Zachary E. Ross

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Education

2016	Ph.D., Geophysics, University of Southern California Thesis Advisor: Prof. Yehuda Ben-Zion
2011	M.S., Civil Engineering, California Polytechnic State University, San Luis Obispo
2009	B.S., Physics, University of California, Davis

Professional Appointments

2021-	William H. Hurt Scholar, California Institute of Technology
2019-	Assistant Professor of Geophysics, California Institute of Technology
2016-2019	Postdoctoral Scholar in Geophysics, California Institute of Technology
2011-2016	Graduate Student Researcher, University of Southern California

Honors and Awards

2022	CAREER Award, National Science Foundation
2022	Packard Fellow for Science and Engineering, David and Lucile Packard Foundation
2022	Kavli Fellow, National Academy of Sciences
2021	William H. Hurt Scholar (Endowed Chair for Junior Faculty), California Institute of Technology
2019	Keiiti Aki Early Career Award, American Geophysical Union
2019	AGU Editors' Citation for Excellence in Refereeing
2019	High Performance Computing Innovation Excellence Award, Hyperion Research
2016	University Ph.D. Achievement Award, University of Southern California
2011	Graduation with Distinction, Cal Poly, San Luis Obispo

Patents

Zhu, W., Biondi, E., Li, J., Yin, J., **Ross, Z. E.**, and Z. Zhan, 2023-02-08. "Seismic Phase Arrival-Time Picking On Distributed Acoustic Sensing Data Using Semi-Supervised Learning".

Publications

Legend: *Graduate Student, ^Postdoctoral Scholar, †Undergraduate Student

In review:

[76] *Zou, C., Azizzadenesheli, K., **Ross, Z. E.**, and R. W. Clayton. Deep Neural Helmholtz Operators for 3D Elastic Wave Propagation and Inversion, submitted. arXiv: 2311.09608

[75] *Wilding, J. D. and **Z. E. Ross**. Insights on the state of stress in the mantle beneath Pahala, Hawai`i, *submitted*.

[74] *Shi, Y., Lavrentiadis, G., Asimaki, D., **Ross, Z. E.**, and K. Azizzadenesheli. Broadband Ground Motion Synthesis via Generative Adversarial Neural Operators: Development and Validation, *submitted.* https://arxiv.org/abs/2309.03447

[73] **Ross, Z. E.**, Measuring the dip of fault zones in Southern California with seismicity.

[72] ^Sun, H., **Ross, Z. E.**, Zhu, W., and K. Azizzadenesheli. Phase Neural Operator for Multi-Station Picking of Seismic Arrivals. *Geophys. Res. Lett.*

[71] ^Sun, H., Yang, Y., Azizzadenesheli, K., Clayton, R. W., and **Z. E. Ross**. Accelerating Time-Reversal Imaging with Neural Operators for Real-time Earthquake Locations.

Published:

[70] *Atterholt, J. and **Z. E. Ross** (2024). Finite Source Properties of Large Strike-Slip Earthquakes, *Geophys. J. Int.*, in press.

[69] ^Zhu, W., Biondi, E., Li, J., Yin, J., **Ross, Z. E.**, and Z. Zhan (2024). Seismic Arrival-time Picking on Distributed Acoustic Sensing Data using Semi-supervised Learning, *Nature Communications,* in press.

[68] **Ross, Z. E.**, Zhu, W., and K. Azizzadenesheli (2023). Neural mixture model association of seismic phases.

[67] Rahman, M. A., **Ross, Z. E.**, and K. Azizzadenesheli (2023). U-NO: U-shaped Neural Operators, *Transactions on Machine Learning Research*, 2835-8856, https://openreview.net/forum?id=j3oQF9coJd

[66] Cochran, E. S., Page, M., van der Elst, N. J., **Ross, Z. E.**, and D. T. Trugman (2023). Fault Roughness at Seismogenic Depths and Links to Earthquake Behavior. *The Seismic Record*; 3 (1): 37–47. doi: https://doi.org/10.1785/0320220043

[65] *Yang, Y., Gao, A. F., Azizzadenesheli, K., Clayton, R. W., and **Z. E. Ross** (2023). "Rapid Seismic Waveform Modeling and Inversion With Neural Operators," in *IEEE Transactions on Geoscience and Remote Sensing*, vol. 61, pp. 1-12, 2023, Art no. 5906712, doi: 10.1109/TGRS.2023.3264210.

