

SIAM MPE Community Meetings: Colloquium

Dr. Dan Lu

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Advancing Earth System Predictability with Machine Learning Methods

Abstract: Understanding and predicting the Earth system have profound impacts on both society and environments. Despite its importance, Earth system prediction presents significant challenges. The current observing system captures only a fragment of the Earth's complexity, necessitating reliance on Earth system models to bridge the gaps in space, time, and spectral regions not covered by observations. Over time, these models have evolved remarkably—from empirical, to theoretical, to computational, and now are moving to data-driven machine learning (ML) approaches. In this seminar, we will explore a range of ML methodologies to enhance Earth system predictability. The topics include surrogate modeling, inversion-free prediction, and invertible neural networks to reduce computational costs of numerical Earth system model simulation and uncertainty quantification, and physics-informed, explainable, and trustworthy ML techniques to advance data-driven Earth system predictions. The applications of these methods cover terrestrial ecosystem model, hydrological model, and geological carbon storage.

Biography: Dr. Dan Lu is a Senior Staff Scientist in Computational Earth Sciences Group at Oak Ridge National Laboratory (ORNL). She earned her Ph.D. in Computational Hydrology at Florida State University in 2012, and joined ORNL in 2013 after one-year postdoctoral appointment at the U. S. Geological Survey. Her research interest includes machine learning, uncertainty quantification, surrogate modeling, inverse modeling, sensitivity analysis; experimental design, and numerical simulations in earth, climate, and environment sciences. She is leading several ML related projects funded by different programs across U.S. Department of Energy. She is currently serving as an Associate Editor of the journal Artificial Intelligence for the Earth Systems, an Associate Editor of the journal Frontiers in Water, and a Topic Editor of the journal Geoscientific Model Development.

Thursday, Nov. 30, 2023

11:00 AM EST

Zoom link: siam.zoom.us/j/81561821731

Host:
Pierre Lermusiaux
<http://mseas.mit.edu>

Adapted Estimates

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