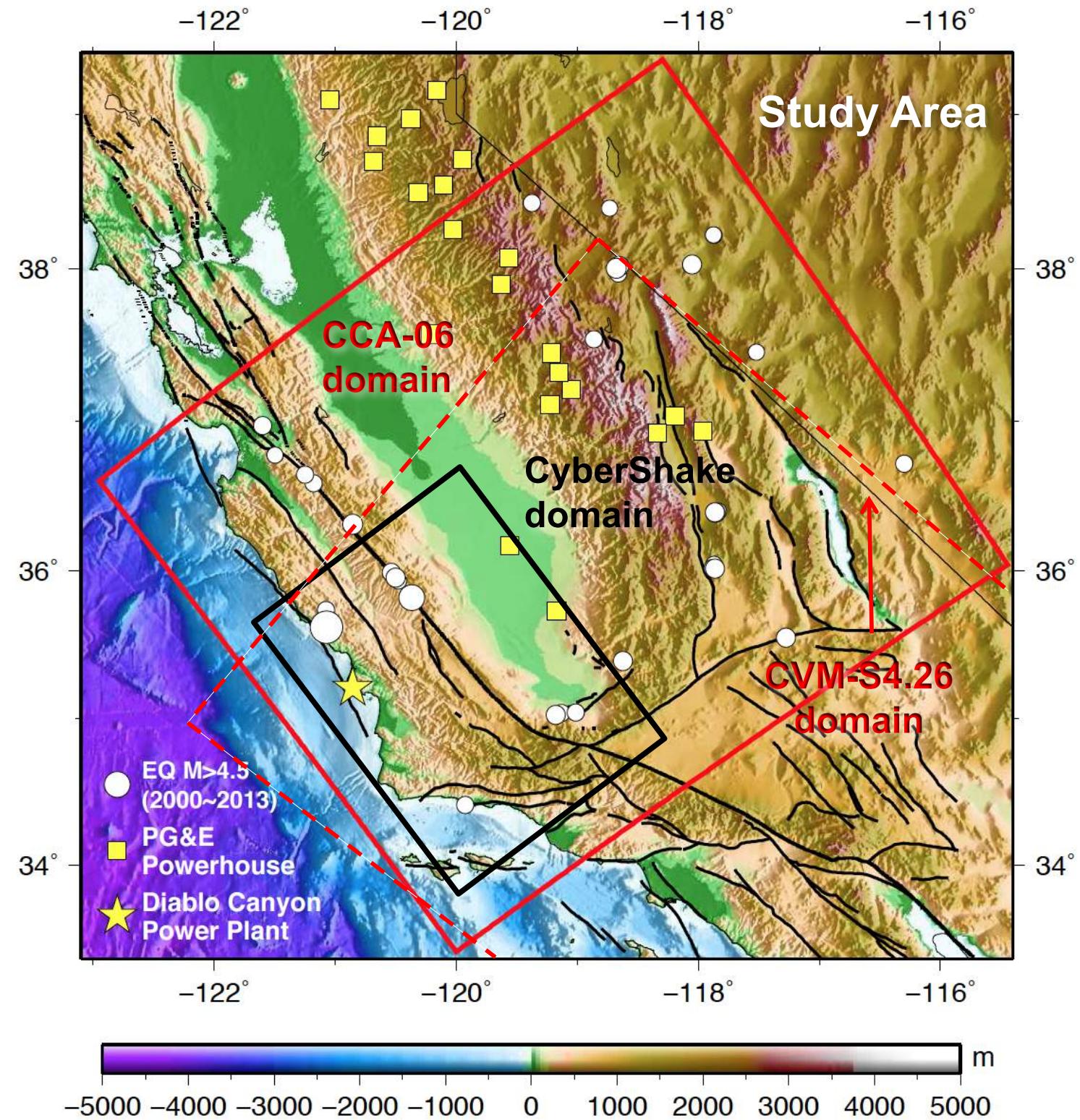


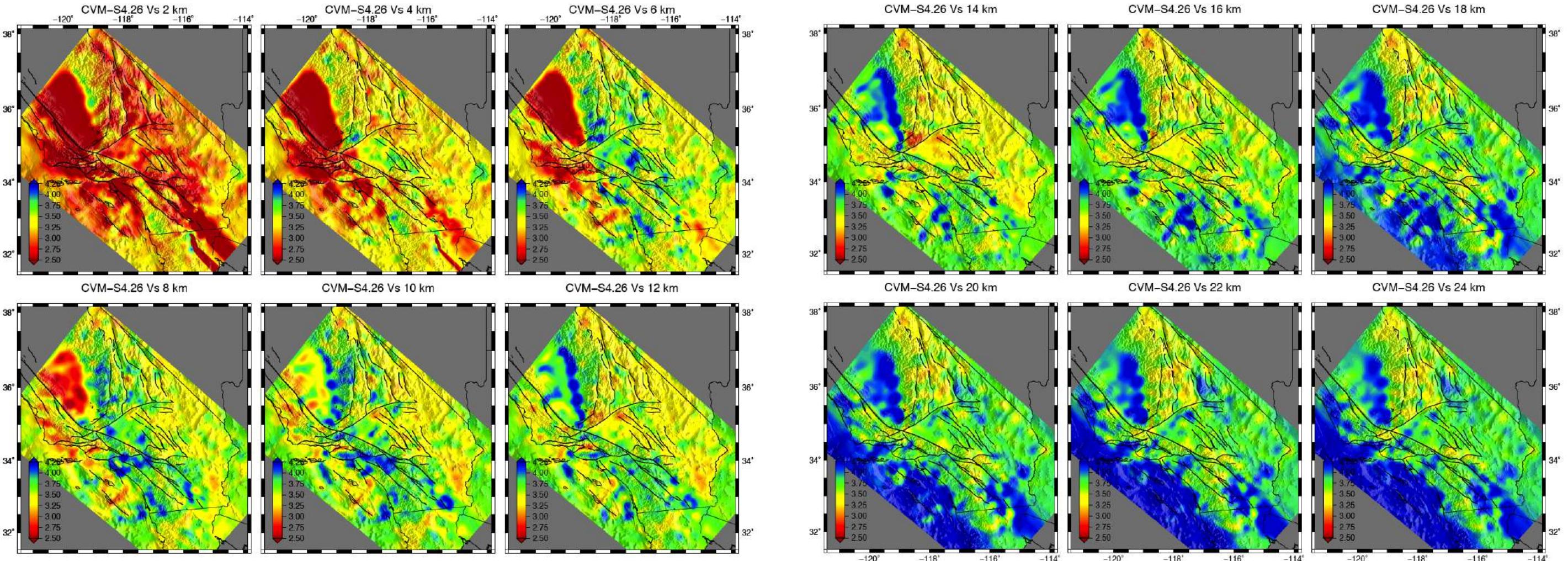
SCEC Central Coast Seismic Velocity Model

Tom Jordan & Scott Callaghan
USC/SCEC

Central California Seismic Project

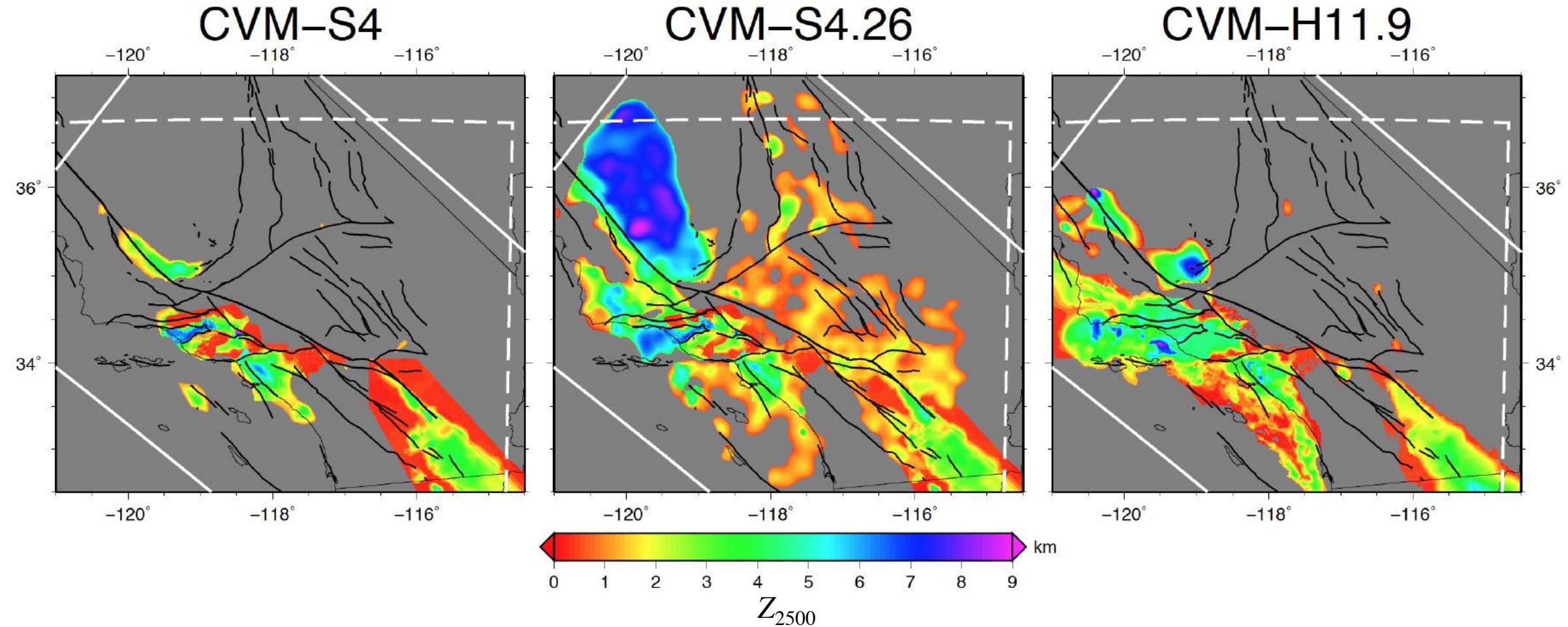


CVM-S4.26 (Lee et al., 2014)



- CVM-S4 starting model
- 26th iterate of a full-3D tomographic (F3DT) inversion procedure using 550,000 differential waveform measurements at $f \leq 0.2$ Hz
 - 38,000 earthquake seismograms
 - 12,000 ambient-noise Green functions

