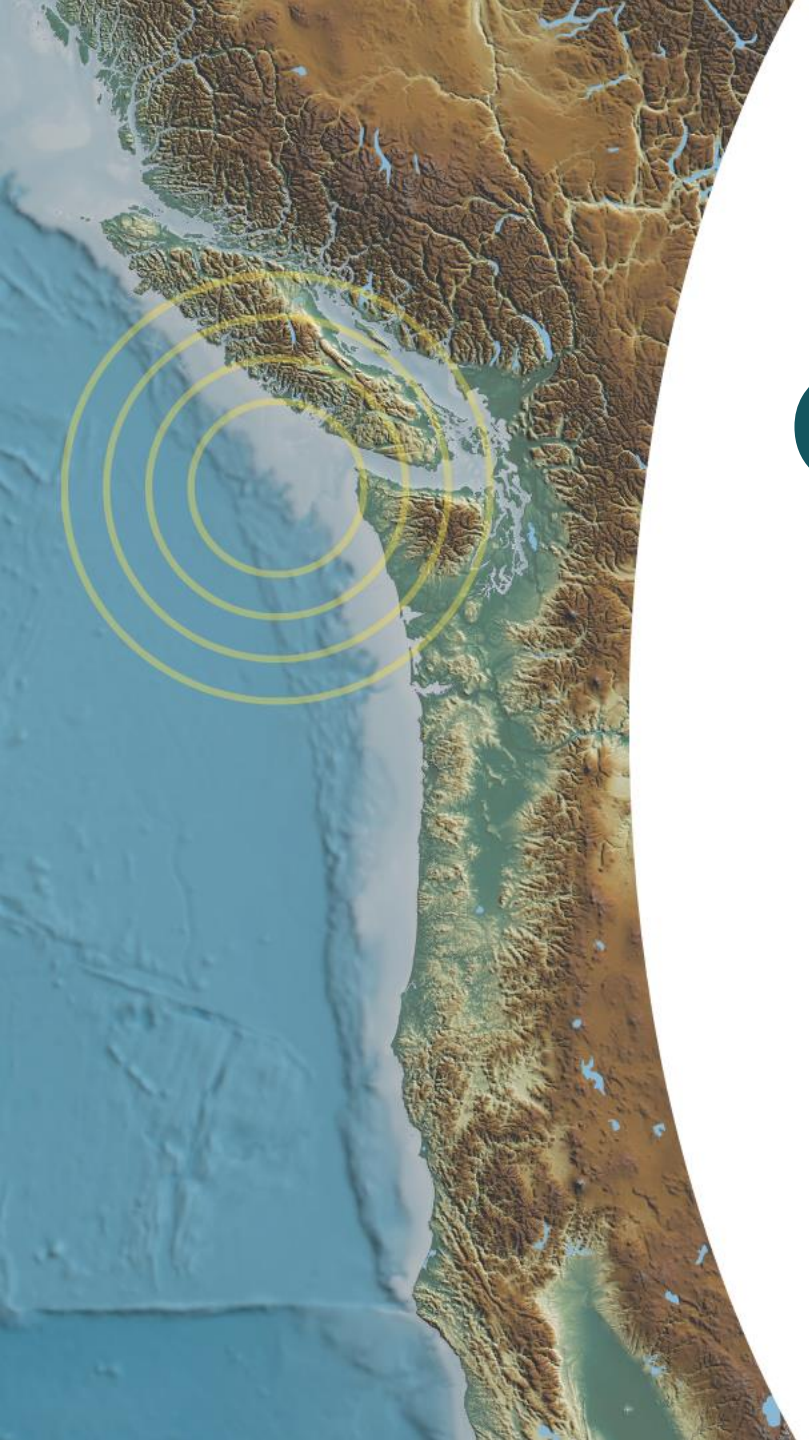


CRESCENT midstream

Science and Applications in the Cascadia Region Earthquake Science Center

CRESCENT
CASCADIA REGION EARTHQUAKE SCIENCE CENTER

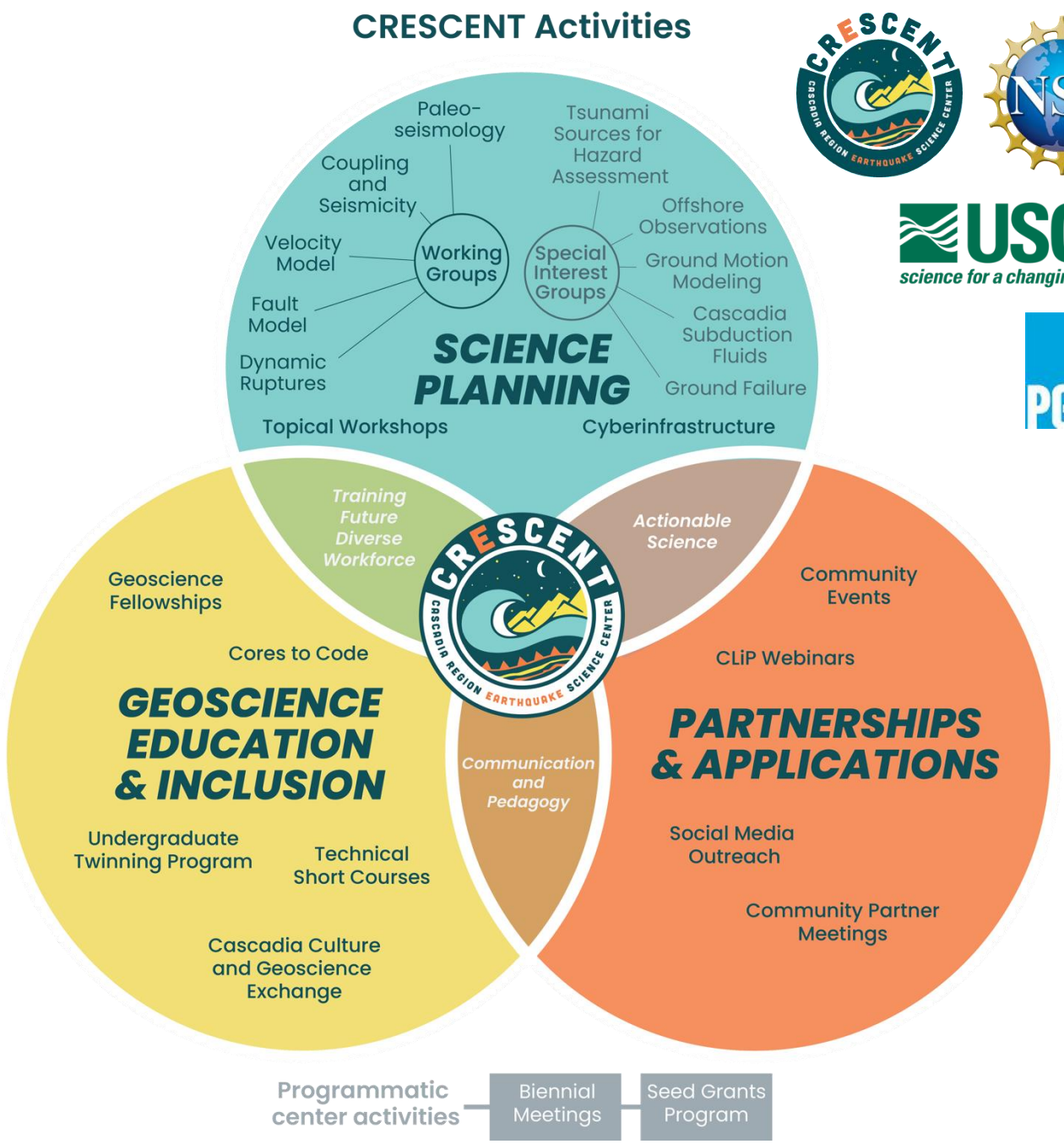
USGS
science for a changing world

PG&E

NSF

Center Overview

- A $15M NSF-funded center headquartered at the University of Oregon
- **7 center staff** for program management and cyberinfrastructure
- Senior personnel from 14 universities and other organizations include well over **50 researchers**
- 3 objectives or "pillars"
  - The **science** behind earthquakes and their hazards
  - Connecting the science to meaningful societally relevant outcomes through **partnerships** and development of **applications**
  - Expanding access to careers through **geoscience education and inclusion**



Executive Committee

The team responsible for ensuring the overall success of the center and coordinating leadership across CRESCENT's three pillars.

Diego Melgar
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Cyberinfrastructure Lead
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Valerie Sahakian
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Center Staff

The administrative team managing project timelines, communications, logistics, and day to day operations.

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William Marfo
Research Cyberinfrastructure Specialist
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Key Science Questions

Q1: How does tectonics drive hazard?

Q2: How is strain accumulated and released throughout the EQ cycle?

Q3: What is the temporal and spatial variability of past earthquakes?

Q4: What are the controls on rupture dynamics during megathrust events?

Q5: What is the seismic hazard from intra-plate (crust and slab) earthquakes?

Q6: What is the nature of strong motion in the CSZ?

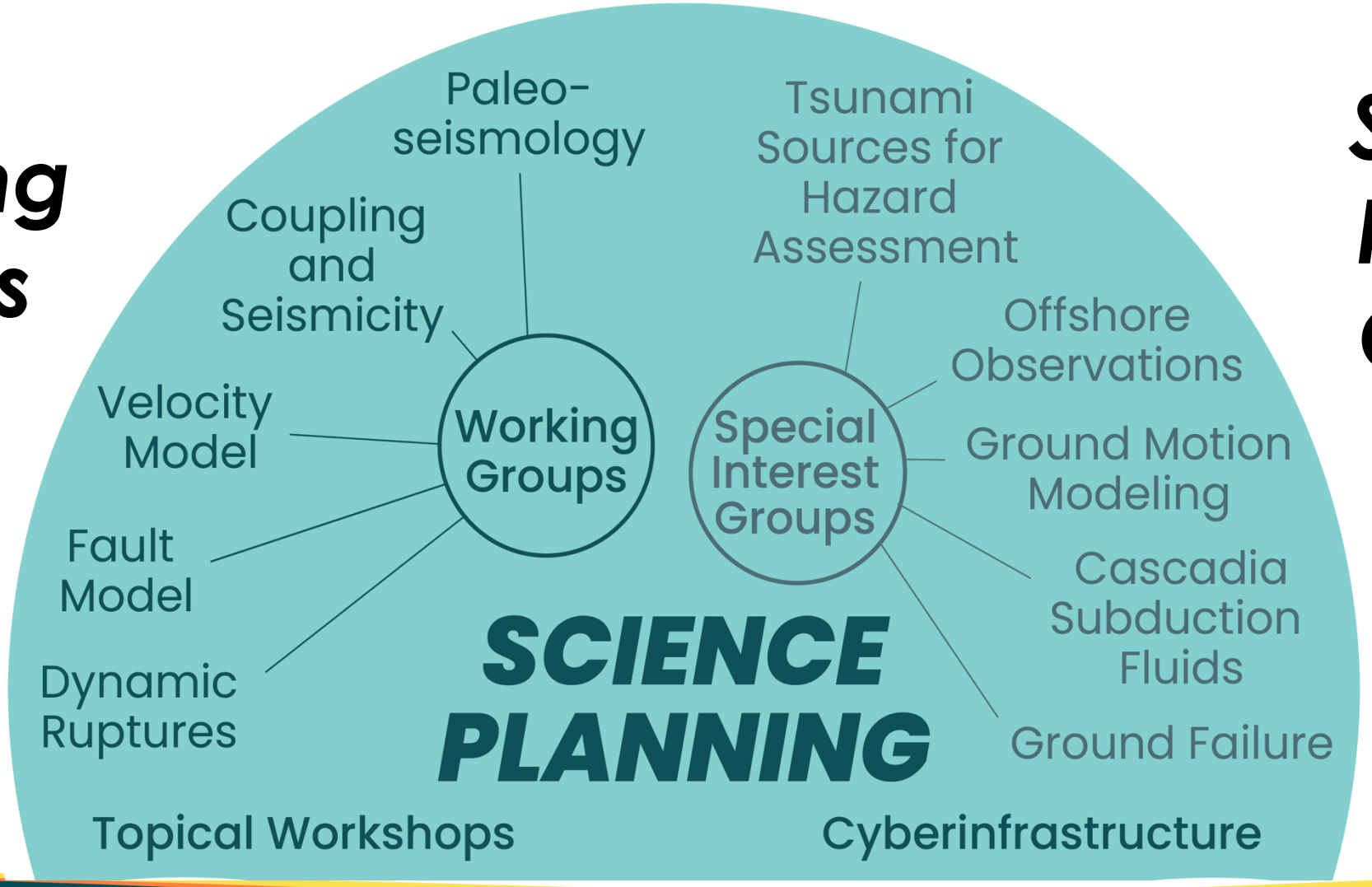
Q7: What are the tsunami sources in the CSZ and what controls inundation?

Basic science: Research is about Earth processes

Applied science: Research is about the impacts

CRESCENT Science Pillar

Working Groups

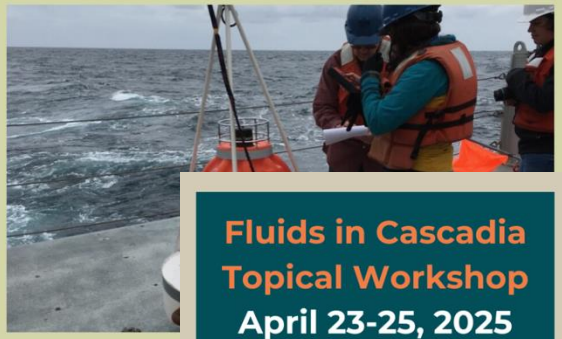


Special Interest Groups

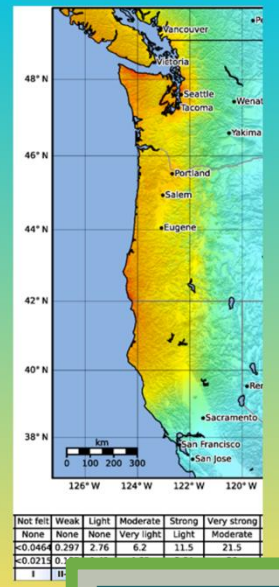
Workshops and Meetings!

