ENVIRONMENTAL & WATER RESOURCES SEMINAR

Machine Learning-Based Reconstructions of Historical Daily and Monthly Runoff for the Laurentian Great Lakes

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Bio:
Rohini Gupta is a Postdoctoral Research Associate in the Steinschneider Lab at Cornell University. She completed her B.S in Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign in 2017 and her M.S. (2019) and Ph.D (2024) at Cornell University in Reed Research Group. Her research interests center around robust operations and decision making in water resources planning and management. Her postdoctoral work develops deep learning and explainable AI models to generate new insights and datasets that support regional water systems planning. This builds on her doctoral research, which integrated hydrology, dendrochronology, and complex systems modeling to characterize past and future hydroclimate hazards in the Western U.S., examine their interactions with water infrastructure systems, and identify strategies to build resilience.

Abstract:
High-quality regional streamflow datasets are necessary to support local water resources planning and management. However, observed streamflow records are often limited by the availability of surface water gauges, which frequently go in and out of service over time. Long-term reconstruction products that fill in missing data are not always consistently available. This challenge is prevalent across the United States, including in the Great Lakes region, which contains 20% of the world's freshwater and serves as a critical resource for both the United States and Canada. In the Great Lakes, there is also a specific interest in estimating aggregate runoff into the lakes to better understand the regional water balance and lake level variability. Existing aggregate runoff data products are typically derived using approaches that can be hindered by model parameter uncertainty and a limited ability to capture the vast spatial heterogeneity of the basin. Furthermore, of the products that exist, most do not start until 1980.
In this seminar, I share a new, historical reconstruction (1950-2013) of daily streamflow at over 650 gauged locations throughout the Great Lakes basin, created using a novel regional Long Short-Term Memory (LSTM) model that integrates local climate data, physical catchment characteristics, and runoff observations from nearby gauged sites. We also estimate monthly runoff into the lakes over the same time period. The daily reconstruction product will equip water managers with information to understand emerging hydroclimate trends and provide a basis to support local water resources analyses. The aggregate runoff product shows strong potential for improving estimates of monthly lake-wide runoff, which can ultimately help resolve the complete water balance of the Great Lakes and provide critical context for lake level shifts under a changing climate.