Curriculum Vitae

Xuehang Song

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General Information

Address: Hydrology Technical Group
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Professional Preparation

2014 Ph.D. in Hydrology & Water Resources Engineering, Wuhan University.
Supervisor: Jinzhong Yang, Liangsheng Shi.

Song, Xuehang. (2014). *Data Assimilation Application to the Saturated-unsaturated Flow*. Unpublished doctoral dissertation, Wuhan University.

2009 B.E. in Hydrology & Water Resources Engineering, Wuhan University.

Nondegree Education and Training

2015–2018 Post-doc, Atmospheric Sciences & Global Change, Earth and Biological Sciences Directorate, Pacific Northwest National Laboratory.

2014–2015 Post-doc, Department of Scientific Computing, Florida State University.

Professional Experience

2018–present Earth Scientist, Hydrology Technical Group, Energy and Environment Directorate, Pacific Northwest National Laboratory. Responsible research in

the field of computational subsurface hydrology, reactive transport modeling, Bayesian data assimilation and geostatistics.

Current Membership in Professional Organizations

American Geophysical Union
Geochemical Society

Publications

Refereed Journal Articles

Zachara, J., Chen, X., Song, X., Shuai, P., Murray, C., Resch, C., Kilometer-scale hydrologic *Water Resources Research 56, no. 2 (2020): e2019WR025258. https://doi.org/10.1029/2019WR025258.*

Song, X., Chen, X., Ye, M., Dai, Z., Hammond, G., & Zachara, J. M. (2019). Delineating Facies Spatial Distribution by Integrating Ensemble Data Assimilationand Indicator Geostatistics With Level-Set Transformation. *Water Resources Research*, (509), 2018WR023262. https://doi.org/10.1029/2018WR023262

Shuai, P., Chen, X., Song, X., Hammond, G. E., Zachara, J., Royer, P., et al. (2019). Dam Operations and Subsurface Hydrogeology Control Dynamics of Hydrologic Exchange Flows in a Regulated River Reach. *Water Resources Research*, 2018WR024193. https://doi.org/10.1029/2018WR024193

Dai, H., Chen, X., Ye, M., Song, X., Hammond, G., Hu, B., & Zachara, J. M. (2019). Using Bayesian Networks for Sensitivity Analysis of Complex Biogeochemical Models. *Water Resources Research*, 2018WR023589. https://doi.org/10.1029/2018WR023589

Dai, H., Ye, M., Hu, B. X., Niedoroda, A. W., Zhang, X., Chen, X., et al. (2019). Hierarchical sensitivity analysis for simulating barrier island geomorphologic responses to future storms and sea-level rise. *Theoretical and Applied Climatology*, *136*(3–4), 1495–1511. https://doi.org/10.1007/s00704-018-2700-5

Song, X., Chen, X., Stegen, J., Hammond, G., Song, H., Dai, H., et al. (2018). Drought Conditions Maximize the Impact of High-Frequency Flow Variations on Thermal Regimes and Biogeochemical Function in the Hyporheic Zone. *Water Resources Research*, *54*(10), 7361–7382. https://doi.org/10.1029/2018WR022586

Zhou, T., Bao, J., Huang, M., Hou, Z., Arntzen, E., Song, X., et al. (2018). Riverbed Hydrologic Exchange Dynamics in a Large Regulated River Reach. *Water Resources Research*, *54*(4), 2715–2730. https://doi.org/10.1002/2017WR020508

Dai, H., Chen, X., Ye, M., Song, X., & Zachara, J. M. (2017). A geostatistics-informed

hierarchical sensitivity analysis method for complex groundwater flow and transport modeling. *Water Resources Research*, *53*(5), 4327–4343. https://doi.org/10.1002/2016WR019756

Song, H.-S., Thomas, D. G., Stegen, J. C., Li, M., Liu, C., Song, X., et al. (2017). Regulation-Structured Dynamic Metabolic Model Provides a Potential Mechanism for Delayed Enzyme Response in Denitrification Process. *Frontiers in Microbiology*, *8*, 1866. https://doi.org/10.3389/fmicb.2017.01866

Zhou, T., Huang, M., Bao, J., Hou, Z., Arntzen, E., Mackley, R., et al. (2017). A New Approach to Quantify Shallow Water Hydrologic Exchanges in a Large Regulated River Reach. *Water*, *9*(9), 703. https://doi.org/10.3390/w9090703

Shi, L., Song, X., Tong, J., Zhu, Y., & Zhang, Q. (2015). Impacts of different types of measurements on estimating unsaturated flow parameters. *Journal of Hydrology*, *524*, 549–561. https://doi.org/10.1016/j.jhydrol.2015.01.078

