Lijing Wang

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Education

Stanford University

Ph.D. in Earth and Planetary Sciences 2017/09 - 2023/03
(Formerly Geological Sciences)
Ph.D. minor in Computer Science 2021/09 - 2023/03
Dissertation title: *Integrating data and models for sustainable decision-making in hydrology*
Committee: Jef Caers (Primary advisor), Kate Maher, Tapan Mukerji, Peter Kitanidis, Mykel Kochenderfer

Peking University

B.S. in Space Physics and Applied Mathematics 2013/09 - 2017/07

Hong Kong University of Science and Technology

Physics, exchange program with a full-tuition scholarship 2014/09 - 2014/12

Professional Experience

Lawrence Berkeley National Laboratory (LBNL)

Postdoctoral Fellow, Climate & Ecosystem Science Division 2023/04 - present

Research Interests

Model-data integration for hydrology, machine learning-based inverse methods, data science for geosciences, stochastic geomodeling, non-stationary geostatistics, decision making for uncertain hydrologic systems

Research Experience

Bayesian inversion methods for earth observation data 2018 - present
With J. Caers (Stanford), P. Kitanidis (Stanford)

- Used hierarchical Bayesian framework for complex earth model parameterization
- Developed machine learning-based inversion for non-linear inversion problem
- Developed local principal component analysis method to perform inversion with local data (i.e. borehole measurements)

Quantifying water exchanges uncertainty of floodplain 2021 - present
With K. Maher (Stanford), J. Caers (Stanford)

- Built a hydrologic modeling workflow and assimilated water head measurements and hydraulic gradient
- Performed sensitivity analysis to understand driven factors for hydrologic dynamics
- Investigated the beavers' impact on floodplain hydrologic dynamics
- Used data science to understand hydrobiogeochemical processes

Fast climate resilience assessment of groundwater contamination 2022 - present

With H. Wainwright (MIT), Z. Xu (Lawrence Berkeley National Lab)

- Developed a deep learning surrogate model for groundwater flow and contaminant transport
- Combined both data-driven factors and physical boundary constraints (physics-informed neural network) in loss functions
- Provided a fast and reliable assessment for site managers: how contaminant concentration changes spatial-temporally under different future climate projections

Statistical modeling of 3D redox architectures 2018 - present

With Geological Survey of Denmark and Greenland, HydroGeophysics Group in Aarhus U

- Used geostatistics and statistical learning to predict 3D redox architecture given geophysical EM survey and redox boreholes. A 3D redox architecture is essential for a more accurate and effective targeted nitrogen regulation
- Identified statistically important geological structures for redox conditions

Data-driven geological interface modeling 2019 - present

With J. Caers (Stanford), E.J. MacKie (U of Florida), L. Peeters (CSIRO)

- Developed a new implicit optimization method for uncertain inference modeling
- Combined geological constraints and data-driven losses
- Applied to 1) bed topography simulation in Greenland 2) palaeovalley modeling in Australia

Sequential mineral exploration planning 2021 - present

With J. Caers (Stanford)

- Built a fast inversion workflow for sequential mineral exploration planning
- Generated uncertain ore bodies using implicit level set methods

Books

[1] **L. Wang**, Z. Yin, J. Caers, Data Science for the Geosciences, *Cambridge University Press*, 2023 (in press)

Journal Publications

[12] **L. Wang**, A. Meray, T. Kurihana, I. Mastilovic, S. Praveen, Z. Xu, M. Memarzadeh, A. Lavin, H. Murakami-Wainwright, Physics-informed surrogate modeling for supporting climate resilience at groundwater contamination sites, 2023 (in prep.)

[11] **L. Wang**, Z. Perzan, T. Babey, M. Briggs, S. Pierce, B. Rogers, J. Bargar, K. Maher, Uncertainty quantification of water exchanges due to beaver-induced inundation, 2023 (in prep.)

