Hongyu Xiao, Ph.D.

Research Associate, the University of Oklahoma | Oklahoma Geological Survey

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Research Interests

Observational seismology and crustal imaging and tectonophysics processes in continental interiors

ML-enhanced seismic event detection, phase picking, and induced seismicity monitoring

Carbon capture, utilization, and storage (CCUS) monitoring with seismic data

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 Experience

Research Associate, University of Oklahoma, Oklahoma Geological Survey **2024-now.**

- Designed ML integration for real-time monitoring of induced seismicity in CCUS projects.
- Designed transfer learning workflows and neural network models for microseismic detection and phase picking.
- Integrated ML pipelines with regional nodal seismic arrays to improve detection of low-magnitude events.
- Designed ML algorithms to edge computing devices
- Presented findings to stakeholders for informed decision-making.

Research Assistant, University of Illinois Urbana-Champaign, Geology Department **2017 - 2022**

- Applied a revised receiver function analysis in central and north midcontinent of U.S. and constructed high-resolution Moho depth maps.
- Developed high-resolution joint inversion seismic tomography models for the central and northern midcontinent using receiver functions and ambient noise surface waves.

Graduate Student Intern, the Illinois Geological Survey **2022**

- Conducted diverse geophysical surveys such as seismic streamers, electrical conductivity surveys, and Horizontal-to-Vertical Spectral Ratio (HVSR)
- Developed a Raspberry Shake based HVSR tool for horizontal-to-vertical spectral ratio (HVSR) and depth-to-bedrock analysis in Illinois.

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

- Built a 3-layer neural network model of early earthquake warning system based on historical seismicity records.
- Managed large datasets of historical seismic records for supervised training and performed data cleaning, preprocessing, and feature design.

Projects / Funding

DOE – Oklahoma Geological Survey, Midcontinent Carbon Management (2024–2026)

- Research on ML-enhanced monitoring of induced seismicity related to CCUS.
- Responsible for dataset curation, workflow integration, pipeline development, and project coordination.

Data Institute for Societal Challenges Seed Funding (2025)

- Awarded to pivot research toward societally relevant ML-based seismic monitoring.

Publications

Peer-Reviewed Publications

- Xiao, Hongyu, et al. "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 (2025): 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 / Under Review

- (Submitted) Xiao et al., "Transfer Learning and Benchmarking for Induced Seismic Events Detection: Insight from Oklahoma"

- (In prep) Xiao, Hongyu, et al. " Performance of Automated Deep-Learning Seismic Event Detectors on Nodal Array Data"

- (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. "

- (In prep) Balakian, Riley & Xiao, Hongyu " Horizontal to Vertical Spectral Ratio (HVSR) Analysis with SPRITE: An Open-Source Python-Based Software for Accurate Bedrock Interpretation "

Conference Presentations & Invited Talks

- 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: SPRIT HVSR: An Open-Source Software Package in Python for Processing, Analyzing, and Visualizing Ambient Seismic Vibrations
  Riley Balikian, **Hongyu Xiao,** Alexandra Sanchez
  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.

Software & Technical Contributions

- **spritHVSR**: Open-source Python tool for HVSR analysis and shallow subsurface characterization.

Honors and Awards

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