

ACMS Statistics Seminar

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Tuesday, April 11, 2023
101A Crowley Hall
3:30 PM – 4:30 PM

Multi-model Ensemble Analysis with Neural Network Gaussian Processes

Multi-model ensemble analysis integrates information from multiple climate models into a unified projection. However, existing integration approaches based on model averaging can dilute fine-scale spatial information and incur bias from rescaling low-resolution climate models. We propose a statistical approach, called NN-GPR, using Gaussian process regression (GPR) with an infinitely wide deep neural network based covariance function. NN-GPR requires no assumptions about the relationships between climate models, no interpolation to a common grid, and automatically downscales as part of its prediction algorithm. Model experiments show that NN-GPR can be highly skillful at surface temperature and precipitation forecasting by preserving geospatial signals at multiple scales and capturing inter-annual variability. Our projections particularly show improved accuracy and uncertainty quantification skill in regions of high variability, which allows us to cheaply assess tail behavior at a 50 km spatial resolution without a regional climate model (RCM). Evaluations on reanalysis data and SSP2-4.5 forced climate models show that NN-GPR produces similar, overall climatologies to the model ensemble while better capturing fine scale spatial patterns. Finally, we compare NN-GPR's regional predictions against two RCMs and show that NN-GPR can rival the performance of RCMs using only global model data as input.

The Department of Applied and Computational
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