Tsunami Topical Workshop
Nov 7-8, 2024
Eugene, OR

Offshore Observations Topical Workshop
October 27, 2025
Seattle, WA



Ground Motion Modeling Topical Workshop
May 27, 2026
Eugene, OR

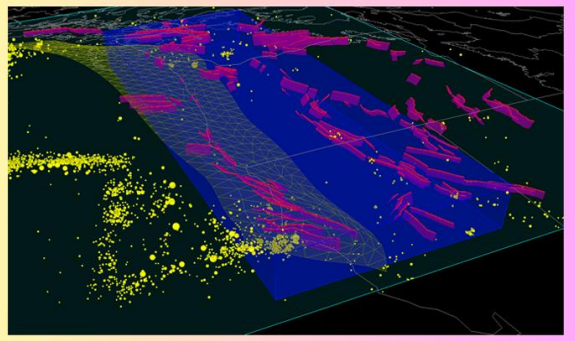


Not felt	Weak	Light	Moderate	Strong	Very strong
None	None	None	Very light	Light	Moderate
<0.0464	0.297	2.76	6.2	11.5	21.5
<0.0215	0.3				
I	II-III				

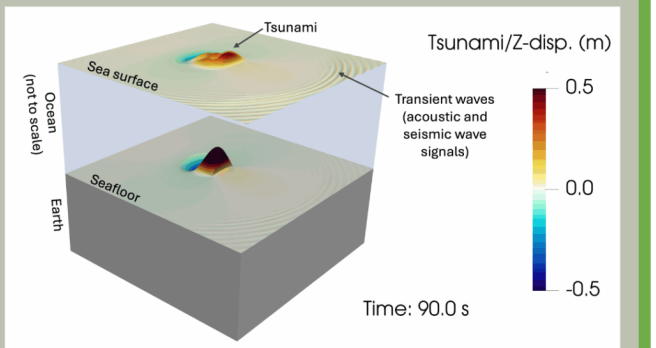
Fluids in Cascadia Topical Workshop
April 23-25, 2025
Portland, OR

Cascading Hazards Topical Workshop
March 7, 2025
Newport, OR

Community Fault Model Topical Workshop
August 12-13, 2025
Portland, OR



Shallow Rupture and Tsunamigenesis Topical Workshop
May 28-29, 2026
Eugene, OR



CRESCENT-affiliated researchers here at SSA

Thursday, April 16th

- Zoe Krauss, "Exploring the Use of Existing Offshore Cabled Infrastructure for Earthquake Early Warning in the Pacific Northwest" (Talk) 8:30 AM in Ballroom E
- Raul Benjamin Mendoza, "First Paleoseismic Evidence of Late Quaternary Surface Rupture in the Fraser Canyon of British Columbia, Canada" (Talk) 11:15 AM in Ballroom A
- Alice Gabriel, SEED GRANT PROJECT, "Do Coupled Megathrusts Rupture?" (Talk) 3:00 PM in Ballroom F
- Yohai Magen, "Coupling Heterogeneity in the Cascadia Slow-Slip Zone From GNSS Inversions and Physics-Based Modeling" (Talk) 3:00 PM in Ballroom G
- Daisy Briseno, TWINNING PROGRAM UNDERGRADUATE INTERN, "Preliminary Characterization of the Multorpor Mountain Fault: Evidence for Repeated Late Quaternary Faulting on the Mount Hood Fault Zone, North-central Oregon" (Poster) in Exhibit Hall A+B
- Bochen Dong, SEED GRANT PROJECT, "Machine Learning Detection of Offshore Tremor in the Cascadia Subduction Zone Using Multi-year Continuous Offshore and Onshore Seismic Data" (Poster) in Exhibit Hall A+B
- Becky Fildes, "A 2D and 3D Community Fault Model for the Cascadia Subduction Zone: Release of CRESCENT CFM Version 1.0" (Poster) in Exhibit Hall A+B
- Sarah Rysanek, PROFESSIONAL DEVELOPMENT FELLOWSHIP RECIPIENT, "Revisiting the Tectonic Geomorphology of the Nicaragua Segment of the Middle America Trench Using Newly Collected High-resolution Bathymetry and Reprocessed Marine Seismic Reflection Data" (Poster) in Exhibit Hall A+B
- Janet Watt, "Using Seafloor Geodesy to Constrain Gorda Plate Kinematics and Shallow Megathrust Locking in Southern Cascadia" (Poster) in Exhibit Hall A+B

Wednesday, April 15th

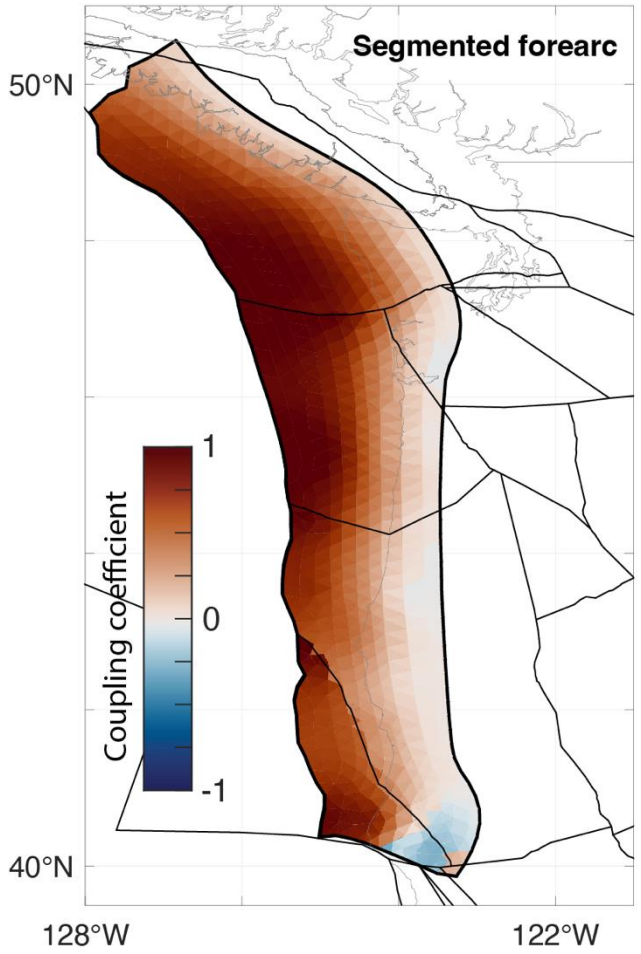
- Audrey Dunham, "Scenario ShakeMaps for Cascadia Subduction Zone Megathrust Earthquakes Using 3D Ground Motion Simulations" (Talk) 11:15 AM in Ballroom B
- Tiegan Hobbs, "Financial Recovery Modelling for Earthquake Risk in Canada" (Talk) 5:15 PM in Ballroom B
- Bill Stephenson, "Shear-wave Velocities in the Bellingham and Everett Basins, Washington State: Insights From Multimethod Characterization With krSPAC and Active-source Linear Arrays" (Poster) in Exhibit Hall A+B

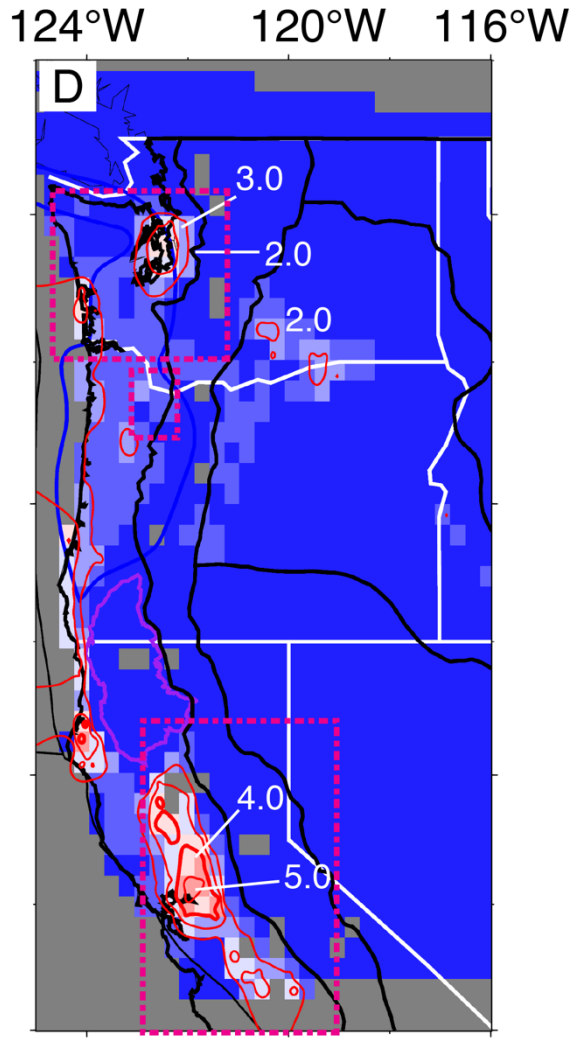
Friday, April 17th

- Zoe Krauss, "DAS Beyond Repeaters: Multi-span Monitoring Using Submarine Cables in the Pacific Ocean" (Talk) 5:30 PM in Ballroom E
- SESSION: "Data-Driven Advances in Liquefaction Hazard Analysis" (Poster) in Exhibit Hall A+B
- Joan Gomberg, "A New Agent, Pycorelator, Advances the Starring Role of Triggering in Paleoseismology" (Poster) in Exhibit Hall A+B
- Alamgir Hosain, PROFESSIONAL DEVELOPMENT FELLOWSHIP RECIPIENT, "Dynamic Earthquake Triggering Regions in Texas and the Role of Fluid Injection" (Poster) in Exhibit Hall A+B
- Itzel Noriega, TWINNING PROGRAM UNDERGRADUATE INTERN, "Investigating Dynamic Triggering in Cascadia Volcanic Systems Using Seismic Network Data" (Poster) in Exhibit Hall A+B

What is the Structural Framework of Cascadia governing the hazards?

- CVM Community Velocity Model
- C3S Block Models
- CFM Faults inventory and Visualization





Community Fault Model (CFM)

- Q1: How does tectonics drive hazard?
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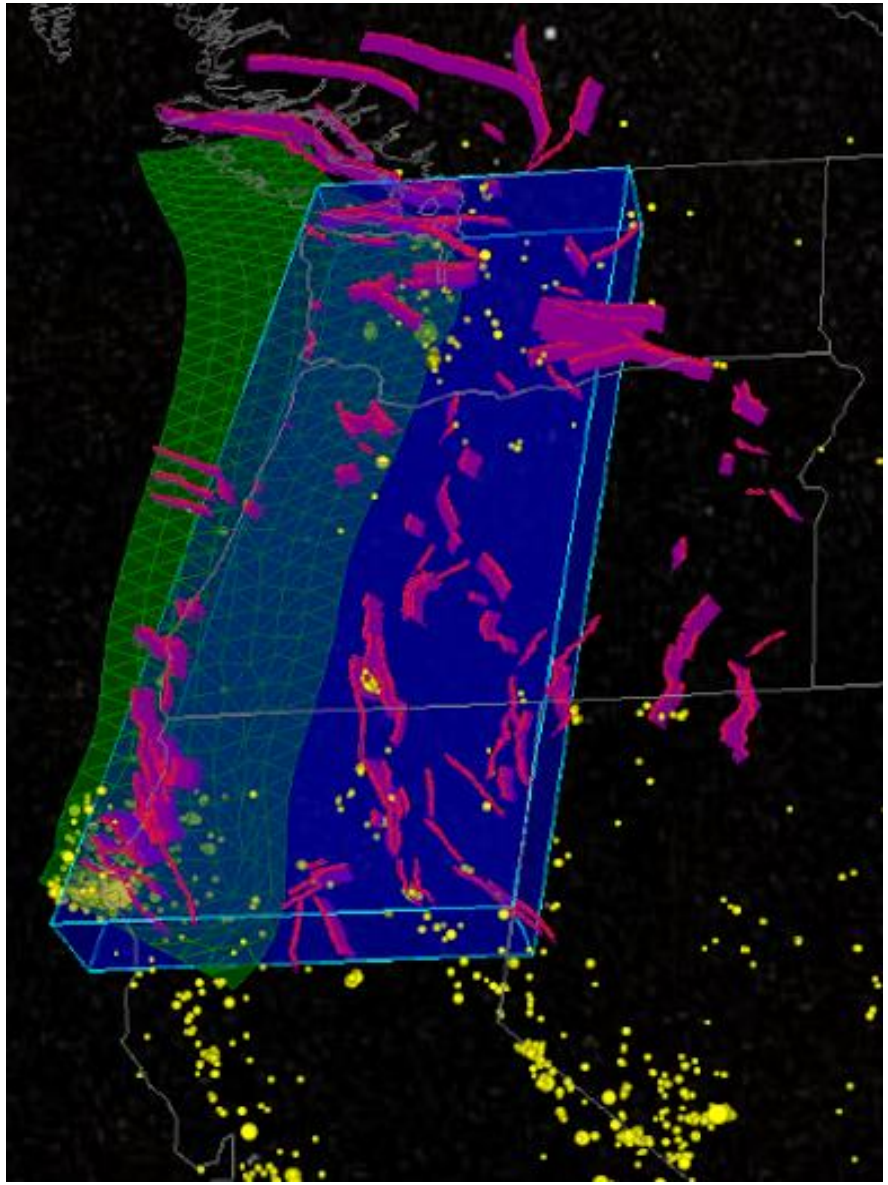


CFM Version 0.1 (pre-release)

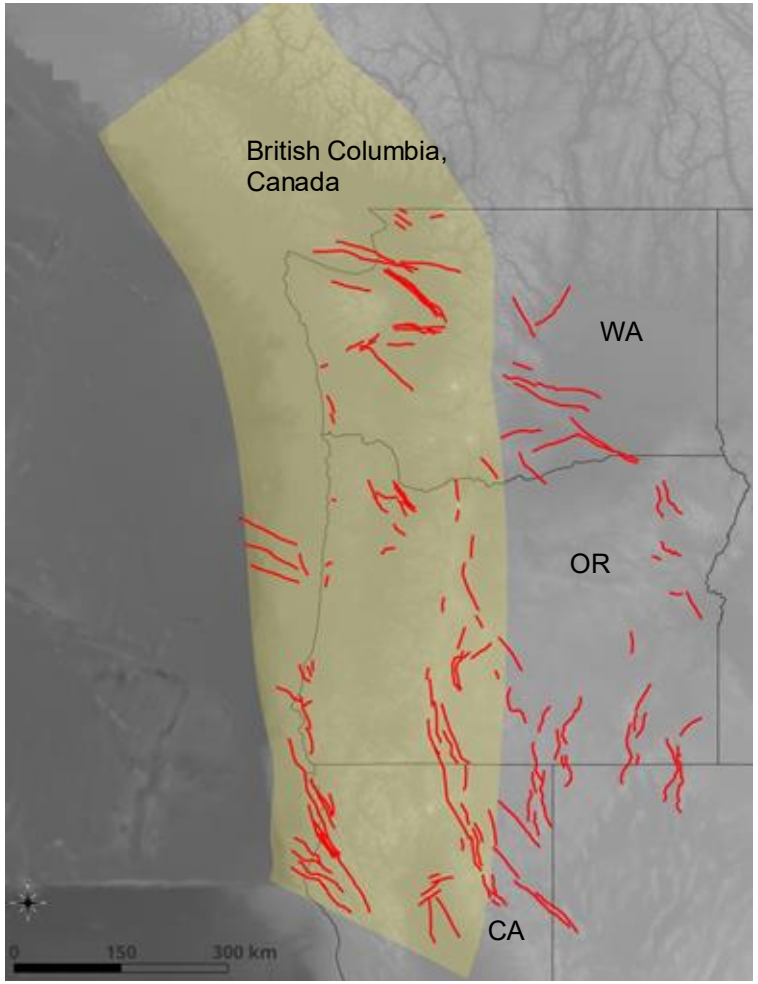
2D and 3D geometries for ~150 faults *(red lines)*

- 2023 National Seismic Hazard Model (NSHM) *(Hatem et al., 2022)*
- GEM & Canada Geological Survey faults collaborative research *(Hobbs et al, in prep; Styron et al., in prep)*

3D slab interface models from 4 studies

CFM v1.0 now in peer review

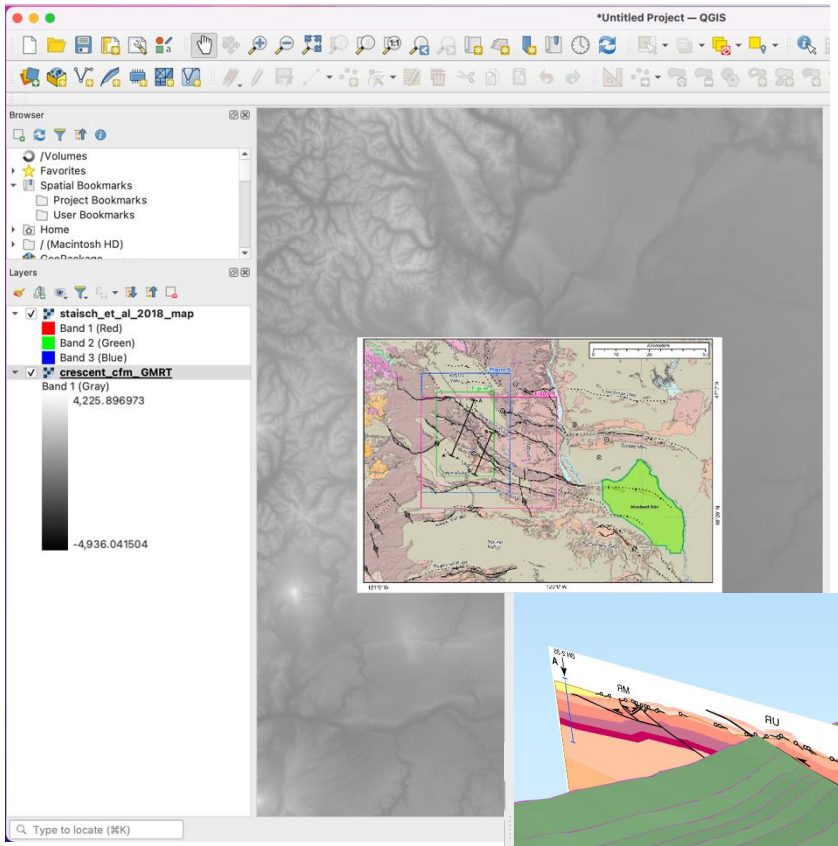
- Developed criteria for inclusion
- Incorporated numerous additional onshore and offshore faults
- ***2D and 3D Interactive visualization***

