

## Tieyuan Zhu

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### APPOINTMENTS

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**Associate Professor** 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

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**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

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Environmental Geophysics, Critical Zone, CO2 Sequestration and Storage, Geothermal, Wave Physics, Planetary Geophysics, Geohazards, Weather-Induced Seismic

### HONORS AND AWARDS

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2020 [E. Willard and Ruby S. Miller Faculty Fellow](#), College of Earth&Mineral Sciences, Penn State University  
2018 [J. Clarence Karcher Award](#), Society of Exploration Geophysicists  
2018 [Wilson Research Initiation Award](#), College of Earth&Mineral Sciences, Penn State University  
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 [\[Google Scholar\]](#)

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Citation statistics from Google Scholar: **Total citations = 1800; h-index = 20; i10-index: 39.**

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

### 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 CO<sub>2</sub> 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 CO<sub>2</sub> 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).

### SUBMITTED MANUSCRIPTS/IN PREP

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7. \*Roth N., †Czarny R., Gao Y., and **Zhu T.**, “Modeling and Analysis of Thunderquakes Measured by a Distributed Acoustic Sensing Array”, *BSSA* In prep, (2022).
6. \*Shen J. and **Zhu T.**, “Searching for storm-induced seismic signals from underground optical fibers in urban areas”, *Journal of Geophysical Research - Solid Earth*. In prep, (2022).

5. †Czarny R. and **Zhu T.**, “Estimating Rayleigh surface wave from ambient noise recorded by distributed acoustic sensing (DAS) dark fiber array in the city”, *GJI* In prep, (2022).
4. \*Hone S. and **Zhu T.**, “Near-surface characterization using thunderquakes from underground DAS sensors”, *BSSA* In prep, (2022).
3. †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* In prep, (2022).
2. \*Guo C. and **Zhu T.**, “Deep-learning microearthquake location: Application to Newberry Geothermal microearthquake”, *Journal of Geophysical Research - Solid Earth*. In prep, (2021).
1. †Huang C., **Zhu T.** and \*Xing G., “Monitoring dynamic evolution of CO<sub>2</sub> plumes during geological sequestration using data assimilated visco-acoustic full-waveform inversion”, *Geophysics*. In review, (Nov 2021).

## NON-PEER-REVIEWED PUBLICATIONS

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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

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[≈\$5M/5yr to Penn State]

### Active

- |           |   |
|-----------|---|
| 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, Laura McPhillips)  |
| 2022-2023 | <i>USGS</i> , “Real-time sensing groundwater dynamics in urban areas by underground telecommunication fiber optics”, (\$50K, 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)                     |
| 2021-2024 | <i>DOE</i> , “High-resolution CO <sub>2</sub> 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</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))             |
| 2020-2023 | <i>NSF</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)   |

- 2019-2023 *DOE*, "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.)
- 2018-2022 *DOE*, "Integration of seismic-pressure-petrophysics inversion of continuous active-source seismic monitoring for monitoring and quantifying CO<sub>2</sub> plume", (\$2.5M, PI, Co-I: E. Morgan (PSU-EME), S. Srinivasan (PSU-EME), J. Ajo-Franklin (LBL), A. Sun (UT))

### Completed

- 2019-2022 *NSF*, "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 *Penn State ICDS Seed Grant*, "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 *Penn State IEE & INGAR Seed Grant Programs*, "Initiating the Penn State Fiber-Optic Sensing Array", (\$70K, PI)
- 2018-2019 *Penn State CyberScience Seed Grant Program*, "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 *Jackson School of Geosciences, UT-Austin*, "Postdoc Fellowship Research Grant", (\$20K, PI)

### Pending

- 2023-2025 *NSF*, "4D imaging of spatiotemporal hydrological dynamics in Earth's critical zone using DAS fiber-optic sensors", (\$530K, PI: Tieyuan Zhu (PSU), Co-PI: Brandon Forsythe (PSU))
- 2023-2025 *NSF*, "Collaborative Research: Continuous Full-Waveform Imaging of Shear Wave Velocity Changes in Urban Areas using Fiber-optic Telecommunication Infrastructure", (\$800K, PI: Tieyuan Zhu (PSU), Co-PIs: Eileen Martin (CSM), Khiem Tran (UFL), Tong Qiu (PSU))

