

**FINAL TECHNICAL REPORT: CRESCENT Annual Meeting** (January 10, 2025) in conjunction with USGS Subduction Zone Meeting (Jan 8 &9, 2025)

USGS Award #G25AC00110 (December 2024 – September 2025)

**Jill Elizabeth, Diego Melgar, and CRESCENT team**

University of Oregon  
5219 University of Oregon  
Eugene, OR 97403  
779.704.0590  
jillf@uoregon.edu  
dmelgarm@uoregon.edu



*This material is based upon work supported by the U.S. Geological Survey under Grant No. G25AC00110. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of the U.S. Geological Survey. Mention of trade names or commercial products does not constitute their endorsement by the U.S. Geological Survey.*

Introduction.....	1
Meeting Overview .....	2
Discussion of Results.....	2
Conclusions.....	17
Appendix A: CRESCENT Annual Meeting Packet.....	18
Appendix B: CRESCENT Annual Meeting Feedback Survey .....	28

## Introduction

Thanks to the leadership and vision of the Subduction Zone Science Organizing Committee (Erin Wirth, alex grant, Lydia Staisch, Joan Gomberg, Fred Pollitz, Michelle Coombs, Emily Johnson, Wes Thelen, and Aaron Wech), we enjoyed several days of excellent presentations and community building at the [U.S. Geological Survey Subduction Zone Science Meeting](#) in Seattle on January 8 & 9, 2025.

Following that, and with generous support from the USGS, we hosted our [CRESCENT Annual Meeting](#). 120 scientists gathered in Alder Hall at the University of Washington to hear about exciting Cascadia research, ranging from offshore geophysics presented by Suzanne Carbotte, to triple junction tectonics by Kathryn Materna, and dendrochronology by Bryan Black. We also reviewed our cyberinfrastructure, working and special interest groups accomplishments over the last 14 months, and honed our plan for the next year.

With gratitude we acknowledge the efforts of the CRESCENT Executive Committee in close collaboration with the USGS Subduction Zone Workshop planning committee to plan the meeting and to all of you who presented and participated so enthusiastically. It was an exciting meeting – the rooms were abuzz with energy that we are carrying into 2025 – a great reminder of the power in collaboration and why we engage in this work.

## Meeting Overview

Our goals for the meeting were to:

- 1) Foster collaboration between our working groups and special interest groups;
- 2) Bridge gaps, and increase communication among subduction zone research groups; and
- 3) Identify and encourage synergistic collaborative activities between CRESCENT and the USGS.

## Overview of Agenda

- 8:30 am – Opening Remarks
- 8:45 am – Scientific Frontiers in the Cascadia Subduction Zone Presentations
- 9:55 am – CRESCENT Working Groups Present
  - ❖ Community Velocity Model (CVM)
  - ❖ Community Fault Model (CFM)
  - ❖ Dynamic Rupture, Earthquake Cycle, and Tsunamis (DET)
  - ❖ Coupling, Seismicity, and Slow Slip (C3S)
  - ❖ Cascadia Paleoseismology (CPAL)
- 10:25 am – Cyber Infrastructure
- 11:00 am – Working Group Meetings
- 1:00 pm – Scientific Frontiers in the Cascadia Subduction Zone Presentation
- 1:35 pm – CRESCENT Working Groups on the Horizon
- 2:40 pm – CRESCENT Special Interest Groups Present
  - ❖ Ground Motion Modeling
  - ❖ Ground Failure
  - ❖ Offshore Observations
  - ❖ Fluids
- 3:00 pm – Breakout Discussions
  - ❖ CPAL + DET
  - ❖ CVM + CFM + DET
  - ❖ C3S + CFM
  - ❖ C3S & Cyberinfrastructure
- 4:30 pm – Wrap-up

For the detailed agenda, please see Appendix A: CRESCENT Annual Meeting Packet.

## Meeting Content

The meeting opened with a welcome from Luciana Astiz, NSF Program Officer, and Gavin Hayes, USGS Senior Science Advisor for Earthquake and Geologic Hazards, followed by opening remarks from CRESCENT's Director, Diego Melgar, Ann & Lew Williams Associate Professor of Earth Sciences, University of Oregon.

Professor Melgar spoke on “CRESCENT as a hub for earthquake hazards research and resilience.”

The meeting featured three presentations by guest speakers to provide participants with insight into the “Scientific Frontiers in the Cascadia Subduction Zone.” (*meeting goals #2 & #3*)

Suzanne Carbotte, Bruce Heezen Lamont  
Research Professor, Columbia University,  
presented “Regional-scale crustal architecture of the offshore Cascadia Subduction Zone  
revealed from active source seismic studies: implications for along-strike structural  
segmentation within the seismogenic zone.”

Kathryn Materna, Assistant Professor, University of Colorado Boulder, presented “Ferndale,  
Petrolia, and Cape Mendocino, oh my! Lessons and Open Questions from Southern  
Cascadia.”

Bryan Black, Associate Professor, University of Arizona, presented “Emerging techniques for  
precisely dating trees killed in Cascadia Subduction Zone earthquakes.”

Each of the CRESCENT Working Groups and Special Interest Groups was asked to present an  
update on their current activities. (*meeting goal #1*)

In the morning, the following folks presented on the CRESCENT Working Groups:

- Community Velocity Model (CVM) *presented by* Pieter Ewald-Share, Assistant Professor, Oregon State University
- Community Fault Model (CFM) *presented by* Ashley Streig, Associate Professor, Portland State University
- Dynamic Rupture, Earthquake Cycle, and Tsunamis (DET) *presented by* Eric Dunham, Professor, Stanford University
- Coupling, Seismicity, and Slow Slip (C3S) *presented by* Jack Loveless, Professor of Geosciences, Smith College
- Cascadia Paleoseismology (CPAL) *presented by* Tina Dura, Assistant Professor, Virginia Tech

In the afternoon, the following researchers provided updates on the CRESCENT Special Interest Groups:

- Ground Motion Modeling *presented by* Diego Melgar, Director, CRESCENT
- Ground Failure *presented by* Ben Leshchinsky, Professor, Oregon State University
- Offshore Observations *presented by* Will Wilcock, Professor, University of Washington
- Fluids *presented by* Cailey Condit, Assistant Professor, University of Washington

Three sessions on the day were aimed at our overarching meeting goals. (*meeting goal #1, #2, and #3*)

First, an hour was dedicated Working Group Meetings. Participants were asked to join one of the five breakout meetings. By having members of the special interest groups, other research centers and USGS personnel join the regular working group discussions, we aimed to foster communication and collaboration.

Second, each CRESCENT Working Group presented on their future plans and next steps.

- CVM *presented by* Jonathan Delph, Assistant Professor, Purdue University
- CFM *presented by* Becky Fildes, Postdoctoral Researcher, Western Washington University
- DET *presented by* Alice Gabriel, Associate Professor, University of California, San Diego
- C3S *presented by* Hanna Elston, Postdoctoral Research Associate, Smith College

- CPAL *presented by* Lydia Staisch,  
Research Geologist, United States  
Geological Survey

Third, we organized interworking group breakout discussions to foster communication and collaboration across groups. The interworking group breakouts were organized as follows:

#### CPAL + DET

- How can paleoseismic data inform and refine the predictive capability of dynamic rupture models?
- Can findings from earthquake cycle models predict or reproduce patterns in paleoseismic records, such as variability in recurrence intervals?
- How can paleoseismic data and modeling approaches be integrated into probabilistic seismic hazard assessments at subduction zones?

#### CVM + CFM + DET

- The nature of the megathrust: How are the findings and products of both groups being used to produce an authoritative version of the megathrust geometry?
- How do velocity structures identified by CVM interact or inform the inferred behavior of known faults in the CFM?
- Do we understand standardized formats and protocols for data sharing between the CVM and CFM teams and for inclusion in downstream workflows (e.g. ground motion modeling).

#### C3S + CFM

- How are fault geometry, segmentation, connectivity, and slip rates incorporated into the CFM guiding assumptions about block modeling?
- What is the strategy for incorporating high-resolution seismic catalogs to refine fault geometries, particularly for blind faults or areas of complex faulting?
- How is the distinction between locked zones, slow-slip zones, and fully creeping segments of faults considered in coupling models and by the CFM?

#### C3S & Cyberinfrastructure

- Cloud-Based Data Management: Are all the tools in place for scalable storage and querying of large seismic datasets with real-time access?
- ML Integration: Are ML models ready for cloud platforms for automated event detection and classification?
- Data Standardization: Do we have APIs and FAIR-compliant formats for seamless data interoperability?
- Collaborative Tools: How can we enable global access and large-scale analysis with cloud-native tools like JupyterHub?

The meeting concluded with a wrap up discussion.

## Discussion of Results



As part of our NSF cooperative agreement, CRESCENT contracts with an external evaluator to conduct feedback surveys on our major activities. A total of 68 usable survey responses were received after the meeting.

A few highlights:

- I really enjoyed the information presented and thought that the speaker line up and sessions were well thought out.
- The concise presentations on working group progress/on the horizon were useful to see the highlights of each group.

A few challenges:

- CRESCENT-related science brings together a group of people with similar and common goals that can share resources that could save time and allow research to progress more quickly. Can be a challenge to form truly broad collaborative research groups on a scale sufficient to make substantial advances in subduction zone science.
- Distilling all the great science that is coming out of CRESCENT and its collaborators down into a way that is simple and easy to understand for emergency management, planners or policy makers, and the public. One major concern is that while science is always evolving and improving, the rate at which it does so can leave people with greater uncertainties than before despite having more data and scientific advances.

We have shared and discussed the feedback with CRESCENT staff, Executive Committee, Science Planning Committee, and the planning committee for the upcoming annual meeting.

For the details on the feedback from the Annual Meeting, please see Appendix B: Annual Meeting Feedback Survey.

## **Science Pillar at CRESCENT Annual Meeting**

### ***Working Group Activities***

#### **❖ Earthquake Catalogue Meeting**

The goal of the meeting was to develop a plan for creating a fully open-source, version 0, paradigm-shifting ML/AI-based earthquake catalog for the western United States—intended for use in both scientific research and broader applications. The meeting brought together 20 attendees, including representatives from NSF, CRESCENT, SCOPED, the EarthScope Consortium, the National Data Platform (NDP), and USGS.

The agenda focused on identifying the data to be included in the catalog, considering factors such as geographic coverage, time span, and sensor types. The group reviewed the current strategy for applying ML/AI pickers to EarthScope data and discussed the selection of pickers, features, and metadata to include, as well as proposed output formats. Additional topics included phase associations, event locations, magnitudes, and focal mechanisms.

In the second half of the meeting, participants outlined a project plan and took stock of available resources. Each organization committed to one or more major tasks, including picking, association, location, magnitude estimation, and quality control, laying the foundation for a collaborative effort moving forward.

