For Details, Contact:

E.N. Koffi

Météo-France
CNRM /GMME/PI
42 Av. G. Coriolis
31057 Toulouse
Cedex, France
e-mail: koffi@cnrm.meteo.fr

Conference on European Tornadoes and Severe Storms

Quantitative aspects of European Mesoscale Convective Systems electrical life-cycle

E.N. Koffi, S. Sénési and C. Morel

The goal of this study is to objectively check, on a large data set and for Europe, some results related to the electrical life-cycle of Mesoscale Convective Systems (MCS), which have yet been shown on case studies only. This addresses for instance i) the conceptual model of an early Cloud-to-Ground (CG) activity of negative polarity, followed by a reversal of the dominating polarity, ii) the time-lag between peak electrical activity and MCS collapse, iii) the anomalous cases of early CG positive activity associated with severe or rapidly developping MCS. All these results may provide useful rules or hints for MCS nowcasting.

The method makes use of an automated identification and tracking of MCS cloud shields from the geostationnary satellite METEOSAT infrared channel images. Thanks to this tracking system, the satellite life-cycle of a large number of MCSs has been documented over Europe (currently the five warm seasons of 1993-1997 period). The Météo-France/Météorage lightning detection network, based on the IMPACT technology, measures the CG lightning flashes with both a high location accuracy and a high detection efficiency over France and surroundings. CG lightning flashes are integrated over the tracked cloud shields.

In a first step, the tracking method is tuned in order to ensure that diagnosed MCSs depict their earliest flashes. This includes a sensitivity study on the temperature and area thresholds used to define MCS cloud shields. This also allows to define a physically meaningful distance threshold for the

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linking of flashes to the relevant MCS cloud shield. In addition, some statistical results are derived about the cloud top temperature at which flashes may begin to occur.

Next, we study the number of flashes of both polarity integrated over the whole life-cycle of the MCSs, and the flash density, in relation to the other, satellite-derived aspects of the MCSs, including duration and time-integrated area. This allows for the derivation of a new and somewhat comprehensive system-related statistics of lightning aspects of MCS. It also provides grounds for the last phase, which will check the kind of results invoked in the introduction.