[10] **L. Wang**, L. Peeters, E.J. MacKie, J. Caers, Unraveling the uncertainty of geological interfaces through data-knowledge-driven trend surface analysis, *Computers & Geosciences*, 2023 (under review)

[**9**] E.J. MacKie, M. Field, **L. Wang**, Z. Yin, N. Schoedl, M. Hibbs, A. Zhang, GStatSim V1.0: a Python package for geostatistical interpolation and simulation, *Geoscientific Model Development*, 2023 (under review)

[**8**] **L. Wang**, H. Kim, A. V. Christiansen, B. Hansen, J. Caers, Statistical modeling of 3D redox architecture from non-colocated redox borehole and transient electromagnetic data, *Hydrogeology Journal*, 2023 (accepted, in press, SI: Geostatistics and Hydrogeology)

[**7**] **L. Wang**, F. Joncour, P. Barrallon, T. Harribey, L. Castanie, S. Yousfi, S. Guillon, Semi-supervised semantic segmentation for seismic interpretation, *Geophysics*, 2023 (accepted, in press)

[**6**] T. Hall, C. Scheidt, **L. Wang**, Z. Yin, T. Mukerji, J. Caers, Sequential value of information for subsurface exploration drilling, *Natural Resources Research*, 2022

[**5**] **L. Wang**, P. Kitanidis, J. Caers, Hierarchical Bayesian inversion of global variables and large-scale spatial fields, *Water Resources Research*, 2022

[**4**] J. Caers, C. Scheidt, Z. Yin, **L. Wang**, T. Mukerji, K. House, Efficacy of information in mineral exploration drilling, *Natural Resources Research*, 2022

[**3**] A. Miltenberger, S. Uhlemann, T. Mukerji, K. Williams, B. Dafflon, **L. Wang**, H. Murakami-Wainwright, Probabilistic evaluation of geoscientific hypotheses with geophysical data: application to electrical resistivity imaging of a fractured bedrock zone, *Journal of Geophysical Research - Solid Earth*, 2021

[**2**] E. C. Johnston, F. Davenport, **L. Wang**, J. Caers, S. Muthukrishnan, M. Burke, N. S. Diffenbaugh, Quantifying the influence of precipitation intensity on landslide hazard in urbanized and non-urbanized areas, *Geophysical Research Letters*, 2021

[**1**] Q. Li, **L. Wang**, Z. Perzan, J. Caers, G. Brown, J. Bargar, K. Maher, Global sensitivity analysis of a reactive transport model for mineral scale formation during hydraulic fracturing, *Environmental Engineering Science*, 2021

Conference Publications

[**2**] **L. Wang**, T. Kurihana, A. Meray, I. Mastilovic, S. Praveen, Z. Xu, M. Memarzadeh, A. Lavin, H. Murakami-Wainwright, Multi-scale Digital Twin: Developing a fast and physics-infused surrogate model for groundwater contamination with uncertain climate models, *Machine Learning and the Physical Sciences Workshop at the 36th conference on Neural Information Processing Systems*, 2022

[**1**] R. M. Rustowicz, R. Cheong, **L. Wang**, S. Ermon, M. Burke, D. Lobell, Semantic segmentation of crop type in Africa: A novel dataset and analysis of deep learning methods, *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops*, 2019

Invited Talks

University of Arizona | Department of Hydrology and Atmospheric Sciences Seminar — Apr 2023

SLAC National Accelerator Laboratory | Environmental Geochemistry Group Research Talk — Mar 2023

University of Connecticut | Department of Earth Sciences Seminar — Feb 2023

University of Florida | Department of Geological Sciences Seminar — Jan 2023

Teaching and Mentoring

Data Science for Geoscience (GEOLSCI 6, GEOLSCI 240)
Teaching Assistant, Stanford University — 2019 - 2022

- Taught both graduate level ($\sim$ 40 students) and undergraduate level ($\sim$ 15 students) classes
- Developed new course materials including geoscientific data case studies, python notebooks and homework
- Mentored students to apply data science tools to their own geoscientific problems
- Designed a new textbook: Data Science for the Geosciences