### ❖ Community Velocity Model (CVM)

The CRESCENT Community Velocity Model (CVM) group has two overarching goals. The first is to build and produce multi-scale seismic velocity (isotropic  $V_p$  and  $V_s$ ) and density models of the Cascadia region and related seismic-hazard estimates in a FAIR (Findable, Accessible, Interoperable and Reusable) manner. The second is, in collaboration with CRESCENT Cyberinfrastructure, to produce a platform through which the CRESCENT CVM (all versions) as well as other parameter models that fit the CRESCENT CVM footprint (latitude 39-52N and longitude 116-130W) can be uploaded, viewed and extracted. On the first goal, version 1 of the viewer is ready and live (<https://cvm.cascadiaquakes.org/>) as well as the GitHub repository ([https://cascadiaquakes.github.io/cvm-tools-book/contribution\\_guidelines.html](https://cascadiaquakes.github.io/cvm-tools-book/contribution_guidelines.html)) where new models can be contributed. In addition to 3D parameter volumes, the online tool now also hosts prominent 2D surfaces and interfaces (e.g., subducting slab surface and Moho) to allow comparisons and tight integration between the CVM and these products. Several models and interfaces are online and ready for exploration. Future versions of the online tool are earmarked to enable hosting and extraction of parameters that go beyond isotropic elasticity (e.g., attenuation, potentially earthquake-relevant non-seismic parameters) as well as improvements to optimally position the tool for maximum community benefit.

The building of the CVM has started with a focus on the entire CRESCENT footprint and relatively coarse (~10s km-scale) resolutions. Toward this aim, ambient noise-derived surface wave and teleseismic P-wave arrival data have been used. Resultant model images produced with these data were presented at the meeting. These represent a key first step in producing a CVM using cutting-edge imaging tools and large seismic datasets (onshore and offshore) over a significant area that includes the Cascadia Subduction Zone. There was great enthusiasm from the attendees about how they can contribute to this effort and plans were discussed.

Future steps in this effort over the next year or so are:

- Joint inversion of the ambient noise and teleseismic data to produce a 3D shear-wave velocity model that will, in turn, be translated into P-wave velocity and density models. All of these will constitute CRESCENT CVM v0.
- When ready and vetted, v0 will be released on the online CRESCENT CVM platform.
- Model v0 will then be used as a basis for all future updates that includes higher resolution (~1 km scale) models of the crust in key areas (e.g., Willamette Valley and Seattle Basin) to be generated using full-waveform methodologies.
- The development of multi-scale model-merging tools will also continue with one aim being the fusion of high-resolution active-source shallow seismic models and the CVM.

### ❖ Community Fault Model (CFM)

The Community Fault Model Version 0.1 can now be viewed at the CFM repository website (<https://cfm.cascadiaquakes.org/>) that includes 2D and 3D web viewers for the active faults in Cascadia and geometry files available for download. The python code used to build these faults is available on our GitHub page



(<https://github.com/cascadiaquakes/CRESCENT-CFM>). This version is built from the NHSM for the US faults and includes a few Canadian faults. We currently follow the NHSM inclusion criteria for deciding if faults are a part of the CFM.

Ongoing projects and plans for the next year include:

- Building a metadata table that includes information about the faults included in the CFM (e.g., fault physical characteristics and references) that will be available as another product along with the fault geometries;
- Incorporation of newly published offshore faults into the CFM (2D traces, 3D geometries, updated plate interface geometry); and
- Revision of existing onshore fault geometries (e.g., editing fault intersections, incorporating topographic data).

We will continue to actively collaborate with state and federal agencies, and are currently planning a summer 2025 workshop to get feedback from the community on current version of CFM.

#### ❖ Dynamic Rupture, Earthquake Cycle, and Tsunamis (DET)

The DET group has three main activities: 1) dynamic rupture modeling, 2) earthquake cycle modeling, and 3) community benchmarking activities for earthquake models.

Alice Gabriel's research group performed 3D dynamic rupture models of Cascadia megathrust ruptures, building on prior work by Marlon Ramos, Yihe Huang, and collaborators. In a project led by PhD student Jonatan Glehman, they developed a workflow for setting initial stress and frictional strength conditions using geodetically constrained interseismic coupling inversions. They explored the effects of spatially variable elastic properties, pore fluid pressure (which controls frictional strength through the effective normal stress), and the choice of geodetic inversion. Model results are validated by comparison to coastal subsidence constraints from the 1700 earthquake. This work is currently under review, with a preprint available (Glehman et al., 2024). These models were performed without an ocean (placing the free surface along the seafloor). In the upcoming year, the group will add an ocean for self-consistent modeling of tsunami generation, as well as splay faults and inelastic yielding of sediments. This overall line of research will provide more realistic, validated source models for earthquake and tsunami hazards.

Eric Dunham's research group has been exploring longer timescale processes using a combination of modeling approaches. The goal of this work is to combine petrology,

geodynamics, and experimental constraints to understand controls on pore fluid pressure, fault strength, and the partitioning of deformation between frictional slip and viscous flow along the megathrust. Postdoctoral fellow So Ozawa, Dunham, and collaborator Cailey Condit, model fluid production by metamorphic dehydration reactions, with fluids channeled up-dip; the pore pressure from the flow calculation controls fault frictional strength. This is combined with a viscous flow law. The model predicts a broad zone of overlapping frictional and viscous deformation below the seismogenic zone, possibly explaining the gap between the coupled seismogenic zone and the deeper region hosting slow slip and tremor. The model can also produce a transition back to frictional deformation at low effective stress in the slow slip region. This model is steady state and the group is preparing a publication. Another postdoctoral fellow, Wenqiang Zhang, is working with Ozawa and Dunham to perform 3D earthquake cycle models, built on the steady state modeling results, to study time-dependent changes in deformation style.

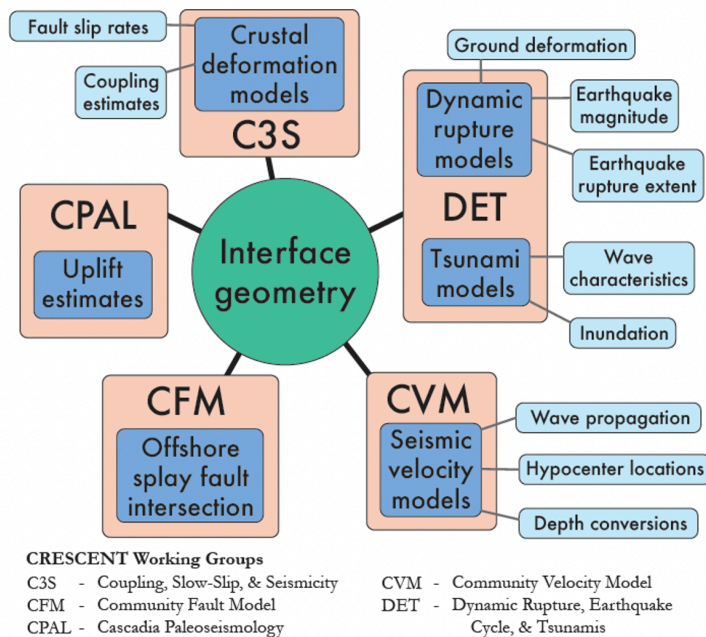
Finally, Brittany Erickson has been working with Loic Bachelot on a new code verification web platform that will be used in the DET group's code comparison project. PhD student Fabian Kutschera, working with Gabriel and Dunham, developed two 3D dynamic rupture benchmark problems involving slip on a low angle thrust fault in an elastic solid with an ocean on top. The benchmark problems are extensions of a similar benchmark problem developed by the SCEC/USGS dynamic rupture group, led by Ruth Harris and Michael Barall, that were designed with input from DET. The SCEC/USGS benchmark problem did not include an ocean. In the new DET benchmarks, the ocean is compressible and has gravity, thus allowing for ocean acoustic waves and tsunamis as well as earthquake rupture and seismic waves. The benchmark will verify coupled earthquake-tsunami modeling capabilities that several groups in the US and Japan are using to study subduction zone hazards.

Feedback from the meeting participants in the breakouts involving DET was positive, with general support for the modeling approaches and community engagement through benchmarking activities. There was considerable interest in expanding DET's efforts to encompass tsunami modeling. This will be partially addressed through the new benchmark problems as well as Gabriel's dynamic rupture models that will include an ocean. However, additional efforts that extend further into probabilistic tsunami hazard assessment, or at least the generation of a broader suite of scenarios than is currently planned, are of interest to some stakeholders. This would require external funding beyond that provided by NSF and USGS.

#### ❖ Coupling, Seismicity, and Slow Slip (C3S)

In the Year 1 summary presentation, we described progress made by each of the three components of the C3S group. Hanna Elston is leading construction of the coupling model, supported by Jack Loveless, and major milestones include incorporation of the Community Fault Model's "Version 0" into the crustal block model geometry used to estimate the subduction interface coupling. The integration of the CFM into the coupling model is enabling exploration of the segmentation of the forearc and how deformation may be partitioned across subduction zone processes and upper plate faults. Finally, Elston has investigated the impact of slab geometry on interseismic deformation, and in the process, she generated this summary graphic illustrating the ways in which the interface geometry impacts all facets of CRESENT:

## Interconnected Nature of Slab Geometry



In terms of slow slip, Tim Melbourne worked to expand the geographic footprint of the routine PANGA processing, so that interseismic velocities spanning the entire region of the crustal block model are available. Brendan Crowell investigated the sensitivity of slow slip detection methods, describing how the inferred slip pattern is affected by the geodetic detection threshold. Additionally, he developed a framework for a slow slip event community detection exercise, to be run ahead of the October annual meeting. On the seismicity front, Amanda Thomas and Daniel Trugman drafted a Jupyterbook documenting the processing workflow, gained access to a massive database of seismograms via EarthScope, and liaised with the community to work on applying machine learning algorithms to earthquake detection. These latter tasks in particular relied heavily on Thomas' work in developing cyberinfrastructure policies and practices for CRESCENT.

In the Year 2 presentation, we presented goals for the C3S group for the upcoming year. Crowell plans to run a slow slip event detection exercise to compare the performance of several detection algorithms. Tentatively, details on participation will be advertised in spring/summer 2025, and the exercise will take place in October. In terms of geodetic velocity fields, Melbourne will provide PANGA processed data and Crowell will produce velocity fields using the slow slip detection algorithm. As for the block model, Elston will incorporate updates from the CFM and continue to refine the model with support from Loveless. In the coming year, Loveless and Elston will work with CFM to settle on a "version 1" block model. Coupling estimates from models that use the geodetic velocity fields from Crowell will provide insight on time-dependent coupling patterns. Related to seismicity, Thomas and Trugman will continue developing an earthquake catalog. Thomas convened a meeting with several community members (described in "Earthquake Catalog Meeting" section above) and will progress toward a comprehensive seismicity catalog over the coming year.

❖ Cascadia Paleoseismology (CPAL)



In Year 1, the CPAL Working Group made significant strides in reconstructing both the 1700

CE and earlier earthquake histories along the Cascadia Subduction Zone. This included fieldwork at key sites like Salmon River (OR), Lagoon Creek (CA), and Willapa Bay (WA), where teams collected sediment cores and conducted high-resolution tsunami deposit mapping using grain-size and diatom analyses. These data were used to improve understanding of the inland extent of tsunami inundation and the amount of coseismic subsidence associated with past earthquakes. New reconstructions compared diatom- and foraminifera-based estimates of land-level change, refining estimates of earthquake magnitude and rupture extent.

The team also advanced efforts to enhance earthquake and tsunami chronologies by collecting pre-1700 CE event data and expanding radiocarbon age control. Strategic linkages between geologic records and modern flood hazard projections were explored, demonstrating how coseismic subsidence could greatly expand high-risk flood zones. In addition to research, the group laid groundwork for community resources—including updated paleoseismic and microfossil databases—and engaged in science communication, securing media coverage, and growing student involvement through the GEI "Cores to Code" summer program.

