

관측 및 예보 분과 [P-250]

Assessment of western North Pacific tropical cyclone genesis in the AI models

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In recent years, advances in AI-based weather prediction models have led to notable improvements in forecasting major meteorological variables traditionally simulated by dynamical models. A particularly remarkable enhancement has been observed in the prediction of tropical cyclone (TC) tracks, which are strongly influenced by the surrounding environmental flows. In the case of Typhoon Gaemi, which formed on July 20, 2024 and made landfall in Taiwan, AI-based models provided faster and more accurate track forecasts than the dynamical model, highlighting the potential value of incorporating AI models into operational weather prediction. Previous study comparing TC track forecasts from state-of-the-art AI systems—Pangu-Weather, FourCastNet, GraphCast, FuXi, and FengWu—suggested that improved representation of large-scale environmental flows significantly contributes to enhanced TC track prediction. Compared to the ECMWF’s IFS, a conventional dynamical model, AI-based models appear to correct environmental steering flows more rapidly, resulting in earlier improvements in track forecasts. In particular, the improved TC track forecasts produced by ECMWF’s AIFS model are likely attributable to a better simulation of TC translation speed. Despite these advances, AI models still tend to underestimate TC intensity and associated precipitation. Thus, a comprehensive evaluation of not only track, intensity, and rainfall, but also genesis skill, is essential. TC genesis in the western North Pacific (WNP) is strongly linked to the variability of the WNP subtropical high and the monsoonal flows. To address this, we adopt the Okubo–Weiss Zeta Parameter (OWZP) TC tracking method to assess the 2020 WNP TC genesis performance using AI models—GraphCast and Pangu-Weather—trained on 0.25° ERA5 reanalysis data provided by WeatherBench2. The performance in reproducing TC genesis in the AI models initialized with both ERA5 reanalysis and IFS analysis data, is evaluated against the International Best Track Archive for Climate Stewardship (IBTrACS). The year 2020 was historically notable as no TC formed in July, likely due to strong warming over the equatorial Indian Ocean, while TC genesis was active in August and October.

Keywords: Tropical cyclone genesis, AI weather prediction model, WeatherBench 2