Donghui Xu

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EDUCATION

University of Michigan, Ann Arbor
Ph.D. in Civil Engineering, April 2020
Graduate Certificate in Computational Discovery and Engineering, April 2020
Master's in Applied Mathematics, May 2018
Master's in Civil Engineering, May 2015

Hohai University
B.S. in Hydrology and Water Resources Engineering, Jun 2013

WORK EXPERIENCE

Earth Scientist at Pacific Northwest National Lab, Dec 2022 to present

- Develop land-ocean coupling in Energy Exascale Earth System Model (E3SM) to understand the impacts of seawater intrusion on groundwater system
- Develop a 2-dimensional river dynamical core (RDycore) with support for heterogeneous computing architectures as a next-generation river component for E3SM
- Develop a coupled modeling framework including atmosphere, ocean, land, and river models to simulate compound flooding event at "human-action" scales
- Evaluate global river transport model on structured and unstructured mesh

Postdoc research associate at Pacific Northwest National Lab, May 2020 to Nov 2022

- Model development of Energy Exascale Earth System Model (E3SM) to couple human-land-river-ocean interactions
- Developed a data-driven macro-scale floodplain inundation scheme in E3SM
- Calibrated runoff relevant parameters in E3SM with an Uncertainty Quantification framework, and evaluate the parametric uncertainty
- Evaluated the uncertainty of runoff projections under climate change conditions
- Developed a new infiltration scheme in E3SM to improve the wetland dynamics and project its changes under climate change
- Sensitivity analysis on streamflow simulation with land surface model and global river transport model

Ph.D. Internship at Pacific Northwest National Lab, Jun 2019 to Aug 2019

- Developed a parallel 2D Shallow Water Equation model with PETSc written in Fortran
- Validated the overland flow model with dam break example, and visualized the results in Python
- Applied Method of Manufactured Solutions for code verification
- Coupling the overland flow model to a dynamic ground water model to understand surface-subsurface interactions

GRADUATE RRESEARCH EXPERIENCE

Uncertainty quantification of urban flooding at 'Human Action' scale with reduced order method

- Generated unstructured mesh of urban watershed for the flooding model from Triangulated irregular network and building footprints
- Reproduced Houston 2017 flooding event with a dynamic routing model based on finite volume method
- Used truncated Karhunen-Loève expansion to reduce rainfall field dimensionality
- Constructed surrogate model with polynomial chaos expansion for computational efficiency
- Propagate uncertainty of stochastic inputs and parameters to the output use random sampling with Monte Carlo simulation

Effect of climate change on hydrologic cycle

- Modified a Bayesian framework to couple with a stochastic downscaling model

- Downscaled some principal hydrological variables from coarse climate model resolution to station-level resolution
- Corrected climate model projection bias with VIC model outputs
- Quantified the change of flood timing, magnitude in the future from CMIP5 model ensemble through a multi-variate Bayesian method for US continent
- Assessed effect of climate change to evapotranspiration at US continent scale in the future

Investigate response of vegetation to droughts in Amazon rainforest

- Clustering analysis (spectral cluster method, K-means, Gaussian mixture method, etc.) of precipitation in Amazon region with gauge measurements
- Investigate relationship between vegetation indices and precipitation through Recurrent Neural Network

Drought Resilience and Interannual Variability of Evapotranspiration of Amazon Rainforest

- Applied an innovative method to estimate evapotranspiration with satellite data over Amazon basin
- Validated multiple satellite\reanalysis evapotranspiration products with observation in Amazon basin
- Derived an index to indicate drought intensity based on satellite data

TEACHING EXPERIENCE

Guest Lecturer, *University of Houston*, Mar 2025

- Give two lectures on the topic of floods for Global Climate: Physical Models

Guest Lecturer, *University of Houston*, Mar 2024

- Give two lectures on the topic of floods for Global Climate: Physical Models

Graduate Student Instructor, *University of Michigan, Ann Arbor***,** Sep 2016 to Apr 2019

- Teach the lab sections of hydrology and floodplain analysis for senior students (size about 60 students)
- Led and scheduled hydraulic experiments on a flume
- Discuss and reformulate the lab syllabus with the instructor
- Topics include watershed delineation, frequency analysis, unit hydrograph, rational methods, storm sewer design, detention pond design and other fundamental hydrology/hydraulic topics

COMPUTER SKILLS

- Programming: Fortran, C++, Python, Matlab, R, VB
- Version Control: Git
- Applications: ArcGIS, QGIS, Latex, open foam, AutoCAD, EPANET 2, Office

