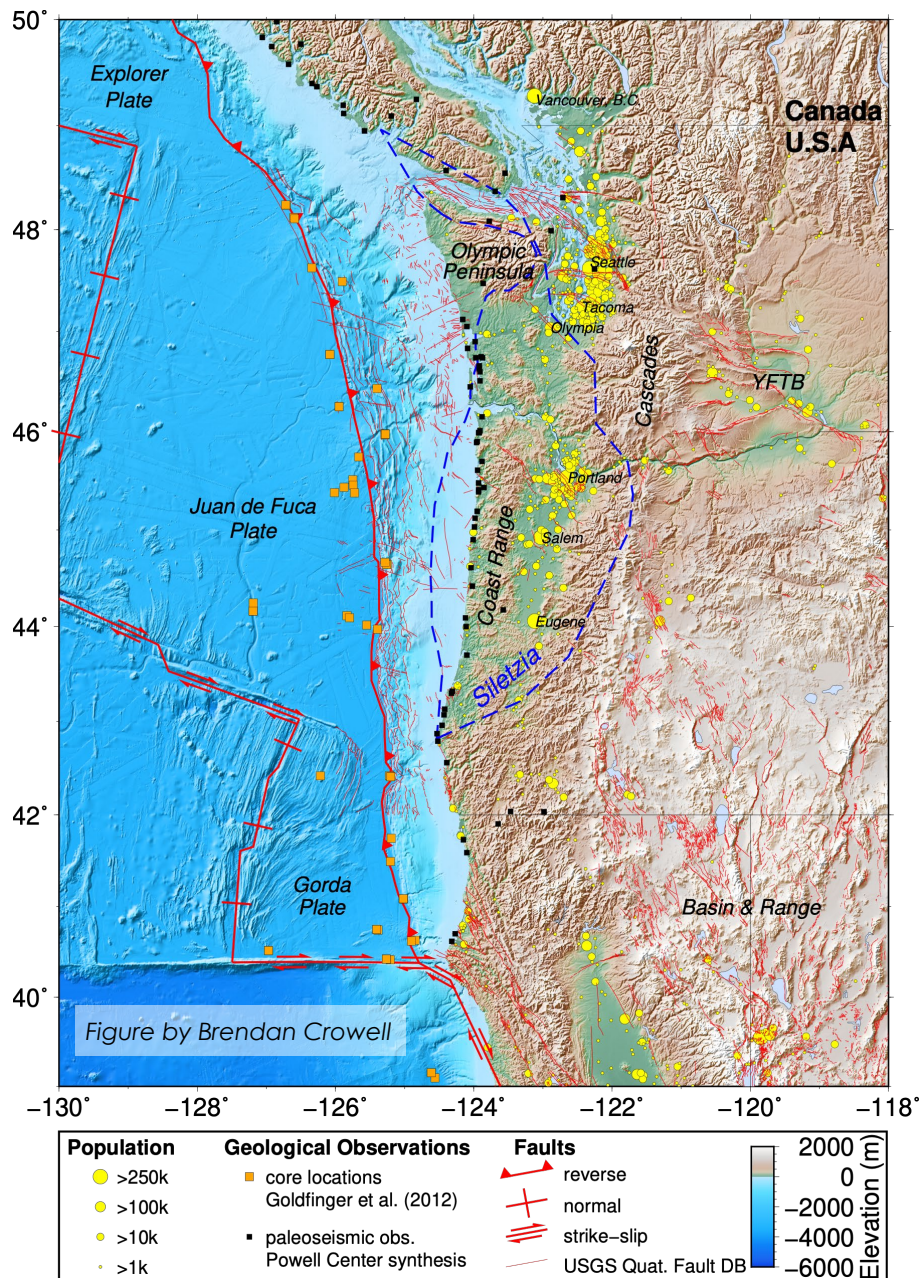
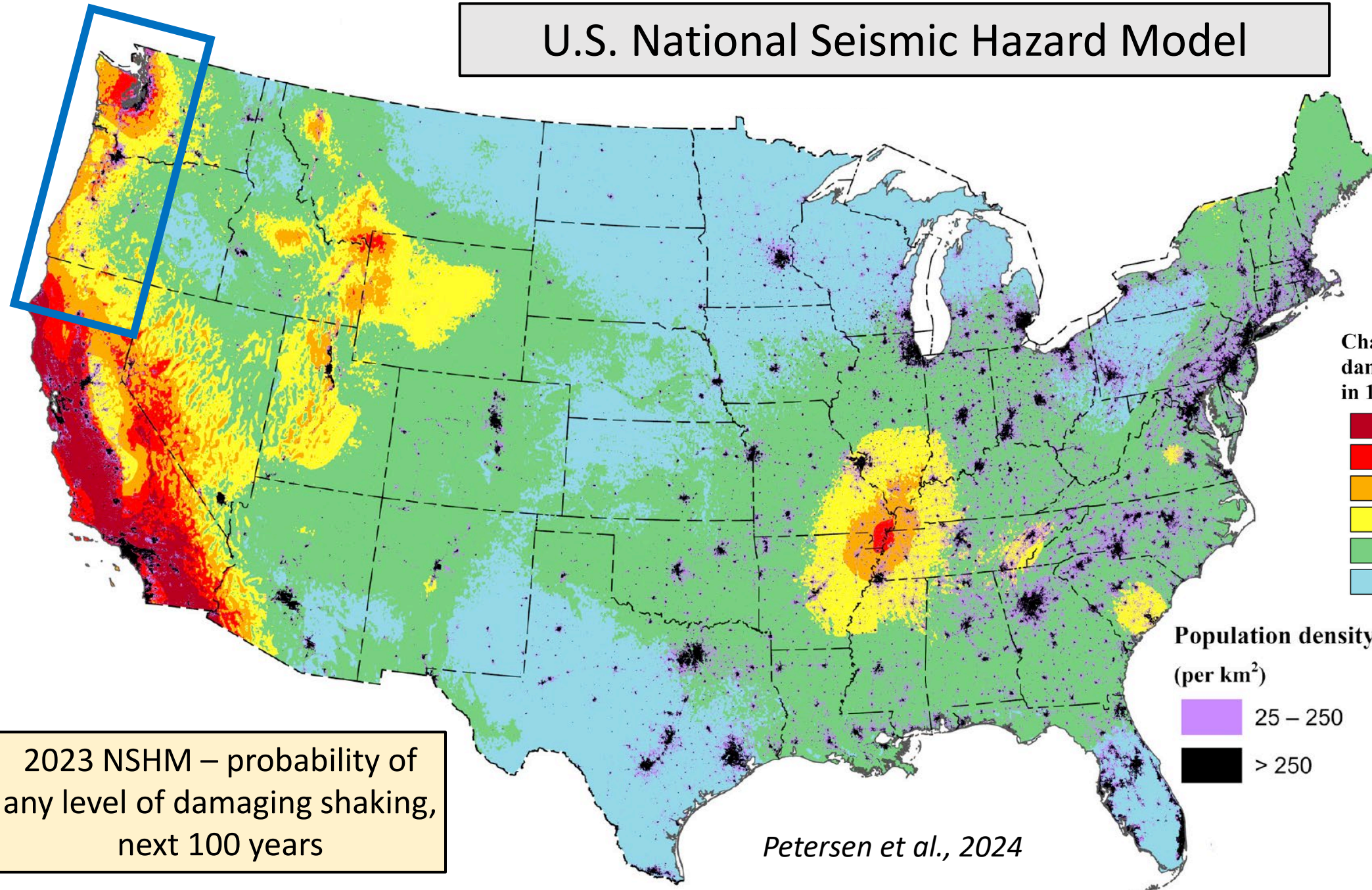


The Science of CRESCENT:

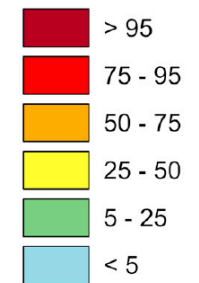
Building a community of researchers advancing our understanding of Cascadia's earthquake system



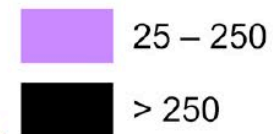
U.S. National Seismic Hazard Model



Chance of slight (or greater)
damaging earthquake shaking*
in 100 years



Population density
(per km²)



2023 NSHM – probability of
any level of damaging shaking,
next 100 years

Petersen et al., 2024

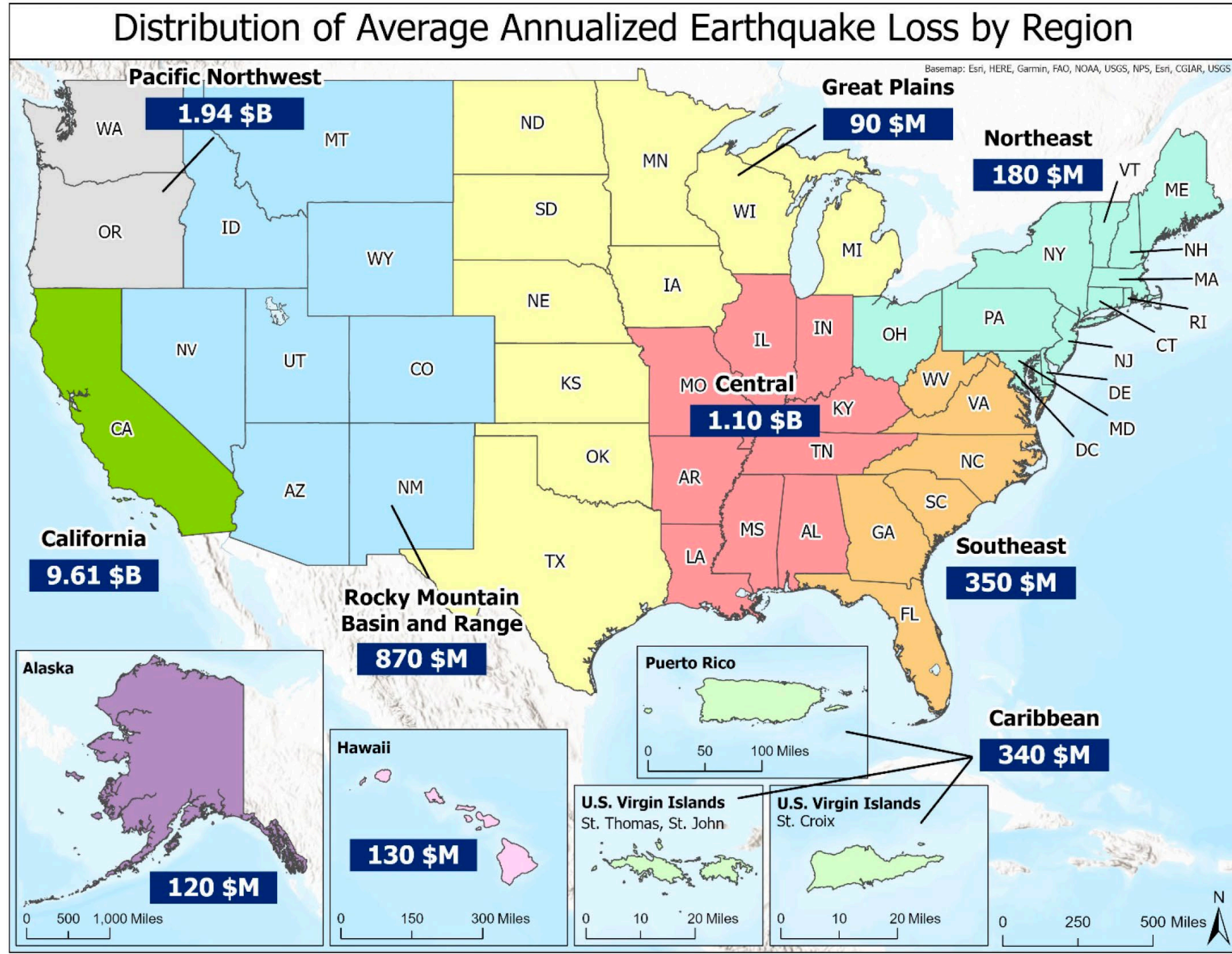
FEMA map of Annualized Earthquake Losses

(expected cost per year
of earthquake damage)

PNW *\$1.94 billion*

Washington:
\$1.4 billion

Oregon:
\$0.7 billion



Cascadia earthquake sources

Deep Slab Earthquakes

Magnitude 6.5 - 7-ish

e.g., Nisqually 2001

Few to no aftershocks

~85% chance in 50 yr.

Cascadia Subduction Fault

Giant earthquake every:

300-800 years in north

~260 years in south

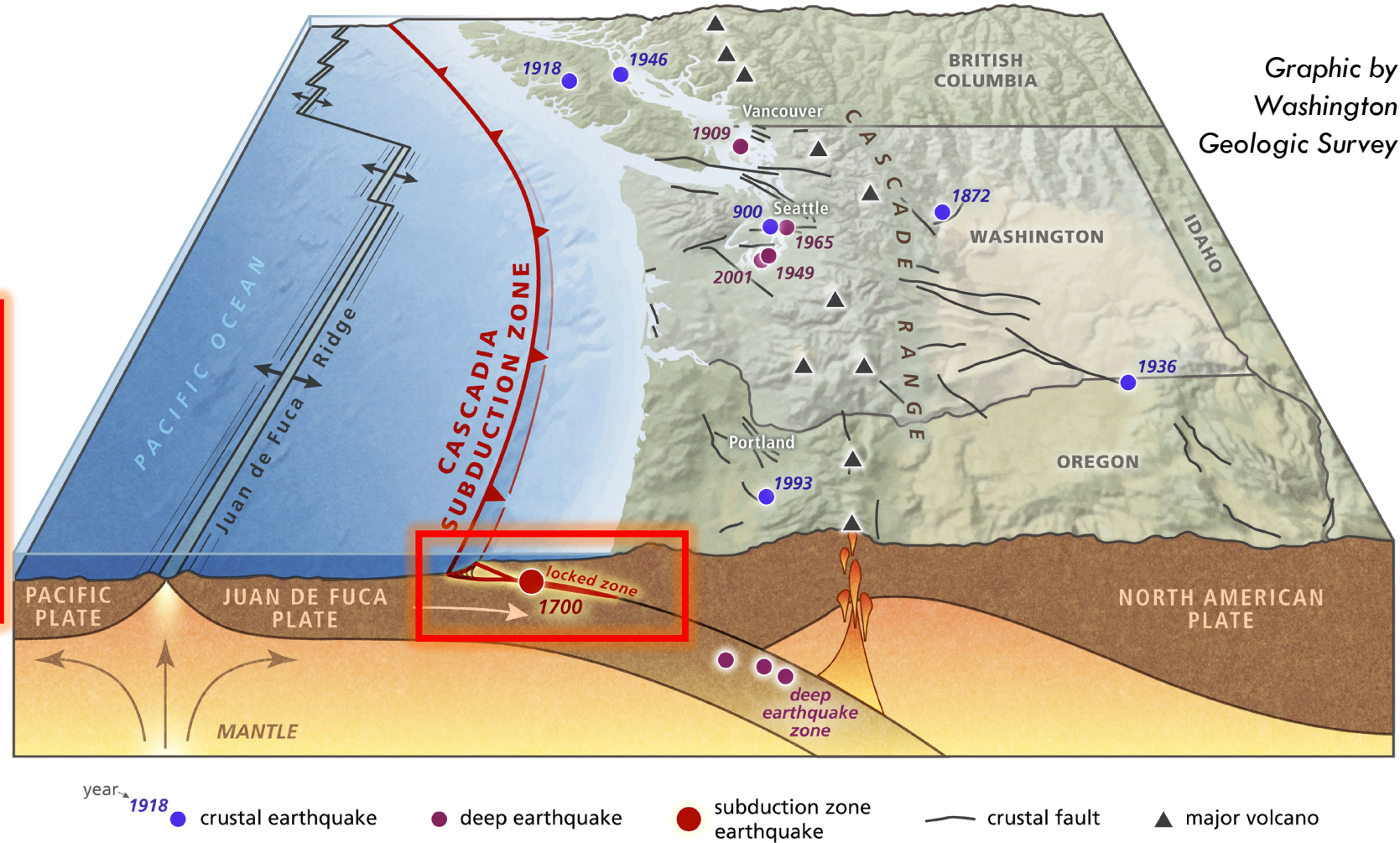
~12-25% probability in 50 years

“Shallow” Crustal Faults

Magnitude 7-ish

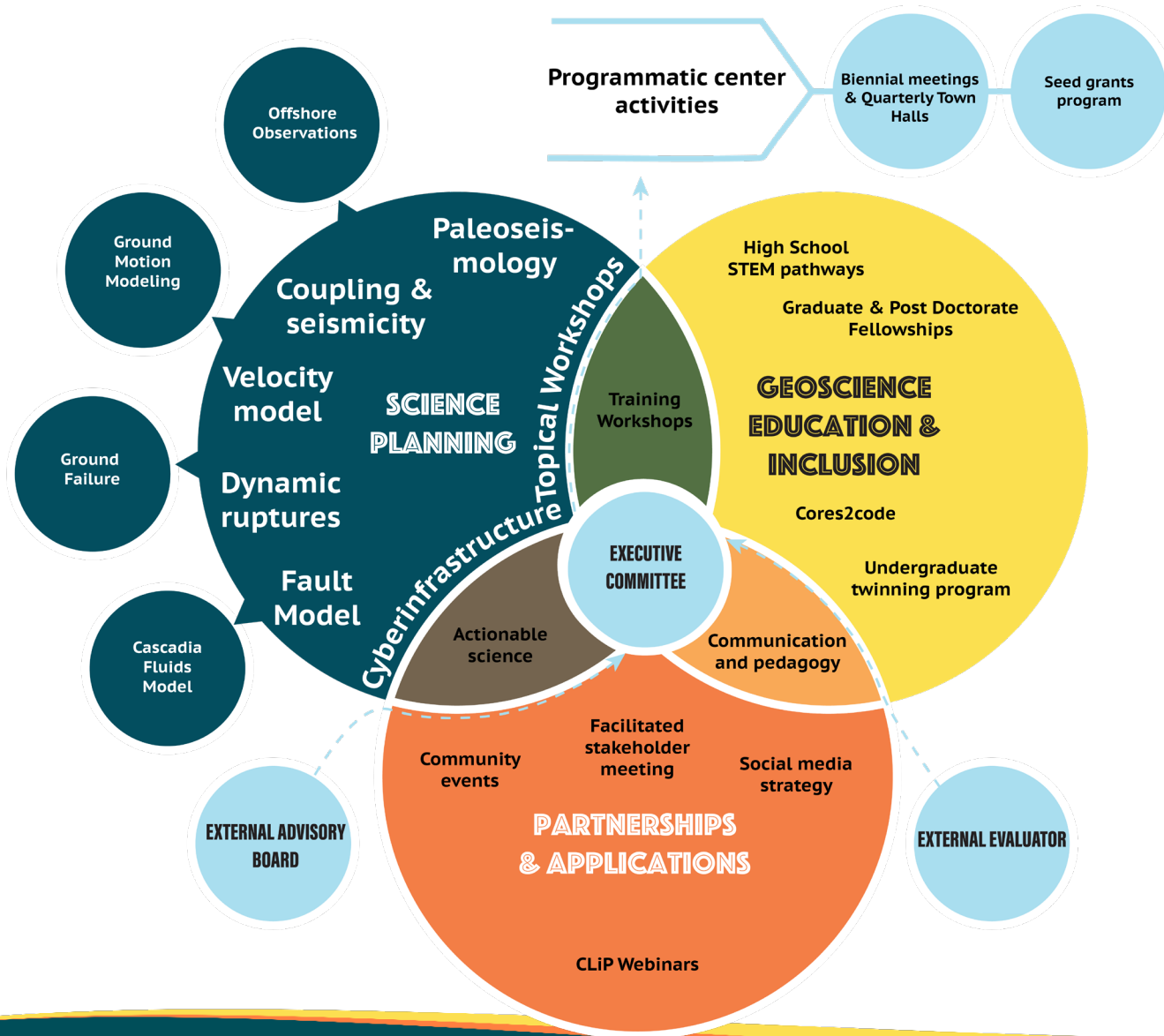
1872 (largest historic)

~15% probability in 50 yr.



Expressed values are synthesized from the USGS NSHMP calculations of Petersen et al. 2018 & 2024

About CRESCENT



- The **science** behind our region's earthquakes and their attendant cascading hazards
- Connecting the science to meaningful societally relevant outcomes through **partnerships** and development of **applications**
- Expanding access to careers through **geoscience education and inclusion**

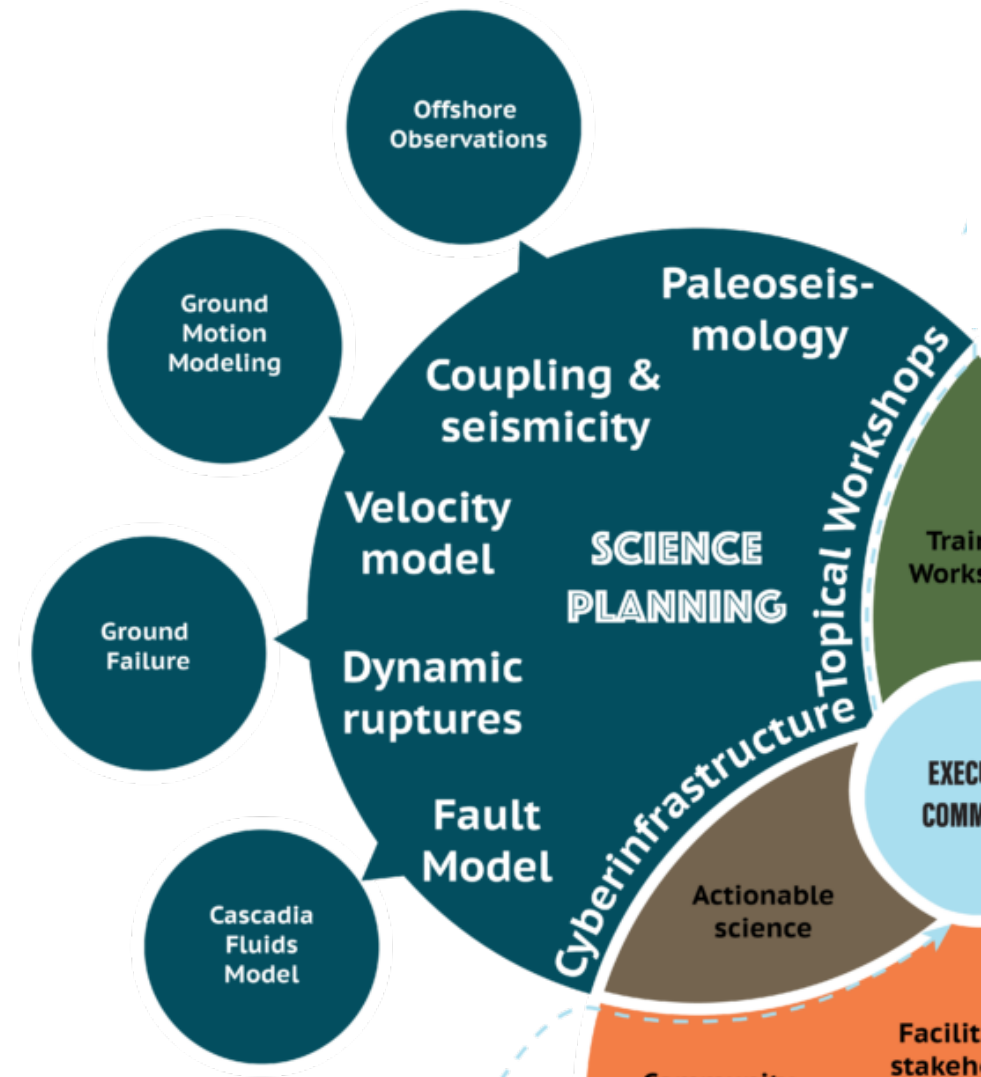
The Science Pillar

- **Five Working Groups (WGs)**

- **Synthesize and assess the state of knowledge** on key elements of the earthquake system
- **Build science products** that can be leveraged by the community
- Have **dedicated cyberinfrastructure** to develop key tools and products
- Respond to **community feedback** (you!)

