Use of Total Lightning Information at a National Weather Service Field Office

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Abstract

The National Weather Service (NWS) in Melbourne (MLB), Florida has unique real-time access to data streams which depict the total lightning signal (in-cloud, cloud-to-cloud, cloud-to-air, and cloud-to-ground lightning) associated with local thunderstorms. The primary data source is the Lightning Detection and Ranging (LDAR) system located at the Kennedy Space Center. This system was specifically developed to depict individual point-sources in support of space vehicle launch, landing, and ground operations. To complement LDAR, data from the National Lightning Detection Network (NLDN) is available for the specific depiction of cloud-to-ground (CG) discharges. In the spirit of collaboration, NWS MLB forecasters explored the potential applications of total lightning information for serving the general public relative to the agency's mission of protecting life and property, as well as enhancing area commerce through increased (air) transportation efficiency.

One area of application involves the use of total lightning information (TLI) when discerning severe local storms over east central Florida (ECFL). Together with teams from Marshall Space Flight Center (MSFC) and Lincoln Laboratories at the Massachusetts Institute of Technology (MIT/LL), innovative research has been initiated by processing LDAR point-source information into flashes which then are associated with specific convective cells. This information is combined with radar parameter trend information from the local WSR-88D and displayed on a Lightning Imaging Sensor Data Application Demonstration (LISDAD) workstation developed specifically for this project.

Local research related to severe thunderstorms has been categorized into three primary storm types. (1) pulse severe cells - use of total lightning flash information was explored in an attempt to improve warning lead-times for pulse severe storms during central Florida's wet season (May through Sept.). In these instances, severe weather is often manifest through damaging microbursts and marginally severe (dime size) hail. Inherently short warning lead-times have been expanded during certain circumstances; (2) shallow tropical cyclone supercells - the mere presence of total lightning has been deemed significant for improving the detection of tornadoes associated with the outer rainbands of tropical cyclones. Such tornadoes are spawned within rainband mesocyclones having compact physical dimensions, making them more difficult to discern with radar alone. Within a favorable thermodynamic environment, the apparent cyclic response of the total lightning signal can be used to trace updraft acceleration pulses which might lead to tornado (re)occurrence through vortex

stretching; and (3) tornadic supercells - the outbreak of strong and violent killer tornadoes over ECFL on 22-23 February 1998 brought the rare opportunity to evaluate total lightning data within a strongly sheared baroclinic environment. Dramatic increases in flash rates for several of the tornado-producing severe thunderstorms were observed. In certain instances, equally dramatic decreases in flash rates were roughly correlated to times of tornado occurrence and the collapse of the bounded weak echo region.

Another application of TLI deals with improving aviation forecasts for ECFL airports. This includes the timely inclusion and removal of thunderstorms within Terminal Aeordrome Forecasts. Intentions have been to optimize the use of total lightning information to issue and amend TAFs to more accurately reflect the 0-2 hour time frame during convective situations. Positive results have been yielded to help fulfill the demanding need for accurate and precise flight planning and routing information. A parallel function has been to support several local airports with lightning information for ground operations via Airport Weather Warnings. The early detection of electrical discharge within 5 and 10 nmi radii surrounding each runway complex has proved beneficial in this regard.

With Florida being the leader of lightning casualties, another goal was to examine methods of better informing the public of imminent CG lightning threats. During the summer of 1997, NWS MLB began including lightning information into public products. Climatological, statistical, and safety information were included within daily Hazardous Weather Outlooks (HWO) according to the current synoptic and mesoscale weather pattern. The HWO is a product for public and interagency planning purposes and was used to describe the geographical distribution and timing of the onset/ending of CG lightning strikes. Particular attention was given to lightning sensitive situations where large outdoor gatherings were expected. Then, as each convective event unfolded, lightning information was routinely included in short-term forecasts. Since casualty statistics indicate that the onset and end of CG strike activity are dangerous times, LDAR information was used to detect early signs of electrical activity aloft to provide lead-time for CG strikes and to help determine diminishing potential for CG discharges. Modest, but promising successes have been achieved in this arena.