Building on the progress of Year 1, CPAL's future work will prioritize completing and expanding inland tsunami and subsidence mapping at sites like Alsea Bay, with a focus on leveraging existing cores to constrain down-dip rupture limits. Ongoing high-resolution analyses of tsunami deposits, including marine diatom signals, will refine inundation boundaries beyond the reach of sand layers. These data will serve as benchmarks for earthquake and tsunami modeling efforts and help evaluate variability in rupture characteristics over time. Efforts will also continue to integrate paleoseismic benchmarks into sediment transport and dynamic rupture models for events like the 1700 CE Cascadia earthquake.

Future work also includes enhancing age models through improved radiocarbon dating and dendrochronology to distinguish between closely timed events, and to better assess whether past full-margin ruptures were instead sequences of partial events. CPAL will continue updating community-facing databases and coordinating with the CFM and DET groups to support model-data integration. Additional outreach will include the Year 3 CPAL/CFM workshop, new student training opportunities, and a potential educational publication from the Cores to Code program.

During the morning breakout, the CPAL group discussed recent and upcoming fieldwork across Cascadia, including southern Humboldt and Alsea Bay, with expanded tsunami mapping and permitting efforts underway. Opportunities were flagged for workforce development through seed grants, NSF REUs, and partnerships with twinning programs and institutions like Portland State and UO. The group also emphasized the importance of publishing data from underrepresented areas (e.g., northern WA), incorporating geomorphology (e.g., Will Stuble's work), and continuing development of the paleoseismic database beyond basic USGS releases by digitizing logs and applying new tools such as machine learning. Planning began for the Year 2 (2025) *Cores to Code* (C2C) activities, including student engagement, road access, and potential publication on geoscience education.

### ***Working Group Collaboration***

#### **❖ CPAL + DET**

The afternoon CPAL+DET session focused on integrating paleoseismic data with dynamic rupture models. Key insights included refining model boundaries to match deformation profiles,



exploring uplift and subsidence signatures to constrain slip distributions, and addressing the non-uniqueness of inverse problems. Recurring themes were the need for denser site coverage to model down-dip slip limits, improving coherence of subsidence signals across sites, and integrating multiple proxies to reduce subsidence uncertainties (typically ~20–30 cm). DET emphasized the utility of paleoseismic data, recurrence variability, and high-resolution dating to inform earthquake cycle models, while also calling for greater offshore data synthesis and input on database needs to support future modeling.

### *Key Notes*

- **Model Calibration & Rupture Parameters**
  - Model tuning involves modifying updip/down-dip boundaries and stress drops to match subsidence or slip magnitudes.
  - Adjustments to frictional properties (e.g., velocity weakening/strengthening) influence fault behavior.
  - Dynamic rupture and deformation models are both useful, but sometimes deformation alone suffices.
  - Higher stress drop can produce larger slip events to match paleoseismic data.
- **Geologic Observations**
  - Southern Oregon provides the most complete paleoseismic record; data quality diminishes moving north due to tectonic uplift.
  - Observed subsidence often exceeds 1 meter; recovery periods between events are critical for distinguishing discrete events.
  - Sea-level data is “relative” and must be interpreted in context with paleo-sea-level reconstructions.
- **Dating & Resolution Challenges**
  - Radiocarbon dating has a practical resolution limit (~15 years best case); diatoms capture changes faster than foraminifera.
  - LOI, diatoms, and buried soils are used to constrain interseismic and coseismic changes.
  - Models and observations both contain variability—focus is on identifying “best fits” rather than exact matches.
- **Hazard Modeling Implications**
  - Full-margin vs. partial-margin ruptures influence recurrence estimates and hazard assessments.
  - Probabilistic models should account for spatially variable recurrence intervals and uncertainties.
  - Offshore data, once organized by DET, could help constrain down-dip rupture limits and slip distribution.
- **Integration Across Groups**
  - Coordination between CPAL and DET is essential for constraining rupture models with geological observations.
  - Database development should weight data quality and proxy reliability.
  - There are no standard workflows yet to match specific paleoseismic sequences to dynamic models.

### *Important Takeaways*

1. Paleoseismic data can meaningfully inform rupture models, particularly by constraining recurrence intervals, vertical deformation, and slip patterns—but challenges remain in integrating these with high-resolution simulations.

2. Model tuning is an inversion problem, where stress, friction, and boundary conditions are iteratively adjusted to best match observed geological patterns.
3. Subduction zone records vary significantly by latitude, making full-margin comparisons and hazard modeling complex.
4. Chronologic resolution and proxy quality are critical for interpreting geologic signals and informing models—progress depends on both methodological improvements and collaborative data synthesis.
5. There is value in using Cascadia as a test case, but comparisons to other subduction zones may offer additional insights.
6. Greater DET–CPAL collaboration is encouraged, especially in organizing, evaluating, and applying offshore and onshore datasets to better constrain seismic hazard models.

❖ CVM + CFM + DET

Representatives from the velocity model, fault model, and dynamic rupture, earthquake, and tsunami groups met to discuss needs for merging individual disparate datasets (e.g., fault spatial distributions) with regional and local seismic property models, and how those input might affect resulting ground motion predictions and rupture simulations.

*Key Notes*

- *What is the best way to create a regional-scale megathrust geometry model?* Megathrust geometric characteristics are challenging to estimate globally due to uncertainty in earthquake locations, non-uniqueness in seismic images and interpretations, and the limited scale of the megathrust (generally on the order of hundreds of meters) compared to geophysical imaging techniques. While offshore megathrust geometry is relatively well constrained due to the high frequencies of the data and shallow depth to the megathrust, uncertainties increase inland due to limited high frequency wave energy and increasing depth, which fundamentally limits our ability to recover the megathrust. The active and passive seismic imaging communities need to leverage their different datasets to resolve the full extent of the plate interface by merging estimates from different seismic techniques. Given the uncertainties in the associated datasets and their variable resolution to plate interface structure, it was agreed that multiple models should be created. These models will be of varying resolution and confidence so that studies can use a range of models to understand how megathrust geometry will affect their results, thus leading to the ability to test the robustness and consistency of results derived from models dependent on the plate interface geometry.
- *Do we integrate (non-plate boundary) faults and the CVM?* Faults can represent 1<sup>st</sup> order seismic discontinuities that are poorly recovered by regional-scale studies. These discontinuities reflect the juxtaposition of contrasts in elastic properties, usually due to the vertical motion associated with dip slip faults. Generally, regional velocity models can recover increased seismic property gradients across faults, but the near-fault seismic properties are often far weaker than expected from surface geology and fault-adjacent rock properties. Discussion on the subject tended to favor a CVM that doesn't explicitly include fault structures, as they are often below the seismic resolution of the datasets, and could lead to artefacts in imaging that would propagate into predicted ground shaking estimates from earthquake simulations. However, it was noted that imaged velocity structures from the CVM could potentially validate/refine fault models in the CFM onshore where vegetation often precludes clear observations of forearc faulting domains. Further integration between C3S and CFM was also discussed, as seismicity patterns

could be very useful for constraining “blind” fault zones, as well as fault depth extents. Constraints on strike-slip faults and fault damage zones prove much more difficult to constrain with seismic imaging due to their small scale and lack of significant differences in geology on either side of minor strike slip faults, and were agreed on as 2<sup>nd</sup> order features that did not require attention at this point.

- *We need clear data sharing, version control, and protocols practices.* Given the future growth of different versions of CRESCENT data products (e.g., fault models, seismic property models, and megathrust geometries), we need to be sure that the details of the different models that are produced are concisely and accurately documented. The broad, interdisciplinary takeaways that will result from CRESCENT require a clear standardized deliverable from the groups that can be integrated with relative ease into the workflows and products of the other groups. This includes handling uncertainties, which is important for later products that estimate ground motion modeling.
- *How can we integrate other seismic properties into the CVM that could be important for DET?* While seismic velocities are a major control on the results of ground motion modeling, other parameters are also important, such as seismic attenuation and fault geometry around significant basin structures. A seed grant was advertised for a study that aims to constrain attenuation at the regional scale in Cascadia, while smaller basin bounding structure could be incorporated at the local scale through model merging tools that are currently in progress by the CVM.

#### *Important Takeaways*

1. CRESCENT should produce a range of version-controlled models for seismic velocity and megathrust geometry. It would be helpful if the CRESCENT CVM (or CFM) explicitly labeled a “preferred” model for these properties once created, but a range of models will allow flexibility for application to both local and regional-scale studies. These models should attempt to incorporate data uncertainties, so that the reliability of results in different parts of the model can be at least qualitatively understood.
2. Currently, minor fault geometry will not be included in the regional-scale CVM to prevent biasing the final model with ill-constrained structures that may not be justifiable for the dataset used in model creation. However, the regional CVM could help delineate/validate the presence of hidden or weakly constrained fault locations, and fine-scale structure from the CFM could be integrated in local, higher resolution studies at later stages in development. It was encouraged that C3S and CFM worked closely to better constrain fault zone spatial distribution using seismicity and surface faulting constraints.
3. While seismic velocities are the most important parameter for controlling ground motion modeling results, other properties (e.g., attenuation) should be estimated in the future and incorporated into the CVM.

#### ❖ C3S + CFM

The meeting focused on improving fault modeling in the Cascadia region by integrating seismic data and refining fault geometries.

#### Key points included:

1. **Fault Geometry:** Connecting discontinuous faults and using geophysical signals to define block boundaries, with challenges in defining continuous boundaries.

2. **Seismic Catalogs:** Advanced seismic relocation and machine learning were discussed for mapping blind faults and understanding slow-slip and microseismicity.
3. **Fault Behavior:** The importance of distinguishing between locked, slow-slip, and creeping fault segments in coupling models.
4. **Geological Models:** Integrating geological maps with geophysical data, though challenges remain in connecting active faults with existing datasets.
5. **Collaboration and Tools:** Emphasis on greater collaboration between modelers and fault mappers, and developing tools for integrating data and adjusting fault models.
6. **Offshore Data:** The need for better offshore geodesy and shallow zone data, with suggestions to use legacy datasets and small-scale marine geophysics.
7. **Model Updates:** Discussion on tools for updating fault models and improving community involvement in model refinement.

The meeting highlighted the need for better data integration, collaboration, and improved tools to refine fault models in Cascadia.

#### ❖ C3S & Cyberinfrastructure

At the C3S and Cyberinfrastructure breakout meeting, discussions centered around advancing cloud-based data management for large seismic datasets. Participants emphasized the need for scalable storage solutions and real-time data querying capabilities, noting that key decisions must still be made regarding which datasets to prioritize for storage and distribution—particularly with a focus on high-quality seismic data. The PNSN’s historical seismic archive, spanning several decades, was highlighted as a valuable resource, and the potential of the National Data Platform (NDP) architectures to integrate EarthScope and regional datasets was discussed.

In terms of machine learning (ML) integration, the group outlined a vision of making the full earthquake detection pipeline—encompassing earthquake locations, magnitudes, focal mechanisms, and intermediate products—publicly accessible through cloud platforms. Workflow design and quality control were identified as critical to this effort, with particular attention given to the availability of large pick databases and the future possibility of moving association steps into the cloud.

Participants also discussed the need for improved data standardization and collaborative tools. Ensuring interoperability through APIs and FAIR-compliant data formats was seen as essential for supporting global access and enabling large-scale analyses. Cloud-native tools such as JupyterHub were proposed as key components for facilitating this, alongside cloud literacy initiatives, like the workshops planned by Earthscope, to help the broader community engage effectively with these resources.