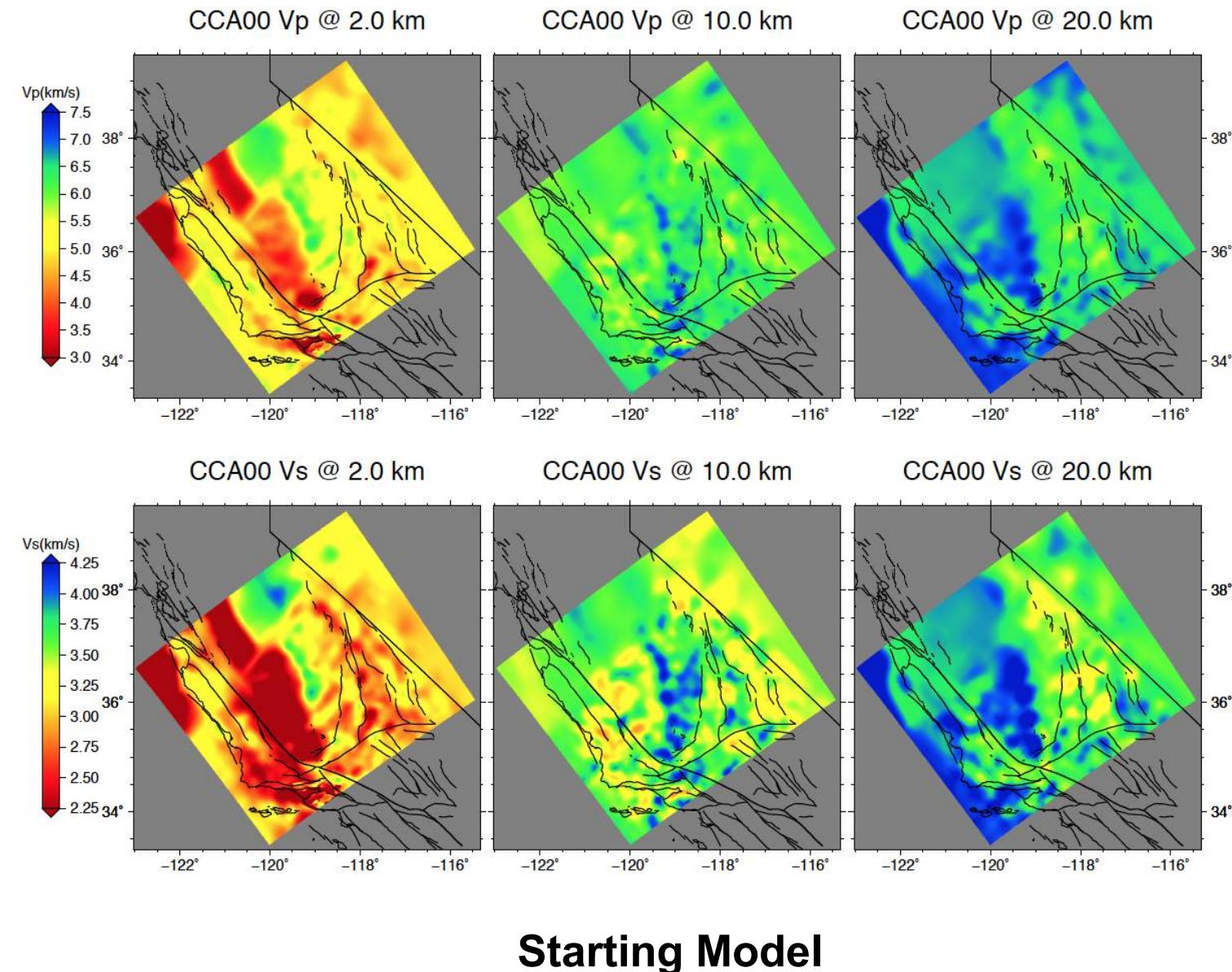
Basin Structures



Z_{2500} : iso-velocity surfaces at $V_S = 2.5$ km/s

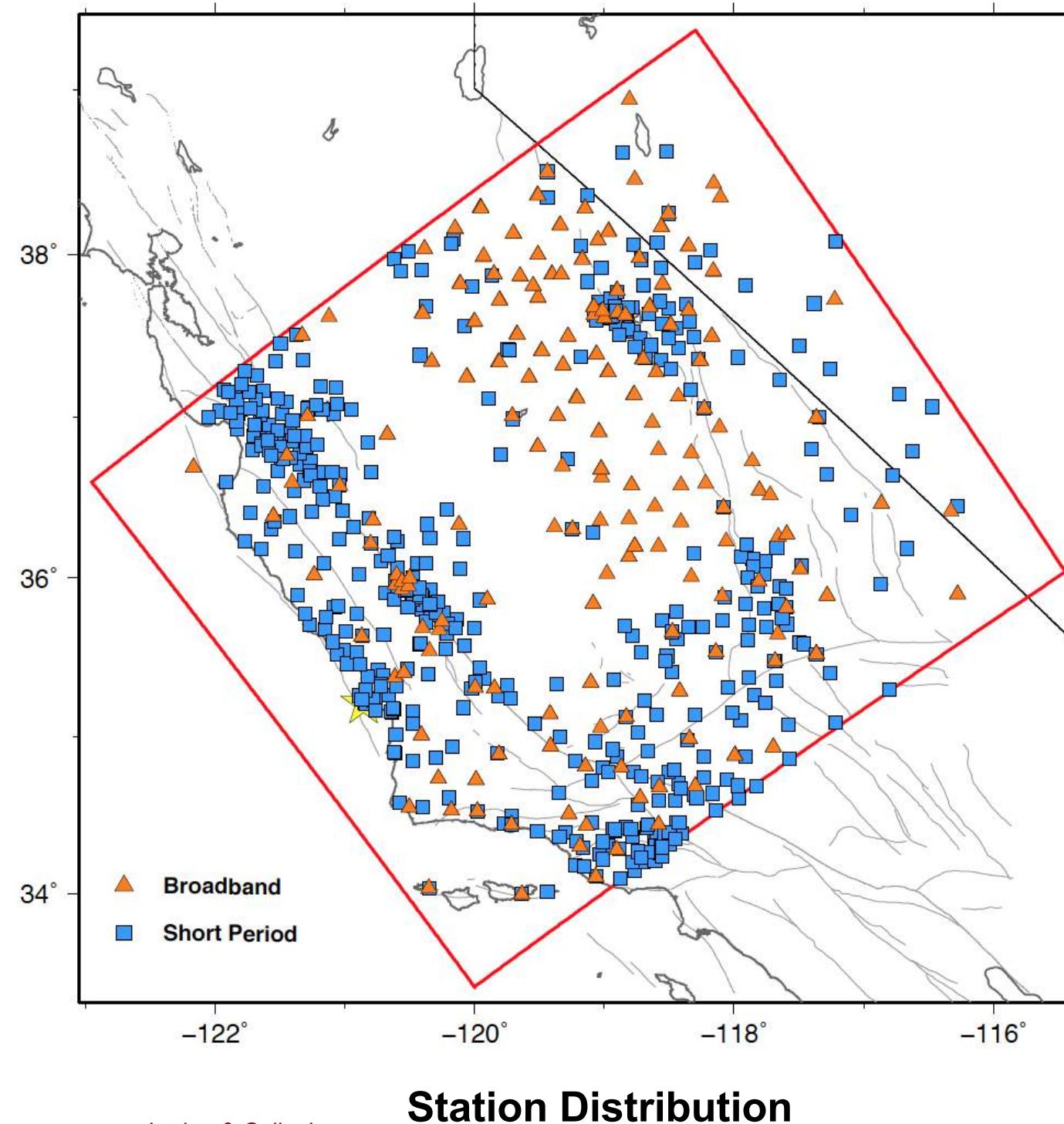
Development of CCA Velocity Models

- F3DT inversions represented on a 500-m mesh
 - 512 x 448 x 50 km
 - 91,750,400 nodes
- Starting model
 - USGS Bay Area 08.3.0 in NoCal
 - CVM-S4.26 in SoCal
 - Lin-Thurber elsewhere
- Inversions performed on ALCF's *Mira* supercomputer
 - 6th iteration of Stanford ANGF dataset