[64] *Muir, J. B., and **Z. E. Ross** (2023). Aseismic forcing during the 2016-2020 Cahuilla swarm sequence determined with a deep Gaussian process model. *Geophys. J. Int.*, ggad074, https://doi.org/10.1093/gji/ggad074

[63] *Wilding, J. D., Zhu, W., **Ross, Z. E.**, and J. M. Jackson (2022). The magmatic web beneath Hawai'i, *Science*, doi: 10.1126/science.ade5755

[62] Sirorattanakul, K., **Ross, Z. E.**, Khoshmanesh, M., Cochran, E. S., Acosta, M., & Avouac, J.-P. (2022). The 2020 Westmorland, California earthquake swarm as aftershocks of a slow slip event sustained by fluid flow. *Journal of Geophysical Research: Solid Earth*, 127, e2022JB024693. https://doi.org/10.1029/2022JB024693

[61] Rahman, M. A., Florez, M. A., Anandkumar, A., **Ross, Z. E.**, and K. Azizzadenesheli (2022). Generative Adversarial Neural Operators, *Transactions on Machine Learning Research*, https://openreview.net/forum?id=X1VzbBU6xZ

[60] **Ross, Z. E.**, Ben-Zion, Y., and I. Zaliapin (2022). Geometrical properties of seismicity in California, *Geophys. J. Int.*, doi: 10.1093/gji/ggac189

[59] *Wilding, J. D. and **Z. E. Ross** (2022). Aftershock moment tensor scattering. *Geophysical Research Letters*, 49, e2022GL098473. https://doi.org/10.1029/2022GL098473

[58] *Atterholt, J. and **Z. E. Ross** (2022). Bayesian framework for inversion of second-order stress glut moments: application to the 2019 Ridgecrest Sequence Mainshock, *J. Geophys. Res.: Solid Earth*, e2021JB023780, doi: 10.1029/2021JB023780

[57] ^Florez, M. A., Caporale, M., Buabthong, P., **Ross, Z. E.**, Asimaki, D., and M.-A. Meier (2022). Data-driven Accelerogram Synthesis using Deep Generative Models, *Bull. Seismol. Soc. Am.*, doi: 10.1785/0120210264 [arXiv:2011.09038]

[56] *Liu, Y.-K., **Ross, Z. E.**, Cochran, E. S., and N. Lapusta (2022). A unified perspective of seismicity and fault coupling along the San Andreas Fault, *Science Advances*, 8(8) doi: 10.1126/sciadv.abk1167

[55] *Gao, A. F., Castillo, J., Yue, Y., **Ross, Z. E.**, and K. L. Bouman (2021). DeepGEM: Generalized Expectation-Maximization for Blind Inversion. *Advances in Neural Information Processing Systems*, *34*.

[54] *Yang, Y., *Gao, A. F., *Castellanos, J. C., **Ross, Z. E.**, Azizzadenesheli, K., and R. W. Clayton (2021). Seismic wave propagation and inversion with Neural Operators, *The Seismic Record*, 1 (3), 126-134

[53] ^Li, B. Q., Smith, J. D., and **Z. E. Ross** (2021). Basal nucleation of ascending swarms in Long Valley Caldera, *Science Advances*, doi: 10.1126/sciadv.abi8368.

[52] ^Smith, J. D., **Ross, Z. E.**, Azizzadenesheli, K., and J. B. Muir (2022). HypoSVI: Hypocenter inversion with Stein variational inference and Physics Informed Neural Networks, *Geophys. J. Int.*, 228, 698–710 doi: 10.1093/gji/ggab309. [arXiv:2101.03271].

