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Evaluation of the ability of progressively finer MNWP models to reproduce wind regimes in complex terrain

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In the complex terrain of the eastern Adriatic where wind climate is governed by regional/local winds, it is beneficial to utilize a chain of numerical models to refine the associated wind predictions. The principal questions we address are i) whether an increase of model chain resolution improves the accuracy and ii) could simplified, computationally cheaper mesoscale meteorological models be used in the model chain for assessment and forecasting of wind properties?

To answer the above questions wind forecasts from Aire Limitée Adaptation dynamique Développement InterNational (ALADIN) Mesoscale Numerical Weather Prediction (MNWP) model with 8 km horizontal grid spacing were used in period 2010-2012. Those forecasts were further refined to 2 km grid spacing using: i) full-physics model forecasts, and ii) so-called dynamical adaptation method (DADA) over subdomain that covers broader area around Croatia. Statistical and spectral verification were performed for three different forecasting setups using measured wind speeds from several meteorological stations that represent different climate regimes of Croatia.

Based on variety of statistical scores as well as spectral measures inferred in frequency domain, the performed verification suggests that the results generally improved with increasing the model resolution. The largest portion of errors can be attributed to phase errors. The most significant increase of accuracy was found for statistical scores related to wind variability, in particular for diurnal periods of motions. Furthermore, DADA forecasts have proven to be successful in forecasting wind properties on a majority of stations, but at some stations near the very coast and steep terrain, the DADA method showed less appropriate to represent regional/local wind systems than the full-physics model. Finally, kinetic energy, vorticity and divergence spectra were studied to provide scale-dependent measure of model properties as well as to study the gross effects of horizontal diffusion on the effective model resolution.