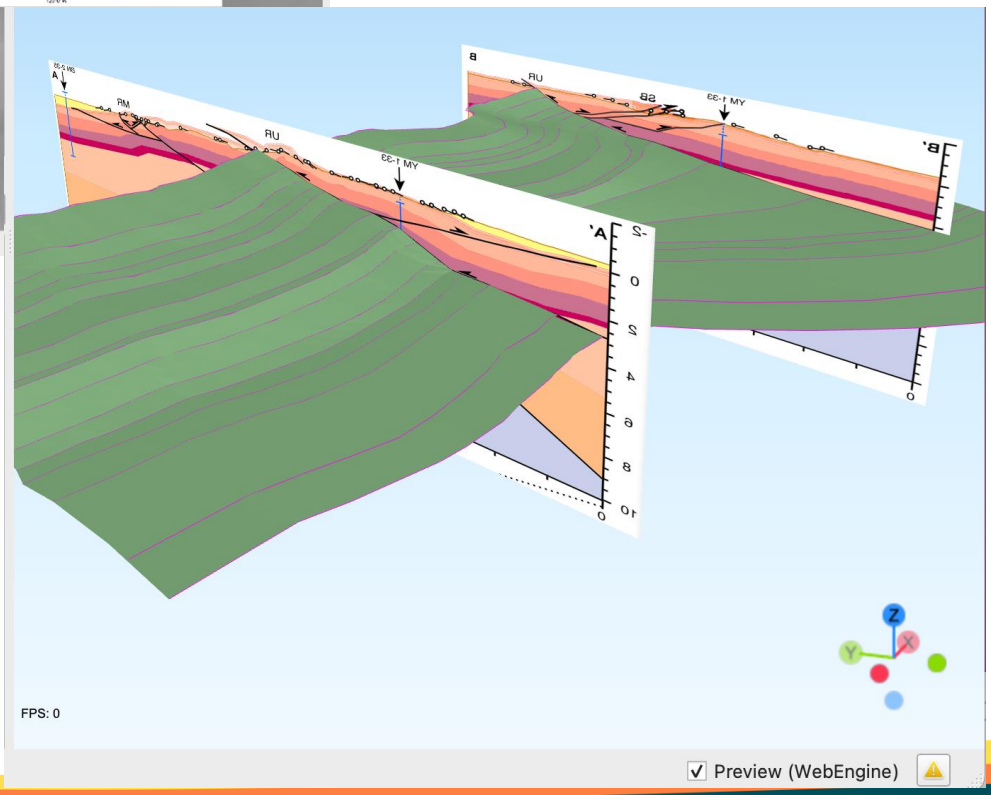


CFM 0.1 (NSHM faults only)

CFM QGIS plugins

1. **Import and geo-reference traces and cross sections.**
2. View cross sections in the 3D viewer.
3. Digitize the fault data, making it available in the map view.
4. Drawing contours using the digitized points, setting elevation.
5. Contours are viewable in the 3D viewer.
6. **Meshing the fault.**
7. Again, possible to verify in the 3D viewer.





Cyberinfrastructure Team

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Loïc Bachelot
Data Scientist
lbachelo@uoregon.edu

William Marfo
Research Cyberinfrastructure Specialist
wmarfo@ucdavis.edu

Cyberinfrastructure Team!

CRESCENT staff plus effort from Earthscope personnel

Community Velocity Model (CVM)

Q1: How does tectonics drive hazard?

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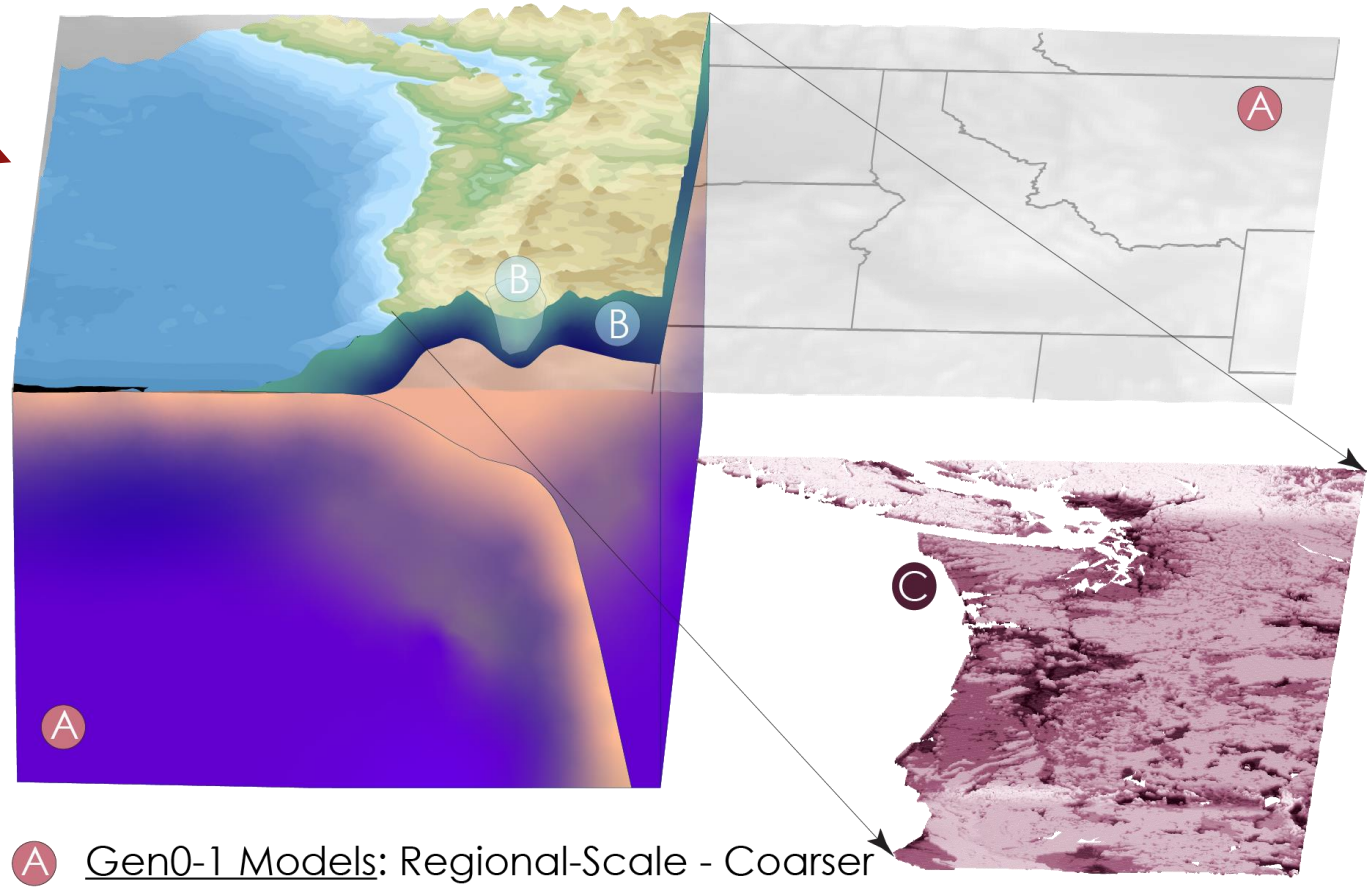


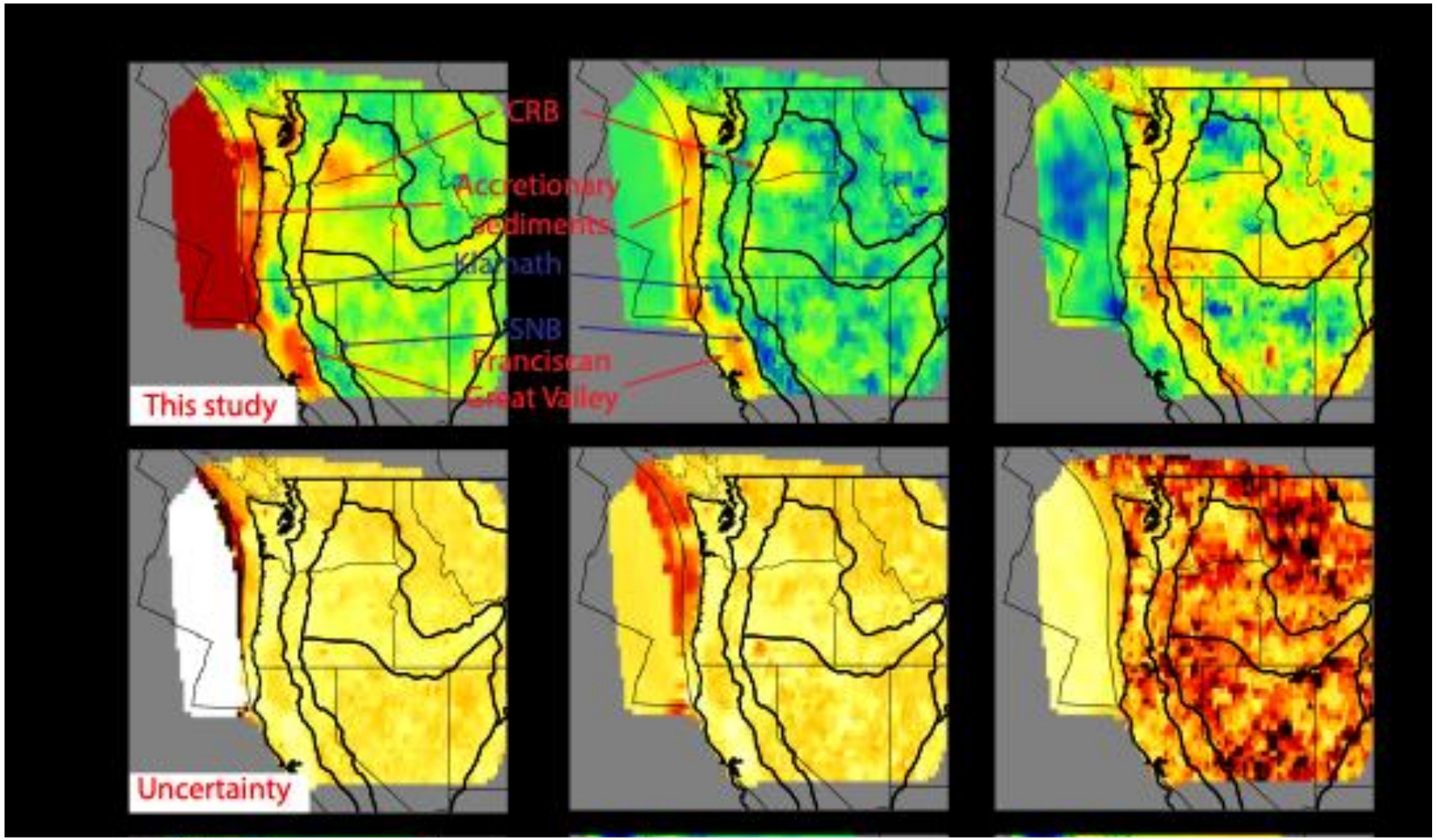
A Gen0-1 Models: Regional-Scale - Coarser

B Gen2 Models: Upper Crustal - Higher Resolution, Shallower, Basins

C Gen3 Models: Near-Surface - Geotechnical Layer and Topography

Sahakian et al., *in revision*

CVM-0: Coarse structure



- Basin materials and structures are critical for GMM
- Limited resolution at shallow depth, but our model reveals major basin shapes and depth.

PURDUE UNIVERSITY

He et al., in revision

Coupling, Seismicity, and Slow Slip Working Group (C3S)

Q1: How does tectonics drive hazard?

