

Tieyuan Zhu

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APPOINTMENTS

Associate Professor, E. Willard and Ruby S. Miller Faculty Fellow 2022-present
Pennsylvania State University, Department of Geosciences

- affiliated to Energy Institute
- affiliated to Institute of Computational and Data Sciences
- affiliated to Planetary System Science Center

Assistant Professor 2016-2022
Pennsylvania State University, Department of Geosciences

Postdoctoral Fellow 2014-2016
University of Texas at Austin, Jackson School of Geosciences

EDUCATION

Ph.D. Geophysics 2008-2014
Stanford University

"Seismic modeling, inversion and imaging in attenuating media"
Thesis advisor: Jerry M. Harris

M.S. Geophysics 2005-2008
Chinese Academy of Sciences, Institute of Geology and Geophysics

"Seismic wave propagation in fractured media"

B.S. Geophysics 2001-2005
China University of Geosciences (Beijing)

RESEARCH INTERESTS

Environmental Geophysics, Permafrost degradation, Ice Wedges, Carbon Sequestration, Geothermal, Geohazards, Water in Critical Zone, Lunar/Mars, Waves

HONORS AND AWARDS

2020	E. Willard and Ruby S. Miller Faculty Fellow , Earth&Mineral Sciences, Penn State
2018	J. Clarence Karcher Award , Society of Exploration Geophysicists
2018	Wilson Research Initiation Award , Earth&Mineral Sciences, Penn State
2014	Distinguished Postdoctoral Fellowship , Jackson School at UT-Austin
2013	Best Student Paper Award (one recipient per year), Society of Exploration Geophysicists
2008	Best Graduate Student, Inst. Geophysics, Chinese Academy of Sciences
2005	Best Senior Thesis, China University of Geosciences (Beijing)

PEER-REVIEWED JOURNAL PAPERS [\[Google Scholar\]](#)

*graduate student author, †postdoc author, and **undergraduate student author

SUBMITTED MANUSCRIPTS

3. *Shen J. and **Zhu T.**, “Constraining water dynamics in the Earth’s critical zone using fiber-optic seismic sensing data”, *JGR*, In review (2024).
2. *Bozzi., *Shen J., **Zhu T.** et al. , “Modelling uncertainty in P-wave arrival-times retrieved from DAS data: case-studies from 15 fiber optic cables”, *GJI*, In review (2024).
1. *Shadoan T., Ajo-Franklin J., Patterson J., and **Zhu T.**, “Active-seismic monitoring of reservoir pressure changes in an analog reservoir”, *Geophysics*, In review (2024).

2024

58. †Yu P. **Zhu T.**, Marone, C., Elsworth, D., and Yu, M., “[DASEventNet: AI-based microseismic detection on distributed acoustic sensing data from the Utah FORGE well 16A \(78\)-32 hydraulic stimulation](#)”, *Journal of Geophysical Research: Solid Earth* 129, e2024JB029102 (2024).
57. *Leong Z. **Zhu T.**, “[Machine learning-assisted microearthquake location workflow for monitoring the Newberry enhanced geothermal system](#)”, *Journal of Geophysical Research: Machine Learning and Computation* 1, e2024JH000159 (2024).
56. *Xing G. **Zhu T.**, “[Advancing seismic attenuation estimation through integration of the Hessian in multiparameter viscoacoustic full-Waveform inversion](#)”, *Geophysics* 89, R429-R442 (2024).
55. *Roth N. **Zhu T.**, and A. Gao, “[Characterizing Liquid Water in Deep Martian Aquifers: A Seismo-Electric Approach](#)”, *Journal of Geophysical Research – Planets* 129, e2024JE008292 (2024).
54. *Tourei A., *Ji X.H., *dos Santos G., M. Xiao, E. Martin. and **Zhu T.**, “[Mapping Permafrost Variability and Degradation Using Seismic Surface Waves, Electrical Resistivity and Temperature Sensing: A Case Study in Arctic Alaska](#)”, *Journal of Geophysical Research - Earth Surface* 129, e2023JF007352 (2024).
53. Singha K., et al., and **Zhu T.**, “[Expanding the spatial reach and human impacts of critical zone science](#)”, *Earth’s Future* 12, e2023EF003971 (2024).
52. *Ji X.H., M. Xiao, E. Martin, and **Zhu T.**, “[Statistical Evaluation of Seismic Velocity Models of Permafrost](#)”, *Journal of Cold Regions Engineering* 38, 04024021 (2024).
51. *Leong Z. **Zhu T.**, and A. Sun, “[Time-Lapse Seismic Inversion for CO2 Saturation with SeisCO2Net: An Application to Frio-II Site](#)”, *International Journal of Green Gas Control* V.2, 104058 (2024).