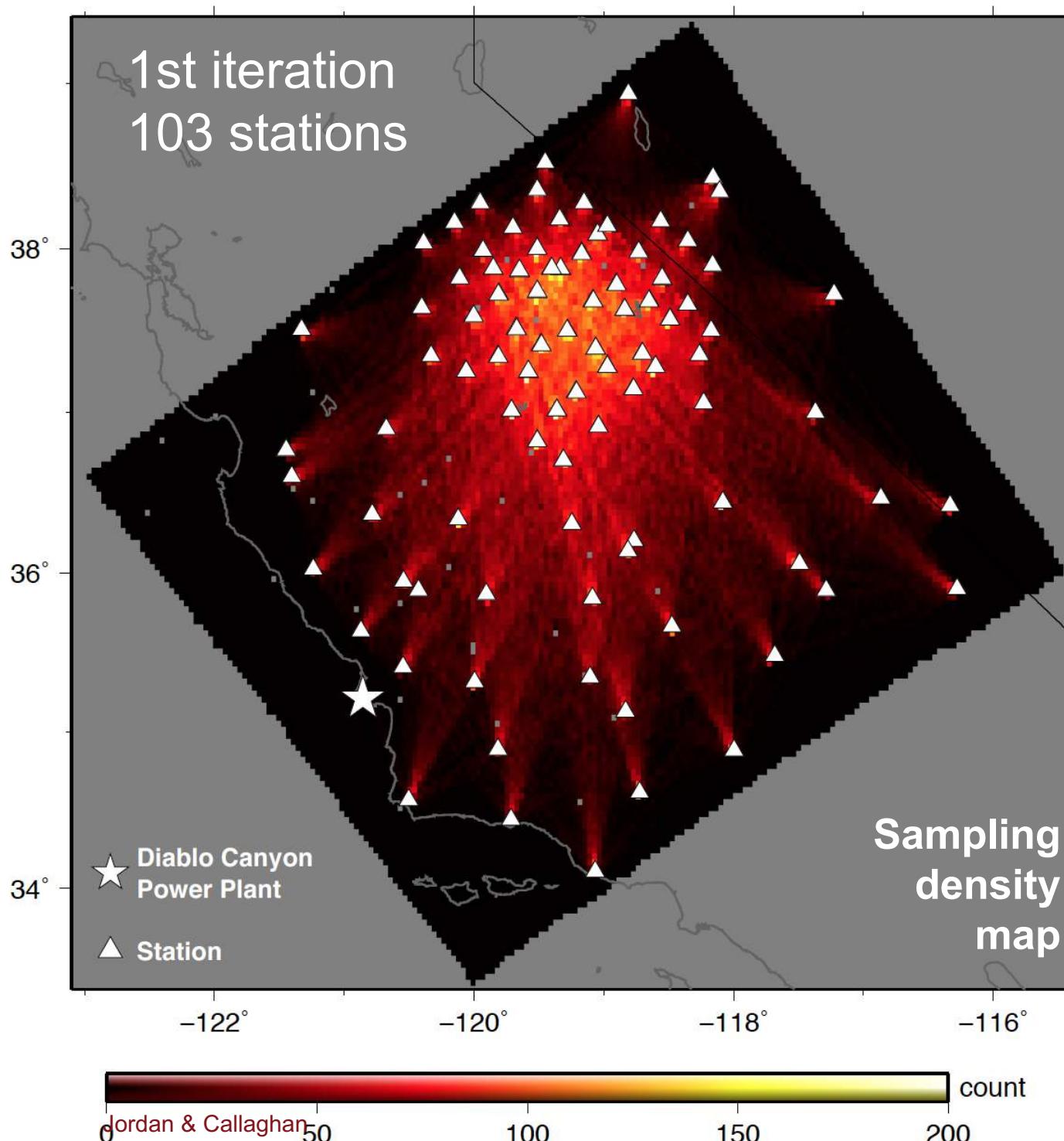
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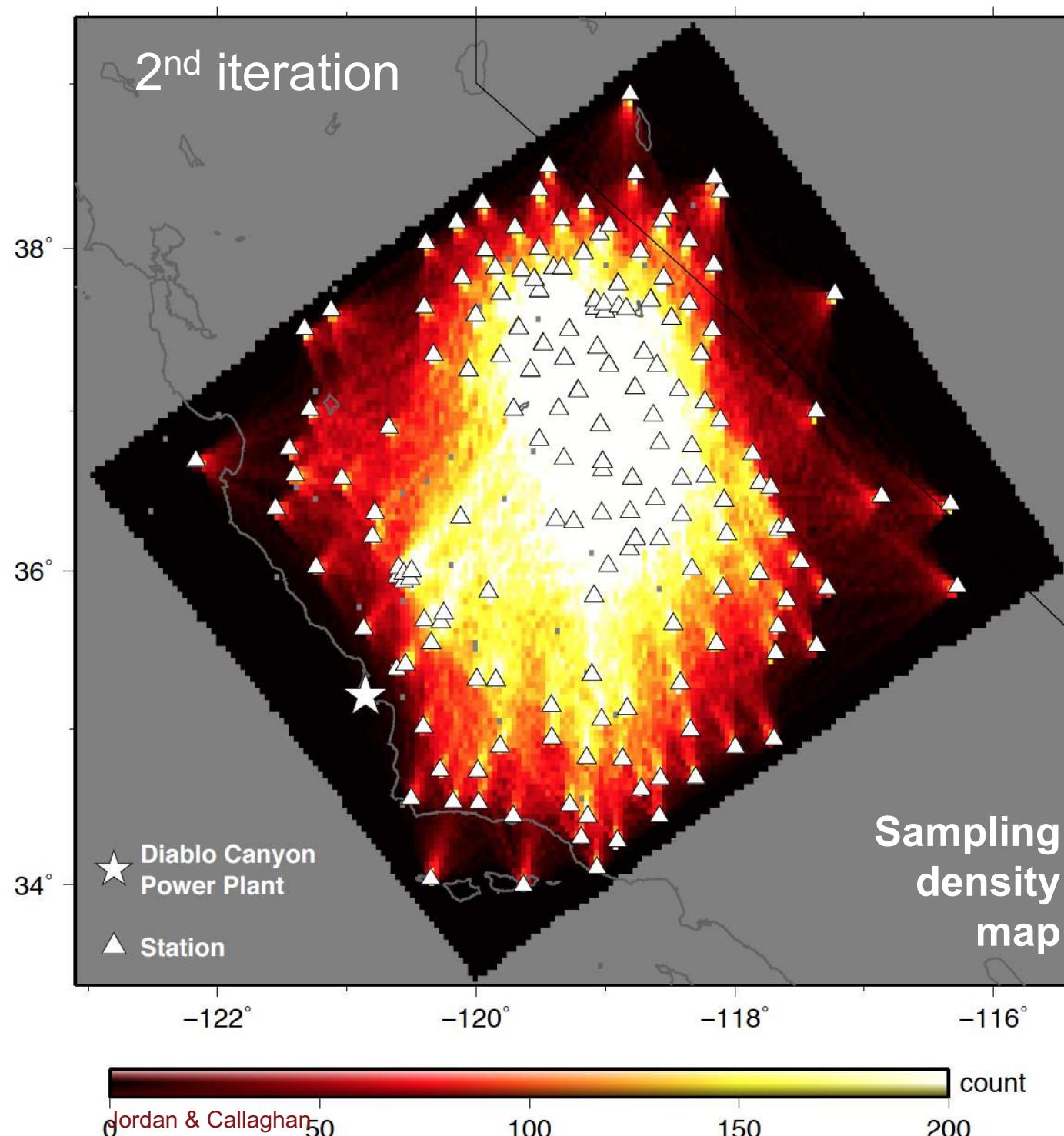
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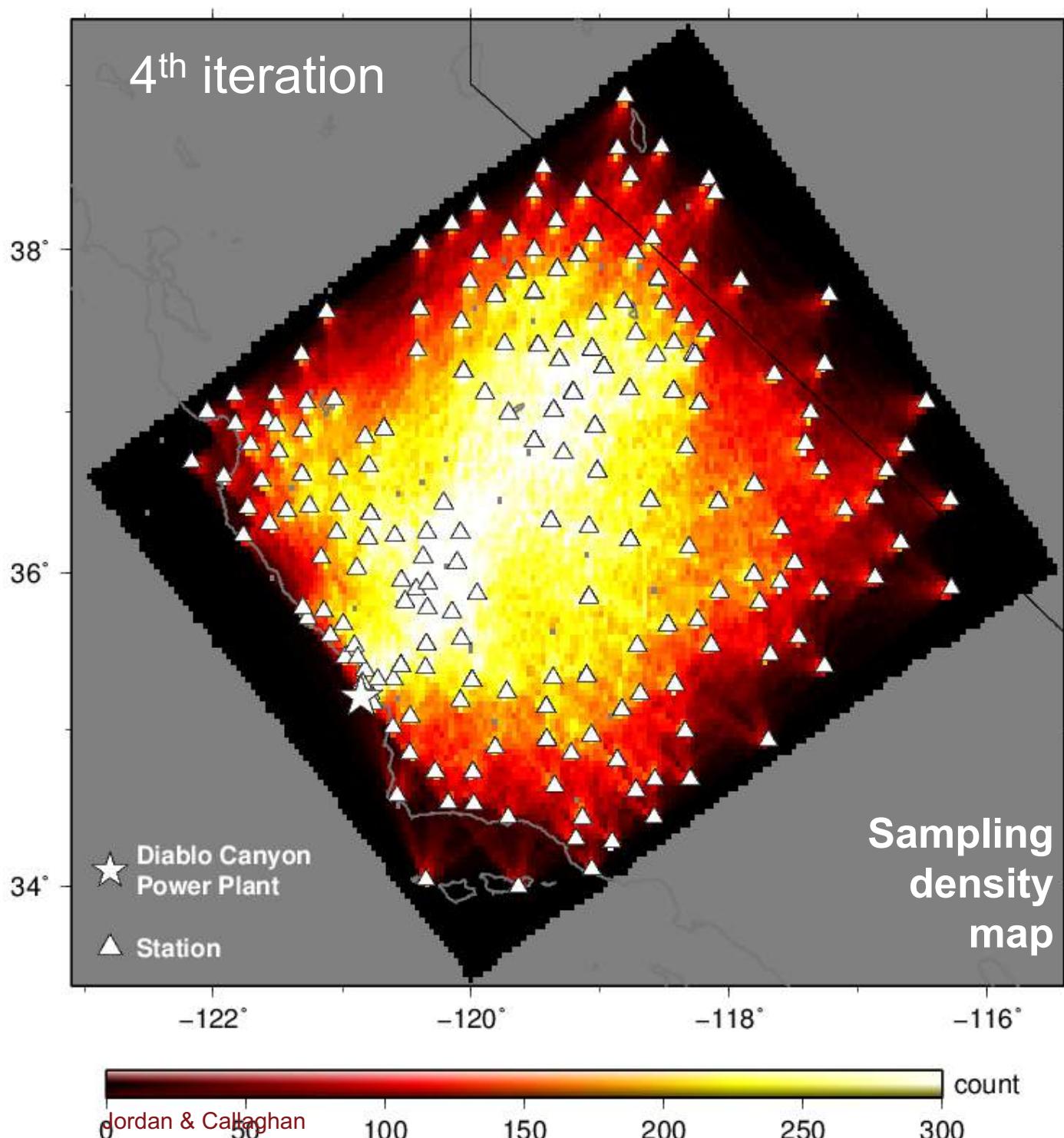
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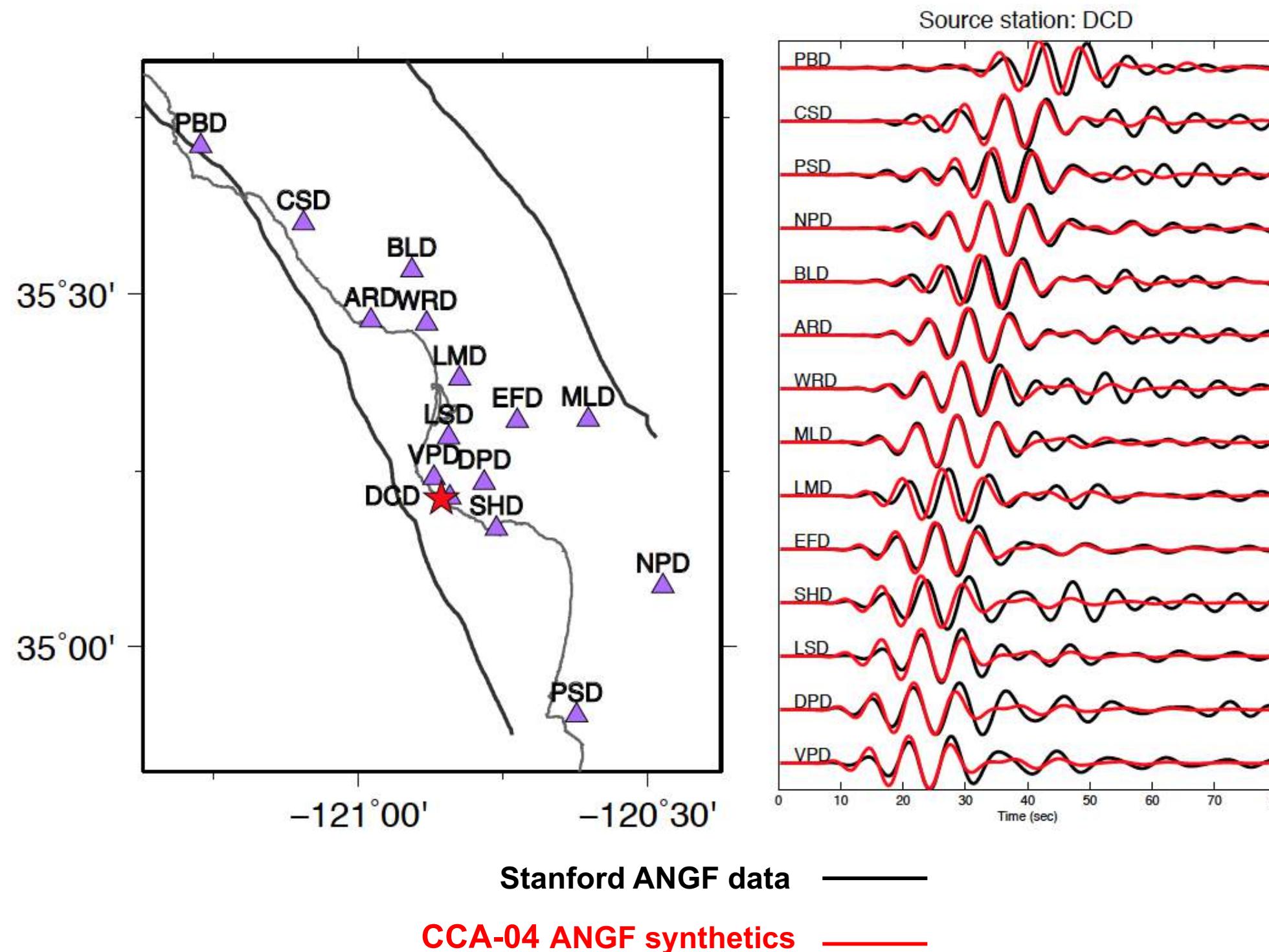


