Efforts to Improve the CVM-H
SCEC CVM workshop 2019
3D velocity structures are inherently complex, presenting challenges in their representation.

- Velocity structure is heterogeneous over a wide range of scales.
- Velocity measurements vary in type, abundance, scale, and frequency.
- Tectonically active regions generally have complex structures that reflect a long geologic history.
Basin structure of the California Crust

**Coastal basins**
- Southern California coastal basins (Los Angeles, Ventura-Santa Barbara, Santa Maria) formed during early Tertiary transtension associated with block rotations.
- Late Tertiary thrusting and sedimentation led to further basin subsidence.

Plesch et al., (2010)

Hauksson (2000)
USR development workflow begins with the definition of geological and geophysical horizons that represent important velocity interfaces.
Basement structure in the SCEC CVM/USR

Basement structure is defined by surface geology, seismic reflection and refraction surveys, wellbore data, and potential field measurements.
Volumetric description of basin sediments

Süss & Shaw (2003)
Industry sonic logs

- Well with sonic velocities
- Shotpoint with stacking velocities

Map showing well locations and velocity logs with a focus on the top basement.
Industry data coverage

- 100,000 km 2D seismic data
- 3D seismic surveys
- 10,000 wells
Velocity parameterization through geostatistics - kriging

Velocity data in Inner California Borderlands

Variance analysis

Define correlation ellipsoid

Rivero et al., 2004
Rule based velocity structure

Velocity gradients as a function of total basin depth

Salton Trough

Lovely et al., (2007)
Velocity as a function of depth and total basin depth

Salton Trough

Lovely et al., (2007)
Geostat based
Rule based (D)
Rule based (D & D)
Improve by applying methods more systematically and reproducably, or by identifying new methods:

- Database effort to collate collected data sets into open formats
- Enhance metadata
- Apply kriging with trend throughout
- Collect used rules, reassess
- Apply rules consistently
Basins for CCA-06

CVM-H basins as a modular component
Embedding basins

Inversion resolves San Joaquin and Santa Maria basins

CVM has well defined basin velocities

Combination by embedding
Extracting the Santa Maria basin

- Extracted from CVMH-15.10
- Isolated from Santa Barbara Channel model
- Complex basin boundary
- 150 x 150 x 200 cells
- 1000m x 1000m x 100m resolution
- Ca. 96000 basin cells
Grid challenges

- Squashed basin grid needs to be mapped to CCA grid
- By nearest neighbour
- Could also be by interpolation from nearest neighbours
- Due to discretization some nearest neighbours for the surface level ($z = 0m$) are above ground level (air).
Santa Maria basin embedded
Potential opportunities for CVM-H improvement efforts

• basement surface: critical as it is a strong velocity interface and serves as a container for basin models; involves incremental update of basin parametrization; how to leverage existing model best?

• systematic reparametrization of basins: start with extensive data collation and organization effort?

• improve family of CVMs by ‘cross-pollination’: start with embedding?