Experimental studies in Spain relating to CAL

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During last three summers electric and magnetic fields were measured under and at the vicinities of thunderstorms. These measurement campaigns were carried out over Catalonia (N-E of Spain).
Electric field, magnetic fields and quasi-static electric field, were measured by two flat plates antennas, two magnetic loops and a field mill. Additionally, on summer 2004 digital video was included. Since Catalonia has not a very high lightning activity, the measurement station was arranged for mobile transportation.

Additionally of the field measurements, lightning information is offered by the three lightning location networks which are available for the Catalan region. The XDDE network operated by the Catalan Meteorological Service (SMC) is composed by three VHF interferometers, the National Institute of Meteorology (INM) operates a fifteen magnetic direction finding and time-of-arrival (MDF+TOA) sensor network and Ingesco operates four time-of-arrival (TOA) sensors. VHF interferometer network is useful to locate intra-cloud events while both MDF+TOA and TOA networks are employed for cloud-to-ground strokes. Meteorological radar and radiosounding are also employed for analysis.

The main study was the investigation of the electrical charge related to lightning and its sources inside the thundercloud. Total electric field changes were computer analyzed to determine the total charge transferred by cloud-to-ground and intra-cloud lightning. In aim to estimate locations lightning data from location networks and temperature profiles from radiosounding balloons were included into the model. Electric field changes versus distance were also analyzed and compared with previous measurements carried out over NASA Kennedy Space Center (KSC). The analysis showed that typical KSC altitude for negative region was around 8.3 km meanwhile in Catalonia negative charge region was located around 6.75 km. Also, median value for the charge transferred to ground by colud-to-ground flashes in Catalonia was 9.74 C. Other analyses were focused in the characterization of the return stroke currents from the electromagnetic measurements and the evaluation of the efficiency of the lightning location networks in Catalonia.

Regarding to the CAL project lightning and radar data for the August 22th thunderstorm episode where five sprites were produced will be presented. The event was located around a 39.7º of latitude and -1º of longitude at 21:30h. This location is too far for Catalonian radars and is in the boundary of the VHF interferometer network. Some negative and positive flashes were located by the VHF interferometer network nearby this location at this time. Final manuscript will include lightning locations form the national lightning location network which covers the mentioned region. Valencia radar covers the region where sprites were produced, the final manuscript will also include several radar products information.

Sprites seem to be initiated by an energetic cloud-to-ground lightning flash and associated with positive lightning. In the final manuscript a discussion of the type of lightning detected by the lightning location networks and probably related to the Spanish sprites event will be presented. Also thundercloud characteristics from radar products will be included.

Next summer 2005 for a fourth time, the measurement campaign will be carried out. For this campaign a tower in a Pre-Pyrenees mountain top (around 2300 m) will be instrumented for lightning current measurement. Moreover electromagnetic sensors will be installed near the tower. These field measurements, lightning and radar data could be useful for the CAL project. Especially electromagnetic measurements will be important in order to characterize sprite initiation and to evaluate sprite production by negative cloud-to-ground flashes.