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Observing relationships between lightning and ice water content profiles by means of a satellite cloud radar

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Cloud electrification and related lightning activity in thunderstorms have their origin in the charge separation and resulting distribution of charged iced particles within the cloud. So far, the ice distribution within convective clouds has been investigated mainly by means of ground based meteorological radars. In this paper we show how also the products from Cloud Profiling Radar (CPR) on board Cloudsat, a polar satellite of NASA's Earth System Science Pathfinder (ESSP), can be used to obtain information from space on the vertical distribution of ice particles, ice content and relate them to the lightning activity.
The analysis has been carried out focusing on five convective events occurred over Italy that have been crossed by CloudSat overpasses during significant lightning activity. The CPR products considered here are the vertical profiles of cloud Ice Water Content (IWC) and Effective Radius (ER), to be compared to the number of strokes as measured by a ground lightning network (LINET).
The main results show a strong correlation between the number of strokes and the Ice Water Content: the profiles with the highest number of strokes correspond to higher columnar ice water content. Moreover a positive correspondence between the mean cloud particles effective radius and the number of strokes has been found. Such results confirm the importance of the ice phase in the mechanism that lead to the separation of charges in the cloud, with special emphasis on the role of smaller, cloud-top ice particles, difficult to detect with ground-based weather radars.