#### *Special Interest Group Activities*

##### ❖ Ground Motion Modeling

This SIG’s presentation surrounded its vision for advancing Cascadia-specific ground motion simulations by integrating detailed 3D geologic models, such as the Community Velocity Model (CVM), with established engineering-based approaches. The presentation emphasized the importance of this hybrid framework to better capture complex wave propagation effects in the Cascadia subduction zone and improve hazard-relevant predictions. Key science questions were outlined, including how basin structures, rupture complexity, and site

response influence ground motions.

The group invites interested researchers to contribute and collaborate as it builds momentum toward coordinated modeling efforts.

❖ **Ground Failure**

The presentation highlighted the importance of GF SIG as a potential platform for community-building for ground failure enthusiasts in Cascadia and summarized the upcoming Cascading Hazards Workshop in Newport. There are numerous opportunities for collaboration, especially with the CPAL and CVM groups.

❖ **Offshore Observations**

The OO SIG presentation noted the recent accomplishments of the geoscience community offshore in Cascadia and the potential for CRESCENT as a vehicle to accelerate that progress. The coordinating group has about 20 members and has organized two zoom meetings to discuss SZ4D's plans for seafloor geodetic infrastructure offshore and a well-attended lunchtime SIG at USGS subduction zone science meeting that discussed various topics.

❖ **Fluids**

The goal of the Fluids SIG is to engage the interdisciplinary community that works on fluid-related phenomena and work to develop a community fluid model to map fluid sources, volumes, and behaviors using the diverse geologic and geophysical community's data. Fluids play a central role in many subduction zone deformation processes from earthquakes to episodic tremor and slip to aseismic slip. These fluids may have a first order control on strain partitioning and modes of slip. Thus, this model will allow us to test current hypotheses about fluid's role in slip behaviors, and will complement and use other CRESCENT models like CVM, CFM, and C3S. SIG leadership is planning a CRESCENT Fluids workshop is planned for April 2025, featuring scientific sessions, keynote talks, community engagement, and career development for early-career researchers.

### ***Cyberinfrastructure***

In discussions related to CRESCENT cyberinfrastructure, attendees expressed strong enthusiasm for the newly developed visualization tools, particularly the CVM and CFM viewers. These tools were recognized for their broad applicability across a range of earthquake-related disciplines. Participants also emphasized the importance of open science, highlighting the need for community-driven development of products, tools, and workflows.

Looking ahead, there was significant interest in expanding training opportunities to help users effectively engage with the cyberinfrastructure tools. Participants were also excited about the development of new products, including a database of slow slip phenomena (e.g., slip inversions, low-frequency earthquakes), a tsunami source database, and models of fluids and thermal fields.

The group stressed the importance of increasing engagement with end-users, particularly within the engineering community, to ensure the tools have practical impact beyond academic research. In addition, SCEC expressed interest in pursuing joint high-performance computing (HPC) allocation requests to better support large-scale computational needs.



Overall, the community-driven, open-access nature of the CRESCENT cyberinfrastructure was seen as a major strength, and participants encouraged maintaining and expanding this approach as the project evolves.

### **Geoscience Education and Inclusion (GEI) Pillar at CRESCENT Annual Meeting**

The annual meeting proved to be a highly productive time for advancing Geoscience Education and Inclusions (GEI)'s work and fostering new and building on current connections that would not have been possible otherwise.

The CRESCENT Director gave an overview of GEI's programs, helping to raise awareness and visibility among the broader community. The GEI team hosted a Graduate Student & Postdoc Lunch as an optional networking event, which created a unique opportunity for students and early-career researchers to connect directly with members of the CRESCENT leadership team.

Key outcomes of the annual meeting included a productive in-person meeting between the GEI Program Manager and instructors for the Cores to Code summer program. This was the first time the full instructional team had met face-to-face, and it allowed them to efficiently coordinate logistics and strengthen collaboration ahead of the program's start this June. The GEI Program Manager also met with the graduate student leads for the Quileute and Makah teams in the Cascadia Culture and geoScience Exchange program to finalize plans for an upcoming site visit in the Spring which the GEI Program Manager would be attending. This was also the first time the GEI Program Manager met the team leads in person. Finally, the GEI Program Manager met with Valerie Sloan, former Director of the GEO REU Network and a recent addition to the GEI committee. This was another first time for a face-to-face meeting. They discussed future directions for GEI, and Sloan invited the GEI Program Manager to consider joining the GEO REU committee—an opportunity that emerged directly from their in-person discussion.

This meeting allowed the GEI Program Manager to finally be able to connect with key collaborators face-to-face after the last year of virtual communication. The in-person interactions sparked productive conversations and strengthened relationships that will support the continued growth of GEI initiatives.

### **Partnerships and Applications (P&A) Pillar at CRESCENT Annual Meeting**

The Director highlighted the importance of the P&A mission and role of CRESCENT as a community hub during the opening of the meeting, where he shared the center's success in bringing a wide cross-section of researchers and practitioners together for the various events offered during the first year of operation. The opening address also reminded attendees of the communications channels with which to stay engaged with the center and provided a summary of the main outcomes of the inaugural Partnerships & Applications workshop held in June 2024.

The Partnerships & Applications Manager was able to connect with CRESCENT External Advisory Board (EAB) members, and individuals at the state geological surveys, USGS and FEMA regarding potential participation in the planning committee for the 2025 Partnerships & Applications Workshop. The P&A Program Manager, P&A Program Lead and GEI Program Manager also had time to discuss outreach and education ideas with science communication specialist and CRESCENT EAB member Wendy Bohon from California Geological Survey.



## Conclusion

The recent CRESCENT meeting highlighted major achievements across working groups—from developing integrated fluid, fault, and velocity models to pioneering machine learning-based earthquake catalogs and refining dynamic rupture and tsunami simulations. A key outcome was the clear recognition that enhanced coordination, data integration, and community engagement are essential for tackling the complex challenges of subduction zone science.

Moving forward, efforts will prioritize expanding open-access infrastructure, improving data interoperability, and strengthening collaborations with partners such as the USGS, NSF, and engineering communities. Ongoing and future initiatives—such as joint model development, FAIR data standards, and tools for public and emergency management use—reflect the project’s commitment to both scientific excellence and societal impact. Critical next steps include refining model resolutions, building version-controlled frameworks, supporting early-career training, and preparing for the upcoming 2025 workshops that will shape the next phase of CRESCENT’s growth.

Ultimately, this meeting reaffirmed CRESCENT’s role as a leader in subduction zone research, uniting geoscientific domains to produce actionable, integrated insights that benefit both science and society.

## Project Publications

None.

## References

Event website, <https://cascadiaquakes.org/2024/11/26/january-2025-crescent-annual-meeting/>

Melgar, D., Thomas, A. M., Sahakian, V. J., Meigs, A. J., Share, P. E., Tobin, H. J., Melbourne, T. I., & Elizabeth, J. (2024). The Cascadia Region Earthquake Science Center Strategic Plan 2023-2027 (1.0). CRESCENT Open Documents Library. [h\[ps://doi.org/10.5281/zenodo.11212220](https://doi.org/10.5281/zenodo.11212220)

## Appendix A: CRESCENT Annual Meeting Packet



Scheduled adjacent to the USGS Subduction Zone Meeting, the agenda for the CRESCENT meeting aims to resonate with and follow from the USGS Subduction Zone Meeting to advance science goals in productive ways.

The primary goal for the meeting is to review science accomplishments in our first year and to plan for the next year. We also hope the meeting will facilitate collaborations within and between working groups, as well as with existing research centers, USGS scientists, and key partners, and provide additional guidance for working groups on their plans.

CRESCENT is committed to providing a safe, productive and inclusive environment for all center-related activities. We seek to foster open dialogue and exchange of scientific ideas, to promote full participation and belonging for all participants, and to create a scientific community free of discrimination and harassment.

All Attendees agree to abide by the CRESCENT Code of Conduct:

[https://cascadiaquakes.org/wp-content/uploads/2024/08/code\\_of\\_conduct.pdf](https://cascadiaquakes.org/wp-content/uploads/2024/08/code_of_conduct.pdf)

Contact us at [cascadiaquakes@uoregon.edu](mailto:cascadiaquakes@uoregon.edu).

## Agenda

**8:00 am – Check-in and Coffee** *(in Alder Commons)*

**8:30 am – Opening Remarks** *(in Alder Auditorium)*

“CRESCENT as a hub for earthquake hazards research and resilience” *presented by* **Diego Melgar**, Director, CRESCENT, Ann & Lew Williams Associate Professor of Earth Sciences, University of Oregon

**8:45 am – Scientific Frontiers in the Cascadia Subduction Zone Presentations** *(in Alder Auditorium)*

“Regional-scale crustal architecture of the offshore Cascadia Subduction Zone revealed from active source seismic studies: implications for along-strike structural segmentation within the seismogenic zone” *presented by* **Suzanne Carbotte**, Bruce Heezen Lamont Research Professor, Columbia University

“Ferndale, Petrolia, and Cape Mendocino, oh my! Lessons and Open Questions from Southern Cascadia” *presented by* **Kathryn Materna**, Assistant Professor, University of Colorado Boulder

**9:55 am – CRESCENT Working Groups Present** *(in Alder Auditorium)*

- ❖ **Community Velocity Model (CVM)** *presented by* **Pieter Ewald-Share**, Assistant Professor, Oregon State University
- ❖ **Community Fault Model (CFM)** *presented by* **Ashley Streig**, Associate Professor, Portland State University
- ❖ **Dynamic Rupture, Earthquake Cycle, and Tsunamis (DET)** *presented by* **Eric Dunham**, Professor, Stanford University
- ❖ **Coupling, Seismicity, and Slow Slip (C3S)** *presented by* **Jack Loveless**, Professor of Geosciences, Smith College
- ❖ **Cascadia Paleoseismology (CPAL)** *presented by* **Tina Dura**, Assistant Professor, Virginia Tech

**10:25 am – Cyber Infrastructure** *presented by* **Loic Bachelot**, Developer/Data Scientist, CRESCENT *(in Alder Auditorium)*

**10:40 am – Coffee break** *(in Alder Commons)*

**11:00 am – Working Group Meetings**

- **CVM** *(in Alder Hall Room 103)*
- **CFM** *(in Alder Auditorium)*
- **DET** *(in Alder Hall Room 107)*
- **C3S** *(in Alder Hall Room 105)*
- **CPAL** *(in Alder Hall Room 106)*

**Noon – Lunch** (*buffet set in Alder Commons*)

**Graduate Student & Postdoc Lunch: Meet the CRESCENT Leadership**

*Graduate students, post docs, and early career researchers are invited to eat lunch with members of CRESCENT leadership for an optional networking opportunity. Please join us in room 107.*

**1:00 pm – Scientific Frontiers in the Cascadia Subduction Zone Presentation** (*in Alder Auditorium*)

“Emerging techniques for precisely dating trees killed in Cascadia Subduction Zone earthquakes” *presented by* **Bryan Black**, Associate Professor, University of Arizona

**1:35 pm – CRESCENT Working Groups on the Horizon** (*in Alder Auditorium*)

- ❖ **CVM** *presented by* **Jonathan Delph**, Assistant Professor, Purdue University
- ❖ **CFM** *presented by* **Becky Fildes**, Postdoctoral Researcher, Western Washington University
- ❖ **DET** *presented by* **Alice Gabriel**, Associate Professor, University of California, San Diego
- ❖ **C3S** *presented by* **Hanna Elston**, Postdoctoral Research Associate, Smith College
- ❖ **CPAL** *presented by* **Lydia Staisch**, Research Geologist, United States Geological Survey

**2:10 pm – Coffee Break** (*in Alder Commons*)

**2:40 pm – CRESCENT Special Interest Groups Present** (*in Alder Auditorium*)

- ❖ **Ground Motion Modeling** *presented by* **Diego Melgar**, Director, CRESCENT
- ❖ **Ground Failure** *presented by* **Ben Leshchinsky**, Professor, Oregon State University
- ❖ **Offshore Observations** *presented by* **Will Wilcock**, Professor, University of Washington
- ❖ **Fluids** *presented by* **Cailey Condit**, Assistant Professor, University of Washington

**3:00 pm – Breakout Discussions**

- **CPAL + DET** (*in Alder Hall Room 105*)
  - How can paleoseismic data inform and refine the predictive capability of dynamic rupture models?
  - Can findings from earthquake cycle models predict or reproduce patterns in paleoseismic records, such as variability in recurrence intervals?
  - How can paleoseismic data and modeling approaches be integrated into probabilistic seismic hazard assessments at subduction zones?

