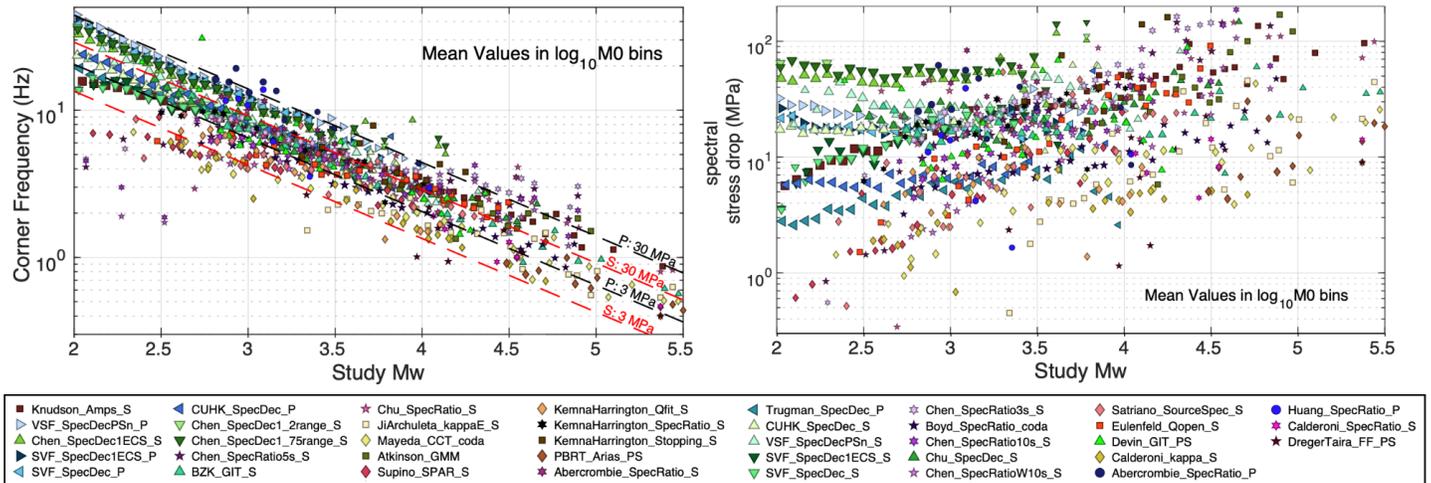


2025 Workshop Report for:
SCEC Award 25134:

Community Stress Drop Validation Project 2025 Workshops

2025 SCEC Stress Drop Workshop, January 20, 2026
Virtual Workshop

<https://www.scec.org/events/2026-community-stress-drop-validation-workshop/>



Cover Figure: (a) Corner frequency and (b) study recalculated spectral $\Delta\sigma$ averaged in discrete moment bins from many of the 56 submitted results from the first round of the Community Study, to show systematic offsets and trends in larger studies. Note that there are distinctly different trends and offsets between different methods and submissions. The dashed lines in panel (a) show constant stress drop trends for P and S waves. From *Abercrombie, Baltay et al. (2025)*.

Submitted by Annemarie Baltay
and Rachel Abercrombie

SCEC Award: 25134

Amount Requested: \$12,500

Category: Workshop Proposal

Conveners: Annemarie Baltay (USGS) and Rachel Abercrombie (Boston University)

SUMMARY of COMMUNITY STRESS DROP VALIDATION PROJECT: The Community Stress Drop Project is focused on understanding the nature and causes of discrepancies in earthquake spectral stress drop, as well as where random and physical variability arises, and effectively disseminating these results towards more effective collaboration with key users of earthquake stress drop. The importance and timeliness of this work is evidenced by the large, global attendance (> 100 people from 5 continents) at virtual workshops, regular attendance at informal zoom meetings, and well-supported Special Sessions at multiple AGU, SSA, JpGU and EGU meetings.

Stage 1 of the Community Project began in 2021 with the Ridgecrest Study, in which we distributed a common dataset to be analyzed by the community. The PIs have continually coordinated and led the Project through workshop organization, Zoom meetups, distribution of datasets, and designing and coordinating benchmarks. To date, we have received results from 20+ unique research groups for the 2019 Ridgecrest Earthquake sequence, for a total of 56 submissions. Throughout the study, Abercrombie, Baltay, Cochran, Shearer and others have been performing meta-analysis to guide the group comparisons. The team spearheaded and guest edited a successful BSSA special issue on the topic with 46 included papers.

