Studies in Italy related with CAL

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In this paper, we present the studies on lightning physics that are performed at the Institute of Atmospheric Sciences and Climate and that can be of general interest for the CAL project. This research is carried out by analysing various thunderstorm datasets (lighting data, radar reflectivities and microwave radiances) in conjunction with a numerical thunderstorm model, which is used for understanding cloud electrification and interpreting the measurements.

To this end, we have adopted the 1.5D University of Washington - Explicit Microphysics Thunderstorm Model (EMTM) to simulate cloud electrical activity and its association to cloud microphysical properties. Our approach will be illustrated by considering a particular key study (3-4 August 2002 flash flood event on the Po Valley, Northern Italy) in which the EMTM model is used to simulate the convective portion of the storm. In particular, we will present a new method to initialize the EMTM model by means of mesoscale model (MM5) atmospheric simulations, rather than by the conventional sounding measurements, for different meteorological situations – i.e., deep active convective towers with light/moderate/high flash rate, or stratiform clouds.

A large number of different EMTM simulations have been performed by using this technique, and a large database of detailed microphysical cloud profiles and associated lightning occurrence has been generated. Then, these results have been used within a 3-year data analysis based on the measurements provided by the Tropical Rainfall Measuring Mission (TRMM) space observatory payload – i.e., the Lightning Image Sensor (LIS) for total lighting rate; the Precipitation Radar (PR) for cloud reflectivity and precipitation rate profiles; and the TRMM Microwave Imaging (TMI) radiometer for microwave brightness temperatures at 5 different frequencies. We will finally show that this EMTM model / TRMM observations synergistic approach is very useful for understanding the physical correlation between lightning rate and microphysical properties of Mediterranean storms.