



Common Gamma-ray Glows above Thunderclouds

Nicole Kelley (1), David Smith (1), Joseph Dwyer (2), Bryna Hazelton (3), Brian Grefenstette (4), Alex Lowell (5), Michael Splitt (2), Steven Lazarus (2), and Hamid Rassoul (2)

(1) SCIPP, University of California, Santa Cruz, CA, USA (nakelley@ucsc.edu), (2) Florida Institute of Technology, Melbourne, FL, USA, (3) University of Washington, Seattle, WA, USA, (4) Caltech, Pasadena, CA, USA, (5) University of California, Berkeley, CA, USA

Gamma-ray glows are continuous, long duration gamma- and x-ray emission seen coming from thunderclouds. The Airborne for Energetic Lightning Emissions (ADELE) observed 12 gamma-ray glows during its summer 2009 flight campaign over the areas of Colorado and Florida in the United States. For these glows we shall present their spectra, relationship to lightning activity and how their duration and size changes as a function of distance. Gamma-ray glows follow the relativistic runaway electron avalanche (RREA) spectrum and have been previously measured from the ground and inside the cloud. ADELE measured most glows as it flew above the screening layer of the cloud. During the brightest glow on August 21, 2009, we can show that we are flying directly into a downward facing relativistic runaway avalanche, indicative of flying between the upper positive and negative screening layer of the cloud. In order to explain the brightness of this glow, RREA with an electric field approaching the limit for relativistic feedback must be occurring. Using all 12 glows, we show that lightning activity diminishes during the onset of the glow. Using this along with the fact that glows occur as the field approaches the level necessary for feedback, we attempt to distinguish between two possibilities: that glows are evidence that RREA with feedback, rather than lightning, is sometimes the primary channel for discharging the cloud, or else that the overall discharging is still controlled by lightning, with glows simply appearing during times when a subsidence of lightning allows the field to rise above the threshold for RREA.