

# Pin Shuai

ASSISTANT PROFESSOR · UTAH STATE UNIVERSITY

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## Research Interests

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My research interests lie primarily in two areas. The first area is understanding of the hydrological, biogeochemical processes occurring at the aquatic-terrestrial interface under the impact of groundwater and surface water interactions. The second area is quantifying the flow and transport of heat, nutrients and contaminants from bedrock to canopy top in a watershed, and feedbacks between hydrology, land use, and climate change. I apply a model-data integrative approach which combines field, laboratory, and remote sensing techniques with numerical models leveraging the power of high-performance computing to improve understanding of hydrological processes. I am also a strong advocate for open source and reproducible scientific research.

## Education

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### Texas A&M University

College Station, TX

#### PHD GEOLOGY

2013 - 2017

- Advisors: Dr. Peter Knappett and Dr. M. Bayani Cardenas (University of Texas, Austin)
- Dissertation: Nutrients and Contaminants Fate and Transport under the Impact of Groundwater and Surface Water Interactions

### Wuhan University

Wuhan, China

#### MS WATER RESOURCES ENGINEERING

2011 - 2013

- Thesis: Estimation of Groundwater Recharge in the Northern China Plain: A Field and Laboratory Study

### Wuhan University

Wuhan, China

#### BS WATER RESOURCES ENGINEERING

2007 - 2011

- Thesis: Groundwater Exploitation of Shijin Irrigation District (China)

## Professional Experience

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- 2022-  
present **Assistant Professor**, Dept. of Civil and Environmental Engineering, Utah Water Research Laboratory, Utah State University
- 2020-2022 **Earth Scientist**, Atmospheric Sciences and Global Change Division, Pacific Northwest National Laboratory
- 2017-2020 **Post Doctorate Research Associate**, Atmospheric Sciences and Global Change Division, Pacific Northwest National Laboratory
- 2016 **Summer Intern**, Atmospheric Sciences and Global Change Division, Pacific Northwest National Laboratory
- 2013-2017 **Graduate Research Assistant**, Texas A&M University
- 2011-2013 **Graduate Research Assistant**, Wuhan University

## Publications

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### PUBLISHED

See a full list of publication and citation on [Google Scholar](#)

Coon E and **Shuai P**, Watershed Workflow: a toolset for parameterizing data-intensive, hyperresolution hydrologic models. *Environmental Modeling & Software*. doi: 10.1016/j.envsoft.2022.105502

**Shuai P**, Chen X, Mital U, Coon E and Dwivedi D, The Effects of Spatial and Temporal Resolution of Gridded Meteorological Forcing on Watershed Hydrological Responses. *Hydrology and Earth System Sciences*. doi: 10.5194/hess-2021-501

Chen K, Chen X, Song X, Briggs MA, Jiang P, **Shuai P**, Hammond G, Zhan H, Zachara JM. Using Ensemble Data Assimilation to Estimate Transient Hydrologic Exchange Fluxes under Highly Dynamic Flow Conditions. *Water Resources Research*.