- **CVM + CFM + DET** *(in Alder Hall Room 107)*
  - The nature of the megathrust: How are the findings and products of both groups being used to produce an authoritative version of the megathrust geometry?
  - How do velocity structures identified by CVM interact or inform the inferred behavior of known faults in the CFM?
  - Do we understand standardized formats and protocols for data sharing between the CVM and CFM teams and for inclusion in downstream workflows (e.g. ground motion modeling).
- **C3S + CFM** *(in Alder Hall Room 103)*
  - How are fault geometry, segmentation, connectivity, and slip rates incorporated into the CFM guiding assumptions about block modeling?
  - What is the strategy for incorporating high-resolution seismic catalogs to refine fault geometries, particularly for blind faults or areas of complex faulting?
  - How is the distinction between locked zones, slow-slip zones, and fully creeping segments of faults considered in coupling models and by the CFM?
- **C3S & Cyberinfrastructure** *(in Alder Hall Room 106)*
  - Cloud-Based Data Management: Are all the tools in place for scalable storage and querying of large seismic datasets with real-time access?
  - ML Integration: Are ML models ready for cloud platforms for automated event detection and classification?
  - Data Standardization: Do we have APIs and FAIR-compliant formats for seamless data interoperability?
  - Collaborative Tools: How can we enable global access and large-scale analysis with cloud-native tools like JupyterHub?

**4:30 pm – Wrap-up** *(in Alder Auditorium)*

**5:00 pm – Meeting Adjourns**







## Wifi Access

**Wifi Access at Alder Hall:** A shared temporary UW NetID has been created. Any person who receives this UW NetID should be made aware of the following items:

- **For Wireless Access Only** - This UW NetID may only be used for access to the UW's wireless networks.
- **Proper Use** - Using UW Wireless to send spam, illegally trade files, or spread viruses will result in restriction of UW network privileges. More information about the appropriate use of university information resources and computing technology can be found at: <https://itconnect.uw.edu/it-at-the-uw/it-governance-and-policies/appropriate-use/>.
- **Abuse Will Result in Cancellation of This UW NetID** - If this UW NetID is used improperly, it may be cancelled, disabling wireless access for everyone using it.
- **Infected Computers May Be Restricted** - If their computer is infected with a virus or if it is not fully patched, their access to the UW's Wireless Network may be restricted to protect others.

**UW NetID: event0532**

**Password: oACr\_oADj\_oUKp**

## Keynote Speakers



**Suzanne Carbotte** is a marine geophysicist with expertise in marine seismic techniques for characterizing oceanic crustal architecture at tectonic plate boundaries. Her current research includes studies of ocean crust formation at the Juan de Fuca Ridge, crustal evolution across the Cascadia basin, and subduction at the Cascadia Subduction Zone. Carbotte is Bruce C. Heezen Lamont Research Professor at Lamont Doherty Earth Observatory of Columbia University.



**Kathryn Materna** is an assistant professor at the University of Colorado Boulder whose research specializes in tectonic geodesy. Before joining CU, she was a Mendenhall postdoctoral fellow at USGS at Moffett Field, working in the Induced Seismicity and Deformation projects. She earned her PhD from UC Berkeley in 2019 and BS from MIT in 2014. Kathryn uses GNSS, satellite radar, and other geophysical data sets to study the processes of fault movement, the earthquake cycle, and the generation of seismicity, including induced seismicity. Specifically, she is interested in coseismic and interseismic deformation, aseismic creep, seasonal elastic loading, and geothermal energy.



**Bryan Black** applies dendrochronology techniques to growth increments formed in trees as well as the hard parts of marine and freshwater organisms including fish, bivalves, and corals. Resulting chronologies are used to establish long-term patterns in productivity and climate in the oceans and atmosphere while demonstrating linkages among marine, freshwater, and terrestrial ecosystems. These same samples, especially trees, also reveal histories of landslides and earthquakes, and Bryan is interested in emerging isotopic and high-resolution radiocarbon techniques to provide exact calendar years for wood that could not be dated with existing approaches.

## CRESCENT Annual Meeting Participants



Norman Abrahamson, University of California - Berkeley

Marcus Adair, Scientific Computing and Imaging Institute

Rasheed Ajala, Columbia University

Kate Allstadt, United States Geological Survey - Geologic Hazards Science Center

Megan Anderson, Washington Geological Survey

Stephen Angster, United States Geological Survey - Earthquake Science Center

Asif Ashraf, University of Oregon

Loïc Bachelot, CRESCENT

Thorsten Becker, University of Texas - Austin

Scott Bennett, United States Geological Survey

Greg Beroza, Stanford / Statewide California Earthquake Center

Katie Biegel, University of Oregon

James Biemiller, United States Geological Survey

Magali Billen, University of California - Davis

Bryan Black, University of Arizona

Wendy Bohon, California Geological Survey

Adam Booth, Portland State University

Brian Boston, Auburn University

Emily Brodsky, SZ4D

Ben Brooks, United States Geological Survey - Earthquake Science Center

David Bruce, Virginia Tech

Suzanne Carbotte, Columbia University

Andy Clifford, CRESCENT

Cailey Condit, University of Washington

Avery Conner, University of Oregon

Zac Cross, University of Oregon

Tim Dawson, California Geological Survey

Jonathan Delph, Purdue University

John DeSanto, University of Washington

Maximilian Dixon, Washington Emergency Management Division

Yoichiro Dobashi, University of Washington

Alex Dolcimascolo, Washington Geological Survey

Ben Duan, Texas A&M University

Eric Dunham, Stanford University

Audrey Dunham, United States Geological Survey

Tina Dura, Virginia Tech

Alison Duvall, University of Washington

Ahmed Elbanna, University of Illinois - Urbana Champaign

Jill Elizabeth, CRESCENT

Hanna Elston, Smith College

Gabe Epstein, University of Miami / University of Washington

Brittany Erickson, University of Oregon

Daniel Eungard, Washington Geological Survey

Shannon Fasola, CRESCENT

Anaïs Férot, SZ4D / University of California - Santa Cruz

Becky Fildes, Western Washington University

Erik Fredrickson, University of Texas - Austin

Alice Gabriel, University of California - San Diego

Jonatan Glehman, Scripps Institution of Oceanography - University of California - San Diego

Joan Gomberg, United States Geological Survey

Jianhua Gong, Indiana University

alex grant, United States Geological Survey

Julia Grossman, University of Washington

Alex Hamilton, EarthScope Consortium

Andrea Hawkes, University of North Carolina - Wilmington

Gavin Hayes, United States Geological Survey

Eileen Hemphill-Haley, University of Oregon

Brenton Hirao, University of Oregon

Barry Hirshorn, Scripps Institution of Oceanography - University of California - San Diego

Tiegan Hobbs, Geological Survey of Canada

Emilie Hooft, University of Oregon

Michael Hubenthal, EarthScope Consortium

Helen Janiszewski, University of Hawai'i - Mānoa

Zhe Jia, University of Texas Institute for Geophysics

Kaj Johnson, Indiana University

Cyril Journeau, University of Oregon

Haiyang Kehoe, United States Geological Survey

Harvey Kelsey, Cal Poly Humboldt

Akash Kharita, University of Washington

Maleen Kidiwela, University of Washington

Albert Kottke, Pacific Gas & Electric Company

Ozgur Kozaci, Pacific Gas & Electric Company

Fabian Kutschera, Scripps Institution of Oceanography - University of California - San Diego

Carrie Garrison-Laney, Washington Sea Grant / University of Washington

Martin Lawrence, Independent Engineering Geologist

Anna Ledeczi, University of Washington

Ben Leshchinsky, Oregon State University

Yajing Liu, McGill University

Jack Loveless, Smith College

Madeleine Lucas, University of Washington

Philip Maechling, Statewide California Earthquake Center

Yohai Magen, Scripps Institution of Oceanography - University of California - San Diego

Charity Mann, University of Oregon

Kathryn Materna, University of Colorado - Boulder

Ian McBrearty, Stanford University

Sara McBride, United States Geological Survey

Andrew Meigs, Oregon State University

Timothy Melbourne, Central Washington University

Diego Melgar-Moctezuma, CRESCENT

Raul Benjamin Mendoza, University of British Columbia

Christopher Moore, National Oceanic and Atmospheric Administration

Yiyu Ni, University of Washington

Edwin Nissen, University of Victoria

Jason Patton, California Geological Survey

Nick Pelyk, Nanometrics Inc.

Anna Podhorodeski, University of Victoria

Renmin Pretell, University of Nevada - Reno

Emily Roland, Western Washington University

Bo Rong, University of California - Berkeley

Peter Ruggiero, Oregon State University

Natalia Sannikova, Cooperative Institute for  
Marine and Atmospheric Research

Max Schneider, United States Geological  
Survey

Adam Schultz, Oregon State University

Pieter-Ewald Share, Oregon State University

Brandon Shuck, Louisiana State University

Lynn Simmons, Pacific Northwest Seismic  
Network

Valerie Sloan, NSF National Center for  
Atmospheric Research

Lydia Staisch, United States Geological Survey

Alex Steely, Washington Geological Survey

Heidi Stenner, GeoHazards International

William Stephenson, United States Geological  
Survey

Ian Stone, United States Geological Survey

Ashley Streig, Portland State University

Will Struble, University of Houston

Richard Styron, Global Earthquake Model  
Foundation

Tianhaozhe Sun, Geological Survey of Canada  
- Natural Resources Canada / University of  
Victoria

Chih-Hsuan Sung, University of California -  
Berkeley

Sunjay Sunjay, Seismic Imaging Centre  
Geophysics BHU Varanasi India

Jess Tate, University of Utah

Amanda Thomas, University of Oregon

Mika Thompson, University of Washington

Harold Tobin, University of Washington

Man Yin Tsang, University of Washington

Kelin Wang, Geological Survey of Canada

Janet Watt, United States Geological Survey

Yong Wei, University of Washington / NOAA  
Pacific Marine Environmental Laboratory

Scott White, National Science Foundation

William Wilcock, University of Washington

Erin Wirth, United States Geological Survey

Hang Xu, University of Victoria

Alan Yong, United States Geological Survey

Clara Yoon, United States Geological Survey

Yifan Yu, Stanford University

Wenqiang Zhang, Stanford University

Weiqliang Zhu, University of California -  
Berkeley

## Appendix B: CRESCENT Annual Meeting Feedback Survey

A total of 68 usable survey responses were received after the meeting, with complete or mostly complete responses to the substantive questions that were asked after the initial self-descriptors at the beginning of the survey. Sample sizes for specific questions may vary slightly since a few people left particular questions unanswered. In some of the following tables, reported percentages may not sum to 100 due to rounding.