2023

50. *Shen J. and **Zhu T.**, “[DAS with telecommunication fiber-optic cable in urban areas can record storm-induced seismic noise](#)”, *Geophysical Journal International* 235, 3 (2023).
49. *Roth N., †Czarny R., Gao Y., and **Zhu T.**, “[Wavefield Modeling and Analysis of Thunderquakes Measured by a Distributed Acoustic Sensing Array](#)”, *BSSA* In press, (2023).

48. †Czarny R., **Zhu T.**, and *Shen J., “Spatiotemporal evaluation of Rayleigh surface wave estimated from roadside dark fiber DAS array and traffic noise”, *Seismica* 2, 2 (2023).
47. †Liu X., **Zhu T.**, and Ajo-Franklin J., “Understanding subsurface fracture evolution dynamics using time-lapse full waveform inversion of continuous active-source seismic monitoring data”, *Geophysical Research Letters* 50, e2022GL101739 (2023).
46. Spica Z., Ajo-Franklin J., Biondo B., . . . *Shen J., and **Zhu T.**, “PubDAS: A PUBLIC Distributed Acoustic Sensing Datasets Repository for Geosciences”, *Seismological Research Letters* 50, e2022GL101739 (2023).
45. *Xing G. and **Zhu T.**, “Compensating the attenuation effects in the full waveform inversion with dissipation-dispersion decoupling”, *Geophysics* 88, R645-R654 (2023).

2022

44. †Huang C., **Zhu T.** and *Xing G., “Monitoring dynamic evolution of CO₂ plumes during geological sequestration using data assimilated visco-acoustic full-waveform inversion”, *Geophysics* , (Oct 2022).
43. *Wang N., *Xing G., and **Zhu T.**, “Propagating seismic waves in anisotropic attenuating media using fractional viscoelastic wave equation”, *Journal of Geophysical Research - Solid Earth* 127(4), e2021JB023280 (2022).
42. †Liu X., **Zhu T.** and Hayes J., “Critical zone structure by elastic full waveform inversion of seismic refractions in a sandstone catchment, central Pennsylvania, USA”, *Journal of Geophysical Research - Solid Earth* 127(3), e2021JB023321 (2022).
41. *Xing G. and **Zhu T.**, “Decoupled Fréchet kernels based on a fractional viscoacoustic wave equation”, *Geophysics* 87, T61-T70 (2022).

2021

40. **Zhu T.**, Zhang J.H., and Y.T. Lin, “Ultra-Thick Paleoregolith Layer Detected by Lunar Penetrating Radar: Implication for Fast Regolith Formation Between 3.6 and 2.35 Ga”, *Geophysical Research Letters* 48, e2021GL095282 (2021).
39. *Shen J. and **Zhu T.**, “Tracking cite-scale noise reduction caused by COVID-19 pandemic using fiber optic seismological sensors”, *The Seismic Record* 1, 46–55 (2021).
38. *Leong Z.X. and **Zhu T.**, “Direct Velocity Inversion of Ground Penetrating Radar Data Using GPRNet”, *Journal Geophysical Research-Solid Earth* 126, e2020JB021047 (2021).
37. *Hone S. and **Zhu T.**, “Seismic observations of four thunderstorms using underground fiber optic array”, *Seismological Research Letters* 92, 2389–2398 (2021).
36. *Ji A., **Zhu T.**, H. Marín-Moreno, and X. Lei,, “How do the gas hydrate saturation and hydrate morphology control seismic attenuation: A case study from the Southern Hydrate Ridge”, *Interpretation* 9(2), SD27 (2021).
35. *Xing G. and **Zhu T.**, “A viscoelastic model for seismic attenuation using fractal mechanical network”, *Geophysical Journal International* 224, 1658–1669 (2021).
34. **Zhu T.**, *Shen J., and Martin E.R., “Sensing earth and environment dynamics by telecommunication fiber-optic cables: An urban experiment in Pennsylvania USA”, *Solid Earth* 12, 219–235 (2021).

2020

33. *Guo C., **Zhu T.**, Gao Y., Wu S., and Sun J., “[AEnet: Acoustic Emission Traveltime Picking via Deep Learning](#)”, *IEEE: Geoscience and Remote Sensing* 59, 5293-5303 (2020).
32. **Jakkampudi S., *Shen, J., **Li W., **Dev A., **Zhu T.**, and Martin, E. R., “[Footstep Detection in Urban Seismic Data with a Convolutional Neural Network](#)”, *The Leading Edge* 39, 654 (2020).
31. †Huang C. and **Zhu T.**, “[Towards real-time monitoring: data assimilated time-lapse full waveform inversion for seismic velocity and uncertainty estimation](#)”, *Geophysical Journal International* 223, 811-824 (2020).
30. *Wang N., **Zhu T.**, Zhou H., Chen H., Zhao X. and Tian Y., “[Fractional Laplacians viscoacoustic wavefield modeling with k-space based time-stepping error compensating scheme](#)”, *Geophysics* 85, 1JF-Z3 (2020).
29. *Liu T., Liu X., and **Zhu T.**, “[Joint analysis of P-wave velocity and resistivity for morphology identification and quantification of gas hydrate](#)”, *Marine and Petroleum Geology* 112, 104036 (2020).

