Some examples of lightning related research in atmospheric science by the Italian community

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Lightning has charmed and provoked scientists for as long as they have watched the skies, but only recently, mainly due to the success of the Lightning Imaging Sensor (LIS) onboard the Tropical Rainfall Measuring Mission (TRMM - http://trmm.gsfc.nasa.gov), its study has been officially integrated with satellite-based remotely sensed atmospheric measurements and with cloud modeling research. LIS has provided (and is still providing) a unique amount of high quality optical lightning data over tropics (Adamo et al., 2007), while the establishment of new regional and global lightning networks, with improved location accuracy and detection efficiency, has further augmented the utilization of lightning data in many meteo-climatic studies even at mid-latitudes. Some examples are briefly reported here.

Precipitation retrieval techniques from passive microwave sensors (i.e. Panegrossi et al., 1998, Tripoli et al., 2007) have recently started to explore the correlation between lightning and convection to constrain the selection of candidate profiles in Cloud Dynamics and Radiation Database (CDRD) algorithms. (Sanò et al., 2012)

Real time techniques aiming at the precipitation nowcasting infer the development (movement, morphology, and intensity) of convective rain cells from the spatial and temporal distribution of lightning strokes (Dietrich et al., 2011). They are based on the cooperation between microwave multi-frequency brightness temperature data and lightning occurrences. These techniques have been successfully applied to study Mediterranean severe storms in the frame of EU FLASH project (Price et al., 2011)

Satellite-based multisensor studies (Buiat, 2011) of cloud electrical properties related to microphysical structure are nowadays possible at mid-latitudes by using Cloud Profiling Radar (CPR) on Cloudsat (http://cloudsat.atmos.colostate.edu/). Great advances are expected after the launch (2014) of the Global Precipitation Measurement (GPM - http://science.nasa.gov/missions/gpm/) satellite mission (thanks to the presence of the first spaceborne dual frequency radar) when better insights into microphysical structures of mid-latitudes storms will be available.

Cloud electrification models, such as the 1D Explicit Microphysics Thunderstorm Model (Solomon et al., 2005), allow to carry out sensitivity studies of electrical activity and microphysics structure within the convective cloud. In these models explicit microphysics is required in order to include a charge transfer mechanism that is dependent on particle size (Formenton et al., 2012).

Non-hydrostatic regional atmospheric modeling system used to make operational weather forecasts, such as the Calabria Regional Atmospheric Modeling System (CRAMS) (Federico et al., 2011), have begun to test and include methodologies for providing lightning forecasting based on simulated microphysics (i.e. Dahl et al., 2011).

Finally, studies about the impact of lightning and transient luminous events on NOx production (Arnone et al., 2008) benefit from the improvement in lightning monitoring.

All these applications demonstrate the growing interest of the Italian atmospheric science community in cloud electrification and its applications to atmospheric science.

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