

Camilla Cattania

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Research Interests

My research focuses on fault mechanics and earthquake physics across a range of spatiotemporal scales, from steady sliding at plate velocities to fast earthquakes. I combine fracture mechanics, numerical modeling and earthquake statistics to reveal how local fault processes give rise to large-scale seismic behavior, with particular emphasis on questions relevant to seismic hazard - where and how earthquakes nucleate, what determines rupture complexity, and what limits their final size.

Education

- 2015 PhD in Geophysics, GFZ German Research Center for Geosciences/University of Potsdam, Germany
Improvement of seismicity models based on Coulomb stress interactions and rate-state friction
- 2011 B.A. - M.Sci. Natural Sciences – Experimental and Theoretical Physics
University of Cambridge, Cambridge, UK

Academic position

- 2020- Assistant Professor, Massachusetts Institute of Technology (MA), USA
- 2017-20 Research Scientist, Stanford University (CA), USA
- 2016-17 Postdoctoral Fellow, Stanford University (CA), USA and GFZ Potsdam, Germany
- 2015 Guest Investigator, Woods Hole Oceanographic Institution, Woods Hole (MA), USA
- 2015 Guest Scientist, GFZ Potsdam, Germany

Awards

- 2024 NSF CAREER award
- 2024-25 CIG Distinguished Speaker (declined)
- 2022- Cecil and Ida Green Career Development Assistant Professorship
- 2016 Postdoctoral Researchers International Mobility Experience (PRIME) fellowship
Friedrich-Robert-Helmert-Preis for excellent PhD thesis (GFZ Potsdam)

Publications

* indicates student, ** indicates postdoc, † indicates visiting student

27. *Sun, Y., **C. Cattania** (2026), *Back-propagating earthquakes on simple faults*, AGU Advances. doi: 10.1029/2025AV001649
26. *Moser, L., **C. Cattania**, M. Peč (2026), *Temperature insensitive viscous deformation limits megathrust seismogenesis*, Earth and Planetary Science Letters, 673, 119698. doi: 10.1016/j.epsl.2025.119698
25. Aguilar Suarez, A. L., P. Segall, **C. Cattania** (2025), *Pore pressure perturbations on rough fault earthquake cycle simulations*, Bulletin of the Seismological Society of America. doi: 10.1785/0120250035
24. Song, Y. L., **C. Cattania**, G. C. McLaskey (2025), *Fault healing and asperity partitioning on a frictionally heterogeneous laboratory fault*, Journal of Geophysical Research: Solid Earth. doi: 10.1029/2025jb032055