[51] Yu, E., Bhaskaran, A., Chen, S.-L., **Ross, Z. E.**, Hauksson, E., and R. W. Clayton (2021). Southern California Earthquake Data Now Available in the Amazon AWS Cloud, *Seismol. Res. Lett.*, doi: 10.1785/0220210039

[50] *Stephenson, O. L, Koehne, T., Zhan, E., Cahill, B. E., Yun, S.-H., **Ross, Z. E.**, and M. Simons (2021). Deep Learning-based Damage Mapping with InSAR Coherence Time Series, *IEEE Trans. Geosci. Rem. Sens.*, doi: 10.1109/TGRS.2021.3084209.

[49] **Ross, Z. E.**, and E. S. Cochran (2021). Evidence for latent crustal fluid injection transients in Southern California from long-duration earthquake swarms, *Geophys. Res. Lett.*, doi: 10.1029/2021GL092465.

[48] Richards, C., Tape, C., Abers, G. A., and **Z. E. Ross** (2021). Anisotropy variations in the Alaska subduction zone based on shear-wave splitting from intraslab earthquakes, *Geochem. Geophys. Geosys.*, 22, e2020GC009558.

[47] Marsan, D. and **Z. E. Ross** (2021). Inverse migration of seismicity quiescence during the 2019 Ridgecrest sequence (2021), *J. Geophys. Res-Solid Earth*, doi: 10.1029/2020JB020329

[46] Hauksson, E., Olson, B., Grant, A., Andrews, J. R., Chung, A. I., Hough, S., Kanamori, H., McBride, S. K., Michael, A., Page, M., **Ross, Z. E.**, Smith, D. E., Valkaniotis, S (2021). The Normal Faulting 2020 Mw5.8 Lone Pine Eastern California Earthquake Sequence, *Seismol. Res. Lett*, doi:10.1785/0220200324.

[45] Avouac, J. P., Vrain, M., Kim, T., Smith, J., Ader, T., **Ross, Z.**, and T. Saarno (2020). A Convolution Model for Earthquake Forecasting Derived from Seismicity Recorded During the ST1 Geothermal Project on Otaniemi Campus, Finland. In Proceedings World Geothermal Congress (p. 1).

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Time Earthquake Monitoring at the National Earthquake Information Center, *Seismol. Res. Lett*, doi: 10.1785/0220200178

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[41] **Ross, Z. E.**, Cochran, E. S., Trugman, D. T., and J. D. Smith (2020). 3D fault architecture controls the dynamism of earthquake swarms, *Science*, 368 (6497), doi: 10.1126/science.abb0779.

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[39] †Zhang, X., *Jia, Z., **Ross, Z. E.**, and R. W. Clayton (2020). Extracting dispersion curves from ambient noise correlations using deep learning, *IEEE Trans. Geosci. Rem. Sens.*, doi: 10.1109/TGRS.2020.2992043 [arXiv:2002.02040]

[38] Cochran, E. S., Skoumal, R. J., McPhillips, D., **Ross, Z. E.**, and K. M. Keranen (2020). Activation of optimally- and unfavorably-oriented faults in a uniform local stress field during the 2011 Prague, Oklahoma, sequence, *Geophys. J. Int*, ggaa153, doi: 10.1093/gji/ggaa153.

[37] Trugman, D. T., **Ross, Z. E.**, and P. A. Johnson (2020). Imaging Stress and Faulting Complexity Through Earthquake Waveform Similarity, *Geophys. Res. Lett.*, e2019GL085888, doi:10.1029/2019GL085888.

[36] Kanamori, H., **Ross, Z. E.**, and L. Rivera (2020). Estimation of radiated energy using the KiK-net downhole records--Old method for modern data--, *Geophys. J. Int*, ggaa040, doi:10.1093/gji/ggaa040.

[35] **Ross, Z. E.**, Trugman, D. T., Azizzadenesheli, K., and A. Anandkumar (2020). Directivity Modes of Earthquake Populations with Unsupervised Learning, *J. Geophys. Res-Solid Earth*, doi: 10.1029/2019JB018299

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[33] Trugman, D. T. and **Z. E. Ross** (2019). Pervasive foreshock activity across southern California, *Geophys. Res. Lett.*, doi: 10.1029/2019GL083725. [EarthArXiv:qenm2].