Development of CCA Velocity Models

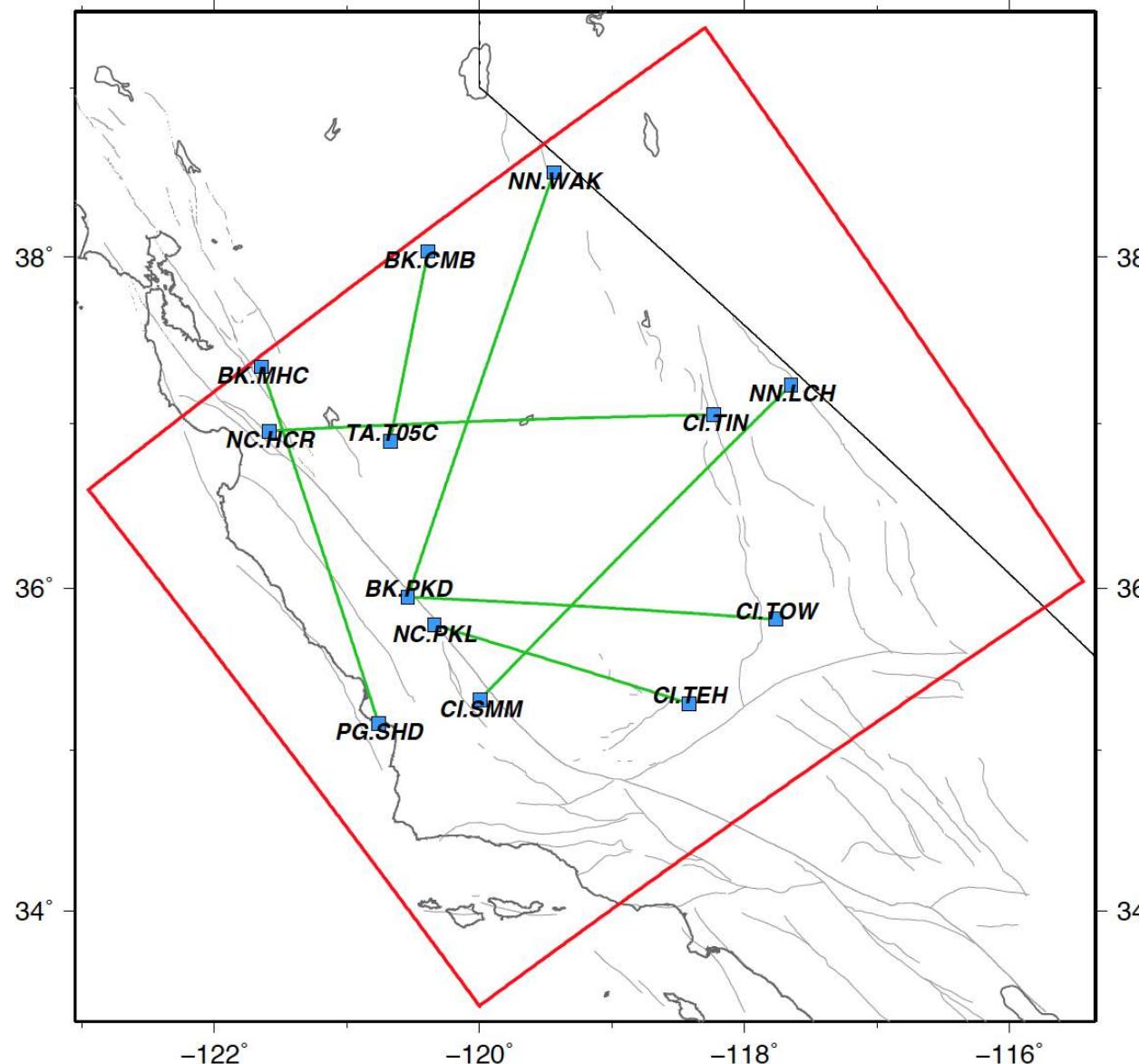
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CCA-04 Data-Synthetic Comparisons

