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The Importance of locating intra-cloud Lightning Flashes for nowcasting of severe Thunderstorms in the State of São Paulo: A Case Study

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The Meteorological Research Institute (IPMet) of the São Paulo State University has been monitoring the three-dimensional structure of severe thunderstorms, including the radial velocities inside and near these storms, since 1992 and 1994, respectively, using two S-band Doppler radars in the central and western part of the State of São Paulo. Since one of IPMet´s main objectives is the dissemination of nowcasting bulletins for the public, and especially emergency services, criteria for the early detection of severe wind and hailstorms have been sought and are already, at least in part, incorporated in the real-time monitoring and alert system. However, research into the relationship between radar echoes and lightning discharges only commenced in 2004. One of the tools used presently is the latest version of NCAR's (National Center for Atmospheric Research) TITAN (Thunderstorm Identification Tracking Analysis and Nowcasting) Software, which had been implemented at IPMet and adapted for local requirements in 2006. Cloud-to-Ground (CG) lightning strokes are available from the National Lightning Detection Network (formerly known as RINDAT), operated by the Lightning Research Group of the National Space Research Institute.

During an intensive international field campaign, TroCCiBras (Tropical Convection and Cirrus experiment Brasil) campaign, which was conducted jointly with the European HIBISCUS and TROCCINOX projects in January to March 2004, 3-D lightning

observations were provided by an experimental network of VHF Broadband Digital Interferometers (DITF), which was operated near Bauru by the Lightning Research Group of Osaka University (Japan). The main feature of broadband DITF is its bandwidth (from 20MHz to 100MHz) and implicit redundancy for estimating VHF source locations, permitting the imaging of precise lightning channels. Thus, strong Intra-Cloud (IC) lightning activity can already be identified during the early stages of cell development, indicating a very likely intensification of that cell into a severe storm some 15-30 minutes before the detection of CG strokes by the conventional RINDAT network and well before the radar would initiate an alert.

This paper focuses on the importance of also observing intra-cloud (IC) and Cloud-to-Cloud (CC) lightning activity, which is highlighted in the presentation of a case study (20 February 2004), with IC, CC and CG lightning being superposed on the three-dimensional radar images.

Since the processing of the DITF data is extremely time-consuming, it is proposed to augment the current RINDAT network with 3 – 5 Total Lightning sensors within the ranges of IPMet´s radars, because the availability of real-time IC observations, together with the conventional RINDAT lightning data and high-resolution radar observations could significantly improve IPMet's nowcasting capability and also extend the time range of the nowcast.