Learning Cloud Processes Across Scales Using Machine Learning

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12:15 PM

Maeder Hall Auditorium

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MAE Special Seminar Series

Clouds remain one of the greatest sources of uncertainty in predicting future climate, as they involve complex, non-linear processes that extend from the submicron scale to the kilometer scale. Our current ability to model clouds is limited by significant uncertainties, particularly in the intricate microphysical processes that govern the interaction and growth of cloud droplets and ice crystals, as well as in accurately modeling clouds across the relevant temporal and spatial scales for climate. These same uncertainties limit our ability to assess proposed solar radiation management strategies to mitigate climate change.

Recent advances in scientific machine learning offer promising methods to address these challenges. I will discuss several recent studies applying these methods to cloud processes. First, I will discuss how hybrid-physics machine learning models can be used to reduce structural uncertainty in models of ice growth in the atmosphere using in situ observations from laboratory experiments and airborne field campaigns. Second, I will discuss how data-driven reduced order modeling can be used to develop simplified (bulk) microphysics schemes in an unsupervised manner from more detailed microphysical models. Finally, I will discuss how these methods can be used to learn relevant information from high resolution global storm resolving models, to represent cloud processes at the spatial scales needed to accurately predict processes at the climate scale.

Dr. Kara Lamb is an Associate Research Scientist at Columbia University. Her research lies at the intersection of observations (from laboratory and field studies) and high-resolution modeling, with the goal of better understanding how aerosols and clouds impact the climate. She combines traditional process-based approaches with data science and machine learning. She currently leads projects funded by the Department of Energy and the Zegar Family Foundation, and collaborates with researchers in the NSF Learning the Earth with Artificial Intelligence and Physics (LEAP) Center at Columbia University and with researchers at NASA GISS on the NASA Digital Twins for Climate Science Project. She received her PhD in physics from the University of Chicago, and previously worked as a research scientist at CIRES/NOAA, where she was on the science team for the NASA KORUS-AQ and ATOM aircraft campaigns and the NOAA FIREX Firelab study.

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