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Forecasting a wet microburst with high-resolution numerical models

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On the 1st of August 2015 a severe wet microburst generated by a fast moving multicellular convective storm hit the town of Florence around 17 UTC. The damages reported in a small part of the city were impressive, including one casualty, cars and buildings damaged by large hail and many secular trees downed. This was the second severe downburst in the area in the last couple of years. Considering the possible future increase of severe weather events due to climate change scenarios, the predictability of similar cases is of central interest to the authors. These structures have a horizontal scale of the order of a kilometer and a time scale of minutes, being at the edge of the actual numerical forecasting capability.

Keeping in mind the above considerations the authors try to investigate to which extent an operational numerical model approach is skillful in producing valuable information for these kind of events. To achieve these goals, several high-resolution numerical simulations were performed by using different mesoscale atmospheric models (namely ARW-ARW and MESO-NH) with ECMWF data as initial and boundary conditions both with a deterministic and ensemble approach.

Major findings are: both numerical models, with the closest initial data set (e.g. 12 UTC of the same day) were able to correctly reproduce the storm's physical structure, provided that very high-resolution (hundreds of meters) and very high output frequency (10 minutes) are used. The best simulation is able to predict wind speed around 27-30 m/s and maximum wind gust (computed with a postprocessing technique) around 33 m/s. These values if compared to the observed damages (no in-situ measurements are available) seems low, but still represents high values to keep in count. Deterministic simulations with previous initialization data set (namely 12 UTC of the day before and 00 UTC of the same day) were not able to reproduce the event, limiting the usefulness of this approach to warn population with advance. High resolution Ensemble simulations (3 km of horizontal resolution) were not successful in producing significant probability of severe wind gust.

In conclusion: event predictability with a standard operational forecasting chain, even at high horizontal resolution or ensemble approach, is very low, limiting to the closest initialization and at very high resolution. Models fail in forecasting the exact location of the maximum downburst area and the exact timing but seems to be able to reproduce the physical structure of the event.