

# Tao Huang

jshuangtao08@gmail.com ♦ 765-409-3812 ♦ <https://huan1441.github.io>

## CURRENT POSITION

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### Postdoc in Earth Systems Data Science

Jul.2023 - Present

Earth Systems Science Division, **Pacific Northwest National Laboratory**, Richland, WA

Duties: perform inter-disciplinary and collaborative research, develop grant proposals, and mentor student interns

## EDUCATION

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### Ph.D. Purdue University, West Lafayette, IN

Aug. 2019 - May. 2023

Civil Engineering

Dissertation: Quantifying Uncertainty in Flood Modeling Using Bayesian Approaches

Advisor: Dr. Venkatesh Merwade

### M.S. Tsinghua University, Beijing, China

Aug.2012 - Jun. 2014

Hydraulic Engineering

Thesis: Concrete Autogenous Volume Deformation and the Influence on Stress States of High Arch Dams

### B.S. Tsinghua University, Beijing, China

Aug.2008- Jun. 2012

Hydraulic and Hydropower Engineering

## SKILLS

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**Programming:** Python, R, MATLAB, Visual Basic

**Database:** SQL (Azure SQL Server, Oracle SQL Developer), NoSQL (e.g., MongoDB)

**Tools:** High Performance Computing (HPC), Azure, Docker, TensorFlow, PyTorch, Scikit-learn, Pandas, NumPy

**Research Techniques:** Bayesian Analysis, Uncertainty Quantification, Machine Learning, Deep Learning

## TEACHING & MENTORING EXPERIENCE

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**Purdue University**, West Lafayette, IN

### Lyles Teaching Fellow

Spring 2023

Course: CE340 Hydraulics

- Delivered a series of six lectures focusing on hydrostatics, pipe flow, and open channel hydraulics
- Conducted interactive and engaging learning sessions through the implementation of creative quiz formats
- Collaborated with the Faculty Mentor in preparing homework, quizzes, and exams

### Lyles Teaching Assistant

Spring 2021 & Fall 2021

Course: CE340 Hydraulics

- Held daily office hours to support a class of 150 students in addressing coursework, assignments, and exams
- Assumed responsibility for grading assignments and quizzes, along with conducting pre-exam review sessions

### Teaching Assistant

Fall 2020

Course: CE343 Elementary Hydraulics Laboratory

- Instructed 20 students on fundamental concepts about experimental data and methods in hydraulic measurements
- Led experiments covering the measurement of fluid properties, hydrostatics, hydrodynamics, and more
- Held regular office hours to assist students with coursework, assignments, and exam preparation

**Tsinghua University**, Beijing, China

### Student Counsellor

Fall 2012 & Spring 2013

- Acted as a Student Counselor for 90 students, overseeing the Undergraduate Freshman Training Program
- Conducted regular meetings with students to address inquiries and provided positive counseling on academic and personal aspects of university life

## INDUSTRY PROFESSIONAL EXPERIENCE

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**PowerChina Kunming Engineering Corporation Limited**, Kunming, China.

Jul. 2014 - Jun.2019

Worked as a Civil Engineer for multiple international hydraulic and hydropower projects

**Thalpitigala Reservoir Project**, The Democratic Socialist Republic of Sri Lanka

- Served as the Chief Design Engineer and oversaw strategic communication with stakeholders, ensuring coordination of design objectives with project goals
- Led and motivated a team of six professionals to successfully deliver design projects in adherence to the schedule
- Executed a comprehensive three-dimensional design of the dam using tools such as Civil 3D, Inventor, and AutoCAD, meeting strict US Army Corps of Engineers (USACE) standards.

**Integrated Landslide Mitigation Project**, The Democratic Socialist Republic of Sri Lanka

- Served as the Chief Design Engineer and led a team of five people to develop the landslide mitigation proposal
- Conducted an extensive landslide site survey in Sri Lanka, fostering technical exchanges with engineers from the National Building Research Organization (NBRO) of Sri Lanka
- Evaluated the slope stability by using Google Earth and GeoStudio, ensuring robust engineering solutions

**Nam Ou-4 & Nam Mang I & Nam Khan 3 Hydropower Projects**, The Lao People's Democratic

- Worked as a Design Engineer to analyze and design dam spillways & piers using Ansys, Inventor, and AutoCAD
- Served as the design representative in Laos for one year in managing technical disclosures and addressing construction site technical challenges

**Corumana Dam Project**, The Republic of Mozambique

- Worked as a Design Engineer to analyze and design the structure of the pre-stress pier
- Conducted site survey in Mozambique and engaged in technical exchanges with consulting company, AECOM

## **RESEARCH EXPERIENCE**

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**Pacific Northwest National Laboratory**, Richland, WA

