CRESCENT/USGS Community Velocity Model Topical Workshop Introduction

V.J. Sahakian, 5/13/2024



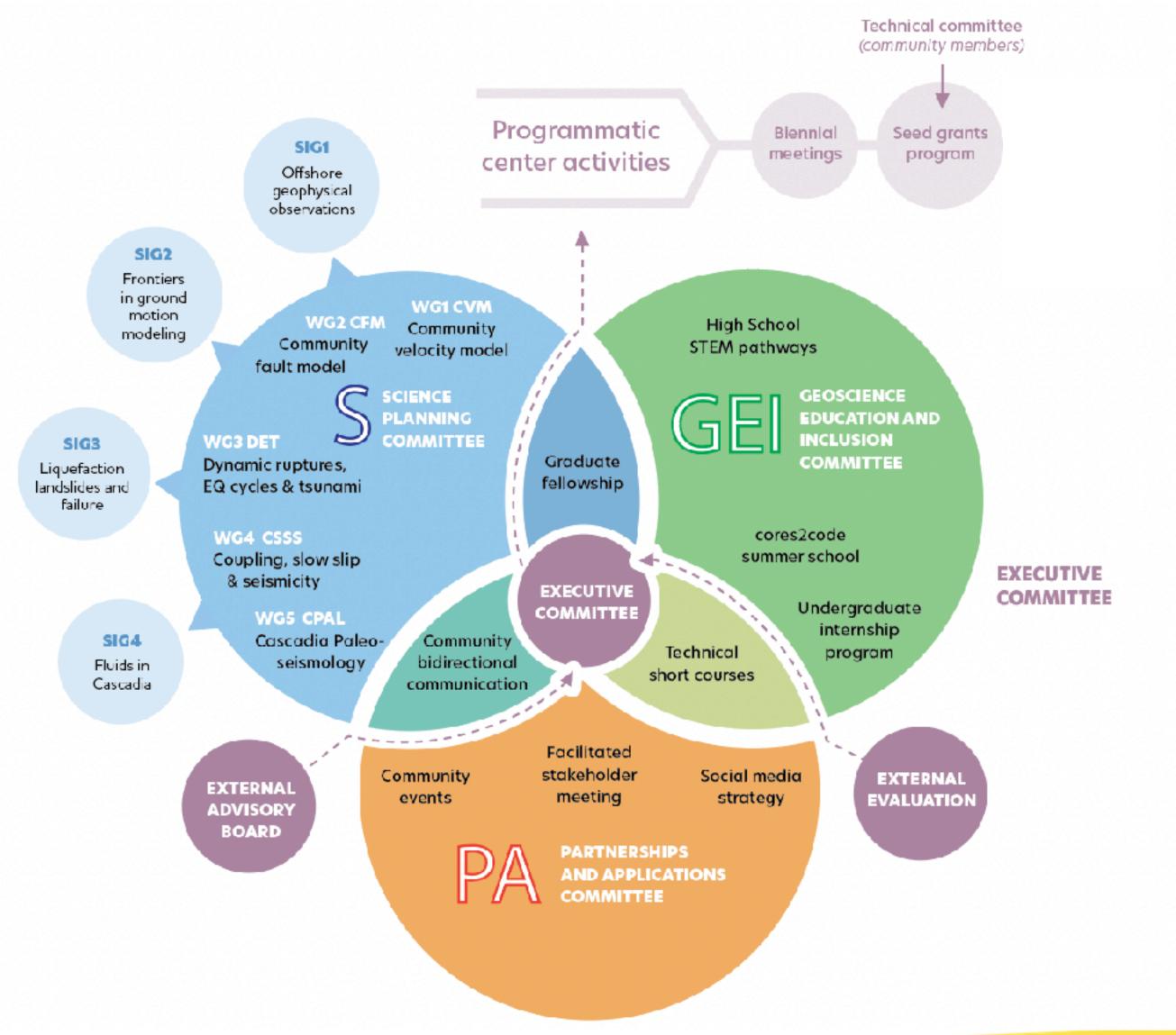


CRESCENT's 3 pillars

- 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.







CVM Godls:

- Generate versions of a 3D, observational-empirical-structural hybrid model, from N. California to S. British Columbia, with:
 - A large-scale regional base developed from inversions of seismological data,
 - Shallow and geotechnical data embedded +
 - Use geological constraints, empirical rock property relationships, and near-surface seismic information.