[32] **Ross, Z. E.**, Trugman, D. T., Hauksson, E., and P. M. Shearer (2019). Searching for Hidden Earthquakes in Southern California, *Science*, 364, 6442, doi:10.1126/science.aaw6888.

[31] Hauksson, E., **Ross, Z. E.**, and E. S. Cochran (2019). Natural Slow-Growing and Extended-Duration Seismicity Swarms: Reactivating Joints or Foliations in the Cahuilla Valley Pluton, Central Peninsular Ranges, Southern California, *J. Geophys. Res.-Solid Earth*, doi:10.1029/2019JB017494

[30] **Ross, Z. E.**, Yue, Y., Meier, M.-A., Hauksson, E., and T. H. Heaton (2019). PhaseLink: A Deep Learning Approach to Seismic Phase Association, *J. Geophys. Res.-Solid Earth*, 124, doi: 10.1029/2018JB016674 [arXiv:1809.02880].

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[24] **Ross, Z. E.**, Meier, M.-A., and E. Hauksson (2018). P-wave arrival picking and first-motion polarity determination with deep learning, *J. Geophys. Res.-Solid Earth*, 123, doi: 10.1029/2017JB015251 [arXiv:1804.08804].
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[18] **Ross, Z. E.**, Rollins, C., Cochran, E. S., Hauksson, E., Avouac, J.-P., and Y. Ben-Zion (2017). Aftershocks driven by afterslip and fluid pressure sweeping through a fault-fracture mesh, *Geophys. Res. Lett.*, 44, doi:10.1002/2017GL074634.
[17] **Ross, Z. E.**, Kanamori, H., and E. Hauksson (2017). Anomalously large complete stress drop during the 2016 Mw 5.2 Borrego Springs earthquake inferred by waveform modeling and near-source aftershock deficit, *Geophys. Res. Lett.*, doi: 10.1002/2017GL073338.
[16] Share, P.-E., Ben-Zion, Y., **Ross, Z. E.**, Qiu, H., and F. L. Vernon (2017). Internal structure of the San Jacinto fault zone at Blackburn Saddle from seismic data of a dense linear array. *Geophys. J. Int.*, doi: 10.1093/gji/ggx191.
[15] Qiu, H., Ben-Zion, Y., **Ross, Z. E.**, Share, P.-E., and F. L. Vernon (2017). Internal structure of the San Jacinto fault zone at Jackass Flat from data recorded by a dense linear array. *Geophys. J. Int.*, doi: 10.1093/gji/ggx096.
[14] **Ross, Z. E.**, Hauksson, E., and Y. Ben-Zion (2017). Abundant off-fault seismicity and orthogonal structures in the San Jacinto fault zone. *Science Advances*, 3 (3), e1601946, doi: 10.1126/sciadv.1601946.

[13] Hauksson, E., Meier, M.-A., **Ross, Z. E.**, and L. M. Jones (2017). Evolution of seismicity near the southernmost terminus of the San Andreas Fault: Implications of recent earthquake clusters for earthquake risk in southern California. *Geophys. Res. Lett.*, 44, doi: 10.1002/2016GL072026.

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[11] **Ross, Z. E.**, White, M. C., Vernon, F. L., and Y. Ben-Zion (2016). An improved algorithm for real-time S-wave picking with application to the (augmented) ANZA network in southern California. *Bull. Seismol. Soc. Am.*, 106 (5), doi: 10.1785/0120150230.

[10] **Ross, Z. E.** and Y. Ben-Zion (2016). Toward reliable automated estimates of earthquake source properties from body wave spectra. *J. Geophys. Res.:Solid Earth*, doi: 10.1002/2016JB013003.

