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Observational study of tornadic cells that hit Corsica during the ADRIAN storm on the 29th October 2018

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The north-western Mediterranean basin often experiences thunderstorms with heavy precipitation, strong wind, lightning activity and sometimes waterspouts/tornadoes. One of the objectives of the EXAEDRE (EXploiting new Atmospheric Electricity Data for Research and the Environment) project is to better monitor the thunderstorms in this area through a better understanding of the physical processes that drive the dynamics, the microphysics and the electrical activity of the convective systems. Characteristics of the electrical activity such as flash rate, charge layer distribution or flash polarity are good proxies for thunderstorm monitoring and good evidences of the storm severity.

The 29th October 2018, an intense trough developed over Mediterranean Sea between Balearic Islands and Corsica. This storm, called ADRIAN, produced several hazards (heavy precipitation, strong winds, intense lightning activity and hailstorm) in Corsica. Two tornadoes and one waterspout were observed in the morning at Porto Vecchio (EF2 tornado and waterspout) and Aleria (EF1 tornado), causing significant damages.

In this study, we take a look at electrical and microphysical characteristics of the two tornadic cells. For that, observations of the LMA (Lightning Mapping Array) SAETTA network, deployed in Corsica, are used to document in 3D the total lightning activity. Complementary 2D lightning observations recorded by the French national lightning detection network METEORAGE are also investigated. We also use weather radar data from the Météo France network. A clustering algorithm is applied on both the lightning and radar data to identify and track the cells to document the evolution of several lightning-related and microphysical characteristics during the lifetime of each cell. We also applied a new method based on lightning leader velocity to automatically infer the vertical and horizontal structure of the electrical charge regions within each electrical cell.

We first introduce the different observations and methodologies applied here. Then the main electrical properties of the tornadic cells (e.g. flash duration, vertical flash extension, charge layer, flash type and polarity) and microphysical characteristics as well as their temporal evolution are presented. Overall, the studied electrical cells produced few cloud-to-ground lightning flashes predominantly of negative polarity. The peaks of electrical activity occurred when

tornadoes hit the land and these storms presented all an anomalous charge structure.