2019

28. **Zhu T.** and Stensrud D., “[Characterizing thunder-induced ground motions using fiber-optic distributed acoustic sensing array](#)”, *Journal of Geophysical Research: Atmospheres* 124, 12810-12823 (2019).
27. *Xing G. and **Zhu T.**, “[Modeling frequency-independent Q viscoacoustic wave propagation in heterogeneous media](#)”, *Journal of Geophysical Research: Solid Earth* 124, 11568-11584 (2019).
26. †Huang C. and **Zhu T.**, “[Passive seismic imaging of subsurface natural fractures: Application to Marcellus Shale microseismic data](#)”, *Geophysical Journal International* 208, 1087-1099 (2019).
25. **Zhu T.**, J. Ajo-Franklin, T. Daley, and C. Marone, “[Dynamically monitoring of geological CO2 plume motion by seismic coda waves](#)”, *Proceedings of the National Academy of Sciences* 116, 2464-2469 (2019).
24. *Bai T. and **Zhu T.**, “[Attenuation compensation for time-reversal imaging in VTI media](#)”, *Geophysics* 84, C205-C216 (2019).
23. **Zhu T.** and *T. Bai, “[Efficient modeling of wave propagation in a transversely isotropic attenuative medium](#)”, *Geophysics* 84, T121-T131 (2019).
22. **Zhu T.**, *Sun J., Gei D., Carcione J.M., P. Cance, and *Huang C., “[Hybrid multiplicative time-reversal imaging reveals the evolution of microseismic events: Theory and field data tests](#)”, *Geophysics* 84, KS71-KS83 (2019).
21. **Zhu T.**, “[Passive seismic imaging of subwavelength natural fractures: theory and synthetic and ultrasonic datasets](#)”, *Geophysical Journal International* 216, 1831–184 (2019).

2018

20. *Xue Z., *Sun J., Fomel S., and **Zhu T.**, “[Accelerating full waveform inversion with attenuation compensation](#)”, *Geophysics* 83(1), A13-A20 (2018).
19. *Sun J. and **Zhu T.**, “[Strategies for stable attenuation compensation in reverse time migration](#)”, *Geophysical Prospecting* 66(3), 498-511 (2018).

2017

18. **Zhu T.**, Ajo-Franklin J., and T. Daley, “Spatio-temporal changes of seismic attenuation caused by injected CO₂ at the Frio-II pilot site, Dayton TX, USA”, *J. Geophys. Res.-Solid Earth* 122(9), 7156-7171 (2017).
17. **Zhu T.**, “Numerical simulation of seismic wave propagation in viscoelastic-anisotropic media using frequency-independent Q wave equation”, *Geophysics* 82, WA1–WA10 (2017).
16. **Zhu T.** and *Sun J., “Viscoelastic reverse-time migration with attenuation compensation”, *Geophysics* 82, S61-S73 (2017).
15. *Yao J., **Zhu T.**, Hussain F., and Kouri D. J., “Locally solving fractional Laplacian viscoacoustic wave equation using Hermite distributed approximating functional method”, *Geophysics* 82, T59–T67 (2017).

2016

14. *Sun J., Fomel S., **Zhu T.**, and J. Hu, “Q-compensated least-squares reverse-time migration using lowrank one-step wave extrapolation”, *Geophysics* 81, S271-S279 (2016).
13. **Zhu T.**, Carcione J. M., and M. Botelho, “Reverse-time imaging of ground-penetrating radar and SH-seismic data including the effects of wave loss”, *Geophysics* 81, H21-H32 (2016).
12. Carcione J. M., **Zhu T.**, Picotti S., and Gei D., “Imaging septaria geobody in the Boom Clay using Q-compensated reverse-time migration”, *Netherlands Journal of Geosciences* 95, 283-291 (2016).
11. **Zhu T.**, “Implementation aspects of attenuation compensation in reverse-time migration”, *Geophysical Prospecting* 64, 657-670 (2016).