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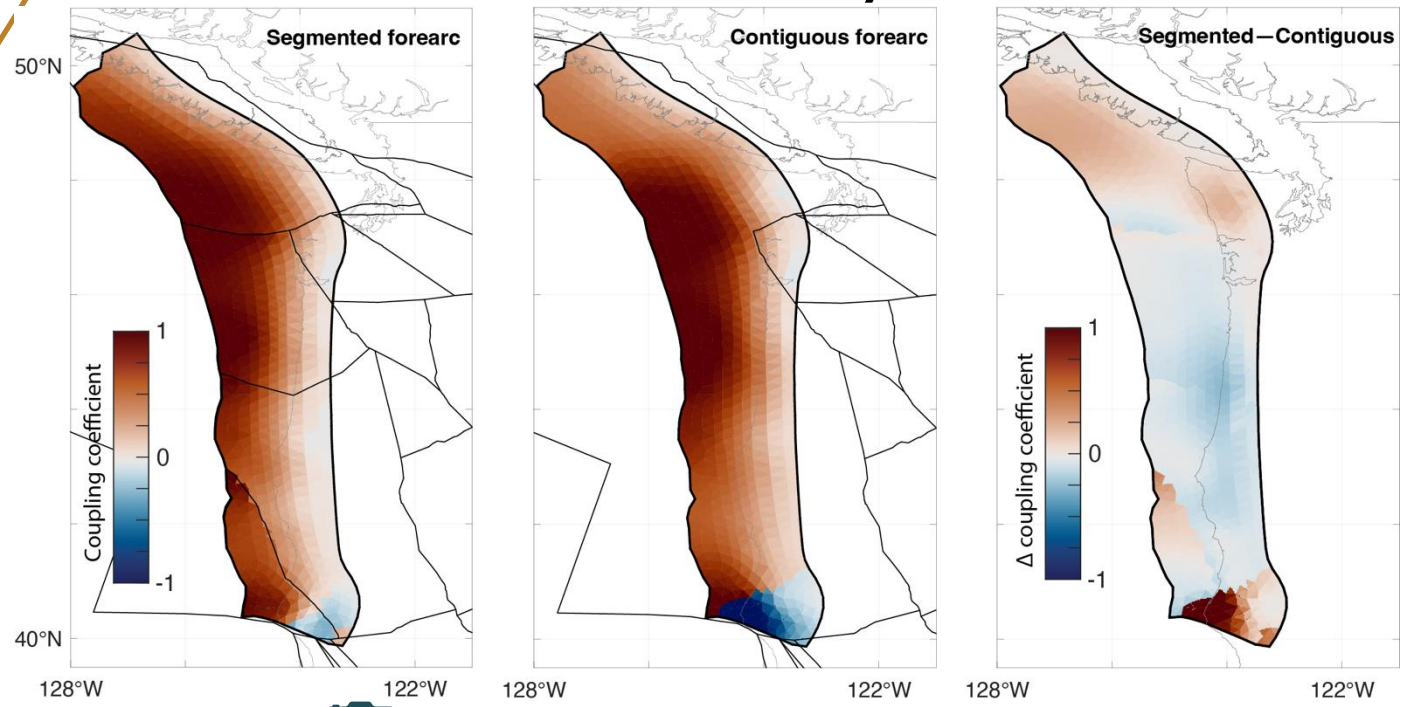
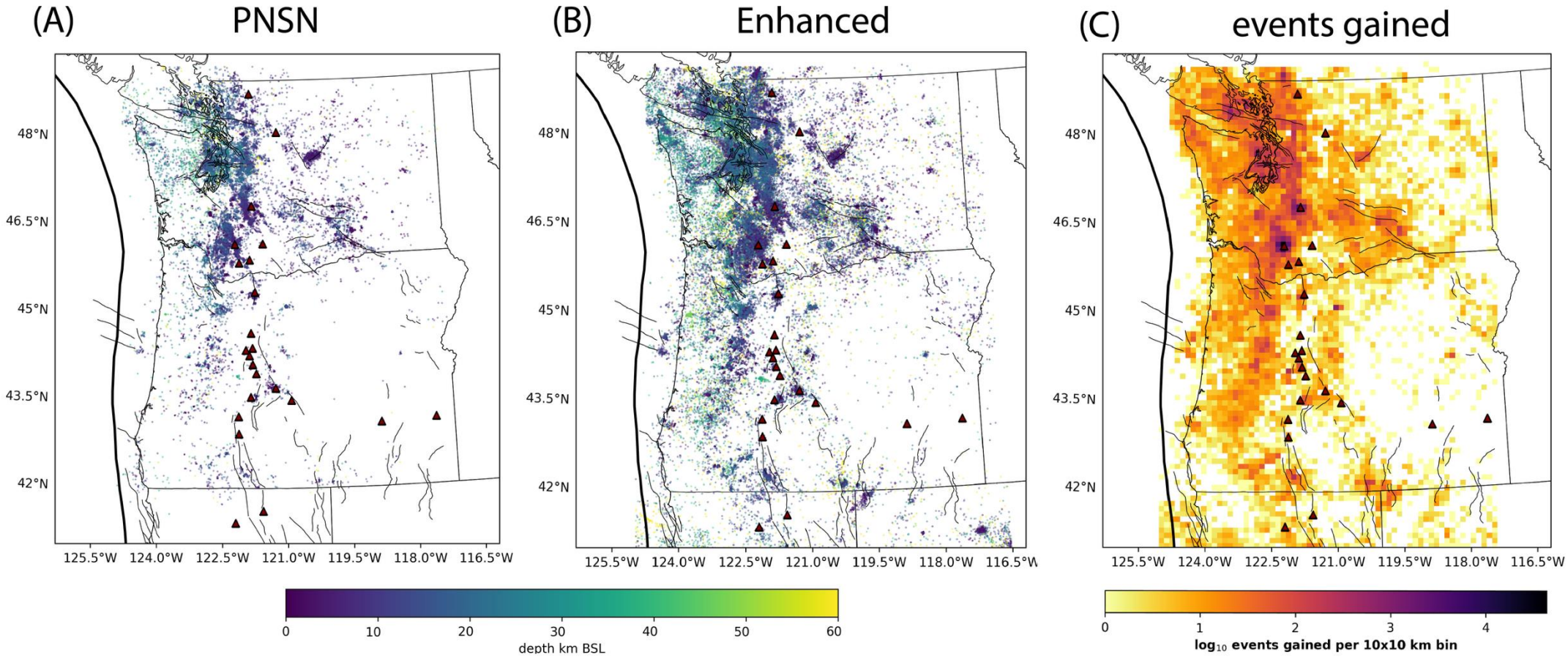
- **Lithospheric block models** to evaluate the strain budget of the PNW for seismic coupling and more
- **Seismogeodetic** detection of **transient** events
- New inventories of **seismicity** & **ETS events**



H. Elston, J. Loveless, et al. 2025

ML Seismicity Catalog



- ML Detection using CRESCENT CVM Gen 0
- 4x increase in events – megathrust quiet, crustal seismicity delineates faults

Hirao et al., in prep

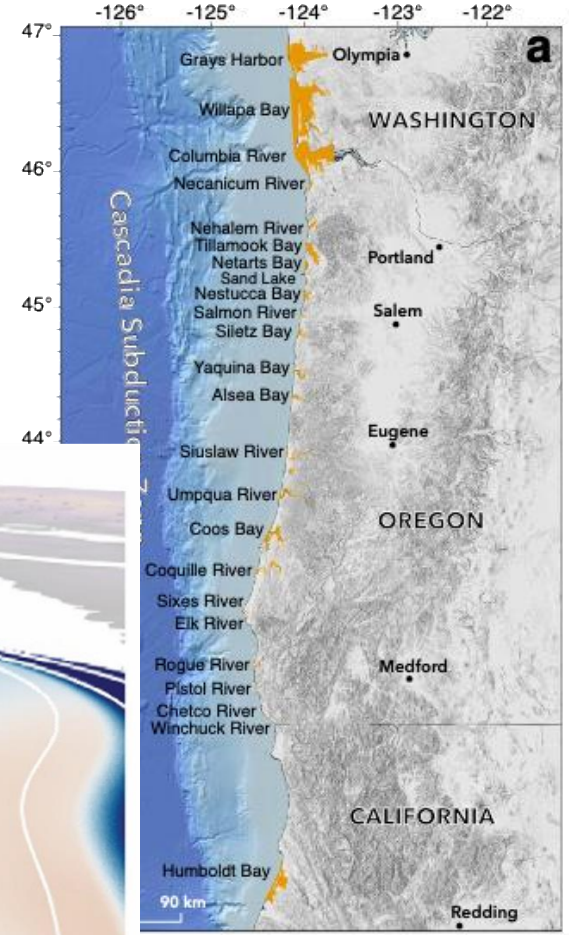
Earthquake Catalog Viewer

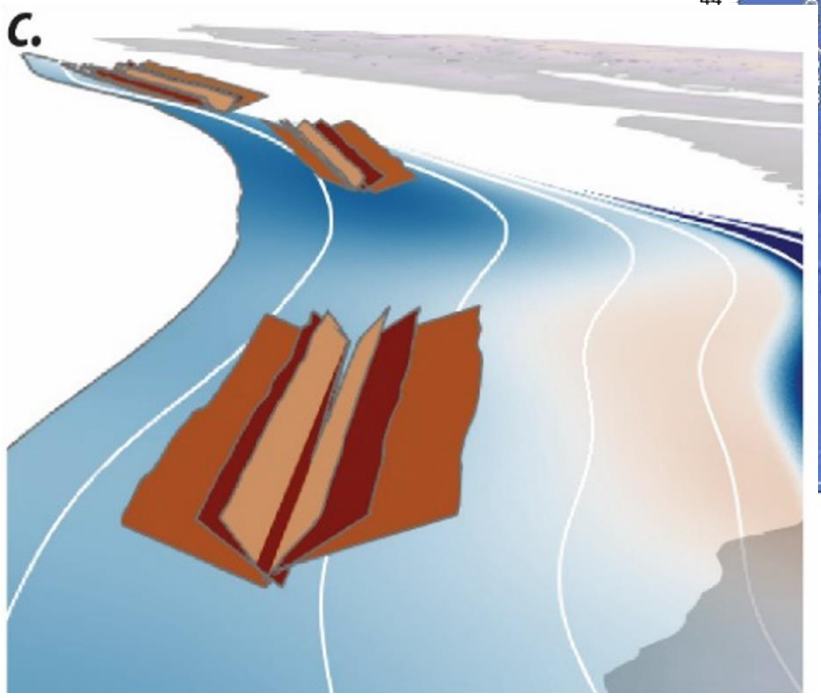
- Community platform for discovering and comparing peer-reviewed Cascadia earthquake catalogs
- Integrates 10+ catalogs with 1.7 million events in standardized format.
- Interactive 2D map with filtering by magnitude, depth, time, and spatial region.
- 3D subsurface viewer with Cascadia slab interface and crustal fault models
- Full CI/CD pipeline with dev/prod environments.

eqcat.cascadiaquakes.org

How have megathrust events happened in the past and what are scenarios for the future?

- CPAL: Paleoseismology, paleotsunami, paleogeodesy
- DET: Dynamic Earthquake Rupture and Tsunami modeling





Cascadia Paleoseismology (CPAL)

Q1: How does tectonics drive hazard?

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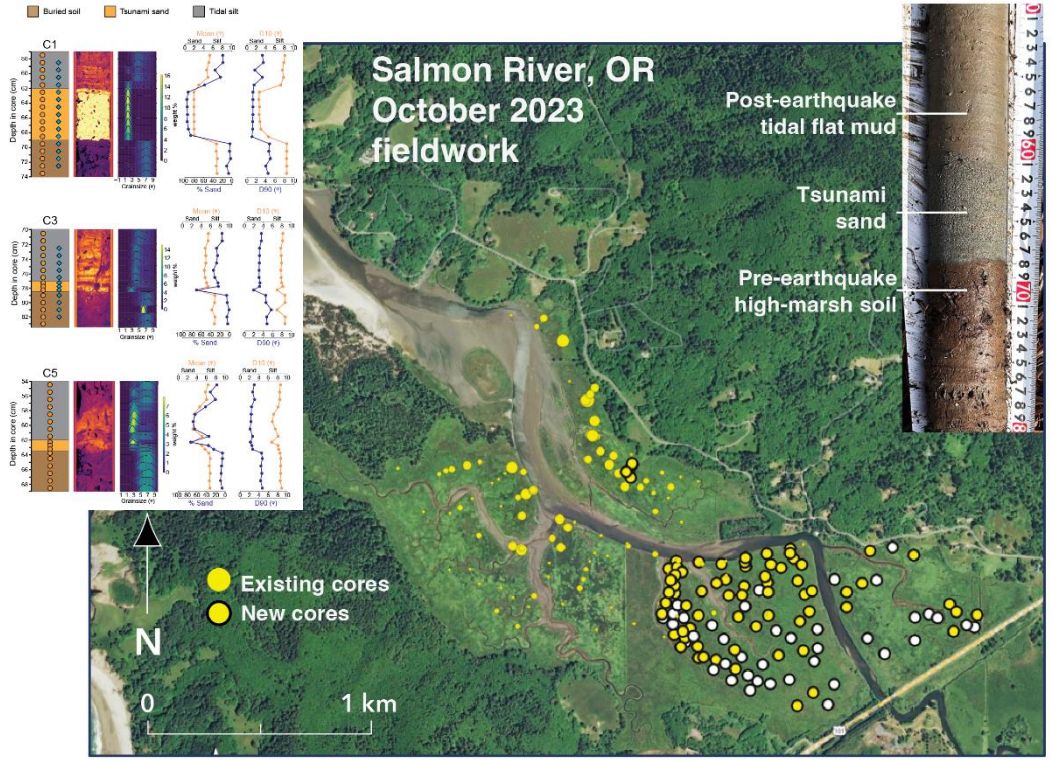
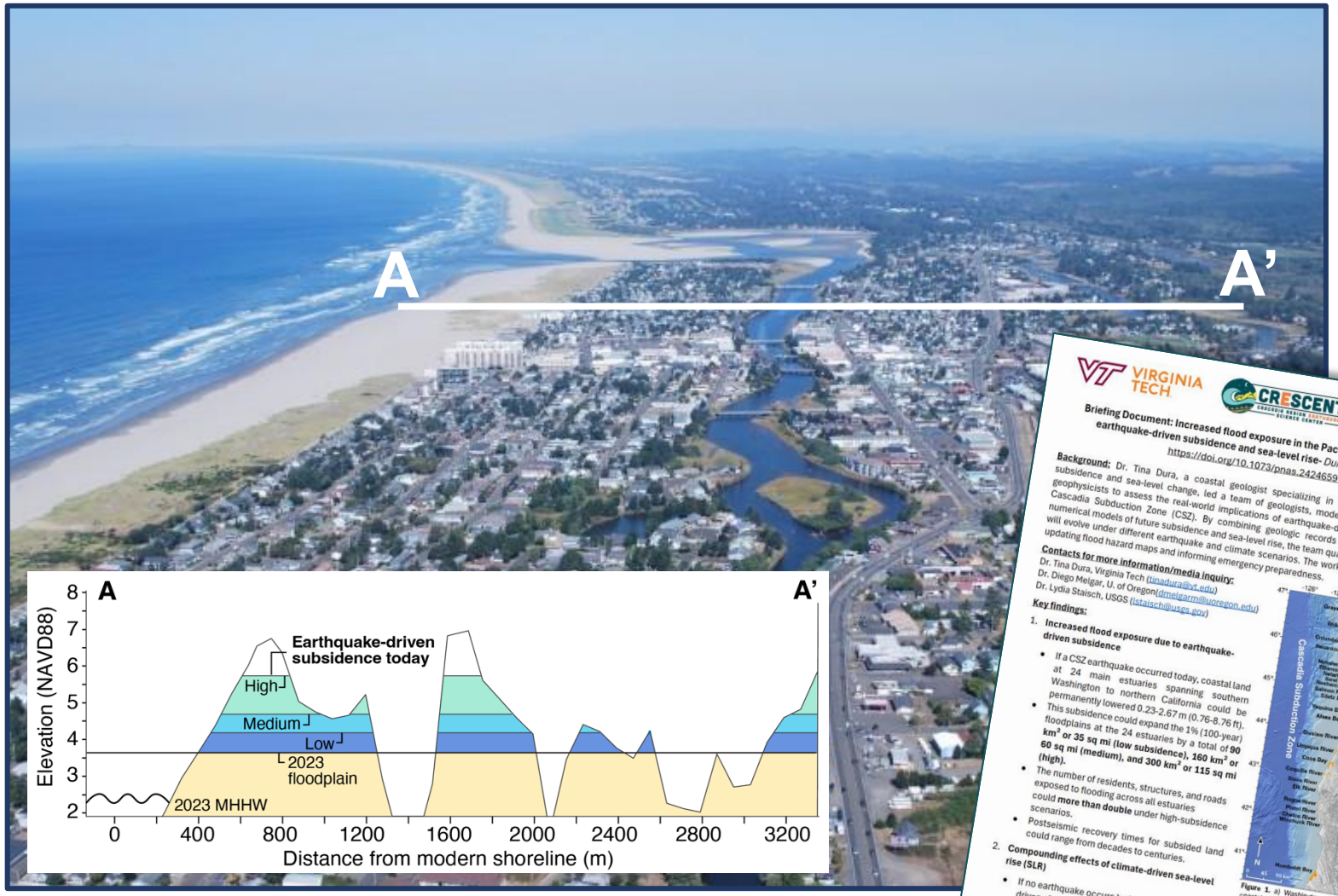
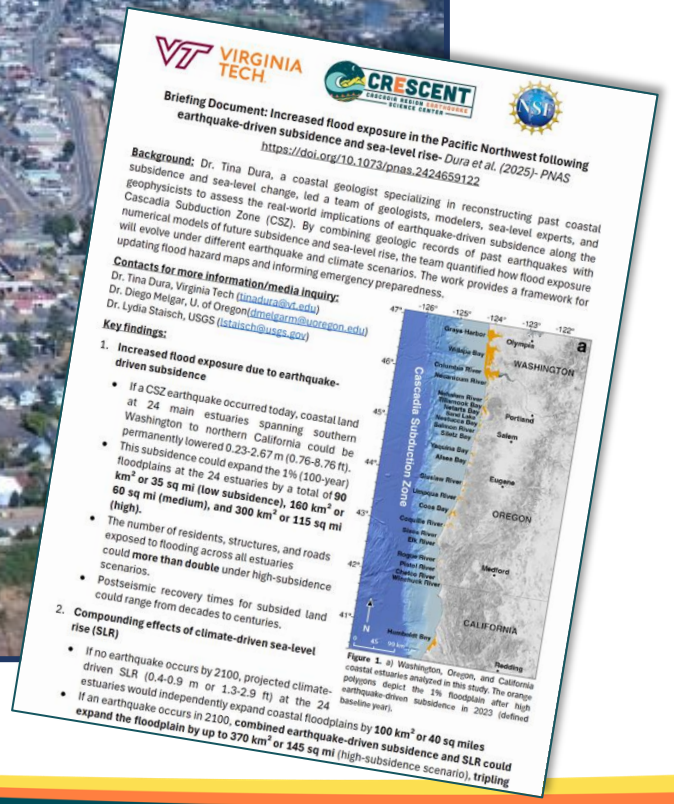


Overarching Goal

Use the geologic record at Cascadia to reveal patterns, timing, and size of past megathrust earthquakes and tsunamis to inform earthquake models.

