Pin Shuai

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Research Interests

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

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

2022-present	**Assistant Professor**, Dept. of Civil and Environmental Engineering and 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

Published

See a full list of publication and citation on **Google Scholar**

Jiang P, **Shuai P**, Sun A, Mudunuru M, and Chen X (2023), Knowledge-Informed Deep Learning for Hydrological Model Calibration: An Application to Coal Creek Watershed in Colorado. *Hydrol. Earth Syst. Sci.*. doi: 10.5194/hess-27-2621-2023.

Coon E and **Shuai P** (2022), 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 (2022), 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 (2022). Using Ensemble Data Assimilation to Estimate Transient Hydrologic Exchange Fluxes under Highly Dynamic Flow Conditions. *Water Resources Research* . doi: 10.1029/2021WR030735

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, Jiang P, Coon, E, and Chen X. The Importance of Explicitly Representing the Streambed in Watershed Models. *Hydrological Processes*. doi: 10.22541/au.168069100.00406132/v1

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*

Open-Source Software & Datasets

Software

Coon E and **Shuai P**, (2022) Watershed Workflow. *Python Package* https://github.com/environmental-modeling-workflows/watershed-workflow

Shuai P et al., (2022) ModVis. *Python Package* https://github.com/pinshuai/modvis

Datasets

Shuai P, Jiang P, Coon, E, and Chen X. Data-model files associated with the manuscript titled "The Importance of Explicitly Representing the Streambed in Watershed Models" (Shuai et al., 2023 HP). River Corridor and Watershed Biogeochemistry SFA, *ESS-DIVE repository*. doi:10.15485/2008111

Shuai P, Chen X, Mital U, Coon E and Dwivedi D, Data-model files associated with the manuscript "The Effects of Spatial and Temporal Resolution of Gridded Meteorological Forcing on Watershed Hydrological Responses" (Shuai et al., 2022 HESS) *ESS-DIVE repository*. doi: 10.15485/1861432

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. *ESS-DIVE repository*. doi:10.15485/1756193

Presentations

** presenting author*

Invited Talks

2022. *Neversink Watershed Modeling*. Seminar with USGS Integrated Modeling Team (Online, 08/22/2022).

2021. *Impact of Surface Water Groundwater Interactions on the Transport of Water, Energy, Nutrients, and Contaminants from the Local to the Watershed Scale*. Utah State University, Logan, UT (12/09/2021).

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, 2023. *Understanding the impact of land cover change on hillslope hydrological and biogeochemical fluxes in a headwater catchment*. Oral presentation at Interagency Conference on Research in the Watersheds 8th Meeting 2023, Corvallis, OR, United States.

Shuai, P et al, 2021. *The Effects of Riverbed Properties on Watershed Hydro-Biogeochemical Processes*. Poster presentation at AGU Fall Meeting 2022, Chicago, Illinois, United States.

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 Fluc- tuations 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

Fall, 2023	**Groundwater Engineering**, Instructor	*Utah State University*
Spring, 2023	**Groundwater Engineering**, Instructor	*Utah State University*
Sept, 2021	**ATS short course**, Instructor	*Online*
Spring, 2017	**Hydrogeology**, Guest Lecturer	*Texas A&M University*
Spring, 2017	**Introduction to Geochemistry**, Teaching Assistant	*Texas A&M University*
Fall, 2016	**Hydrogeology**, Teaching Assistant	*Texas A&M University*
Fall, 2015	**Physical Geology**, Teaching Assistant	*Texas A&M University*
Spring, 2014	**Principals of Geology**, Teaching Assistant	*Texas A&M University*

Research Projects & Grants Funded

CIROH at University of Alabama

PI *Jun. 2023 - May. 2025*

- *Funding Agency*: USGS
- *Projects*: Advance water management-hydrologic model coupling to improve hydrologic forecasting in managed watersheds (Total $340,466, USU:$204,280)

DOE Office of Biological and Environmental Research (BER)

co-PI *Sep. 2023 - Aug. 2026*

- *Funding Agency*: DOE BER ESS
- *Projects*: Dynamics of interconnected surface-subsurface flow and reactive transport processes across the hillslope-riparian zone-river corridor continuum of cold, high-latitude watersheds (Total $1,000,000, USU:$276,000)

ExaSheds subcontract through PNNL - DOE

Single PI *Dec. 2022 - Sep. 2023*

- *Funding Agency*: DOE BER
- *Projects*: ATS modeling in Neversink Watershed (USU: $60,000)

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

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

Student Mentorship

Graduate Students

Jihad Othman (PhD student), Fall 2022 - present
Pamela Claure (PhD student), Fall 2023 - present
Ehsan Ebrahimi (PhD student), Fall 2023 - present

Outreach & Professional Development

Service and Outreach

2022-present	**AGU Groundwater Technical Committee**, member
2022	**Guest Editor**, Frontiers in Water
2020	**AGU Fall Meeting**, Session Primary Convener for ”H226-Recent Advances in Large Scale, High Resolution Hydrologic and Flood Modeling Leveraging High Performance Computing”
2018-2022	**AGU Fall Meeting**, OSPA Judge

Peer Review

Water Resources Research (7), Journal of Hydrology (1), Advances in Water Resources (1), Frontiers in Water (1)

Professional Memberships

American Geophysical Union (2015-present)