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Verification of 24 hours wind field forecast generated by WRF_ARW for January and July of 2009

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The systematic verification of the forecast products is a crucial part of any forecasting system. Parameters such as temperature and precipitation are the most commonly used variables in verification. In this study, we attempt to address the question whether high resolution forecasts increase deterministic skill in wind field beyond what can be accomplished with a coarser-resolution model.

Weather Research and Forecasting (WRF-ARW) Model are used to produce 24hr forecasts over a domain centered on Istanbul, extending to Ukraine on the north, northern Africa on the South, Tyyhrenian Sea on the west and Caspian Sea on the east. 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. Model are initialized and forced by ECMWF operational forecast data at both 00UTC and 12UTC for January and July 2009 to obtain 24hr forecasts. Thus, four sets of simulations are accomplished.

To address the general question of whether high resolution produces better forecasts, we assess how well the high-resolution forecasts replicate near-surface winds relative to the coarser-resolution. The relationship between forecast quality and horizontal grid spacing have been mainly carried out using 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 has been compared to ECMWF- ERA Interim reanalysis for the largest domain to examine the areal limits of forecast accuracy. Second, five radiosonde observations taken in Istanbul, Izmir, Ankara, Isparta, and Athen are compared to the forecasts at the surface and standard pressure levels. Third, we have achieved the verification against nine surface station observations in Istanbul.

Our results indicate that the differences between WRF 24 hour forecasts and ERA Interim re-analysis increase from 0 to 24 hours except that the differences are relatively small at 12:00 UTC. Due to high resolution of WRF-ARW, root-mean square errors are pronounced especially around high topography and land sea boundaries. In general, wind forecasts for July and 12UTC initialization are closer to ERA Interim than January and 00UTC initialization. Comparisons of 24hr wind forecasts with the data observed at 5 radiosonde stations suggest that ECMWF operational forecast model produces wind field closer to the observations than ERA Interim near surface. High resolution WRF model driven by operational forecast data improves the operational forecast near surface up to 700hPa level. However, above 700 hPa, the root mean square errors dramatically increase with height and they are most definite at jet levels. When hourly 10m surface wind speeds are compared with the nearest forecast grid data at 9 stations located in the city of Istanbul, it is found that WRF produces wind field stronger than the observations near the surface. However, approximately 60% of the errors in speed lies between -1.5m/sec and 1.5m/sec interval. Similarly 12:00 UTC initialization yields smaller differences from the station observations. July errors in speed and directions are less than January errors. Since the observational weather station network is inadequate to capture the fine-scale features, the validation of the high-resolution forecast is challenging.