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The use of a potential lightning index in multi-microphysical cloud-resolving simulations of a V-shape convective system.

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Lightning activity is a characteristic phenomenon of severe weather as confirmed by many studies on different weather regimes that reveal strong interplay between lightning phenomena and extreme rainfall process in thunderstorms. The improvement of the so-called total (i.e. cloud-to-ground and intra-cloud) lightning observation systems in the last decades has allowed to investigate the relationship between the lightning flash rate and the kinematic and microphysical properties of severe hydro-meteorological events characterized by strong convection. V-shape back-building Mesoscale Convective Systems (MCSs) occurring over short periods of time have hit several times the Liguria region located in north-western Italy in the period between October 2010 and November 2014, generating flash-flood events responsible for hundreds of fatalities and millions of euros of damage. All these events showed an area of intense precipitation sweeping an arc of a few degrees around the warm conveyor belt originating about 50-60 km from the Liguria coastline. A second main ingredient was the presence of a convergence line, which supported the development and the maintenance of the aforementioned back-building process. Other common features were the persistence of such geometric configuration for many hours and the associated strong lightning activity.

A methodological approach for the evaluation of these types of extreme rainfall and lightning convective events is presented for a back-building MCS event occurred in Genoa in 2014. A microphysics driven ensemble of WRF simulations at cloud-permitting grid spacing (1 km) with different microphysics parameterizations is used and compared to the available observational radar and lightning data. To pursue this aim, the performance of the Lightning Potential Index (LPI) as a measure of the potential for charge generation and separation that leads to lightning occurrence in clouds, is computed and analyzed to gain further physical insight in these V-shape convective processes and to understand its predictive ability.