ATS/CIRA Colloquium

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Machine learning for physics-discovery and climate modeling

Hosted by Elizabeth Barnes

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via Microsoft Teams

Over the past few years, machine learning (ML) has been successfully applied to a wide range of climate problems. In particular, ML is being used to replace traditional physics-driven parameterizations of unresolved processes in climate models. In this talk, I will discuss the potential of combining physics and ML algorithms to advance the field of climate science and modeling. I will focus on two ML examples for ocean mesoscale eddy parameterizations, crucial for the transport and uptake of heat and carbon in the ocean.

In the first example, we use convolutional neural networks (CNNs) for deterministic and stochastic eddy parameterizations that generalize to different dynamical regimes and climate scenarios. While CNN-parameterizations can perform better than traditional physics-driven parameterizations, their black-box nature leads to a lack of interpretability and physical understanding. In the second example, I propose an alternative or complementary method: discovering closed-form equations for parameterizations from data. This method reveals interpretable eddy parameterizations, which can more easily be analyzed and implemented in climate models. Our results suggest that such methods, previously only applied to reveal known equations, can be used to discover unknown equations from data for a range of processes in the climate system.

Colloquia page: atmos.colostate.edu/colloquia