

Generative machine learning for downscaling Earth system model simulations

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Assessing the impacts of climate change relies on accurate and high-resolution Earth system model (ESM) simulations. However, the computational cost of the numerical simulations makes large-ensemble simulations, needed for uncertainty quantification, at a high spatial resolution infeasible. Moreover, parameterizations of unresolved subgrid-scale processes in ESMs can introduce systematic errors, leading, for example, to a misrepresentation of spatial intermittency or extreme events. This talk will give an overview of how generative machine learning-based emulators, trained on high-resolution weather data, can be used for uncertainty-aware downscaling and correction of output fields from numerical Earth system simulations. The proposed approach can be applied to different Earth system models in a scale-adaptive manner without costly retraining. I will also discuss extensions towards improved dynamical consistency and extrapolating to unseen climates.

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