Data Science for Social Good Summer Program
Technical Mentor, Stanford Data Science, Stanford University — Summer 2021

- Mentored three student fellows: one graduate and two undergraduate students
- Technical mentor for the project: Measuring spatial-temporal change of physical conditions in neighborhoods with street view imagery
- Designed computer vision tutorials for student fellows
- Organized guest seminars for student fellows

Service

Reviewer for: Water Resources Research, Advanced in Water Resources, Hydrogeology Journal, Mathematical Geosciences, Scientific Reports

Session chair/primary convener: Advances in Data Assimilation and Uncertainty Quantification of Water Resources Management, *AGU Fall Meeting 2022* — 2022

Stanford Data Science Scholar Blog: Introduction to Spatial Data Analysis — 2022

Student DEI leader representative, Stanford Earth — 2021 - 2022

Graduate panelist for Stanford Earth IDEAL (Inclusion, Diversity, Equity, and Access) faculty search — 2021

Co-president in Association of Chinese Students and Scholars at Stanford — 2019 - 2020

Student organizing committee, Women in Data Science (WiDS) at Stanford Earth — 2019

Honors and Awards

"Unexpected Discovery" Innovation Award, Frontier Development Lab - using sensitivity analysis to improve physical simulations' accuracy	2022
Stanford Data Science Scholars Program Fellowship ($100,000) - among 11 chosen out of 151 applicants - awarded to Stanford Ph.D. students who are involved in the challenging use of data science at the frontiers of their research	2020 - 2022
Geological Sciences Department Travel Fund 2022	2022
Society for Industrial and Applied Mathematics (SIAM) Travel Awards	2021
Geological Sciences Department Travel Fund 2021	2021
Harriet Benson Fellowship Award ($5,000) - honors exceptional scholarship and research accomplishments by graduate students in the Department of Geological Sciences	2020
2nd Prize in Stanford Big Earth Hackathon	2018
Meritorious in COMAP's Mathematical Contest in Modeling	2016
Houston BAA Scholarship	2016
Guanghua Scholarship	2014, 2015
Dean's list in School of Science, HKUST	2014

Presentation and Poster

[18] L. Wang, T. Kurihana, A. Meray, I. Mastilovic, S. Praveen, Z. Xu, M. Memarzadeh, A. Lavin, H. Murakami-Wainwright, Physics-informed surrogate modeling for supporting climate resilience at groundwater contamination sites, *HydroML 2023 symposium* [Plenary eLightning Talk]

[17] L. Wang, C. Scheidt, Z. Yin, K. Maher, J. Caers, Parameter inversion with sequential neural density estimators: an enhanced machine learning-based inversion, *American Geophysical Union, Fall Meeting 2022* [Poster]

[16] L. Wang, T. Kurihana, A. Meray, I. Mastilovic, S. Praveen, Z. Xu, M. Memarzadeh, A. Lavin, H. Murakami-Wainwright, Physics-informed surrogate modeling for supporting climate resilience at groundwater contamination sites, *American Geophysical Union, Fall Meeting 2022* [Poster]

[15] E.J. MacKie, **L. Wang**, Z. Yin, A. Zhang, N. Schoedl, GlacierStats geostatistical software for modeling ice sheet conditions, *American Geophysical Union, Fall Meeting 2022* [Poster]

[14] Q. Li, K. Maher, **L. Wang**, J. Caers, A shale-water interaction model and its sensitivity to each input parameter over the entire domain, *American Geophysical Union, Fall Meeting 2022* [Oral]

[13] L. Wang, T. Kurihana, A. Meray, I. Mastilovic, S. Praveen, Z. Xu, M. Memarzadeh, A. Lavin, H. Murakami-Wainwright, Multi-scale Digital Twin: Developing a fast and physics-infused surrogate model for groundwater contamination with uncertain climate models, *Machine Learning and the Physical Sciences Workshop at the 36th*

conference on Neural Information Processing Systems [Poster]

