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Speaker:Hao-Yun Sun

Advisor:Prof. Ching-Yuang Huang

Exploring the typhoon intensity forecasting through integrating AI weather forecasting with regional numerical weather model

Abstract

AI-based weather forecasting models, such as Pangu, have emerged as powerful tools, offering rapid global forecasts at much lower computational cost than traditional numerical models. However, their coarse resolution leads to systematic underestimation of tropical cyclone intensity and poor representation of the inner-core structure.

To overcome this limitation, we propose a hybrid framework that integrates Pangu's global forecasts with the high-resolution WRF model, enhanced by dynamic vortex initialization.

For validation, we analyzed two major typhoons in 2023—Doksuri and Khanun. Doksuri served as the primary case, allowing us to test intensity, track, and structure forecasts, particularly with the aid of SAR wind data. Khanun was included as a supplementary case to test track prediction and cycle forecasts. In addition, we also examined Typhoon Hato from 2017 as a supporting case, focusing on environmental field validation, which demonstrated the robustness of Pangu's large-scale circulation forecasts.

The results show that Pangu_WRF consistently improves intensity and structural forecasts compared to standalone AI and traditional NWP, while also providing competitive track forecasts. Altogether, this highlights that AI and NWP are not competing but complementary, and their integration offers a promising pathway for more efficient and reliable typhoon forecasting and disaster preparedness.

Keyword

AI weather forecasting

Reference

Hongxiong Xu1, Yang Zhao2,3, Zhao Dajun1, Yihong Duan1 & Xiangde Xu1
1State Key Laboratory of Severe Weather, Chinese Academy of Meteorological Sciences, China Meteorological Administration, Beijing, 100081, China. 2 Frontier Science Centre for Deep Ocean Multispheres and Earth System and Physical Oceanography Laboratory, Ocean University of China, Qingdao, 266100, China.3College of Oceanic and Atmospheric Sciences, Ocean University of China, Qingdao, 266100, China.https://www.nature.com/articles/s41612-025-00926-z