Stage 2 of the Community Project is the proposed broader Technical Activity Group (for which an LOI was submitted in November 2025). This will cover integration of observation, theoretical, and engineering approaches to improve spectral stress drop estimates for advancing earthquake source physics and ground motion modeling, with a five-fold approach:

1. New empirical data set (discussed at the January 20th, 2026 workshop);
2. Simulations/Synthetic data to match the new empirical dataset, including simple approaches that test only certain aspects of the analysis;
3. Continued analysis of the Ridgecrest Study and inclusion of novel data such as DAS;
4. Consideration of Site response including site spectra, kappa, and trade-offs of amplification and attenuation with source spectral features; and,
5. Other/novel estimates of source parameters and connection of spectral $\Delta\sigma$ to other “stress parameter” measurements.

The Community Stress Drop Validation Group upholds key SCEC priorities for (1) advancing understanding of earthquake source physics and rupture processes, and (2) improving ground motion modeling and hazard assessment. Specifically, this Group meets SCEC milestones C1,2,3-1 to “*Develop, extend and maintain ... verification (inter-code comparison) and validation (comparison with observations) standards and exercises in seismic cycle, dynamic rupture and ground motion modeling, ...*” as well as D1-1, “*Assess space- and time-dependent geophysical variables that influence seismicity rates and occurrence patterns across the SAFS, such as heat flow, slow slip and fault network characteristics.*”

JANUARY 20, 2026 WORKSHOP: The January 20, 2026 Community Stress Drop Validation Workshop was held fully virtually on Zoom. The workshop was structured into three main sessions of 90 to 105 minutes each, and then had an optional 30 minute bonus session at the end as wrap up and review for those who could not make the earlier sessions. To ease communication and information sharing, throughout the workshop we put links and took overview notes in a shared Google doc. The main goals for the workshop were (1) to share and discuss ongoing work, both in terms of the Community Group and organization, and also exciting new science from early career researchers; (2) to decide on a new empirical Northern California dataset; and (3) to discuss new avenues including a Community synthetic study.

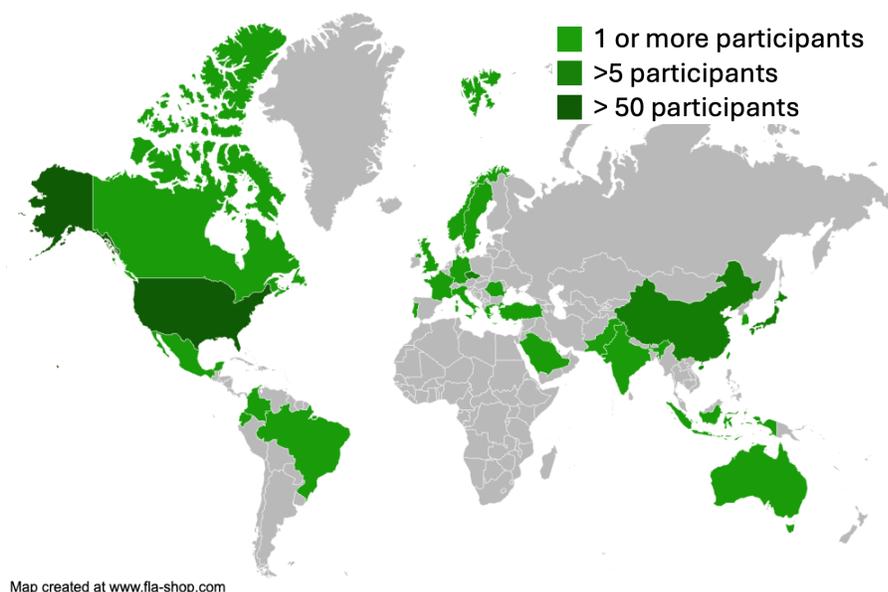


Figure 1. Geographical distribution of workshop participants, representing 132 participants from 27 countries in total, with 43% from the US.

Towards these goals, we invited five early career researchers to give short talks to highlight new, exciting work, and to specifically recognize early career folks. We also had a rousing discussion of new empirical datasets with a poll on what we should choose.

Session I focused on ongoing community work. We started with an introduction to the Community Stress Drop Group and workshop, including a Zoom-chat group introduction in which everyone was asked to input their local time and weather! Rachel Abercrombie gave a brief overview of recent community work and we discussed organization efforts, including the submitted Letter of Intent and the recently awarded 2026 in-person workshop. We held a poll to ask participants when the in-person workshop should be.