2015 -2013

10. **Zhu T.** and J. M. Harris, “Estimation of P-wave velocity S-wave velocity and attenuation factor by iterative joint inversion of crosswell seismic data”, *Journal of Applied Geophysics* 123, 71-80 (2015).
9. *Sun J., **Zhu T.**, and S. Fomel, “Viscoacoustic modeling and imaging using the low-rank approximation”, *Geophysics* 80, A103-A108 (2015).
8. **Zhu T.**, and J. M. Harris, “Improved seismic images by Q-compensated reverse-time migration: application to the crosswell field data, west Texas”, *Geophysics* 80, B61-B67 (2015).
7. **Zhu T.**, and J. M. Harris, “Application of boundary-preserving seismic tomography for delineating boundaries of reservoir and CO₂ saturated zone”, *Geophysics* 80, M33-M41 (2015).
6. **Zhu T.**, “Viscoelastic time-reversal imaging”, *Geophysics* 80, A45-A50 (2015).
5. **Zhu T.**, J. M. Harris, and B. Biondi, “Q-compensated reverse time migration”, *Geophysics* 79, S77-S87 (2014).
4. **Zhu T.** and J. M. Carcione, “Theory and modeling of constant-Q P- and S-waves using fractional spatial derivatives”, *Geophysical Journal International* 196, 1787-1795 (2014).
3. **Zhu T.**, “Time reverse modeling of acoustic wave propagation in attenuating media”, *Geophysical Journal International* 196, 483-494 (2014).
2. **Zhu T.** and J. M. Harris, “Modeling acoustic wave propagation in heterogeneous attenuating media using decoupled fractional Laplacians”, *Geophysics* 79, T105-T116 (2014).
1. **Zhu T.**, J. M. Carcione, and J. M. Harris, “Approximating constant-Q seismic propagation

in the time domain”, *Geophysical Prospecting* 61, 931-940 (2013).

NON-PEER-REVIEWED PUBLICATIONS

2. **Zhu T.**, Lellouch A., and Spikes K.T., “[Introduction to this special section: Distributed acoustic sensing](#)”, *The Leading Edge* 39(11), 775-775 (2020).
1. Shen, Y., Bao, K., Foster, D., Kumar, D., Innanen, K., Chapman, M., Hu, W., and **Zhu T.**, “[Frequency-dependent seismic analysis: Data processing, modeling, and interpretation](#)”, *The Leading Edge* 38(7), 556-557 (2021).

RESEARCH GRANTS

Active

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| 2024-2029 | <i>NSF</i> , “IUCRC Planning Grant: Center for CO2 Storage Modeling, Analytics, and Risk Reduction Technologies (CO2-SMART)”, (\$500K, PI: Tieyuan Zhu (PSU). Co-PIs: Eugene Morgan, Anne Menefee) |
| 2023-2025 | <i>NSF</i> , “CIVIC-FA Track A: Leveraging Existing Fiber-Optic Cables to Identify and Manage Urban Environmental Hazards”, (\$937K, PI: Tieyuan Zhu (PSU). Co-PIs: Zhen Lei, Lauren McPhillips) |
| 2023-2025 | <i>Zanskar Geothermal Inc. - DOE</i> , “Microseismic Signals for Long-term Monitoring using Distributed Acoustic Sensing”, (\$287k, PI: Tieyuan Zhu (PSU)) |
| 2021-2026 | <i>AFRL</i> , “Towards Enhanced Seismic Monitoring with Distributed Acoustic Sensing”, (\$2.5M, Co-PI, PI: Greg Beroza (Stanford), Co-PIs: Tieyuan Zhu (PSU), Eileen Martin (VT), Jonathan Ajo-Franklin (Rice), Herb Wang (UW), and Zack Spica (UM), \$190K to PSU) |
| 2021-2025 | <i>DOE</i> , “High-resolution CO2 Reservoir Seal Integrity Monitoring Using Optimized Borehole Sources and Distributed Acoustic Sensing”, (\$1.5M, Co-PI, PI: Jonathan Ajo-Franklin (Rice), Co-PIs: Tieyuan Zhu, Veronica Tribaldos (Lawrence Berkeley Lab), \$360K to PSU) |
| 2021-2024 | <i>NSF - CMMI</i> , “SITS: Understand and forecast long-term variations of in-situ geophysical and geotechnical characteristics of degrading permafrost in the Arctic”, (\$1.2M, Co-PI, PI: Ming Xiao (PSU), Co-PIs: Tieyuan Zhu (PSU), Eileen Martin (VT), Dmitry Nicolsky (UAF)) |
| 2019-2024 | <i>DOE</i> , “Machine Learning Approaches to Predicting Induced Seismicity and Imaging Geothermal Reservoir Properties”, (\$2M, Marone C. (PI), Co-PIs: Elsworth D., Zhu T., Shokouhi P., Yang J.) |

Completed

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| 2023-2024 | <i>Penn State ICDS Seed Grant</i> , “Towards real-time monitoring of CO2 geological storage using physics-informed machine learning of limited seismic data: from the laboratory to the field”, (\$30K, PI, Co-I: Jacques Riviere (PSU-ME)) |
| 2020-2024 | <i>NSF - Computational Math</i> , “Fractional viscoelastic wave propagation and its efficient solver for processing ‘Large-N’ seismic data”, (\$300K, Co-PI, PI: Yanzhi Zhang (Missouri ST-Math), \$88,268 to PSU) |