HONORS & AWARDS

- First-authored paper in Geophysical Research Letters was selected for AGU Research Spotlight, 2019
- Dow Doctoral Sustainability Fellowship, Fall 2017 to Fall 2019
- Rackham Conference Travel Grants, 2017, 2018
- Streeter Fellowship, Fall 2015 to Winter 2016
- Jiangsu Division in Contemporary Undergraduate Mathematical Contest in Modeling - 3rd place, Sep 2011

PROFESSIONAL SERVICES

Guest editor: *Journal of Hydrologic Engineering*, Special Collection on Water Management in a Changing Climate: Quantification and Communication of Uncertainties in Climate Predictions and Projections to Improve Decision-Making

Membership

- American Geophysical Union (AGU)
- American Society of Civil Engineers (ASCE), Risk, Uncertainty, And Probabilistic Approaches (RUPA) committee member

Journal peer review: Geophysical Research Letter × 8, Earth System Science Data × 8, Journal of Hydrologic Engineering ×5, Journal of Hydrology × 3, Water Resources Research × 4, Geoscientific Model Developments × 4, Frontiers in Water × 4, Environmental Research Letters × 4, Journal of Geophysical Research: Atmospheres × 1, Water × 3, Remote Sensing × 5, GeoHazards × 1, Imaging Science × 1, Journal of Advances in Modeling Earth Systems × 1, npj Climate and Atmospheric Science × 1

RESEARCH IN PROGRESS

Xu, D., Bisht, G., Feng, D., Tan, Z., et al., (2025). Assessing Compound Flooding Risks Caused by Hurricane Irene Using a Kilometer-Scale Earth System Model.

Xu, D., Bisht, G., Tan, Z., Fluet-Chouinard, E., Hao, D., et al., (2025). Contrasting Global Impacts of Future Climate Change Across Wetland Types.

Xu, D., Ivanov., V. Y., Tran, V., Bisht., G., Wang, J. et al., (2025). Estimation of Global Terrestrial Evapotranspiration Using a Simple Hybrid Framework based on Maximum Entropy Production Theory.

Shi, M., **Xu, D.**, Li, H.Y., Tan, Z., Bisht, G., Zhou, T., Leung, L. R., (2025). A New Sediment Land-River Two-Way Exchange Framework in the Energy Exascale Earth System Model.

Liao, C., Engwirda, D., Asay-Davis, X., **Xu, D.**, Zhou, T., et al. (2025). An Unstructured Voronoi Mesh Framework for Hydrologic and Land Surface Models.

IN REVIEW

Liao, C., **Xu, D.**, (2025). Advances in unstructured Voronoi mesh-based flow direction modeling. *Computers and Geosciences.* **[Submitted]**.

Bisht, G., **Xu, D.**, Johnson, J., Feng, D., Brown, J., Knepley, M., Adams, M., Tan, Z., Kumar, M., Engwirda, D., Hao, D., Wolfe, J., (2025). Development of a River Dynamical Core for E3SM to Simulate Compound Flooding on Exascale-class Heterogeneous Supercomputers. *Environmental Modelling and Software.* **[In review].**

Tran, V., Fatichi, S., Bras, R., Babovic, V., Dang, T., Galelli, S., Istanbulluoglu, E., Kim, J., Le, P., Leung, L. R., Nguyen, T., Sargsyan, K., Tran, H., Vivoni, E., **Xu, D.**, Ivanov, V. Y., (2024). Towards Global Streamflow Forecasts with AI that Recognizes Hydrological Mechanisms. *Water Resources Research*. [**In review**].

Tan, Z., **Xu, D.**, Taraphdar, S., Ma, J., Bisht, G., Leung, L. R., (2024). An efficient hybrid downscaling framework to estimate high-resolution river hydrodynamics. *Hydrology and Earth System Sciences*, [**In revision**].

Tran, V., Kim, T., **Xu, D.**, Tran, H., Le, M., Tran, T. Kim, J. Tran, T. Wright, D., Restrepo, P. Ivanov, V., (2024). AI Improves the Accuracy, Reliability, and Economic Value of Continental-Scale Flood Predictions. *AGU Advances.* [**In revision**].

Tan, Z., **Xu, D.**, Zhou, T., Feng, D., Li, L., Cooper, M., Liao, C., Bisht, G., Abeshu, G., Li, H., Kassam, A., Leung, L. R., (2024). The past and future changes of river sediment in the U.S. Mid-Atlantic. *Earth's Future*, [**In review**].

Liu, Y., Huang, H., Wang, S., Zhang, T., **Xu, D.**, Cheng, Y., (2024). ML4Fire-XGBv1.0: Improving North American wildfire prediction by integrating a machine-learning fire model in a land surface model. *Geoscientific Model Development,* [**In revision**].