Cascadia Paleoseismology (CPAL)





VIRGINIA TECH

CRESCENT

Briefing Document: Increased flood exposure in the Pacific Northwest following earthquake-driven subsidence and sea-level rise- *Dura et al. (2025)- PNAS* https://doi.org/10.1073/pnas.2424659122

Background: Dr. Tina Dura, a coastal geologist specializing in reconstructing past coastal subsidence and sea-level change, led a team of geologists, modelers, sea-level experts, and geophysicists to assess the real-world implications of earthquake-driven subsidence along the Cascadia Subduction Zone (CSZ). By combining geologic records of past earthquakes with numerical models of future subsidence and sea-level rise, the team quantified how flood exposure will evolve under different earthquake and climate scenarios. The work provides a framework for updating flood hazard maps and informing emergency preparedness.

Contacts for more information/media inquiry:
Dr. Tina Dura, Virginia Tech (tinadura@vt.edu)
Dr. Diego Melgar, U. of Oregon(dmelgarm@uoregon.edu)
Dr. Lydia Staisch, USGS (lstaisch@usgs.gov)

Key findings:

1. **Increased flood exposure due to earthquake-driven subsidence**
   - If a CSZ earthquake occurred today, coastal land at 24 main estuaries spanning southern Washington to northern California could be permanently lowered 0.23-2.67 m (0.76-8.76 ft). This subsidence could expand the 1% (100-year) floodplains at the 24 estuaries by a total of **90 km² or 35 sq mi (low subsidence), 160 km² or 60 sq mi (medium), and 300 km² or 115 sq mi (high).**
   - The number of residents, structures, and roads exposed to flooding across all estuaries could **more than double** under high-subsidence scenarios.
   - Postseismic recovery times for subsided land could range from decades to centuries.
2. **Compounding effects of climate-driven sea-level rise (SLR)**
   - If no earthquake occurs by 2100, projected climate-driven SLR (0.4-0.9 m or 1.3-2.9 ft) at the 24 estuaries would independently expand coastal floodplains by **100 km² or 40 sq miles**
   - If an earthquake occurs in 2100, **combined earthquake-driven subsidence and SLR could expand the floodplain by up to 370 km² or 145 sq mi** (high-subsidence scenario), **tripling**

Figure 1. a) Washington, Oregon, and California coastal estuaries analyzed in this study. The orange polygons depict the 1% floodplain after high earthquake-driven subsidence in 2023 (defined baseline year).

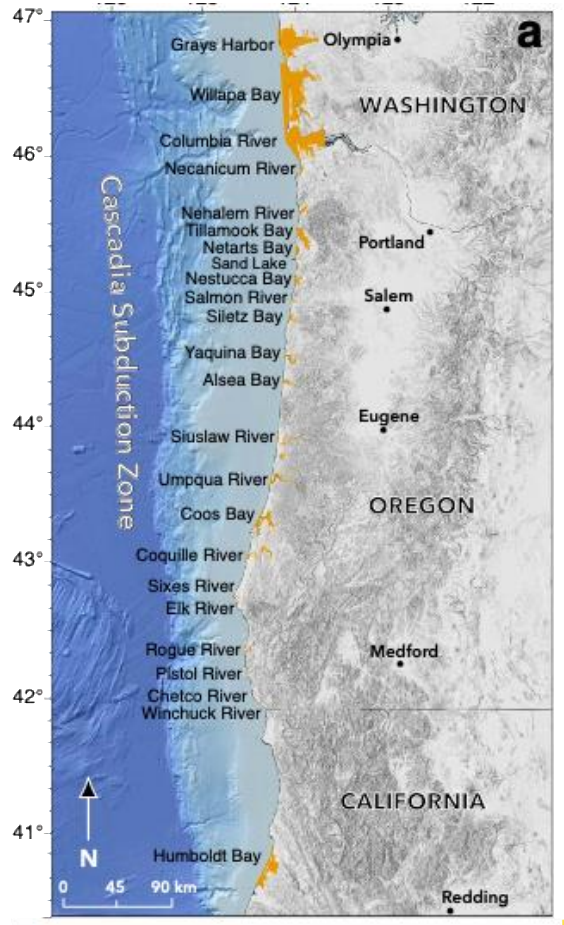
The Washington Post
Democracy Dies in Darkness

Environment

A big Pacific Northwest quake could cause land to sink in minutes

Scientists say the region is overdue for a major tremor, and a new study predicts serious flooding would result along with shaking and a tsunami.

April 30, 2025



Dura et al., PNAS, 2025

Dynamic Rupture, Earthquake Cycle, and Tsunamis (DET)

- Developing a wide range of earthquake simulations using advanced numerical models
- Different modeling approaches, fit-to-purpose for different questions
- Building them on the structural frameworks by CVM, C3S, and CFM groups, and histories from CPAL
- Code Verification effort

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United States Geological Survey
jbiemiller@usgs.gov

Dynamic Ruptures, Earthquake Cycles, and Tsunamis (DET)

Q1: How does tectonics drive hazard?

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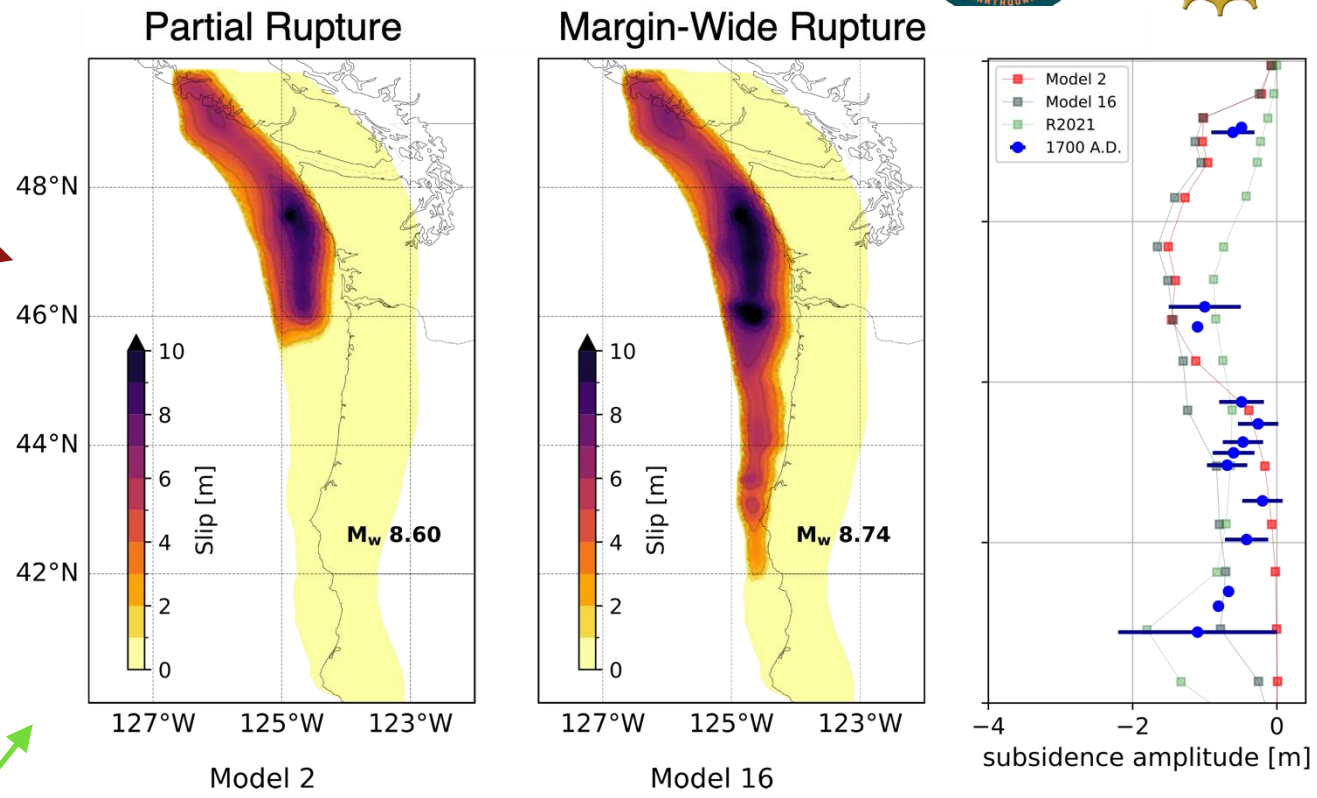


(Glehman, Gabriel, Ulrich, Ramos, Huang, Lindsey, ""**Partial ruptures governed by the complex interplay between geodetic slip deficit, rigidity, and pore fluid pressure in 3D Cascadia dynamic rupture simulations**", 2025, Seismica)

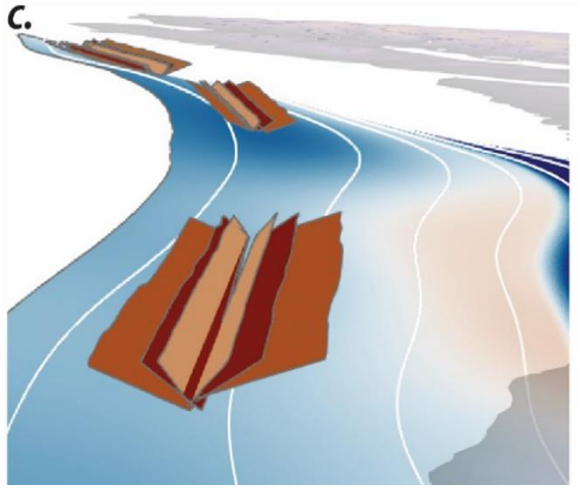
DET Topical Workshop: May 28-29, Eugene OR

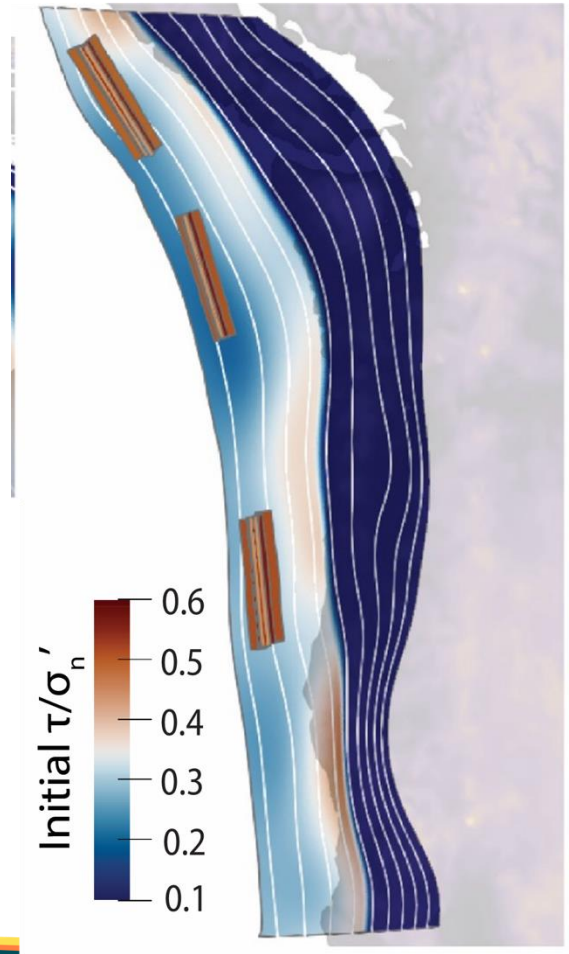
Outline research priorities for physics of tsunamigenesis, shallow deformation, and faulting

https://cascadiaquakes.org/2025/01/20/det-topical-workshop/

Dynamic Ruptures, Earthquake Cycles, and Tsunamis (DET)

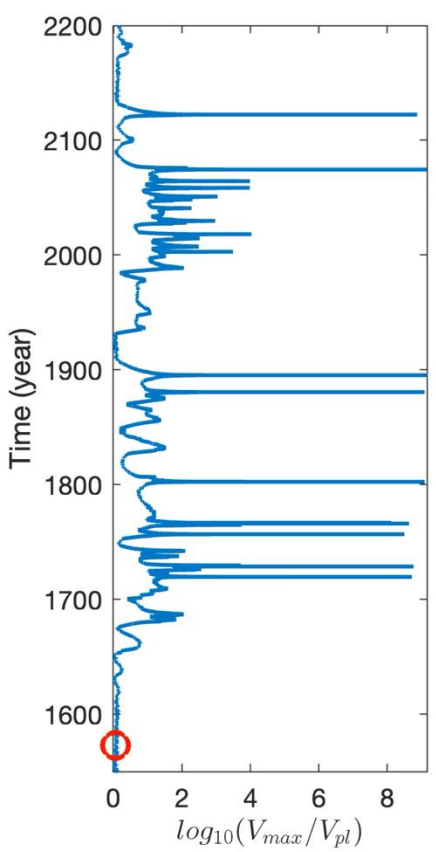
- Impacts of structures and fluid/rigidity properties on tsunamigenesis

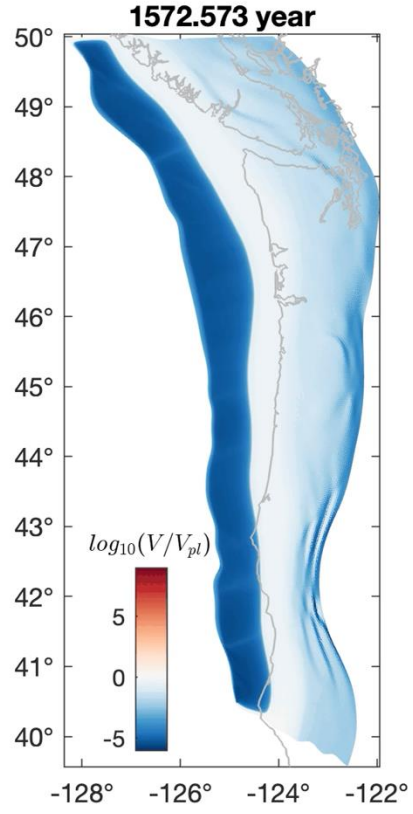


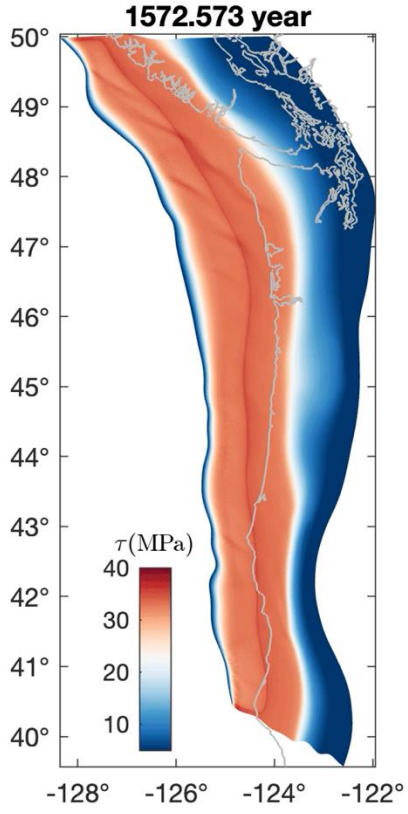


James Biemiller, Alice Gabriel, Lydia Staisch, Thomas Ulrich, Audrey Dunham, Madeleine Lucas, Anna Ledeczi, Harold Tobin, Erin Wirth, Janet Watt, Ruth Harris, **2025**

