EGU21-5642, updated on 20 Oct 2021
https://doi.org/10.5194/egusphere-egu21-5642
EGU General Assembly 2021

Strength and Challenges of global model MPAS with regional mesh refinement for mid-latitude storm forecasting: A case study

Marc Imberger, Xiaoli Guo Larsén, and Neil Davis
Technical University of Denmark, Wind Energy Department, Roskilde, Denmark (maim@dtu.dk)

Mid-latitude storms are large-scale weather patterns. They involve a large range of spatial and temporal atmospheric scales of motion. Their characteristic extreme precipitation, wind gusts and high surface winds can significantly impact wind farms (e.g. shutdowns of turbines due to exceedance of cut-off wind speed) affecting grid performance and safety. Adequate storm forecasting, which relies on high spatial model resolution, is crucial. Traditional methods usually involve the use of limited area models (LAMs). While the performance of LAMs is generally satisfactory, challenges arise when large-scale storm structures enter near the the lateral boundaries of the LAM. In this case, insufficient update intervals of the forcing data at the lateral boundaries and spatial and temporal interpolation can deteriorate the storm structure that cause insufficient storm deepening. The global Model for Prediction Across Scales (MPAS) with regional mesh refinement avoids lateral boundary conditions and allows refinement with smooth transition zones. Based on a case study of storm "Christian", MPAS' capabilities in simulating key storm characteristics are explored in this work. Buoy measurements of sea level pressure, reanalysis and forecast products from the Climate Forecast System (CFSv2) and simulations with the Weather Research and Forecasting (WRF) model are used to evaluate the forecast performance with respect to storm intensity, storm arrival time and storm duration. A mesh configuration with refinement from 54-km to 18-km (further referred to as variable-resolution mesh) is compared with quasi-uniform mesh configurations to examine the impact of transition zone and mesh refinement on the storm structure and forecast performance. It is found that MPAS is generally able to predict the storm intensity based on the local minimum sea level pressure, while the estimation of storm arrival time and storm duration have been negatively influenced by model drifts in MPAS and by impacts of the transition zone on the storm development in the variable-resolution configuration. An additional low pressure system emerged in the variable-resolution mesh whereby its presence is sensitive to model physics. The investigation highlights the importance of the transition zone design in MPAS and the need for additional strategies like data assimilation techniques to prevent model drifts for storm forecasting.