- **Four Special Interest Groups (SIGs)**

- Teams charged with **building community for and advancing science** on specific topics



Science Overview



- **Overarching question: What are the plausible and most likely scenarios for future damaging earthquakes and their cascading effects?**
 - **The Big Ones:** megathrust structure, locking, segmentation, the nature of rupture & recurrence patterns
 - **The Other Ones:** Crustal faults, slab events, adjacent impacts (Mendocino, Nootka)
 - **The Cascading Hazards:** shaking, tsunami generation, landslides, liquefaction, and more
- **The core mission for CRESCENT science is creating focused collaborations creating new *knowledge* that can translate to *action***
 - Developing the frameworks and tools for coordinated, multi-disciplinary research
- **Today: accomplishments and where we are headed**
 - How are the activities of our Working Groups and SIGs addressing these questions?
 - A sampling of major activities so far and what's on the horizon

Frameworks: the Community Models



- **Addressing these key scientific goals requires a common framework for understanding the structure, properties, and history of the earthquake system**
 - ***Community Fault Model: What do we know about active fault systems?***
 - Where are the faults and what is their 3D geometry?
 - What do we know about their event history to make inferences about future hazard?
 - ***Community Velocity Model: Seismic wave velocities in 3D are our core measure of the properties of the crust and upper mantle***
 - Understanding and predicting ground motion in earthquakes
 - Understanding the structure, strength, and elastic properties of the region
 - Underpins simulation of movement in the crust from slow tectonics to fast earthquakes
 - ***Seismicity Catalog: Better 3D archive of all the seismic events that have been recorded***

Workshops!

Tsunami Topical Workshop

Nov 7-8, 2024

Eugene, OR



Cascading Hazards Topical Workshop

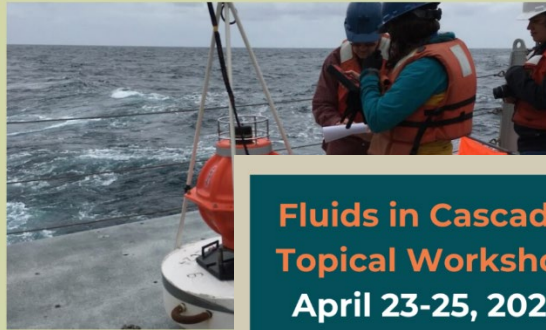
March 7, 2025

Newport, OR



Offshore Observations Topical Workshop

October 27, 2025
Seattle, WA



Fluids in Cascadia Topical Workshop

April 23-25, 2025

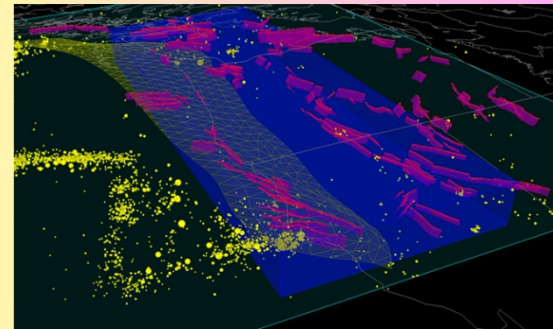
Portland, OR



Community Fault Model Topical Workshop

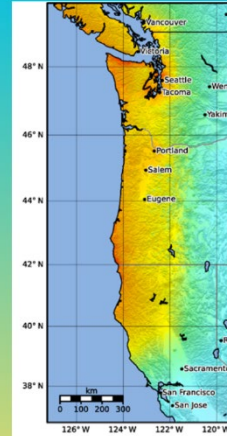
August 12-13, 2025

Portland, OR



Ground Motion Modeling Topical Workshop

~~October 30, 2025~~
Seattle, WA

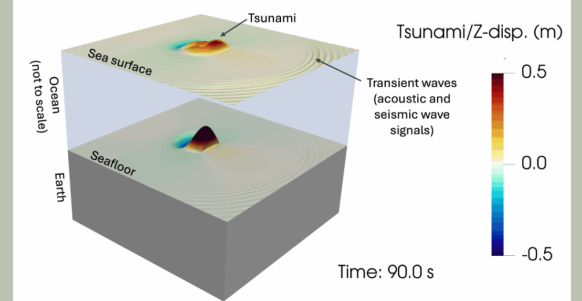


Not felt	Weak	Light	Moderate	Strong	Very strong
None	None	None	Very light	Light	Moderate
0.0464	0.297	2.76	6.2	11.5	21.5
0.0211	0.135	1.41	4.65	9.64	20
1	10	100	1000	10000	100000



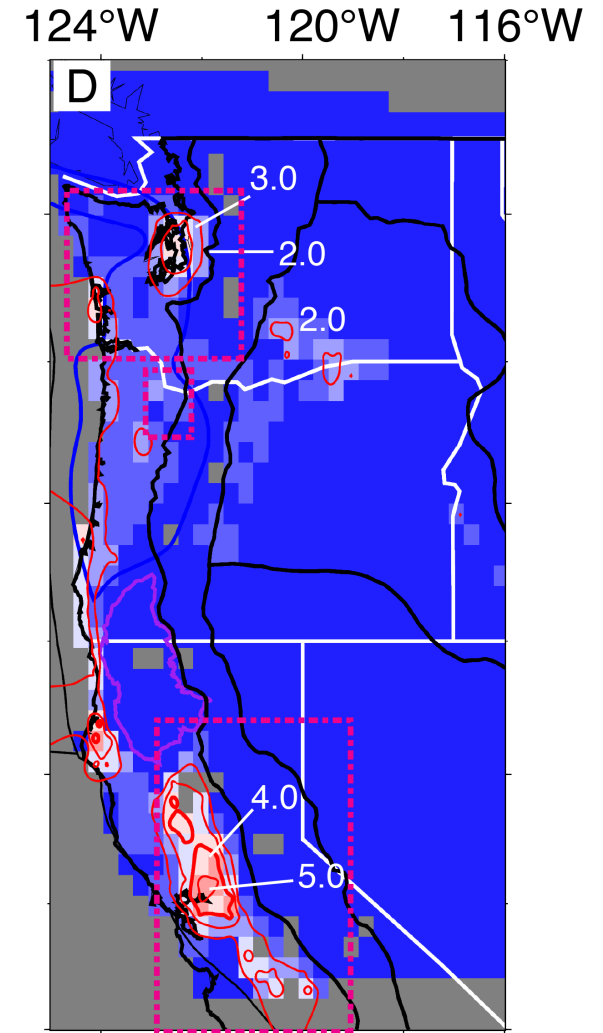
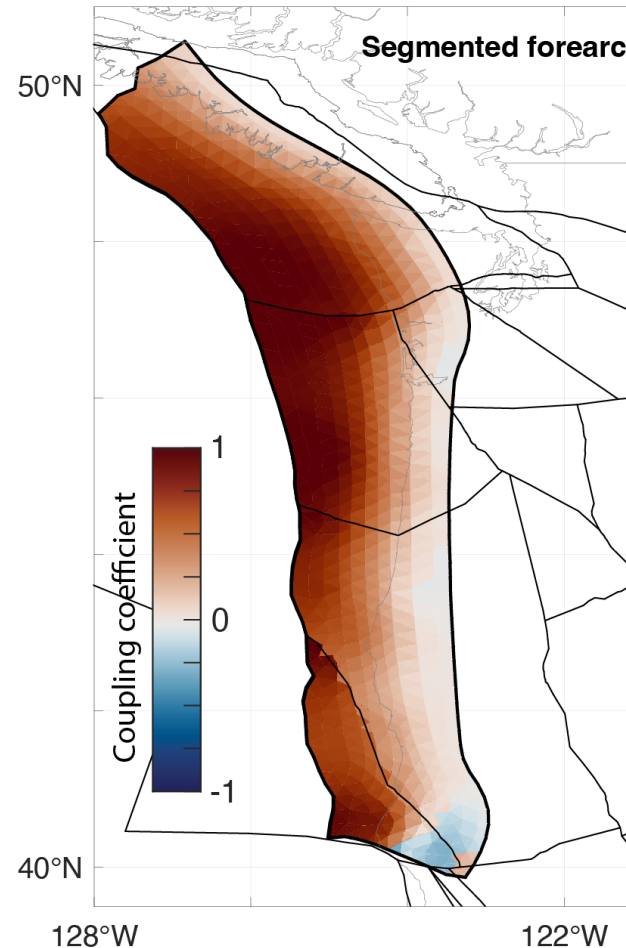
Shallow Rupture and Tsunamigenesis Topical Workshop

May 28-29, 2026
Eugene, OR



What is the Structural Framework of Cascadia?

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



Community Velocity Model (CVM)

Constraining the velocity properties of Earth's lithosphere and upper mantle in 3 *dimensions* allows us to:

- 1) Create **more accurate wave propagation simulations** and **ground motion predictions**
- 2) Define **elastic properties** for modeling
- 3) Delineate “**blind**” **geologic features** in the subsurface



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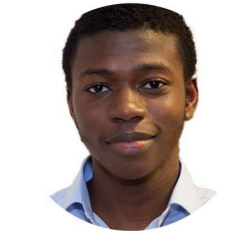
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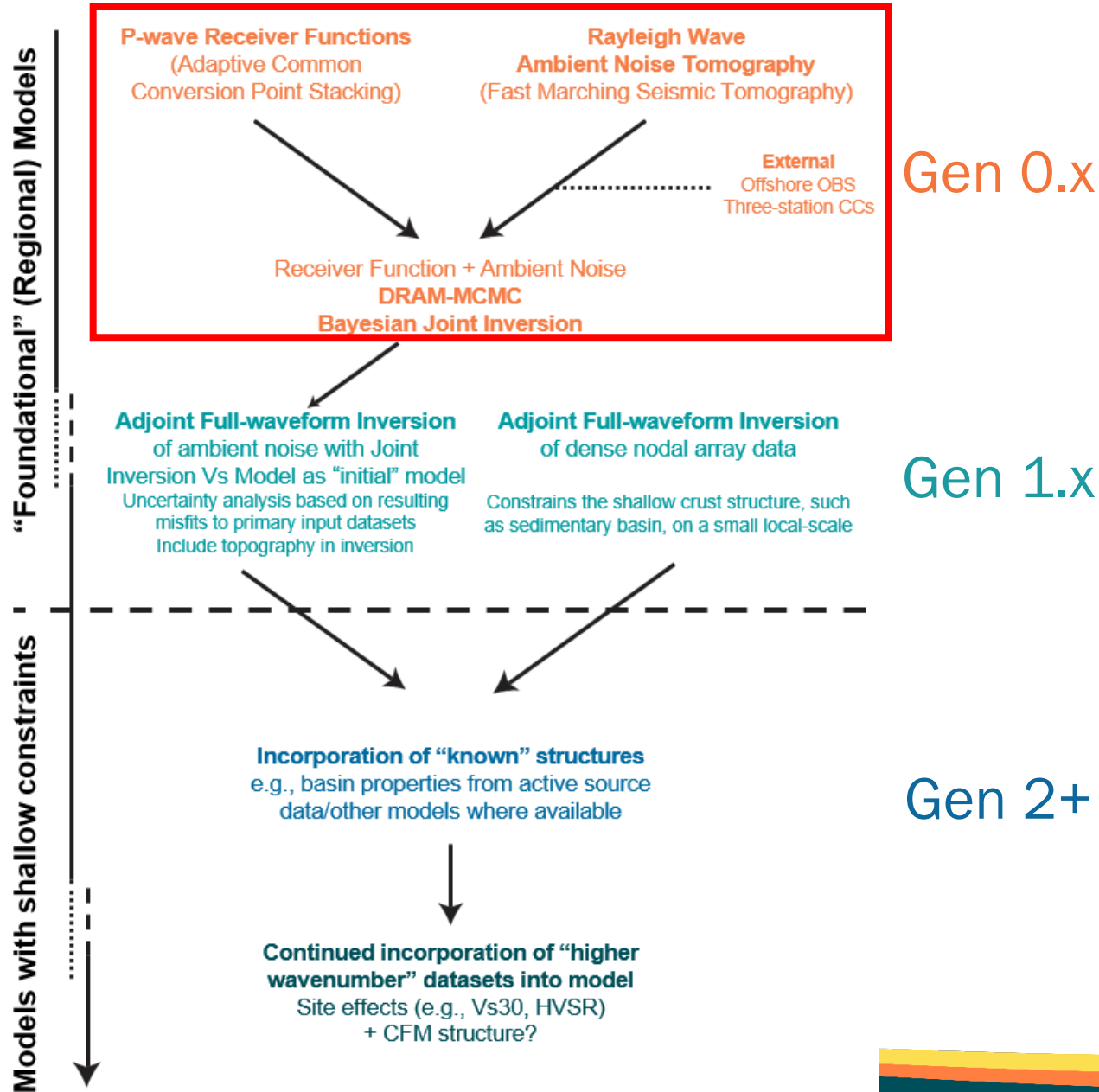
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The CRESCENT CVM Workflow

CVM Generation Development
(Time)



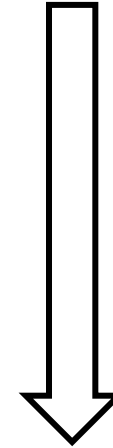
Create *families of models* with similar base methodologies that *build on each other*

“low wavenumber”

Large-scale

Regional Structure

(e.g., teleseismic body waves, surface waves)



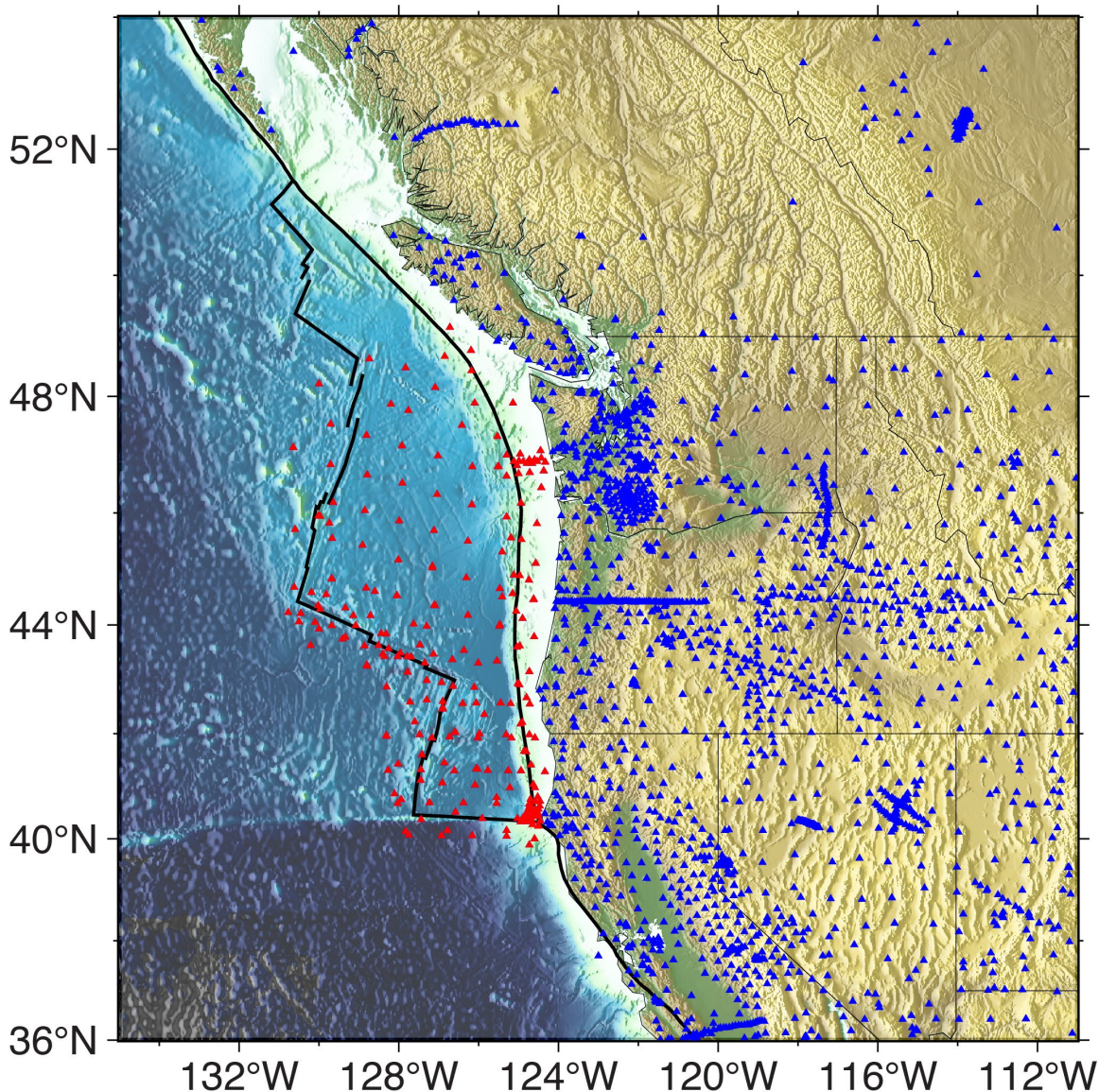
“high wavenumber”

Finer-scale

Local Structure

(e.g., basins, geotechnical layers)

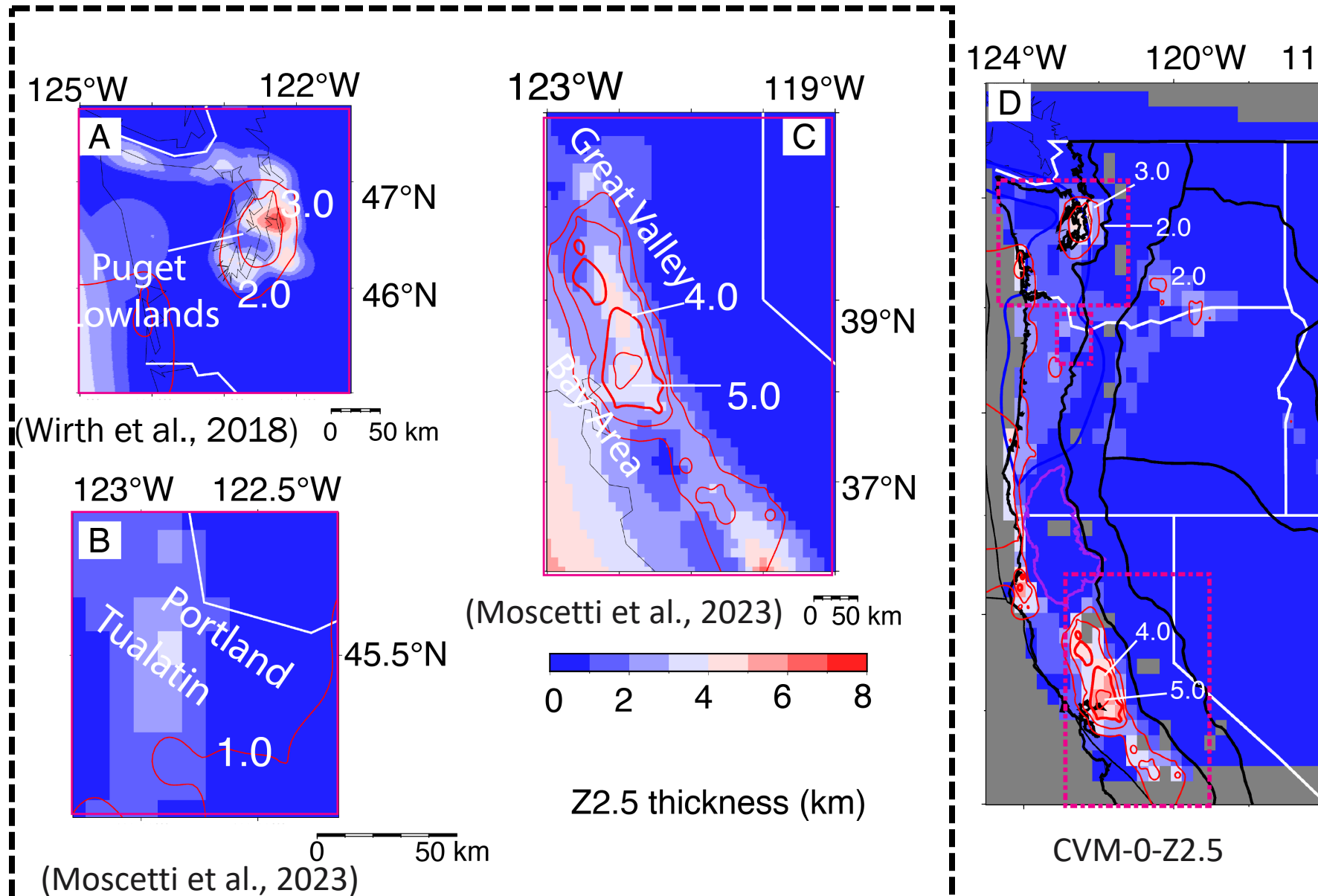
CVM-0: datasets and model settings



DATA: 20+ years Seismic Ambient Noise + Teleseismic P-wave Receiver functions
→ Bayesian Joint inversion

Model metadata:
Lat: 35N-50N
Lon: 132W-110W
Depth: topo-80km
Lateral grids: ~0.2 deg
Vertical grids: ~1.0 km

CVM-0: Implications for seismic hazard (GMM)