23. †Castellano, M., **E. Milanese, **C. Cattania**, D. S. Kammer (2025), *A numerical study on the role of wear during seismic cycles of rough faults*, JGR Solid Earth. doi: 10.1029/2025jb032198
22. Ortega-Arroyo, D., H. O'Ghaffari, M. Peč, Z. Gong, R. R. Fu, M. Ohl, **C. Cattania** (2025), *Lab-quakes: Quantifying the complete energy budget of high-pressure laboratory failure*, AGU Advances. doi: 10.1029/2025av001683
21. Mousavi, S. M., **C. Cattania**, G. C. Beroza (2025), *The pursuit of reliable earthquake forecasting*, Physics Today. doi: 10.1063/pt.tdwq.nppx
20. *Sun, Y., **C. Cattania** (2025), *Propagation of slow slip events on rough faults: Clustering, back propagation, and re-rupturing*, Journal of Geophysical Research: Solid Earth. doi: 10.1029/2024jb029384
19. **Milanese, E., **C. Cattania** (2025), *Coseismic damage of the 2019 Ridgecrest earthquake consistent with Mohr–Coulomb failure*, Geophysical Journal International. doi: 10.1093/gji/ggaf066
18. Kammer, D. S., et al. (2024), *Earthquake energy dissipation in a fracture mechanics framework*, Nature Communications, 15(1). doi: 10.1038/s41467-024-47970-6
17. Turner, A. R., J. Hawthorne, **C. Cattania** (2024), *Partial ruptures cannot explain the long recurrence intervals of repeating earthquakes*, JGR Solid Earth, 129(1). doi: 10.1029/2023JB027870
16. **Cattania, C.** (2023), *A source model for earthquakes near the nucleation dimension*, Bulletin of the Seismological Society of America, 113(3), 909–923. doi: 10.1785/0120220045
15. Erickson, B., et al. (2023), *Incorporating full elastodynamic effects and dipping fault geometries in community code verification exercises for simulations of earthquake sequences and aseismic slip (SEAS)*, Bulletin of the Seismological Society of America, 113(2), 499–523. doi: 10.1785/0220190248
14. Jiang, J., et al. (2022), *Community-driven code comparisons for three-dimensional dynamic modeling of sequences of earthquakes and aseismic slip*, Journal of Geophysical Research: Solid Earth, 127. doi: 10.1029/2021JB023519
13. **Cattania, C.**, P. Segall (2021), *Precursory slow slip and foreshocks on rough faults*, Journal of Geophysical Research: Solid Earth, 126. doi: 10.1029/2020JB020430
12. Erickson, B., et al (2020), *The community code verification exercise for simulating sequences of earthquakes and aseismic slip (SEAS)*, Seismological Research Letters, 91(2A), 874–890. doi: 10.1785/0220190248
11. **Cattania, C.** (2019), *Complex earthquake behavior on simple faults*, Geophysical Research Letters, 46. doi: 10.1029/2019GL083628
10. Mancini, S., M. Segou, M. J. Werner, **C. Cattania** (2019), *Improving physics-based aftershock forecasts during the 2016–2017 Central Italy earthquake cascade*, Journal of Geophysical Research: Solid Earth, 124. doi: 10.1029/2019JB017874
9. **Cattania, C.**, P. Segall (2018), *Crack models of repeating earthquakes predict observed moment–recurrence scaling*, Journal of Geophysical Research: Solid Earth, 123. doi: 10.1029/2018JB016056
8. **Cattania, C.**, M. Werner, W. Marzocchi, S. Hainzl, M. Gerstenberger, M. Rhoades, D. Liukis, A. Christophersen, A. Helmstetter, A. Jimenez, S. Steacy, T. Jordan (2018), *The forecasting skill of Coulomb-based seismicity forecasting models during the 2010–2012 Canterbury, New Zealand, earthquake sequence*, Seismological Research Letters, 89(4), 1238–1250. doi: 10.1785/0220180033
7. Pollitz, F., **C. Cattania** (2017), *Connecting crustal seismicity and earthquake-driven stress evolution in Southern California*, Journal of Geophysical Research: Solid Earth, 122, 6473–6490. doi: 10.1002/2017JB014200
6. **Cattania, C.**, E. Rivalta, S. Hainzl, L. Passarelli, and Y. Aochi (2017), *A slow rupture episode during the 2000 Miyakejima dike intrusion*, Journal of Geophysical Research: Solid Earth, 122. doi: 10.1002/2016JB013722
5. **Cattania, C.**, J. McGuire, J. A. Collins (2016), *Dynamic triggering in the East Pacific Rise*, Geophysical Research Letters, 43. doi: 10.1002/2016GL070857

4. **Cattania, C.**, F. Khalid (2016), *A parallel code to calculate seismicity evolution induced by time dependent, heterogeneous Coulomb stress changes*, Computers & Geosciences, 94, 48–55. doi: 10.1016/j.cageo.2016.06.007
3. **Cattania, C.**, S. Hainzl, L. Wang, F. Roth, B. Enescu (2015), *Aftershock triggering by postseismic stresses: A study based on Coulomb–rate-and-state models*, Journal of Geophysical Research: Solid Earth, 120, 2388–2407. doi: 10.1002/2014JB011500
2. **Cattania, C.**, S. Hainzl, L. Wang, F. Roth, B. Enescu (2014), *Propagation of Coulomb stress uncertainties in physics-based aftershock models*, Journal of Geophysical Research: Solid Earth, 119, 7846–7864. doi: 10.1002/2014JB011183
1. Hainzl, S., Y. Ben-Zion, **C. Cattania**, J. Wassermann (2013), *Testing atmospheric and tidal earthquake triggering at Mt. Hochstaufen, Germany*, Journal of Geophysical Research: Solid Earth, 118, 5442–5452. doi: 10.1002/jgrb.50387