2022-2023	<i>NSF</i> , "CIVIC-PG Track A: Leveraging Existing Fiber-Optic Cables to Identify and Manage Urban Environmental Hazards", (\$50K, PI: Tieyuan Zhu (PSU). Co-PIs: Zhen Lei, Lauren McPhillips)
2022-2023	<i>USGS</i> , "Real-time sensing groundwater dynamics in urban areas by underground telecommunication fiber optics", (\$50K, PI: Tieyuan Zhu (PSU))
2018-2022	<i>DOE</i> , "Integration of seismic-pressure-petrophysics inversion of continuous active-source seismic monitoring for monitoring and quantifying CO ₂ plume", (\$2.5M, PI, Co-I: E. Morgan (PSU-EME), S. Srinivasan (PSU-EME), J. Ajo-Franklin (LBL), A. Sun (UT))
2019-2022	<i>NSF - Geophysics</i> , "Full waveform modeling and inversion of seismic attenuation and application to characterizing near-surface fractures at Susquehanna Shale Hills Critical Zone Observatory", (\$125K, PI)
2020-2021	<i>Penn State ICDS Seed Grant</i> , "Machine learning of massive real-time environmental monitoring data from Penn State fiber-optic array for mitigating urban geohazards", (\$30K, PI, Co-I: Chaopeng Shen (PSU-CEE))
2019-2020	<i>Penn State IEE & INGAR Seed Grant Programs</i> , "Initiating the Penn State Fiber-Optic Sensing Array", (\$70K, PI)
2018-2019	<i>Penn State CyberScience Seed Grant Program</i> , "Theory of fractional viscoelastic wave propagation and its efficient solver for processing 'Large-N' seismic data", (\$33K, PI, Co-I: Anna Mazzucato (PSU-Math))
2014-2016	<i>Jackson School of Geosciences, UT-Austin</i> , "Postdoc Fellowship Research Grant", (\$20K, PI)

Pending

2025-2028	<i>DOE-BES</i> , "Understanding field-scale fracture evolution dynamics using viscoacoustic full waveform inversion and machine learning of continuous active-source seismic monitoring data", (\$550K, PI: Tieyuan Zhu (PSU))
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MENTORING AND ADVISEMENT

Postdoc Fellow

- Zhinong Wang (2024 - present), Ph.D. from China University of Petroleum (2023), "Geohazards using DAS fiber optic seismology" ()
- Donggeon Kim (2023 - present), Ph.D. from Seoul National University (2023), "Fluids characterization using seismic attenuation" ()
- Pengliang Yu (2022 - present), Ph.D. from University of Auckland (2022), "DAS microseismic imaging for Geothermal" (Co-ad with C. Marone)
- Rafal Czarny (2021-2023), Ph.D. from Poland Academy Sciences (2017), "DAS fiber optic seismology in urban areas" (Currently: Mining company in Australia)
- Xuejian Liu (2020-2022), Ph.D. from Chinese Academy Sciences (2017), "Elastic full waveform inversion of seismic refraction datasets from Critical Zone, time-lapse full waveform inversion for continuous seismic monitoring of CO₂" (Currently Geophysicist at Sinopec Houston)

- Chao Huang (2018-2020), Ph.D. from Tongji University (2017), "Microseismic full waveform inversion, time-lapse full waveform inversion for continuous seismic monitoring data" (Currently Associate Researcher at Tongji University)

Graduate Student Advisees

- Dayang Zhou (2024 - present), Ph.D. student, "Permafrost and Ice" ()
- Guilherme Zakarewicz (2024 - present), Ph.D. student, "Understanding Permafrost thaw using DAS" ()
- Joey Miller (2024 - present), M.S. student, "Low-yield blasts using DAS" ()
- Jackson Saffner (2022 - present), Ph.D. student, "Seismic response of field-scale fractures" ()
- Gabriel Santos (2021 - present), Ph.D. student, "Seismic long-term monitoring of permafrost using DAS fiber-optic sensors" ()
- Nolan Roth (2020 - present), Ph.D. student, "Thunderquakes: numerical simulation and tomography for characterizing shallow Earth structure" (Charles E. Knopf Memorial Scholarship-2021)
- Junzhu Shen (2018 - 2024), Ph.D. student, "Monitoring shallow subsurface velocity changes from ambient noise interferometry of Penn State FORESEE fiber array data" (Currently Geophysicist at Zanskar Geothermal Inc.)
- Zi Xian Leong (2018-2023), Ph.D. student, "Deep learning enables seismic monitoring of CO2 geologic storage" (Currently Geophysicist at Chevron)
- Guangchi Xing (2017-2022), Ph.D. student, "Waveform inversion of seismic attenuation: Application to CO2 storage and critical zone structure" (Currently Geophysicist at Chevron)
- Sam Hone (2019-2021), MS student, "Seismic observations of thunderstorms using Penn State FORESEE fiber array" (Geophysicist in Hager GeoScience)
- Aoshuang Ji (2017-2019), MS student, "Seismic attenuation of gas hydrate" (Currently PhD student in Climate Group at Penn State)