## MENTORING AND ADVISEMENT

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### Postdoc Fellow

- Rafal Czarny (2021-present), Ph.D. from Poland Academy Sciences (2017), "DAS fiber optic seismology in Critical Zone" ( )
- 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 CO<sub>2</sub>" (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

- Jackson Saftner (2022-present), Ph.D student, "TBD" ()
- 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-present), Ph.D. student, "Monitoring shallow subsurface velocity changes from ambient noise interferometry of Penn State FORESEE fiber array data" (Shell Geosciences Energy Research Facilitation Award-2021)
- Zi Xian Leong (2018-present), Ph.D. student, "Deep learning enables seismic monitoring of CO2 geologic storage" (Krynine Scholarship-2019; Shell Energy Research Facilitation Award-2020)
- 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

- 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

- 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**

- Young Kim 2022, Ph.D. candidate in Geosc, "Volcano" (Advisor: Christelle Wauthier)
- Clay Wood 2021, 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, 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)
- Clay Wood 2019, Ph.D. candidate in Geosc, "The Effect of Shear on the Elasticity and Permeability of Fractured Rocks" (Advisor: Chris Marone)
- 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**

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| 2023 Mar | University of Memphis Department Colloquium - US, "The FORESEE DAS array"  |
| 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 CO<sub>2</sub> 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<sub>2</sub>"
- 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<sub>2</sub>"
- 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<sub>2</sub> 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<sub>2</sub> migration in Frio-II site"
- 2015 Apr University of Texas at Austin - Geoscience seminar, "Using seismic attenuation for better subsurface imaging and monitoring of sequestrated CO<sub>2</sub>"

2015 Mar	Pennsylvania State University - Geoscience colloquium, "Using seismic attenuation for better subsurface imaging and monitoring of sequestrated CO <sub>2</sub> "
2015 Mar	University of Texas at Dallas - Geoscience seminar, "Using seismic attenuation for better subsurface imaging and monitoring of sequestrated CO <sub>2</sub> "
2015 Mar	University of Oklahoma - Geophysics colloquium, "Using seismic attenuation for better subsurface imaging and monitoring of sequestrated CO <sub>2</sub> "
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

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- GEOSC 444 Matlab applications for Geosciences:  
2020 Spring, 2020 Fall, 2021 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. Anandkrishnan):  
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

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### 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
- 2019 - present 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

- 2020 - present Associate editor, *Computers and Geosciences*
- 2020 - present Associate editor, *Journal of Environmental and Engineer Geophysics*
- 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", *The Leading Edge*
- 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*  
Research reviewer: NSF proposals, Italy Scientific Research Quality in 2004-2010 & 2011-2014.

## CONFERENCE ABSTRACTS

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- 69. \*Leong Z. and **Zhu T.**, "Estimating CO2 saturation maps from seismic data using deep convolutional neural networks", *SEG Annual Meeting* , (Aug 29-Sep 1 2022).
- 68. \*Czarny R. and **Zhu T.**, "Estimating Rayleigh surface wave from ambient noise recorded by distributed acoustic sensing (DAS) dark fiber array in the city", *SEG Annual Meeting* , (Aug 29-Sep 1 2022).
- 67. \*Shen J. and **Zhu T.**, "DAS can record storm-induced seismic signals in urban areas", *SSA Annual Meeting* , (April 19-23 2022).
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### 2021

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64. \*Leong Z.X. and **Zhu T.**, “[Constraining the Dielectric Permittivities of the Moon’s Subsurface Using Physics Informed Deep Learning](#)”, *AGU Fall Annual Meeting* P15C-2106, (December 13-17 2021).
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57. \*Shen J., and **Zhu T.**, “Correlation between seismic noise variation and COVID-19 pandemic measures using recordings from Penn State FORESEE array”, *SEG Technical Program Expanded Abstracts* , 1405-1410 (2021).
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44. \*Xing G. and **Zhu T.**, “Finite-frequency Fréchet Kernels for Adjoint Tomography of Frequency-independent Q”, *AGU Fall Annual Meeting* S34A-05, (December 9-14 2019).
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38. \*Wang N., and **Zhu T.**, “Accurately propagating P- and S-waves in attenuation media using spatial-independent-order decoupled fractional Laplacians”, *SEG Technical Program Expanded Abstracts* , 3805-3809 (2019).
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