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Assessing Subseasonal Forecasts and MJO Propagation in Deep Learning Weather Prediction Models

Abstract

This study evaluates the predictive skill of **NeuralGCM**—a hybrid model integrating differentiable atmospheric dynamics with machine learning physics—in capturing the evolution of the **Madden-Julian Oscillation (MJO)**. Using retrospective forecasts, we analyze the model's ability to represent convective-coupled patterns and the characteristic eastward propagation across the tropical oceans.

Preliminary results indicate that while NeuralGCM effectively assimilates the initial state, its predictive performance exhibits a notable decay over time. Specifically, the model encounters significant challenges in maintaining the MJO amplitude and accurately simulating its propagation speed beyond a lead time of 10 to 15 days. These findings suggest that while hybrid AI-based models provide computational efficiency and competitive short-range accuracy, systematic biases in representing intraseasonal variability may still limit their proficiency in S2S (subseasonal-to-seasonal) regimes.

Future research will extend this evaluation to investigate the downstream impacts of MJO on weather events in Taiwan, focusing on how tropical intraseasonal forcing modulates regional precipitation and atmospheric patterns.

Keywords

MJO (Madden-Julian Oscillation), NeuralGCM