[12] L. Wang, T. Kurihana, A. Meray, I. Mastilovic, S. Praveen, Z. Xu, M. Memarzadeh, A. Lavin, H. Murakami-Wainwright, Physics-informed surrogate modeling for supporting climate resilience at groundwater contamination sites, *Frontier Development Lab 2022 Live Showcase* [Oral]

[11] L. Wang, Z. Perzan, T. Babey, M. Briggs, S. Pierce, B. Rogers, J. Bargar, K. Maher, Uncertainty quantification of water exchanges due to beaver-induced inundation, *American Geophysical Union, Fall Meeting 2021* [Oral]

[10] E.J. MacKie, **L. Wang**, D.M. Schroeder, C. Zuo, Z. Yin, J. Caers, M. Hibbs, The parallel worlds of DEMOGORGN Greenland, *American Geophysical Union, Fall Meeting 2021* [Oral]

[9] T. Babey, Z. Perzan, B. Rogers, **L. Wang**, S. Pierce, J. Bargar, K. Maher, Hydro-biogeochemical response of oxic-anoxic interfaces to beaver dam construction in a simulated floodplain aquifer, *American Geophysical Union, Fall Meeting 2021* [Poster]

[8] L. Wang, L. Peeters, J. Caers, Quantifying uncertainty of non-stationary geological interfaces: Metropolis-Hasting sampling of implicit level sets, *SIAM Conference on Mathematical & Computational Issues in the Geosciences, 2021* [Oral]

[7] L. Wang, T. N. Vilhelmsen, J. Caers, Local decision making through understanding of multi-scale uncertainty: Application to well catchment protections in Denmark *Computational Methods in Water Resources, 2020* [Oral]

[6] L. Wang, L. Peeters, J. Caers, Uncertainty assessment of hydrogeological structures combining geophysical survey and geological knowledge: A stochastic level set optimization framework, *American Geophysical Union, Fall Meeting 2020* [Oral]

[5] L. Wang, T. N. Vilhelmsen, J. Caers, Direct forecasting of local hydraulic conductivity using combined geophysical and hydrological data: Application to well catchment predictions in Danish aquifer system, *American Geophysical Union, Fall Meeting 2019* [Poster]

[4] L. Wang, T. N. Vilhelmsen, J. Caers, Joint Uncertainty Quantification on Spatial and Global Hydrogeological Models: An Application to Danish Groundwater Management, *American Geophysical Union, Fall Meeting 2018* [Poster]

[3] E. C. Johnston, J. Caers, **L. Wang**, F. Davenport, S. Muthukrishnan, N. S. Diffenbaugh, Multi-scale signatures of climate change on landslide susceptibility: a case study for the Pacific Coast of the United States, *American Geophysical Union, Fall Meeting 2018* [Poster]

[2] L. Wang, O. Grujic, J. Caers, Reconstruction and Forecasting Oil Rates Using Functional Data Analysis and Universal Co-Kriging, *NGI Industrial Affiliates Meet-*

ing, Stanford University, 2017 [Poster]

[1] L. Wang, O. Grujic, J. Caers, Statistical Learning on Incomplete Production Profiles of Unconventional Reservoirs, *NGI Industrial Affiliates Meeting, Stanford University, 2016* [Poster]

Industrial Experience

Data Science Intern, TotalEnergies Summer 2020

- AI & Geosciences Program based in Google Cloud Advanced Solutions Lab
- Developed a semi-supervised learning framework to optimize geophysical data interpretation with limit labels
- Quantified uncertainty of the semi-supervised learning framework in order to do active learning and help experts' sequential geophysical interpretations

Skills

Programming languages: Python, R, MATLAB, C/C++
Deep Learning Framework: TensorFlow, Keras, PyTorch
Other Software: LaTeX, Git, Jupyter Notebook, Google Cloud, Azure