Access to California Velocity Models Using SCEC UCVM v25.7

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Introduction

The SCEC UCVM is a unified framework for accessing, comparing, and using community seismic velocity models in ground motion modeling and wave propagation simulations

Why UCVM v25.7 Matters

- Broader access to regional and statewide velocity models that reflect the latest subsurface imaging efforts
- Better support for comparative and ensemble modeling across different CVMs
- More robust component-based software architecture makes the open-source software more extensible and sustainable
- Streamlined tools to bring these models into simulation, hazard, and inversion workflows.

What is new

UCVM v25.7 introduces five new CVMs covering regions from Northern to Southern California

The following plots display shear-wave velocity (VS) at a depth of 1 km, generated using the latest plotting features available in the CVM Explorer.

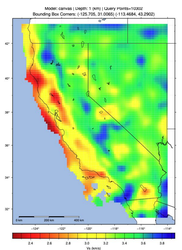

Figure 1.1: California-Nevada Adjoint Simulation Model (canvas)

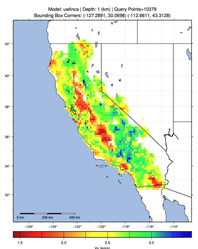

Figure 1.2: UW Statewide California Model (uwlinca)

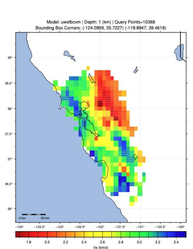

Figure 1.3: UW San Francisco Bay Regional Model (uwsfbcvm)

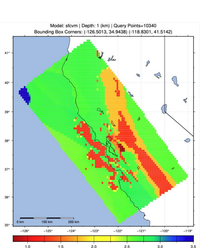

Figure 1.4: USGS San Francisco Bay Region Model (sfcvm)

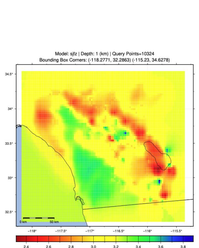

Figure 1.5: San Jacinto Fault Zone Model (sjfz)

Improvements to the UCVM platform

- **Plugin Architecture** – CVMs are now dynamically loaded, allowing modular updates and lightweight deployments
- **JSON-based Configuration** – New setup scripts simplify installation and reproducibility
- **External Data Mounting** – Users can mount large model datasets externally to speed installation and reduce system memory usage
- **Modern Software Stack** – Includes updated support for geospatial libraries (e.g., Proj 8)

Integration and Container Support

- **Container Builds** – Verified builds using Docker and Apptainer/Singularity
- **Web tool** – Integrated with SCEC CVM explorer for web-based model data access and visualization
- **Integration testing** – Continuous integration testing enabled via GitHub Actions

Future Work

- **Standardize Input Formats** – Streamline integration of candidate velocity models by adopting a limited set of standardized input formats and metadata schemas
- **Automate Access Interface Generation** –Use templated code structures to automate the creation of model access interfaces, reducing manual effort and ensuring consistency
- **Support Variable Mesh Resolutions** – Enable flexible model deployment by accommodating velocity models with differing spatial resolutions
- **Collaborate with Geoscientists** – Continue to identify and incorporate new models of interest into UCVM