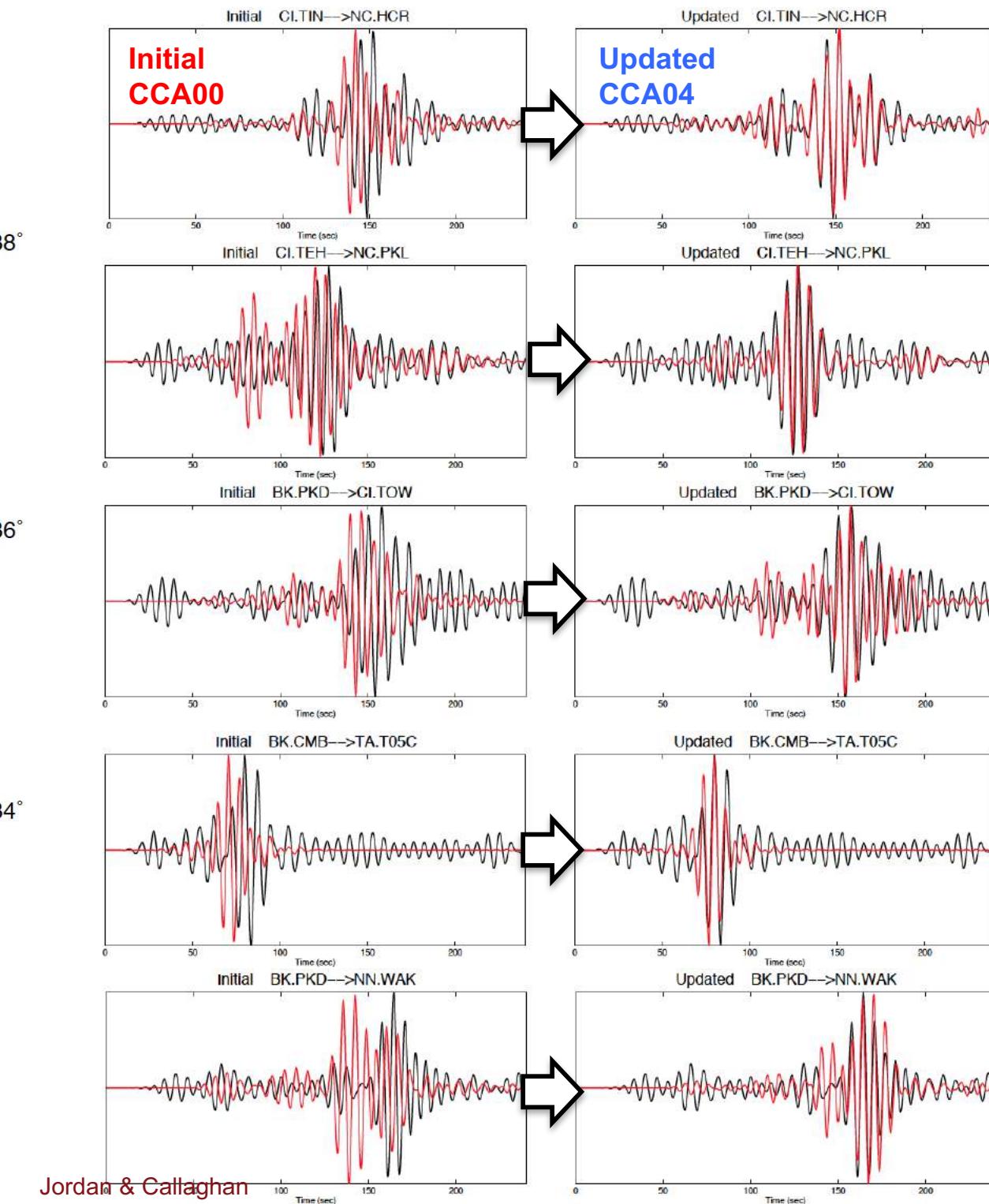


CCA-04 Data-Synthetic Comparisons



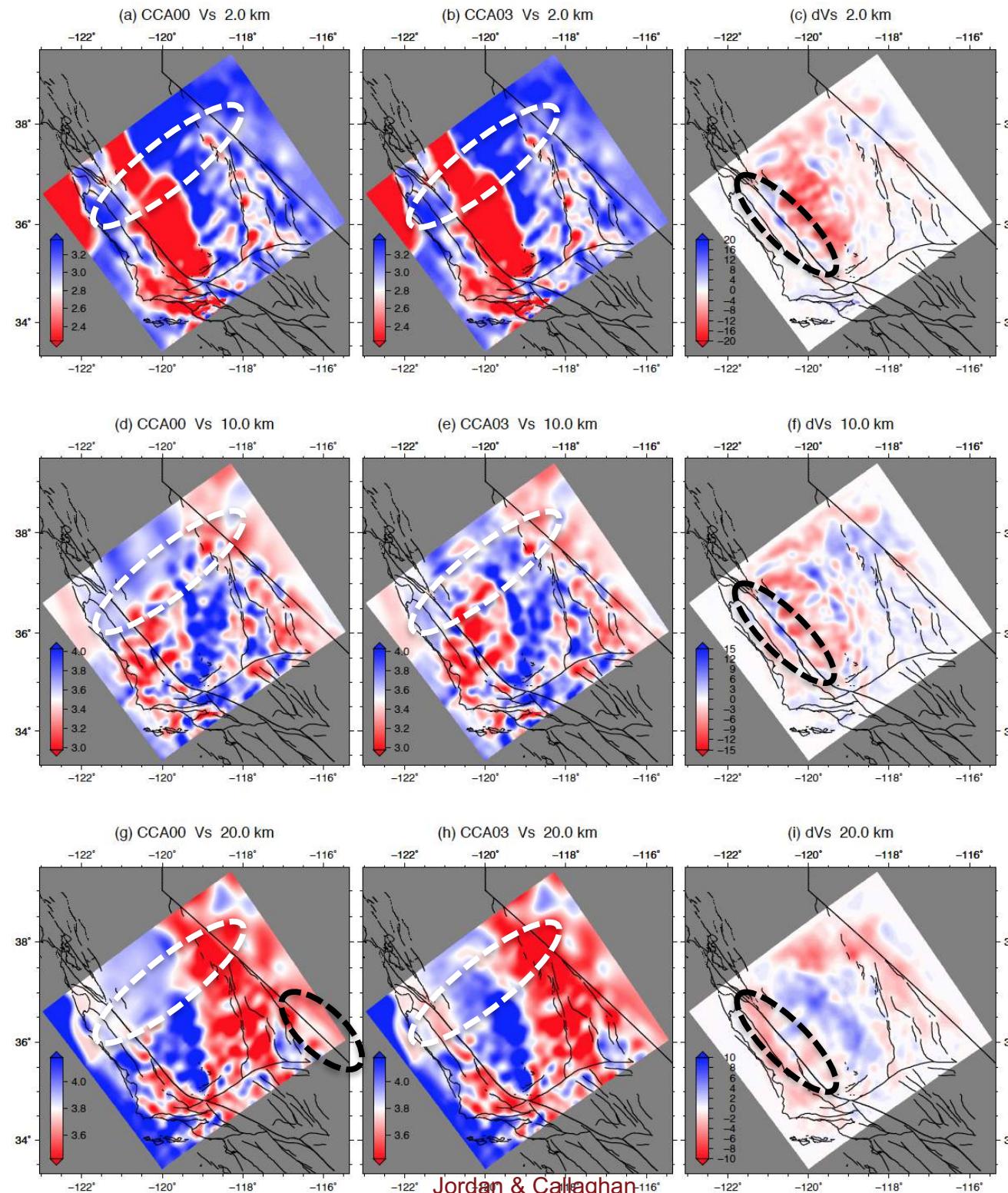
Stanford ANGF data

CCA-04 ANGF synthetics



CCA-03 Velocity Model

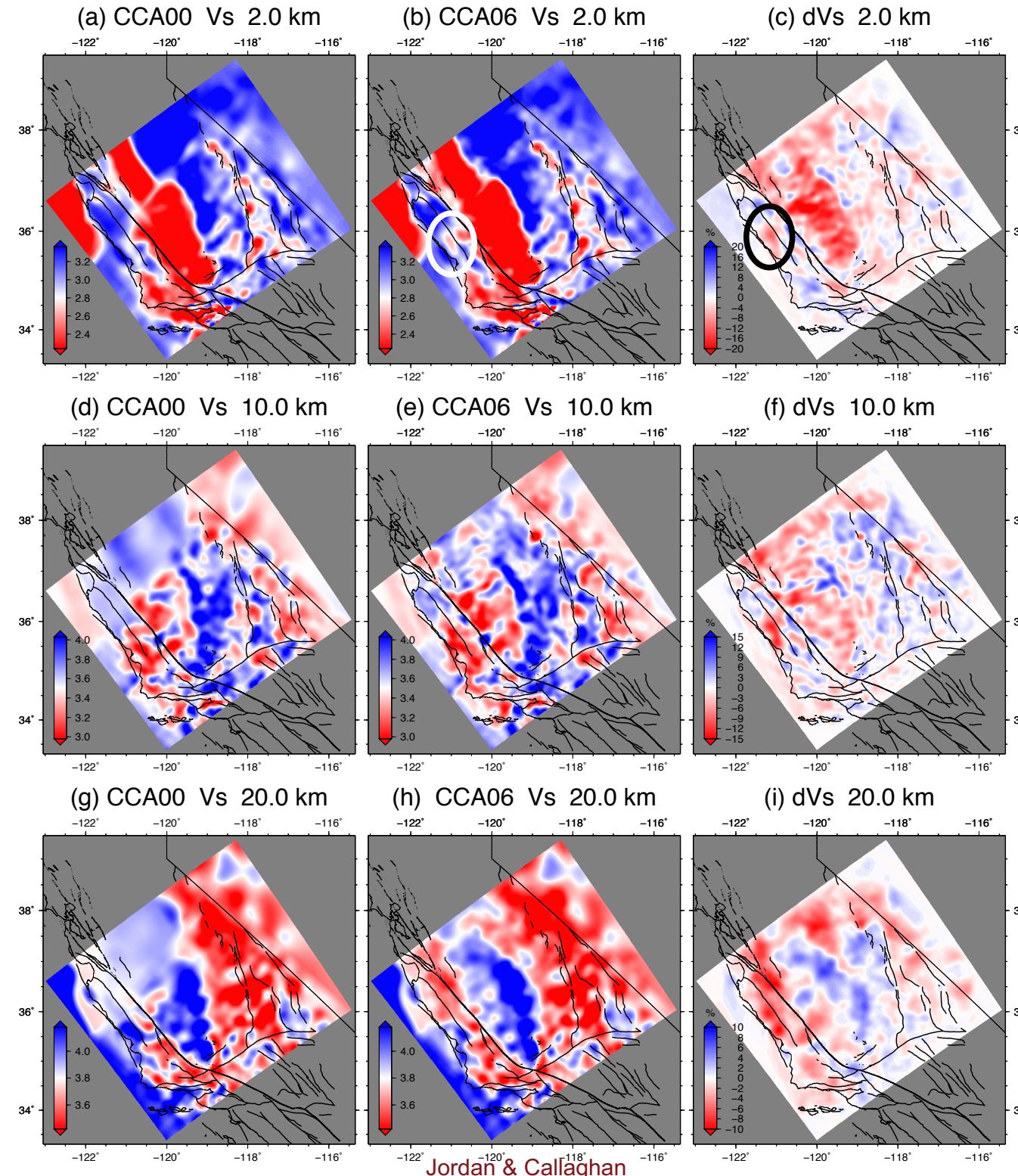
- Perturbations
- smooth the velocity artifacts in starting model
 - increase the velocity gradient across the SAF



3rd iteration
(Vs perturbations)

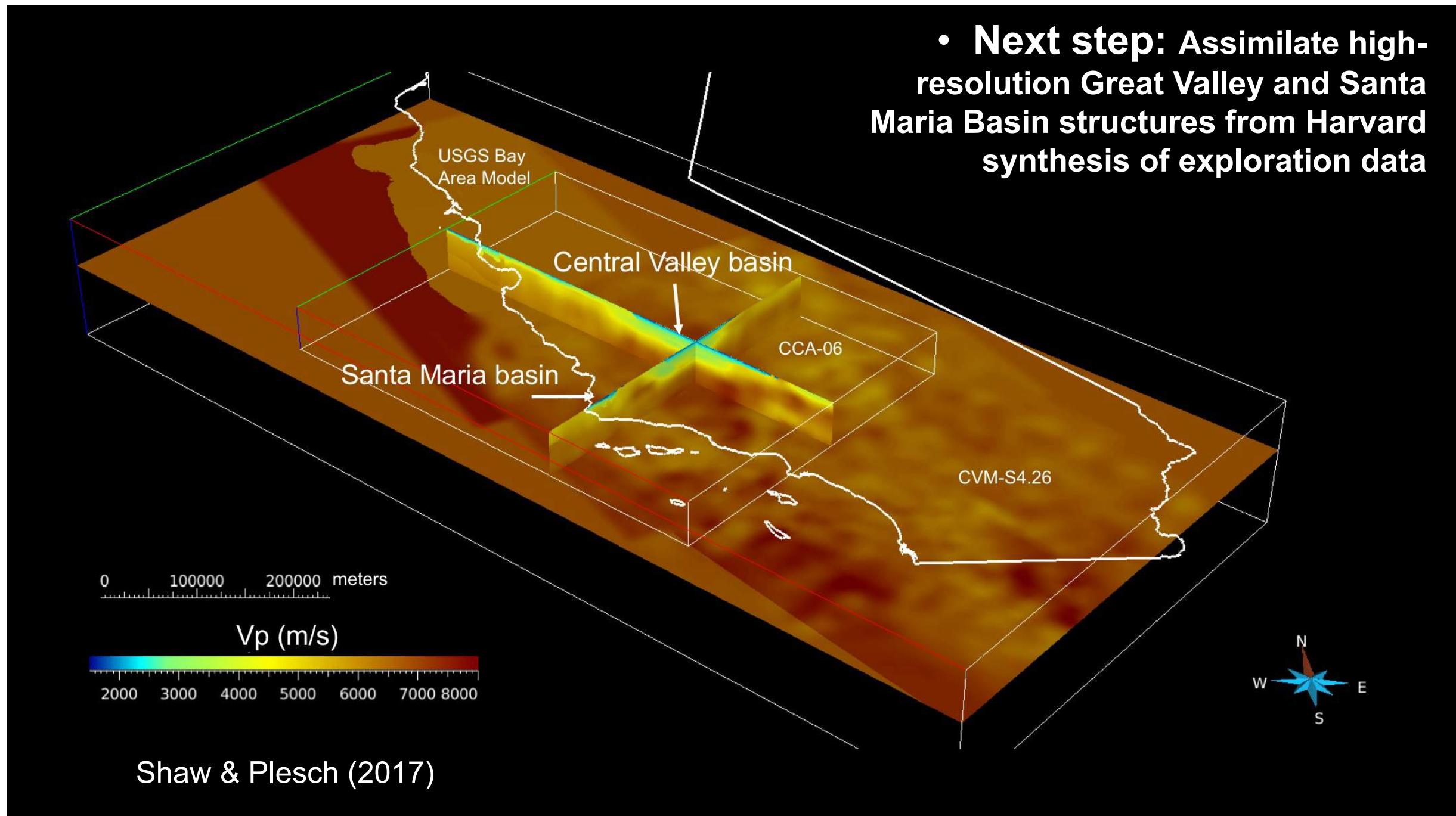
CCA-06 Velocity Model

- Perturbations
- smooth the velocity artifacts in starting model
 - increase the velocity gradient across the SAF
 - introduce new small-scale features
 - e.g., Jolon Valley



