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An Improvement in high-resolution wind forecasting of the WRF Model by using a 3DVAR analysis with radar data for Istanbul/Turkey

Merve Acar (1), Ceren Balli (1), Elcin Tan (1), Altug Aksoy (2), and Yurdanur Unal (1)

(1) Istanbul Technical University, Aeronautics and astronautics, Turkey (merveacar.03@gmail.com), (2) University of Miami RSMAS/CIMAS and NOAA/AOML/HRD

The systematic verification of the forecast products is a crucial part of any forecasting system. In this study, we attempt to address the question whether high-resolution forecasts increase deterministic skills in the wind field beyond what can be accomplished with a coarser-resolution model, and additionally, how 3DVAR analyses improve these high-resolution wind forecasts for Istanbul. The Weather Research and Forecasting (WRF-ARW) model is used to produce 24-hr forecasts over a domain centered on Istanbul, extending to Ukraine in the north, northern Africa in the South, Tyyhrenian Sea in the west and Caspian Sea in the east. A three-nested domain layout is chosen: the coarsest domain with 9-km, finer domain with 3-km, and finest domain with 1-km grid resolution. All domains have 45 vertical levels. The model is initialized and forced at the boundaries by ECMWF operational forecast data at both 00UTC and 12UTC for January and July 2009 to obtain 24-hr forecasts. Thus, four sets of simulations are obtained. The relationship between forecast quality and horizontal grid spacing has been mainly carried out using the traditional objective verification metric of point-wise root-mean squared errors. The forecast grid closest to the observation location is selected for verification. First, the forecasted wind field at the surface and different pressure levels is compared to ECMWF-ERA Interim reanalysis for the largest domain to examine the areal limits of forecast accuracy. Second, five radiosonde observations taken from Istanbul, Izmir, Ankara, Isparta, and Athens are compared to the forecasts at the surface and standard pressure levels. Third, verifications against nine surface station observations in Istanbul are performed. Comparisons of 24-hr wind forecasts with the data observed at 5 radiosonde stations suggest that ECMWF operational forecast model produces wind fields closer to observations than ERA Interim near the surface. High resolution WRF model driven by operational forecast data improves the operational forecast near the surface up to 700 hPa. However, above 700 hPa, the root mean square errors dramatically increase with height, and they are at their extreme at the jet level. When hourly 10-m surface wind speeds are compared with the nearest grid point forecasts at 9 stations located in the city of Istanbul, it is found that WRF overpredicted the wind speed compared to the observations. However, approximately 60% of the errors in speed lie in the +/- 1.5m/sec range. This shows that although high-resolution wind direction is predicted with less error, a 3DVAR analysis might be needed to improve the wind speed forecasts. We applied a 3DVAR analysis approach by using radar data for selected days of January and July, 2009. Forecast accuracy of the results for these selected days will be presented.