**Postdoctoral Research Associate**

July 2023-Present

- Deep Learning for Fish Identification from Sonar Data
- Predicting Absolute Strike Injury Rates of Turbine Passed Fish Using Autonomous Sensor Fish

**Purdue University**, West Lafayette, IN

**Research Assistant**

Aug. 2019-May. 2023

**Evaluating Uncertainty in FEMA Flood Insurance Rate Maps (FIRMs) using Bayesian Model Averaging (BMA) and Hierarchical BMA**

- Investigated various sources of uncertainty in the FEMA FIRMs flood modeling process systematically.
- Quantified the relative impact of individual uncertainty sources using BMA and HBMA approaches.
- Proposed uncertainty coefficients based on the reliability of prediction distributions and the accuracy of deterministic predictions to quantify uncertainty in FIRMs.
- Developed 100-year BMA probabilistic flood maps, offering improved reliability over existing deterministic FIRMs.

**An Integrated Evaluation Framework based on Generalized Likelihood Uncertainty Estimation for Quantifying Uncertainty in Flood Modeling**

- Explored the effect of different prior distributions of the uncertainty sources on the values of evaluation metrics
- Evaluated the effect of the scales of temporal data (different high-flow scenarios) on values of uncertainty metrics
- Measured the impact of the uncertainty of observed data on the values of uncertainty indicators
- Created an integrated statistical framework to demonstrate and quantify the overall uncertainty in flood models

**Estimating Bayesian Model Averaging Parameters of Ensemble Flood Modeling Using Multiple Markov Chains Monte Carlo**

- Applied the Metropolis-Hastings (M-H) algorithm to generate the posterior distribution of BMA parameters.
- Leveraged the M-H algorithm with various proposal distributions to estimate BMA weights.
- Compared the performance of Expectation-Maximization and M-H algorithms for estimating BMA parameters.
- Examined the effect of different posterior distributions of predictor variables on BMA parameters.

## Developing Customized NRCS Unit Hydrographs (UHs) for Ungauged Watersheds in Indiana, USA

- Identified two key parameters (Peak Rate Factor and Lag Time) in the NRCS UH method through literature review
- Collected observed rainfall-runoff data and derived dimensionless UHs based on historical data.
- Developed statewide and regional regression models to relate UH parameters to watershed characteristics.
- Validated the customized UH for Indiana and designed a graphical user interface for its application in TR-20.

## PUBLICATIONS

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**Huang, T., & Merwade, V. (2024).** Developing customized NRCS unit hydrographs for ungauged watersheds in Indiana, *Journal of Hydrologic Engineering*, 29(4), 04024022. Doi: 10.1061/JHYEFF.HEENG-6089

**Huang, T., & Merwade, V. (2024).** Beyond a fixed number: Investigating uncertainty in popular evaluation metrics of ensemble flood modeling using bootstrapping analysis, *Journal of Flood Risk Management*, 17(2), e12982. Doi: 10.1111/jfr3.12982

**Huang, T., & Merwade, V. (2023).** Improving Bayesian model averaging for ensemble flood modeling using multiple Markov Chains Monte Carlo sampling. *Water Resources Research*, 59(10), e2023WR034947. Doi: 10.1029/2023WR034947

**Huang, T., & Merwade, V. (2023).** Uncertainty analysis and quantification in flood insurance rate maps using Bayesian model averaging and hierarchical BMA. *Journal of Hydrologic Engineering*, 28(2), 04022038. Doi: 10.1061/JHYEFF/HEENG-5851 (**Editor's Choice and Best Technical Paper**)

**Huang, T., & Merwade, V. (2023).** Developing customized NRCS unit hydrographs (Finley UHs) for ungauged watersheds in Indiana (Joint Transportation Research Program Publication No. FHWA/IN/JTRP-2023/10). West Lafayette, IN: Purdue University. Doi: 10.5703/1288284317644

**Huang, T., & Zhan, C. (2019).** 2D FEM calculation of pre-stressed pier with an anchor block reserved slot. *Journal of North China University of Water Resources and Electric Power (Natural Science Edition)*, 40(2): 84-89+96. Doi: 10.19760/j.ncwu.zk.2019027

**Huang, T., & Cheng, P. (2018).** Structure calculation of overflow sluice piers. *Water Resources Planning and Design*, 2018(12): 192-198. Doi: 10.3969/j.issn.1672-2469.2018.12.050

Zuo, Z., Hu, Y., Li, Q., Li, B., & **Huang, T.** (2015). Temperature monitoring during concrete setting through cooling pipe monitors. *Journal of Tsinghua University (Sci & Technol)*, 55(1): 21-26. Doi: 10.16511/j.cnki.qhdxxb.2015.01.004

Du, B., Du, G., **Huang, T.**, Liu, M., & Yue, Y. (2014). Temperature and stress analysis of concrete face plate in construction period. *Journal of China Three Gorges University (Natural Sciences)*, 36(3): 23-27. Doi: 10.13393/j.cnki.issn.1672-948X.2014.03.006

**Huang, T.**, Chen, Q., Hu, Y., Zhong, Q., & Liu, T. (2013). Research of XYPEX on the property of concrete crack repair. *Concrete*, 2013 (11): 88-92. Doi: 10.3969/j.issn.1002-3550.2013.11.024

## PRESENTATIONS

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**Huang, T.** (Dec. 2023). Investigating streamflow variability of HUC-2 regions in the Conterminous United States from 2003 to 2022 water years. Poster presentation at American Geophysical Union (AGU) Fall Meeting in San Francisco, CA.