- Work looking at multiple earthquake cycles



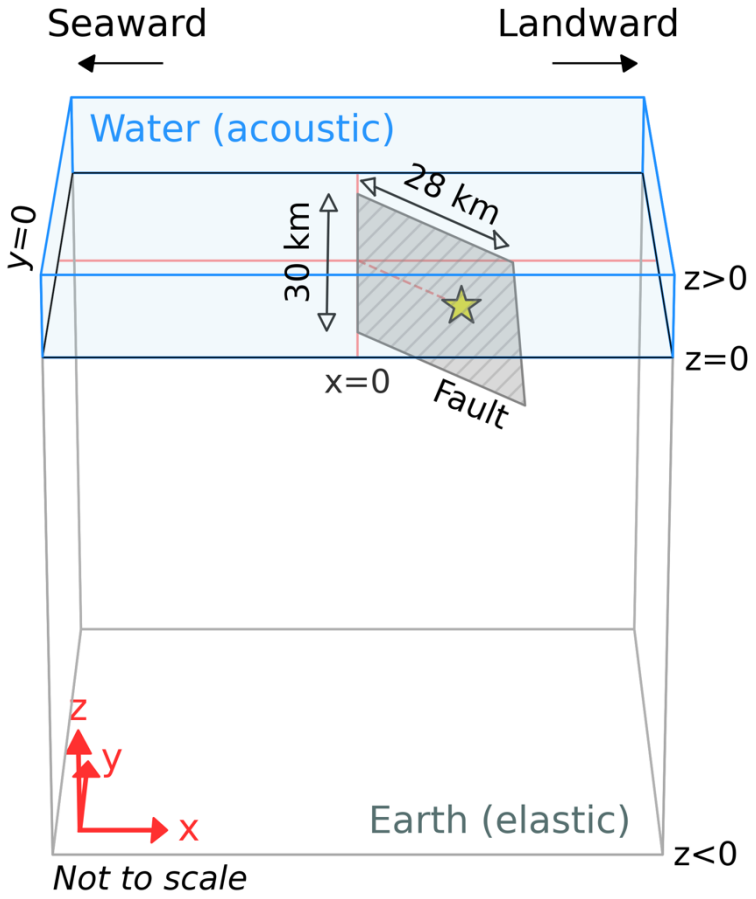


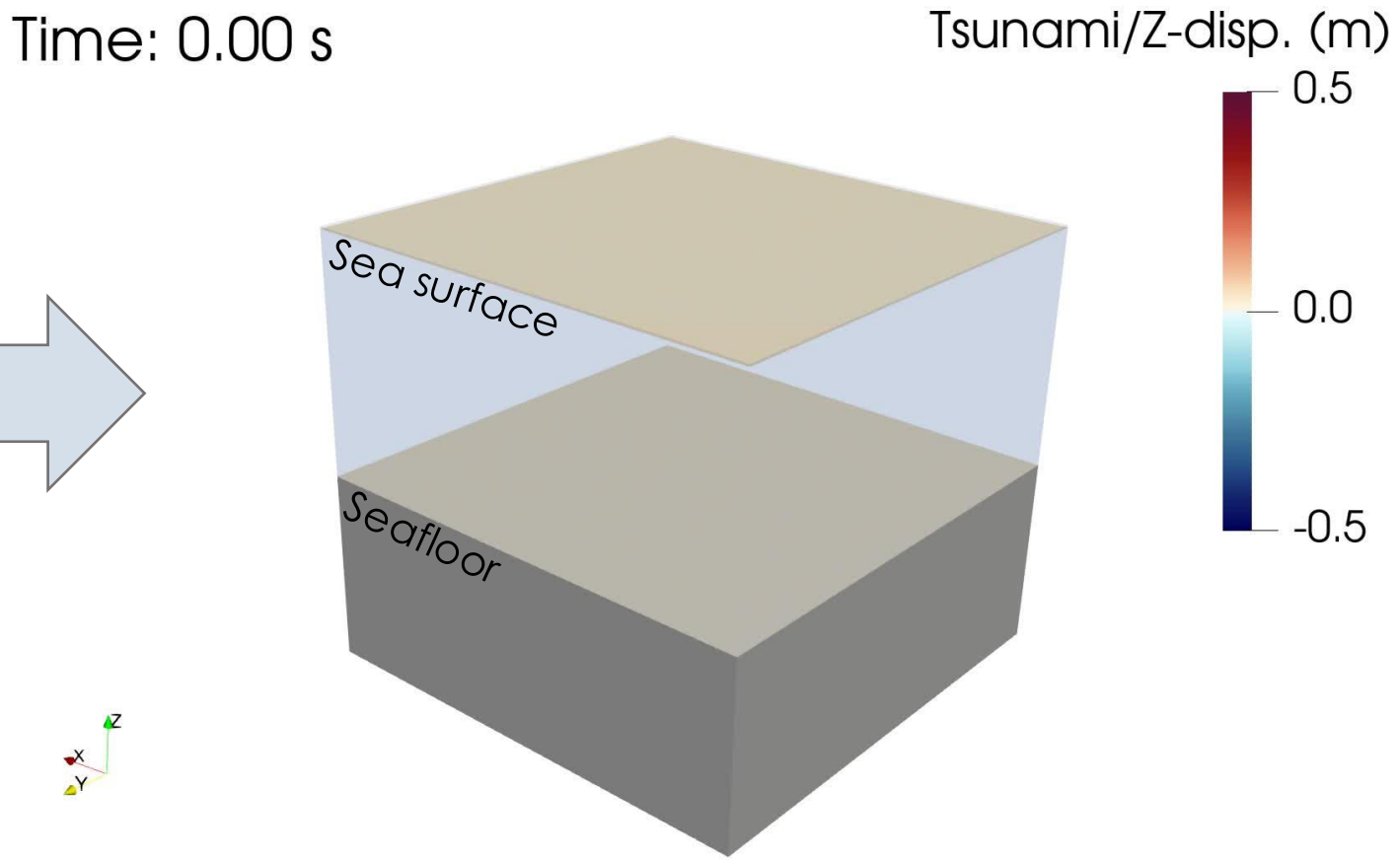


Work by Wenqiang Zhang, So Ozawa, Eric Dunham

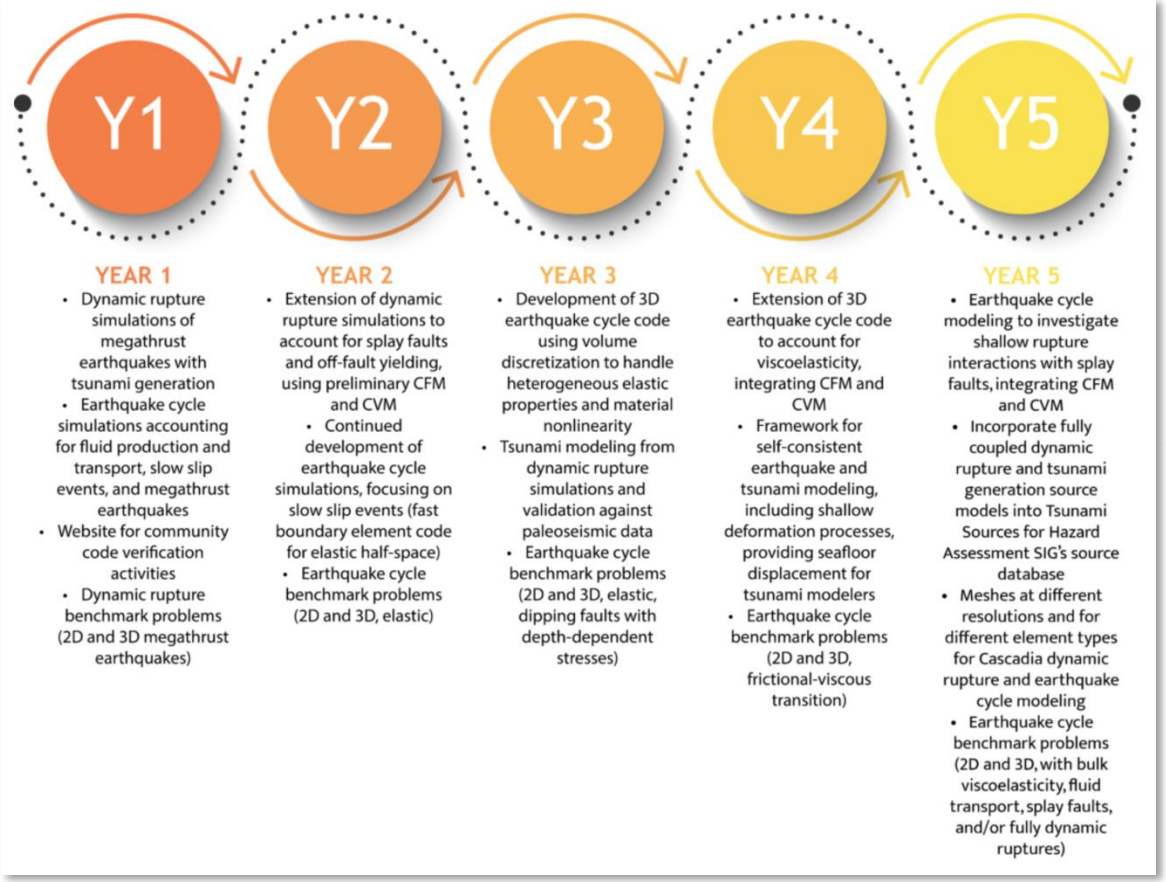
The Tsunami Problem Version 1

- As part of the DET group, we designed **two fully coupled earthquake-tsunami problem versions** and solve for the 3D elastic, acoustic, and tsunami waves, including dispersion effects, **simultaneously**