- Bao J, Chen Y, Fang Y, Song X, Perkins W, Duan Z, **Shuai P**, Ren H, Hou Z, Richmond M, He X, and Scheibe T (2021). Modeling framework for evaluating the impacts of hydrodynamic pressure on hydrologic exchange fluxes and residence time for a large-scale river section over a long-term period. *Environmental Modeling & Software*, doi: 10.1016/j.envsoft.2021.105277
- Zheng L, Wang L, Wang T, Singh K, Zhou J, **Shuai P**, Wang Z, Chen X (2021) Characterizing shear-thinning fluids transitioning from rheology- to inertia-dominated flow regimes in porous media. *Journal of Hydrology*, doi: 10.1016/j.jhydrol.2021.126498
- Cromwell E, **Shuai P**, Jiang P., Coon ET, Painter SL, Moulton JD, Lin Y, Chen X (2021) Estimating Watershed Subsurface Permeability From Stream Discharge Data Using Deep Neural Networks. *Frontiers in Earth Science*, 9:613011. doi: 10.3389/feart.2021.613011
- Fang Y, Song X, Ren H, Perkins WA, **Shuai P**, Richmond MC, Hou Z, Bao J, Chen X and Scheibe TD (2020) High-Performance Simulation of Dynamic Hydrologic Exchange and Implications for Surrogate Flow and Reactive Transport Modeling in a Large River Corridor. *Frontiers in Water*, 2:564211. doi: 10.3389/frwa.2020.564211
- Song X, Chen X, Zachara JM, Gomez-Velez JD, **Shuai P**, Ren H, Hammond G (2020) River Dynamics Control Transit Time Distributions and Biogeochemical Reactions in a Dam-Regulated River Corridor. *Water Resources Research*, doi: 10.1029/2019WR026470
- Zachara JM, Chen X, Song X, **Shuai P**, Murray C, Resch C (2020) Kilometer-scale hydrologic exchange flows in a river corridor and their implications to solute migration. *Water Resources Research*. doi: 10.1029/2019WR025258
- Shuai P**, Chen X, Song X, Hammond G, Zachara JM, Royer P, Ren H, Perkins W, Richmond M, Huang M (2019). Dam Operations and Subsurface Hydrogeology Control Dynamics of Hydrologic Exchange Flows in a Regulated River Reach. *Water Resources Research*. doi: 10.1029/2018WR024193 (**Top downloaded paper 2018-2019**)
- Berube M, Jewell K, Myers K, Knappett PSK, **Shuai P**, Dimova N, Hossain A, Lipsi M, Hossain S, Peterson J, Ahmed KM, Datta S (2018). The fate of arsenic in groundwater discharged to the Meghna River, Bangladesh. *Environmental Chemistry*, 15(2), 29. doi: 10.1071/EN17104
- Shuai P**, Cardenas MB, Knappett PSK, Bennett PC, Neilson BT (2017). Denitrification in the banks of fluctuating rivers: The effects of river stage amplitude, sediment hydraulic conductivity and dispersivity, and ambient groundwater flow. *Water Resources Research*, 53(9), 7951–7967. doi: 10.1002/2017WR020610
- Shuai P**, Knappett PSK, Hossain S, Hosain A, Rhodes K, Ahmed KM, Cardenas MB (2017). The Impact of the Degree of Aquifer Confinement and Anisotropy on Tidal Pulse Propagation. *Groundwater*, 55(4), 519–531. doi: 10.1111/gwat.12509
- Knappett PSK, Mailloux BJ, Choudhury I, Khan MR, Michael HA, Barua S, Mondal DR, Steckler MS, Akhter SH, Ahmed KM, Bostick B, Harvey CF, Shamsudduha M, **Shuai P**, Mihajlov I, Mozumder R, van Geen A (2016). Vulnerability of low-arsenic aquifers to municipal pumping in Bangladesh. *Journal of Hydrology*, 539, 674–686. doi: 10.1016/j.jhydrol.2016.05.035
- Briody AC, Cardenas MB, **Shuai P**, Knappett PSK, Bennett PC (2016). Groundwater flow, nutrient, and stable isotope dynamics in the parafluvial-hyporheic zone of the regulated Lower Colorado River (Texas, USA) over the course of a small flood. *Hydrogeology Journal*. doi: 10.1007/s10040-016-1365-3
- Shuai P**, Shi L, Cai S, Yang J (2014). The usage of bromide as a tracer to estimate groundwater recharge rate at Northern China Plain. *Journal of Irrigation and Drainage*. 33, no. 2:11-16. (In Chinese)

## CONFERENCE PROCEEDINGS

- Knappett PSK, Myers K, **Shuai P**, Rhodes K, Jewell K, Peterson J, Dimova N et al. (2016). Tracking the fate of arsenic in groundwater discharged to the Meghna River. In *Arsenic Research and Global Sustainability: Proceedings of the Sixth International Congress on Arsenic in the Environment (As2016)*, June 19-23, 2016, Stockholm, Sweden, p. 43. CRC Press.