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

CVM-0: Implications for Dynamic Rupture

Dynamic Rupture Simulations

need 3D Earth models

to characterize geologic structure
and rock properties

The CVM can

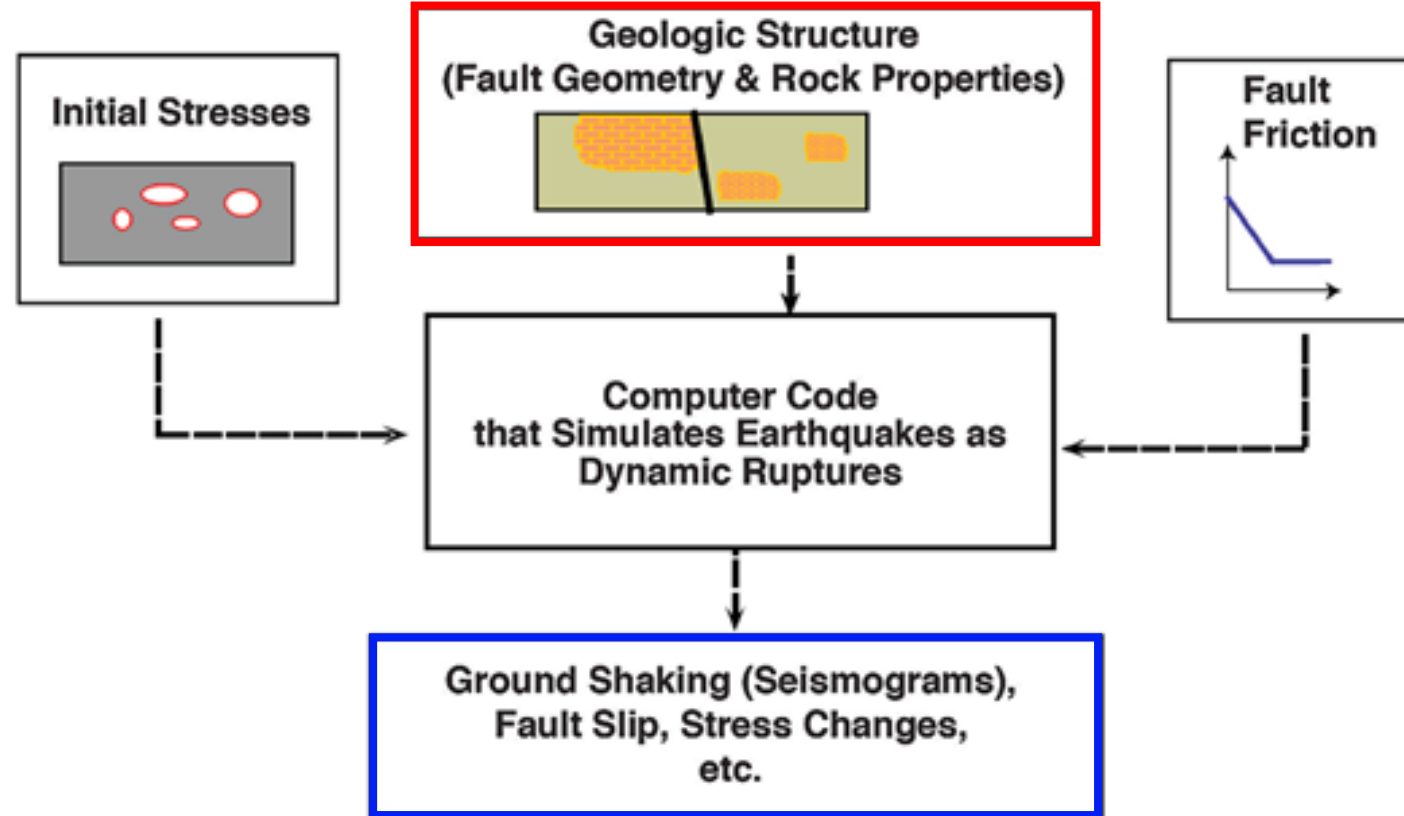
provide properties + uncertainties
to be used in simulations (w/ CFM)

The CVM can be used to

**model/validate shaking at the
local-to-regional scale**

(w/ GMM)

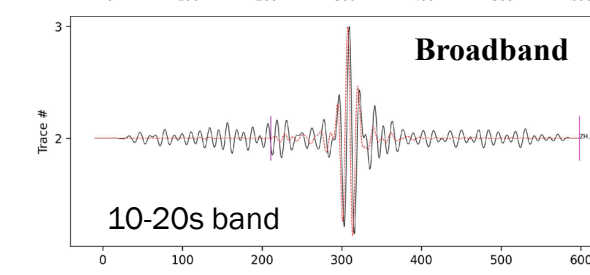
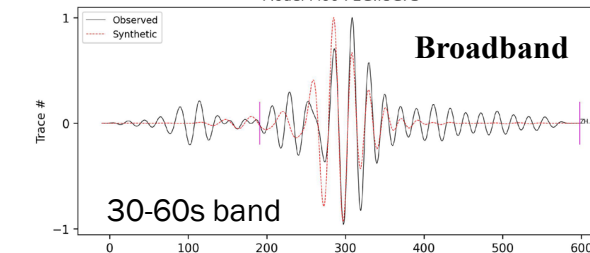
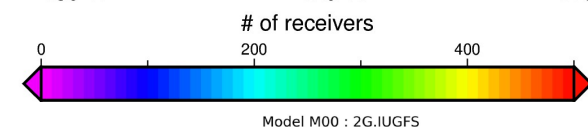
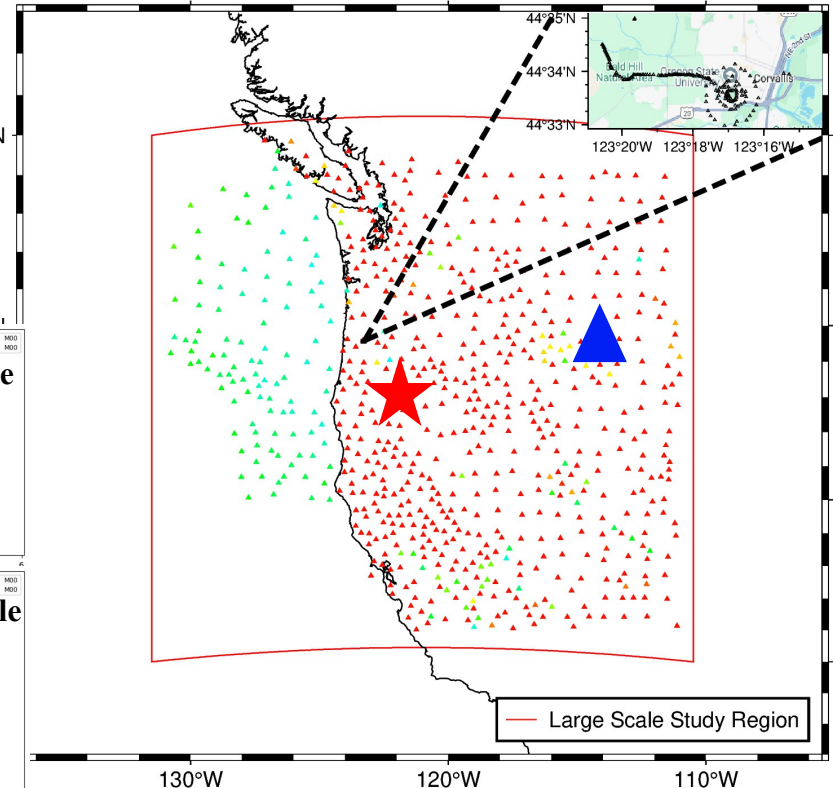
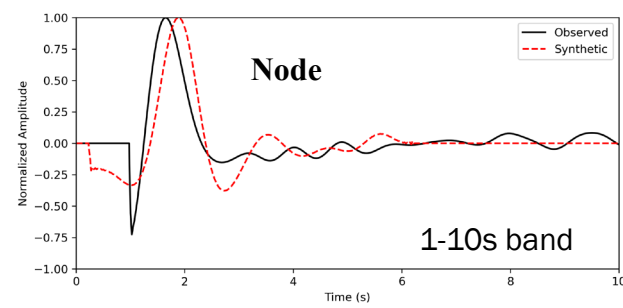
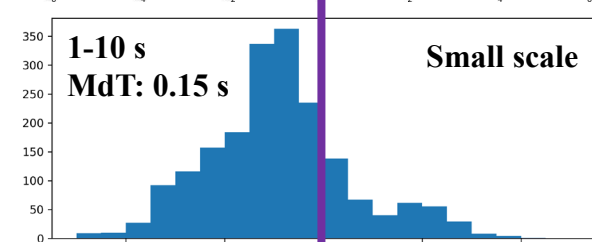
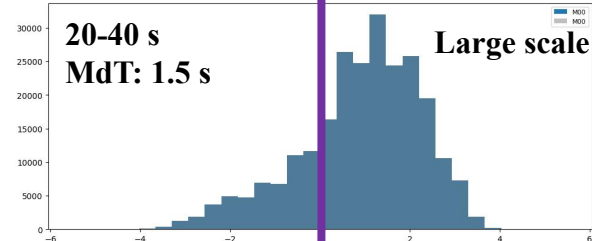
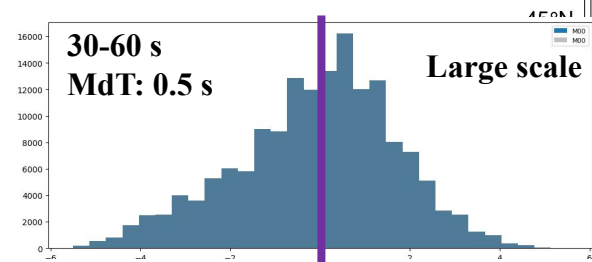
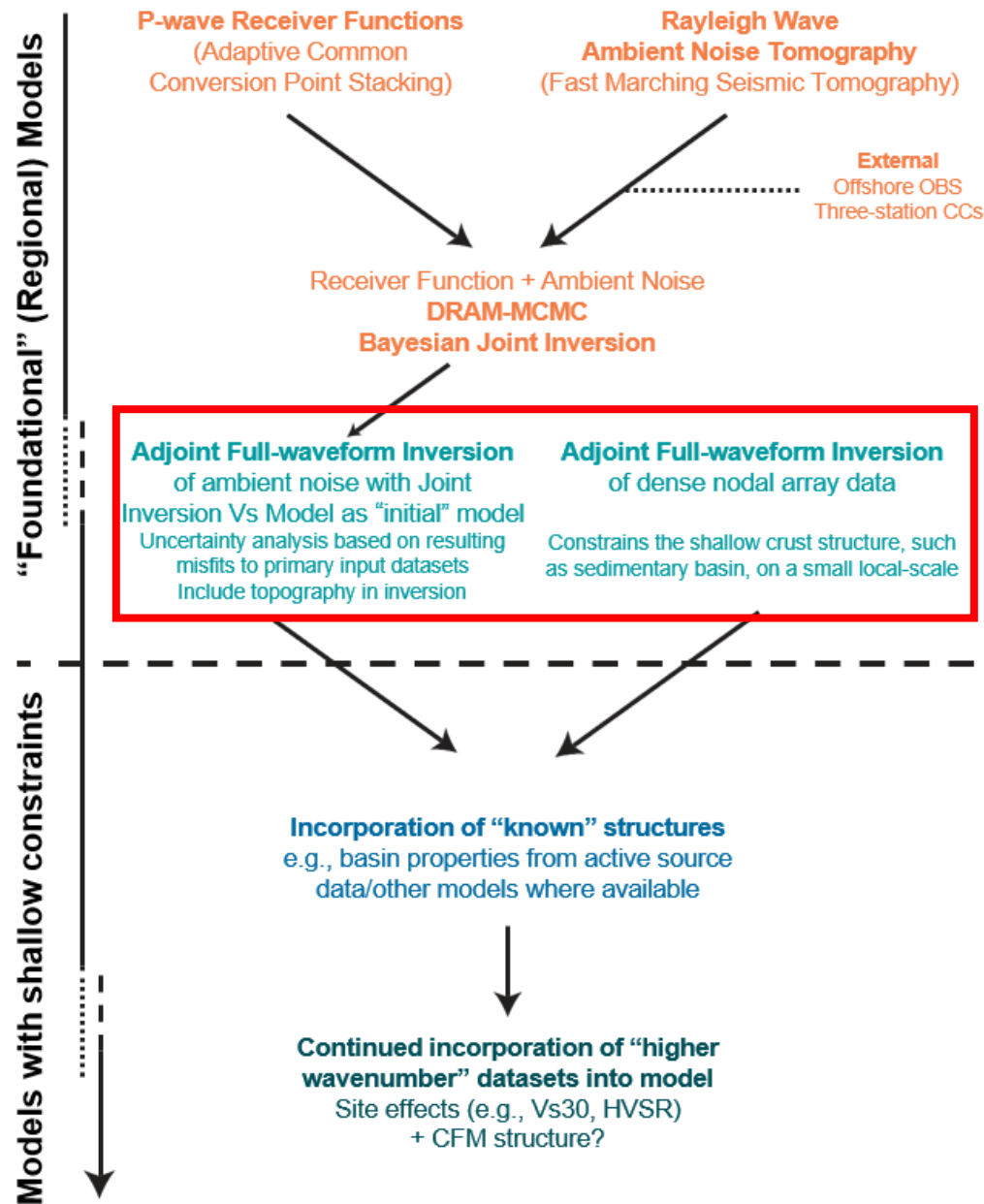
CRESCENT CVMs+CFM



CVM+GMM

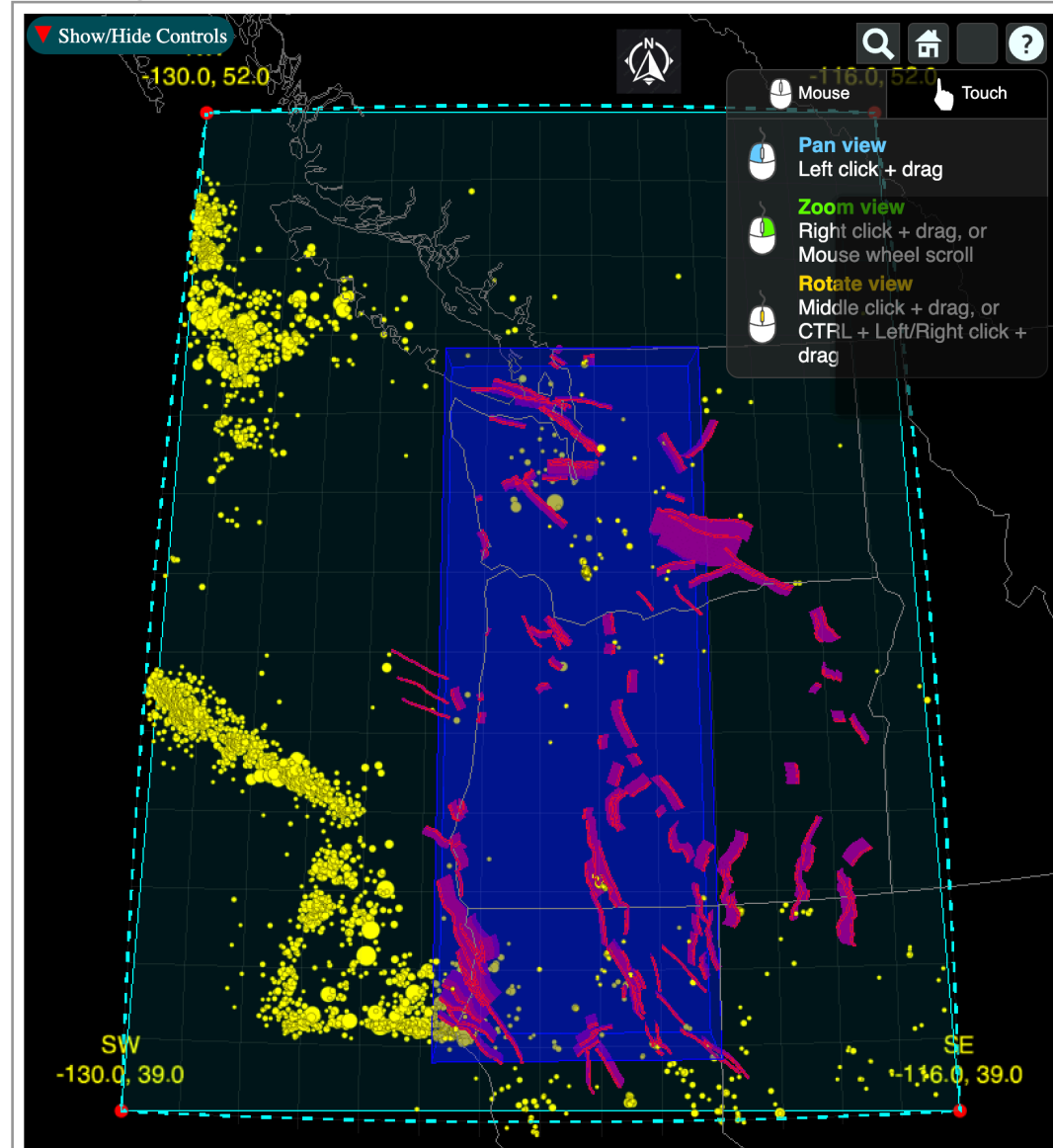
CVM-1: Full waveform inversion

CVM Generation Development
(Time)



CVM Viewer

Model coverage & CRESCENT Cascadia fault traces



- Visualize and interactively explore multiple models of the seismic velocity and density structure
- Includes published models and newly developing CVM working group models

Cyberinfrastructure Team!

Cyberinfrastructure Team



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Cyberinfrastructure Team!

CRESCENT staff plus effort from Earthscope personnel

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

- **Lithospheric block models** to evaluate the strain budget of the PNW for seismic coupling and more
- **Seismogeodetic** detection of **transient** events
- New, richer inventory of **seismicity**



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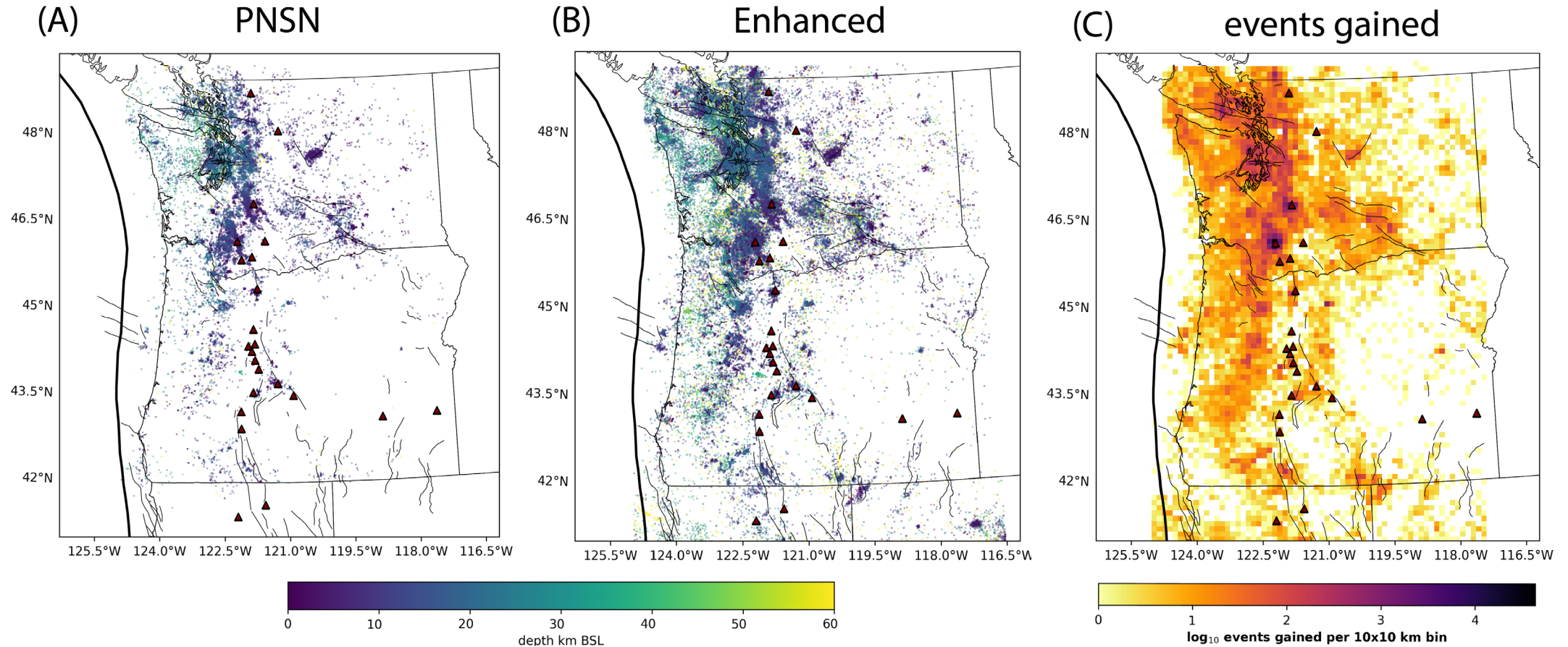


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ML Seismicity Catalog



- **Approach:**

- ML Detection using EQ Transformer (Ni et al. 2023)
- 3D velocity model of He et al. (in prep, CRESCENT CVM gen 1), solve for V_p
- Locate associated picks with nonlinloc (3D V_p and V_s models) & do quality control

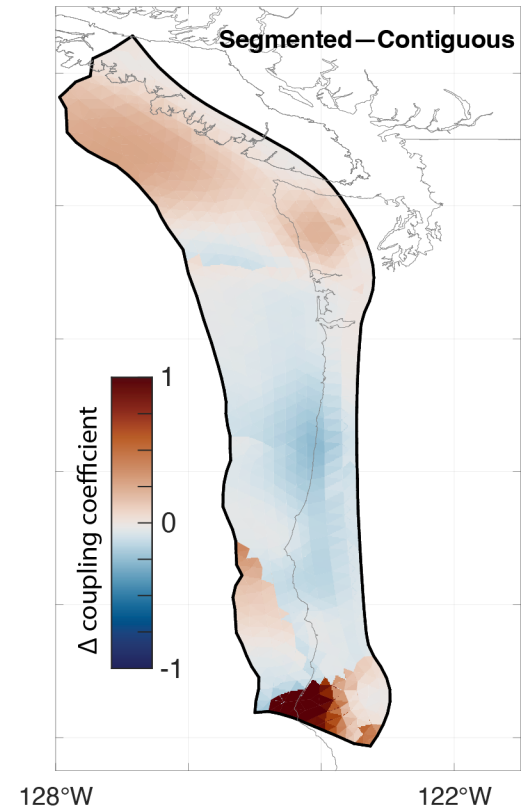
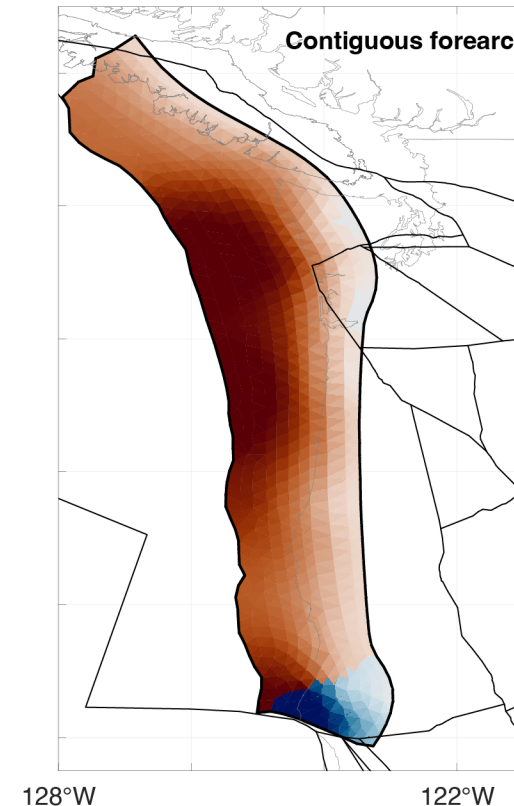
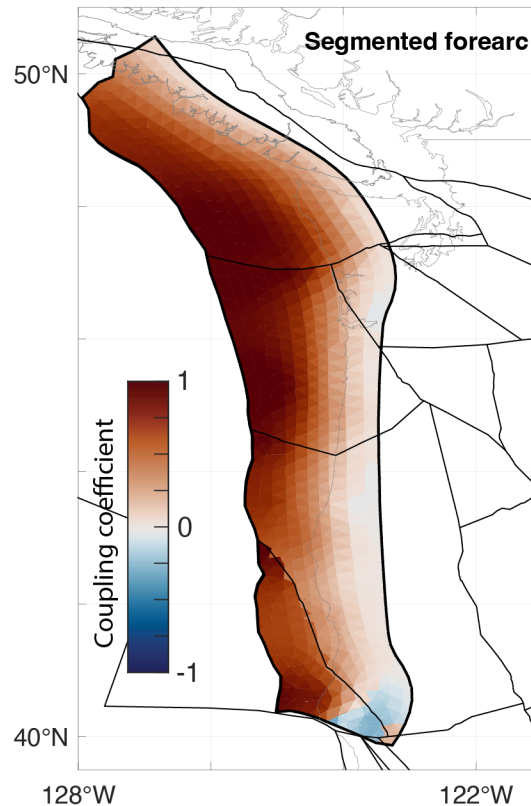
- **Early observations of catalog:**

- 4x increase in number of events
- The megathrust is confirmed as seismically quiet; ML doesn't find many "missing" small earthquakes
- Lots of crustal seismicity that delineates faults
- Swarms!