We then heard from four (of five) early career, invited researchers who each presented on new and ongoing exciting work. First was Gian Maria Boschini (Ruhr University Bochum), who discussed “Earthquake Stress Drop values delineate spatial variations in maximum shear stress in the Japanese forearc lithosphere.” We next heard from Sara Beth Cebry (USGS) about “Source parameters from fully constrained laboratory earthquakes.” Mariano Supino (INGV) updated the community about the exciting Bedretto experiment and micro-earthquake source parameters that they have been able to closely study. Finally, Hilary Chang (Columbia) discussed “Microearthquake stress drop and attenuation from borehole DAS at Cape Modern.”

Session II was geared towards determining the new empirical dataset for the next community collaborative experiment, after a fifth early career talk as a continuation of the previous session with a bridge to exciting data. Keisuke Yoshida (Tohoku University) discussed “Systematic Seismic Rupture Responses to Background Loading: Insights from Source Time Functions of “Quasi-”Repeating Earthquakes.”

We then turned to a discussion of what new dataset the Community should analyze, with an eye towards Northern California or Nevada. The joint goals are for a focus that would enable significant new method development, and measurement improvement, while also providing useful new observations of a region of high interest to the SCEC community studying Northern

California seismic hazard. Several community members represented different regional datasets, showing several slides each on the pros and cons of estimating stress drop in those regions, including the distribution and availability of data, past work on that dataset/region, and key science questions that could be addressed with this regional dataset. Pati Martinez-Garzon discussed the Geysers; Colin Pennington the Source Physics Experiment; Rob Skoumal presented Lake Almanor; Elizabeth Cochran represented the Calaveras/SAF branch region; Peter Shearer discussed Parkfield; Daniel Trugman presented several sequenced in Nevada; Hao Guo showed a region SF Bay Area dataset; and Annemarie Baltay presented the San Ramon Valley swarms. During the presentations and ensuing community discussion of each of these regions, Rachel and Annemarie summarized the data distribution and pros and cons of each dataset in real time on the shared document. We then held a google forms poll asking participants to rank-choice vote for their top three dataset choices.

In Session III, we discussed the design of a simple synthetic study for estimating spectral corner frequency and stress drop, and then held a “Looking forward” session to discuss future organizational efforts.

We first had presentations from community members who themselves have undertaken similar synthetic studies, including Ian Vandeventer, Jamie Neely, Chen Ji, Xiaowei Chen and Dino Bindi. We then presented the overall idea for the Community study, which would be similar to that undertaken by individuals, but made available to the general community. Thus the main driving question is: How well can different methods separate source, path, site, all with known inputs? The approach is to create relatively simple synthetics in which we can specifically control spectral stress drop (corner frequency and moment), attenuation and site spectra, before moving on to larger kinematic and even dynamic simulations. We would start with an initial benchmark like this, then gradually add potential causes of uncertainty and trade-offs, such as source (Brune or Boatwright spectral models, vary high frequency fall-off, 1 or 2 corners, add subevents); path (heterogeneous or frequency dependent Q); and site complexity (such as varying kappa or adding complex frequency-dependent amplification and resonance). In this vein, Annemarie then presented the study design for use of stochastic simulations, following the stochastic SMSIM method (Boore, 2003), which would be co-located earthquakes, with varying magnitudes and stress drops, recorded at “stations” at several set distances, each with a specific kappa and amplification model, all with a fixed Q. Dino will also create similar simple synthetics for testing Annemarie, Rachel, Peter, Dino and Elizabeth are testing these set ups and will present at SSA, before making the dataset public.

Review Session: In recognition of our global community (**Figure 1**), we held an optional 30-minute (which in practice, lasted 60 minutes due to interest level) final session in the Pacific Time Zone afternoon, which allowed participants in other time zones to attend during more reasonable working hours. We briefly recapped the entire workshop and then held a discussion session for the ~10 people who attended.

OUTCOMES OF WORKSHOP.

New empirical dataset: After the workshop, we sent followup emails to the group list to solicit any other votes for the new dataset. Ultimately, the San Francisco Bay Area won out. During the workshop, we had discussed using several sub-datasets from the SF Bay Area: a regional dataset encompassing all of the large events and some smaller and moderate ones, which would be really useful for those running generalized inversions; and 1-2 smaller scale focus

areas, such as San Ramon Valley or along the Hayward Fault, in which there are many small to moderate earthquakes nearly co-located. We are now coordinating with Northern California SCEC researchers to find the specific regions on which it would be most helpful to have a community focus.

Upcoming workshops: The community discussed the funded SCEC workshop to be held at Moffett Field in (northern) spring or summer and there was a lot of enthusiasm for that in person/hybrid event. We polled the participants on dates that would work and will finalize those soon, likely in late June or mid August.