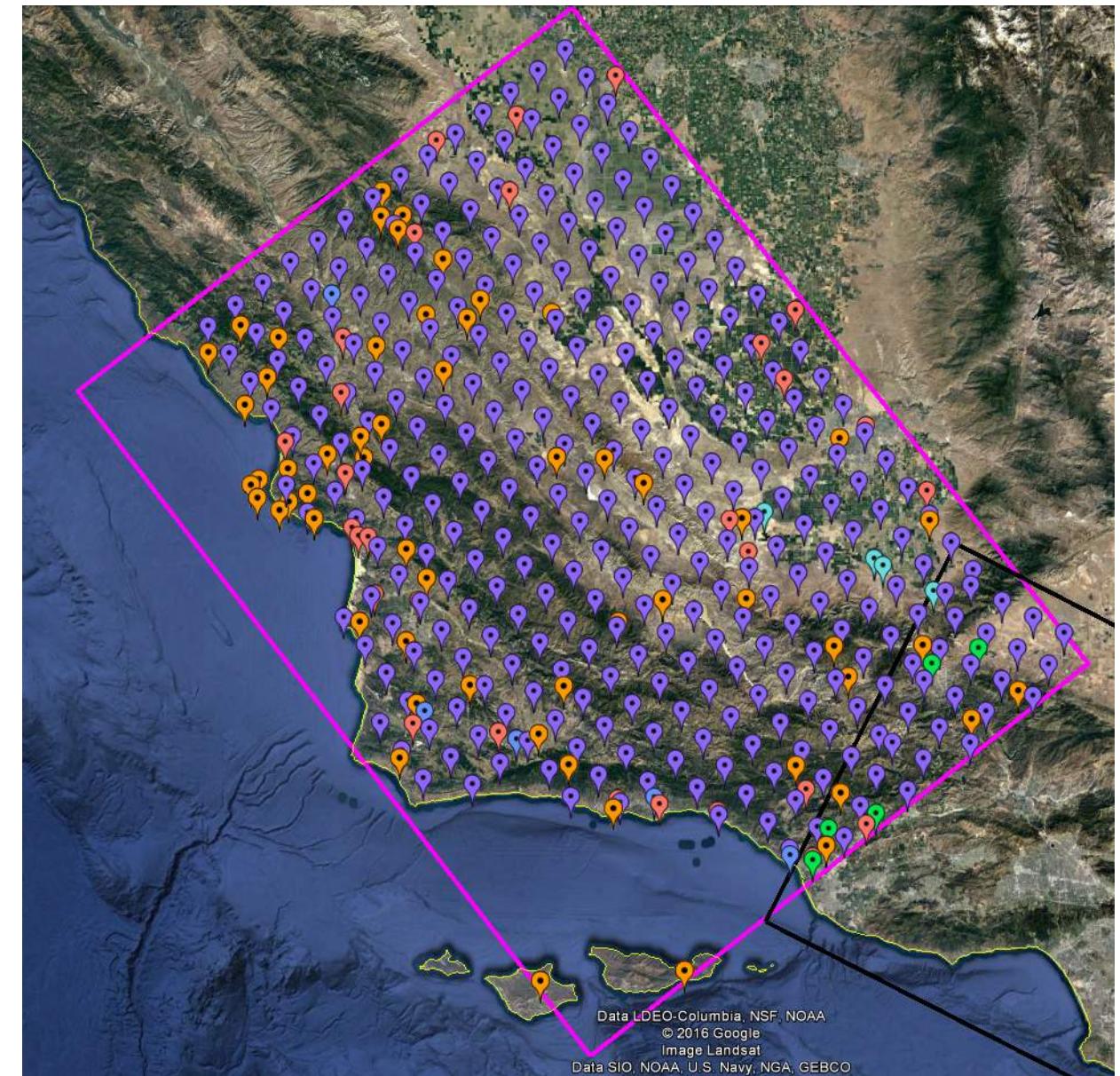
6th iteration
(Vs perturbations)

Development of CCA Velocity Models



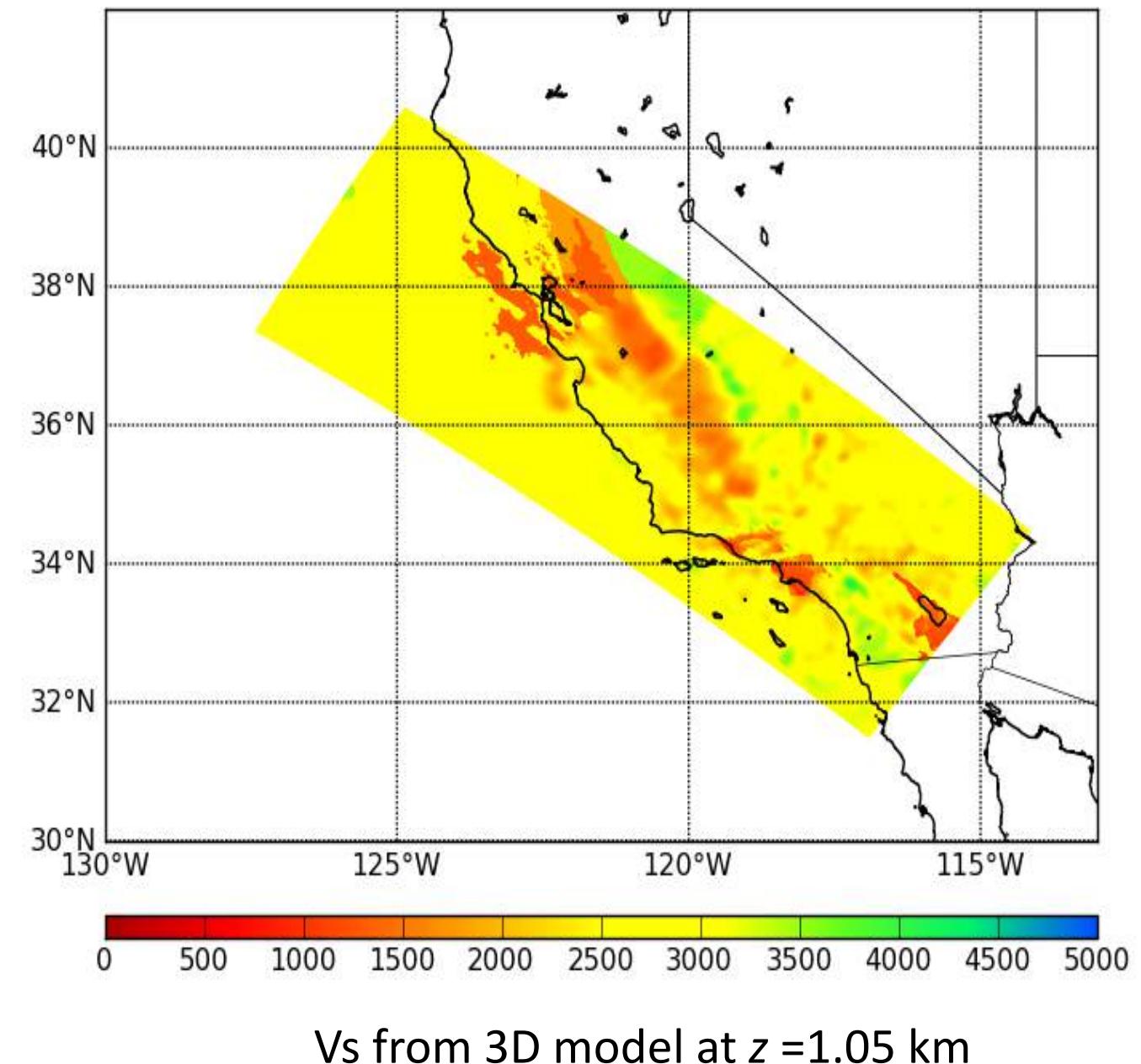
CyberShake Central California

- Proof-of-concept for expanding CyberShake PSHA models to new regions
- Twice the size of CyberShake Southern California
 - 408 new locations including CISN stations, cities, missions, PG&E pumping sites
 - Maximum frequency = 1 Hz
 - Minimum V_s = 900 m/s



Velocity Models for CyberShake Central California

- **3D model**
 - CCA-06 (Central CA F3DT)
 - CVM-S4.26 (Southern CA F3DT)
 - USGS Bay Area
 - Smoothing applied along model interfaces
- **1D model**
 - Average of CCA-06 over land

