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Speaker : Jun-Jia Su

Advisor : Prof. Ching-Yuang Huang

Performance of MPAS-A and WRF in predicting and simulating western North Pacific tropical cyclone tracks and intensities

Abstract

This study compares the performance of the Model for Prediction Across Scales-Atmosphere (MPAS-A) and the Weather Research and Forecasting (WRF) model in predicting the tracks and intensities of tropical cyclones (TCs) in the western North Pacific (WNP). Parallel simulations were conducted for several historical storms that made landfall in southern China, including TCs Hope (1979), Gordon (1989), Koryn (1993), Imbudo (2003), Dujuan (2003), Molave (2009), Hato (2017), and Mangkhut (2018). Both models used ERA-Interim data, with WRF relying on lateral boundary conditions and a nested 15-km/3-km domain, while MPAS-A was running on a global variable-resolution mesh with grids ranging from 60-to-3-km and another configuration with finer 160-to-2-km resolution tailored to the TC tracks.

The results indicated that while both models captured TC tracks reasonably well, storm intensities were generally underestimated. Notably, MPAS-A, which was initialized as a direct prediction model, performed comparably to WRF, which used dynamical downscaling. Additional tests using ERA5 reanalysis as initial data for TCs Molave and Hope showed notable improvements in intensity forecasts, though track predictions improved only slightly. This suggests that the underestimation of intensity may be linked to limitations in the ERA-Interim initial fields. Furthermore, simulations on a custom 60-to-2-km mesh showed better track prediction, implying that MPAS-A's accuracy in forecasting TC tracks may be sensitive to the coarser grid resolution within the variable-resolution mesh.

Keyword

The Model for Prediction Across Scales (MPAS)
Weather Research and Forecasting (WRF)

Reference

Lui, Y.S., Tse, L.K.S., Tam, CY. et al. Performance of MPAS-A and WRF in predicting and simulating western North Pacific tropical cyclone tracks and intensities. *Theor Appl Climatol* **143**, 505–520 (2021). <https://doi.org/10.1007/s00704-020-03444-5>