## IN REVIEW

- Shuai P**, Chen X, Hammond G, Song X, Chen K, Zachara JM, Perkins WA, and Richmond MC. The Interplay between Subsurface Hydrogeology, River Geomorphology and Flow Dynamics Controls River Corridor Thermal Regimes. *Journal of Hydrology*
- Jiang P, **Shuai P**, Sun A, Mudunuru M, and Chen X, Knowledge-Informed Deep Learning for Hydrological Model Calibration: An Application to Coal Creek Watershed in Colorado. *Hydrol. Earth Syst. Sci. Discuss.* <https://doi.org/10.5194/hess-2022-282>, in review, 2022

## Presentations

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\* *presenting author*

### INVITED TALKS

2022. *Neversink Watershed Modeling*. Seminar with USGS Integrated Modeling Team (Online, 08/22/2022).
2021. *Watershed Model Intercomparison between ATS, SWAT and NWM: An example with the American River Watershed*. ATS short course at Oak Ridge National Laboratory, Oak Ridge, TN, United States (Online).
2020. *Hydrogeologic and Geomorphic Controls on Hydrologic Exchange Flows and River Corridor Thermal Regimes in the Hanford Reach of the Columbia River*. Lunchtime seminar at USGS ORWSC, Portland, Oregon, United States.
2019. *Hydrologic Exchange Flows and Thermal Regimes in the Hanford Reach: The Effects of Dam Operations, River Morphology and Subsurface Hydrogeology*. Seminar at Washington State University Tri-Cities, Richland, Washington, United States.
2019. *Hydrologic Exchange Flows Control on Temperature Regime and Ecological Impacts*. SFA Community Watershed Workshop at Pacific Northwest National Laboratory, Richland, Washington, United States
2019. *Simulating flow and heat transport in a large regulated river corridor*. Workshop on Critical Timescales of Hydrologic Transport at University of California-Berkeley, Berkeley, California, United States.

### SELECTED PRESENTATIONS

- Shuai, P** et al, 2021. *The Effects of Spatial and Temporal Resolution of Meteorological Forcing on Watershed Hydrological Responses*. Oral presentation at AGU Fall Meeting 2021, New Orleans, Louisiana, United States.
- Shuai, P** et al, 2020. *Influence of Hydrologic Exchange Flows on Biogeochemical Dynamics in A Regulated River Reach: 3-D Reactive Transport Modeling in PFLOTRAN*. Poster presentation at AGU Fall Meeting 2020, San Francisco, California, United States.
- Shuai, P** et al, 2019. “Dam Induced Hydrologic Exchange Flows Alter River Corridor Thermal Regime.” eLightning presentation at AGU Fall Meeting, San Francisco, California, United States.
- Shuai, P** et al, 2019. “Boosting Research Reproducibility: Managing High Performance Model Simulation Workflow Using Jupyter Notebook.” Poster presentation at AGU Fall Meeting, San Francisco, California, United States.
- Shuai, P** et al, 2019. “Hydrologic Exchange Flows Alter River Corridor Thermal Regime at Hanford Reach.” Oral presentation at Post-graduate Research Symposium at PNNL, Richland, Washington, United States.
- Shuai, P** et al, 2019. “Boosting Research Reproducibility: Managing High Performance Model Simulation Workflow Using Jupyter Notebook.” Oral presentation at Techfest 2019, Richland, Washington.
- Shuai, P**, 2019. “Modeling River Corridor Thermal Regime Using High Performance Parallel Subsurface Simulator: An Example with PFLOTRAN.” Oral presentation at Modflow and More 2019, Golden, Colorado.
- Shuai, P**, 2019. “Dam Operations and Subsurface Hydrogeology Control Dynamics of Hydrologic Exchange Flows in a Large Regulated River Corridor within the Hanford Reach, Washington.” Oral presentation at 12th Washington Hydrogeology Symposium, Tacoma, Washington.
- Shuai, P**, 2018. “Hydrogeomorphic Controls on Hydrologic Exchange Flows Dynamics within a Large Regulated River Corridor.” Poster presentation at AGU Fall meeting, Washington, DC, United States.
- Wang L, **Shuai, P\*** et al. 2018. “Accumulation of arsenic in dynamic iron oxide barriers due to river stage oscillations: A multiphysics modeling analysis.” Oral presentation at AGU Fall meeting, Washington, DC, United States
- Shuai, P**, 2018. “Hydrologic Exchange Flows Dynamics along a Large Regulated River Corridor.” Oral presentation at Post-graduate Research Symposium at PNNL, Richland, Washington, United States.
- Shuai, P**, 2017. “Tidal and Seasonal River Stage Fluctuations Impact the Formation of Permeable Natural Reactive Barriers in Riverbank Sediments”, Oral presentation at AGU Fall Meeting, New Orleans, LA
- Shuai, P**, 2016. “Estimating hydraulic properties of a river bank aquifer under tidal influence”, Poster presentation at GSA Annual Meeting, Denver, CO
- Shuai, P**, 2015. “Modeling arsenic mobilization in a riverbank aquifer under the influence of tidally fluctuating river and irrigation pumping.” Poster Presentation at AGU Fall Meeting, San Francisco, CA