Feng, D., Tan, Z., Engwirda, D., Wolfe, J. **Xu, D.**, Liao, C., Bisht, G., Benedict, J., Zhou, T., Deb, M., Li, H., Leung, L.R., (2024). Disentangling Atmospheric, Hydrological, and Coupling Uncertainties in Compound Flood Modeling within a Coupled Earth System Model. *Natural Hazards and Earth System Sciences*, **[In revision]**.

Hao, D., Bisht, G., **Xu, D**., Kumar, M., Leung, L.R., Divergent Responses of Historic Rain-on-Snow Flood Extremes to a Warmer Climate. *Communications Earth & Environment*, [**In revision]**.

Liao, C., **Xu, D.**, Cooper, M., Zhou, T., Engwirda, D., Tan, Z., Bisht, G., Li, H., Li, L., Feng, D., Leung, L.R., (2024). Evaluation of Flow Routing on the Unstructured Voronoi Meshes in Earth System Modeling. *Journal of Advances in Modeling Earth Systems*, **[In revision].**

Zhou, W., Zhang, L., Sheshukov, A. Y., Wang, J., Zhu, M., Sargsyan, K., **Xu, D.**, Liu, D., Zhang, T., Mazepa, V., Sokolov, A., Valdayskikh, V., Vasiliev, A., Tran, V. N., Ivanov, V. Y., (2024). A Novel Framework to Project the

Permafrost Fate with Explicit Quantification of Soil Property and Future Climate Uncertainties. Journal of Geophysical Research – Earth Surface, [**In revision**].

PUBLICATIONS

Feng D., Tan, Z., Pinel, S., **Xu, D.**, Fernandes, J., Fassoni-Andrade, A., and Bonnet, M., Bisht, G., (2024). Drivers and impacts of sediment deposition in Amazonian floodplains. *Nature Communications.* https://doi.org/10.1038/s41467-025-57495-1

Xu, D., Bisht, G., Engwirda, D., Feng, D., Tan, Z., & Ivanov, V. Y. (2025). Uncertainties in simulating flooding during Hurricane Harvey using 2D shallow water equations. *Water Resources Research*, 61, e2024WR038032. https://doi.org/10.1029/2024WR038032

Sinha, E., **Xu, D.**, Morris, K.A., Drewniak, B.A. and Bond-Lamberty, B. (2025), Interactions Between Climate Mean and Variability Drive Future Agroecosystem Vulnerability. *Glob Change Biol*, 31: e70064. https://doi.org/10.1111/gcb.70064

Xu, D., Bisht, G., Feng, D., Tan, Z., Li, L., Qiu, H., & Leung, L. R. (2024). Impacts of sea-level rise on coastal groundwater table simulated by an Earth system model with a land-ocean coupling scheme. *Earth's Future*, 12, e2024EF004479. https://doi.org/10.1029/2024EF004479

Feng, D., Tan, Z., Engwirda, D., Wolfe, J. D., **Xu, D.**, Liao, C., et al. (2024). Simulation of compound flooding using river-ocean two-way coupled E3SM ensemble on variable-resolution meshes. Journal of Advances in Modeling Earth Systems, 16, e2023MS004054. https://doi.org/10.1029/2023MS004054

Xu, D., Bisht, G., Tan, Z. et al. Climate change will reduce North American inland wetland areas and disrupt their seasonal regimes. Nat Commun 15, 2438 (2024). https://doi.org/10.1038/s41467-024-45286-z

Xu, D., Bisht, G., Tan, Z., Liao, C., Zhou, T., Li, H.Y. and Leung, L.R. 2024. Disentangling the hydrological and hydraulic controls on streamflow variability in Energy Exascale Earth System Model (E3SM) V2 – a case study in the Pantanal region. Geosci. Model Dev. 17(3), 1197-1215.

Qiu, H., Bisht, G., Li, L., Hao, D. and **Xu, D.** 2024. Development of inter-grid-cell lateral unsaturated and saturated flow model in the E3SM Land Model (v2.0). Geosci. Model Dev. 17(1), 143-167.

Zhou, W., Zhang, L., Sheshukov, A., Wang, J., Zhu, M., Sargsyan, K., **Xu, D.**, et al. (2024). Ground heat flux reconstruction using Bayesian uncertainty quantification machinery and surrogate modeling. Earth and Space Science, 11, e2023EA003435. https://doi.org/10.1029/2023EA003435

Xu, D., Ivanov, V. Y., Agee, E., & Wang, J. (2023). Energy surplus and an atmosphere-land-surface "tug of war" control future evapotranspiration. Geophysical Research Letters, 50, e2022GL102677. https://doi.org/10.1029/2022GL102677

Hao, D., Bisht, G., Wang, H., **Xu, D.**, Huang, H., Qian, Y. and Leung, L.R. 2023. A cleaner snow future mitigates Northern Hemisphere snowpack loss from warming. Nature Communications 14(1), 6074.