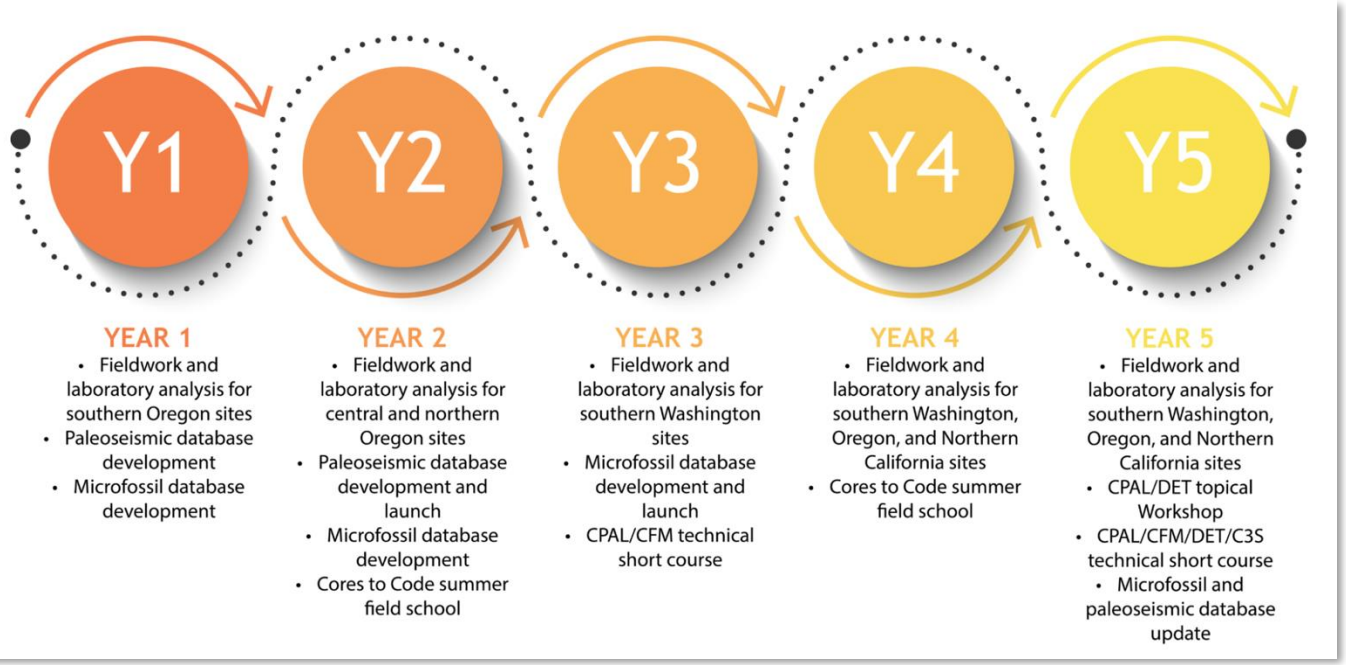


Each WG has a major activity timeline available on the website

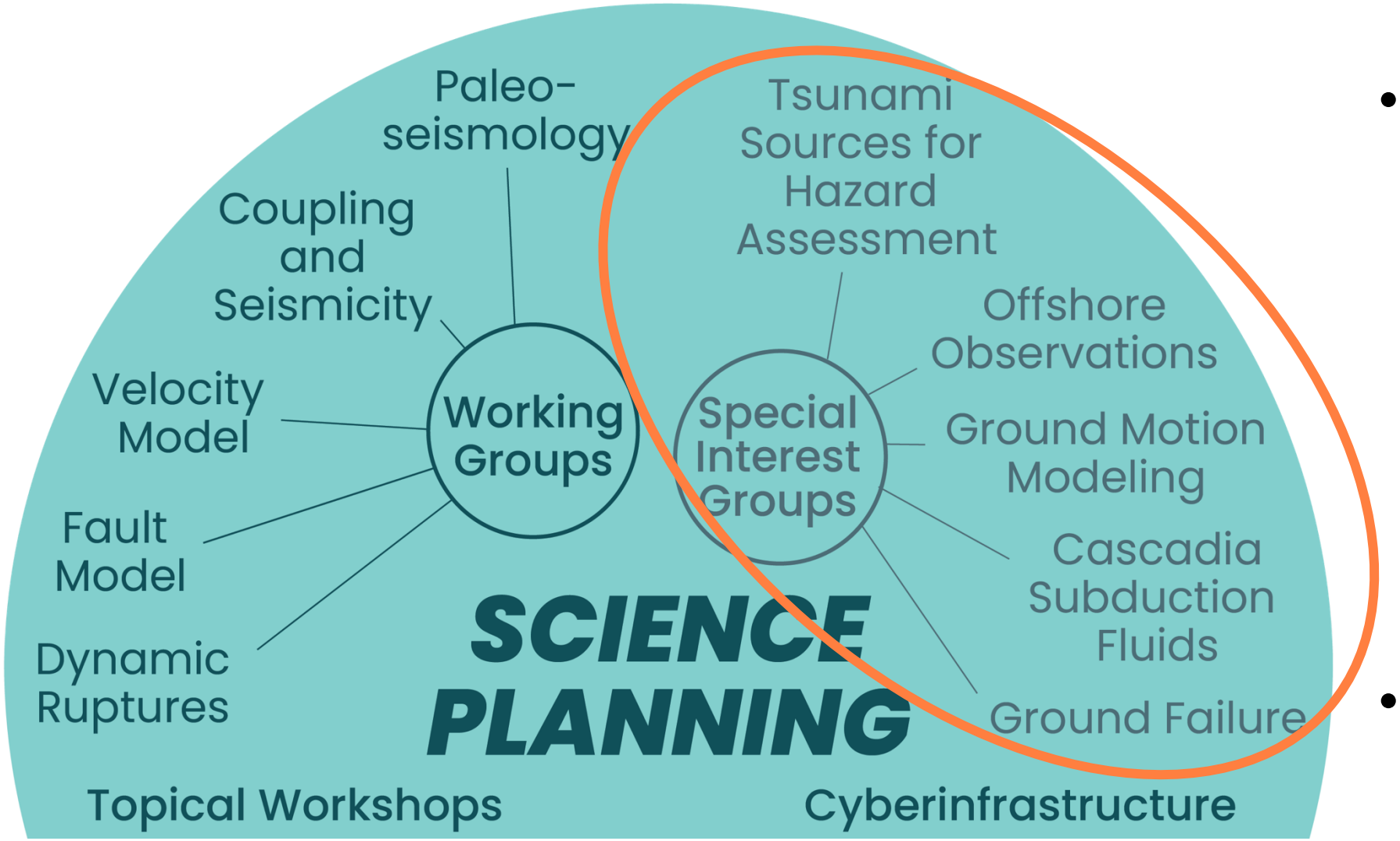


DET Timeline

CPAL Timeline



CRESCENT Special Interest Groups



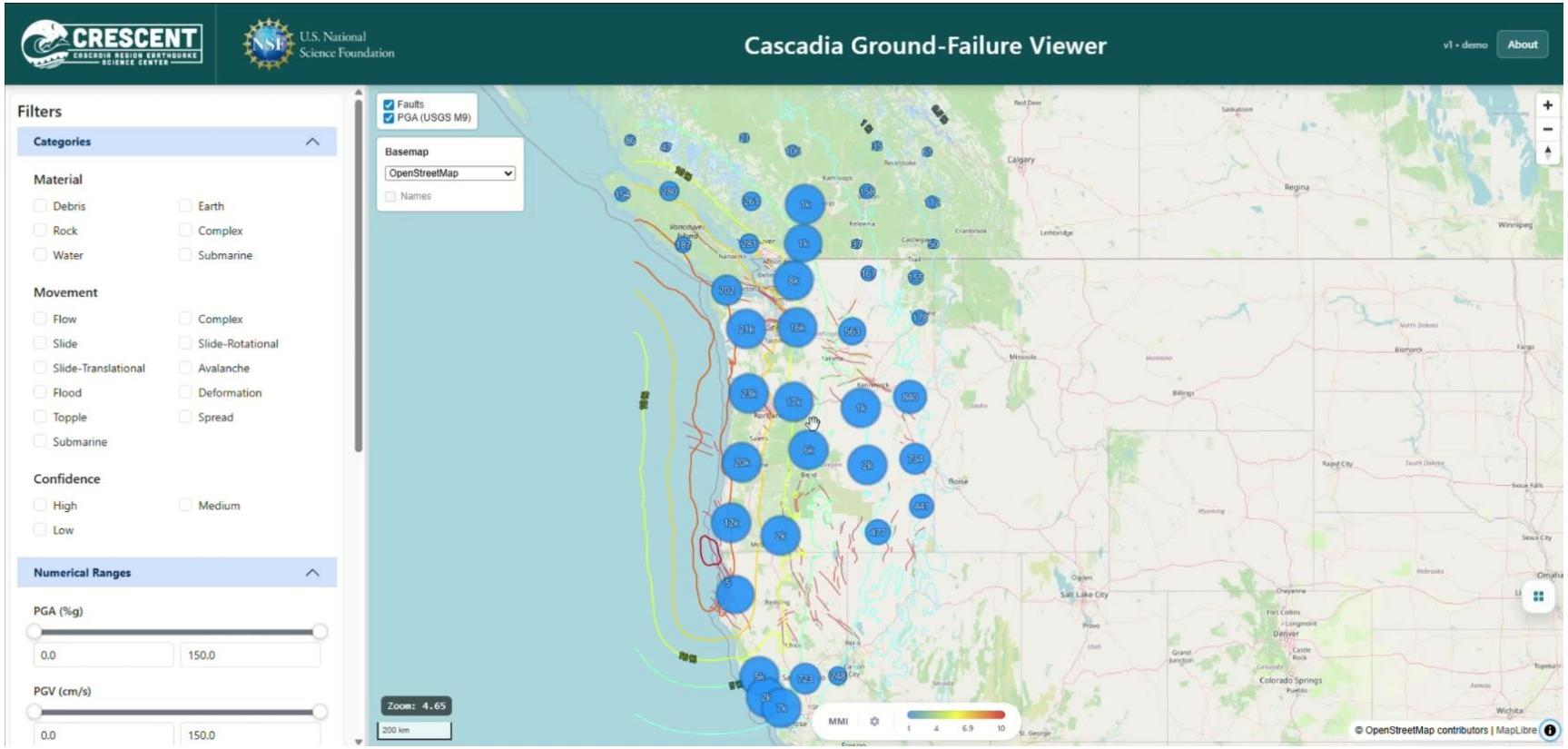
- "Proto" Working Groups
  - Seeking funding
  - Defining new directions
  - Building upon CRESCENT Working Group Products
- Great opportunity for collaborations!

SIG Updates:

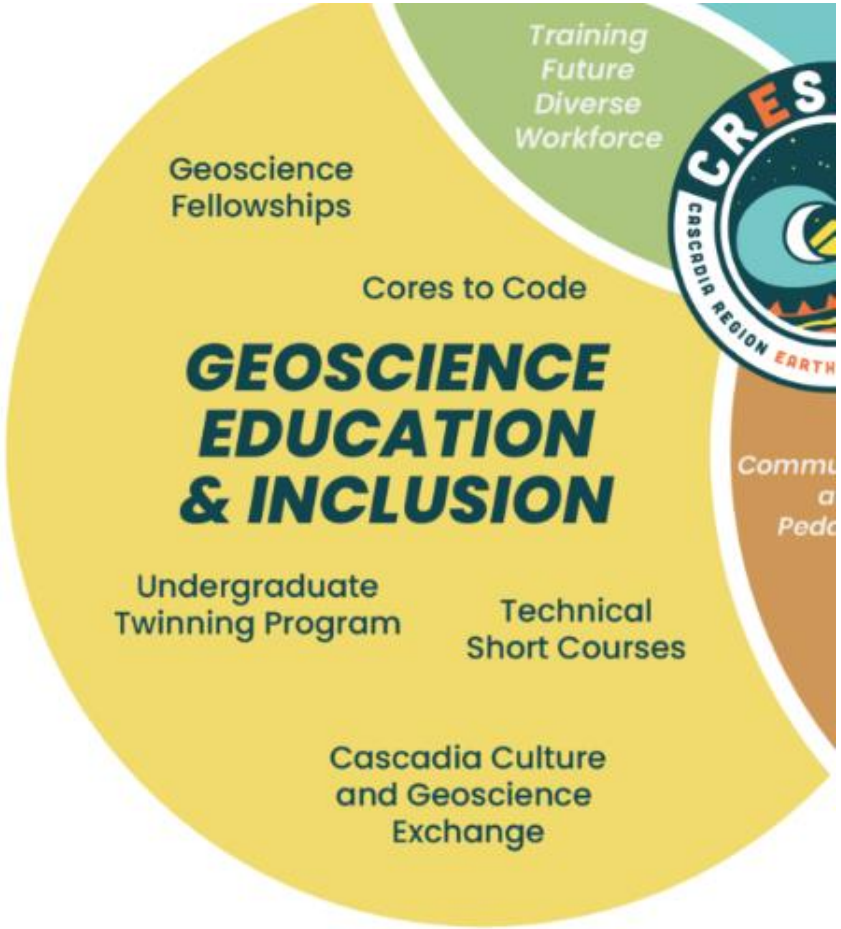
- **Ground Failure:**
  - Ground Failure Viewer
  - White paper in progress:
    - Ground Failure from Past EQs
    - Ground Failure on the Day of the EQ
    - The Legacy of EQs and Data Collection Strategies
- **Offshore Observations:**
  - Early-career led workshop on science needs for offshore observations, October 2025
  - Planning toward future-looking white paper laying out infrastructure & research priorities
- **Ground Motion:**
  - New postdoc (USGS-funded)
    - Framework for physics-based simulations in hazard (uncertainties in velocity model)
  - Workshop series and white paper on decadal strategy for ground-motion studies in Cascadia
- **Tsunami Sources for Hazard Assessment (new!):**
  - Focus on utilizing existing tsunami sources (DET, Powell Center, CoPes Team) for PTHA in Cascadia
  - Strong partnership component with federal and state agencies

Ground Failure Viewer

- A regional platform that integrates, curates, and distributes peer-reviewed ground-failure data across Cascadia.
- Pre-populated with datasets from Northern California, Oregon, Washington, and British Columbia.
- Enables exploration, filtering and data export.
- Provides submission pathway for researchers and agencies to contribute peer-reviewed ground-failure datasets for integration.
- Designed to expand beyond landslides to include liquefaction and other ground-failure data products.



GEI - Programs



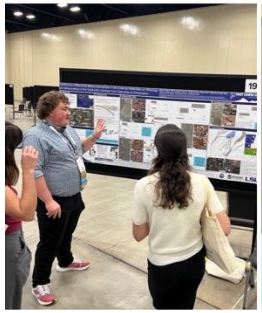
- **CCASE -** Exchange culture and geoscience with high schoolers from Pacific NW indigenous communities **(2 schools)**
- **Undergraduate Twinning Program -** Year-long research opportunity for undergraduates with mentors at 2 institutions **(11/54 applications)**
- **Cores to Codes -** 3-week summer undergraduate program with field, lab, and computational components focusing on past Cascadia earthquakes and tsunamis **(10/171 applicants)**
- **Geoscience Fellowships -** Professional development support for geoscience graduate students and postdocs **(19/74 applicants) → Applications reviewed Jan. & June 15**
- **Technical Short Courses -** Hands-on course employing modern pedagogy and focusing on widely employed research techniques in subduction zone geoscience **(24/61 applicants)**

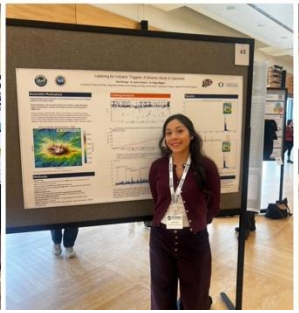
Questions?

GEI Program Manager Shannon Fasola
sfasola@uoregon.edu

GEI: Undergraduate Twinning Program

- Academic year pay, summer stipend, travel stipend for student
- Fall start, Summer visit to mentor institution
- Professional development activities
- Final report and symposium





- Project Director & 'Twin' Mentor collaborate on project design
- From any area within subduction zone /hazards research broadly defined:
  - Science, Engineering, Policy, Social Science
- Mentors from 2YC and non-academic institutions welcomed!

Interested in Mentoring?

Application opens in Fall 2026

Learn More

Twinning Program – Example Project

Influence of megathrust geometry on Cascadia earthquake ruptures

Project Overview:
Compare physics-based dynamic rupture models with varying three-dimensional fault geometries and conduct gravimetry-based field investigations to constrain subsurface structure.

- Build and troubleshoot numerical models on high-performance computing systems, analyze outputs, learn earthquake physics and programming workflows, and process and interpret gravity data collected during summer fieldwork.

Skills Gained
Computational geophysics • Earthquake physics • Field gravimetry • Programming • Hazard assessment

Mentors

SJSU SAN JOSÉ STATE UNIVERSITY

Elizabeth Madden

WASHINGTON STATE DEPT OF NATURAL RESOURCES
WASHINGTON GEOLOGICAL SURVEY

Megan Anderson
Ashley Streig

GEI: Technical Short Courses

What gaps are there in the workforce?

What skills are applicants lacking?

- **May 2025 - Machine Learning: Building Earthquake Catalogs; Seattle, WA**
  - Course Jupyter Notebooks & PPTs online

May 2025 Technical Short Course

Upcoming

- **Strain Accumulation and Release from GNSS (C3S)**
  - June 15-17, 2026; virtual
  - >150 applications received!
- **Paleoearthquake Perspective on Fault Behavior (CPAL/CFM)**
  - August 30 – September 5, 2026; Coos Bay, Oregon
  - Applications open NOW

TSC Website

Additional Activities with Our Partners

Explore Your Future: Geoscience Career Panel

Hosted By: EarthScope Consortium, CRESCENT Cascadia Region Earthquake Science Center

A panel discussion with geoscientists sharing real-world experiences and career insights

Rachel Akie
Cloud Software Engineer III
EarthScope Consortium

Wendy Bohon
Physical Scientist
California Geological Survey

Teresa Butler
Geoscientist
ExxonMobil

Alex Olsen-Mikitowicz
Colliers Engineering & Design - Remote Sensing Manager
AeroTerra Sensing, LLC

Liam Toney
Research Geologist
U.S. Geological Survey

Emily Zawacki
Moderator
Science Communication Associate
EarthScope Consortium

April 29, 2026 @ 11:00 AM–12:30 PM MT | Virtual

Next Virtual Panel:
April 29 @ 10-11:30 AM PT

Register Now

Virtual 2026 Research Mentor Training

April 23–24, 2026
9–11am PDT

Workshop Facilitators:
Gabriela Noriega (SCEC)
Shannon Fasola (CRESCENT)

Advancing Research Excellence for Through Intentional Mentorship for a Stronger Geoscience Workforce!

- Built on evidence-based, interactive mentor training grounded in CIMER's Entering Mentoring curricula
- Designed to strengthen key mentoring skills by focusing on aligning expectations, fostering independence, effective communication, assessing understanding, and promoting professional development.

SCEC, CRESCENT

Register by March 16

Upcoming Training

Mentor: April 23-24, 2026

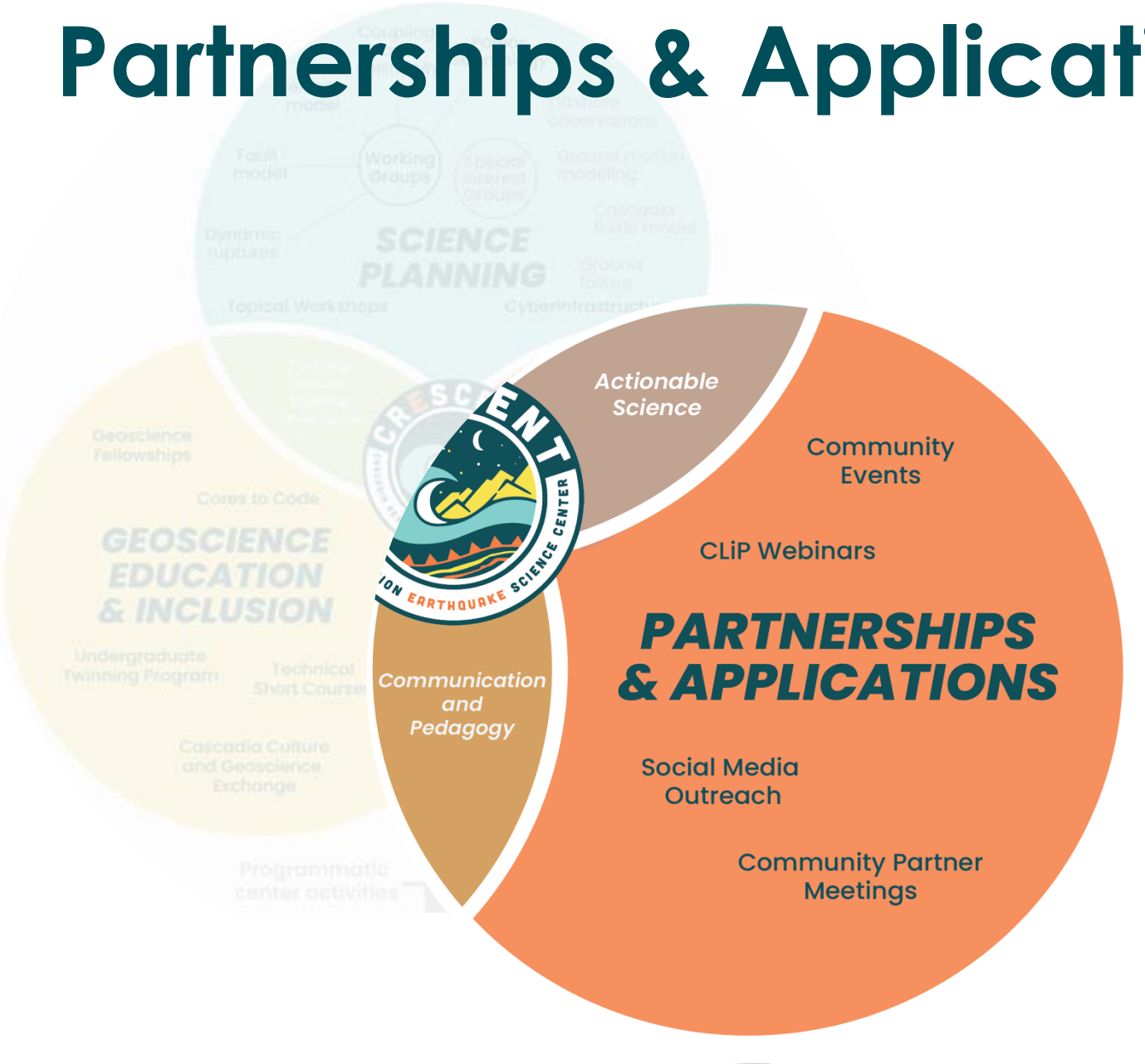
Past Trainings

Mentee (grad students):
April 10-11, 2025
Nov. 20-21, 2025

Mentor:
May 22-23, 2025

Apply Now

Partnerships & Applications



3 objectives or "pillars"