## Teaching Experience

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Sept, 2021	<b>ATS short course</b> , Instructor	Online
Spring, 2017	<b>Hydrogeology</b> , Guest Lecturer	Texas A&M University
Spring, 2017	<b>Introduction to Geochemistry</b> , Teaching Assistant	Texas A&M University
Fall, 2016	<b>Hydrogeology</b> , Teaching Assistant	Texas A&M University
Fall, 2015	<b>Physical Geology</b> , Teaching Assistant	Texas A&M University
Spring, 2014	<b>Principals of Geology</b> , Teaching Assistant	Texas A&M University

## Research Projects & Grants Funded

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### **PNNL Laboratory Directed Research and Development (LDRD) - DOE**

PI Oct. 2021 - Sep. 2022

- Projects: A python package for visualizing unstructured hydrologic models (\$2,500)

### **PNNL SBR SFA - DOE**

TASK LEAD, PI: TIM SCHEIBE, CO-PIs: JAMES STEGEN, XINGYUAN CHEN 2020 - 2023

- Projects: River Corridor Hydrobiogeochemistry from Reaction to Basin Scale

### **PNNL - DOE BER**

TASK LEAD, PI: CARL STEEFEL, CO-PI: SCOTT PAINTER 2020 - 2022

- ExaSheds: Advancing Watershed System Understanding through Exascale Simulation and Machine Learning

### **PNNL Laboratory Directed Research and Development (LDRD) - DOE**

PI Oct. 2019 - Sep. 2020

- Projects: A collection of Jupyter notebooks for geoscientist (\$5,000)

### **PNNL SBR SFA - DOE**

TASK LEAD, PI: TIM SCHEIBE, CO-PIs: JAMES STEGEN, XINGYUAN CHEN 2017 - 2020

- Projects: Influences of Hydrologic Exchange Flows on River Corridor and Watershed Biogeochemical Function

### **Collaborative Research - NSF**

TASK LEAD, PI: BAYANI CARDENAS, CO-PIs: BETHANY NEILSON, PHILIP BENETTE 2014 - 2017

- Projects: The effects of river regulation on lateral and integrated longitudinal mass and energy transfers in coupled terrestrial-aquatic systems

### **Graduate Research Grant - GSA**

PI 2015 - 2016

- Projects: Investigating impacts of irrigation pumping on Arsenic migration from Meghna River (\$2,500)

## Awards & Honors

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2019	<b>Honorable Mention Paper</b> , International Association of Chinese Youth in Water Sciences (CYwater)
2013-2017	<b>Graduate Fellowship</b> , Texas A&M University
2016	<b>GSA On To the Future travel award</b> , Geological Society of America
2011-2013	<b>Graduate Fellowship</b> , Wuhan University

## Professional Skills

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- **Programming:** Python, R, Matlab, Shell, SQL
- **Numerical model/code:** Amanzi-ATS, PFLOTRAN, COMSOL Multiphysics, MODFLOW, HYDRUS 2D
- **Other software:** QGIS, Paraview, Visit, Latex
- **Lab/field equipments:** Ion Chromatography, ADCP, Trimble Total Stations & RTX, YSI Water Quality Meter, Solinst Levellogger & Water Level Meter

## Outreach & Professional Development

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### SERVICE AND OUTREACH

- 2020 **AGU Fall Meeting**, Session Primary Convener for "H226-Recent Advances in Large Scale, High Resolution Hydrologic and Flood Modeling Leveraging High Performance Computing"
- 2018-2020 **AGU Fall Meeting**, Student Judge

### DEVELOPMENT

**ATS short course (2021)**, Workshop instructor

### PEER REVIEW

Water Resources Research, Journal of Hydrology

### PROFESSIONAL MEMBERSHIPS

American Geophysical Union  
Geological Society of America