In addition to reviewing the tables below that display tabulations of participant responses to fixed-response questions, CRESCENT leaders may find useful information and recommendations by reading each individual comment made by participants in response to the open-ended questions. Some of these will likely resonate or take on additional meaning given background context that is familiar to those with more experience in the CRESCENT scientific and public policy arena. A one-off comment that was given little attention by the evaluator may contain ideas considered important by project staff. Color coding has been applied to highlight identified themes mentioned by multiple survey respondents.

Table 1 displays some key professional characteristics of those participants who chose to respond to the post-meeting survey.

**Table 1. Characteristics of Survey Respondents**

What is your <b>primary</b> professional role? (mark only one)	2% Emergency Management 52% Research Scientist 3% Engineering, architecture 3% Educator or Extension Specialist 15% Student 3% Technician, staff member 3% Planning, Zoning, Regulatory 2% Spatial Modeling 12% Post-doc 7% Other (specify): “CRESCENT staff” “Instrumentation Vendor” “On the board for education and inclusion” “Research & extension” “Utility consultant”
Which terms best describe your organization? (mark all that apply)	9% State, regional or local agency 59% University offering related PhD degrees 13% Federal department, agency, or other federal entity 7% Nonprofit organization 4% Public utility 4% University offering related Masters (but not PhD) degrees 2% Private company or industry organization 3% Primarily undergraduate institution (PUI) 2% Minority-serving institution (MSI) <ul style="list-style-type: none"> <li>- Historically Black College or University (HBCU)</li> <li>- Community College</li> <li>- High School or Middle School</li> <li>- Tribal organization</li> </ul> 4% Other (specify): “Gov. funded FFRDC” “Instrumentation Vendor” “NSF/USGS funded research center”

Note. N = 68 responses.



Table 2 displays participant ratings of the major meeting sessions. More than 70% of survey respondents rated the session lengths as “just right,” with the remaining responses typically divided between “not enough” and “too much” time spent on particular topics. However, the session on Special Interest Group Presentations was rated as having “not enough” time by 24% of respondents.

When asked if the presentations were clear and effective, 92% or more rated each session as being “very effective” or “OK.” The sessions on “Scientific Frontiers” and CRESCENT Working Group Presentations received the highest ratings.

**Table 2. Participant Ratings of Workshop Session Length and Effectiveness**

For each session within the workshop, please circle one answer for each of the two questions on the right.		Amount of time spent on topic:			Was the presentation clear and effective?		
		Not enough	Just right	Too much	Not very effective	OK	Very effective
A1	Scientific Frontiers in the Cascadia Subduction Zone Presentations (morning and afternoon)	13 %	81	6	1%	19	79
A2	CRESCENT Working Group Presentations	13	81	6	6	33	61
A3	Working Group Meetings	11	83	6	8	46	46
A4	CRESCENT Working Groups on the Horizon	8	86	6	8	52	40
A5	CRESCENT Special Interest Group Presentations	24	75	1	6	52	42
A6	Breakout Discussions	11	72	17	6	58	36

Note. N = 65 to 68 responses.

The tables on the following pages list verbatim comments offered by meeting participants in response to open-ended questions about the meeting. Thematic analysis will be applied to these responses to identify themes in participant responses. For now, the responses are simply listed for each question

**Table 3. Participant Comments on Meeting Sessions**

A7	Please add comments about the <b>strengths or weaknesses of the specific sessions listed above:</b>
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- *The annual meeting warrants two full days IMO - too much to cover in a single day and not enough time to fully form new collaborative research groups.*
- *Some of the working group meetings were too large to be effective. I particularly felt this in the morning group the C3S group was too large and too much stuff to cover to be effective. The breakout groups in the afternoon could have focused instead on specific outcomes rather than overlap between groups. So those interested in say 'Expanding the Community Fault Model to include geophysical measurements of faults' rather than just the overlap between C3S and CFM would have been more effective because we kept getting sidetracked by people focusing on other things.*
- *I really enjoyed the information presented and thought that the speaker line up and sessions were well thought out. There was some issue or concern regarding siloing of discussions in the first break-out group session, but by having the afternoon breakout having people participating together from different silo's greatly reduced or eliminated that concern.*
- *Another thing that was of lingering concern is how these groups are interacting with Copes Hub and to a greater extent the NTHMP. The former seemed to be have a connection and crossover representation in membership, but the latter largely did not and given how much the work that CRESCENT is doing impacts future tsunami hazard mapping and understanding means this group should be more involved with or communicating to NTHMP on a systematic level.*
- *For a one day meeting, this was a really good agenda that combined really interesting formal presentations, updates on activities, and breakout sessions to help guide the various groups.*
- *It would've been nice to have a Special Interest Group breakout session.*
- *all good but meeting was too short, so presentations by SIGs and WG updates/plans were too short.*
- *If in future webinars there can be translation into Spanish.*
- *The goals of the working group meetings and breakout discussions were a bit unclear. The questions posed for the breakout discussions were helpful for guiding conversation, but the overall anticipated outcome of these sessions was unclear.*
- *More details on the process and community input for the working groups would be great.*
- *I felt the discussion CFM+C3S lacked direction and I wasn't sure what we were trying to solve or collaborate on in the discussion. I think the workgroup leaders needed to get on the same page before the breakout about who amongst them would facilitate and keep the discussion moving in order for the discussion to be effective.*
- *Bc kinda binary answers above. The longer talks in am seemed like 5 min too long.*
- *2nd breakout seemed about 15-30mins too long. I liked that students/early career folks presented (good to see diff faces). Bryan Blacks' talk was great!*
- *breakouts were a bit ad hoc, which is fine, but I felt there should have been more effort beforehand to define the "talking points". The wording was somewhat vague on several of the bullets which I feel bogged down the discussion.*
- *I didn't attend everything. The talks and the working group presentations were excellent. The breakout discussion with PAL was okay, but I think that having had some structure would have helped, like a list of topics to discuss, and it would have been great to have had a white board for drawing on during the discussion.*
- *I feel like the meeting was well-organized to convey a large amount of information in a short amount of time. While all of the sessions could have been longer, I feel like they were an appropriate length to connect with possible collaborators while still maintaining interest and attention following the subduction zone meeting.*
- *I thought that the breakout discussions were valuable, but it took some wondering around to finally settle on the key discussion points. In some cases, having the targeted questions actually distracted from the key interface questions. That being said, the targeted questions were nice to start the discussion. Breaking down the silos is so important for progress, so I am glad to see attempts at doing so.*
- *Solid agenda given that this was a one day meeting. Hopefully the act of convening has sparked connections and inspiration for collaborative follow ups.*
- *For the breakout discussions, I think the discussion questions could have been better and more well rounded, they seemed very specific and from certain people's needs. It would have been nice to have maybe one overarching/guiding questions but then discussion centered on what people in the room actually wanted to talk about.*
- *Overall the meeting was great! The afternoon breakout was a little long for the groups I was with. We didn't need all of the time given to have our discussion.*
- *Excellent choices of invited speakers. Because of the breadth of the presentations, not every presentation was of interest to each attendee, but the lengths and complexities of the presentations were appropriate for the diverse*

Table 4. Participant Comments on Meeting Strengths

C	What was effective about this meeting?
	<ul style="list-style-type: none"> <li>▪ <i>Learning about and understanding the research in progress for Cascadia.</i></li> <li>▪ <i>The featured speakers did a great job.</i></li> <li>▪ <i>I really liked the variety of short form presentations and how quickly things moved in terms of topics covered. It was just enough to cover the big ideas.</i></li> <li>▪ <i>While short, the meeting was able to cover a lot of ground and in a balanced way (longer talks, breakouts, etc.), which made it feel like a remarkably productive day. While I'm not formally involved with any of the working groups, I also appreciated the fairly open ended discussions which allowed for input from anybody and allowed the discussions to flow organically.</i></li> <li>▪ <i>The talks were very informative and the short presentations by the working groups were helpful to know what was going on.</i></li> <li>▪ <i>The planning and cadence of the talks and breaks was really effective for facilitating information sharing and networking.</i></li> <li>▪ <i>Demonstrating the excellent progress made to date.</i></li> <li>▪ <i>The meeting provided a nice update on the progress of each Working Group.</i></li> <li>▪ <i>Being in person! That was very helpful after many online meetings. Overall I thought the meeting was well organized, effective, and an overall very positive and exciting experience.</i></li> <li>▪ <i>The pacing and content were good, the venue space that was used between the breakout groups was compact and not sprawling.</i></li> <li>▪ <i>Inter-working group breakout sessions were very effective for making sure the groups are moving forward in a unified manner on certain topics (e.g., which subduction interface geometry to use in CFM, CVM, DET models, etc.)</i></li> <li>▪ <i>The people! Everyone is very engaged.</i></li> <li>▪ <i>In my opinion, the science talks were the most engaging and I would have liked a bit more time on them.</i></li> <li>▪ <i>In person is very effective. I thought the invited talks were interesting and relevant. I enjoyed mixing the working groups together to allow for collaboration.</i></li> <li>▪ <i>It was good to have most people from the different working groups together in person to discuss CRESCENT progress.</i></li> <li>▪ <i>Gathered CRESCENT community together in-person to exchange ideas. Highly effective! I got new research ideas and learned new things.</i></li> <li>▪ <i>Very good, to understand everything related to earthquakes.</i></li> <li>▪ <i>I liked the size and the focus of the breakout sections.</i></li> <li>▪ <i>Having it tied to the USGS subduction zone meeting was helpful in ways because it enabled introductions and early conversations to begin before the very focused day of CRESCENT specific talks and discussion groups.</i></li> <li>▪ <i>I really enjoyed the variety of topics discussed, especially the frontiers in Cascadia science talks. The day flowed really well; lots of short talks were a great way to break up the day. The early career-CRESCENT leadership lunch was also a great idea and was executed really well.</i></li> <li>▪ <i>It was a nice chance to gather in person to discuss center activities. It was convenient that it was held immediately after the USGS workshop.</i></li> <li>▪ <i>Excellent balance of science, updating the community and getting work done that will move project goals forward.</i></li> <li>▪ <i>Getting together and discussing important science. Getting updates.</i></li> <li>▪ <i>Excellent inclusion of non-academic folks, attention to respect and collaboration, it appears that the CRESCENT leadership is really listening to its constituency, and this was also a great opportunity for side conversations about what we need to do moving forward as a community. Particularly helpful were the 20 minute breaks which allowed for those side conversations.</i></li> <li>▪ <i>Like the variety of delivery and breaks and breakouts.</i></li> <li>▪ <i>Fast paced. the venue seemed well designed for this meeting.</i></li> <li>▪ <i>Learning about the latest research. The energy of this gathering and how the meeting fostered a sense of community and momentum. The organizing of the meeting was stellar! I have never seen a meeting with better organization and communication. Thanks to Amanda, Jill, and others! It was helpful and fun to join the CRESCENT staff for dinner on the night before. It was great to have a chance to talk with Shannon F. about the education programs informally. She is also doing an impressive job.</i></li> <li>▪ <i>Scheduling in cooperation with the USGS Cascadia meeting provided a lot of opportunity for cooperation.</i></li> <li>▪ <i>Good collection of researchers, stakeholders, agencies.</i></li> <li>▪ <i>The presentations that provided updates on the working groups very succinctly provided information. It was useful to have the updates early and provide some time between the updates and having breakout sessions to brainstorm questions and ideas</i></li> </ul>