Coupling distribution estimates Megathrust

$$\text{Coupling coefficient} = \frac{\text{Slip deficit rate}}{\text{Long-term rate}}$$

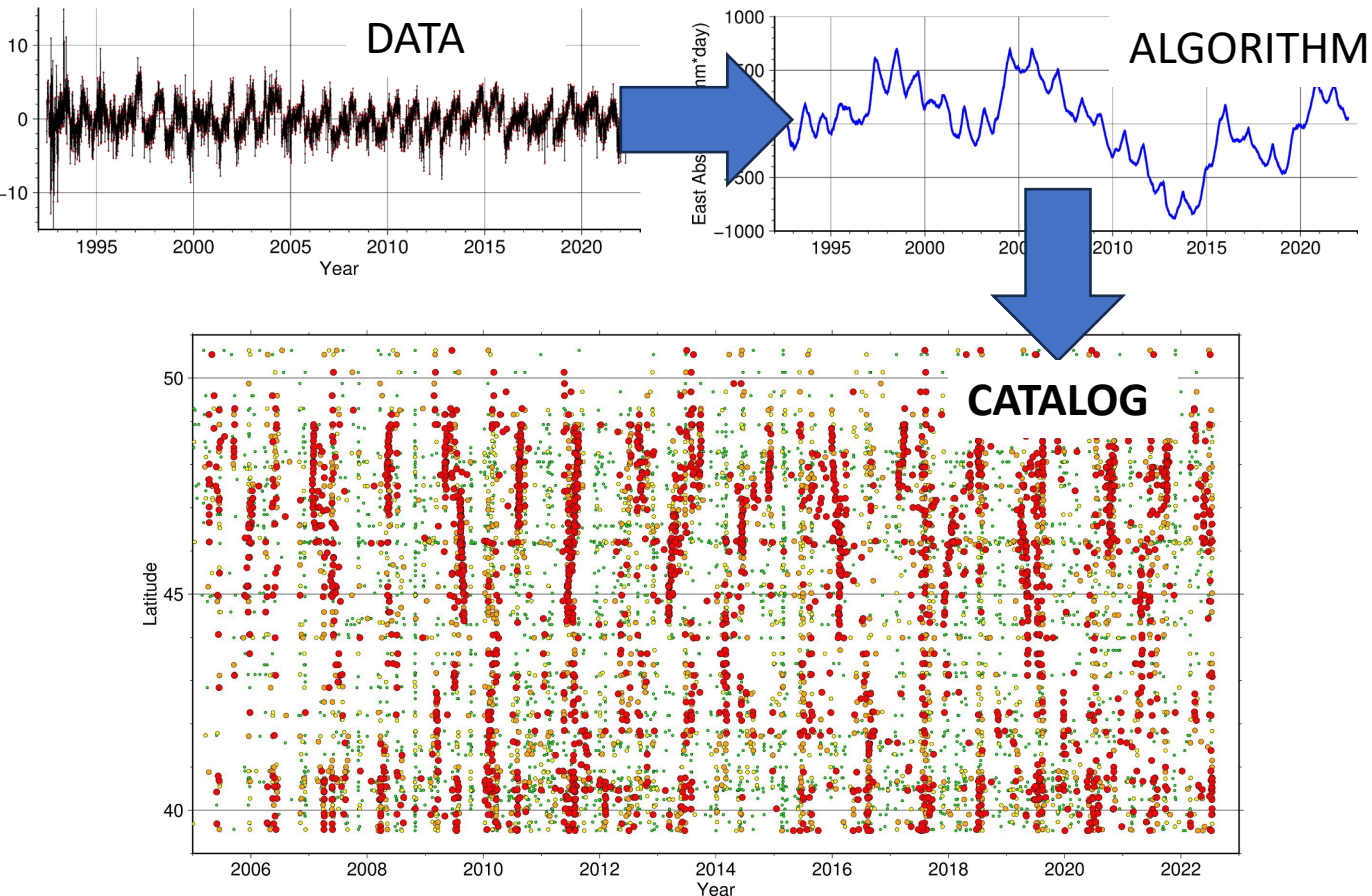
- Uses geodetic (GNSS) data
- Higher coupling coefficient = higher strain accumulation
- Coupling is greater for contiguous model at 43-46°N (blue)
- Coupling is greater for segmented model at 49-50°N (red)
- Also makes coastal uplift predictions that can be compared to tidal/geodetic records



Work of H. Elston, J. Loveless, et al.

Transient Exercise: Ongoing throughout YR3

What it is: A cross-validation exercise to develop, compare, and contrast methodologies for transient detection and characterization.



- **Key science driver:** Properly determining all deformation signals over time will lead to **better coupling models**, the ability to **investigate time-dependent changes in coupling**, and to help **inform of underlying physics/processes**.
- **Data:** Consistent input GNSS time series format for streamlined algorithm development and testing. Synthetic datasets generated in the same format with realistic noise and varied signals.
- **End goal:** A community driven **transient deformation catalog**, **time-dependent interseismic deformation**, and **visualization tools** for validation of algorithms.

Cascadia Subduction Fluids SIG



Addresses:

- Role of geo-fluids in the stress, strain, and rheological properties of the seismogenic and slow-slipping regions of the megathrust
- Long term fluid behavior and budgets
- Geochemical and petrologic constraints on fluid behavior
- Mechanical constraints and effects of fluids



*Organized by Cailey Condit, Eric Dunham,
and Amanda Thomas*

Cascadia Subduction Fluids SIG



Long-term Goal:

- Develop a community fluid model for Cascadia, integrating plate interface geometry, thermal structure, and fluid sources from trench to sub-arc



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



*Organized by Cailey Condit, Eric Dunham,
and Amanda Thomas*

Where are the faults and how potentially active are they?

- *Community Fault Model*
 - focus on all potentially active faults in the region
- *Cascadia Paleoseismology*
 - focus on megathrust event histories

Community Fault Model (CFM)

- Evaluate evidence for potentially active faults throughout Cascadia
- Generate and refine the best 2D and 3D representation of those faults and their hazard
- Deliver that information in a way most useful for numerical modeling & hazard assessment



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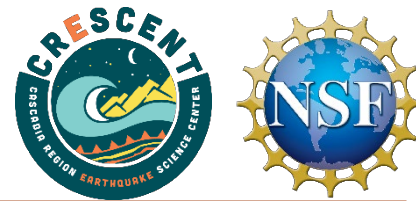
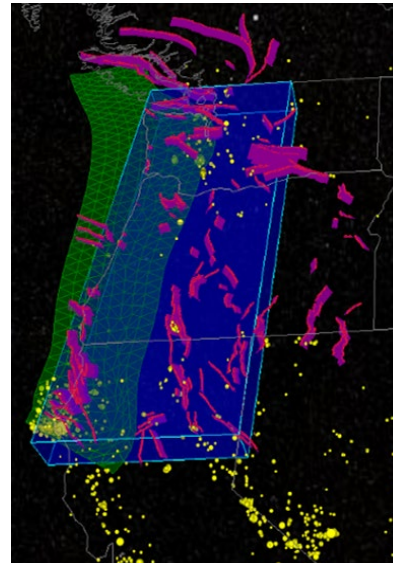


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Community Fault Model (CFM)

Working Group Objectives

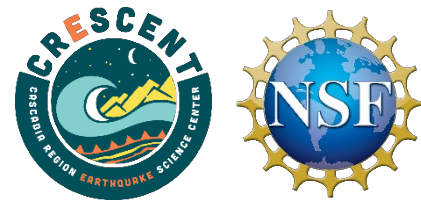
- Generate the best 2D & 3D structural representation of faults. Some anticipated uses of the CFM:
 - ✦ Dynamic earthquake rupture modeling and shaking simulations (DET, C3S, CVM, SIG2)
 - ✦ Knowledge of stress accumulation on faults (C3S, CVM)
 - ✦ Seismic hazard assessment (Community)



Products & Outcomes

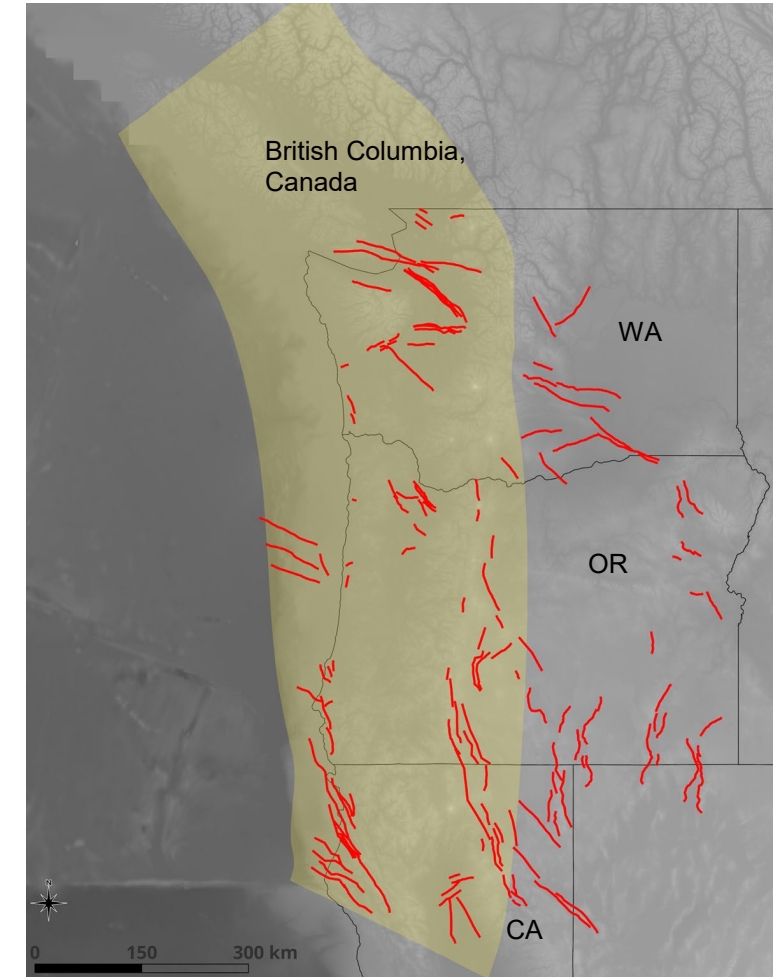
- Collaborative with USGS & SCEC (in northern CA)
- 3D Model of the plate interface and upper plate fault geometries in CSZ
- Interactive web viewer of faults in 2D & 3D, including USGS seismicity layer
- Will include earthquake geology point data (slip, recurrence, displacement)

CFM Version 0.1 (pre-release)

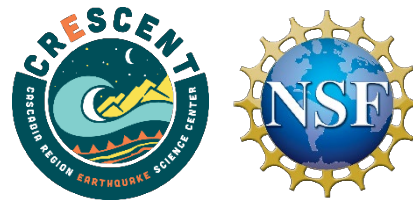


2D and 3D geometries for ~150 faults (*red lines*)

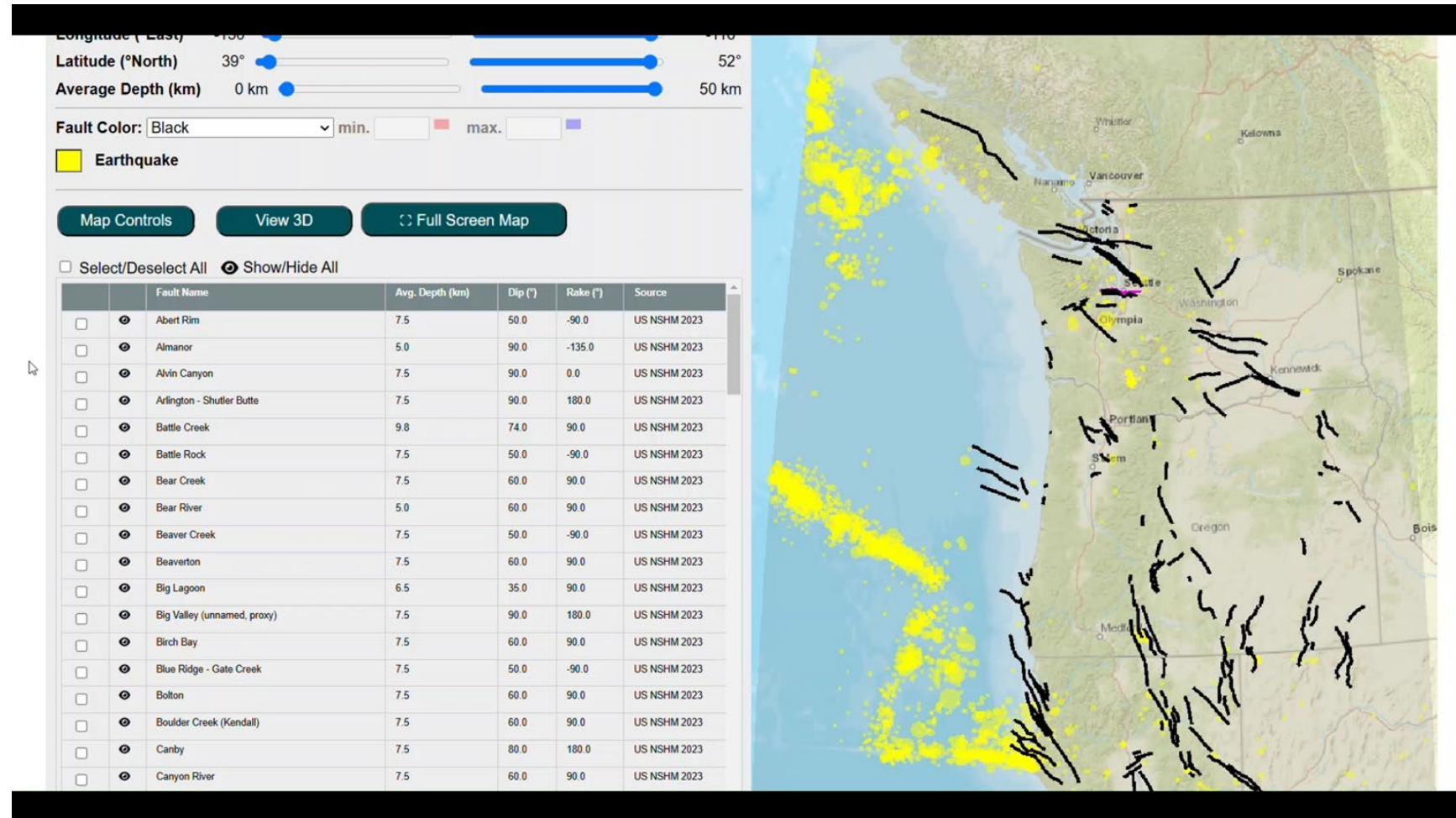
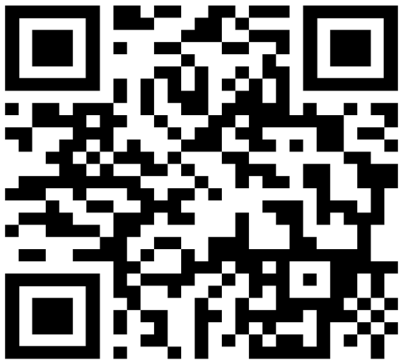
- 2023 National Seismic Hazard Model (NSHM) (Hatem et al., 2022)
- GEM & Canada Geological Survey faults collaborative research (Hobbs et al, *in prep*; Styron et al., *in prep*)
- 3D slab interface models from 4 studies
 - McCrory et al., (2012) (*yellow shading*)
 - Slab2.0 (Hayes et. al, 2018)
 - Carbotte et al., (2024)
 - Graham et al., (2018)



CFM web viewer



- Interactive access to view CFM v0.1
- 2D map view of the faults
- Associated quick view of metadata
- 3D visualization of the faults and slabs

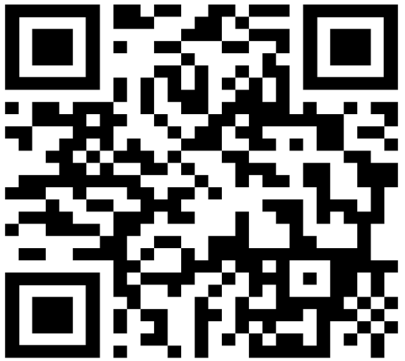


Web viewer:
<https://cfm.cascadiaquakes.org/>

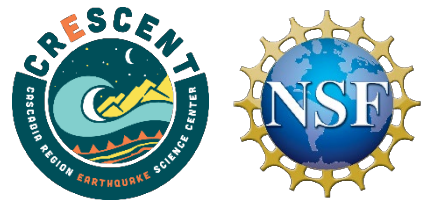
Cyberinfrastructure Team!

CFM web viewer

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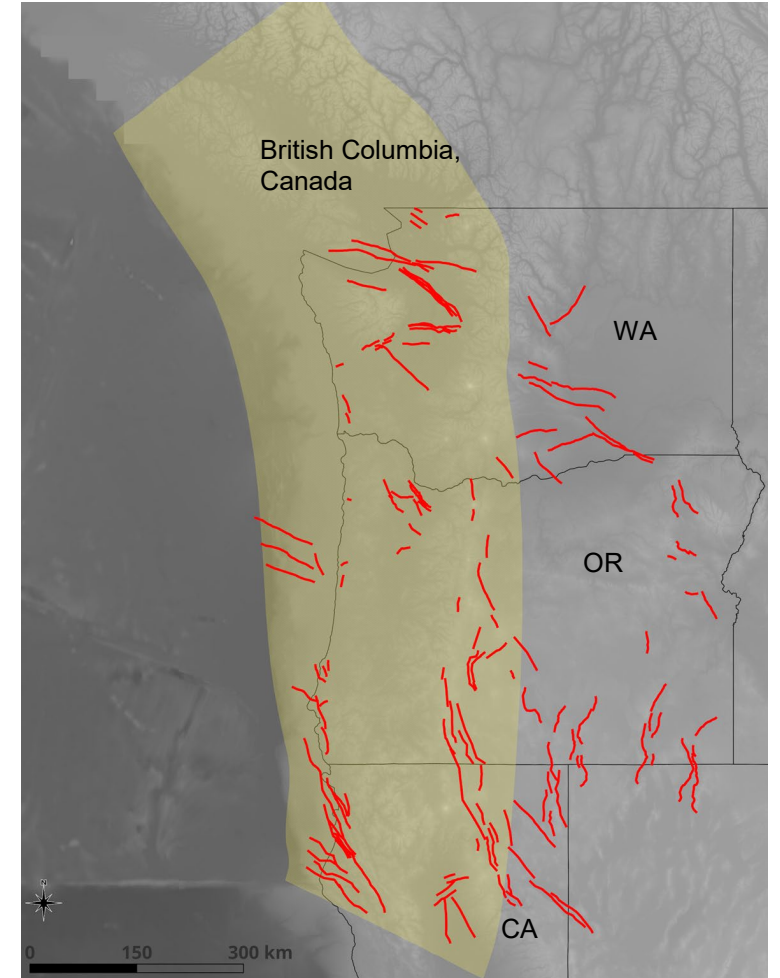


Moving towards CFM v1.0

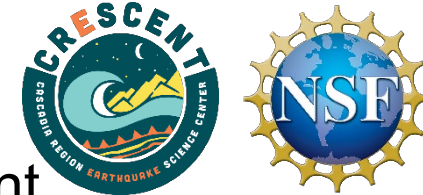


1. Ongoing work with existing faults including
 - Fault complexity (e.g., fault intersections, additional data)
 - Considerations for overlapping region with SCEC
 - Adjust upper and lower depth extents of faults
2. Evaluation and incorporation of additional onshore faults
3. Accretionary wedge faults
 - Addition of faults from recent publications
4. Metadata table
5. CFM topical workshop August 12-13

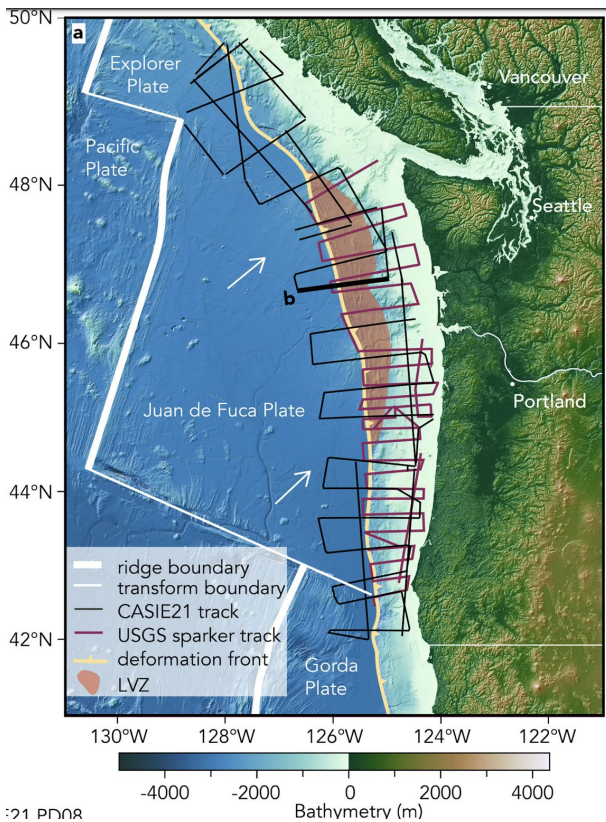
Great in-person and remote participation from community members!