Undergraduate Student Advisees

- Grace Druschel (2024 Fall), B.S., "Geohazards in Pittsburgh" ()
- Joe Miller (2023 Fall), B.S., "Characterizing low-yield mining blast events and their magnitude recorded by Penn State FORESEE DAS array" ()
- Margerat Maenner (2022 Spring), B.S., "Seismic signals from Hurricane Ida by Penn State's fiber optic sensors" ()
- Aziz Almansour (2022 Spring), B.S., "Denoising DAS recordings using machine learning" ()
- Stephanie Snyder (2020-2021), B.S., "Fiber optic seismology" ()

- Whitney Marshall (2019 Spring), B.S., "Investigating the possibility of using thunderquakes by Penn State's fiber optic sensors to map the velocity structure underneath State College" ()
- Sol Oh (2018 Spring), B.S., "Modeling of GPR waves in lunar layered structure using GprMAX" ()
- Ziyad Almai-moni (2018 Spring), B.S., "Ray tomography and full waveform inversion with a Middle East near-surface model" ()

Visiting students

- Jixin Yang (2023-2024), visiting PhD student, "Can Seismic Attenuation be more sensitive to small geological stored CO2 leakages?" (Currently PhD student at Chinese Academic of Sciences/Acoustic Institute)
- Chao Guo (2019-2020), visiting PhD student, "Monitoring of fracture dynamics by seismic attenuation, Earthquake Location using Deep Learning" (Currently PhD student at Uni. of Science and Tech. Beijing)
- Nan Huai (2018-2020), visiting PhD student, "GPR full waveform inversion of permittivity and conductivity" (Currently PhD student at Jilin Uni.)
- Tao Liu (2018-2019), visiting PhD student, "Seismic characterization of gas hydrates" (Currently PhD student at China Uni. of Geosciences)
- Ning Wang (2018-2019), visiting PhD student, "Seismic attenuation modeling" (Currently PhD student at China Uni. of Petroleum)

Exam committee member for

- Xiaohang Ji 2022-24, Ph.D. candidate in CEE, "Permafrost" (Advisor: Ming Xiao)
- Qitao Zhang 2023-24, Ph.D. candidate in EME, "Geothermal" (Advisor: Christelle Wauthier)
- Young Kim 2022-, Ph.D. candidate in Geosc, "Volcano" (Advisor: Christelle Wauthier)
- Clay Wood 2019-23, Ph.D. candidate in Geosc, "Imaging elastodynamic and hydraulic properties of fractured rock: Exploring effects of dynamic stressing, shearing, fracture aperture, and roughness" (Advisor: Chris Marone)
- Shuai Yu 2021-23, Ph.D. candidate in CEE, "Understanding Compaction of Particulate Asphalt Mixtures Using Deep Learning: Mechanism and Automated Assessment" (Advisor: Zhihui Shen)
- Saharnaz Nazari 2020, Ph.D. candidate in CEE, "Development of Automated Monitoring System for Ballast Performance Evaluation using SmartRock Sensor Data" (Advisor: Tong Qiu)
- Te Pei 2020, Ph.D. candidate in CEE, "Landslides using machine learning" (Advisor: Tong Qiu)
- Min Liew 2020, Ph.D. candidate in CEE, "Performances of Civil Infrastructures Affected by Degrading Arctic Permafrost in Alaskan Coastal Communities" (Advisor: Ming Xiao)

- Xiong Lei 2016-2017, Ph.D. candidate in EME, "Characterization of gas-charged sediments from joint inversion of both compressional and shear wave attenuation" (Advisor: Eugene Morgan)
- Eddie Udegbe 2017-2018, Ph.D. candidate in EME, "Pattern Recognition for Fractured Reservoir Characterization using Subsurface Big Data" (Advisor: Sanjay Srinivasan)

