Tianfang Xu

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Arizona State University | Ira A. Fulton Schools of Engineering
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Education

PhD | Civil Engineering Aug. 2016
University of Illinois at Urbana-Champaign
Thesis title: An efficient fully Bayesian approach to uncertainty quantification of groundwater models

MS | Civil Engineering May 2012
University of Illinois at Urbana-Champaign
Thesis title: Use of data-driven models to improve prediction of physically based groundwater models.

BS | Geotechnical Engineering Jun. 2010
Nanjing University, China

Professional Experience

Assistant Professor | Arizona State Univ. 2019-Present

Research Assistant Professor | Utah State Univ. 2017-2019

Postdoctoral Research Associate | Michigan State Univ. 2016-2017

Graduate Research Assistant | Univ. Illinois 2010-2016

Peer-Reviewed Publications

Xu, T. and Liang, F. (2021). The state and opportunities of machine learning applications in hydrology. *WIREs Water*, doi:10.1002/wat2.1533.

Xu, T., Guan, K., Peng, B., Wei, S. and Zhao, L. (2021). Machine Learning-based Modeling of Spatio-temporally Varying Responses of Rainfed Corn Yield to Climate, Soil and Management in the US Corn Belt. *Frontiers in Artificial Intelligence*, 4, 40.

Tennant, H., Neilson, B.T., Miller, M.P. and Xu, T., Ungaged inflow and loss patterns in urban and agricultural sub-reaches of the Logan River Observatory. (2021). *Hydrological Processes*, doi: 10.1002/hyp.14097.

Wang, Y., Shi, L., Xu, T., Zhang, Q., Ye, M. and Zha, Y. (2020). A nonparametric sequential data assimilation scheme for soil moisture flow. *Journal of Hydrology*, *593*, 2021, doi: 10.1016/j.jhydrol.2020.125865.

Cai, Y., Guan, K., Lobell, D., Potgieter, A.B., Wang, S., Peng, J., Xu, T., Asseng, S., Zhang, Y., You, L. and Peng, B. (2019). Integrating satellite and climate data to predict wheat yield in

Australia using machine learning approaches. *Agricultural and forest meteorology*, *274*, pp.144-159.

Xu, T., Deines, J. M., Kendall, A. D., Basso, B., & Hyndman, D. W. (2019). Addressing challenges for mapping irrigated fields in subhumid temperate regions by integrating remote sensing and hydroclimatic data. *Remote Sensing*, *11*(3), 370.

Hyndman, D.W., Xu, T., Deines, J.M., Cao, G., Nagelkirk, R., Viña, A., McConnell, W., Basso, B., Kendall, A.D., Li, S. and Luo, L. (2017). Quantifying changes in water use and groundwater availability in a megacity using novel integrated systems modeling. *Geophysical Research Letters*, *44*(16), pp.8359-8368.

Xu, T., Valocchi, A. J., Ye, M., & Liang, F. (2017). Quantifying model structural error: Efficient Bayesian calibration of a regional groundwater flow model using surrogates and a data-driven error model. *Water Resources Research*, *53*(5), 4084-4105.

Xu, T., Valocchi, A. J., Ye, M., Liang, F., & Lin, Y. F. (2017). Bayesian calibration of groundwater models with input data uncertainty. *Water Resources Research*, *53*(4), 3224-3245.

Xu, T., & Valocchi, A. J. (2015). A Bayesian approach to improved calibration and prediction of groundwater models with structural error. *Water Resources Research*, *51*(11), 9290-9311.

Xu, T. and Valocchi, A.J., 2015. Data-driven methods to improve baseflow prediction of a regional groundwater model. *Computers & Geosciences*, *85*, pp.124-136.

Choi, J., E. Amir, T. Xu and A. J. Valocchi. Learning relational Kalman filtering. In *Proc. 29th AAAI Conf. on Artificial Intelligence (AAAI-15)*, Austin, TX, Jan. 2015.

Xu, T., Valocchi, A. J., Choi, J., & Amir, E. (2014). Use of machine learning methods to reduce predictive error of groundwater models. *Groundwater*, *52*(3), 448-460.

Invited Presentations

Combining Process Understanding and Machine Learning: Two Hydrologic Case Studies. Department of Hydrology & Atmospheric Sciences, Weekly Colloquium, University of Arizona, Nov. 2020.

A tale of models and data: machine learning for improved prediction and understanding of environmental systems, Center for Behavior, Institutions and the Environment (CBIE), Arizona State University, Feb. 2020.

Bridging models and data: towards improved prediction and understanding of environmental systems, Environmental Engineering Seminar, Arizona State University, Tempe, AZ, Nov. 2019.

A tale of two models: applications of machine learning in hydrology, Hydrosystems Engineering Seminar, Arizona State University, Sep. 2020.

Bridging models and data: towards improved prediction and understanding of water resources systems, Math and Statistics Department Applied Math Seminar, Utah State University, Logan, UT, Oct. 2018.

Bridging models and data: error-explicit Bayesian uncertainty quantification of groundwater models, Department of Earth, Atmospheric and Planetary Sciences Friday Seminar Series, MIT, Cambridge, MA, Apr. 2017.

Bridging models and data: Towards improved prediction and understanding of environmental systems, Department of Environmental Science, University of California Riverside, Riverside, CA, Apr. 2017.

Bridging models and data: HPC for Bayesian calibration of groundwater models with structural error, Computational Science and Engineering Annual Meeting, University of Illinois Urbana-Champaign, Urbana, IL, Apr. 2016.

Use of Machine Learning Methods to Improve Prediction of Regional Groundwater Models, Ven Te Chow Hydrosystems Laboratory Seminar Series, University of Illinois Urbana-Champaign, Urbana, IL, Apr. 2014.

