Observations of Compact Intracloud Discharges (CIDs)

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Data from a number of resources were used to study thunderstorms and thunderstorm radio emissions that occurred in the southwestern US between May and September of 1998. These resources included the Los Alamos sferic array, instrumentation on-board the FORTÉ satellite, the National Lightning Detection Network, and pertinent NEXRAD weather surveillance radars. The two former resources are described in detail in other papers of this session.

A primary goal of our campaign was to study compact intracloud discharges (CIDs), unique and isolated thunderstorm events that have been identified as sources of narrow positive and narrow negative bipolar electric field change pulses (NPBPs and NNBPs), subionospheric pulse pairs (SIPPs), and transionospheric pulse pairs (TIPPs). CIDs are powerful, singular discharges that occur in regions of high electric field strength and high charge density. Their physical characteristics are described in detail in another paper of this session.

Many hundreds of CIDs were observed by the sferic array during the summer of 1998 and were located using methods of differential time of arrival. Distances from the discharges to stations of the array ranged from just a few kilometers to many hundreds of kilometers. Source heights were determined using relative delays between CID groundwave signals and reflections from the earth and ionosphere. In some cases, FORTÉ data were also used to determine 3-D source locations. CID locations have been compared to those of other thunderstorm electrical discharges and to images of radar reflectivity. The events occur in localized regions of thunderstorms that also produce regular intracloud and cloud-to-ground lightning. Radar reflectivity data show that these localized regions correspond to thunderstorm cores where reflectivities in excess of 40 dBZ exist.

Further analysis of data from this summer should provide insight into the following questions: Do CIDs of opposite polarity occur at different altitudes within thunderstorms? Do CIDs occur only in regions of high reflectivity? Do all regions of high reflectivity produce CIDs? What are the temporal and spatial relationships between CIDs and other intracloud and cloud-to-ground thunderstorm electrical discharges? Can phases of thunderstorm or different storm types be identified as being more or less likely to produce the events?