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Scale-dependent evaluation of mesoscale low-level winds in coastal areas obtained with ALADIN mesoscale NWP model

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In the complex terrain of the eastern Adriatic coast where wind climate is governed by regional and local winds, it is beneficial to utilize a chain of numerical models to refine wind predictions. Verification of these mesoscale flows is a challenging issue that often does not follow unified approach. As traditionally used moment-based verification measures (like RMSE, MBIAS, MAE, etc.) are not always able to show the benefits of higher horizontal resolution models, we utilized spectral analysis as a supplementary verification method to provide a scale-dependent measure of model performance. An emphasis is on understanding the sources of prediction errors through relating various aspects of physical and spectral verification measures.

The verification was performed on wind forecasts obtained by ALADIN MNWP model with 8 km horizontal grid spacing in period 2010-2012. These forecasts were further refined to 2 km grid spacing using: i) full-physics based model and ii) so-called dynamical adaptation method (DADA) over sub-domain that covers broader area around Croatia.

Based on variety of statistical and spectral scores, it is suggested that wind speed forecast generally improves with increasing the model horizontal resolution. In particular this is the case at stations exposed to severe and gusty downslope windstorm known as bora. The largest portion of root-mean square errors (RMSE) can be attributed to phase errors at majority of stations, while the most significant increase of accuracy was found for diurnal and sub-diurnal periods of motions. Furthermore, we found a significant correlation between different sources of RMSE errors and spectral scores related to synoptic, diurnal and sub-diurnal motions. Finally, it was shown that more complex, full-physics and non-hydrostatic model based forecasts at 2 km horizontal resolution were valuable in forecasting wind properties at stations with significant portion of weaker, thermally driven flows.