Song, X., Shi, L., Ye, M., Yang, J., & Navon, I. M. (2014). Numerical Comparison of Iterative Ensemble Kalman Filters for Unsaturated Flow Inverse Modeling. *Vadose Zone Journal*, *13*(2), 0. https://doi.org/10.2136/vzj2013.05.0083

Tan, X. C., Yang, J. Z., Song, X. H., & Zha, Y. (2013). Estimation of groundwater recharge in North China Plain. *Advances in Water Science*, *24*(1), 73–81. https://doi.org/10.14042/j.cnki.32.1309.2013.01.015

Zha, Y., Yang, J., Shi, L., & Song, X. (2013). Simulating One-Dimensional Unsaturated Flow in Heterogeneous Soils with Water Content-Based Richards Equation. *Vadose Zone Journal*, *12*(2), 0. https://doi.org/10.2136/vzj2012.0109

Accepted

Rockhold, M., Robinson, J., Parajuli, K., Song, X., Zhang, F., Johnson, T.. Characterization and Monitoring of a Complex Industrial Waste Site Using Electrical Resistivity Imaging. Submitted to *Hydrogeology Journal*.

Submitted Journal Articles in revision

Song, X., Chen, X., Zachara, J., Gomez-Velez, J., Shuai, P., Ren, H., Hammond G.. Controls of River Dynamics on Residence Time and Biogeochemical Reactions of Hydrological Exchange Flows in A Regulated River Reach. Submitted to *Water Resources Research.* (major revision)

Song X., Y. Fang, J. Bao, W.A. Perkins, H. Ren, H. Zhou, and Z. Hou, et al. "Spatial variability of hydrological exchange flows and residence time in a large regulated river." Submitted to *Journal of Hydrology* (moderate revision)

Tso, C. M., Johnson, T. C., Song, X., Chen, X., Kuras, O., Wilkinson, P., Uhlemann, S., Chambers, J., Binley, A. Integrated Hydrogeophysical Modelling and Data Assimilation for Geoelectrical Leak Detection. Submitted to *Journal of Contaminant Hydrology* (minor revision).

Rizzoa, C. B., Song, X., de Barrosa, F. P., Chen, X.. Temporal Flow Variations Interact With Spatial Physical Heterogeneity to Impact Solute Transport in Managed River Corridors. Submitted to *Journal of Contaminant Hydrology* (major revision).

Submitted Journal Articles under review

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

Shuai, P., Chen, X., Hammond G., Song, X., Chen, K., Zachara, J., Perkins, W., Richmond, M., Nugent, J.. Hydrologic Exchange Flows Alter River Corridor Thermal Regimes in a Dam-regulated River. Submitted to *Water Resources Research.*

Asmussen R.M., Fang, Y., Song, X., Tartakovsky, G.D., Westsik, J.H., Smith, G.L., Brown E.E., et al.. Defining a Metric to Assess Leachability of Contaminants from Cementitious Waste Forms in Lab. Submitted to *WM Symposium 2020*

Zhu, Y., Johnson, T. C., Thomle, J. N., Strickland, C. E., Song, X., Stegen, J.. Joint hydrogeophysical inversion for monitoring dynamic mass flux at the groundwater-surface water interface. Submitted to *Journal of Hydrology*.

Moghaddam M., Ferre T.P., Chen X., Chen K., Song X., and Hammond G.. "Applying Simple Machine Learning Tools to Infer Streambed Flux from Subsurface Pressure and Temperature Observations." Submitted to *Water Resources Research*

Chen Y., J. Bao, M.C. Richmond, W.A. Perkins, H. Ren, Y. Fang, and X. Song, et al. 2020. "Three dimensional computational fluid dynamics modeling of streamflow in a 30 kilometer long reach over a nine year period using OpenFOAM." Submitted to *Water Resources Research*.

Hou Z., H. Ren, C.J. Murray, X. Song, Y. Fang, E.V. Arntzen, and X. Chen, et al. 2020. "A Novel Construct for Scaling Groundwater-River Interactions Based on Machine-Guided Hydromorphic Classification." Submitted to *Environmental Research Letters*.

Bao J., Y. Chen, Y. Fang, X. Song, W.A. Perkins, Z. Duan, and H. Ren, et al. "Use of numerical modeling to evaluate the impact of hydrodynamic pressure on hydrologic exchange fluxes and resident time for a large-scale river section over a long-term period." Submitted to *Hydrological Processes*

Ren H., Z. Hou, Z. Duan, X. Song, W.A. Perkins, M.C. Richmond, and T.D. Scheibe. 2020.