Papers under review

3. **C. Cattania**, *Slip-dependent frictional restrengthening promotes stable interseismic creep and abrupt runaway ruptures*, PNAS
2. *Verwijs, R., **C. Cattania**, *Subducted seamounts promote slow and fast slip throughout the seismic cycle*, JGR Solid Earth
1. Van Linn, J., G. McLaskey, **C. Cattania**, G. Barcheck, *Precursory slow-slip fronts navigate sticky spots and then initiate faster sliding on the Whillans Ice Plain*, Earth and Planetary Science Letters

Funded Projects

2025	MIT Research Innovation Seed, <i>Sliding stability of geophysical surfaces: faults and glaciers</i>
2024	NSF CAREER, <i>Towards a comprehensive model of seismicity throughout the seismic cycle</i>
2023	NSF-EAR, <i>Collaborative Research: Seismic cycles and earthquake nucleation on heterogeneous faults: Large-scale laboratory experiments, numerical simulations, and Whillans ice stream</i>
	MISTI Global Seed Fund, <i>Improving estimates of seismic risk associated with geothermal energy exploitation operations</i>
	SCEC, <i>Comparing earthquake cycle simulations with discrete and continuum models of fault zone structure</i>
2022	NEHRP award, <i>Induced seismicity and aseismic slip on rough faults</i>
2021	MIT Research Support, <i>The physics of foreshocks on complex fault systems</i>
	NSF-EAR Collaborative Research: <i>The role of subducting seamounts in fault stability and slip behavior throughout the seismic cycle</i>
	SCEC award, <i>Collaborative Project: Investigating properties of small and large earthquakes on geometrically heterogeneous faults</i>
2018	NEHRP award, <i>Investigating the seismic signature of earthquake nucleation with dynamic simulations of microearthquakes</i>
2018	SCEC award, <i>Simulation of earthquake cycles on faults with heterogeneous strength and rate-state friction</i>
2017	SCEC award, <i>Investigating seismic cycles with thermal pressurization using physical models and numerical simulations</i>
2016	DAAD fellowship, <i>Studying the precursory phase of large earthquakes with physical and statistical methods</i>
2014	Computing time at the FutureSOC-Lab of the Hasso Plattner Institute, Potsdam, <i>Massively Parallel Simulation of seismic events following earthquakes</i>