[9] Wu, F. T., **Ross, Z. E.**, Okaya, D., Ben-Zion, Y., Wang, C.-Y., Kuo-Chen, H., and W.-T. Liang (2016). Dense Network, Intense Seismicity and Tectonics of Taiwan, *Tectonophysics*, doi: 10.1016/j.tecto.2016.04.025.

[8] Okaya, D., Christensen, N., **Ross, Z. E.**, and F. T. Wu (2016). Terrane-controlled crustal shear wave splitting in Taiwan. *Geophys. Res. Lett.*, 43(2), doi: 10.1002/2015GL066446

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[6] Ben-Zion, Y., Vernon, F. L., Ozakin, Y., Zigone, D., Ross, Z. E., Meng, H., White, M., Reyes, J., Hollis, D., and M. Barklage (2015). Basic data features and results from a spatially-dense seismic array on the San Jacinto fault zone. *Geophys. J. Int.*, 202 (1), 370-380, doi: 10.1093/gji/ggv142.

[5] **Ross, Z.** E., Y. Ben-Zion, and L. Zhu (2015). Isotropic source terms of San Jacinto fault zone earthquakes based on waveform inversions with a generalized CAP method. *Geophys. J. Int.*, 200 (2), 1269-1280, doi: 10.1093/gji/ggu460

[4] **Ross, Z. E.** and Y. Ben-Zion (2014). Automatic picking of direct P, S seismic phases and fault zone head waves. *Geophys. J. Int.*, 199 (1): 368-381 doi: 10.1093/gji/ggu267.

[3] **Ross, Z. E.** and Y. Ben-Zion (2014). An Earthquake Detection Algorithm with Pseudo Probabilities of Multiple Indicators. *Geophys. J. Int.*, 197 (1), 458–463, doi: 10.1093/gji/ggt516

[2] **Ross, Z. E.** and Y. Ben-Zion (2013). Spatio-temporal variations of double-couple aftershock mechanisms and possible volumetric earthquake strain. *J. Geophys. Res.:Solid Earth*, 118 (5), doi: 10.1002/jgrb.50202.

[1] Moss, R. E. S. and **Z. E. Ross** (2011). Probabilistic Fault Displacement Hazard Analysis for Reverse Faults. Bull. *Seismol. Soc. Am.*, 101 (4), doi: 10.1785/0120100248.

Publications (Non-Refereed)

Hough, S. E., **Ross, Z. E.**, and T. Dawson, 2020. Introduction to the Ridgecrest special issue., *Bull. Seismol. Soc. Am*, 110 (4): 1395–1399, doi: 10.1785/0120200201.

Ross, Z. E., 2016. Applying automated techniques to large seismic datasets for systematic analyses of phases, source, and structure, Ph.D Dissertation, University of Southern California.

Ross, Z. E., 2011. Probabilistic Fault Displacement Hazard Analysis for Reverse Faults and Surface Rupture Scale Invariance, Master's Thesis, California Polytechnic State University, San Luis Obispo.

