Dan Lu

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Education

Ph.D. in Computational Hydrology — 2012
Florida State University, Tallahassee, FL

M.S. in Hydrology and Water Resources — 2007
China University of Geosciences, Beijing, China

B.S. in Environmental Engineering — 2004
Hebei University of Geosciences, Shijiazhuang, China

Professional Experience

Staff Research Scientist — 2016 – Now
Oak Ridge National Laboratory

Postdoctoral Research Associate — 2013 – 2016
Oak Ridge National Laboratory

Postdoctoral Research Associate — 2012 – 2013
U.S. Geological Survey, Menlo Park, CA

Graduate Research Assistant — 2007 – 2012
Florida State University

Internship Researcher — 2010
U.S. Geological Survey, Boulder, CO

Grants

DOE SciDAC - Biological and Environmental Research & Advanced Scientific Computing Research, *Optimization of sensor networks for improving climate model predictions*, $3,800,000 for 2018–2020

ORNL - Laboratory Directed Research & Development, *ORNL artificial intelligence initiative*, $25,000,000 for 2018–2023

DOE - Biological and Environmental Research, *Spruce and peatland responses under changing environments*, $8,300,000 per year since 2010.

DOE - Biological and Environmental Research, *ExaSheds: Advancing Watershed System Understanding through Machine Learning-Based Data-Intensive Extreme-Scale Simulation*, $2,000,000 for 2020

Journal Articles (Published)

Lu, D. , Liu S., and Ricciuto D., *An efficient Bayesian method for advancing the application of deep learning in earth science.* Proceedings of the 2019 IEEE International Conference on Data Mining Workshops (ICDMW 2019), DOI: 10.1109/ICDMW.2019.00048.

Lu, D. , and Ricciuto D., *Learning-based inversion-free model-data integration to advance ecosystem model prediction.* Proceedings of the 2019 IEEE International Conference on Data Mining Workshops (ICDMW 2019), DOI: 10.1109/ICDMW.2019.00049.

Lu, D. and D. Ricciuto, *Efficient surrogate modeling methods for large-scale Earth system models based on machine learning techniques*,Geoscientific Model Development, 12, 1791-1807, 2019.

Mo, S., X. Shi, **D. Lu**, M. Ye, and J. Wu, *An adaptive Kriging surrogate method for efficient uncertainty quantification with an application to geological carbon sequestration modeling*, Computers and Geosciences, 125, 69-77, 2019.

Evans, K., J. Kennedy, **D. Lu**, M. M. Forrester, S. price, J. Fyke, A. Bennett, M. Hoffman, I. Tezaur, C. Zender, and M. Vizcaino, *LIVVkit 2.1: Automated and extensible ice sheet model validation*, Geoscientific Model Development, 12, 1067-1086, 2019.

Walker A. P., M. Ye, **D. Lu**, M. G. De Kauwe, L. Gu, B. E. Medlyn, A. Rogers, and S. P. Serbin, *The multi-assumption architecture and testbed (MAAT v1.0): R code for generating ensembles with dynamic model structure and analysis of epistemic uncertainty from multiple sources*, Geoscientific Model Development, 11, 2018.

Lu, D., D. Ricciuto, M. Stoyanov, and L. Gu, *Calibration of the E3SM land model using surrogate based global optimization*, Journal of Advances in Modeling Earth Systems, 10, 1337–1356, 2018.

Lu, D., D. Ricciuto, and K. Evans, *An efficient Bayesian data-worth analysis using a multilevel Monte Carlo method*, Advances in Water Resources, 113, 223–235, 2018.

Mo, S., **D. Lu**, X. Shi, G. Zhang, M. Ye, J. Wu, and J. Wu, *A Taylor expansion-based adaptive design strategy for global surrogate modeling with applications in groundwater modeling*, Water Resources Research, 53, 10802–10823, 2017.

Shi, X., S. Finsterle, K. Zhang, and **D. Lu**, *Advances in multiphase flow and transport in the subsurface environment.*, Geofluids, https://doi.org/10.1155/2018/2906326, 2018.

Lu, D., D. Ricciuto, A. Walker, C. Safta, and W. Munger, *Bayesian calibration of terrestrial ecosystem models: a study of advanced Markov chain Monte Carlo methods*, Biogeosciences, 14, 4295–4314, 2017.

Xi, M., **D. Lu**, D. Gui, Z. Qi, and G. Zhang, *Calibration of an agricultural-hydrological model (RZWQM2) using surrogate global optimization*, Journal of Hydrology, 544, 456–466, 2017.

Lu, D., G. Zhang, C. Webster, and C. Barbier, *An improved multilevel Monte Carlo method for estimating probability distribution functions in stochastic oil reservoir simulations*, Water Resources Research, 52, 9642–9660, 2016.
(*** This work was reported in *The BAKKEN Magazine in 2015* [online version])

Liu, P., A. S. Elshall, M. Ye, P. Beerli, X. Zeng, **D. Lu**, and Y. Tao, *Evaluating marginal likelihood with thermodynamic integration method and comparison with several other numerical methods*, Water Resources Research, 52, 734–758, 2016.

