BEICHEN ZHANG, PH.D.

Earth and Environmental Sciences Area ◇ Lawrence Berkeley National Laboratory

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PERSONAL PROFILE

Postdoctoral Researcher at Berkeley Lab, specializing in studying **climate extremes**, particularly **drought**, and their environmental and societal impacts. With over 7 years of experience in **geoinformatics**, including advanced remote sensing, geographic information system (GIS), and geospatial analysis, and **applied climatology**. Skilled in **data science**, with over 5 years of hands-on experience in **machine learning** (ML) and **deep learning** (DL) modeling, using Python and R, supported by publications in top-tier journals and conferences. Demonstrates strong ability in developing innovative models to address complex climate-related challenges.

PROFESSIONAL EXPERIENCE

Postdoctoral Researcher, **Lawrence Berkeley National Laboratory** June 2024 - Current
Advisor: Dr. Newsha Ajami
Developed an integrated framework that couples ML-driven agent-based modeling and life cycle assessment (LCA) to evaluate environmental and societal impacts of energy transitions. The work supports comprehensive assessments of natural resources, climate risk, and community impacts to inform decarbonization strategies.

Project Researcher, **Frontier Development Lab** June 2022 - August 2022
Project lead: Dr. Vít Růžička
Funded by NASA and DOE, Developed a self-supervised DL model using high-resolution remote sensing data to monitor wildfire burn areas and assess severity. This work advances rapid and accurate wildfire assessment.

EDUCATION

Ph.D., Natural Resource Sciences, **University of Nebraska-Lincoln** August 2019 - August 2024
Specialized in Climate Assessment and Impacts, with a minor in Statistics
Advisors: Dr. Michael Hayes, Dr. Tsegaye Tadesse
Dissertation: Applications of Artificial Intelligence on Drought Impact Monitoring and Assessment

M.S., Natural Resource Sciences, **University of Nebraska-Lincoln** August 2017 - August 2019
Specialized in Climate Assessment and Impacts
Advisor: Dr. Tsegaye Tadesse
Thesis: Investigation of GRACE-derived Information on Forest Drought Stress Across the Contiguous U.S.

B.S., Geographic Information Science, **Northwest A&F University** August 2013 - July 2017

RESEARCH EXPERIENCE AND INTERESTS

AI modeling and LCA analysis for sustainable and resilient energy transitions

- Developed a coupled ML-driven ABM-LCA modeling framework to evaluate the environmental and societal impacts of energy transition portfolios.
- Developed a conceptual framework to assess inter-dependencies among energy transition pathways; presented at AGU 2024, and submitted to *Science Advances*.
- Analyzed environmental, social, and governance (ESG) data from the BloombergNEF to examine links between policy, ESG scores, and investment patterns in the hydrogen industry.
- Investigated water sustainability challenges of hydrogen production across spatial and temporal scales in California, developing regional and city-level case studies for scenario analysis.

AI modeling for drought monitoring and impact assessment

- Built explainable machine learning models using XGBoost and SHAP to assess drought impacts across multiple sectors; presented at the NeurIPS 2020 workshop, and published in *Science of The Total Environment*.
- Developed an NLP pipeline to extract drought impacts from social media, news, and crowd-sourced data; presented at ICML 2021 workshop, and currently under revision for journal publication.

AI modeling and remote sensing for wildfire monitoring and assessment

- Developed **FireCLR**, a self-supervised DL model for wildfire burn areas and severity detection; presented and published at NeurIPS 2022 workshop; and showcased by FDL.
- Developed the operational Forest Drought Response Index (ForDRI), an unsupervised index using remote sensing and hydrometeorological data; published in *Remote Sensing* and *Forests*.

Causal inference for climate extremes, public health, and societal impacts

- Investigated the relationship between drought indices and cardiovascular and respiratory mortality in California using structural equation modeling; preliminary findings presented at AGU 2023.
- Investigated causal links between climate extremes and protest activity in South Asia using remote sensing and demographic datasets; presented at AGU 2022, and currently being prepared for a journal submission.

TEACHING AND MENTORING EXPERIENCE

Mentor, Scalable & explainable ML for wildfire risk modeling in Southern Europe: A case-study in Portugal

Mentored a research team at the Technical University of Denmark on a 4-week research project on developing an explainable ML model for wildfire risk prediction.

Project Advisor, Analyzing the drought impacts on Washington State's agricultural sector

Mentored a graduate student team at the University of Washington on a 10-week capstone project investigating drought-related risks in agriculture under climate change.

Lab Instructor, Applications of remote sensing in agriculture and natural resources

Taught practical applications of remote sensing for vegetation and ecosystem monitoring, including multispectral and hyperspectral analysis with ENVI and ERDAS Imagine.

Lab Instructor, Introduction to remote sensing

Taught fundamental remote sensing data collection and hands-on data processing with ENVI and ERDAS Imagine, emphasizing multispectral remote sensing experiments.

Lab Instructor, Introduction to geospatial technologies

Taught GIS principles and applications using ArcGIS and QGIS for spatial analysis and data visualization.

PUBLICATIONS

Peer-reviewed

Tadesse, T., Connolly, S., Wardlow, B., Svoboda, M., **Zhang, B.**, ... & Riganti, C. (2025). Development and Evaluation of the Forest Drought Response Index (ForDRI): An integrated tool for monitoring drought stress across forest ecosystems in the contiguous United States. Forests, 16(7), 1187.

Smith, K., Walker, D., **Zhang, B.**,Veness, W., Lam, M., Knutson, C., Stefanski, R., Aich, V. & Svoboda, M. (2025). Baseline assessment of drought impact monitoring. Integrated Drought Management Programme, Integrated Drought Management Tools and Guidelines Series 3. World Meteorological Organization and Integrated Drought Management Programme.