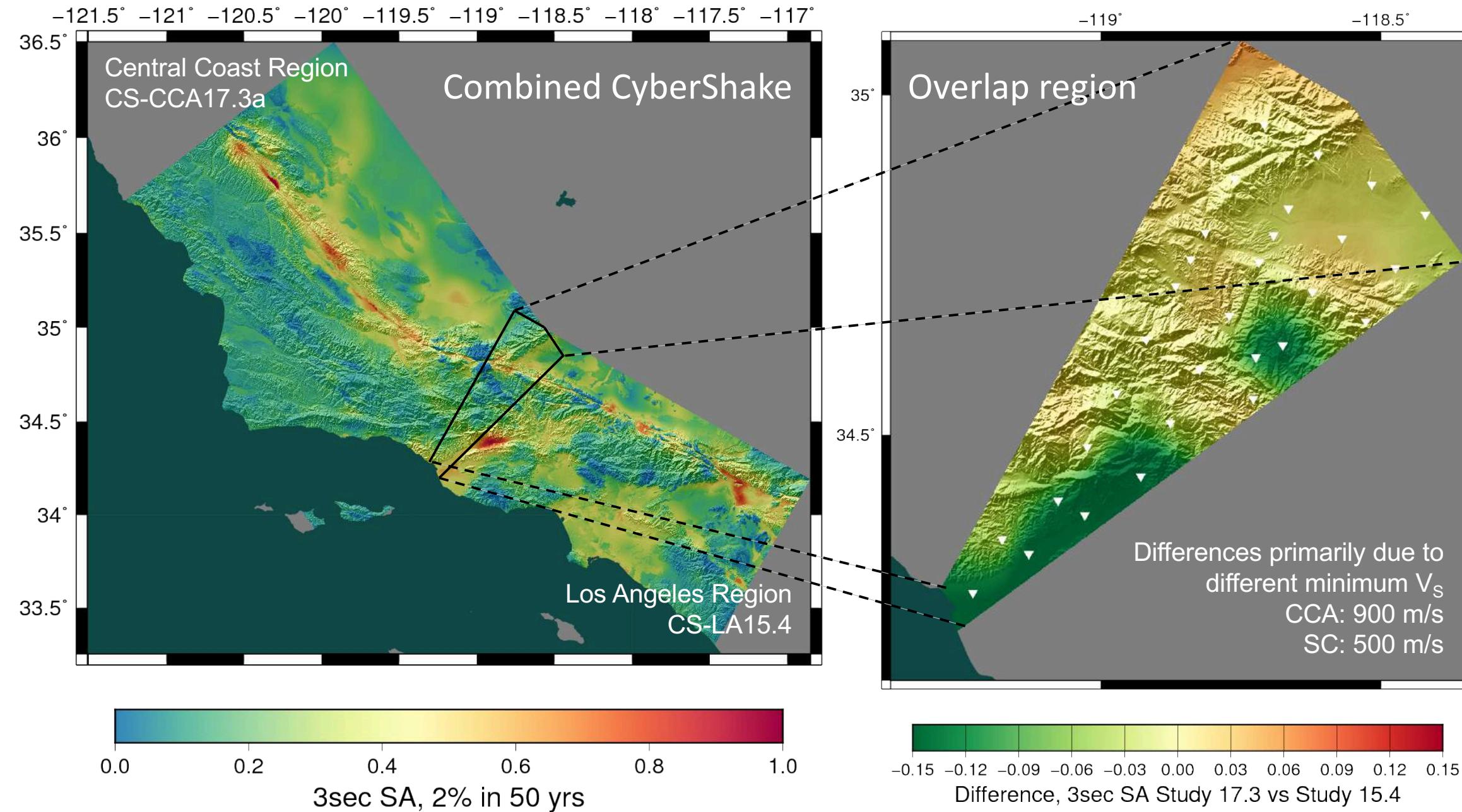


CyberShake Study 17.3

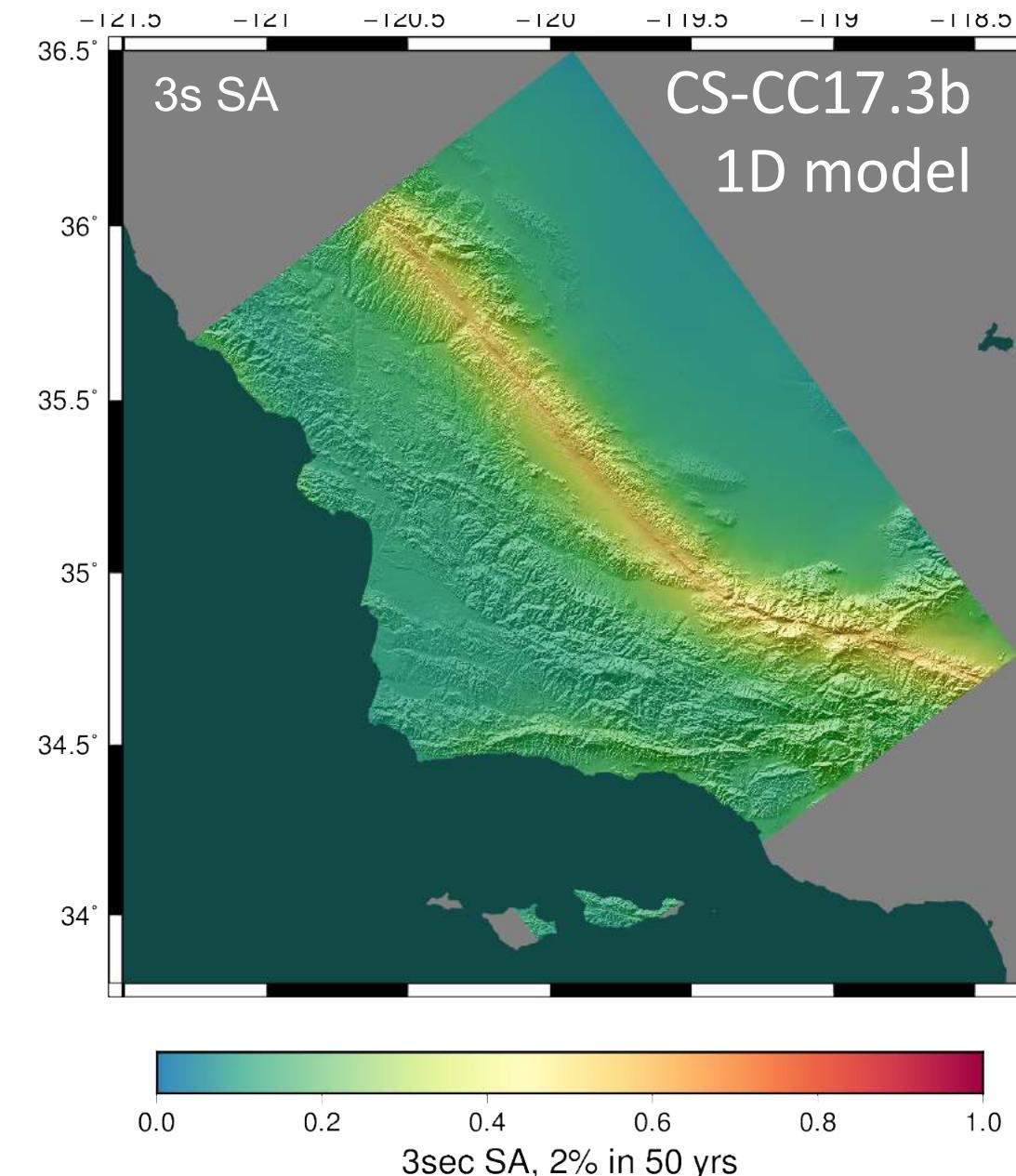
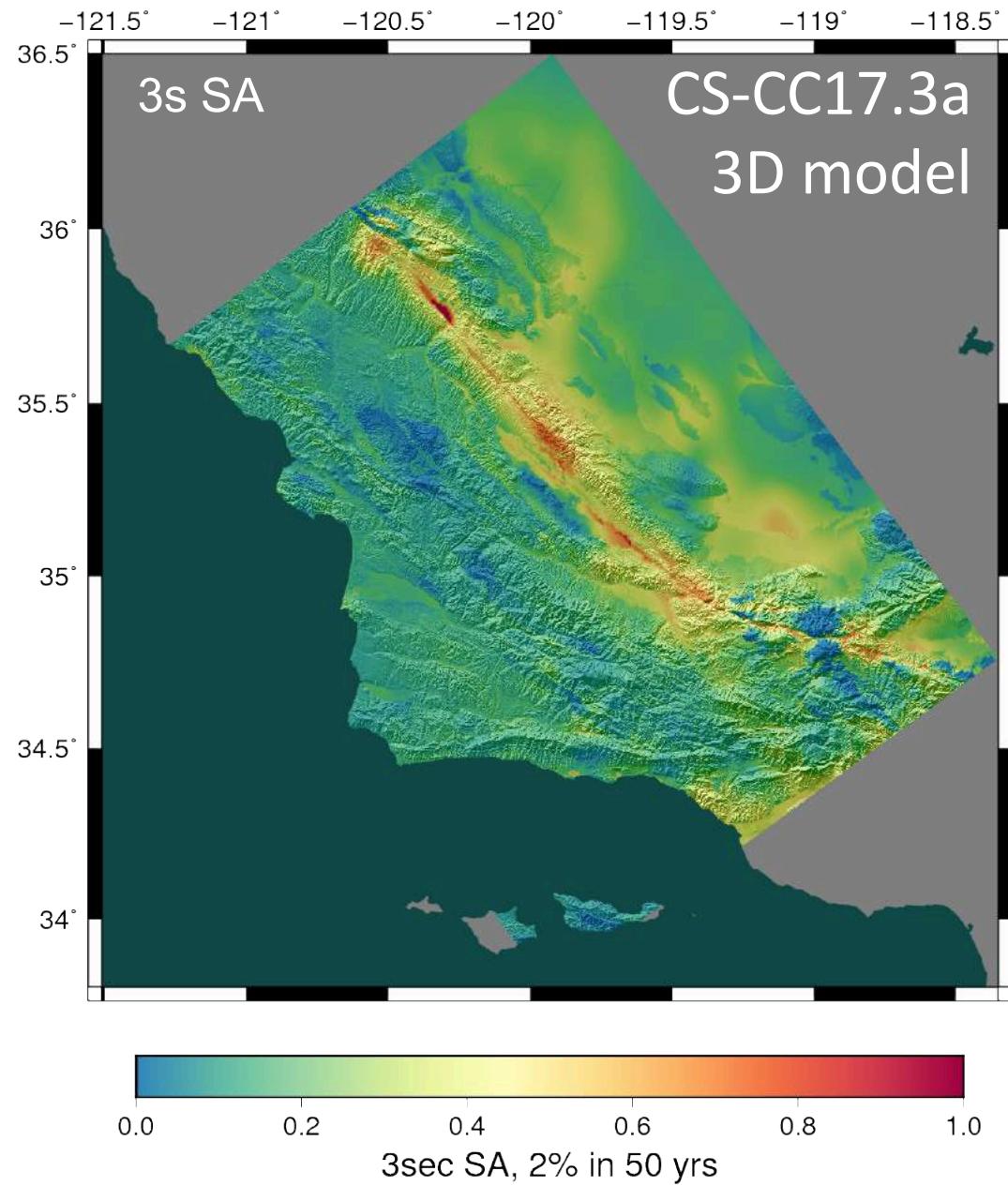
Calculations for 2 velocity models at each of 438 sites