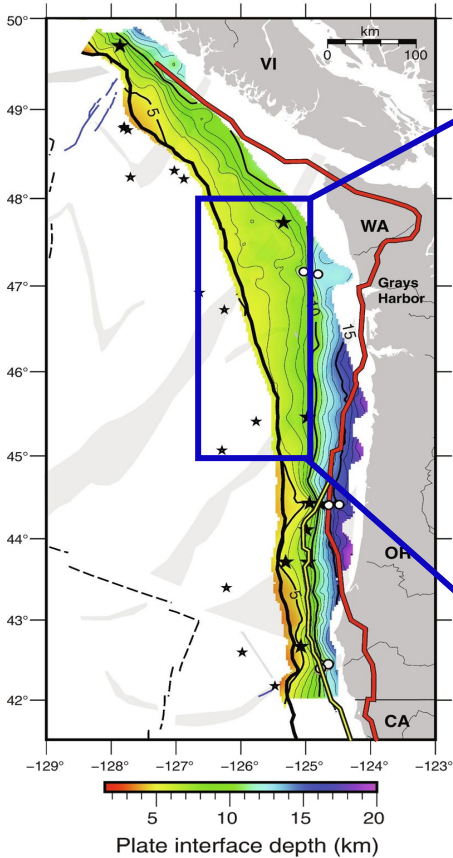
Incorporating Cascadia offshore faults



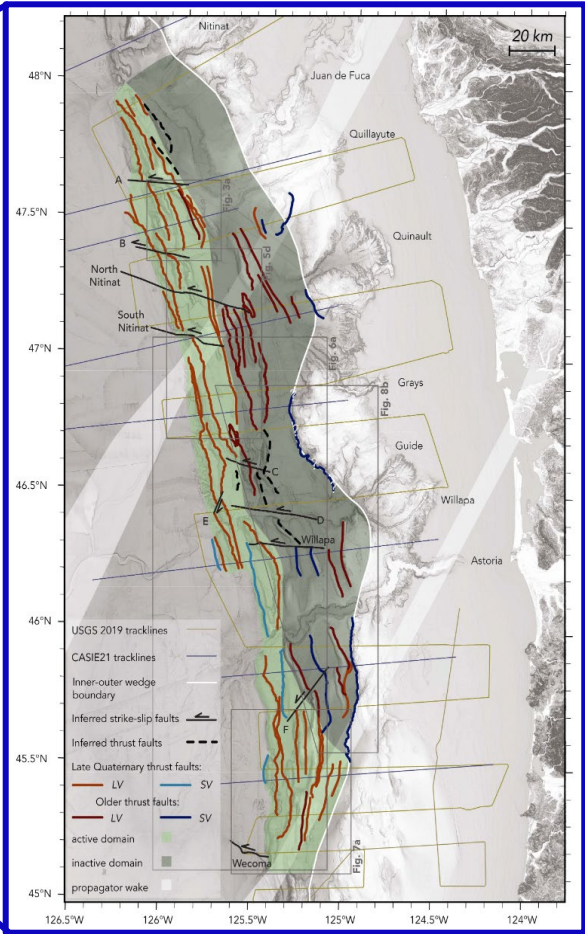
CASIE21: Cascadia Seismic Imaging Experiment 2021 and associated recent publications provide new data sets and models in the central and northern offshore sections (42°N – 50°N) of the Cascadia



Track lines of recently collected seismic data offshore OR and WA (Ledeczi et al., 2024)

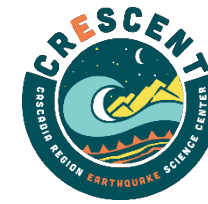


New model of plate interface geometry (modified from Carbotte et al., 2024)

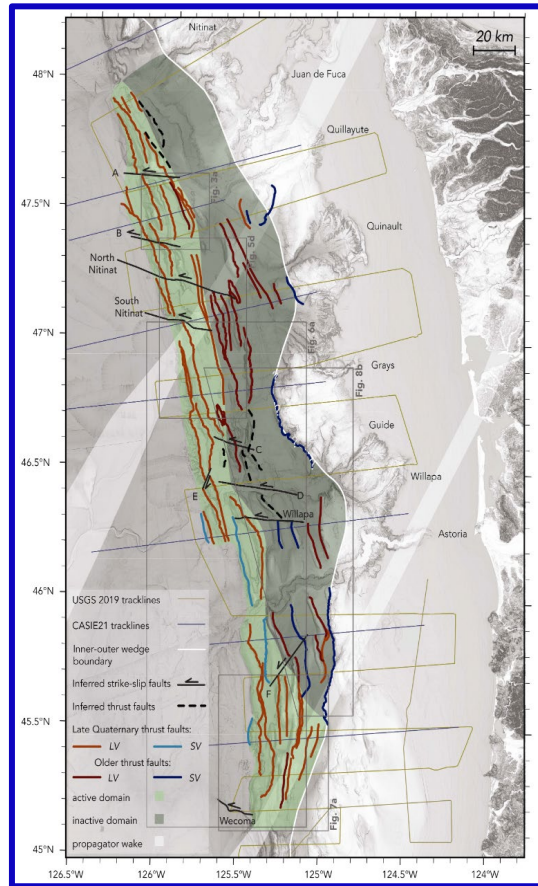


New mapping of accretionary wedge faults (Ledeczi et al., 2024)

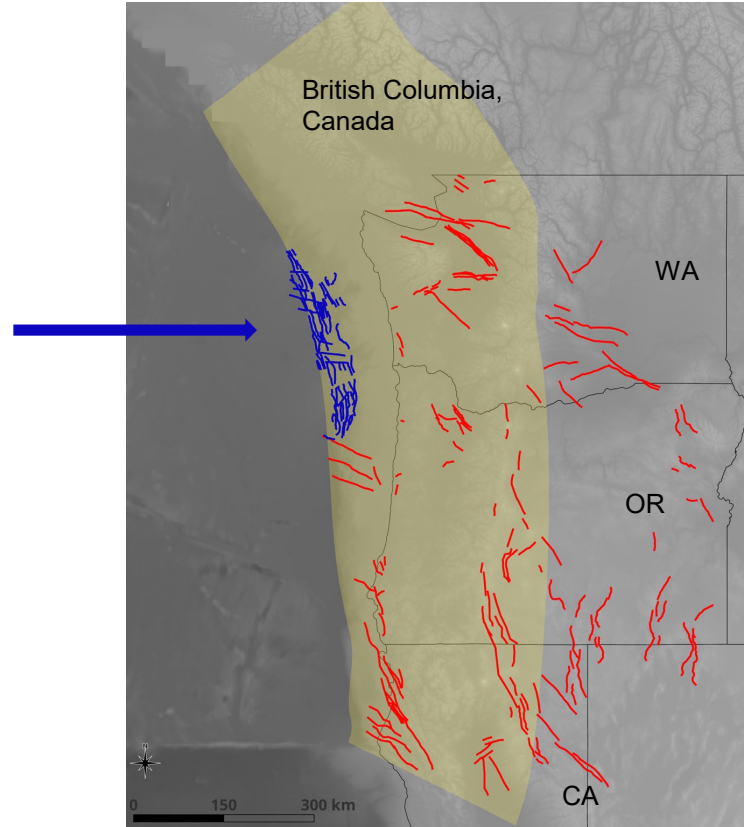
In progress: Offshore fault additions



- Addition of faults: landward-vergent section 45°N – 48°N presented in *Ledeczi et al. (2024)*



New fault mapping in
Ledeczi et al. (2024)



\ Existing v0.1 CFM faults
\ *Ledeczi et al. (2024)* faults
*not yet included

3D splay fault geometries built using

- 2D mapped fault traces
(*Ledeczi et al., 2024*)
- 3D fault depth interpretations
(*A. Ledeczi*)
- processed seismic lines
(*CASIE21 data, Carbotte et al., 2023*)
- plate boundary interface model
(*Carbotte et al., 2024*)
- bathymetry

Tools used:

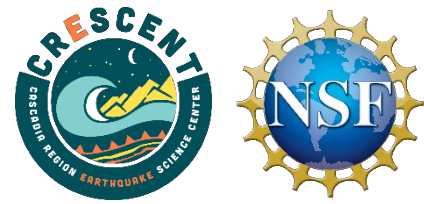


Move 2024 - IPM 13.5

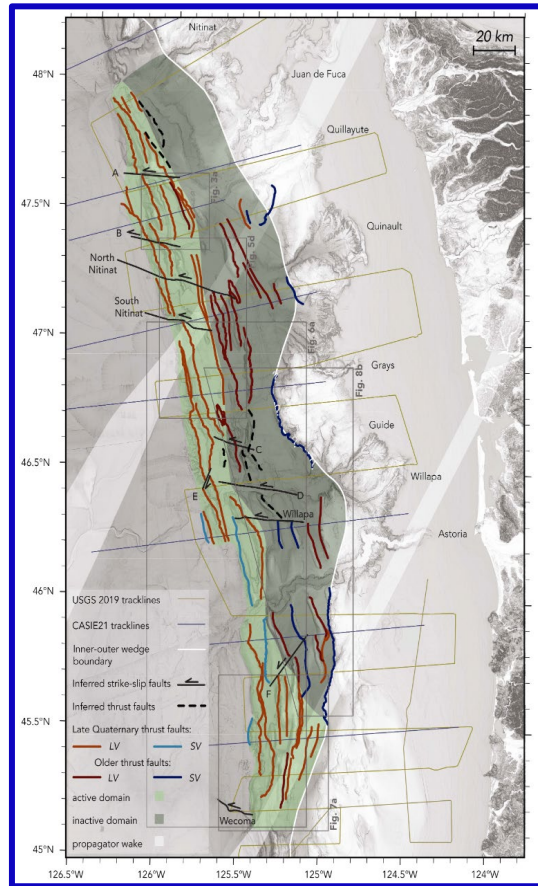


Aspen SKUA
V14.5

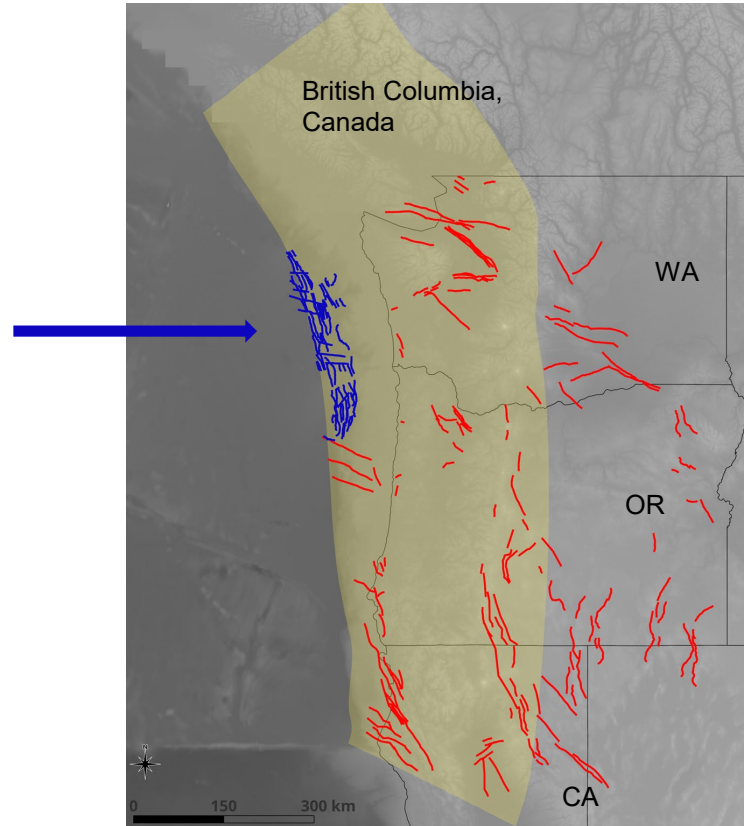
In progress: Offshore fault additions



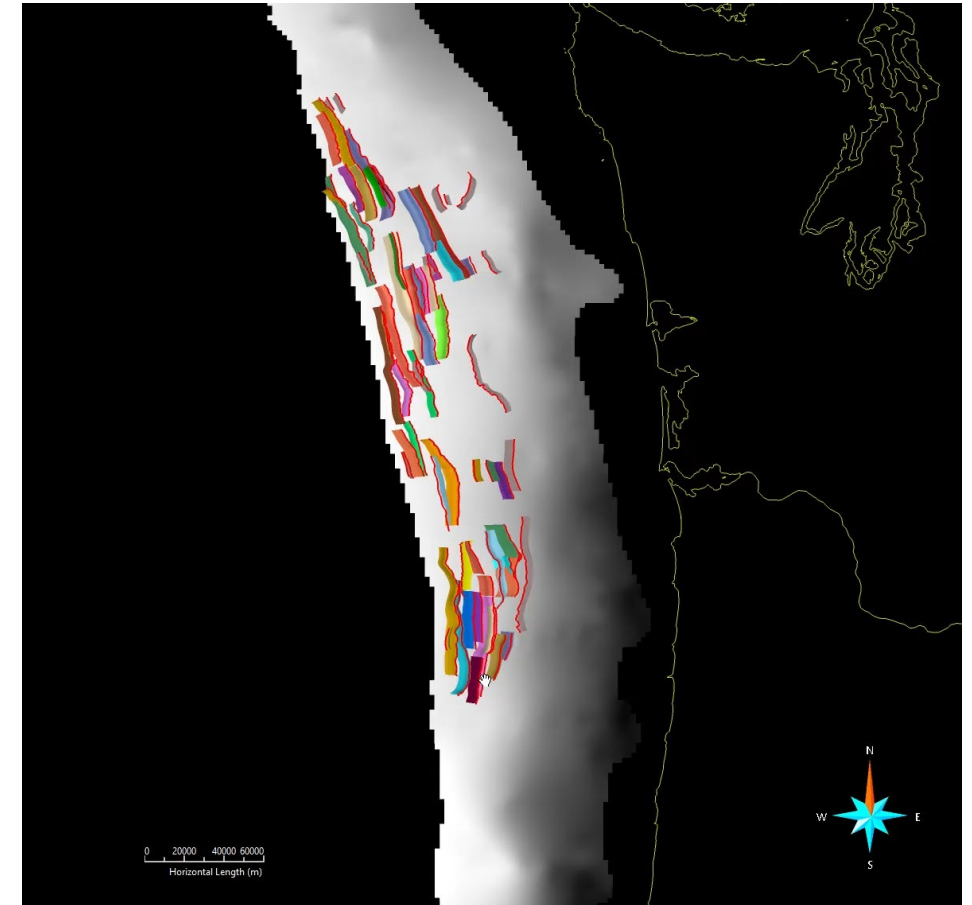
- Addition of faults: landward-vergent section 45°N – 48°N presented in *Ledeczi et al. (2024)*



New fault mapping in
Ledeczi et al. (2024)



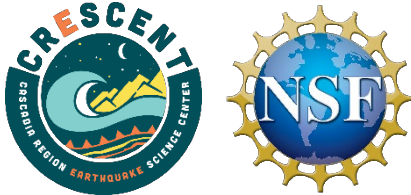
\ Existing v0.1 CFM faults
\ *Ledeczi et al. (2024)* faults
*not yet included



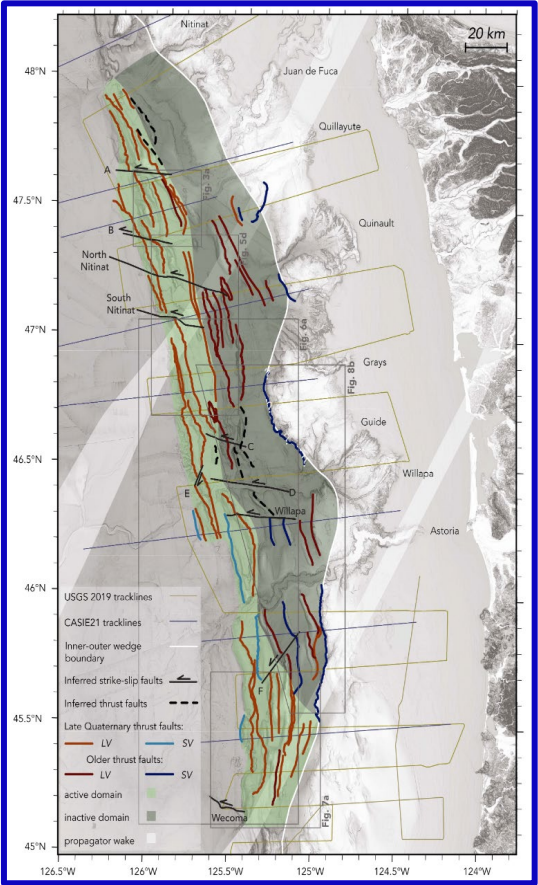
Work in progress 3D faults surfaces

Generated in Aspen SKUA™

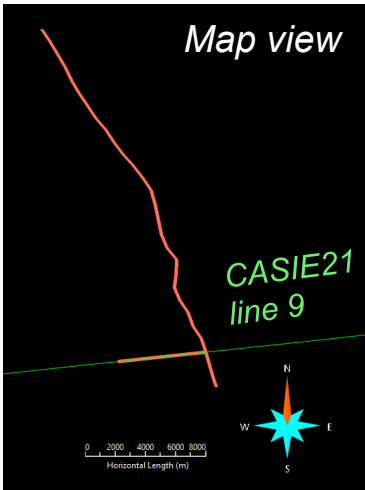
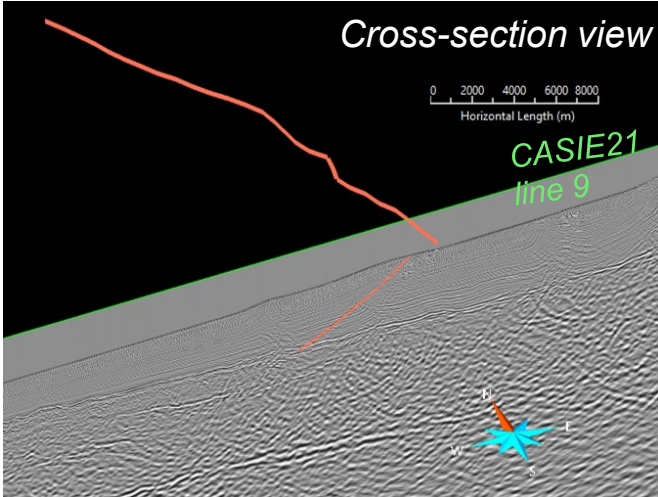
In progress: Offshore fault additions



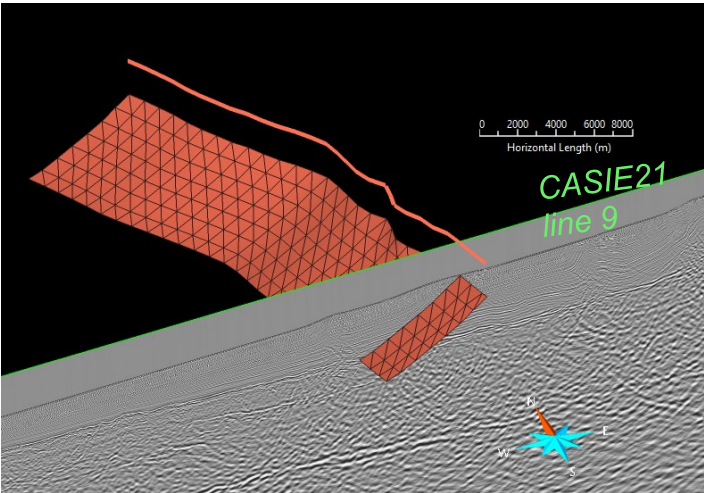
Fault geometry constraints: splay geometry and surface trace



New fault mapping in
Ledeczi et al. (2024)



3-D 1km smooth mesh



Tools used:



Field fault characterization



Oak Graben fz, OR



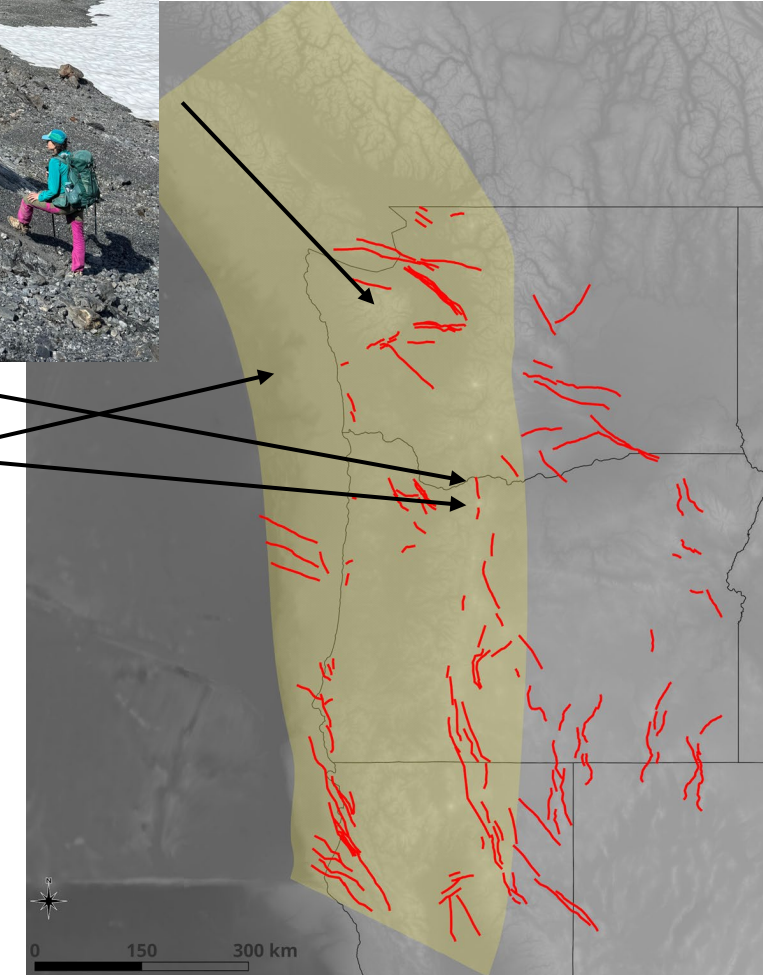
Twin Lakes fault, OR



Olympic Mtns
paleomegathrust

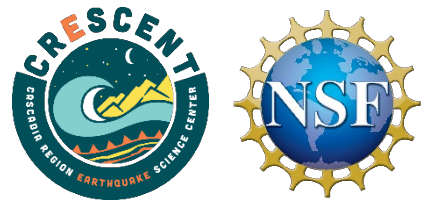


M/V Langseth
survey vessel

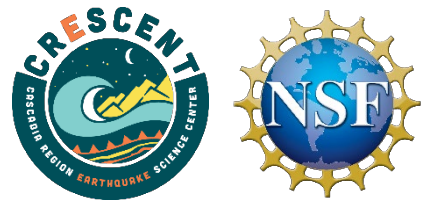


New publications? Email us!
Seeking input from the research community, and collaborating with SCEC, State & Federal agencies as we update CFM fault geometries.