Hill, M. C., D. Kavetski, M. Clark, M. Ye, M. Arabi, **D. Lu**, L. Foglia, and S. Mehl, *Practical use of computationally frugal model analysis methods*, Ground Water, 54, 159–170, 2015.

Lu, D., M. Ye, and G. P. Curtis, *Maximum likelihood Bayesian model averaging and its predictive analysis for groundwater reactive transport models*, Journal of Hydrology, 529(3), 1859–1873, 2015.

Lu, D., M. Ye, M. C. Hill, E. P. Poeter, and G. P. Curtis, *A computer program for uncertainty analysis integrating regression and Bayesian methods*, Environmental Modeling & Software, 60, 41–56, 2014.

Zhang, G., **D. Lu**, M. Ye, M. Gunzburger, and C. Webster, *An adaptive sparse-grid high-order stochastic collocation method of Bayesian inference in groundwater reactive transport modeling*, Water Resources Research, 49(10), 6871–6892, 2013.

Lu, D., M. Ye, P. D. Meyer, G. P. Curtis, X. Shi, X. Niu, and S. B. Yabusaki, *Effects of error covariance structure on estimation of model averaging weights and predictive performance*, Water Resources Research, 49(9), 6029–6047, 2013.

Hill, M. C., D. Kavetski, M. Clark, M. Ye, and **D. Lu**, *Uncertainty quantification for environmental models*, SIAM News, 45(9), 2012.

Lu, D., M. C. Hill, and M. Ye, *Analysis of regression confidence intervals and Bayesian credible intervals for uncertainty quantification*, Water Resources Research, 48(9), W09521, 2012.
(*** This paper was selected as *Editor's Highlight* entitled new insights into faster computation of uncertainties)

Lu, D., M. Ye, S. P. Neuman, and L. Xue, *Multimodel Bayesian analysis of data-worth applied to unsaturated fractured tuffs*, Advances in Water Resources, 35, 69–82, 2012.

Neuman, S. P., L. Xue, M. Ye, and **D. Lu**, *Bayesian analysis of data-worth considering model and parameter uncertainties*, Advances in Water Resources, 36, 75–85, 2012. (*** *Top 10 Cited Paper* in 2012-2013 of Advances in Water Resources [Certificate])

Lu, D., M. Ye, and S. P. Neuman, *Dependence of Bayesian model selection criteria and Fisher information matrix on sample size*, Mathematical Geoscience, 43, 2011.

Ye, M., **D. Lu**, S. P. Neuman, and P. D. Meyer, *Comment on "Inverse groundwater modeling for hydraulic conductivity estimation using Bayesian model averaging and variance window" by Frank T.-C. Tsai and Xiaobao Li*, Water Resources Research, 46, W02801, 2010.

Refereed Conference Publications

Zhang, G., **D. Lu**, M. Ye, M. Gunzburger, and C. Webster, *An efficient surrogate modeling approach in Bayesian uncertainty analysis*, 11th International Conference of Numerical Analysis and Applied Mathematics, 1558, 898–901, 2013.

Ye, M., **D. Lu**, S. P. Neuman, and L. Xue , *Multimodel Bayesian analysis of data-worth applied to unsaturated fractured tuffs*, International Conference on Groundwater: Our Source of Security in an Uncertain Future, Pretoria, South Africa, 2011.

Lu, D., M. C. Hill, and M. Ye, *Analysis of regression and Bayesian predictive uncertainty measures*, MODFLOW and More 2011 Conference, Golden, CO, 2011.

Neuman, S. P., L. Xue, M. Ye, and **D. Lu**, *Multimodel assessment of the worth of data under uncertainty*, Water Management Symposium, Phoenix, AZ, 2011.

Ye, M., **D. Lu**, G. Miller, G. P. Curtis, P. D. Meyer, and S. B. Yabusaki, *Assessment of predictive uncertainty in coupled groundwater reactive transport modeling*, Conference on Goldschmidt – Earth, Energy and Environment, Knoxville, TN, 2010.

Technical Reports

Barbier, C., **D. Lu**, N. Collier, F. Curtis, C. G. Webster, and Y. Polsky, *High performance computing simulations for shale gas formation flow transport and uncertainty quantification analysis*, ORNL Technical Report, ORNL/TM-2015/543, 2015.

Software Development

UCODE_2014: A Computer Code for Sensitivity Analysis, Model Calibration, and Uncertainty Evaluation

Sponsor: U.S. Geological Survey

Developers: Eileen P. Poeter, Mary C. Hill, **Dan Lu**, and Steffen Mehl

Webpage: http://igwmc.mines.edu/freeware/ucode/

Selected oral Presentations

(Invited) *Efficient surrogate modeling methods to advance model-data integration*, American Geophysics Union annual meeting, Washington D.C., 2018.