Liao, C., Zhou, T., **Xu, D.**, Tan, Z., Bisht, G., Cooper, M. G., et al. (2023). Topological relationship-based flow direction modeling: Stream burning and depression filling. Journal of Advances in Modeling Earth Systems, 15, e2022MS003487. https://doi.org/10.1029/2022MS003487

Tran, V. N., Ivanov, V. Y., **Xu, D.**, & Kim, J. (2023). Closing in on hydrologic predictive accuracy: Combining the strengths of high-fidelity and physics-agnostic models. Geophysical Research Letters, 50, e2023GL104464. https://doi.org/10.1029/2023GL104464

Feng, D., Tan, Z., **Xu, D.** and Leung, L.R. 2023. Understanding the compound flood risk along the coast of the contiguous United States. Hydrol. Earth Syst. Sci. 27(21), 3911-3934.

Liao, C., Zhou, T., **Xu, D.,** Cooper, M. G., Engwirda, D., Li, H.-Y., & Leung, L. R. (2023). Topological relationship-based flow direction modeling: Mesh-independent river networks representation. *Journal of Advances in Modeling Earth Systems*, 15, e2022MS003089. https://doi.org/10.1029/2022MS003089

Xu, D., Bisht, G., Zhou, T., Leung, L.R. and Pan, M., 2022. Development of Land‐River Two‐Way Hydrologic Coupling for Floodplain Inundation in the Energy Exascale Earth System Model. Journal of Advances in Modeling Earth Systems, p.e2021MS002772.

Xu, D., Bisht, G., Sargsyan, K., Liao, C. and Leung, L.R., 2022. Using a surrogate-assisted Bayesian framework to calibrate the runoff-generation scheme in the Energy Exascale Earth System Model (E3SM) v1. Geoscientific Model Development, 15(12), pp.5021-5043.

Feng, D., Tan, Z., Engwirda, D., Liao, C., **Xu, D.**, Bisht, G., Zhou, T., Li, H.Y. and Leung, L.R. 2022. Investigating coastal backwater effects and flooding in the coastal zone using a global river transport model on an unstructured mesh. Hydrol. Earth Syst. Sci. 26(21), 5473-5491.

Li, H.Y., Tan, Z., Ma, H., Zhu, Z., Abeshu, G.W., Zhu, S., Cohen, S., Zhou, T., **Xu, D**. and Leung, L.R., 2022. A new large-scale suspended sediment model and its application over the United States. Hydrology and Earth System Sciences, 26(3), pp.665-688.

Liao, C., Zhou, T., **Xu, D**., Barnes, R., Bisht, G., Li, H.Y., Tan, Z., Tesfa, T., Duan, Z., Engwirda, D. and Leung, L.R., 2022. Advances in hexagon mesh-based flow direction modeling. Advances in Water Resources, 160, p.104099.

Ivanov, V. Y., **Xu, D. (corresponding author),** Dwelle, M. C., Sargsyan, K., Wright, D. B., Katopodes, N., et al. (2021). Breaking down the computational barriers to real-time urban flood forecasting. *Geophysical Research Letters*, 48, e2021GL093585. https://doi.org/10.1029/2021GL093585

Xu, D., Ivanov, V. Y., Li, X., & Troy, T. J. (2021). Peak runoff timing is linked to global warming trajectories. *Earth's Future*, 9, e2021EF002083. https://doi.org/10.1029/2021EF002083

Abdelhady, A.U., **Xu, D.**, Ouyang, Z., Spence, S.M., McCormick, J. and Ivanov, V.Y., 2022. A framework for estimating water ingress due to hurricane rainfall. Journal of Wind Engineering and Industrial Aerodynamics, 221, p.104891.

Xu, D., Agee, E., Wang, J., Ivanov, Y. V. 2019. Estimation of Evapotranspiration of Amazon Rainforest Using the Maximum Entropy Production Method. *Geophysical Research Letters*. https://doi.org/10.1029/2018GL080907

Xu, D., Ivanov, Y. V., Kim, J., Fatichi, S. 2018. On the use of observations in assessment of multi-model climate ensemble. *Stochastic Environmental Research and Risk Assessment*. https://doi.org/10.1007/s00477-018-1621-2