**Huang, T., & Merwade, V.** (Dec. 2022). An integrated evaluation framework based on generalized likelihood uncertainty estimation for quantifying uncertainty in flood modeling. Oral presentation at AGU Fall Meeting in Chicago, IL.

**Huang, T., & Merwade, V.** (Dec. 2022). Estimating Bayesian model averaging weights and variances of ensemble flood modeling using multiple Markov chains Monte Carlo. Poster presentation at AGU Fall Meeting in Chicago, IL.

**Huang, T., & Merwade, V.** (Sep. 2022). Developing customized NRCS unit hydrographs for ungauged watersheds in Indiana. Oral presentation at the Indiana Association for Floodplain and Stormwater Management Annual Conference in South Bend, IN.

**Huang, T., & Merwade, V.** (May 2022). Evaluating uncertainty in FEMA flood insurance rate maps using Bayesian model averaging (BMA) and hierarchical BMA. Oral presentation at American Water Resources Association (AWRA) Geospatial Water Technology Conference in Austin, TX.

**Huang, T., & Merwade, V.** (May 2022). Developing customized NRCS unit hydrographs for ungauged watersheds in Indiana, USA. Oral presentation at AWRA Geospatial Water Technology Conference in Austin, TX.

**Huang, T., & Merwade, V.** (Dec. 2021). Evaluating uncertainty in modeling of FEMA flood insurance rate maps using Bayesian model averaging (BMA) and hierarchical BMA. Oral presentation at AGU Fall Meeting in New Orleans, LA.

**Huang, T., & Merwade, V.** (Dec. 2021). Developing customized NRCS unit hydrographs for ungauged watersheds in Indiana, USA. Poster presentation at AGU Fall Meeting in New Orleans, LA.

## HONORS & AWARDS

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**Best Technical Paper** (Feb. 2024), Environmental & Water Resources Institute award to the 2024 Best Technical Paper for "Uncertainty Analysis and Quantification in Flood Insurance Rate Maps Using Bayesian Model Averaging and Hierarchical BMA" published in *Journal of Hydrologic Engineering*, Environmental & Water Resources Institute

**Editor's Choice** (Feb, 2023), the Chief Editor of *Journal of Hydrologic Engineering* selected the paper entitled "Uncertainty Analysis and Quantification in Flood Insurance Rate Maps Using Bayesian Model Averaging and Hierarchical BMA" in Issue 28(2) to be featured on the journal homepage, ASCE Library

**Lyles Teaching Fellowship** (Jan. 2023), Lyles School of Civil Engineering fellowship presented to an outstanding graduate student who is working with a Faculty Mentor to teach an undergraduate course in civil engineering, Purdue University

**Jacques Delleur Travel Award** (Dec. 2022), Lyles School of Civil Engineering award to cover travel expenses for graduate students to attend a scientific meeting that has strong relevance to the students' research, Purdue University

**Dorothy Faye Dunn Fellowship** (Oct. 2022), Lyles School of Civil Engineering award presented to an outstanding graduate student in the hydraulic and hydrologic engineering field, Purdue University

**C4E Travel Grant** (Apr. 2022), Purdue's Center for the Environment award to cover travel expenses for graduate students to attend a scientific meeting that has strong relevance to the students' research, Purdue University

**Yeh Travel Fellowship** (Nov. 2021), Lyles School of Civil Engineering award to cover travel expenses for graduate students to attend a scientific meeting that has strong relevance to the students' research, Purdue University

**Zhang Guangdou Scholarship** (July 2014), Department of Hydraulic Engineering award presented to an outstanding graduate student in the water resources engineering field, Tsinghua University

**Undergraduate Mentor Certificate of Honor** (July 2013), Tsinghua University award presented to an outstanding graduate student in undergraduate mentoring, Tsinghua University

**Outstanding Undergraduate Thesis** (June 2012), Tsinghua University award presented to an outstanding undergraduate thesis, Tsinghua University

## PROFESSIONAL AFFILIATIONS

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American Geophysical Union	2021-Present
American Society of Civil Engineers	2022-Present
American Water Resources Association	2022-Present