Yuan Liu

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CONTACT INFORMATION

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EDUCATION

University of Wisconsin-Madison, Madison, WI

Ph.D. student, Civil and Environmental Engineering, 2021 – Present, GPA: 3.95

Advisor: Daniel B. Wright

Dalian University of Technology, Dalian, China

B.S., Harbor Waterway and Coastal Engineering, 2016 - 2020, GPA: 3.8

PUBLICATIONS

1. **A nonstationary probabilistic approach for probable maximum precipitation estimation based on global climate model large ensembles**
   Y Liu, DB Wright, F Quintero, J England, J Smith
   Under review by Water Resources Research, 2024

2. **Increased flooding hazard due to sequential extreme storms in the Lower Mississippi River**
   Y Liu, DB Wright, F Quintero, A Michalek, G Villarini, J Smith
   Under review by Science Advances, 2024

3. **A nonstationary stochastic rainfall generator conditioned on global climate models for design flood analyses in the Mississippi and other large river basins**
   Y Liu, DB Wright, DJ Lorenz
   Water Resources Research 60 (5), 2024

4. **Accessing environmental, economic, and social impacts of inter-basin water transfer in China**
   Y Liu, Z Xin, S Sun, C Zhang, G Fu
   Journal of Hydrology 625, 130008, 2023

5. **A storm-centered multivariate modeling of extreme precipitation frequency based on atmospheric water balance**
   Y Liu, DB Wright
   Hydrology and Earth System Sciences 26 (20), 5241-5267, 2022

6. **Flood-induced geomorphic change of floodplain extent and depth: A case study of Hurricane Maria in Puerto Rico**
   Y Li, DB Wright, Y Liu
   Journal of Hydrologic Engineering 27 (10), 04022019, 2022

7. **Real-time construction of sloshing-induced hydrodynamic field based on an intelligent image processing technique integrated with artificial damping model**
   Y Liu, J Dai, C Zhang
   Ocean Engineering 219, 108382, 2021

CONFERENCE ABSTRACT

1. **Increasing flood hazard due to extreme storm sequences in the Lower Mississippi River Basin in a warming climate**
   Y Liu, DB Wright, F Quintero, A Michalek, G Villarini, J Smith
   AGU 2024 Fall Meeting, Dec 2024

2. **Stochastic Downscaling and Ensemble Generation of Seasonal Predictions of Extreme Rainfall Using a Space-Time Nonstationary Stochastic Rainfall Model**

Y Derin, DB Wright, Y Liu, R Emberson, LC Andrews, T Stanley
AGU 2024 Fall Meeting, Dec 2024

3. **Process-Based Flood Frequency Analysis in a Changing Climate**
   DB Wright, M Abbasian, Y Liu, MA Hussain, A Pradhan, B FitzGerald
   AGU 2024 Fall Meeting, Dec 2024

4. **Proceed with Caution: The Critical Role of Precipitation Accuracy, Resolution, and Uncertainty in Large-Scale Hydrologic and Flood Hazard Modeling**
   DB Wright, Y Liu, K Peng
   AGU 2024 Fall Meeting, Dec 2024

5. **A Semi-dynamic model of rainstorms and rainfall frequency up to the probable maximum precipitation for continental river basins**
   Y Liu, DB Wright, D Lorenz
   2024 EWRI Congress, May 2024

6. **A climate-model-informed stochastic rainfall generator for the Mississippi River Basin**
   Y Liu, DB Wright, D Lorenz
   AGU 2023 Fall Meeting, Dec 2023

7. **Estimating and simulating precipitation uncertainty data for large-scale hydrologic applications**
   DB Wright, S Hartke, Z Li, K Peng, A Alexander, Y Liu
   EGU General Assembly 2023, Apr 2023

8. **A multivariate model of atmospheric water balance to estimate extreme storm frequency in the Mississippi basin**
   Y Liu, DB Wright
   AGU 2022 Fall Meeting, Dec 2022

9. **Spatiotemporal characteristics of heavy precipitation systems in the Upper Midwestern United States**
   Y Tao, DB Wright, Y Liu
   AGU 2022 Fall Meeting, Aug 2022

10. **Path-dependent flood hazard in Puerto Rico is driven by tropical cyclones**
    D Wright, Y Li, P Byrne, BP Bledsoe, Y Liu
    Frontiers in Hydrology, 2022

