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Temporal Evolution and Statistical Correlations of 3D Total Lightning Activity and Conventional and Polarimetric Radar Parameters of Thunderstorms in Southern Germany

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The temporal evolution of three-dimensionally resolved total lightning activity, microphysical structure, and ground precipitation pattern of thunderstorms in southern Germany have been investigated in order to assess how their correlation and development can be used to estimate the state and further development of a thunderstorm and its electrical activity. Special focus has been laid on consequent discrimination of in-cloud and cloud-to-ground lightning events.

A new thunderstorm tracker ec-TRAM (Tracking and Monitoring of electrically charged cells) has been developed in the framework of the German BMBF "klimazwei"-project RegioExAKT (1). The prototype is designed to identify, track, and monitor thunderstorms by combining the information of independently tracked radar and lightning cells. Radar cells are identified and tracked based on high-resolution two-dimensional ground precipitation scans provided by the DWD C-band radar Fürholzen, Germany. Lightning cells are identified and tracked based on spatially and temporally clustered lightning frequency maps. Lightning data are provided by the European lightning detection network LINET. To interpret life-cycle patterns monitored by ec-TRAM in terms of underlying physical processes the observed quantities were complemented with three-dimensional polarimetric radar data which additionally allow for a hydrometeor classification. The polarimetric radar data are provided by the C-band dual-polarization Doppler Radar POLDIRAD at the DLR in Oberpfaffenhofen, Germany. Correlations suggested by the case-studies were further tested in statistical analyses over the complete thunderstorm data set collected in south Germany during the thunderstorm season of 2008.

First the temporal evolution of thunderstorm parameters like cell area, cell reflectivity pattern, total lightning activity, IC/CG ratio, IC discharge height and others during a thunderstorm life-cycle will be discussed with respect to the underlying storm dynamics and possible parameter correlations in an example storm. Then correlations between lightning activity, precipitation pattern, and cell stage introduced by the case study and found in the statistical analyses will be presented.

(1) RegioExAKT: Regional Risk of Convective Extreme Weather Events: User-oriented Concepts for Climatic Trend Assessment and Adaptation