

Title

Lightning activity associated to Amazonian coastal squall lines: a case study

Authors

Laure Madeleine Dentel¹, Brigida Ramati Pereira da Rocha¹⁻³, José Ricardo Santos de Souza², Ronald L. Holle⁴, Jaci Maria Bilhalva Saraiva³

¹UFPA Universidade Federal do Pará, Faculdade de Engenharia Elétrica, Belém-PA

²UFPA Universidade Federal do Pará, Faculdade de Meteorologia, Belém-PA

³SIPAM – Sistema de Proteção da Amazônia, CTO/BE, Belém-PA

⁴Vaisala Inc.

Abstract

This work analyzes the electrical activity produced during the life cycle of coastal Amazon Squall Lines (ASL) observed on 23 June, 2011; and monitored by various systems, including two VLF Lightning Detection Networks (GLD360 and STARNET) and three Electric Field Mills (EFM) located at in the Airport Val-de-Can, the localities of Benevides and Outeiro (Pará, Brazil). The VLF-network-detected lightning diurnal distribution presented three strong peaks of activity: the first and largest occurred at the beginning of the ASL intensification phase, when the growth rate of the area covered by cloud top temperature < -70 °C was maximum. The second occurred in the middle of the intensification phase. The third, and smallest, occurred at the end of the intensification phase, determining the ASL maturation. Thus, a time shift of 1 hour and 15 minutes between the highest peak of lightning strikes and the beginning of the maturation phase of that meteorological system was observed. The lightning clusters detected by the VLF networks were always observed in the expansion boundary of the ASL and on the edge of -70 °C cloud top temperatures, corresponding to the intense convective region. By tracking the main lightning clusters in time, it was observed that the ASL was mainly expanded towards the west, until the middle of the intensification phase, when the core of the dominant cell storm reached the Amazon River. Subsequently, the dominant cell of the ASL changed its drift direction, close to the experimental sites of Outeiro and Benevides. At that time, the electric field measured by the EFM located at Outeiro presented the strongest variations with a total of 21 cloud-to-ground strokes identified in the signal, which corresponded to an occurrence rate of 1 stroke/min, superimposed to a deep electrostatic field excursion associated with precipitation (FEAWP). Next, the ASL was mainly expanded towards the Southwest and the core of the dominant cell storm seemed to follow the Amazon River side.