**Table 5. Participant Suggestions for Improvement**

C 2	Any suggestions for improvement? Consider length, timing, location, venue, facilitation, structure, and content.
	<ul style="list-style-type: none"> <li>▪ <i>More accessibility for students.</i></li> <li>▪ <i>Yes - lengthen meeting to two days.</i></li> <li>▪ <i>Changes to the structure of the discussion groups would be good. Or to have perhaps more of an agenda to cover in the breakout sessions.</i></li> <li>▪ <i>None. I felt like for a meeting of this size and scope, the length, location, structure, etc. was great.</i></li> <li>▪ <i>Not everyone is involved with working groups; it would have been helpful to have additional options for discussions during that time.</i></li> <li>▪ <i>Everything was very well put together and organized, no real suggestions for improvement.</i></li> <li>▪ <i>There was a lot crammed into one day, and considering the number of attendees, more presentations, discussion time and networking opportunities could be included if the meeting was turned into 1.5 days long?</i></li> <li>▪ <i>1 day seemed too short. I suggest 2 days for the next in-person CRESCENT annual meeting.</i></li> <li>▪ <i>I found the breakout session between (bridging) working groups was important but a bit long.</i></li> <li>▪ <i>Some of the breakout group sessions might have benefitted from more guidance or directed conversation. The layout of lines of desks in the breakout rooms themselves made effective communication difficult.</i></li> <li>▪ <i>Given the USGS Subduction Science meeting included so many great science talks in the days before the CRESCENT meeting, fewer science talks in the CRESCENT meeting might have been appropriate (leaving more time for different inter-working-group breakout sessions). Apart from that, the meeting agenda was well-balanced and effective. Thanks for organizing it!</i></li> <li>▪ <i>Another half day would have been nice for more time for posters. Also, the poster room was a little crowded, so either a larger room, or being able to have multiple sessions would be nice.</i></li> <li>▪ <i>Maybe time to meet with the special interest groups as well.</i></li> <li>▪ <i>SIG breakouts would be nice. Much of the meeting was useful for CRESCENT WGs, but we didn't get to discuss the "science" much.</i></li> <li>▪ <i>Venue was great, duration was too short, need more opportunities for science idea exchange.</i></li> <li>▪ <i>Introduce practical workshops to engage colleagues and students.</i></li> <li>▪ <i>The meeting could've been 1.5 days to allow for the working group discussions to go a little longer or have two of them. The working group discussions felt like the most productive part of the day that led to action items and had good community input/discussion, so having a little longer for these would've been great. Venue was good with multiple rooms for breakout, but there was some scrambling to be able to utilize the projectors in some of the smaller rooms and finding the right cords.</i></li> </ul>

- *The meeting focused a lot on overviews of what each working group is doing, but many people at the meeting weren't explicitly in a working group. I might have preferred to see presentations about specific projects/results from people in the working groups, as opposed to 2 sessions dedicated to working group past/future overviews.*
- *For this particular meeting, one day felt sufficient. I think that some clearer communication of the anticipated outcome of future breakout sessions would make them more productive.*
- *This went amazingly well (up until that fire alarm went off!) :-)*
- *More time at the next meeting. Several days would be ideal.*
- *Wonder if a student poster session might be good eventually if enough involved. Because I am on east coast, it will always be a hike for a one day meeting. Timing is a struggle because of teaching load and was on first week of class (but there is never a good time). Venue was good (my gosh Seattle is \$\$\$).*
- *Having it be 1.5 days would be good, although that's more money. That way, dinners out could be organized by theme, like group/topic, etc. It would have been nice to have the Board of GEI gathered, even if only at a coffee time. I didn't feel like I got to meet people from the community outside of the CRESCENT staff, but that is okay.*
- *It was a great meeting.*
- *It was very convenient for the meeting to happen immediately after the subduction zone meeting, but it did mean that everyone was a couple of days into meetings and feeling the related fatigue. I don't really have a suggestion for improvement, it is more just a thought related to the timing.*
- *Quality of lunch can be improved.*
- *While I appreciate the time constraints and science oriented nature of the meeting with it's close association with USGS, I feel that we could have pushed for a GEI and P&A considerations discussion bullet point for the WG and inter-WG discussions. Even as a place-holder this would help emphasize the goal for these pillars to be integrated in the science research workflows.*
- *I thought the timing was really good and effectively used the day. As more of an on-looker rather than a participant in any of the groups, I think there are still gaps in how to effectively involve others, especially since the working groups have their goals and plans already laid out and is very PI driven.*
- *It was just about perfect length. Adding it to the end of the USGS meeting worked very well for me, as did the location since I'm in Seattle. The venue, facilitation, structure, and content were all very good.*
- *Guest speaker from other tsunami/earthquake zone (Japan, Chile, Mexico etc.) would be a good option to learn new approaches.*
- *The meeting was great. I hope the length of the meeting could be longer, like 2-day long, so we can have more time to reach out and discuss more with people.*
- *I thought it was very well planned and the sessions and lengths of talk were appropriate. Traveling to Seattle was expensive but the venue and hotel were top notch.*
- *1 day short meeting is appreciated.*
- *The breakouts were perhaps less useful then the offline discussions with colleagues and the presentations.*
- *Would two days be warranted or feasible? The CPAL working group ended up with too much to discuss for the allotted time, with a plan to meet later in the year instead to tie up the loose ends. But could a second day dedicated to the working groups have helped accomplish this without the need for another meeting?*
- *Venue was nice, length was good, it just didn't end up covering topics that were most relevant to me, but that seems to be mainly a function of what NSF decided to fund.*
- *Both breakout sessions I participated in were not very effective. The discussions tended to meander without clear direction from the leaders. I would suggest in the future designing these breakout sessions around some pre-determined questions, topics, etc. to keep them focused.*
- *There are enough groups and projects that future workshops may need to be split over two days. As tools mature, hands-on demonstrations would be great.*
- *The auditorium was good, but the classrooms were not laid out well for group discussion (everyone facing the WG leaders at the front)*
- *More science talks.*
- *Live captioning on presentations. The breakout discussions were great, but I felt like I missed valuable conversations because there were three of interest happening at the same time. I totally understand time constraints and benefitted from the discussion I was in, but if there were a longer meeting, potentially shortening the time slot a bit and spreading out the breakout discussions so that working groups aren't split across two or three at the same time could be beneficial.*

**Table 6. Participant Comments on Professional Challenges and Potential Benefit of CRESCENT**



C 3	<p>What are some of the biggest challenges you face in your work related to Cascadia subduction zone hazards, and how could that work benefit from CRESCENT-related science?</p> <ul style="list-style-type: none"> <li>▪ <i>The biggest challenge I face is coding to analyze various datasets. CRESCENT-related science brings together a group of people with similar and common goals that can share resources that could save time and allow research to progress more quickly.</i></li> <li>▪ <i>Can be a challenge to form truly broad collaborative research groups on a scale sufficient to make substantial advances in subduction zone science.</i></li> <li>▪ <i>Density of earthquakes and seismic catalog completeness.</i></li> <li>▪ <i>Often, cross-disciplinary collaborations and knowing who to reach out to (or just having a more formal venue for building collaborations) has been one of the bigger challenges for me. I met several people at this CRESCENT meeting I have been aware of for years, but I had never had a chance to formally interact. Now, I feel optimistic about potential future collaborations with them (or at least collective brainstorming).</i></li> <li>▪ <i>Understanding the complex infrastructure of organizations across the west coast of NA and their roles in understanding and working towards mitigating the hazards from Cascadia.</i></li> <li>▪ <i>Distilling all the great science that is coming out of CRESCENT and its collaborators down into a way that is simple and easy to understand for emergency management, planners or policy makers, and the public. One major concern is that while science is always evolving and improving, the rate at which it does so can leave people with greater uncertainties than before despite having more data and scientific advances. I think the CRESCENT collaborators should be mindful of this and incorporate plain language summaries into all their published products and consider sensitivity testing of models to understand that when the science advances and makes a change in our models, what impact that has on what we understood previously.</i></li> <li>▪ <i>The biggest challenge is assembling the emerging body of new scientific data and interpretations into a coherent suite of peer-reviewed models and datasets for expert evaluation in PSHA model building. CRESCENT and its mission is an important step to compiling the critical datasets and models for such PSHA studies.</i></li> <li>▪ <i>Very little funding exists to study the distributed upper-plate structures that are a critical component of the Cascadia Subduction Zone. USGS NEHRP appears only interested in funding projects for the few faults that underlie urban areas. CRESCENT appears poised to fund small to medium scientific research that are critical to understanding the complete subduction zone plate boundary across Cascadia.</i></li> <li>▪ <i>Finding students and technicians who can help with the research, though I suspect the training through CRESCENT initiatives will help.</i></li> <li>▪ <i>CRESCENT data products (e.g., CFM faults, CVM) will be valuable inputs/constraints for the next iterations of our CSZ dynamic rupture models. Thanks CRESCENT team!</i></li> <li>▪ <i>Any work to help better communicate the science to the public and policymakers would be beneficial to all participants</i></li> <li>▪ <i>Supporting students to work on this science.</i></li> <li>▪ <i>Linking earthquake modeling to tsunami generation/modeling.</i></li> <li>▪ <i>Need multidisciplinary set of scientists to help me understand fluids.</i></li> <li>▪ <i>Lack of seismic data to conduct research.</i></li> <li>▪ <i>More opportunities for funding science.</i></li> <li>▪ <i>It's a challenge that I'm excited about is maintaining our duty (at the state level) to our emergency management/engineering/other very applied stakeholders, yet also benefiting from and contributing to this more research-academic community effort in an effective way. I feel like a bridge between those two communities and its exciting and needed, but also difficult to do that without greatly increasing workloads of myself or others. It takes a lot of thought, planning and conversation.</i></li> <li>▪ <i>Just the time on the ground in the field and having enough students to actually do the work. Applying to land permits...soo many entities per site, takes forever!</i></li> <li>▪ <i>IT infrastructure. Standardized visualization tools.</i></li> <li>▪ <i>Understanding upper plate faults. Progress on the CFM would be helpful.</i></li> <li>▪ <i>I work with landslides, so I am excited for the upcoming ground failure working group.</i></li> <li>▪ <i>Deploy more seismic stations!</i></li> <li>▪ <i>Overcoming the paradigm of science driven research agendas. Hopefully CRESCENT can move towards including social and applied science research elements as we attract external funding sources beyond NSF.</i></li> <li>▪ <i>Having an accurate velocity model to model ground shaking to engineering frequencies will be a huge contribution from crescent. I think there are some unforeseen challenges with this moving forward in terms of model merging and expanding to various elastic properties in the region. It is disappointing that the WG did not decide to go with a geologic rather than tomographic version of the velocity model</i></li> </ul>
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**Table 7. Participant Comments on Using CRESCENT Products**