"Mapping Spatially Heterogeneous Riverbed Permeability using Machine Learning." Submitted to *Frontiers in Water*.

Nonrefereed Reports

Asmussen R.M., Y. Fang, G.D. Tartakovsky, X. Song, J.H. Westsik, and G.L. Smith. 2019. Performance Metric for Cementitious Waste Form Inventory Release in the Integrated Disposal Facility. PNNL-28992. Richland, WA: Pacific Northwest National Laboratory. Performance Metric for Cementitious Waste Form Inventory Release in the Integrated Disposal Facility.

Rockhold M.L., X. Song, J.D. Tagestad, P.D. Thorne, G.D. Tartakovsky, and X. Chen. 2018. Sensitivity Analysis of Contaminant Transport from Vadose Zone Sources to Groundwater. PNNL-28065. Richland, WA: Pacific Northwest National Laboratory.

Yonkofski C., D. Appriou, X. Song, J.L. Downs, C.D. Johnson, and V.C. Milbrath. 2018. Water Application for Dust Control in the Central Plateau: Impacts, Alternatives, and Work Strategies. PNNL-28061. Richland, WA: Pacific Northwest National Laboratory.

Presentations

Nonrefereed Presentations at Conferences

Shuai P., X. Chen, X. Song, K. Chen, and G. Hammond (2019). Dam Induced Hydrologic Exchange Flows Alter River Corridor Thermal Regime. In *AGU San Francisco, California*, United States.

Chen Y., J. Bao, M.C. Richmond, W.A. Perkins, Z. Duan, H. Ren, and Y. Fang, et al (2019). Modeling the effects of discharge nonstationarity and bathymetric heterogeneity on streambed resistance and dynamic pressure distribution in streams using OpenFOAM. In *AGU San Francisco, California*, United States.

Bao J., Y. Chen, Y. Fang, X. Song, W.A. Perkins, Z. Duan, and H. Ren, et al. (2019). Three-dimensional OpenFOAM-PFLOTRAN coupled model for large-scale river hydrologic exchange flows over long-term period. In *AGU San Francisco, California*, United States.

Song X., Y. Fang, J. Bao, W.A. Perkins, H. Ren, H. Zhou, and Z. Hou, et al. (2019). Spatial variability of hydrological exchange flows and resident time distributions in a large regulated river

Shuai P., X. Chen, X. Song, and K. Chen. (2019). Boosting Research Reproducibility: Managing High Performance Model Simulation Workflow Using Jupyter Notebook. In *AGU San Francisco, California*, United States

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Ren H., Z. Hou, X. Song, Y. Fang, W.A. Perkins, Z. Duan, and Y. Chen, et al. (2019). Machine Learning Applied to Flux/Residence Times of Hydrological Exchange Flows in the

Columbia River. In *AGU San Francisco, California*, United States.

Chen K., X. Chen, X. Song, M. Briggs, P. Jiang, P. Shuai, and G.E. Hammond, et al. (2019). Using Ensemble Data Assimilation to Estimate Transient Hydrologic Exchange Fluxes under Highly Dynamic Flow Conditions. In *AGU San Francisco, California*, United States.

Song X., X. Chen, J.M. Zachara, J. Gomez-Velez, P. Shuai, H. Ren, and G. H. (2019). Dynamic River Stage Variations Lead to Multimodal Residence Time Distributions of Hydrological Exchange Flow. In *12th Washington Hydrogeology Symposium*,. Tacoma, WA, United States.

Song, X, Chen, X., Zachara, J. M., Gomez-Velez, J. D., Shuai, P., Ren, H., & Hammond, G. E. (2018). Dynamic River Stage Variations Lead to Multimodal Residence Time Distributions of Hydrologic Exchange Flows. In *AGU Annual Meeting*. Washington DC, United States.

Chen, X., Shuai, P., Song, X., Dai, H., Hammond, G. E., Johnson, T. C., & Zachara, J. M. (2018). Using Sensitivity Analysis and Data Assimilation to Improve Process Understanding of Hydrologic Exchange Flows in Dynamic River Corridors from km-to Reach Scales. In *AGU Annual Meeting*. Washington DC, United States.

Johnson, T. C., Zhu, Y., Strickland, C. E., Thomle, J. N., Stegen, J., Song, X., & Chen, X. (2018). Joint hydrogeophysical inversion: application to dynamic mass flux monitoring at the groundwater/surface water interface. In *AGU Annual Meeting*. Washington DC, United States.

