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Speaker:Hao-Yun Sun

Advisor:Prof. Ching-Yuang Huang

Pangu-Weather: A 3D High-Resolution System for Fast and Accurate Global Weather Forecast

Abstract

Pangu-Weather is a high-resolution AI-based global weather forecasting system designed to provide rapid and precise predictions. Utilizing 43 years of hourly ERA5 reanalysis data, this model comprises deep neural networks with approximately 256 million parameters, offering a forecast resolution of 0.25° × 0.25°, on par with ECMWF's Integrated Forecast Systems (IFS). Notably, it is the first AI system to outperform state-of-the-art numerical weather prediction (NWP) methods in terms of accuracy, measured through latitude-weighted RMSE and ACC, across all weather factors (such as geopotential, humidity, wind speed, and temperature) and time frames, from hourly to weekly. Key innovations include the 3D Earth Specific Transformer (3DEST) that captures atmospheric height (or pressure level) within a 3D framework, and a hierarchical temporal aggregation technique that reduces cumulative errors over time. Pangu-Weather excels in short- to medium-range forecasting, from one hour up to one week, and is capable of addressing diverse forecasting needs, such as extreme weather events and real-time ensemble forecasting. This system demonstrates that AI can not only match but surpass traditional NWP models, paving the way for further advancements in deep learning weather forecasting.

Keyword
Root Mean Square Error (RMSE)
Anomaly Correlation Coefficient (ACC).

Reference

Kaifeng Bi, Lingxi Xie, Hengheng Zhang, Xin Chen, Xiaotao Gu, and Qi Tian, *Fellow, IEEE:*Pangu-Weather: A 3D High-Resolution Model for Fast and Accurate Global Weather Forecast

https://arxiv.org/abs/2211.02556