CFM web viewer demonstrations



How to engage and provide feedback



 **CRESCENT**
CASCADIA REGION EARTHQUAKE SCIENCE CENTER

Community Fault Model (CFM)

Visualization ▼ Data ▼ More ▼ Guide ▼

How to Submit a Question or Request Help

- For general questions, not technical issues: Send an email to crescentcfm@cascadiaquakes.org.
- If you have any questions or need assistance regarding the CFM web, please follow the steps outlined below for a smooth process. To simplify submissions and track requests, we use GitHub issues for all inquiries and help requests. This ensures that nothing gets overlooked. Simply follow these steps:
 - Go to the CRESCENT-CFM Issue Page** — [Click here](#) to be taken directly to our GitHub issue tracker.
 - Create a New Issue** — Once on the page, click the "New Issue" button to start a new submission or help request.
 - Provide Details** — In your question or request, please include the following information:
 - A brief description of your question or issue.
 - Any relevant files (e.g., images, data) can be linked or attached.
 - Submit** — After providing all the necessary details, submit your issue. We will review it and get back to you as soon as possible.

We are happy to assist with any questions or requests!



← **Explore v0.1 in the web viewer:**
<https://cfm.cascadiaquakes.org/>

Email us!

crescentcfm@cascadiaquakes.org

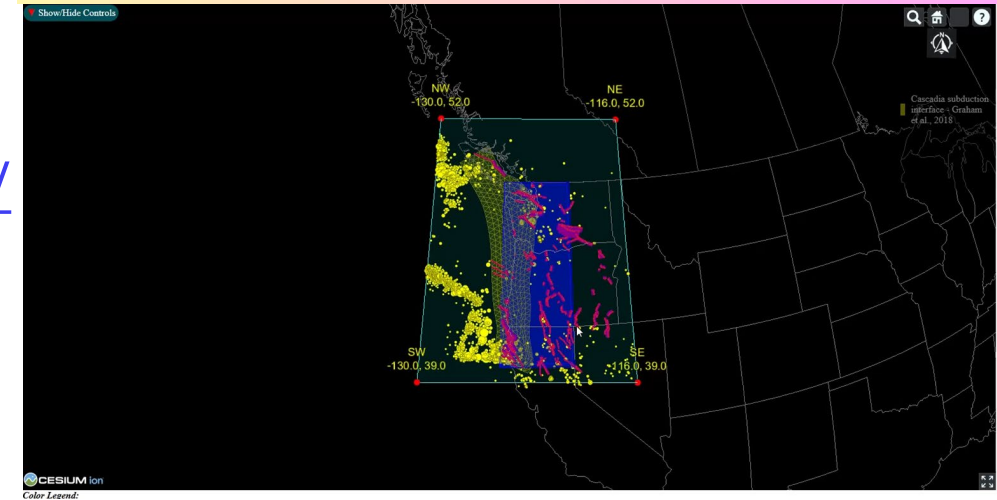
cascadiaquakes.org

2025 summer workshop:

**Community Fault
Model (CFM)
Topical Workshop
August 12-13, 2025
Portland, OR**



CRESCENT
CASCADIA REGION EARTHQUAKE
SCIENCE CENTER



How to engage and provide feedback



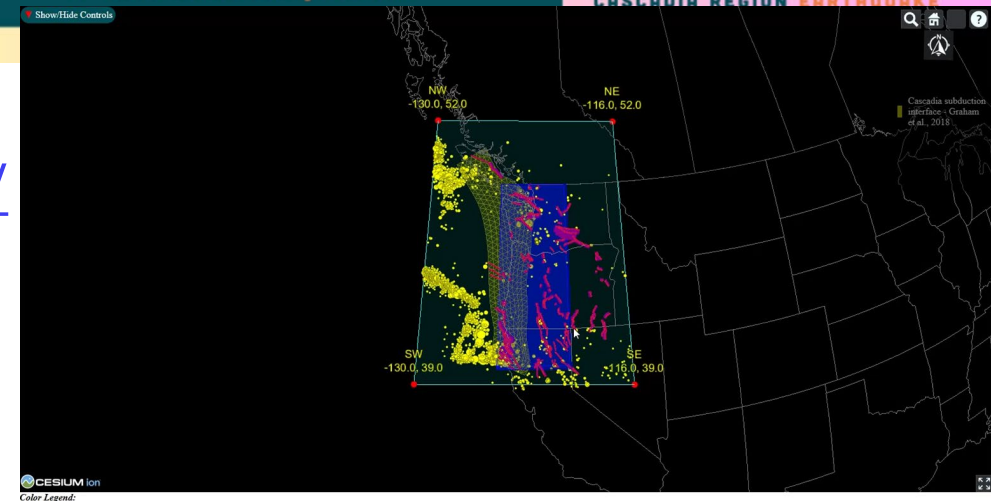
2025 summer workshop:

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er:
crescentcfm.org/



Email us!

crescentcfm@cascadiaquakes.org

Cascadia Paleoseismology (CPAL)

Overarching Goal

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



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hawkesa@uncw.edu



Rob Witter
United States Geological Survey
rwitter@usgs.gov



Lydia Staisch
United States Geological Survey
lstaisch@usgs.gov



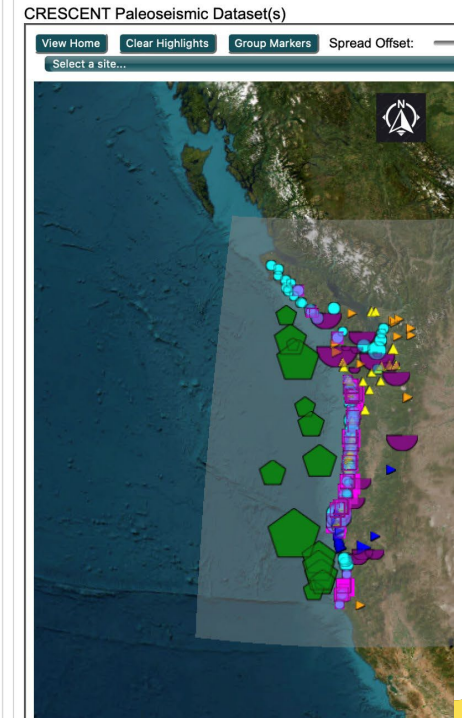
Harvey Kelsey
Cal Poly Humboldt
harvey.kelsey@humboldt.edu



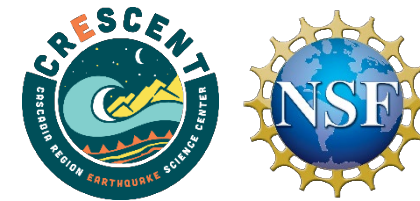
Eileen Hemphill-Haley
Cal Poly Humboldt
eileen.hemphill-haley@humboldt.edu



Paleoseismic viewer



Cascadia Paleoseismology (CPAL)



Product

Dura et al., PNAS, 2025

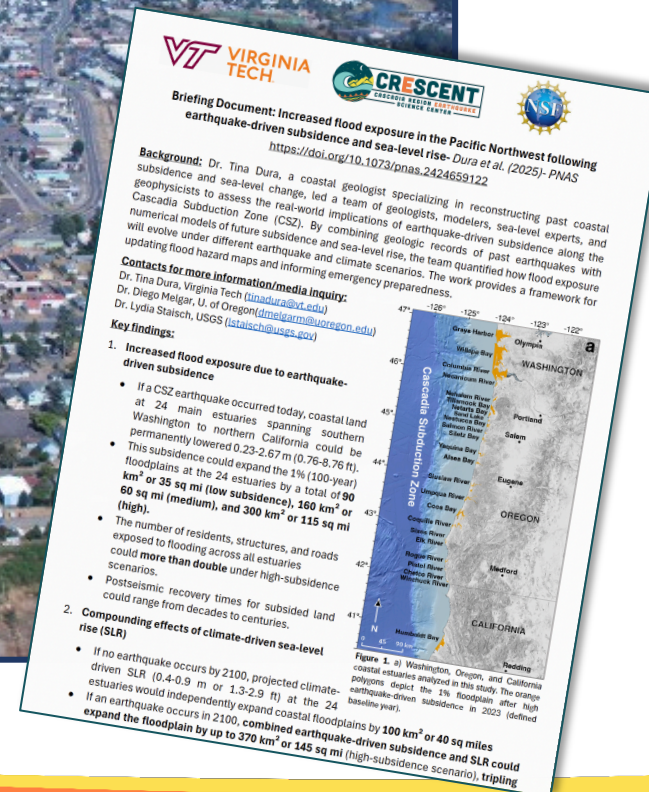
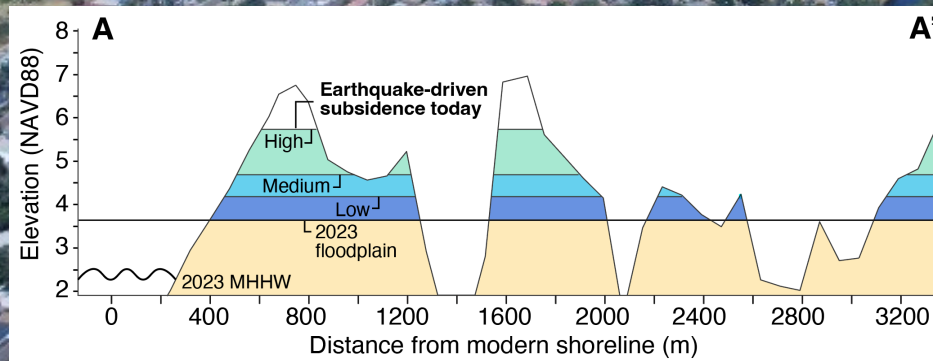
The Washington Post
Democracy Dies in Darkness

Environment

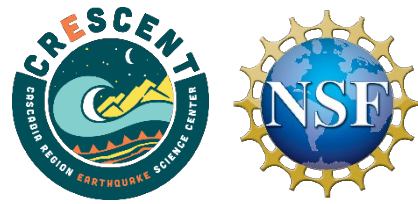
A big Pacific Northwest quake could cause land to sink in minutes

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



Cascadia Paleoseismology (CPAL)



Year 3: Updated inland tsunami inundation extent datasets

- Publish Salmon River, OR and Bone River, WA work
- Establish diatoms as a proxy for tracking inland inundation beyond sand extent
- Use new inundation limits to constrain rupture and inundation models

Year 3: Updated earthquake chronologies

- Publish new radiocarbon results from Lagoon Creek, CA
- Update chronologies at the Coquille River, Salmon River, and Alsea Bay

Looking ahead: Deformation over multiple earthquake cycles

- Publish downcore subsidence estimates at the Coquille River, Salmon River, and Alsea Bay

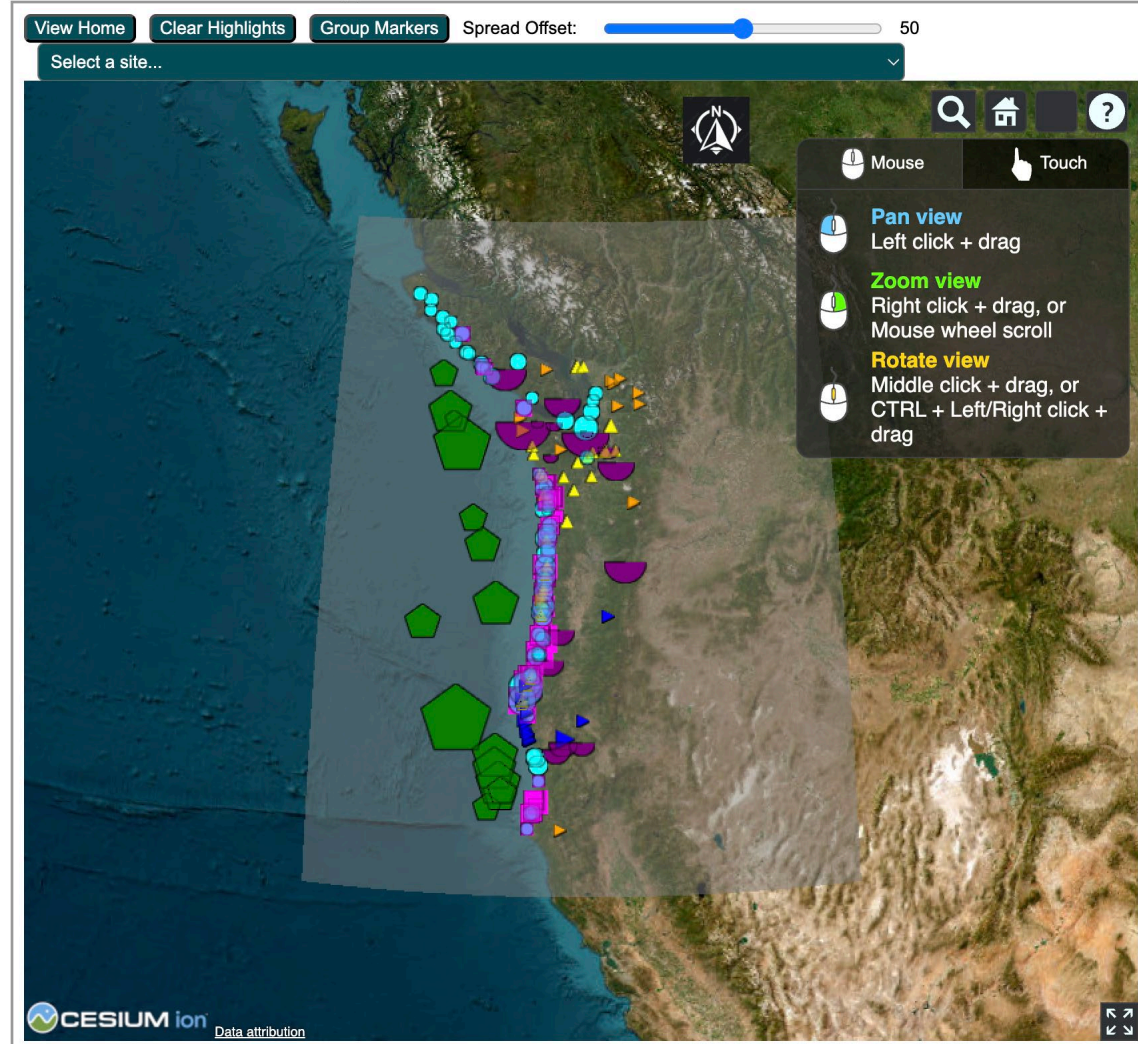
Pushing the limits

- Interseismic microfossil-based deformation reconstructions!
- Trench-perpendicular deformation reconstructions



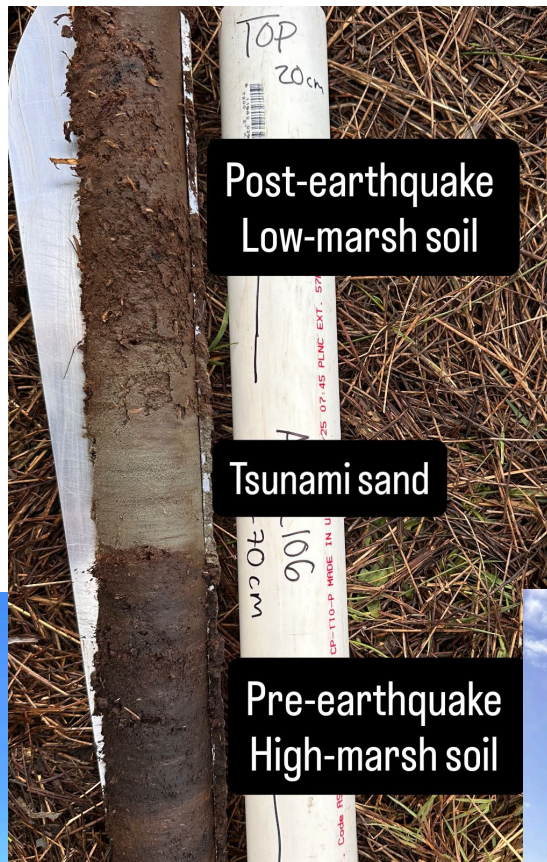
CPAL Viewer

CRESCENT Paleoseismic Dataset(s)



- Interactive platform for mapping, cataloging, and visualizing paleoseismic datasets associated with past megathrust earthquake evidence
- Open source, builds off USGS products and expands them
- Much more to come!

Cyberinfrastructure Team!



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
- Informed by the earthquake histories uncovered by CPAL



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Dynamic Rupture, Earthquake Cycle, and Tsunamis (DET)

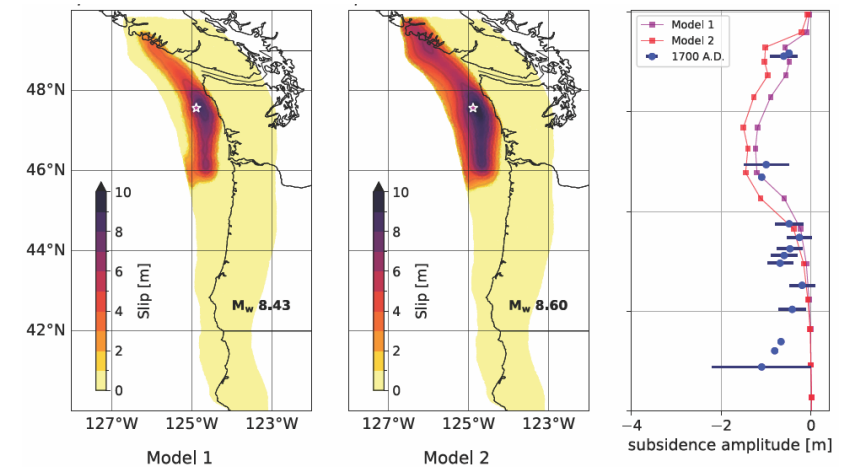


Working Group Objectives

- Models of earthquakes & tsunami generation
 - ✦ **Single-event dynamic ruptures** (with coupling to ocean for tsunami generation)
 - ✦ **Earthquake cycle models** spanning thousands of years, capturing earthquakes, frictional-viscous transition, and slow slip events
- Community **code verification**
 - ✦ Dynamic rupture (including coupling with tsunami) & earthquake cycle benchmarks
 - ✦ Joint with SCEC/USGS

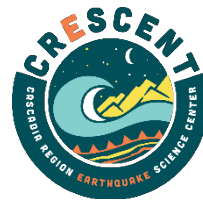
Products & Outcomes

- Open-source software
- Web platform for code comparison



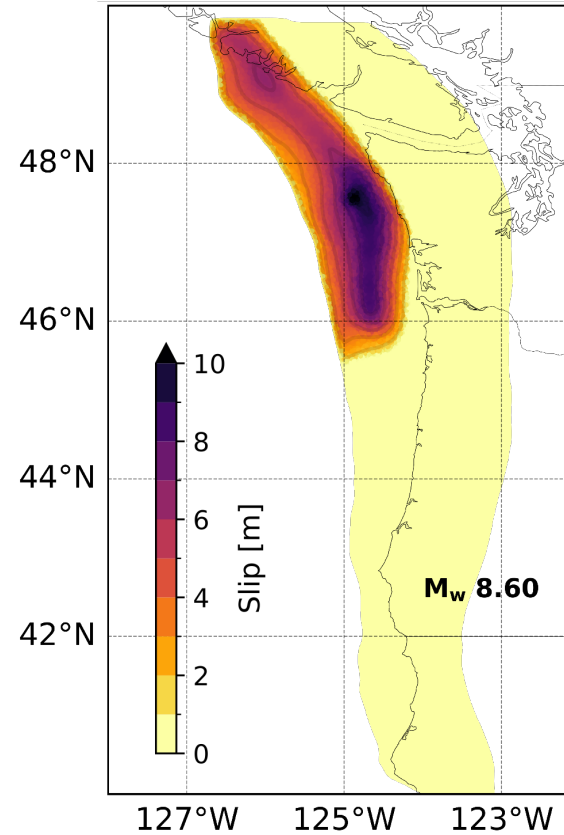
(Glehman, Gabriel, Ulrich, Ramos, Huang, Lindsey, "Partial ruptures governed by the complex interplay between geodetic slip deficit, rigidity, and pore fluid pressure in 3D Cascadia dynamic rupture simulations", 2025, Seismica)

Dynamic rupture (informed by slip deficit models) at Cascadia



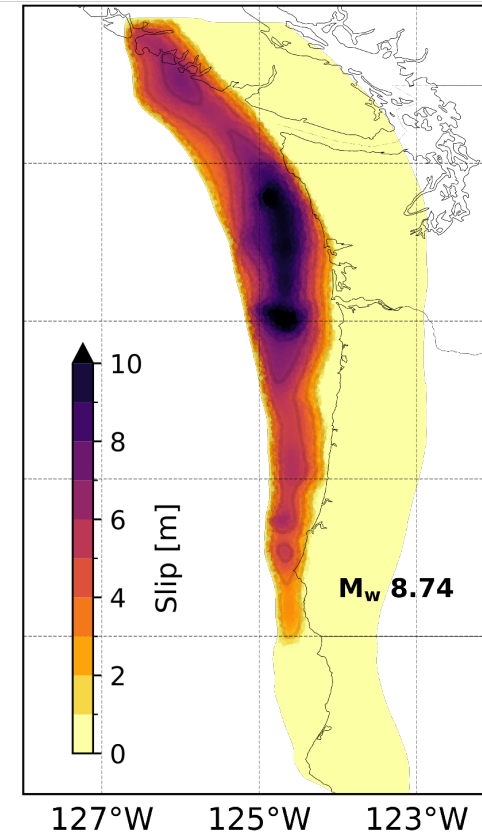
- Geodetic slip deficit models (SDMs) informed single-event dynamic ruptures
- 22 dynamic rupture scenarios to unravel the dynamic trade-offs of assumptions for SDMs, rigidity, and pore fluid pressure
- **→ Margin-wide rupture requires a large slip deficit in the central CSZ**

