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# WRF model simulations forced with GEFS: an ensemble approach for the prediction of wind speed near a complex coastline

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The Weather Research and Forecasting mesoscale model (WRF) has been used to simulate hourly 10m wind speed and direction over the city of Taranto (southeastern Italy). Being characterized by a large industrial area including the largest European steel plant, this area is subject to a Regional Air Quality Recovery Plan [1]. This plan constrains industrial plants in the area to reduce by 10% the mean daily emissions by diffuse and point sources during specific meteorological conditions named wind days. A wind day event is characterized by the contemporary occurrence of wind speed greater than 7 m/s blowing from the north-west quadrant, with a persistence of at least three hours. According to the Recovery Plan, the Regional Environmental Agency ARPA-PUGLIA is responsible for forecasting these specific meteorological conditions 72 hours in advance and possibly provide an early warning message. For this reason, the accurate forecast of local wind speed and direction is of fundamental importance. The aim of the present study is to improve wind forecast in this specific context.
WRF output fields are affected by systematic errors depending both on the uncertainties in the initial and boundary conditions provided by global models and on the physical parameterizations. This is true in particular for near-surface fields and in regions with rough topography; thus, these errors can dramatically affect the prediction of wind fields near the complex coastline surrounding Taranto. For this reason, we have analyzed here how the initial condition may affect the simulation of wind speed.
For this purpose, we have forced the WRF model with ten perturbed initial/boundary conditions provided by the Global Ensemble Forecast System (GEFS)[2]. The simulations are performed in a real-time configuration since our intention is to analyze the same implementation used by ARPA-PUGLIA for operational runs. The validation is focused on a time range extending from 49 to 72 hours with hourly time resolution. The performance is assessed by comparing the WRF model output with the ground data measured at a monitoring weather station in Taranto close to the steel plant. Different case studies are analyzed to identify the additional value of using an ensemble of initial/boundary conditions instead of a deterministic approach.

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[2] Hamill, T. M., Bates, G. T., Whitaker, J. S., Murray, D. R., Fiorino, M., Galarneau Jr, T. J., ... & Lapenta, W. (2013). NOAA's second-generation global medium-range ensemble reforecast dataset. Bulletin of the American Meteorological Society, 94(10), 1553-1565.