SELECTED TALKS

- AGU 2024 Fall Meeting, Washington, D.C. *Increasing flood hazard due to extreme storm sequences in the Lower Mississippi River Basin in a warming climate*. Dec 2024.
- 2024 EWRI Congress, Milwaukee, WI. *A Semi-dynamic model of rainstorms and rainfall frequency up to the probable maximum precipitation for continental river basins*. May 2024.
- AGU 2023 Fall Meeting, San Francisco, CA. *A climate-model-informed stochastic rainfall generator for the Mississippi River Basin*. Dec 2023
- 8th Annual Probabilistic Flood Hazard Assessment Research Workshop, Rockville, MD. *Stochastic design storm sequence in the Lower Mississippi River Basin.* Mar 2023
- AGU 2022 Fall Meeting, Chicago, IL. *A Multivariate model of atmospheric water balance to estimate extreme storm frequency in the Mississippi basin.* Dec 2022

- Iowa Flood Workshop for NSF-ICFM8 awardees, Iowa City, IA. *A storm-centered multivariate modeling of extreme precipitation frequency based on atmospheric water balance.* Aug 2022

RESEARCH EXPERIENCE

University of Wisconsin-Madison, Madison, WI 2021 - Present
Research Assistant, advisor: Dr. Daniel B. Wright

Stochastic rainfall downscaling at continental scales based on global climate models

- I developed StormLab, a stochastic downscaling model that generates high-resolution (4-km, 6-hour) rainfall fields based on coarse-scale (100-km, 6-hour) global climate models (GCMs) at continental scales.
- StormLab uses nonstationary Gamma distribution to represent statistical relationships between fine-scale rainfall and coarse-scale GCM variables.
- Exact realizations and spatiotemporal patterns of downscaled rainfall fields are modeled by a latent 2-D Gaussian noise field that explicitly considers rainfall spatial heterogeneity and advection.

Lower Mississippi flood hazard due to sequential extreme storms in a changing climate

- I generated long-term high-resolution rainfall fields over the Mississippi River Basin (MRB) using stochastic downscaling based on 50 ensembles of a global climate model (CESM2).
- By combining downscaled rainfall with a hydrologic model and GEV analysis, I simulated the impacts of extreme storm sequences on producing peak discharge along the Mississippi River.
- I found a significant increasing trend of extreme MRB floods under future climate conditions. The increased flood hazard is linked to an intensification of the extreme storm sequences that occurred prior to the flood peak.

Cascading deep learning model framework for rainfall spatial downscaling

- I developed a deep learning model structure to downscale 1-degree global climate model precipitation into high-resolution 0.03-degree rainfall fields
- Two deep neural networks (EDSR) and a generative adversarial network (pix2pix) were combined to increase precipitation spatial resolution by 32 times

Atmospheric drivers of the May 2015 Texas extreme rainfall events

- I analyzed atmospheric circulation patterns and concurrent teleconnections (e.g., ENSO, MJO, NAO) during the extreme rainfall events in Texas in May 2015.
- I found that anomalous sea surface temperatures in the tropical Pacific contributed to persistent blocking patterns over the U.S. West Coast, generating successive short-wave troughs that led to extreme rainfall in the Texas-Oklahoma regions.

TEACHING EXPERIENCE

Teaching assistant, UW-Madison CIVENGR 311 Hydroscience Spring 2024

- 3 credits undergraduate course with 56 students
- Median TA evaluation: 4.7/5.0

AWARDS AND HONORS

- National Outstanding Water Resources Graduate (20 awardees annually nationwide) 2020
- State Outstanding Graduates 2020
- Silver medal (31/3614 teams), Kaggle data science competition 2019
- CCCC-FHDI Engineering Co., Ltd. Scholarship 2018
- HIWIN Elite Student Scholarship (8 awardees annually school-wide) 2018
- First Class Academic Scholarship 2018
- Outstanding student at Dalian University of Technology 2018

SKILLS

High performance/throughput computing: CUDA, OpenMP, MPI, HTCondor
Machine learning frameworks: PyTorch
Programming languages: Python, R, MATLAB, C++, Java
Software: HEC-RAS, HEC-HMS, SWMM, ArcGIS, QGIS

OPEN-SOURCE SOFTWARE

- **StormLab: Space-time Nonstationary Rainfall Model for Large Area Basins** (https://github.com/lorenliu13/StormLab)
- **Starch: Storm Tracking and Regional Characterization** (https://github.com/lorenliu13/starch)

PROFESSIONAL SERVICE

- **Reviewer**

- Water Resources Research, Journal of Hydrology, Hydrology and Earth System Sciences, Journal of Hydrologic Engineering, Hydrological Processes, Ocean Engineering, International Journal of Climatology