Synthetic datasets: As discussed in the synthetics section, a subgroup will work on creating plausible simple synthetic spectra with two methods (SMSIM - Annemarie; and Dino’s method) to be tested. We solicited ideas and help with designing and testing these datasets, especially from those who have done similar work, and there was excitement to have the synthetic datasets distributed to the Community soon.

REFERENCES

Abercrombie, R. E., A. Baltay, S. Chu, T. Taira, D. Bindi, O. S. Boyd, X. Chen, E. S. Cochran, E. Devin, D. Dreger, et al. (2025). Overview of the SCEC/USGS Community Stress Drop Validation Study Using the 2019 Ridgecrest Earthquake Sequence, *Bull. Seismol. Soc. Am.* 115, 734–759, doi: [10.1785/0120240158](https://doi.org/10.1785/0120240158)

Boore, D. M. (2003). Simulation of ground motion using the stochastic method, *Pure and Applied Geophysics* **160**.

APPENDIX 1: January 20, 2026 WORKSHOP AGENDA

09:00 - 10:45	Session I: Introduction and Ongoing Work We will hear a few invited talks on ongoing work, and then have time for contributed slides and discussion from the whole community on current progress. We are especially interested in how methods have evolved recently given feedback from the first stage of the Community Project.	Rachel Abercrombie, Annemarie Baltay
	<i>Earthquake Stress Drop values delineate spatial variations in maximum shear stress in the Japanese forearc lithosphere</i>	Gian Maria Bocchini
	<i>Source parameters from fully constrained laboratory earthquakes</i>	Sara Beth Cebry
	<i>Microearthquake stress drop and attenuation from borehole DAS at Cape Modern</i>	Hilary Chang
	<i>Bedretto micro-earthquakes</i>	Mariano Supino
10:45 -11:00	<i>Break</i>	
11:00-12:30	Session II: New Data Sets Presentations from community members on new empirical datasets and regions, with a discussion and vote on what data to utilize next.	

	<i>Source time functions from repeating earthquakes off Tohoku</i>	Keisuke Yoshida
	Presentation of candidate datasets and group discussion	Colin Pennington, Rob Skoumal, Elizabeth Cochran, Peter Shearer, Daniel Trugman, Hao Guo, Patti
12:30 - 13:30	<i>Break</i>	
13:30 - 15:00	Session III: Synthetics and looking forward We will hear about previous synthetic data analysis for earthquake stress drop or source parameters, and then a discussion of several stochastic and other simplistic datasets we will use for the Community Project.	
	Ongoing/completed synthetic dataset study	Ian Vandevent, Jamie Neely, Chen Ji, Xiaowei Chen, Dino Bindi
	Discussion of community synthetic datasets	Dino Bindi, Annemarie Baltay, Peter Shearer, Rachel Abercrombie
	Looking forward: SCEC, NSF, international	Rachel Abercrombie
15:00 - 15:30	Wrap up and review of morning for those joining from other timezones and commitments	Rachel Abercrombie, Annemarie Baltay

APPENDIX 1: January 20, 2026 WORKSHOP PARTICIPANTS - 132 total

First Name	Last Name	Organization
Rachel	Abercrombie	Boston University
Claudia	Abril	Ludwig-Maximilians-University of Munich
Byeong Seok	Ahn	Pukyong National University
Ahmad	Alhakim	Agency of Meteorology Climatology and Geophysics
Trevor	Allen	Geoscience Australia
Solene	Antoine	Caltech
Ralph	Archuleta	University of California, Santa Barbara
Emma	Armstrong	Utah State University
Richard	Asirifi	Texas A&M University
Luciana	Astiz	National Science Foundation

Andrea	Attolico	University of Rome La Sapienza
Shuyu	Bai	East China University of Technology
Adam	Baig	Nanometrics
Annemarie	Baltay	USGS Earthquake Science Center
Walid	Ben Mansour	Washington University in Saint Louis
Dino	Bindi	GFZ
Gian Maria	Bocchini	Ruhr University Bochum
Chas	Bolton	UT-Austin
Felix	Borleanu	National Institute for Earth Physics
Brittany	Botell	University of Memphis
Oliver	Boyd	USGS
Sierra	Boyd	Berkeley Seismology Lab

