray detectors, antennas and other scientific equipment on-board. In addition to this, we analysed images of the cloud systems obtained from weather satellites and lightning data from local LMAs.

During their flights, both aircraft traversed strong updraft regions with characteristic overshooting tops. Lightning density maps of the regions show evidence of a lightning hole around the updraft. In both cases on-board gamma-ray detectors showed increased count rate indicating a phenomenon known as long gamma-ray glow. Detailed analysis of the Colorado storm brought us to conclusion that it had an inverted charge structure (anomalous polarity storm). In Australia, where the aircraft was flying at the lower altitude of 12 km, a positron annihilation signature was detected simultaneously with the gamma-ray glow.

In this presentation we want to show the experimental data side by side and draw general scientific attention to the regions of strong updrafts and overshooting tops. Apparently, such regions can sustain conditions necessary for background particle acceleration and need to be studied more thoroughly in the future.