Conference Presentations

T. Xu, Y. Long, C. Tyson, R. Zeng, B. T. Neilson, D. G. Tarboton, Hybrid physically-based and deep learning modeling of a snow dominated mountainous karst watershed. Presented at AGU Fall Meeting, San Francisco, CA, Dec. 2019.

T. Xu, Machine learning approach to irrigation mapping and yield prediction, Identifying Emerging Opportunities in Arizona Agriculture Workshop, Mesa, AZ, Oct. 2019.

C. Tyson, T. Xu, Assessing Effects of the Choice of Meteorological Forcing Datasets and Downscaling on Distributed Snow Simulations in a Mountainous Watershed. Presented at *AGU Fall Meeting*, New Orleans, LA, Dec. 2018.

T. Xu, J. M. Deines, A. Kendall, B. Bass, and D. H. Hyndman, Addressing challenges for mapping irrigated fields in subhumid temperate U.S. systems, CUAHSI Hydroinformatics Conference, Provo, UT, Jul. 2019.

T. Xu, J. M. Deines, A. Kendall, D. H. Hyndman, and B. Basso. Identifying spatiotemporal dynamics of irrigated area in southwestern Michigan using remote sensing and climate data. Presented at *AGU Fall Meeting*, New Orleans, LA, Dec. 2017.

T. Xu, A. J. Valocchi, M. Ye and F. Liang A fast surrogate facilitated data-driven Bayesian approach to uncertainty quantification of a regional groundwater flow model with structural error. Presented at *AGU Fall Meeting*, San Francisco, CA, Dec. 2016.

T. Xu and A. J. Valocchi, A HydroClient-based learning module of constructing a data-driven rainfall-runoff model. Presented at *CUAHSI Data-Driven Education Workshop, CUAHSI Biennial Symposium*, Shepherdstown, WV, Jul. 2016.

T. Xu, A. J. Valocchi, Y. F. Lin and F. Liang, A Bayesian calibration approach to input data variability in groundwater models. Presented at *AGU Fall Meeting*, San Francisco, CA, Dec. 2015.

T. Xu and A. J. Valocchi. A fully Bayesian approach to improved calibration and prediction of groundwater models with structural error. Presented at *AGU Fall Meeting*, San Francisco, CA, Dec. 2014.

T. Xu and A. J. Valocchi. Use of Data-driven Methods to Improve Baseflow Prediction of a Regional Groundwater Model. Presented at *Illinois water conference*, Urbana, IL, Oct. 2014.

T. Xu and A. J. Valocchi. A Fully Bayesian approach to calibrate groundwater flow models with structural error. Presented at *6th International Conference on Porous Media & Annual Meeting (INTERPORE)*, Milwaukee, WI, May 2014.

T. Xu and A. J. Valocchi. Use of Machine Learning Techniques to Enhance Groundwater Model Predictions. In *Proc. MODFLOW and more*, Golden, CO, Jun. 2013.

T. Xu and A. J. Valocchi. Use of data-driven models to enhance prediction of groundwater models. Presented at *EGU General Assembly*, Vienna, Austria, Apr. 2013.

T. Xu, A. J. Valocchi, J. Choi and E. Amir. Improving groundwater flow model prediction using complementary data-driven models. In *Proc. XIX International Conference on Computational Methods in Water Resources (CMWR)*, Jun. 2012.

Professional Memberships

American Geophysical Union (AGU)

Society for Industrial and Applied Mathematics (SIAM)

Teaching

CEE 540 *Groundwater Hydrology*, Arizona State Univ.	Spring 2020, 2021
CEE 341 *Fluid Mechanics*, Arizona State Univ.	Fall 2019, 2020
CEE 5430/6430 *Groundwater Engineering*, Utah State Univ.	Fall 2017 & 2018

Research Projects

Collaborative Research: Quantifying Watershed Dynamics in Snow-Dominated Mountainous Watersheds Using Hybrid Physically Based and Deep Learning Models. NSF GEO-EAR-HS, $284,867, 3/2021-2/2024 (PI).

Developing an irrigation dataset for assessment of anthropogenic impacts on terrestrial-atmosphere energy-water coupling using machine learning-based data fusion. NOAA COM, $288,793, 9/2020-8/2022 (co-PI).

Quantifying trade-offs in water quantity and quality in a managed aquifer recharge system. ASU, $49,656, 1/2020-12/2020 (co-PI).

Elements: Advancing Data Science and Analytics for Water (DSAWS). NSF, $576,946, 10/2019-9/2022 (co-PI).

Understanding the variability of recharge and groundwater control on mountainous stream discharge in karst environments. USGS 104(b)/UWRL, $73,003, 6/2018-5/2019 (PI).

Awards

Computational Science and Engineering (CSE) Fellow | Univ. Illinois 2015-2016
Proposal: Bridging Models and Data: High Performance Computing for Bayesian Calibration of Geoscience Models with Structural Error

Chen Loh Kwan Fellowship | Univ. Illinois 2010-2011

Professional Memberships

American Geophysical Union (AGU)

European Geosciences Union (EGU)

Society for Industrial and Applied Mathematics (SIAM)

Professional Services

Associate Editor, *Groundwater*

Reviewer & Panelist, NSF, DOE

Student Member, AGU Hydrologic Uncertainty Technical Committee, 2014-2017

Reviewer, *Advances in Water Resources*, *Environmental Earth Sciences*, *Environmental Modeling & Software*, *Groundwater*, *HESS*, *Journal of Contaminant Hydrology*, *Journal of Hydro-environment Research*, *Journal of Hydrology*, *Remote Sensing*, *Water Resources Research*