Jan	Burjánek	Institute of Geophysics of the Czech Academy of Sciences
Margaux	Buscetti	Uppsala University
Birsen	Can	Bogazici University Kandilli Observatory and Earthquake Research Institute
Raul	Castro	CICESE
Sara Beth	Cebry	USGS
Hilary	Chang	Lamont-Doherty Earth Observatory
Estelle	Chaussard	FM
Xiaowei	Chen	Texas A&M University
Sungwon	Cho	Pukyong National University
Elizabeth	Cochran	USGS
Fabrice	Cotton	GFZ
Jialing	Dai	KAUST
Siddharth	Dey	University of Wisconsin-Madison
Haoran	Dong	East China University of Technology
Jin	Fang	University of Leeds
Reza	Filizadeh	University of Nebraska-Lincoln
George	França	Universidade de São Paulo
František	Gallovič	Charles University in Prague
Athanassios	Ganas	NOA
Sandro	Gomes	UFRN
Gerard	González	Colombian Geological Survey
Hao	Guo	University of Wisconsin-Madison
Ruth	Harris	USGS
Grégoire	Heller	CEA
Daniela	Henriques	Instituto Português do Mar e Atmosfera
stephen	hernandez	IGEPN
Gabrielle	Hobson	University of California San Diego
Joanna	Holmgren	NORSAR
Xinrong	Hou	University of Tokyo
Martin	Hronek	Charles University

Chen	Huang	NORSAR
Nadine	Igonin	University of Texas at Dallas
Seongju	Jeong	University of Oklahoma
Chen	Ji	UCSB
Yu	Jiang	University of Nevada, Reno
Nato	Jorjashvili	Iliia State University
Lav	Joshi	Charles University
Yoshi	Kaneko	Kyoto University
Özlem	Karagöz	Çanakkale Onsekiz Mart University
Tatiana	Kartseva	ISTere, Grenoble
Chun-Yu	Ke	National Taiwan University
Debi	Kilb	Scripps Institution of Oceanography
Trey	Knudson	Stanford University
Diana	Konrádová	Geophysical Institute Czech Academy of Science
Olga-Joan	Ktenidou	National Observatory of Athens
Fabian	Kutschera	Scripps Institution of Oceanography, UC San Diego
Jiayan	Liao	China University of Geosciences
Yajing	Liu	McGill University
Semechah	Lui	University of Toronto
Björn	Lund	Uppsala University
Paul Martin	Mai	KAUST
Sawas	Marcou	UC Berkeley Seismology Lab
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Kevin	Mayeda	Air Force Technical Applications Center
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Christipher	Menges	USGS
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Sherry	Nie	Tufts University
Adrien	Oth	European Center for Geodynamics and Seismology
Shweta	Pandey	NGRI
Michael	Pasyanos	Lawrence Livermore National Laboratory
Edric	Pauk	USC/SCEC
Andres	Pena Castro	University of New Mexico
Colin	Pennington	Lawrence Livermore National Laboratory
Anica Otilia	Placinta	National Institute for Earth Physics
Kenia	Rodríguez	CICESE
Badie	Rowshandel	California Earthquake Authority
Natalie	Schaal	California State University, Northridge (CSUN)
Hannah	Shabtian	Brown University
Prof Daya	Shanker	Indian Institute of Technology Roorkee
Peter	Shearer	UC San Diego
Lin	Shen	Institute of Geology and Geophysics, Chinese Academy of Sciences
Zheng-Kang	Shen	UCLA
Shuzhong	Sheng	East China University of Technology
Rob	Skoumal	USGS
Minkyung	Son	KIGAM
Yu-Sheng	Sun	University of Oregon
Mariano	Supino	INGV
Muhammad	Taimoor	OGDCL
Onur	Tan	Istanbul University - Cerrahpasa

Dhiroj	Thapa	Tribhuvan University
Yanfang	Tong	East China University of Technology
Daniel	Trugman	UNR
Takahiko	Uchide	Geological Survey of Japan, AIST
Lubica	Valentova K.	Charles University, Prague
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Gisela	Viegas	Newmont Corporation
William	Walter	LLNL
Shawn	Wei	Michigan State University
Samsul	Wiyono	BMKG
Qimin	Wu	Lettis Consultants International
Qisheng	Xu	Donghua University
Yueyi	Xu	CEA
Takuji	Yamada	Ibaraki University
Shenghao	Yang	East China University of Technology
Yucheng	Yang	Cornell University
Clara	Yoon	USGS
Keisuke	Yoshida	Tohoku Univ.
Nana	Yoshimitsu	Kyoto University
Yuehua	Zeng	USGS
Siyuan	Zhang	Other
Yurong	Zhang	Michigan State University
Zhuoran	Zhang	Michigan State University
Jiangcheng	Zhou	Peking University