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Prithvi-Typhoon: A Foundation Model Approach for Enhanced Tropical Cyclone Intensity Prediction

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We present Prithvi-Typhoon, an innovative adaptation of the Prithvi WxC weather foundation model for tropical cyclone intensity prediction. Through a novel three-stage progressive fine-tuning framework, we bridge the gap between general weather forecasting and specialized tropical cyclone prediction. The model integrates multi-source data from tropical cyclones (1987-2023), incorporating satellite observations, reanalysis products, and historical records. Our architecture features domain-specific feature extraction and multi-scale integration, enabling adaptive balance between local storm features and global atmospheric patterns.

Evaluation results demonstrate substantial improvements over existing methods. Notably, Prithvi-Typhoon shows enhanced skill in predicting rapid intensification events, outperforming both traditional numerical models and existing deep learning approaches. This work represents a advancement in applying foundation models to extreme weather prediction, offering a computationally efficient solution while maintaining physical consistency.