Expanding UCVM with New Models, Methodologies, and Data Formats

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Introduction

The Statewide California Earthquake Center (SCEC) Unified Community Velocity Model (UCVM) framework provides a standardized platform for accessing, integrating, and querying three-dimensional seismic velocity models for use in ground motion modeling and high-resolution 3D wave propagation simulations. As community models continue to grow in geographic coverage, complexity, and data volume, UCVM must support rapid integration of new models, modern storage formats, and simulation workflows that extend beyond existing model boundaries.

What's New

- **Integrated MUSCALNC and SJQBN community velocity models into UCVM**
- **Developed a nearest-neighbor boundary extension method for consistent model extension**
- **Added native support for NetCDF and TileDB model formats**

New Velocity Models

Multi-Scale Statewide California Velocity Model (MUSCALNC)*

Figure 1.1: MUSCALNC model boundary

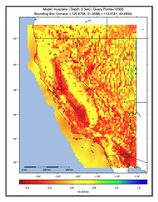

Figure 1.2: horizontal slice of Vs at 0 km depth

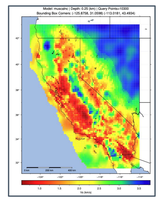

Figure 1.3: horizontal slice of Vs at 0.25 km depth

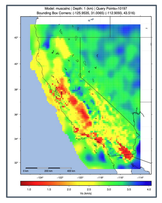

Figure 1.4: horizontal slice of Vs at 1 km depth

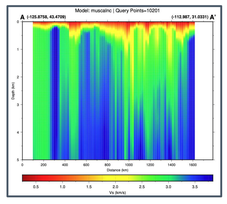

Figure 1.5: vertical cross section of Vs extending from 0 km to 5 km depth

San Joaquin Basin Model (SJQBN)**

Figure 2.1: SJQBN model boundary

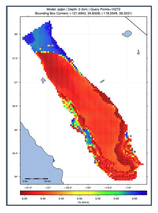

Figure 2.2: horizontal slice of Vs at 0 km depth

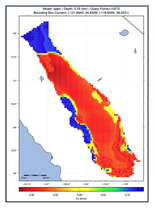

Figure 2.3: horizontal slice of Vs at 0.25 km depth

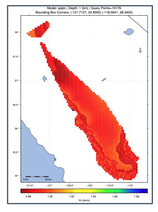

Figure 2.4: horizontal slice of Vs at 1 km depth

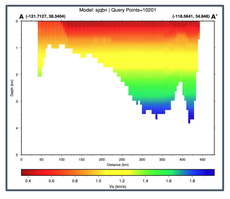

Figure 2.5: vertical cross section of Vs extending from 0 km to 5 km depth

Nearest-Neighbor Background (NNB) Methodology

- **Extract model vertical boundary polygons**
- **For locations outside the model domain, the NNB method assigns properties from the nearest boundary point**

The NNB method extends model properties beyond the original domain while preserving model continuity and reducing boundary artifacts. (ROI = ○)

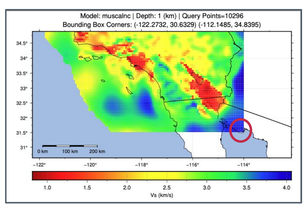

Figure 3.1: horizontal slice of Vs at 1 km depth with no background

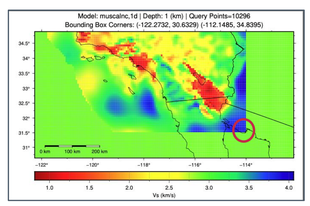

Figure 3.2: horizontal slice of Vs at 1 km depth with 1D background

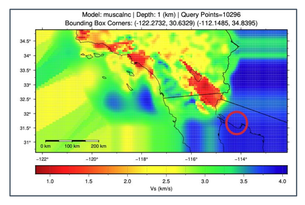

Figure 3.3: horizontal slice of Vs at 1 km depth with NNB background

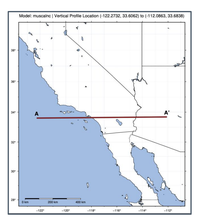

Figure 4.1: Vs vertical cross section baseline

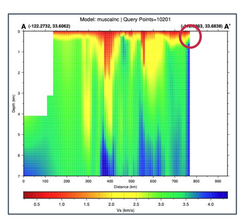

Figure 4.2: Vs vertical cross section of MUSCALNC

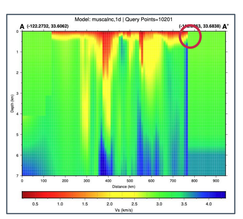

Figure 4.3: Vs vertical cross section of MUSCALNC with 1D background

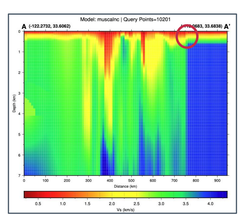

Figure 4.4: Vs vertical cross section of MUSCALNC with NNB background

Support for New Model Data Formats

Native integration of **NetCDF** and **TileDB** datasets

Building the Foundation for UCVM-NEXT

The integration of new community models, support for modern data formats, and development of methods for extending models beyond their original domains establish key capabilities for **UCVM-NEXT**, a multi-year effort to modernize UCVM as a scalable and extensible platform for the next generation of community velocity models and earthquake simulations.

UCVM-NEXT will build on this foundation by :

- **Streamlining integration of new community velocity models**
- **Expanding support for modern data storage technologies**
- **Improving metadata management and model provenance tracking**
- **Enhancing scalability for large-scale simulation workflows**

References and Acknowledgements

* Yeh, T.-Y., Y. Ben-Zion, and K. B. Olsen, 2026. Multi-Scale P and S Seismic Velocity Models of California and Western Nevada, JGR, in review

** Shaw, J., & Plesch, A. (2016). Development of a Unified Structural Representation for Central California (Final Technical Report No. SCEC Award 15029). Los Angeles, CA: Statewide California Earthquake Center

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