Invited Conference Talks

17. C. Cattania, *Stress heterogeneity and seismicity patterns on complex fault systems*, International Workshop on Swarm-like Seismicity, France (2026)
16. C. Cattania, *A unified fracture mechanics model for fault slip throughout the seismic cycle: interseismic decoupling, precursory transients and earthquake nucleation*, SSA Annual Meeting (2025)
15. C. Cattania, *Spatio-temporal evolution of seismicity controlled by damage zone architecture*, SSA Annual Meeting (2025)
14. Cattania., Y. Yin, X. Cui, *Interseismic decoupling and precursory transients on heterogeneous faults*, Workshop on Earthquake Physics and Applications of ML to Tectonic Faulting workshop, Rome (2025)
13. C. Cattania, Y. Yin, *Stress heterogeneity and seismicity patterns on geometrically complex faults*, AGU Annual Meeting (2025)
12. C. Cattania, *Fracture Mechanics insight into earthquake behavior*, Fracture across fields: insights from materials science, biology, and geophysics, Princeton (2024)
11. C. Cattania, *Temporal evolution of cascading foreshocks controlled by damage zone architecture*, Earthquake Physics and Applications of ML to Tectonic Faulting workshop, Rome (2023)
10. C. Cattania, *The seismological signature of earthquake nucleation*, SSA Annual Meeting (2023)
9. C. Cattania, *Spatio-temporal evolution of foreshock sequences in the damage zone* (2022)
8. C. Cattania, *Seismic cycles and earthquake statistics on heterogeneous faults*, U.S.-Japan Natural Resources Panel on Earthquake Research (2022)
7. C. Cattania, *Acceleration and coalescence of damage zone seismicity leading up to large earthquakes*, SSA Annual Meeting (2021)
6. C. Cattania, *Preseismic slip and foreshocks on rough faults embedded in a damage zone*, JpGU Meeting (2022)
5. C. Cattania, *Preseismic slip and foreshocks on rough faults embedded in a damage zone*, EGU General Assembly (2022)
4. C. Cattania, P. Segall, *Foreshocks on Geometrically Heterogeneous Faults*, AGU Fall Meeting (2021)
3. C. Cattania, P. Segall, *Fracture mechanics insights into the earthquake cycle of seismic asperities*, Megathrust Modeling Workshop, Eugene, OR, USA (2019)
2. C. Cattania, S. Hanzl, P. Segall, *Foreshocks and aftershocks on geometrically complex faults*, Annual Meeting of the Southern California Earthquake Center, Palm Springs, CA, USA (2019)
1. C. Cattania, et al. *Evaluation of physical, statistical and hybrid models during the 2010-2012 Canterbury earthquake sequence*, CSEP Workshop: Informing Earthquake Debates with CSEP Results, Palm Springs, CA, USA (2017)

Invited Seminars

2025	Columbia University
2024	Harvard University
	USGS Earthquake Seminar
	Workshop on Earthquake Processes, UT Austin
2023	UTIG Austin
	Northwestern University
	CalTech Seismolab Seminar
	Tufts University
2022	CIG webinar
	University of Toronto Mississauga
2021	Boston College
	Njord Centre for Studies of the Physics of the Earth, University of Oslo
	Princeton Brown Bag Seminar

2020	ERC Tectonic Seminar USGS Earthquake Seminar University of California, Santa Cruz
2019	MIT Department Lecture Series CalTech Seismolab Seminar Berkeley Seismolab Seminar
2018	University of Michigan ETH Zurich
2015	Yale University

Teaching

2026	12.002 Introduction to Geophysics and Planetary Science, MIT
2025	<i>parental teaching relief</i>
2024	12.002 Introduction to Geophysics and Planetary Science, MIT 12.210 Introduction to Seismology, MIT
2023	MTMOD subduction zone summer school, UT Austin Crosby Department Field Trip, MIT 12.S490 Special Seminar in Geochemistry and Geobiology, MIT 12.002 Introduction to Geophysics and Planetary Science, MIT
2022	12.525 Mechanics of Earthquakes and Faulting, MIT
2021	12.S591 Geophysics seminar, MIT
2020	12.S591 Geophysics seminar, MIT
2018	GP130 Introductory Seismology, Stanford (guest lecture) GP287 Earthquake Seismology, Stanford (guest lecture) GP385L Seminar on Earthquake Seismology, Deformation, and Stress, Stanford

News

2026	MIT news, <i>New study unveils mechanism behind “Boomerang” earthquakes</i> EOS, <i>Boomerang Earthquakes Don’t Need Complex Faults</i>
2021	Phys.org, <i>What causes earthquake foreshocks?</i>
2019	EOS, <i>Earthquake statistics vary with fault size</i>
2018	Phys.org, <i>International collaboration studies the predictability of earthquakes</i>

Students supervised

Graduate Students:

2022-	Rosalie Verwijs, current student
2025-	Xuancheng Huang (second project, MIT-WHOI Joint Program, transferred to Berkeley)
2020-2025	Yudong Sun, now postdoc at Stanford University
2021-2025	Liam Moser (second project, MIT-WHOI Joint Program), now a Fullbright Postdoctoral Fellow at Reykjavík University

Postdocs:

2021-2023	Enrico Milanese, Swiss National Science Foundation Fellow, now information systems associate in Marine Chemistry & Geochemistry, WHOI
2023-2024	Yifan Yin, Swiss National Science Foundation Fellow, now data analyst at the Broadband Array in Taiwan for Seismology (BATS), Academia Sinica, Taiwan

2023-2025 Xin Cui, now postdoctoral associate with Dr. Ben Holtzman (ERL/EAPS, MIT)

Visiting students:

2023 Miguel Castellano, visiting PhD student from ETH Zurich

Undergraduate students:

2023 Andrew Hutchison (UROP)

2024 Ashley Zhang (UROP)

Mentoring

MIT thesis committees

Ayako Tsuchiyama
Daniel Ortega-Arroyo
Faye Elgart
Meghana Ranganathan
Ekaterina Bolotskaya
Neosha Narayana

External thesis committees

Shanna Chu (Stanford)
Gaspard Farge (IGPG)
Leoncio Cabrera (Grenoble)
Shumon Mia, (University of Illinois)

General exams committees

Mathilde Wimez, Faye Hendley Elgart, Elias Nathaniel Mansbach, Hongze Bo, Natalie Hummel
Shumon Mia (University of Illinois), Emily Carrero Mustelier (Harvard)

Department Service

2025 - Committee on the Education Program
2024 - WHOI-MIT Joint Program in Marine Geology and Geophysics committee
2024 EAPS Postdoctoral fellowship committee
2023 - pre-thesis faculty mentor
2022 - EAPS Department Lecture Series committee
2023 Faculty search committee (EAPS)
2022 Faculty search committee (EAPS)
2021 Research Scientist search committee (WHOI)

Professional Service

2026 - National Earthquake Prediction Evaluation Council member
2023 - SCEC6 board of directors
2023 - Associate Editor for the Journal of Geophysical Research, Solid Earth

2021 NSF EAR review panel
2017 Field work: site survey and testing of seismic stations for the European project AlpArray

- Reviewer for *Journal of Geophysical Research*; *Tectonophysics*, *Pure and Applied Geophysics*; *Geophysical Research Letters*; *Earth, Planets and Space*; *Nature Scientific Reports*; *Nature*; *Nature Communications*; *Philosophical Transactions A*; *Science*, *Proceedings of the National Academies of Sciences*; *Nature*
- Reviewer for NSF EAR proposals
- Session convener at the AGU Fall meeting (1-2 sessions every year, 2020-2025), SSA Annual Meeting (2019); Panel moderator, SCEC annual meeting (2020), Earthquake Physics and ML workshop (2025)
- Invited contributor to the white paper “Modeling earthquake source processes: from tectonics to dynamic rupture” submitted to the National Academies (2018) and the Megathrust Modeling Workshop Report of the The Modeling Collaboratory for Subduction (2020)

Outreach

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| 2026 | <i>Earthquakes: Perspectives from seismologists and engineers</i> , Club Europeo di Ispra, Italy (talk)
<i>Under our feet: the physics of earthquakes</i> , MIT New Hampshire Annual meeting (talk) |
| 2021 | STEM week with 826 Boston (K-12 outreach program) |
| 2017 | TV documentary on seismicity in the Eastern Alps (TV channel: ARTE) |
| 2013 | Co-author of the article <i>Modellierung als Werkzeug: Erdbebeninteraktion verstehen und Seismizität vorhersagen</i> (Modeling as a tool: understanding earthquake interaction and forecasting seismicity), <i>System Erde. GFZ-Journal</i> (2013) 3-1 (aimed at the general public) |

Professional Memberships

American Geophysical Union, Seismological Society of America, European Geosciences Union