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Analysis of the development mechanisms of a large-hail storm event, on the Adriatic Sea using an atmosphere-ocean coupled model (COAWST)

Antonio Ricchi[1,2], Vincenzo Mazzarella[3], Frank Marzano[4,2,1], Mario Marcello Miglietta[5], Errico Picciotti[8], Mario Montopoli[5], Luca Baldini[5], Gianfranco Vulpiani[6], Alessandro Tiesi[5], Simone Mazzà[7], and Rossella Ferretti[1,2]

[1]Università of L'Aquila, Department of Physics and Chemical Sciences, L'Aquila, Italy (antonio.ricchi@vunivaq.it)
[2]CETEMPS (Center of Excellence in Telesensing of Environment and Model Prediction of Severe Events)
[3]CIMA Research Foundation
[4]Sapienza University of Rome
[5]CNR ISAC
[6]Department of Civil Protection
[7]Università della Calabria
[8]HIMET s.r.l

On the morning of 10 July 2019, an intrusion of relatively cold and dry air, over the Adriatic Sea, through a "bora jet", gave rise to a frontal structure at the ground, which moved rapidly from the Northern to the Southern Adriatic. The intense thermal gradient (together with a high positive sea surface temperature anomaly), the interaction of the jet with the complex topography of Apennines and the coastal boundary, generated a storm structure that moved parallel to the central Italy coast. In particular, between 8UTC and 12UTC, a supercell developed along the coast to the north of Pescara city (middle Adriatic), producing rainfall that reached 130 mm in 3 hours, and a violent hailstorm (estimated diameter greater than 10 cm).

In this work, the frontal dynamics and the genesis of the thunderstorm are studied using the numerical system COAWST. Local polarimetric radar observations are also used to check the consistency of the simulations in the mature phase of the supercell. Numerical experiments are performed using a 1 km grid over central Italy, initialized using the ECMWF IFS analysis/forecasts. The sensitivity study investigates the role of the orography, the sea surface temperature (SST) and the coupling between ocean and atmosphere. Orography tests include simulations where the relevant peaks of the Apennine range (such as Gran Sasso and Picentini) are removed as well as cases where their peaks are modified compared to their real values. In terms of SST, we employ, using an uncoupled approach, the ECMWF SST dataset, the MFS-CMEMS Copernicus dataset at 4 km, 0.01°C Satellite SST, and we investigate the role of the SST anomaly (adding +1°C and +2°C to the real field). The role of the ocean-atmosphere interaction is tested using the COAWST numerical model using an ocean model numerical grid at 1 km resolution over the whole Adriatic Sea.