INVITED SEMINARS AND TALKS

2024 Oct	Photonic Seismology - SSA Workshop, "FORESEE-X"
2024 July	HUT Engineering Department Colloquium, "Carbon Storage"
2024 Apr	SMU Earth Science Department Colloquium, "The FORESEE DAS array"
2024 Mar	Colorado School of Mines Heiland Lecture, "The FORESEE DAS array"
2023 Dec	AGU - Machine learning meets real data, "Deep learning of limited seismic data: examples from monitoring CO2 storage and EGS"
2023 Oct	7th Near-Surface Geophysics - UAE, "Deep learning of limited seismic data: examples from monitoring CO2 storage"
2022 Dec	AGU - Near-Surface Geophysics in a Changing Climate - Chicago US, "The FORESEE DAS array"
2022 Dec	2nd EAGE/SEG Workshop on Geophysical Aspects of Smart Cities - Hong Kong China, "The FORESEE DAS array"
2022 Nov	Penn State Meteorology Department Colloquium, "Weather shaking the ground: observations from underground existing fiber"
2022 Apr	SSA Annual Meeting, "Pushing the Boundaries of Seismology: Examples from DAS Monitoring Experiments"
2021 Sep	Chevron - Geophysics/Geomechanics seminar, "Towards Real-time Seismic Monitoring of geological stored CO2 plume"
2021 Feb	Los Alamos National Lab - Geophysics seminar, "DAS with Dark Fibers Enable Continuous Urban Seismic Monitoring"
2021 Feb	SEG-CICESE student chapter (Mexico), "DAS fiber optics enable continuous seismic monitoring in urban areas"
2020 Dec	AGU - workshop in DAS, "Lessons learned from implementing the FORESEE DAS array"
2020 Oct	SEG - postworkshop in Applied Geophysics, "DAS fiber optics enable continuous seismic monitoring in urban areas"
2020 Oct	SEG - postworkshop in DAS, "Fiber Optic Seismic Monitoring Experiment at Penn State University"
2020 Sep	Rice University Earth Seminar, "Thunderquake observations and mechanism"
2020 Sep	ExxonMobil - Applied Geophysics Seminar (Zoom), "Data assimilated time-lapse seismic waveform inversion for real-time reservoir monitoring"
2020 Jun	AAPG Annual Meeting Carbon Session (Zoom), "Seismic monitoring of carbon storage"
2019 Dec	SEG/EAGE workshop: Geophysical Aspects of Smart Cities, "New signals in massive data acquired by fiber-optics acoustic array"
2019 Nov	Penn State Geoscience Club, "Fiber-optic for environmental sensing array"
2019 Sep	Penn State Geodynamic Seminar, "Fiber-optic for environmental sensing array"

2019 Mar	Total, "Seismic monitoring of CO ₂ "
2018 Oct	Penn State Geodynamic Seminar, "Tracking seismic sources"
2018 Jun	China University of Geosciences (Beijing) - Geophysics colloquium, "Coda wave interferometry"
2018 Jun	Central South University - Geophysics colloquium, "Seismic monitoring of CO ₂ "
2018 Jun	Institute of Geology and Geophysics, Chinese Academy of Sciences, "Seismic attenuation"
2018 May	Seismological Society of America Annual Meeting, Miami, Florida, "Recent advances in seismic Q modeling and imaging"
2018 Mar	Penn State Geodynamic Seminar, "Quantifying CO ₂ plume dynamics using coda wave interferometry"
2017 Feb	GSA Eastern Section - Pittsburgh, PA, "Imaging induced and natural fractures"
2015 Sep	Xi'an Jiaotong University - Geophysics colloquium, "Advances in Q modeling and imaging"
2015 Sep	China University of Petroleum (Beijing) - Geophysics colloquium, "Advances in Q modeling and imaging"
2015 Sep	Research Institute of Petroleum Exploration and Development, CNPC, "Advances in Q modeling and imaging"
2015 Aug	Institute of Geology and Geophysics, Chinese Academy of Sciences, "Advances in Q modeling and imaging"
2015 May	University of Texas at Austin - BEG colloquium, "Spatial-temporal seismic attenuation changes indicate CO ₂ migration in Frio-II site"
2015 Apr	University of Texas at Austin - Geoscience seminar, "Using seismic attenuation for better subsurface imaging and monitoring of sequestered CO ₂ "
2015 Mar	Pennsylvania State University - Geoscience colloquium, "Using seismic attenuation for better subsurface imaging and monitoring of sequestered CO ₂ "
2015 Mar	University of Texas at Dallas - Geoscience seminar, "Using seismic attenuation for better subsurface imaging and monitoring of sequestered CO ₂ "
2015 Mar	University of Oklahoma - Geophysics colloquium, "Using seismic attenuation for better subsurface imaging and monitoring of sequestered CO ₂ "
2014 Sep	University of Texas at Austin - FRAC consortium colloquium, "Fracture imaging"
2014 Mar	San Diego State University - Geology colloquium, "Q modeling and QRTM imaging"
2014 Feb	Lawrence Berkeley National Lab - Geophysics colloquium, "Q modeling and QRTM imaging"
2014 Jan	University of Texas at Austin - Geophysics colloquium, "Q modeling and QRTM imaging"

TEACHING

- GEOSC 444 Matlab applications for Geosciences:
2020 Spring, 2020 Fall, 2021 Fall 2022 Spring, 2024 Fall - "Dr. Zhu, while hindered by the remote nature of the course, went out of his way to help students struggling with homework. I enjoyed working along with the professor in class which helped me understand the material because I was able to learn through guided first-hand experience. Thorough covering of topics touched on in class. Homework was mostly helpful too. Instructor was helpful and very responsive when needed. I think the homeworks were well spaced, and gave good practice. I

like how the class exercises included details of what the code did. I also liked that the exercises were posted on canvas.”

