Project Title

Advancing Multiscale Interactions and Predictability Limits in Weather and Climate with Novel Transformer Attention-based Models: Scaling Law vs. Chaos Theory

Project Summary

A novel AI transformer-based approach is proposed for investigating the predictability of multiscale weather and climate. Using chaotic data from the high-order generalized Lorenz model, the initial goal is to develop a core system that reveals the role of multiscale interactions in determining predictability. The long-term goal involves integrating this core system into a comprehensive weather foundation model for reassessing predictability limits.

Team Description, Experience, and Expertise (200 words)

- Dr. Bo-Wen Shen, an Associate Professor in the Department of Mathematics and Statistics at SDSU, specializes in mesoscale and global modeling, high-performance computing (HPC), nonlinear dynamics, and machine learning. He was the PI for NASA's CAMVis project.
- Professor Roger Pielke Sr is a Senior Research Scientist at CU-Boulder with an H-Index over 100. Research includes atmospheric numerical modeling, dynamics and observational studies. He is a Fellow of the AMS and AGU.
- Dr. Xubin Zeng is the Agnese Haury Chair and Professor of Atmospheric Sciences at the University of Arizona. He is a fellow of AMS, AGU, and AAAS. He leads two major international programs on water and climate (GEWEX and GPEX).
- Dr. Xiping Zeng is a Senior Meteorologist in Army Research Laboratory. He uses HPC and satellite data to explore the predictability of atmospheric processes, including turbulence, radiation transfer, aerosols, and clouds/precipitation.
- Dr. Shu-Hua Chen, a Professor in the Department of Land, Air & Water Resources at the UC Davis, specializes in atmospheric science, mesoscale modeling, cloud and hurricane dynamics, and data assimilation.
- Dr. Sara Faghih-Naini is a researcher at ECMWF, specializing in HPC and dynamical core development. She received her Ph.D. in Applied Mathematics from the University of Bayreuth.

Contributing Entity Information (50 words)

- JTB Technology (webpage), a private AI company in Taiwan. POC: Mr. Hsiang-Lin Huang (email address), CTO (specializes in AI, machine learning, cloud-native architecture, digital twin technologies).
- Amiko AI Corporation (webpage), a private AI company in Taiwan. POC: Mr. Yu-Min Lai (email address), Co-founder (expertise in large language models, deep learning, computational biology).

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Shen, B.-W., R. A. Pielke Sr., X. Zeng, and X. Zeng, 2024: Exploring the Origin of the Two-Week Predictability Limit: A Revisit of Lorenz's Predictability Studies in the 1960s. Atmosphere, 15(7), 837; https://doi.org/10.3390/atmos15070837 (A review of AI-powered models is provided)