**DIPARTIMENTO DI INGEGNERIA CIVILE, EDILE E AMBIENTALE - I C E A**
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# Where are the Limits of Hydrologic Predictions?

# Physics-embedded AI Reveal Global Shifts and Patterns

🗓️ **Date**: 3 July 2025
🕒 **Time**: 11:00
📍 **Location**: Room T
🎤 **Speaker**: Prof. Chaopeng Shen, The Pennsylvania State University

## Abstract

Where are the limits of hydrologic predictability given available data? To what extent can learned hydrologic knowledge generalize across scales and to data-scarce environments? In this seminar, Prof. Chaopeng Shen explores these questions through **physics-embedded, AI-empowered hydrologic models**—a new class of differentiable models that integrate physical laws with neural networks to learn hydrologic responses with both realism and generality.

Unlike traditional global water models, this approach effectively captures **long-term hydrologic signatures** and uncovers **systematic global shifts**—up to 20% in two decades—with serious implications for floods and baseflow trends. These models excel in predicting extremes and scale-dependent fluxes such as groundwater recharge and evapotranspiration.

Beyond hydrology, the talk introduces a new **Sensitivity-Constrained Fourier Neural Operator (SC-FNO)** to overcome the limitations of existing AI-PDE solvers, enabling more reliable and physically consistent modeling even under sparse data and concept drift.

## About the Speaker

**Chaopeng Shen** is a Professor in Civil Engineering at **The Pennsylvania State University**. With a Ph.D. in Environmental Engineering from Michigan State University, he has contributed extensively to computational hydrology and the development of **physics-informed machine learning** for geosciences. His research combines data science, physics, and environmental modeling to advance hydrologic prediction and understanding.

Prof. Shen is an active thought leader in AI for science, serving as Editor for *Journal of Geophysical Research – Machine Learning & Computation*, Chief Special Editor for *Frontiers in AI: Water and AI*, and Associate Editor for *Water Resources Research*.

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📩 **All are welcome!**
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