Invited Presentations

[49] *Machine Learning in Solid Earth Geoscience, Santa Fe, NM,* January 2024.
[48] *Committee on Seismology and Geodynamics, National Academy of Sciences*, November 2023.
[47] *University of California, Berkeley, Berkeley Seismological Laboratory Seminar*, August 2023.
[46] *American Geophysical Union*, December 2023.
[45] *ERC TECTONIC Workshop: Earthquake Physics and Applications of Machine Learning to Tectonic Faulting*, Rome, Italy, September 2023.
[44] *Plenary Session on Machine Learning for Real-time Monitoring, SSA Annual Meeting, San Juan, Puerto Rico*, April 2023
[43] *Seismological Laboratory Centennial Celebration*, November 2022.
[42] *Kavli Frontiers of Sciences, 3rd Japanese-American-German FOS*, *Beckman Center of the National Academies of Sciences and Engineering*, Sept 2022.
[41] *University of California, Los Angeles, Departmental Colloquium*, May 2022
[40] *American Geophysical Union, New Orleans, LA,* December 2021
[39] *Sala Baldini, Rome, Physics of Earthquake Faulting: Machine Learning to Illuminate Earthquake Precursors and Predict Laboratory Earthquakes*, September 2021.
[38] *Rice University, Earth, Environmental and Planetary Sciences Department Seminar*. November 2021.
[37] *Center for Nonlinear Studies, Los Alamos National Laboratory*, *Machine Learning in Solid Earth Geoscience,* March 2021.
[36] *University of Toronto, Geophysics seminar*. February 2021.
[35] *Michigan State University*, *Computational Mathematics, Science and Engineering Colloquium,* October 2020.
[34] *Earth2Earth UK-wide Zoom Seminar*, October 2020.
[33] *University of Utah*, *Distinguished Lecture Series,* September 2020.
[32] *Deformation and Tectonics (DeTect) Zoom Seminar series,* September 2020.
[31] *American Geophysical Union*, December 2020.
[30] *Geological Society of America*, October 2020.
[29] *Center for Nonlinear Studies, Los Alamos National Laboratory, Machine Learning in Solid Earth Geoscience*, Santa Fe, NM, March 2020. (canceled due to COVID-19).
[28] The structural architecture of fault zones and its role in earthquake physics, *University of California, Los Angeles, Tectonics Seminar,* November 2019.
[27] Searching for hidden earthquakes in Southern California, *Committee on Seismology and Geodynamics, National Academy of Sciences*, Washington DC, October 2019
[26] How deep learning is transforming earthquake seismology, *IST seminar, Dept. of Computing and Mathematical Sciences, Caltech*, October 2019.
[25] The structural architecture of fault zones at depth, *IRIS SAGE/GAGE*, Portland, October 2019
[24] The structural architecture of fault zones and its relation to earthquake physics, *Distinguished Lecturer Series, University of Utah*, October 2019.
[23] Earthquakes and the era of artificial intelligence, *Jet Propulsion Laboratory*, Pasadena, CA, September 2019.

[22] Earthquakes and the era of artificial intelligence, *Earthquake Research Institute, University of Tokyo*, Tokyo, Japan, August 2019.
[21] Earthquakes and the era of artificial intelligence, *Geological Survey of Japan, AIST*, Tsukuba, Japan, August 2019
[20] A Deep Learning Pipeline for Earthquake Detection, *StatSei11*, Hakone, Japan, August 2019.
[19] A Deep Learning Pipeline for Earthquake Detection, *Seismological Society of America Annual Meeting*, Seattle, WA, April 2019.
[18] A Deep Learning Pipeline for Earthquake Detection, *Machine Learning in Solid Earth Geoscience*, Santa Fe, NM, March 2019.
[17] A deep learning approach to seismic phase association, *American Geophysical Union*, Washington, D.C., December 2018.
[16] Detection of earthquakes, phases, and first-motion polarities with deep learning, *International Induced Seismicity Workshop*, Banff, Canada, October 2018.
[15] How big data and artificial intelligence are transforming seismology, *GPS Division Seminar, California Institute of Technology*, October 2018.
[14] Detecting millions of earthquakes in Southern California with template matching, *Southern California Earthquake Center*, Palm Springs, CA, September 2018.
[13] Earthquakes and artificial intelligence, *Berkeley Seismological Laboratory, UC Berkeley,* Berkeley, CA September 2018.
[12] Earthquakes and artificial intelligence, *United States Geological Survey, Golden*, Golden, CO, July 2018.
[11] Detecting millions of earthquakes in Southern California with template matching, *ETH Zurich*, June, 2018.
[10] Generalized seismic phase detectors with deep learning, *Seismological Society of America Annual Meeting*, Miami, FL, May, 2018.
[9] Generalized seismic phase detectors with deep learning, *Lawrence Livermore National Laboratory*, Livermore, CA, April 2018.
[8] Connecting fault zone structure and earthquake source processes, *IGPP Seminar, Scripps Institution of Oceanography*, San Diego, CA, January 2018.
[7] Aftershocks driven by afterslip and fluid pressure sweeping through a fault-fracture mesh. *American Geophysical Union*, New Orleans, LA, December 2017.
[6] Connecting fault zone structure and earthquake source processes, *University of California, Los Angeles,* Los Angeles, CA, October 2017.
[5] Using GPU clusters to detect millions of earthquakes in southern California with template matching. *Stanford University*, Stanford, CA, February 2017.
[4] Toward reliable automated estimates of earthquake source properties of body wave spectra. *American Geophysical Union*, San Francisco, CA, December 2016.
[3] Applying automatic techniques to large seismic datasets for comprehensive studies of regional and fault zone environments. Department of Earth and Planetary Sciences, *University of California, Santa Cruz*, Santa Cruz, CA, October 2015.
[2] Applying automatic techniques to large seismic datasets for comprehensive studies of regional and fault zone environments. Seismolab Seminar*, California Institute of Technology*, Pasadena, CA, April 2015.

