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# Accelerating continental-scale groundwater simulation with a fusion of machine learning, integrated hydrologic models and community platforms

*Wednesday, 24 May 2023 10:15 (15 minutes)*

Today, water and resource managers face a huge challenge managing systems that are rapidly evolving in a warming climate, and where historical observations are no longer a reliable guide. Existing water management tools significantly lag the state of the science and are often ill-equipped to provide reliable forecasts under these conditions. Similarly, historical observations are of limited use on their own, without additional modeling and analysis. Simulations with integrated hydrology models (that solve the 3D Richards' equation and 2D shallow water equations in a globally-implicit manner) provide robust results all the way to continental scales, yet are computationally expensive, running on supercomputers. Our approach trains Machine Learning (ML) emulators of integrated hydrology models to drastically reduce the computational burden. We combine these emulator approaches with both purely data-driven approaches and Simulation-Based Inference, to generate seasonal to annual hydrologic scenarios of both groundwater and surface water systems using observations and sophisticated physics-based hydrologic models. This talk will highlight the technical challenges of this rapidly developing branch of hydrologic modeling and discuss the platform we have developed, HydroGEN, which provides seasonal forecasts over the Continental US (CONUS). We will also the path forward for this platform and ongoing work to develop inclusive and diverse pilot studies.

## Participation

In-Person

## References

Leonarduzzi, E., Tran, H.V., Bansal, V., Hull, R., De La Fuente, L., Bearup, L.A., Melchior, P., Condon, L.E. and Maxwell, R.M. Training machine learning with physics-based simulations to predict 2D soil moisture fields in a changing climate. Frontiers in Water, DOI:10.3389/frwa.2022.927113, 2022.
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Tran, H., Leonarduzzi, E., De la Fuente, L., Hull, R.B., Bansal, V., Chennault, C., Gentine, P., Melchior, P., Condon, L.E., and Maxwell, R.M. Development of a Deep Learning Emulator for a Distributed Groundwater-Surface Water Model: ParFlow-ML. Water,13(23), 3393, doi:10.3390/w13233393, 2021.

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## Energy Transition Focused Abstracts

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