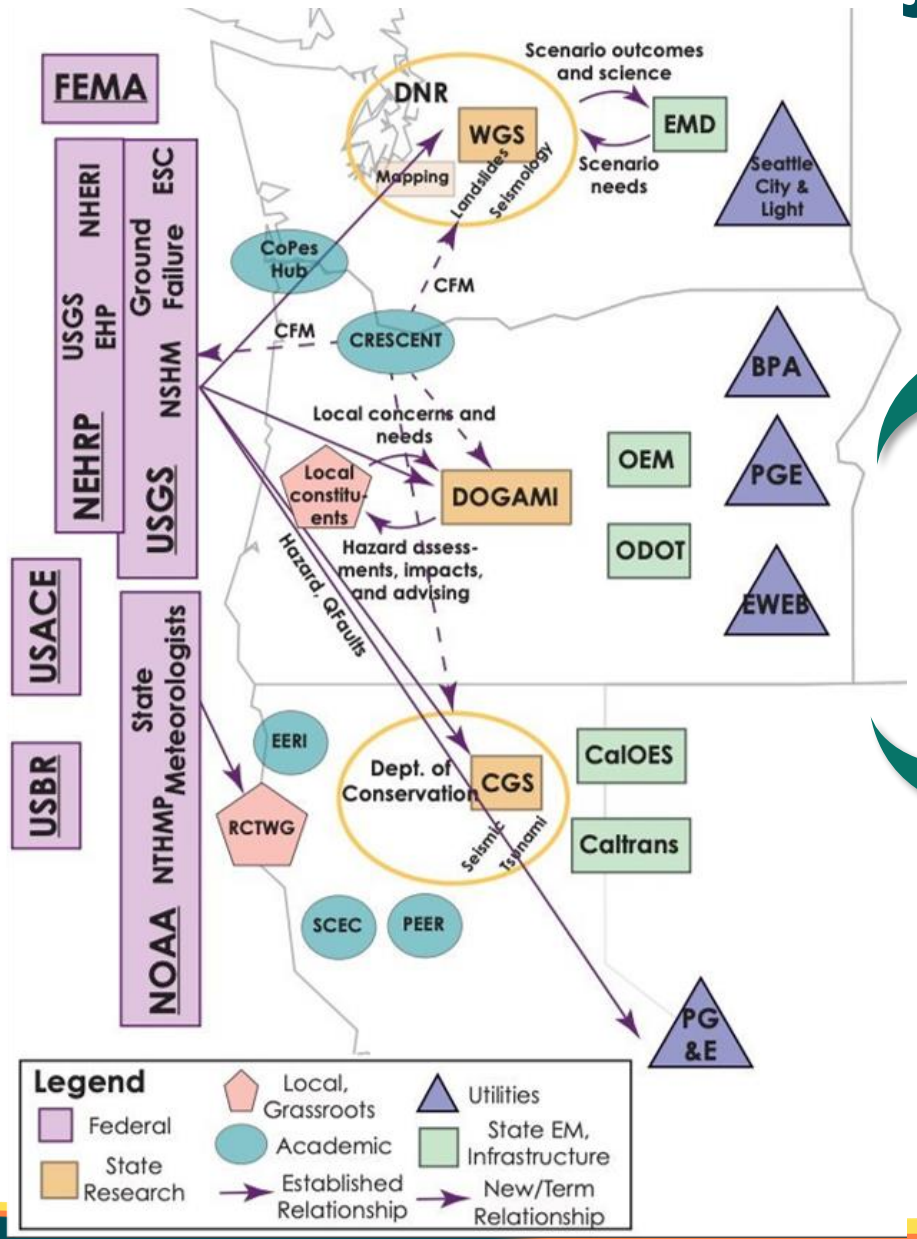
- The science behind earthquakes and their hazards
- Expanding access to careers through geoscience education and inclusion
- Connecting the science to societally relevant outcomes through partnerships and development of applications = **CRESCENT as a hub**

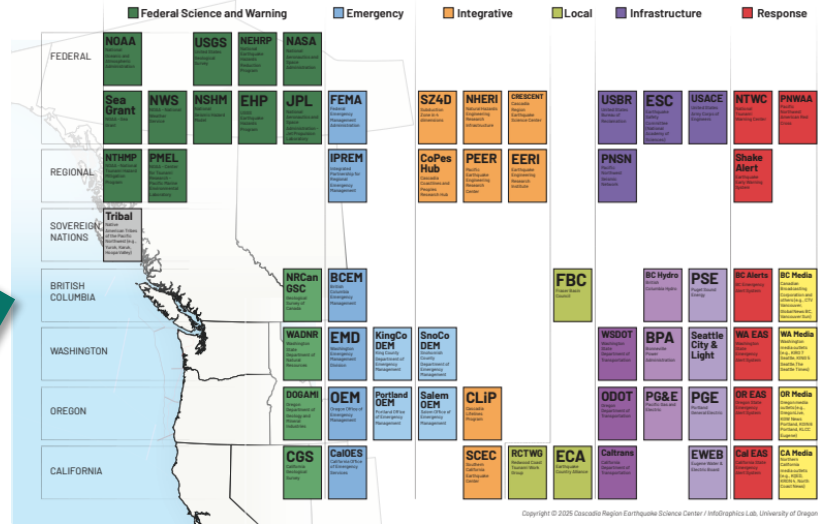
Cascadia Connections Project

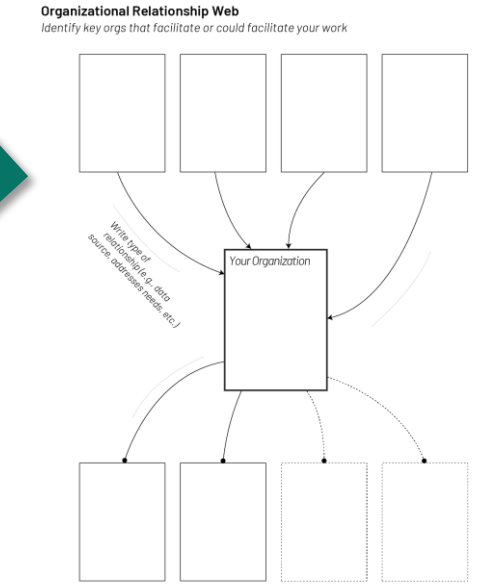
Motivation

The "science to resilience" space in the PNW is complex and diverse.

- Who is doing what and how do they engage?
- What are the opportunities to collaborate?

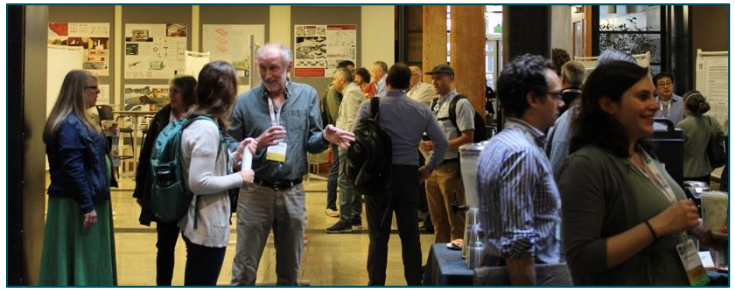


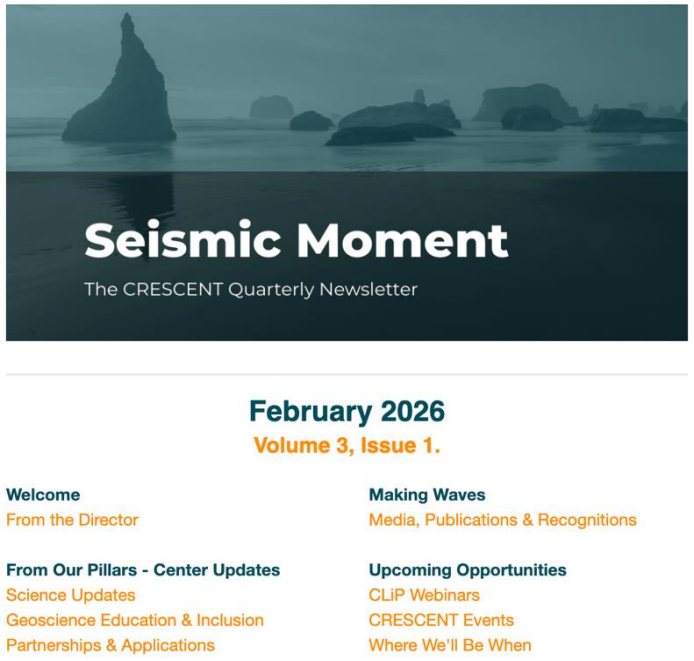




P&A Activities:

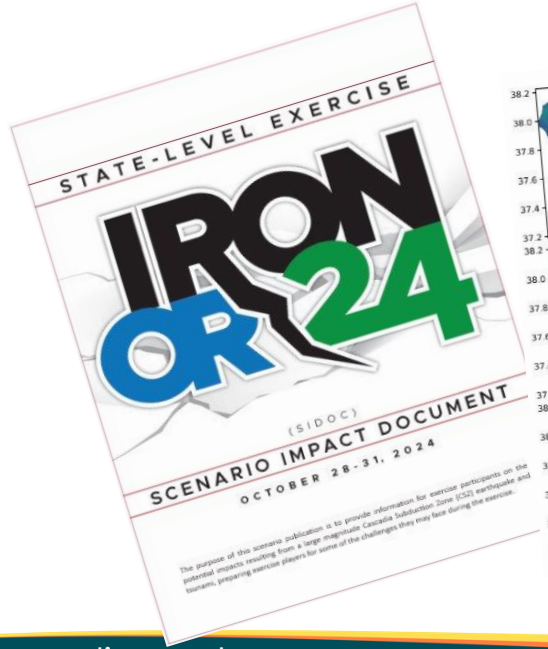
- Annual workshop: ~150 people, multi-disciplinary
- Outreach: *Seismic Moment* Newsletter + email, social
- Cascadia Lifelines Program (CLiP) webinars
- Relationship Building:
  - Partner meetings, Working Group/SIG connections
  - Collaboration on local resilience events
  - Attending and presenting at multihazard forums

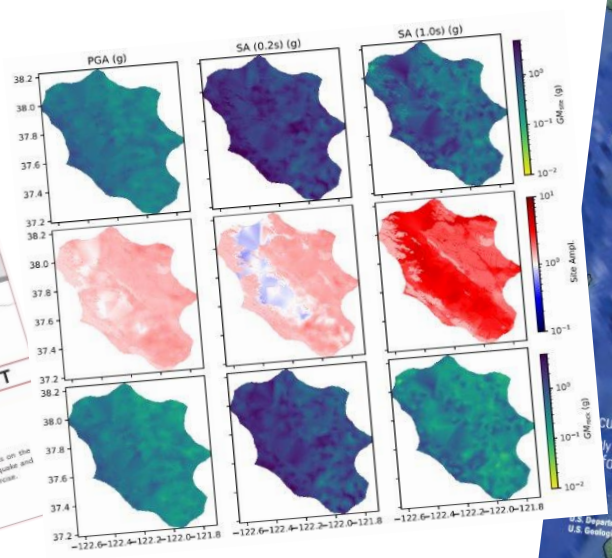


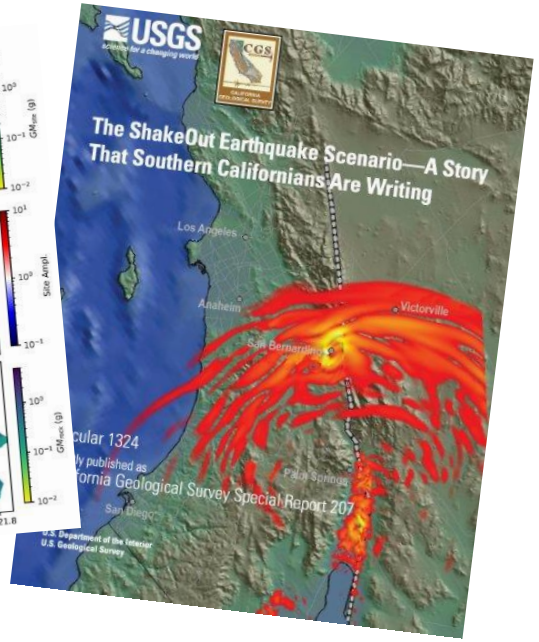


Upcoming Scenarios Workshop

- Broad interest in developing/ curating cross-border scenarios for:
  - Risk assessment
  - Emergency response planning
  - Exercises and training
  - Policy, education, and outreach







Upcoming opportunities

- **CRESCENT SEED GRANT PROGRAM RFP is out now**
  - ***Proposal deadline is May 15, 2026***

- **Paleoearthquake Perspective on Fault Behavior (CPAL/CFM)**
  - August 30 – September 5, 2026; Coos Bay, Oregon
  - Applications open NOW
- **2026 P&A WORKSHOP** - applications open!
  - **June 26-27**, Portland OR

Seed Grant Program

- 25 grants funded to date
- Proposals for the next round accepted until May 15
- See website for the announcement and read the priorities carefully

Spring Virtual Session Updates on 2024-25 Seed Awards

April 21, 2026 | 12:00 - 1:00 PM PDT | ZOOM

Patrick Bassal (The Ohio State U.) and **Chukwuebuka Nweke** (U. Southern California) "Nonlinear Dynamic Analyses of 2001 Nisqually Ground Failures to Validate Ground Motion Simulations"

Obinna Ozioko (Portland State U.) "Constraining paleoearthquake characteristics from landslide geomorphology for the crustal Gales Creek Fault, Oregon"

Elizabeth Sherrill (Indiana U.) "Towards Linking Coseismic Slip to Interseismic Coupling at Cascadia"

Lee Liberty (Boise State U.) "Seismic imaging of the Portland Hills fault through downtown Portland"

Elizabeth Madden (San Jose State U.) "Energy budget analyses of scenario earthquake ruptures at Cascadia"

Erick Velasco Reyes (Oregon State U.) "Tsunami Morphodynamics and Their Role in Hazard, Risk and Resilience Modulation and Environmental Impact in Newport"

Yujie Zheng (U. Texas-Dallas) "Precise Localization and Measurement of Slow Slip Events in Central Cascadia with InSAR"

Contact Us:

cascadiaquakes@uoregon.edu

Feb '26 edition out now!

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