[1] Automatic detection and picking of direct P, S and fault zone head & trapped waves. Tectonics Seminar, *Department of Earth and Space Sciences, UCLA*, Los Angeles, CA, January 2015.

Service

Board of Directors, Southern California Earthquake Center, 2021-present
Associate Editor, *The Seismic Record*, 2020-present
SCEC Standing Committee for Research Computing and Cyberinfrastructure, 2021-2023
USGS NEHRP External Grant Review Panel, August 2022.
Scientific organizing committee for StatSei12 workshop in Carges, Corsica, October 2022.
SCEC Task Force on Research Computing and Cyberinfrastructure, 2021.
Keiiti Aki Early Career Award Selection Committee, AGU Seismology Section, 2021-2022.
Instructor for AGU Seismology Summer School on Machine Learning, August 2020.
Guest editor at *Bulletin of the Seismological Society of America* for the Ridgecrest earthquake special issue, 2019-2020.
Session convener on "The 2019 M6.4 Searles Valley and M7.1 Ridgecrest Earthquakes", *American Geophysical Union*, 2019.
Session convener on "How do earthquakes start?", *American Geophysical Union*, 2019.
Invited speaker at *National Academy of Sciences,* Committee on Seismology and Geodynamics, "Searching for hidden earthquakes in southern California", October 2019.
Congressional Briefing on "Machine Learning in Seismology: Using AI to Improve Earthquake Monitoring", *United States Senate*, February 2019.
Dept. of Energy Panel Reviewer, *Los Alamos National Laboratory*, January 2019.
Reviewer for *Bulletin of the Seismological Society of America*; 2016, 2017, 2018, 2019, 2020
Reviewer for *Department of Energy*; 2019, 2020, 2021
Reviewer for *European Research Council*; 2018, 2021
Reviewer for *G3*; 2018, 2021
Reviewer for *Geophysical Journal International*; 2017, 2018, 2021
Reviewer for *Geophysical Research Letters*; 2017, 2018, 2019
Reviewer for *IEEE Transactions on Geoscience and Remote Sensing*; 2018, 2019, 2020, 2021
Reviewer for *Israeli Science Foundation*; 2022
Reviewer for *Journal of Geophysical Research – Solid Earth*; 2016, 2017, 2019, 2021
Reviewer for *National Science Foundation*; 2018, 2019, 2020, 2021
Reviewer for *Nature*; 2022
Reviewer for *Nature Communications*; 2019, 2020
Reviewer for *Nature Geoscience*; 2021, 2022
Reviewer for *Physics of the Earth and Planetary Interior*; 2018
Reviewer for *Pure and Applied Geophysics*; 2018
Reviewer for *Rock Mechanics and Rock Engineering*; 2019
Reviewer for *Science*, 2021, 2022
Reviewer for *Science Advances*; 2018, 2019, 2020
Reviewer for *Scientific Reports*; 2019
Reviewer for *Seismological Research Letters*; 2018, 2020
Reviewer for *Singapore National Research Foundation*; 2020.
Reviewer for *Tectonophysics*; 2016, 2020

Professional Associations

2023 – Present	Member, American Association for the Advancement of Science (AAAS)
2010 – Present	Member, Seismological Society of America
2015 – Present	Member, American Geophysical Union