- GEOSC 454 Geology for Oil and Gas:
Every Spring
- GEOSC 481 Environmental Geophysics:
Every Fall - This course provides an overview of the principle of applied geophysics for applications to near-surface and resources exploration.
- GEOSC 558 Seismic Data Processing (Co-taught with S. Anandakrishnan):
2017 Spring, 2019 Spring - This course will cover the basics of modern multi-channel land- and marine seismic data acquisition terminology, field-methods, and data processing flows.
- GEOSC 597 Machine Learning in Geophysics (seminar):
2018 Fall, 2019 Fall This seminar organizes students to read the latest literature in the mixing topics of geophysics issues by machine learning.
- GEOSC 597 Seismic Earth Imaging (3 credits):
2020 Spring - This course introduces the principle of seismic imaging of reflection seismic data as well as seismic imaging of earthquake data from Large-N seismic arrays.

SERVICES AND OUTREACH

I. Service to Penn State

2022	Energy Institute Director Search Committee, EMS college
2021	IES Faculty Search Committee, Department of Geosciences
2021	Geomechanics/Geofluid Faculty Search Committee, Department of Geosciences
2020	EME Faculty Search Committee, Department of EME
2019 - present	Research Computing and CyberInfrastructure committee,
2019	Geology Club Speaker, Department of Geosciences
2024 - present	GPC committee, Department of Geosciences
2019 - 2023	UPC committee, Department of Geosciences
2018 - present	SEG Student Chapter Faculty Adviser, Department of Geosciences
2017	Sedimentary Geology Faculty Search Committee, Department of Geosciences
2016,2017,2021	Graduate Admission Committee, Department of Geosciences

II. Service to Professional Organization

2022 - present	Associate editor, <i>Geophysics</i>
2020 - present	Associate editor, <i>Computers and Geosciences</i>
2020 - present	Associate editor, <i>Journal of Environmental and Engineer Geophysics</i>
2021	Session Convener in Environmental Seismology, Society of Seismological American Meeting
2021	Session Convener in Ambient Noise Interferometry, Society of Seismological American Meeting
2020	Guest editor for the special section "Distributed Acoustic Sensing", <i>The Leading Edge</i>

- 2020 - present Member of AGU-SEG workshop committee, AGU-SEG
- 2020 - present Member of Research Coordinate Network on Distributed Acoustic Sensing, NSF
- 2020 Session Convener in ambient noise interferometry, Society of Seismological American Meeting
- 2018 Convener in the SEG postworkshop in seismic attenuation, Society Exploration Geophysicists Annual Meeting 2018

III. Journal Review

Geophysics, Geophysical Journal International, Journal of Applied Geophysics, Journal of Geophysical Research, Geophysical Research Letter, Natural Hazards, Journal of Geophysics and Engineering, Computers & Geosciences, Wave Motion, Computational Geosciences, International Journal of Solids and Structures Registration, IEEE Geoscience and Remote Sensing

MEDIA NEWS

- 2024 [Fiber-optic sensing of geohazards and water flooding in Pittsburgh](#), Penn State Today
- 2024 [Marsquakes may help reveal whether liquid water exists underground on red planet](#), Penn State Today
- 2024 [Machine learning to monitor stored CO2 saves cost and time, researchers report](#), Penn State Today
- 2023 [Fiber-optic DAS will provide a cost-effective way to identify and manage city-scale geohazards and infrastructure hazards in Pittsburgh PA](#), Penn State Today
- 2023 [Thunderquakes Map the Subsurface](#), AGU Eos
- 2023 [Using machine learning, existing fiber optic cables to track Pittsburgh hazards](#), Penn State Today
- 2023 [Penn State researcher says fiber optic cables could give early warnings about sinkholes, like the one at Eisenhower Parking Deck](#), WPSU
- 2023 [Real-time monitoring may improve understanding of fracture dynamics](#), Penn State
- 2021 [Lunar radar data uncovers new clues about moon's ancient past](#), Penn State Today
- 2021 [Cheap and Rugged Optical fibers Are Revealing Earth's Hidden Motions](#), Science
- 2021 [Underground fiber optic sensors record sounds of COVID lockdown, reopening](#), Penn State Today
- 2021 [How Underground Fiber Optics Spy on Humans Moving Above](#), Wired
- 2021 [Internet fiber optics could provide valuable insight into geological phenomena](#), Penn State Today
- 2020 [Cold vibrations: Researchers to study the movement of thawing Arctic permafrost](#), Penn State Today
- 2019 [Fiber-optic cables capture thunderquake rumbles](#), Penn State Today
- 2019 [Thunderquakes Make Underground Fiber-Optic Telecommunications Cables Hum](#), AGU News
- 2019 [Carbon Sequestration](#), Daily American
- 2019 [Coda waves reveal carbon dioxide storage plume](#), Eurekalert
- 2018 [At Penn State, researchers push for answers on carbon capture: Will it stay where we put it?](#), NPR
- 2017 [2.5 million grant funds real-time monitoring of underground carbon sequestration](#), Eurekalert