• Expected Uses:

- Compute Green's Functions for block models and strain modeling (C3S) +
- Seismicity relocation (C3S, CFM, Community) •
- Dynamic rupture simulations (DET)
- Ground-Motion Modeling (SIG2, Community) +
- Tectonics and Geodynamics (Community)





CVM Committee



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Starting June 2024:



Rasheed Ajala Columbia University



Work Plan

YEAR 1

- CVM topical workshop to gather input
- Compile regional-scale models of velocity and major discontinuities
 - Generate the Generation (Gen) 0 large-scale, onshore/offshore CVM

YEAR 2

- Perform validation and uncertainty analyses for the Gen 0 CVM
 - Compile data for shallow velocity structure and sediment-basement interface
 - Begin embedding shallow structure for the Gen 1 CVM





YEAR 3

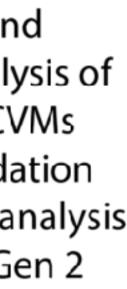
• Finish embedding the shallow structure, to complete the Gen 1 CVM • Embed USGS Geotechnical Layer to make a Gen 2 CVM

YEAR 4

- Begin validation and uncertainty analysis of Gen 1 CVM
- Complete and uncertainty analysis of Gen 1 and 2 CVMs
- Training Workshop on Geophysical Inversion and Interpretation

YEAR 5

- Complete and • uncertainty analysis of Gen 1 and 2 CVMs
- Complete validation and uncertainty analysis of Gen 1 and Gen 2 CVMs



Work Plan

P-wave Receiver Functions (uncertainty from bootstrapping/jacknifing)

Receiver Function + Ambient Noise Bayesian Joint Inversion considering prior uncertainties

Adjoint Full-waveform Inversion of ambient noise with "initial" model as Joint Inversion Vs Model Uncertainty analysis based on resulting misfits to primary input datasets Include topography in inversion?

Year

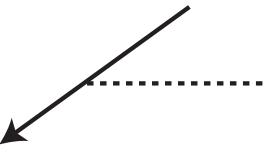
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INPUTS

Ambient Noise Tomography

(uncertainty obtained using Voronoi Tomography approach)



External? Offshore OBS CCs Longer period EQ SWs

DATA PRODUCTS

3D Adaptive Common Conversion Point Amplitude Model of Cascadia margin from receiver functions

2D frequency maps of ANT Phase Velocities from ?-50s

"Generation 0" Models* Joint Inversion (JI) base

1) 3D Vs Model with posterior uncertainties 2) Moho "surface" model

"Generation 1" Models* JI + Adjoint inversion base 3D Model* for initial use by other groups

Work Plan

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YEAR

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YEAR

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	Incorporation 1) Shallow \

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Adjoint Full-waveform Inversion ambient noise with "initial" model as Joint Inversion Vs Model Uncertainty analysis based on resulting misfits to primary input datasets Include topography in inversion?



"Generation 2" Models

3D Model with offshore structure constrained by imaging, shallow structure, and constraints on basins Include Vp constraints where available??

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Bostock

pre discontinui-

Incorporation of shallow velocity structures (~5km lateral, 1-2km depth resolution)

- 1) Jointly analyze noise-based data at higher frequencies and local passive sources (Vp and Vs)
 - A. Include CASIE nodal array
 - B. Incorporate basin/sedimentary properties from active source data/other models (e.g., USGS, Molnar, Sahakian etc.) where available

"Generation 3" Models Gen2 model + geotechnical layer / CFM constraints

of Geotechnical Layer (~<200m) Vs profiles and proxies

Model Validation comparing observed waveform characteristics to SW4 output 1) Small regional sources

> 2) Predominantly shallower structure resolution

Model Performance Metrics Constraints on regions and characteristics of model performance

Workshop Goals:

- Build CVM Community and collaborations
- Learn about and synthesize community needs for a CVM, to incorporate into the Working Group's workflow and considerations as much as possible
- Tutorial and feedback on community tools for model conversion, access, and sampling
- Discuss model repository (for model merging, other community uses)







Talks featuring expected uses of the CVM Breakout Groups to discuss needs and uses of the CVM



