

SHORT-RANGE LIMITED-AREA ENSEMBLE FORECASTS FOR TWO EUROPEAN WINTER STORMS: THE IMPACT OF MOIST SINGULAR VECTORS AND HORIZONTAL RESOLUTION

André Walser,, M. Arpagaus, M. Leutbecher, C. Appenzeller

Abstract: The impact of moist singular vectors and horizontal resolution. Current medium-range global weather forecasting systems account for intrinsic predictability limitations by using ensemble prediction systems (EPSs), while short-range mesoscale forecasting systems mostly rely on deterministic numerical weather predictions. The latter choice may not generally be ideal, especially when considering the forecast of extreme weather events. These are rare and populate the tails of the probability density function (PDF) of possible atmospheric states. EPSs predict an estimate for the time evolution of the PDF and hence provide a basis for weather risk information. However, current global EPSs, typically using coarse model resolutions, are limited in predicting extreme weather events, in particular those with regional scale. In this study, the impact of "moist" singular vectors (SVs) and horizontal resolution on short-range limited-area ensemble forecasts for two severe winter storms is investigated. The methodology consists of 51 member ensembles generated with the global EPS of the European Centre for Medium-Range Weather Forecasts which are downscaled with the nonhydrostatic limited-area model LM. The resolution dependency is studied by comparing 3 different limited area ensembles: a) 80 km grid-spacing, b) 10 km grid-spacing and c) 10 km grid-spacing with a topography coarse grained to 80 km resolution. In the global ensembles, the initial condition perturbations are based on singular vectors with two configurations: i) the operational SV configuration: T42 truncation, 48-h optimisation time, dry tangent-linear model and ii) the "moist" SV configuration: TL95 truncation, 24-h optimisation time, moist tangent-linear model. LM ensembles are analyzed for the European winter storms Lothar and Martin, both occurring in December 1999, with particular attention paid to near-surface wind gusts and storm track predictions. It is shown that forecasts using the moist SV configuration predict higher probabilities for strong wind gusts during the storm period compared to forecasts with the operational SV configuration. Similarly, the forecasts with increased horizontal resolution - even with coarse topography - lead to higher probabilities compared to the low resolution forecasts. Overall, the two case studies suggest that currently developed operational high-resolution limited-area EPSs, such as COSMO-LEPS, have a great potential to improve early warnings for severe winter storms, particularly when the driving global EPS employs moist SVs.