C 4	Which CRESCENT products might be applicable to you and your organization, and how would you like to interact with these products?
	<ul style="list-style-type: none"> <li>▪ <i>A community velocity model ensures that we are all working with the same tool to produce our research results in a common and reliable manner.</i></li> <li>▪ <i>Produced model volumes; all PPTs presented at all Crescent meetings.</i></li> <li>▪ <i>The CFM sounds interesting particularly for interpretation of seismicity. The CVM and the new seismicity catalogues will be useful as well once those are online.</i></li> <li>▪ <i>The Cyberinfrastructure products from CFM is a great example and I think CRESCENT is uniquely poised to produce web maps, databases, and other digital data products that are largely not available elsewhere.</i></li> <li>▪ <i>All of them.</i></li> <li>▪ <i>CFM would be used to identify where additional active fault hazard research is needed.</i></li> <li>▪ <i>I don't have a specific suggestion but suspect the collating and online posting of Cascadia-related data will ultimately prove helpful.</i></li> <li>▪ <i>Cascadia earthquake catalog. I work with EarthScope and we would directly host many of these data products.</i></li> <li>▪ <i>CFM, CVM: the online data portals/platforms seem like great access options.</i></li> <li>▪ <i>Looking forward to the paleoseismic database being expanded and updated.</i></li> <li>▪ <i>Paleoseismic database - awesome collection of data and great reference.</i></li> <li>▪ <i>CVM, CFM.</i></li> <li>▪ <i>Obtaining seismic data for research purposes.</i></li> <li>▪ <i>The availability of cyberinfrastructure is a nice resource, and I'm glad that many working groups are using it as a basis for visualizing and sharing results (and hopefully incorporating the broader community's results).</i></li> <li>▪ <i>Fault structure - I'd like to include these dynamic models of the subduction zone to understand their role in transferring stress inboard.</i></li> <li>▪ <i>Pretty much everything.</i></li> <li>▪ <i>Honestly, all of them. For me and my job in particular CFM is foremost. I am already interacting by being involved in conversations with CFM members--I would like to contribute, collaborate and ingest this product into our state database.</i></li> <li>▪ <i>CVM. Currently on the working group.</i></li> <li>▪ <i>CFM.</i></li> <li>▪ <i>Community velocity models and community fault models. We would like to query the CVM to run ground motion simulations. We would like to use the CFM to build earthquake rupture forecasts.</i></li> <li>▪ <i>Eq catalog.</i></li> <li>▪ <i>All - objective of my role is to make these relevant to other stakeholders.</i></li> <li>▪ <i>The CVM and im very excited for the online platform.</i></li> <li>▪ <i>The paleoseismic database will be very useful to me. I'll use it for proposals and research.</i></li> <li>▪ <i>CASIE21.</i></li> <li>▪ <i>Online databases for paleoseismology and microfossils.</i></li> <li>▪ <i>I am interested in CVM, CFM, earthquake catalog and cloud computing.</i></li> <li>▪ <i>CVM, CFM.</i></li> <li>▪ <i>Seismic velocity model.</i></li> <li>▪ <i>The CFM is most relevant to my work (and is also what I hope to contribute towards).</i></li> <li>▪ <i>Web-based GUI is always a good doorway to the data products, but especially for the models.</i></li> <li>▪ <i>Cyber infrastructure was impressive. Some of the initiatives seem to be duplicates of what my agency does but just focused only in Cascadia, but I like that they are community versions of those efforts.</i></li> </ul>

**Table 8. Participant Comments on Improving CRESCENT Products or Features**

C 5	<p>In the context of what you've learned today about CRESCENT, what products/research are missing or could better serve you? (e.g., new features, refinements to existing features, changes to make things easier to use, better instructions or tutorials, etc.)</p>
	<ul style="list-style-type: none"> <li>▪ <i>The completed CVM and tutorial.</i></li> <li>▪ <i>Broaden scope of model volume types in 3-D data and model volume visualizations, please any geological data ties.</i></li> <li>▪ <i>I think it's just a waiting game to get the new data out at this point.</i></li> <li>▪ <i>Comprehensive tsunami source database including all deterministic and probabilistic sources available in Cascadia and possibly beyond. See NTHMP for past efforts and limitations on this database.</i></li> <li>▪ <i>Nothing comes to mind at this time.</i></li> <li>▪ <i>Additional training of junior scientists, but I know that's an ongoing goal in CRESCENT.</i></li> <li>▪ <i>The more tutorials the better!</i></li> <li>▪ <i>Community stress model of some sort; community thermal model?</i></li> <li>▪ <i>Available database and archival of earthquake models.</i></li> <li>▪ <i>Fluids model.</i></li> <li>▪ <i>Modeling tutorials and workshops.</i></li> <li>▪ <i>More comprehensive online availability of research products will be good, and it seems the center is working towards this.</i></li> <li>▪ <i>Nothing to add here.</i></li> <li>▪ <i>Community Thermal Model (updated thermal model of Cascadia using all new data).</i></li> <li>▪ <i>Nothing yet at this early-ish stage.</i></li> <li>▪ <i>Based on planned products, nothing clear is missing thus far.</i></li> <li>▪ <i>We would like an interface to your CVM that inputs lat,lon, depth and returns VP, Vs, and density. And this interface should be fast to we can build meshes with millions of points, in a reasonable length of time.</i></li> <li>▪ <i>EQ catalog.</i></li> <li>▪ <i>A lay-person's description of the science research and function of each of the work groups and special interest groups.</i></li> <li>▪ <i>More focus and involvement with end-users such as the engineering community.</i></li> <li>▪ <i>None that I can think of.</i></li> <li>▪ <i>Online databases for paleoseismology and microfossils.</i></li> <li>▪ <i>We need a 3D thermal model for the margin.</i></li> <li>▪ <i>I'd like to see wider compatibility of the CFM database (e.g. file downloads for Google Earth, QGIS, GMT, etc.) so that undergraduate and graduate students can plot the model in the software they are most familiar with.</i></li> <li>▪ <i>Always better and more tutorials and instruction. Webinars would be great to have more often.</i></li> <li>▪ <i>At present, it seems like many of the databases are separate. I hope that there are plans to incorporate them together into a single platform. It would be great to be able to visualize seismic velocities with overlaid fault structures, for example.</i></li> <li>▪ <i>Not sure, I haven't used them yet.</i></li> <li>▪ <i>I am too new to CRESCENT's products to comment.</i></li> </ul>

**Table 9. Participant Comments on Facilitating Collaboration**

C 6	Do you have any suggestions for fostering connections between your work, other groups, and/or center staff?
	<ul style="list-style-type: none"> <li>▪ <i>Compiling an accessible list of researchers and their areas of study for ease of finding networking and collaboration connections.</i></li> <li>▪ <i>I think perhaps a list of open projects or open postdocs/PhD projects at collaborating institutions could perhaps be helpful to include in the meeting information packet.</i></li> <li>▪ <i>Continue to work on integrating and collaborating with Copes Hub, NTHMP, ITIC, the TWCs, NOAA, and USGS so that all this great research is getting documented, made available, and ultimately communicated and utilized by the entire community of researchers out there.</i></li> <li>▪ <i>I think we have very good connections and interactions.</i></li> <li>▪ <i>I've been very pleased with the new connections that have been fostered through CRESCENT and expect those to continue.</i></li> <li>▪ <i>Occasional targeted inter-working group meetings throughout the year might be useful (in addition to the monthly individual working group meetings).</i></li> <li>▪ <i>More intergroup collaborations - one groups needs would drive another groups priorities.</i></li> <li>▪ <i>I am part of the CVM group, and I think it would be helpful to have check-ins with CFM or C3S on progress every once in a while, even if it is just sitting in on the monthly call.</i></li> <li>▪ <i>Annual instead of biannual meetings (but combining with USGS workshop was great idea since it effectively extended the meeting duration).</i></li> <li>▪ <i>Translation into Spanish.</i></li> <li>▪ <i>More workshops and frequent communication.</i></li> <li>▪ <i>I think that a close relationship needs to be maintained between the CVM and CMV working groups to ensure that, at some level, faults at depth are consistent with seismic velocity structure.</i></li> <li>▪ <i>As you get into HPC, we should consider working on HPC allocations requests that include both SCEC and CRESCENT researchers.</i></li> <li>▪ <i>Host more working group meetings.</i></li> <li>▪ <i>Working on this - 1:1 meetings with work groups for P&amp;A, more regular check ins with science staff for their needs and updates regarding partnerships and outreach.</i></li> <li>▪ <i>My professional role is to develop and online microfossil database, and this would benefit from input from other taxonomists outside of CRESCENT. There isn't an applicable level of expertise within CRESCENT.</i></li> <li>▪ <i>Featuring research related to Cascadia in the slack channel or hosting regular online seminar, although I know there are already several online seminar going on.</i></li> <li>▪ <i>My experience from SCEC is that some of the best collaborative science initiated at poster sessions. This is where ideas can be shared. I definitely recommend that CRESCENT engage the scientific community by giving plenty of opportunities for people to present their own work. It is is great to hear about progress made by CRESCENT PIs, but this alone does not engage the community.</i></li> <li>▪ <i>Continued collaboration between U.S. and Canadian network operators and scientists is essential for creating a complete picture of the CSZ. I encourage further efforts towards reaching across the border.</i></li> <li>▪ <i>Getting the WGs mixed for the breakouts was very effective.</i></li> </ul>

**Table 10. Participant Comments on Facilitating Interorganizational Collaboration**

C 7	How can CRESCENT best facilitate interorganizational collaboration?
	<ul style="list-style-type: none"> <li>▪ <i>More social media presence and/or live, ongoing discussion groups that people can join.</i></li> <li>▪ <i>Is there a slack or something? Having a way to join the slack if you've not been added would be nice.</i></li> <li>▪ <i>Listening sessions between organizations.</i></li> <li>▪ <i>Continue to have meetings like this with interorganizational break out groups and collaboration opportunities.</i></li> <li>▪ <i>Keep up the good work!</i></li> <li>▪ <i>The annual meeting was extremely helpful. I expect that training workshops will facilitate deeper interactions among groups of similar interest.</i></li> <li>▪ <i>Mailing lists. Maybe a webinar series?</i></li> <li>▪ <i>Keep bringing people together at CRESCENT meetings and events like this one.</i></li> <li>▪ <i>I think concurrent meetings (like this on with the prior USGS meeting) or joint meetings would foster collaborations. Perhaps done with an engineering group and charged with developing a long term initiative of where we want to be in 5-10 years</i></li> <li>▪ <i>Upcoming workshops are a great idea. Maybe expand fieldtrip and/or collaborative fieldwork opportunities.</i></li> <li>▪ <i>Email newsletter? Pushing the Twinning mentorship program.</i></li> <li>▪ <i>Create a regional data center to have access to them and be able to apply them in my geophysics classes and research.</i></li> <li>▪ <i>The model viewers that are being developed seem to invite collaboration with other organizations, as they provide opportunity to compare different organizations' results.</i></li> <li>▪ <i>Small meetings with small number of people invited and a specific agenda and desired outcomes.</i></li> <li>▪ <i>Community science projects, code sharing, etc.</i></li> <li>▪ <i>Make the time for plenty of conversation between organizations. Make sure CRESCENT understands who their stakeholders are and takes the time and energy to reach out to those people, rather than waiting for stakeholders to reach out to CRESCENT members/leaders.</i></li> <li>▪ <i>With respect to USGS and CRESCENT, keep lines of communication open between CRESCENT senior management and USGS Natural Hazards Mission Area. Seems to be good communication so far, so keep it up!</i></li> <li>▪ <i>Continue the SCEC/CRESCENT coordination calls.</i></li> <li>▪ <i>Keep convening meetings, joining other groups/partners in their meeting places and forums.</i></li> <li>▪ <i>A seminar series?</i></li> <li>▪ <i>I think the organization of workshops that bring people together helps that happen.</i></li> <li>▪ <i>A joint meeting with Canadian colleagues would be very useful.</i></li> <li>▪ <i>Seems to be doing a fine job.</i></li> <li>▪ <i>Organized working groups, which are already in place, continued advertisement, and the development of multi-disciplinary papers.</i></li> <li>▪ <i>Unsure. The in-person meeting was effective, but obviously can't be held frequently.</i></li> </ul>