Hongyu Xiao, Ph.D.

Geophysicist II | Research Scientist

Oklahoma Geological Survey, University of Oklahoma

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Research Interests

1. Computational seismology for imaging crustal and lithospheric structure and understanding tectonic evolution
2. Artificial intelligence and machine learning for earthquake detection, phase picking, seismic catalog development, and real-time seismic monitoring
3. Geophysical monitoring of induced seismicity and carbon capture, utilization, and storage (CCUS) through multi-modal sensing and data integration

Education

Ph.D. in Geophysics/Geology, University of Illinois Urbana-Champaign, 2023 Advisor: Dr. Xiaodong Song

M.S in Geophysics/Physics, University of Chicago, 2016 Advisor: Dr. Douglas MacAyeal

B.E.S in Geological Engineering, China University of Petroleum, Beijing, 2014

Honor Program, Top Graduate

Professional Appointments

Geophysicist II, Oklahoma Geological Survey, University of Oklahoma **2026-present**

- Lead research on AI/ML assisted seismic monitoring and induced seismicity.
- Developed machine learning and edge computing workflows for earthquake detection and catalog curation.
- Conduct research on geophysical monitoring for carbon capture and storage (CCUS).
- Mentor graduate and undergraduate researchers and contribute to proposal development.

Research Associate, Oklahoma Geological Survey, University of Oklahoma **2024 - 2026**

- Developed machine learning workflows for real-time monitoring of induced seismicity associated with carbon capture, utilization, and storage (CCUS).
- Developed transfer learning frameworks for seismic event detection and phase picking using regional earthquake catalogs.
- Integrated machine learning pipelines with regional nodal seismic arrays to enhance detection and characterization of low-magnitude seismic events.
- Developed and distilled lightweight deep learning models for deployment on edge computing platforms for real-time seismic monitoring.

Research Assistant, Department of Geology, University of Illinois Urbana-Champaign **2017 - 2023**

- Applied an advanced receiver function analysis to investigate crustal architecture across the central and northern U.S. midcontinent, producing high-resolution Moho depth maps.
- Developed joint inversion seismic tomography models by integrating receiver functions and ambient noise surface waves, providing new constraints on crustal and lithospheric structure beneath the central and northern U.S. midcontinent.

Graduate Student Intern, the Illinois Geological Survey, Prairie Research Institute **2022**

Research Assistant, University of Chicago, Department of the Geophysical Sciences **2015 - 2016**

Projects / Funding

Seismological Society of America Community Grant - Principal Investigator **2026**

- Awarded to support “Machine Learning for Induced Seismicity Detection: A Hands-On Technical Workshop,” introducing rural Oklahoma college STEM students to seismology and machine learning approaches for detecting induced seismicity.

Department of Energy – Co-Principal Investigator

Oklahoma Geological Survey, Midcontinent Carbon Management **2024–2026**

- Developed machine learning methods for detecting and monitoring induced seismicity associated with industrial operations.
- Curated large-scale (>1 million) labeled seismic datasets and developed end-to-end workflows for seismic event detection and phase picking.
- Integrated machine learning pipelines into regional seismic monitoring systems to support near real-time analysis.

Data Institute for Societal Challenges Seed Funding – Principal Investigator **2025**

- Awarded seed funding to advance data-driven seismic monitoring approaches using machine learning for societally relevant applications, including induced seismicity and hazard assessment.

Publications

Peer-Reviewed Publications

- Xiao, H., Walter, J. I., & Ogwari, P. (2026). Edge seismic phase picking: Model distillation for multimodal early-warning systems. PNAS Nexus, pgag322.
- Xiao, H., Walter, J. I., Ogwari, P., Ho, L. M., Thiel, A. D., Gregg, N., ... & Woelfel, I. (2026). Transfer learning and benchmarking for induced seismic event detection: Insights from Oklahoma. *Journal of Geophysical Research: Machine Learning and Computation*, *3*(4), e2025JH001194.
- Xiao, H., Marshak, S., DeLucia, M., & Song, X. (2025). Moho depth (crustal thickness) variations under the northeastern midcontinent of North America, based on H-κ− c receiver-function analysis. *Earth and Planetary Science Letters*, *658*, 119289.
- Xiao, Hongyu, et al. "Crustal Thickness Variations in the Central Midcontinent, USA, and Their Tectonic Implications: New Constraints Obtained Using the H-κ-c Method." *Geophysical Research Letters* 49.17 (2022): e2022GL099257.