Partial Rupture

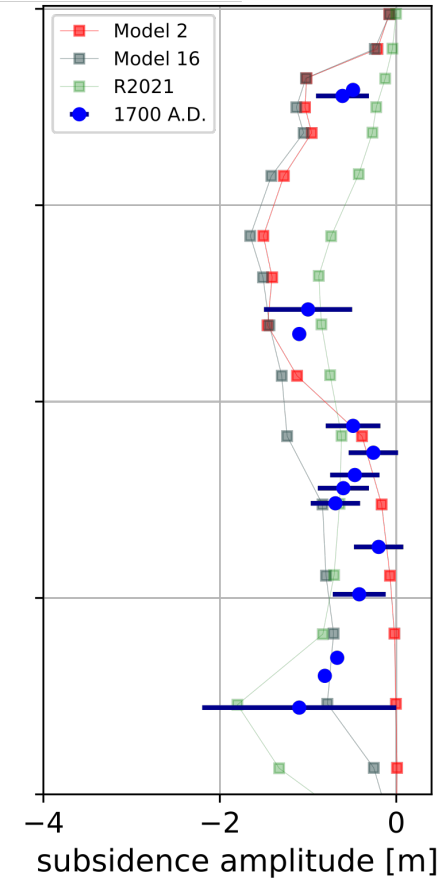


Model 2

Margin-Wide Rupture

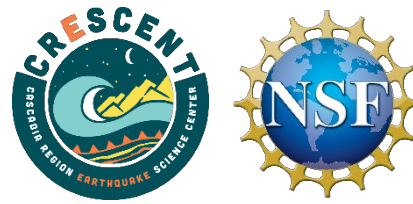


Model 16

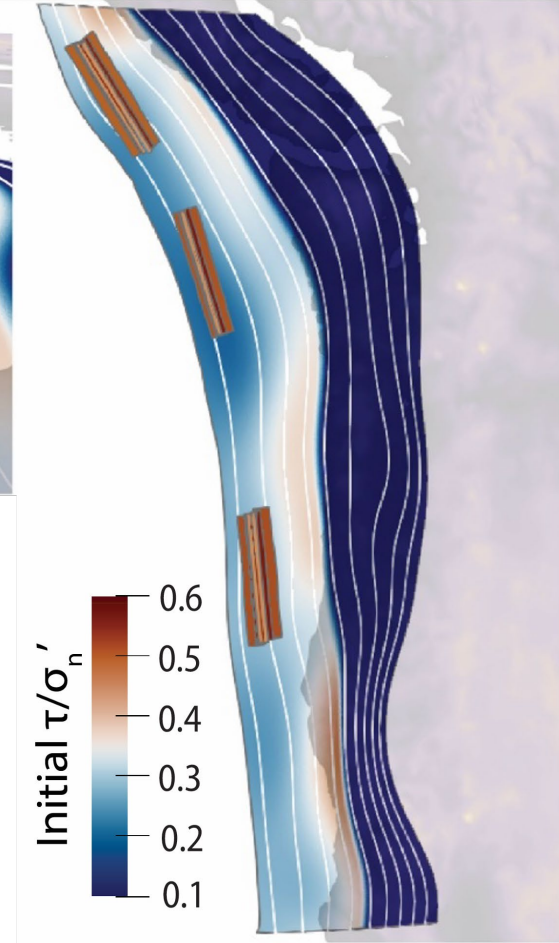
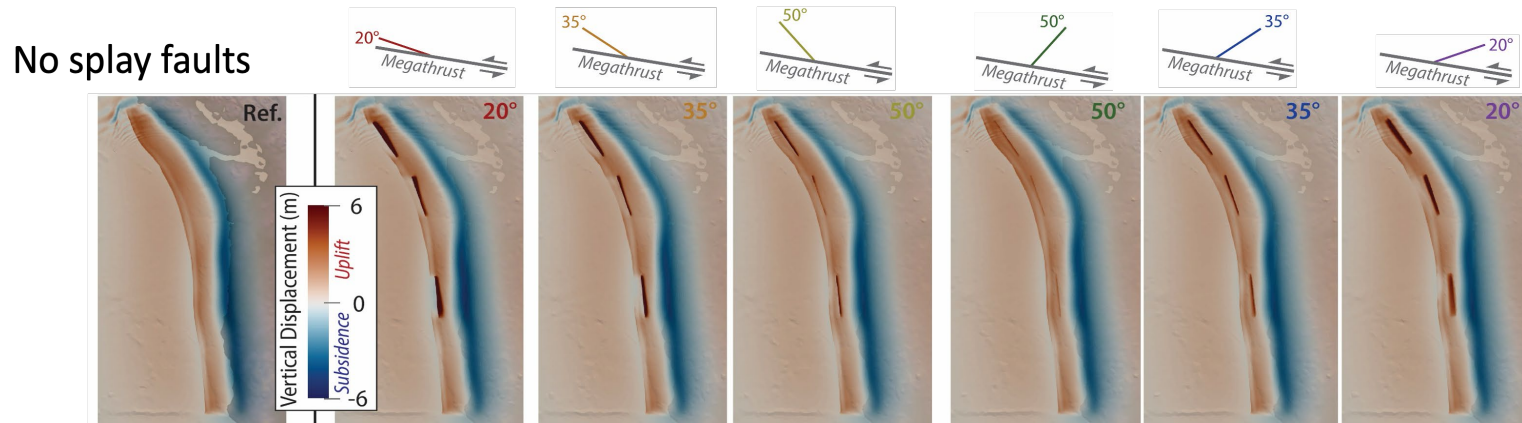
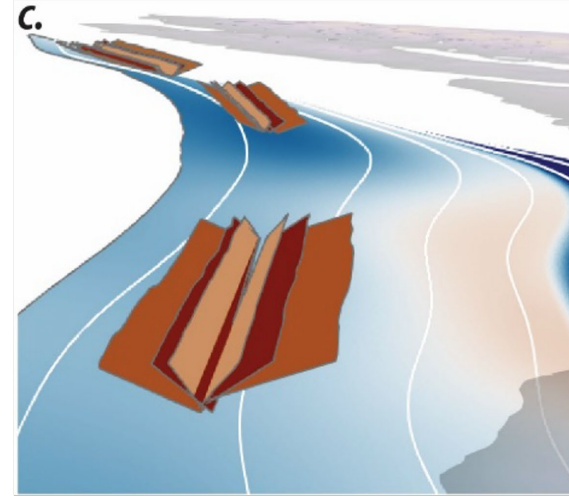


(Glehman, Gabriel, Ulrich, Ramos, Huang, Lindsey, "Partial ruptures governed by the complex interplay between geodetic slip deficit, rigidity, and pore fluid pressure in 3D Cascadia dynamic rupture simulations", 2025, Seismica)

Dynamic Rupture (with splays) + Tsunamigenesis at Cascadia



- 3D dynamic rupture models of Cascadia subduction zone earthquakes reveal coseismic competition between megathrust and splay fault rupture
- Fault geometry modulates shallow slip partitioning: gently dipping seaward-vergent splays slip more than steeper, landward-vergent splays
- Distinct static and dynamic mechanisms result in dip- and vergence-dependent splay fault slip during megathrust earthquake ruptures



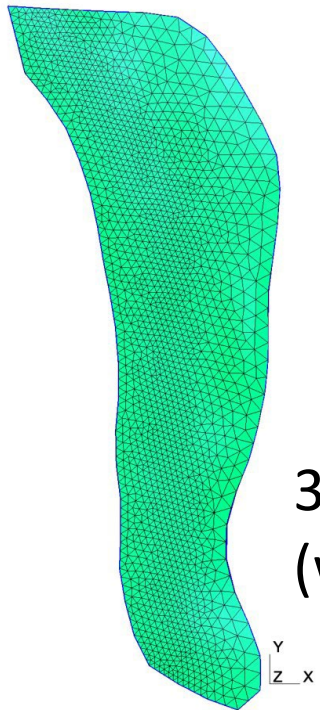
James Biemiller, Alice Gabriel, Lydia Staisch, Thomas Ulrich, Audrey Dunham, Madeleine Lucas, Anna Ledeczi, Harold Tobin, Erin Wirth, Janet Watt, Ruth Harris, *in press*, **AGU Advances**

DET: 3D Earthquake Cycle Simulations

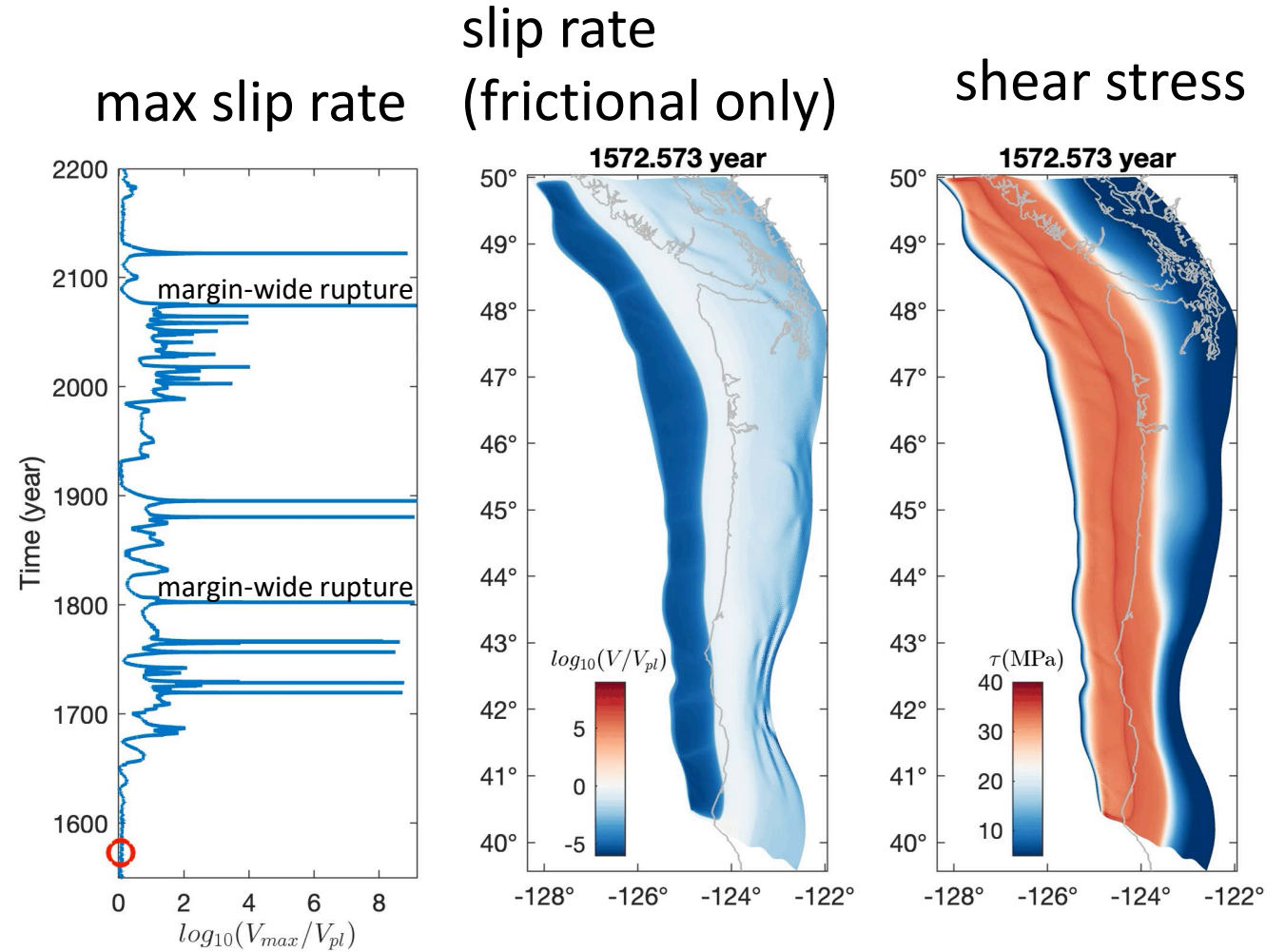
1. steady state fluid model
to set pore pressure and
effective normal stress

2. project
effective stress vs
depth along strike
for 3D modeling

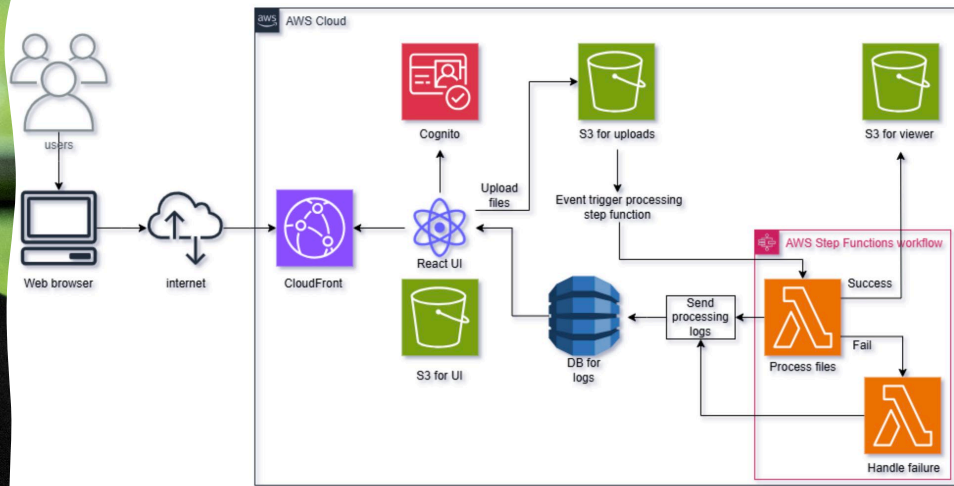
3. cycle simulations
(with **fixed pore pressure**)



Slab 2.0 geometry (Hayes, 2018)



Work by Wenqiang Zhang, So Ozawa, Eric Dunham



Earthquake Dynamic Rupture, Seismic Cycle and Tsunami Code Verification Platform

Led by Loic Bachelot & Amanda Thomas, with Fabian Kutschera, Alice Gabriel



Code Verification Platform



Control panel

Dataset selection

- Dataset choice
- ☐ MAFE_ttpv2_v2: [info](#)
 - ☒ MAFE_ttpv2_v2: [info](#)
 - ☐ kutschera_ttpv2_v3.0: [info](#)
 - ☐ kutschera_ttpv2_v4.0: [info](#)
 - ☐ kutschera_ttpv2_v4.1: [info](#)
 - ☒ kutschera_ttpv2_v5.0: [info](#)
 - ☐ zhang_ttpv2: [info](#)
 - ☐ zhang_ttpv2_O4: [info](#)
 - ☐ zhang_ttpv2_O5: [info](#)
 - ☐ zhang_ttpv2_v2: [info](#)

Show graphs

Graph control

Choose the file type

Sea Surface

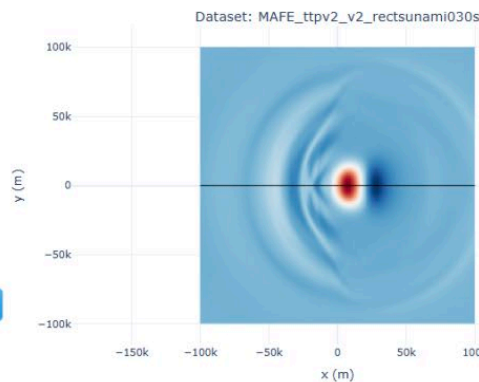
Choose the receiver

tsunami030s

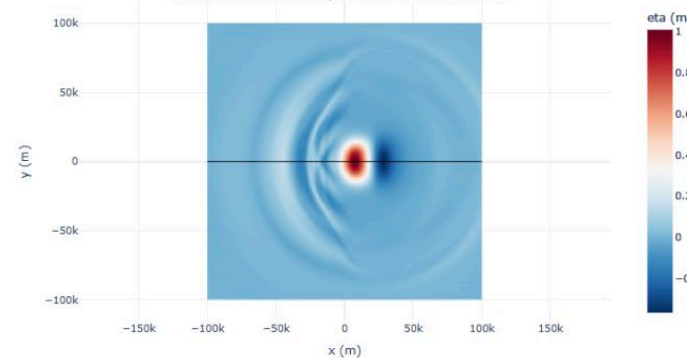
Upload File

Warning: Single file upload is not supported for surface files.

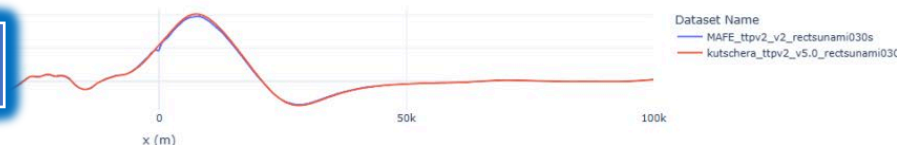
Heatmap of x vs y colored by eta [m] (Re gridded Data)



Dataset: kutschera_ttpv2_v5.0_rectsunami030s



Cross section of eta at y=0m



- The CRESCENT Code Verification Platform provides a cloud-based, open-access system for verifying and comparing earthquake, tsunami, and earthquake-cycle simulation codes across the community

- The platform enables standardized community benchmarks, interactive visualization, and future extensions toward automated quantitative metrics between models advancing reproducibility and trust in complex geophysical simulations

Cyberinfrastructure Team!

DET Updates:

Dynamic rupture benchmark (with SCEC/USGS)

CRESCENT Tsunami Benchmark
(with SCEC/USGS)

Fluids in Cascadia Topical Workshop

Continued **Platform** Development with CRESCENT developers (thanks Loic!)

Ongoing science projects – see posters & talks (and publications)

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



CRESCENT
CASCADIA REGION EARTHQUAKE
SCIENCE CENTER



3D EQ cycle code development
& initial benchmark - joint with SCEC SEAS

Tsunami modeling (coupled with dynamic rupture) and
validation with paleoseismic data

Integration with CVM (3D elastic heterogeneities, not just
layered) & **CFM** (alternative slab models)

EQ cycle code development
& additional benchmarking; initial steps toward integration
of viscoelasticity, fluid transport.

Coupled **earthquake + tsunami** modeling in self-consistent
framework

Fully **3D EQ cycle** code development &
additional benchmarking with
integrated viscoelasticity, fluid transport,
CFM, and CVM.

Coupled earthquake+tsunami modeling
for **hazard assessment**.

DET Goals

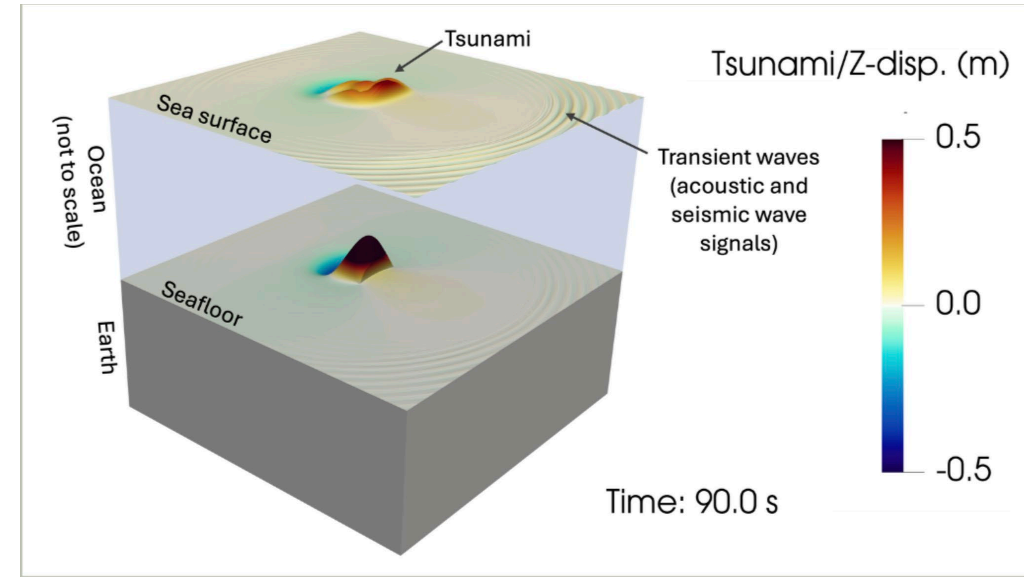
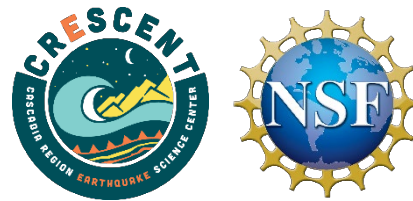


Figure by Fabian Kutschera and Loïc Bachelot

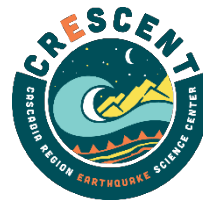
CRESCENT Topical Workshop

Tian Sun, Ignacio Sepulveda & Alice Gabriel

SHALLOW RUPTURE AND TSUNAMIGENESIS

May 28-29, 2026, University of Oregon, Eugene

DET Year 4 Goals



EQ cycle code development
& additional benchmarking; initial steps toward integration of
viscoelasticity, fluid transport.