Werum, R., Hayes, M., Schaefer, D., & **Zhang, B.** (2025). Climate Extremes and Protests in India, Pakistan, and Bangladesh, 1995–2013. Weather, Climate, and Society, 17(2), 161-175.

Zhang, B., Salem, F. K. A., Hayes, M. J., Smith, K. H., Tadesse, T., & Wardlow, B. D. (2023). Explainable machine learning for the prediction and assessment of complex drought impacts. *Science of The Total Environment*, 165509.

Zhang, B., Wang, H., Alabri, A., Bot, K., McCall, C., Hamilton, D., & Růžička, V. (2022). Unsupervised wildfire change detection based on contrastive learning. *NeurIPS Workshop on Artificial Intelligence for Humanitarian Assistance and Disaster Response*.

Zhang, B., Schilder, F., Smith, K., Hayes, M., Harms, S., & Tadesse, T. (2021). TweetDrought: A deep-learning drought impacts recognizer based on Twitter data. *ICML Workshop on Tackling Climate Change with Machine Learning*.

Zhang, B., Abu Salem, K. F., Hayes, M., & Tadesse, T. (2020). Quantitative assessment of drought impacts using XGBoost based on the Drought Impact Reporter. *NeurIPS Workshop on Tackling Climate Change with Machine Learning*.

Tadesse, T., Hollinger, D. Y., Bayissa, Y. A., Svoboda, M., Fuchs, B., **Zhang, B.**, ... & Richardson, A. D. (2020). Forest drought response index (ForDRI): A new combined model to monitor forest drought in the eastern United States. *Remote Sensing*, 12(21), 3605.

Under Review

Zhang, B., Smith, K., Schilder, F., Abu Salem, K. F., Samal, A., Tadesse, T. & Hayes, M. Tracking drought impacts: AI assisted drought impact reporter.

Qianqian Li, **Zhang, B.**, Wang, R., Li, H., Zhan, Y, Tong, D. & Bell, J. E. Effects of soil moisture and soil temperature on coccidioidomycosis.

Werum, R., Schaefer, D. **Zhang, B.**, & Hayes, M. Most politics are local: women's protests in South Asia, 2016-2022

Zaki, M.T., **Zhang, B.** & Ajami, N. Beyond silos: a framework for assessing inter-dependencies in emerging environmental and social resilience of energy transition pathways.

In Progress

Zhang, B., Zaki, M.T., Breunig, H., & Ajami, N. Coupling agent-based modeling and life cycle assessment to analyze Trade-offs in resilient energy transitions.

Hersbach, T. J. P., **Zhang, B.**, Makhijani, A., Ajami, N. & Sokaras, D., Time- and location-dependent water availability affects the siting and scaling of hydrogen production.

Zhang, B., Zhou, Y., Guan, Y., Shi, X., Werum, R., Tadesse, T. & Hayes, M. Investigation of the causal relationship between drought and protests.

CONFERENCE PRESENTATIONS

"Novel AI Applications for Drought Impact Monitoring and Assessment" *AGU Fall Meeting*. December, 2024.

"An Integrated Framework for Environmental and Social Impact Assessment of Emerging Decarbonization Pathways" *AGU Fall Meeting*. December, 2024.

"Investigation of the Relationships between Drought Characteristics and Respiratory- and Cardiovascular-Related Mortality" *AGU Fall Meeting*. December, 2023.

"Application of Reinforcement Learning to Represent Human-Flood Interactions" *AGU Fall Meeting*. December, 2023.

"Explainable Machine Learning Applications to Predict and Assess Complex Drought Impacts based on a Multi-sourced Dataset" *AMS Annual Meeting*. January, 2023.

"Unsupervised Wildfire Change Detection based on Contrastive Learning" *AGU Fall Meeting*. December, 2022.

"Can Causal Inference Help Investigate Drought Impacts on Social Unrest in India?" *AGU Fall Meeting*. December, 2022.

"Unsupervised Wildfire Change Detection based on Contrastive Learning" *NeurIPS Workshop Artificial Intelligence for Humanitarian Assistance and Disaster Response*. December, 2022.

"TweetDrought: A Deep-Learning Drought Impacts Recognizer based on Twitter Data" *ICML Workshop Tackling Climate Change with Machine Learning*. July, 2021.

"Quantitative Assessment of Drought Impacts Using XGBoost based on the Drought Impact Reporter" *NeurIPS Workshop Tackling Climate Change with Machine Learning*. December, 2020.

HONORS AND AWARDS

Claire M. Hubbard Water, Climate, and Health Fellowship, University of Nebraska 2022-2024
Awarded $17,500 annually to support exceptional doctoral research in climate science

TECHNICAL SKILLS

Statistical modeling: regression analysis, multivariate analysis, spatiotemporal analysis, causal inference.
AI-related: machine learning, deep learning, computer vision, natural language processing.
Geoinformatics: remote sensing, geographic information system, geospatial data analysis.
Programming Languages: Python, R, MATLAB, JavaScript, SQL.
Professional Software: ArcGIS, QGIS, ENVI, ERDAS, Google Earth Engine.

PROFESSIONAL MEMBERSHIP

American Meteorological Society (AMS), American Geophysical Union (AGU)

LANGUAGE

English: Proficient; Chinese: Native

REFERENCES

Postdoc advisor: Newsha Ajami

Ph.D. advisors: Michael Hayes, Tsegaye Tadesse

Director of National Drought Mitigation Center: Mark Svoboda

Director of Center for Advanced Land Management Information Technologies: Brian Wardlow