In Preparation

- (In prep) Xiao, Hongyu, et al. " Performance Evaluation of Automated Deep-Learning Seismic Event Detectors Using Nodal Array Data"
- (In prep) Xiao, Hongyu, et al. "Adaptive-XiaoNet: An Adaptive Inference Edge Model for Real-Time Seismic Event Detection."
- (In prep) Xiao, Hongyu, et al. " Joint Inversion of Surface Wave Dispersions and Receiver Functions in The Central Midcontinent of The United States: Implications for the Central Midcontinent of the USA "
- (In prep) Xiao, Hongyu, et al. " Crustal Thickness Variations Across North American Cratonic Basins: New Constraints from the Williston, Illinois, and Michigan Basins Using Receiver-Function Analysis. "

Conference Presentations & Invited Talks

- **(Invited Talk)** Topic: Localized Transfer Learning for Detection of Induced Seismicity Across Diverse Monitoring Systems
  Hongyu Xiao, Jacob Walter, Paul Ogwari, Long Ho, Andrew Thiel, Nicholas Gregg, Brandon Mace, Isaac Woelfel
  SSA Annual Meeting in Pasadena, California, USA – 2026

- Topic: Machine Learning for Effective Microseismicity Monitoring
  Hongyu Xiao, Jacob Walter, Paul Ogwari, Andrew Thiel, Nicholas Gregg, Brandon Mace, Isaac Woelfel
  ES-SSA Annual Meeting in St. Louis, Missouri, USA – 2025

- Topic: Unveiling Shear Velocity Anomalies in the Central Midcontinent of the United States through High-Resolution Joint Inversion
  Hongyu Xiao, Stephen Marshak, Xiaodong Song
  ES-SSA Annual Meeting in St. Louis, Missouri, USA – 2025

- Topic: High-Fidelity Seismicity Dataset and Machine Learning Fine-Tuning Framework for Induced Seismicity Monitoring in Oklahoma
  Hongyu Xiao, Jacob Walter, Paul Ogwari, Andrew Thiel, Nicholas Gregg, Brandon Mace, Isaac Woelfel
  AAPG MCS Annual Meeting in Oklahoma City, OK, USA – 2025

- (**Invited Talk**) Topic: What Lies Beneath: Moho Depth and Crustal Structures in the Central Midcontinent, USA
  Hongyu Xiao, Stephen Marshak, Xiaodong Song
  John D. Pigott Colloquium, Department of Geoscience, University of Oklahoma, 2025

- Topic: Benchmarking Transfer Learning for Enhanced Detection and Monitoring of Induced Earthquakes from Regional and Microseismic Arrays
  Hongyu Xiao, Jacob Walter, Paul Ogwari
  AGU Annual Meeting in Washington. DC, USA – 2024

- (**Invited Talk**) Topic: Continental-Interior Deformation Deeper Down: Hints of Crustal Buckling and Trans-Crustal Shear Zones in the Cratonic Platform, Midcontinent USA
  Stephen Marshak**, Hongyu Xiao,** Benjamin Murphy**,** Michael DeLucia**,** Xiaodong Song
  GSA Annual Meeting in Pittsburgh, Pennsylvania, USA – 2023

- Topic: The Varying Crustal Thickness Underneath the Cratonic Basins in the Midcontinent of USA and its Implications: New Insights Using the H-κ-c Method
  H Xiao, MS DeLucia, X Song, S Marshak
  AGU Fall Meeting 2022

- Topic: Surface Wave Tomography from Ambient Noise in Central U.S. and its Implications for Illinois Basin and New Madrid Seismic Zone
  H Xiao, X Song, S Marshak
  GSA Annual Meeting in Indianapolis, Indiana, USA – 2018

Teaching & Mentoring

Teaching Assistant, University of Illinois Urbana-Champaign (2017–2023)

- Led laboratory instruction for undergraduate courses: Planet Earth, Physical Geology, Mineralogy, Structural Geology.
- Mentored undergraduate research students in seismic data analysis and geophysical methods.

Program Instructor, University of Chicago (2016–2017)

- Designed and delivered STEM curricula integrating cutting-edge research for underprivileged students.
- Built partnerships with schools, government agencies, and industry to enhance program impact.

Academic Service

- National Science Foundation (NSF), Proposal Review Panelist
- Department of Geology Climate Working Group, Member , UIUC
- Geology Graduate Student Council, Vice President, UIUC

Honors and Awards

Poser Award, DISC Data Science Symposium, OU, 2025
Best Poster Award, OU Sustainability Forum, 2025
Jackson Graduate Research Award, UIUC, 2020
Teachers Ranked as Excellent by Students, UIUC (2019, 2021, 2022)