MMM SEMINAR SERIES

Improving climate model bias and variability via a Convolutional Neural Network (CNN) - based state-dependent model-error correction

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Systematic biases and variability errors remain a major challenge in climate and weather models, limiting their predictive skill across timescales. In this talk, I will explore how these errors arise and how we can use simple data assimilation (DA) to diagnose and correct them. Specifically, we propose a CNN-based parameterization for state-dependent model-error correction in the atmospheric component of the Community Earth System Model (CESM), moving beyond traditional climatological bias corrections. By learning to predict systematic increment adjustments derived from a linear relaxation towards the ERA5 reanalysis, our method dynamically adjusts the model state, significantly improving simulation accuracy.

Our results demonstrate substantial reductions in root mean square error across all state variables. A highlight of this is that precipitation biases over land improve by 25-35%, depending on the season. A particularly notable improvement is seen in the Madden-Julian Oscillation (MJO). The CNN-corrected model successfully propagates the MJO across the Maritime Continent, a well-known challenge for many climate models. Using the trio-interaction theory, we analyze the underlying dynamical mechanisms driving these improvements and what lessons this teaches us about the errant physics in our modeling system. Lastly, I will discuss how integrating physics-informed emerging technologies in NCAR's CREDIT framework can further advance weather and climate prediction.

Thursday, 08 May 2025, 2:00PM

Refreshments 1:45PM

Please also join colleagues for refreshments and informal discussion after the seminar until 3:30pm

NCAR-Foothills Laboratory, 3450 Mitchell Lane

FL2-1022, Large Seminar

Seminar will also be live webcast

https://sundog.ucar.edu/public/page/MMM

Participants may ask questions during the seminar via Slido.