(Invited) *2nd workshop on quantifying and reducing uncertainty in Earth system model projections*, University of Leeds, UK, 2019.

(Invited) *Optimization of sensor networks for improving climate predictions*, Germantown, Maryland, 2018.

(Invited) *A systematic Bayesian uncertainty quantification framework in environmental modeling*, Jinan University, Guangzhou, China, 2018.

(Invited) *Efficient surrogate modeling methods for model-data integration*, Geological Survey of Japan, AIST, Japan, 2018.

(Invited) *Efficient uncertainty quantification methods in groundwater contaminant risk assessment*, Japan Geosciences Union Annual Meeting, Chiba, Japan, 2018.

(Invited) *Application of reduced-order modeling techniques for uncertainty quantification*, CSMD-CSED Cross-Divisional Seminar, 2018.

(Invited) *Potential exascale applications for quantifying uncertainty in the land-atmosphere system*, Exascale Application in Climate and Environmental Science workshop, 2018.

(Invited) *Advance climate model development, prediction, and risk assessment using artificial intelligence*, AI for Climate Sciences Seminar, 2018.

An efficient Bayesian data-worth analysis using a multilevel Monte Carlo method, American Geophysics Union Annual Meeting, New Orleans, LA, 2017.

Quantum behaved particle swarm optimization for parameter estimation in terrestrial ecosystem models, 2017 ESS PI Meeting, Washington D.C., 2017.

Calibration of the Community Land Model (CLM4.5) using surrogate based global optimization, American Geophysics Union Annual Meeting, San Francisco, CA, 2016.

A systematic Bayesian framework for uncertainty quantification in environmental modeling, Earth System Modeling Workshop, Oak Ridge National Laboratory, TN, 2015.

Multilevel Monte Carlo method with application to uncertainty quantification in oil reservoir simulation, American Geophysics Union Annual Meeting, San Francisco, CA, 2014.

Assessment of predictive performance of Bayesian model averaging in groundwater reactive transport models, 2014 SIAM Conference on Uncertainty Quantification, Savannah, GA, 2014.

Maximum likelihood Bayesian model averaging of groundwater reactive transport models, 2014 SIAM SEAS Annual Meeting, Melbourne, FL, 2014.

Integration of Markov chain Monte Carlo simulation into UCODE for Bayesian uncertainty analysis, Geological Society of America Annual Meeting, Charlotte, NC, 2012.

Effects of temporal error correlation on quantification of predictive uncertainty in groundwater reactive transport modeling, annual PI meeting of the Subsurface Biogeochemical Research Program of the Department of Energy, Washington D.C., 2012.

Effects of temporal residual correlation on model weights, American Geophysics Union Annual Meeting, San Francisco, CA, 2011.

Multimodel Bayesian analysis of data-worth applied to unsaturated fractured tuffs, Geosciences Applications Opening Workshops on Uncertainty Quantification, Research Triangle Park, NC, 2011.

Analysis of predictive uncertainty measures of regression and Bayesian, 2011 MODFLOW and More Meeting, Golden, CO, 2011.

A controlled experiment for investigating prediction accuracy and prediction uncertainty in groundwater flow modeling, American Geophysics Union Annual Meeting, San Francisco, CA, 2010.

Honors and Awards

Selected Early Career Scientist to DOE-BER headquarter for the annual meeting, 2018.

Student Travel Fellowship to the annual PI meeting of the subsurface biogeochemical research program of the Department of Energy, 2012.

Statistical and Applied Mathematical Sciences Institute (SAMSI) Travel Award to the geosciences applications opening workshops on uncertainty quantification, 2011.

Graduate Student Scholarship for Academic Excellence, China University of Geosciences, China, 2004–2007

Excellent Undergraduate Student of Hebei Province, China, 2003

Undergraduate Student Scholarship for Academic Excellence, Hebei University of Geosciences, China, 2000–2004

Organizing committees

Groundwater Technique Committee for AGU, 2016 – present

Program Committee Member for the Climate and Weather Domain of the PASC19 Conference, 2019

Supervising Ph.D. students

Kan Zhang, Illinois Institute of Technology

Siyan Liu, University of Kansas

Editorial Services

Co-editor: *Special issue on advances in multiphase flow and transport in the subsurface environment*, **Geofluids**, https://doi.org/10.1155/2018/2906326, 2018, co-organized with Shi, X., S. Finsterle, K. Zhang.

Reviewer for Journals

Water Resources Research

Advances in Water Resources

Journal of Hydrology

Environmental Modeling & Software

Stochastic Environmental Research and Risk Assessment

Analytical Chemistry

Hydrogeology Journal

Hydrological Processes

Biogeosciences

Geoscientific Model Development

Hydrology and Earth System Sciences

Theoretical and Applied Climatology

Memberships

American Geophysical Union (AGU)

Japan Geoscience Union (JpGU)

Geologic Society of America (GSA)

Society for Industrial and Applied Mathematics (SIAM)

Chinese American Water Resources Association (CAWRA)