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Observation and simulation of a tornadic supercell over the plain of Caserta (Southern Italy) using X-band weather radar and WRF model in LES mode

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This work aims to describe the development of a tornadic supercell occurred on 12 March 2018 over the plain of Caserta (Campania region, Italy). The tornadic event caused relevant damages to houses, cars, infrastructures plus eight injuries.
Some remarkable information about the convective cell responsible of the tornadic event have been retrieved from the reflectivity measurements of an X-band weather radar (named WR-10X), located in the urban area of Naples at a distance of about 30 km from the plain of Caserta. According to the WR-10X reflectivity volumes, the convective cell, after showing its first signature at 16:30 UTC over the nearby mountains, close to the Tyrrhenian coast, moved south-easterly with an estimated average translation velocity of 13 m/s. The analysis of reflectivity at low levels proves that the transition of the convective cell in a supercell occurred at 17:40 UTC. A clear Forward Flank Notch (FFN) signature appeared at 17:50 UTC, pointing out a strong updraft which caused a deflection of upper level winds around the core of the storm. The supercell approached the neighbourhood of Caserta at 18:00 UTC, when it showed a classic "hook-echo" signature. The Range Height Indicator (RHI) scan reveals that the supercell had the classical theoretical structure, including two distinct downdrafts (the Forward-Flank Downdraft (FFD) and the Rear-Flank Downdraft (RFD)). The presence of the mesocyclone was also associated with a bounded weak echo region (BWER), a vertical channel of weak radar echo, related to a very strong updraft.
With the aim of understanding the processes that triggered the tornadic supercell, several simulations with the WRF model in the Large Eddy Simulation (LES) mode are performed. A more accurate Global Digital Elevation Model (ASTER GDEM) and the new CORINE Land Cover 2018 are used for this purpose. The LES experiments allow to accurately simulate the interaction between the flow and the complex terrain, pointing out the relevance of vertical wind shear and the role of topography in the triggering of convective cell.