Scheibe, T. D., Stegen, J., Chen, X., Huang, M., Bao, J., Fang, Y., et al. (2018). Merging Process Understanding with Numerical Models across Scales to Predict River Corridor and Watershed Function. In *AGU Annual Meeting*. Washington DC, United States.

Shuai, P., Chen, X., Song, X., Hammond, G. E., Zachara, J. M., Royer, P., & Ren, H. (2018). Hydrogeomorphic Controls on Hydrologic Exchange Flows Dynamics within a Large Regulated River Corridor. In *AGU Annual Meeting*. Washington DC, United States.

Chen, X., Song, X., Shuai, P., Hammond, G. E., Ren, H., & Zachara, J. M. (2017). Quantifying Km-scale Hydrological Exchange Flows under Dynamic Flows and Their Influences on River Corridor Biogeochemistry. In *AGU Annual Meeting*. New Orleans, LA, United States.

Song, Xuehang, Chen, X., Shuai, P., Gomez-Velez, J. D., Ren, H., & Hammond, G. E. (2017). Hyporheic Zone Residence Time Distributions in Regulated River Corridors. In *AGU Annual Meeting*. New Orleans, LA, United States.

Tso, C. H. M., Johnson, T. C., Song, X., Chen, X., & Binley, A. M. (2017). Using coupled hydrogeophysical models and data assimilation to enhance the information content in geoelectrical leak detection. In *AGU Annual Meeting*. New Orleans, LA, United States.

Chen, X., Ren, H., Dai, H., Song, X., Goldman, A. E., Mackley, R., & Zachara, J. M. (2016). Understanding the Spatial and Temporal Variability of Groundwater and Surface Water Interaction Using a Multi-year Multi-sensor Dataset. In *AGU Annual Meeting*. San Francisco, CA, United States.

Dai, H., Chen, X., Ye, M., Song, X., & Zachara, J. M. (2016). A Bayesian Network Based Global Sensitivity Analysis Method for Identifying Dominant Processes in a Multi-physics Model. In *AGU Annual Meeting*. San Francisco, CA, United States.

Scheibe, T. D., Yang, X., Song, X., Chen, X., Hammond, G. E., Song, H. S., et al. (2016). A Multiscale Simulation Framework to Investigate Hydrobiogeochemical Processes in the Groundwater-Surface Water Interaction Zone. In *AGU Annual Meeting*. San Francisco, CA, United States.

Song, H. S., Li, M., Qian, W., Song, X., Chen, X., Scheibe, T. D., et al. (2016). Functional enzyme-based modeling approach for dynamic simulation of denitrification process in hyporheic zone sediments: Genetically structured microbial community model. In *AGU Annual Meeting*. San Francisco, CA, United States.

Song, X, Chen, X., Dai, H., Hammond, G. E., Song, H. S., & Stegen, J. (2016). Quantifying Hydro-biogeochemical Model Sensitivity in Assessment of Climate Change Effect on Hyporheic Zone Processes. In *AGU Annual Meeting*. San Francisco, CA, United States.

Zachara, J. M., Chen, X., Murray, C. J., Shuai, P., Rizzo, C., Song, X., & Dai, H. (2016). Solute Transport Dynamics in a Large Hyporheic Corridor System. In *AGU Annual Meeting*. San Francisco, CA, United States.

Zhou, T., Bao, J., Huang, M., Hou, Z., Arntzen, E., Mackley, R., et al. (2016). Quantifying hyporheic exchange dynamics in a highly regulated large river reach. In *AGU Annual Meeting*. San Francisco, CA, United States.

Song X., X. Chen, M. Ye, Z. Dai, and G. H. (2015). Delineating Facies Spatial Distribution by Integrating Ensemble Data Assimilation and Indicator Geostatistics. In *AGU Annual Meeting*. San Francisco, CA, United States.

Invited Workshops

Song X., and G. Hammond. (2018, December). PFLOTRAN Reaction Sandbox. Workshop delivered at AGU Fall Meeting 2018, Washington D.C.

Contracts and Grants

Contracts and Grants Pending

Mays, D (PI), Neupauer, R. (Co-PI), & Song, X. (Co-PI). (Apr 2019). Chaotic *Advection, Groundwater Flow, and Biogeochemical* Reactions. Submitted to U. S. Department of Energy.

The Profession

Guest Reviewer for Refereed Journals

Inverse Problems in Science & Engineering (2016-present).

Soil Science Society of America Journal (2016–present).

Advances in Water Resources (2017–present).

Water Resources Research (2017–present).

Journal of Hydrology (2018–present).

Journal of Hydrologic Engineering (2019–present)

Resources (2019–present)

Water (2019–present)