Coupled **earthquake + tsunami** modeling in self-consistent framework

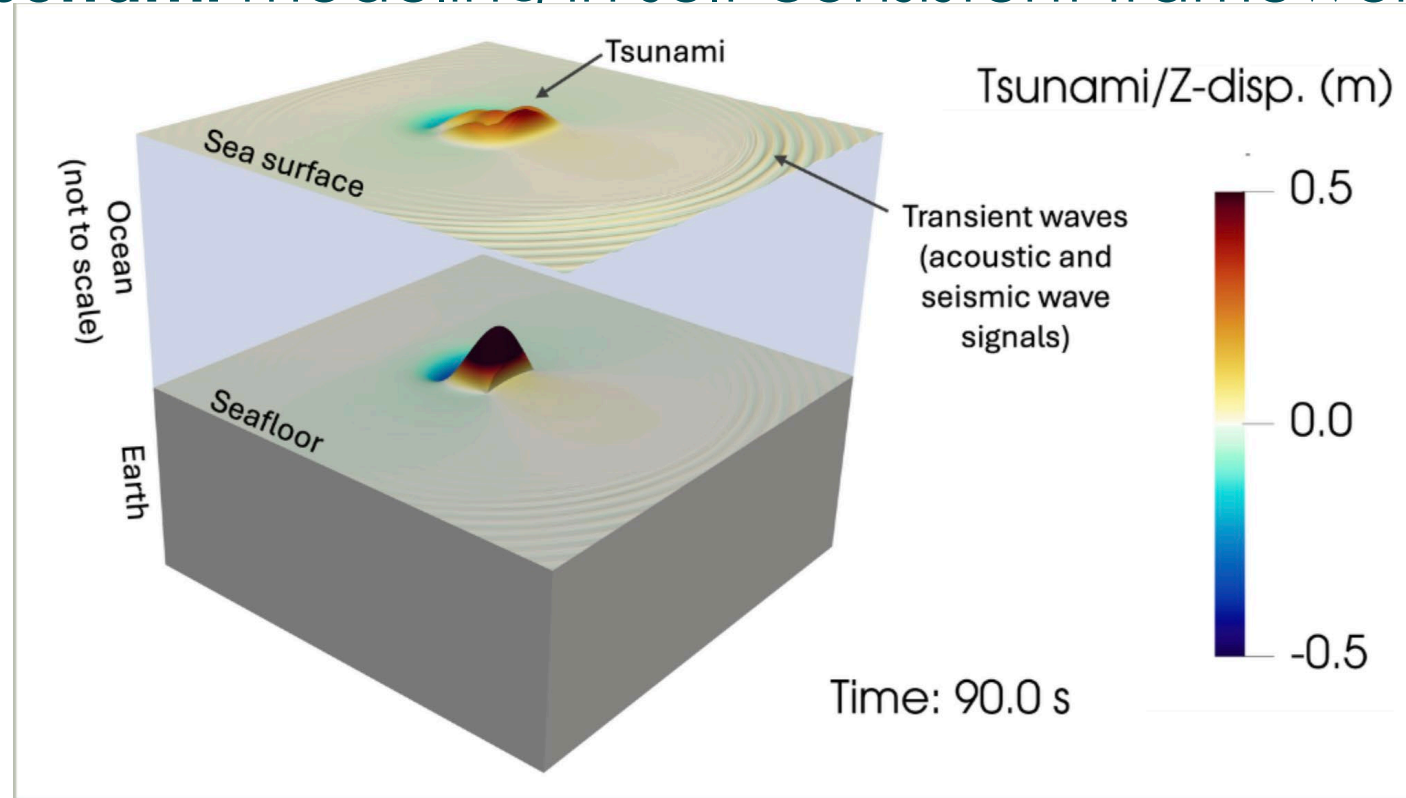


Figure by Fabian Kutschera and Loïc Bachelot

Ground Failure SIG

- Landslides, liquefaction, and lateral spreading are among the key cascading hazards of earthquakes in the PNW
- The SIG's goals are to:
 - bring together researchers on the potential for (and history of) seismic triggering of these effects
 - Consider them on a regionally-consistent, quantitative basis
 - Facilitate translation of the WG outputs to useful ground failure information



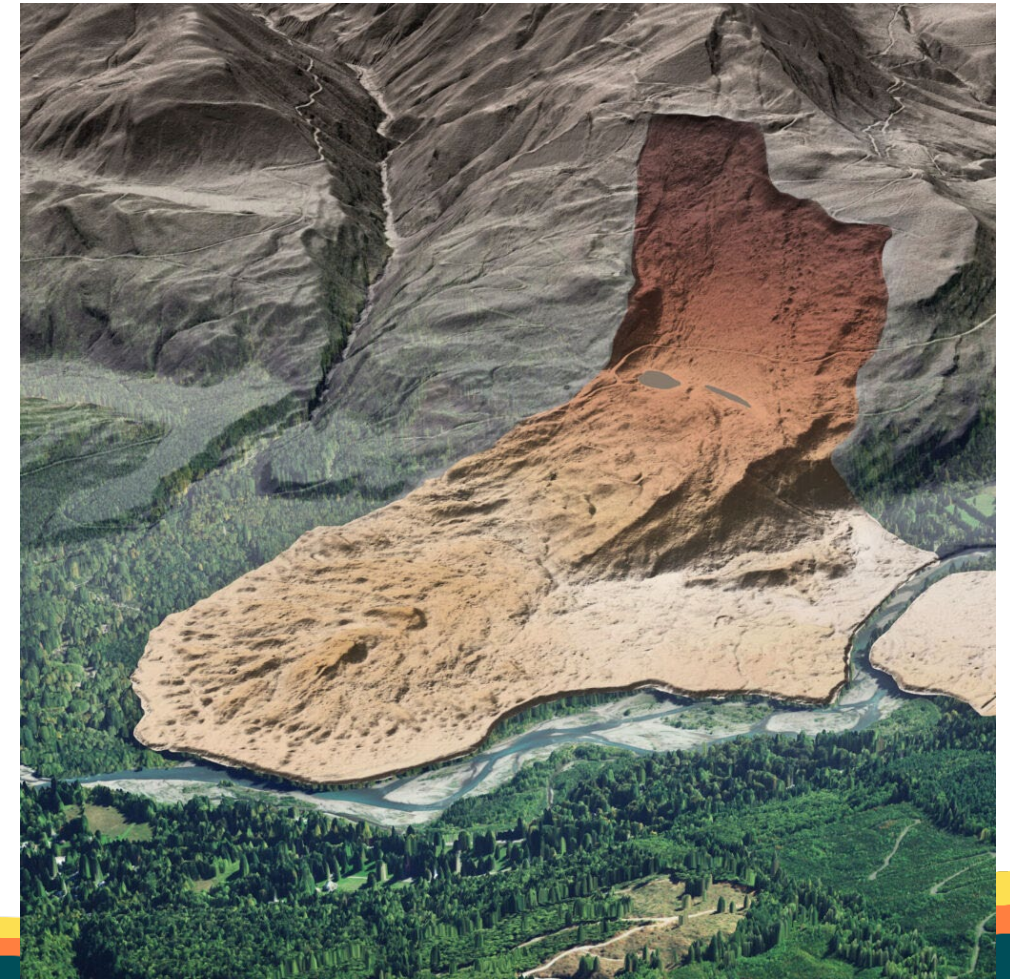
Ben Leshchinsky
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Oregon State University
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Michael Olsen
Oregon State University
michael.olsen@oregonstate.edu



Pieter-Ewald Share
Oregon State University
pieter.share@oregonstate.edu



Cascading Hazards: Landslides, Liquefaction and Ground Failure

- Earthquakes drive significant ground failure, directly affects post-earthquake recovery.
- **The Past:**
 - Leverage expertise and best science to better understand past Cascadia impacts.
 - Analysis of past landslides, liquefaction data to constrain past EQ shaking intensity.
- **The Present:**
 - Expand on CRESCENT science products to constrain ground failure impacts to communities, lifelines.
 - Develop tools for planners that enable more resilient design and emergency planning.
- **The Future:**
 - Evaluate how long hazards remain after shaking.
 - Evaluate best practices for recovery.



Ground Failure Workshop

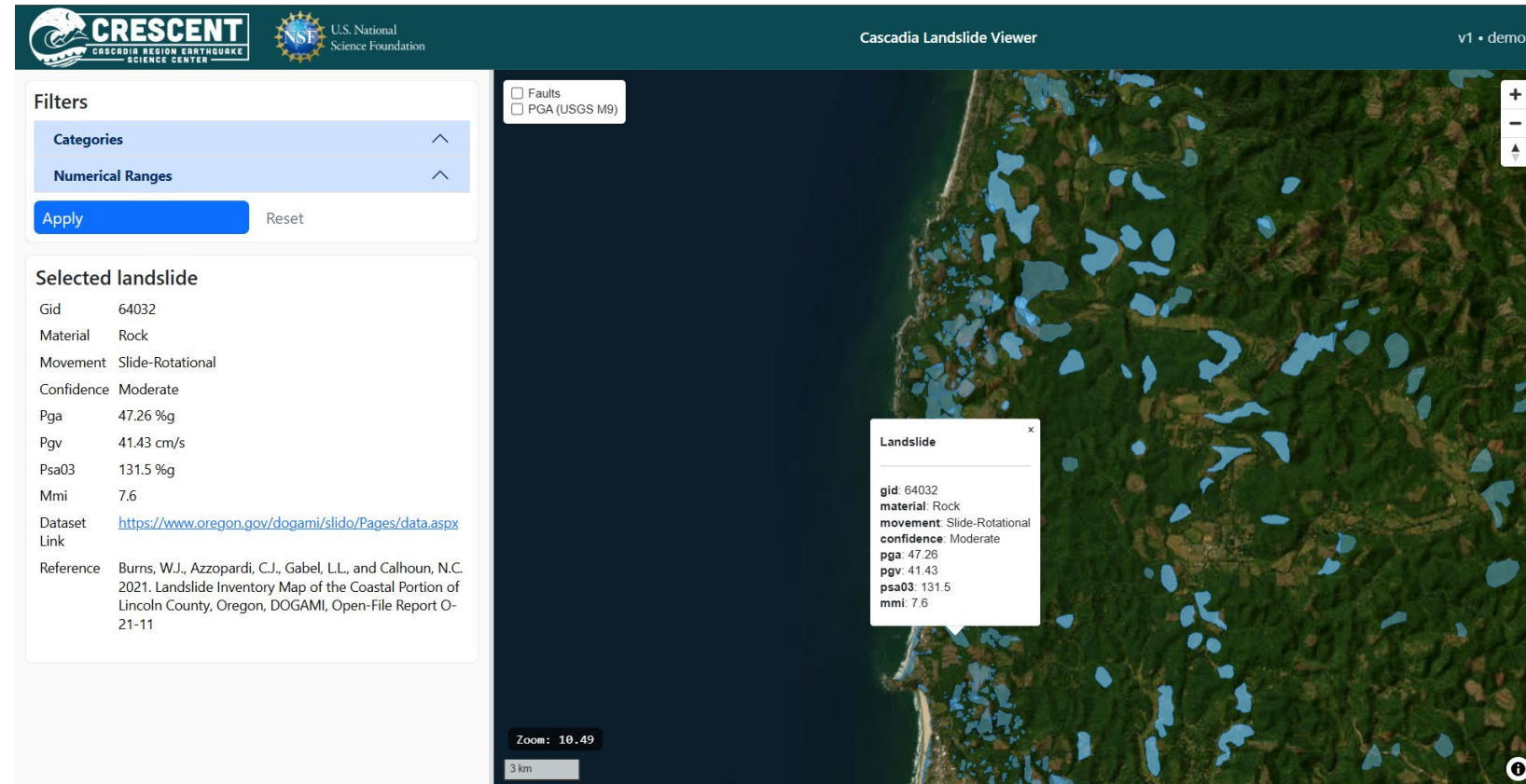
- **Hosted in-person Ground Failure workshop in Newport in March 2025**
 - >30 Attendees from across US, Canada
 - Planners, state/federal partners, researchers
 - Focused on state of knowledge, needs, opportunities based on objectives.
 - Consensus/discussion on important ground failure questions and needs in Cascadia.
- **Review Paper planned with three key themes:**
 - Looking at Ground Failure from Past EQs
 - Ground Failure on the Day of the EQ
 - The Legacy of EQs and Data Collection Strategies
 - Want to be involved? Reach out to Ben Leshchinsky!



Landslide Viewer



- New effort by Loic Bachelot, Prasaya Acharya, Ben Leshchinsky
- Hosting referenced landslide inventories from Canada, US.
- Consistent metadata for landslides.
- Can query, export data by M_w 9.0 PGA, PGV, landslide type, any metadata
- Upload function for sharing ground failure data online soon.
- Next steps: added functionality, curation of new databases, gathering feedback.



Ground Motion Models (GMM) SIG

- Take the knowledge coming from the other WGs – *fault architecture, rupture models, seismic velocity structure* – and translate that into state-of-the-art estimates of shaking
- Develop roadmaps to improved practice in the PNW



alex grant
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Norman Abrahamson
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Ground Motion Models (GMM) SIG

- Take the knowledge coming from the other WGs – *fault architecture, rupture models, seismic velocity structure* – and translate that into state-of-the-art estimates of shaking
- Develop roadmaps to improved practice in the PNW



postponed...

Offshore Observations SIG

- Advance the frontier of data collection relevant to the earthquake system beyond the shoreline
- Held a workshop yesterday!



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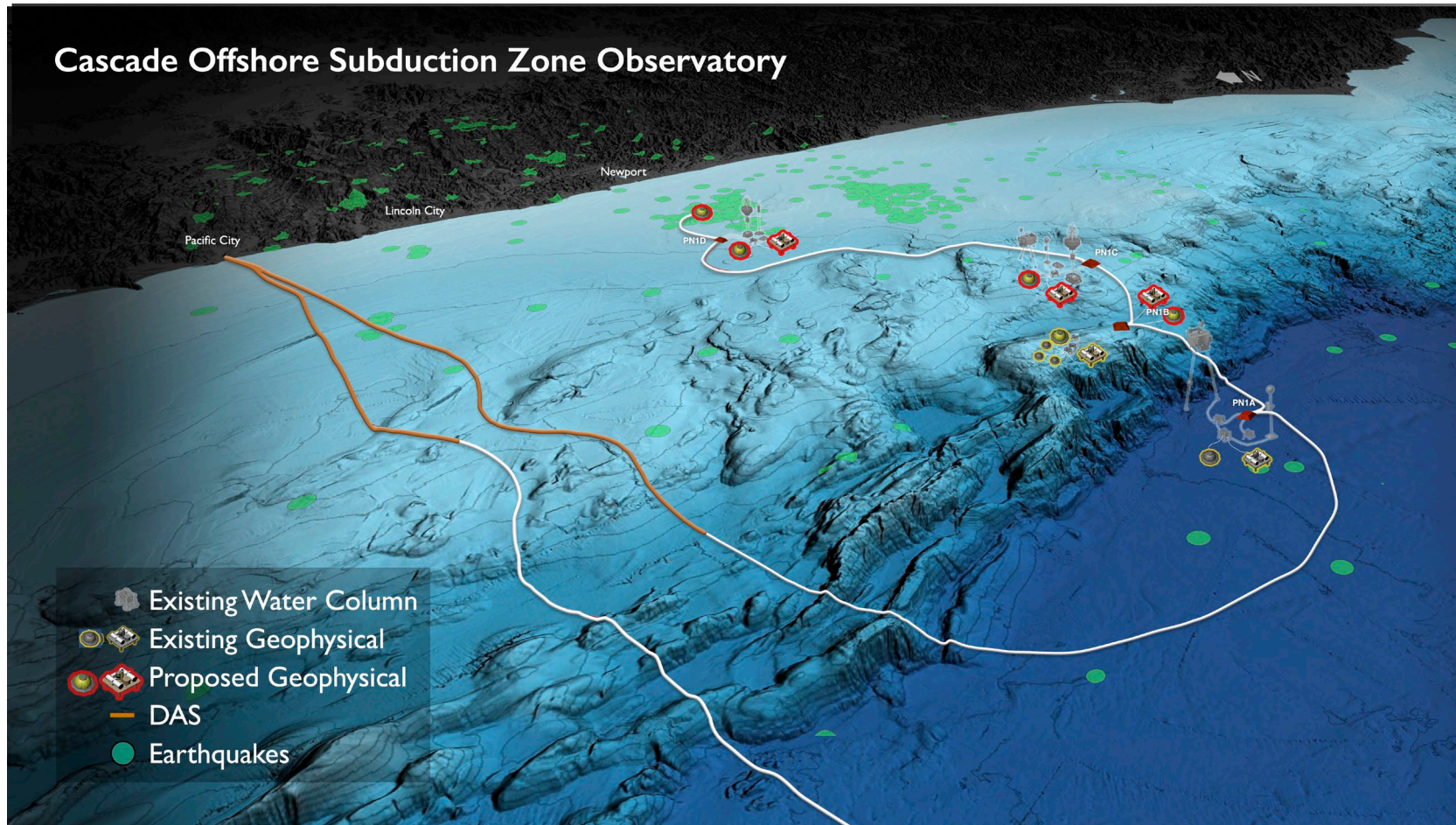


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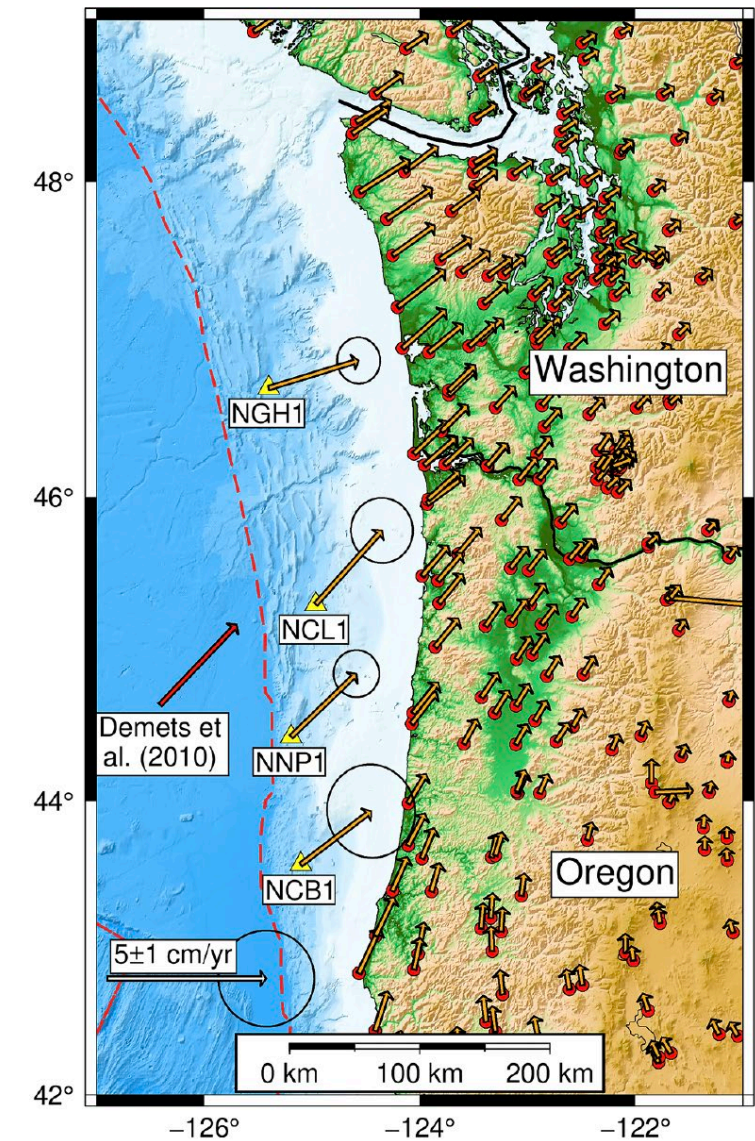


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Offshore Observations SIG



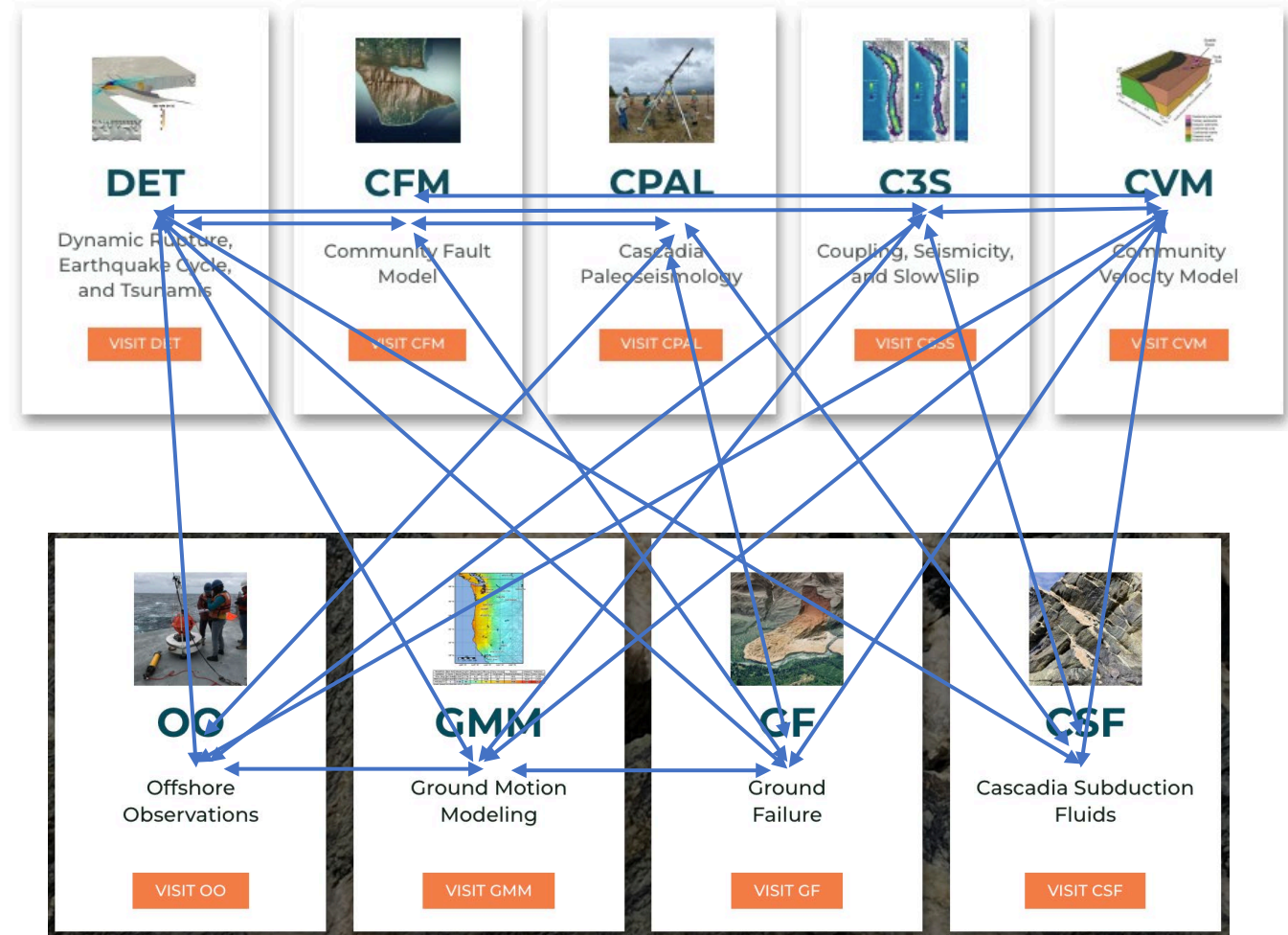
Cabled seafloor observatories



DeSanto et al., 2025 EPSL

Seafloor geodesy

CRESCENT is weaving a web of data, models, and methods while building a vibrant research community



The developing whole is much greater than the sum of its parts