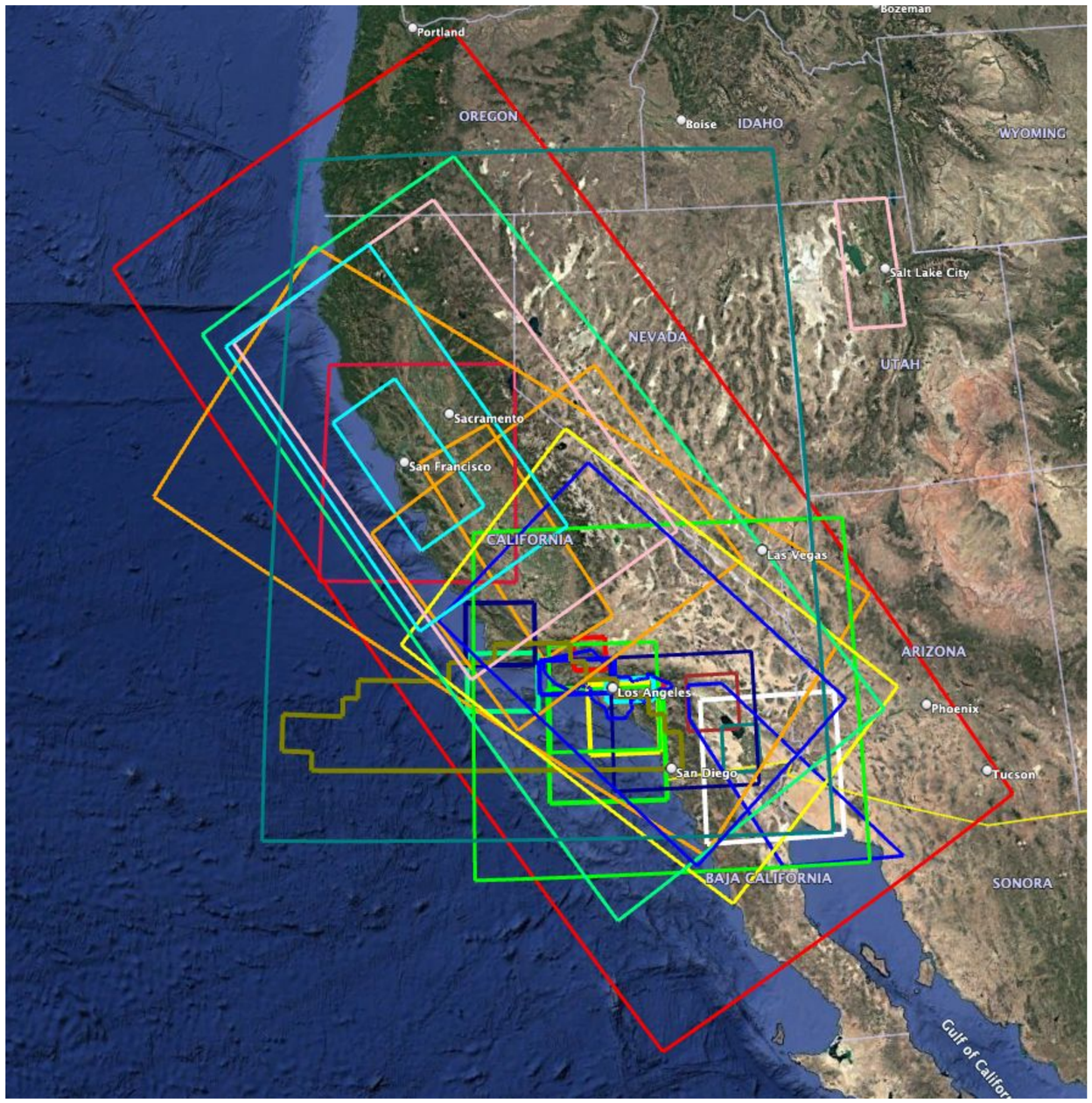

Figure 2: Coverage region for UCVM 2D maps (large red rectangle) overlaid with various velocity models (ordered from north to south and right to left). CANVAS: green rectangle, UW statewide: large spring green rectangle, Wasatch front Utah: small pink rectangle to the right, CS248 Cybershake Study's Tiled Velocity Model: large pink rectangle CVM-H high resolution: small spring green square, CVM-H low resolution: larger spring green square, CS17.3, CS17.3-H: large orange rectangle, CVM-H San Joaquin Basin Model: small orange long rectangle, USGS High Resolution Bay Area: small teal rectangle, USGS Low Resolution Bay Area: large teal rectangle, UW San Francisco Bay: large red square, CCA 06: orange rectangle in the mid state , CVM-S4.26, CVM-S4.26M01: large yellow rectangle, CVM-S4: navy, CVM-S4 geotechnical regions: navy polygons, CVM-S4.26, CVM-S4.26M01: large yellow rectangle, CVM-H Santa Maria Basin: small navy square, CVM-H Ridge Basin: small red square, Albacore: irregular mustard green, CVM-H Santa Barbara Channel Basin: spring green square, CVM-H Ventura Basin: navy square, San Jacinto Fault Zone: large black square, CVM-H San Gabriel Basin: small teal rectangle, CVM-H LA Basin: small yellow square, CVM-H Inner Borderland Basin: large bright green square, CVM-H San Bernardino Basin: small red square, SSIP Coachella Valley: small dark red square, CVM-H Salton Trough Basin: large white square, SSIP Imperial Valley: small green rectangle.

Abstract @SCEC

UCVM v25.7 @zenodo

CVM References @Github wiki page

Acknowledgements

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