- **Used OLCF Titan and NCSA Blue Waters**
 - Workflow tools scheduled 15,581 jobs to both systems
 - Transferred 308 TB of intermediate data between the two systems
- **Averaged 1295 nodes (CPU + GPU) for 31 days, maximum of 5374**
 - 900,000 node-hours consumed
- **Generated 285 million two-component seismograms**
 - 43 billion intensity measures
- **Workflow tools managed 777 TB of data**
 - 10.7 TB of output data automatically staged back for archival storage

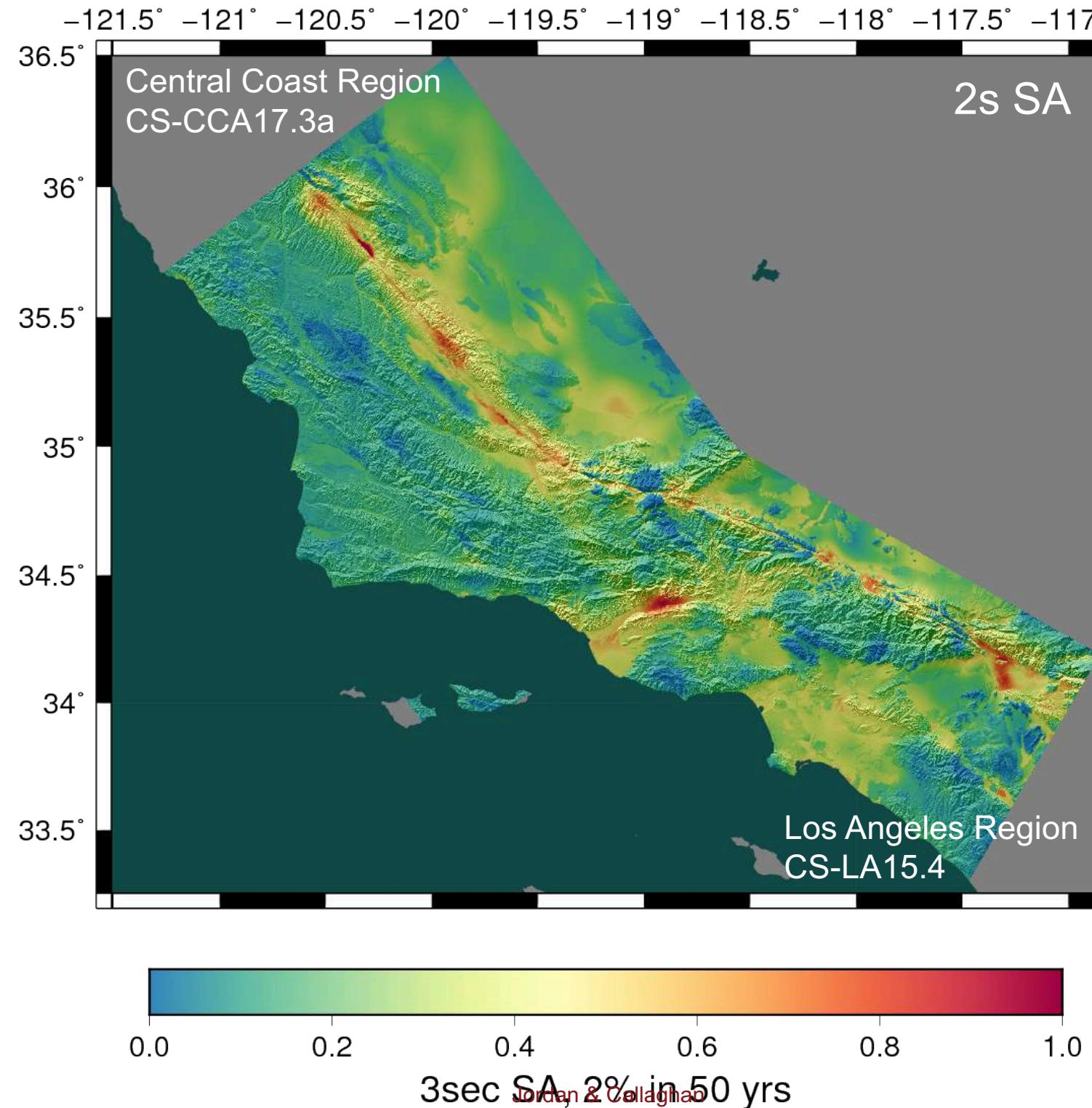
CyberShake Study 17.3 Results: CCA and LA



CyberShake Models for Central California



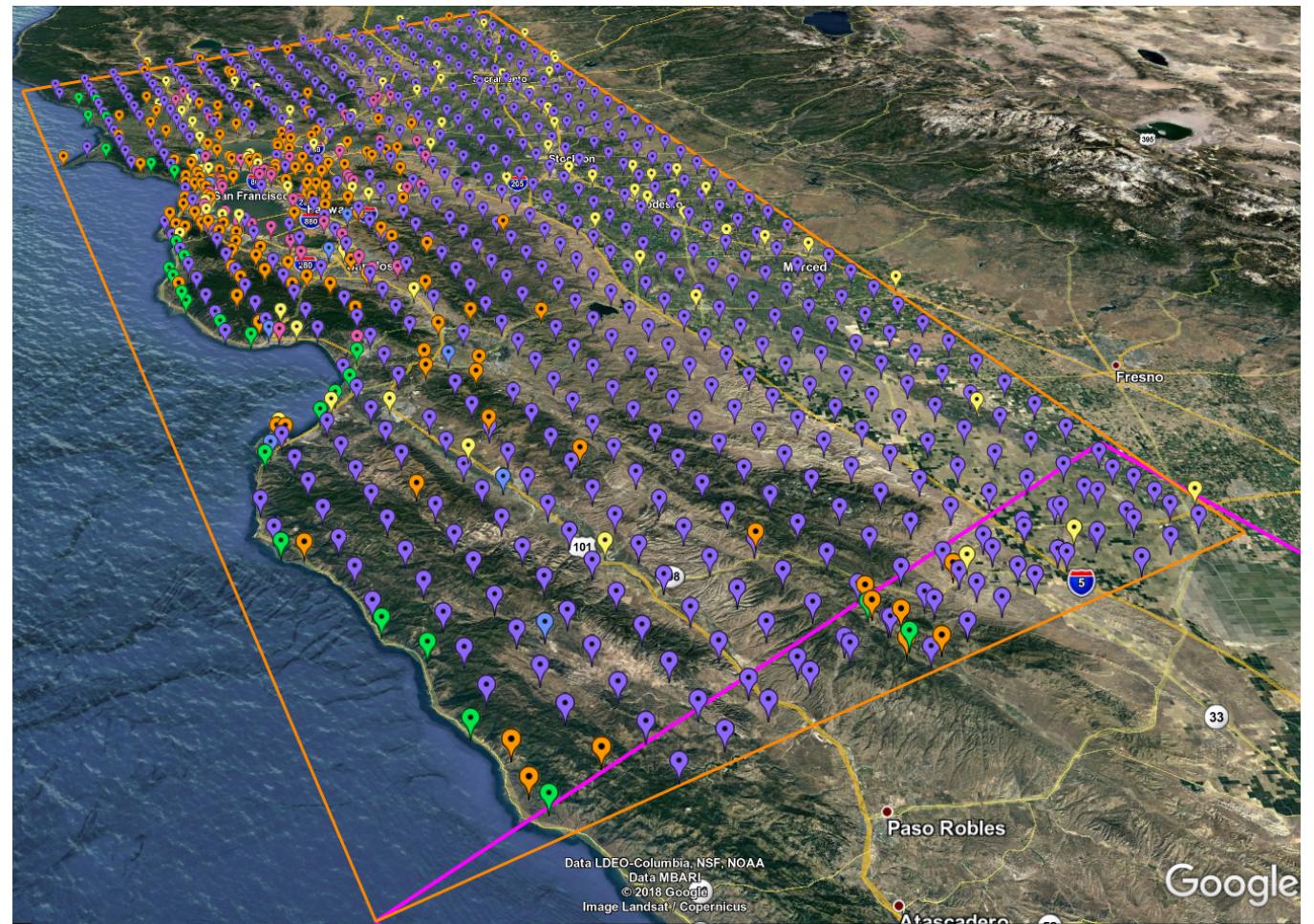
CyberShake PSHA Map for Central and Southern California



CyberShake 18.3 – Northern CA

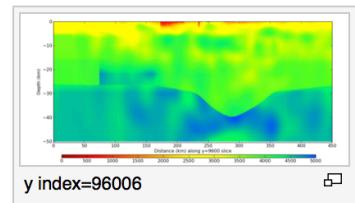
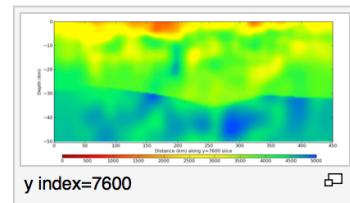
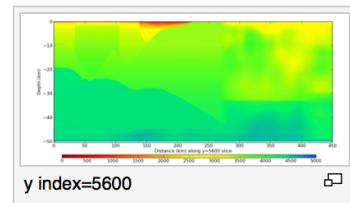
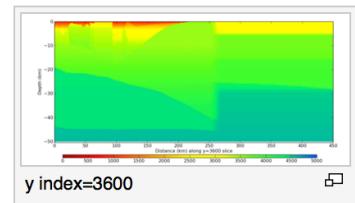
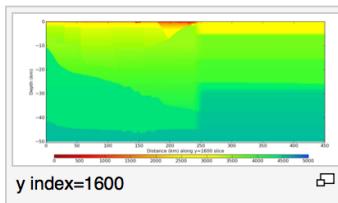
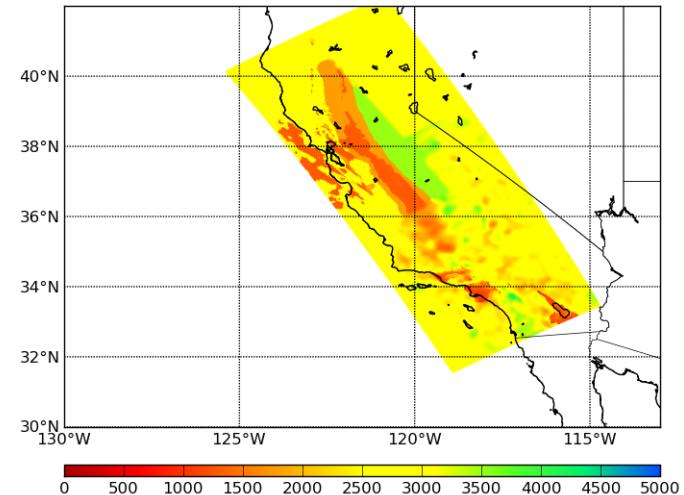
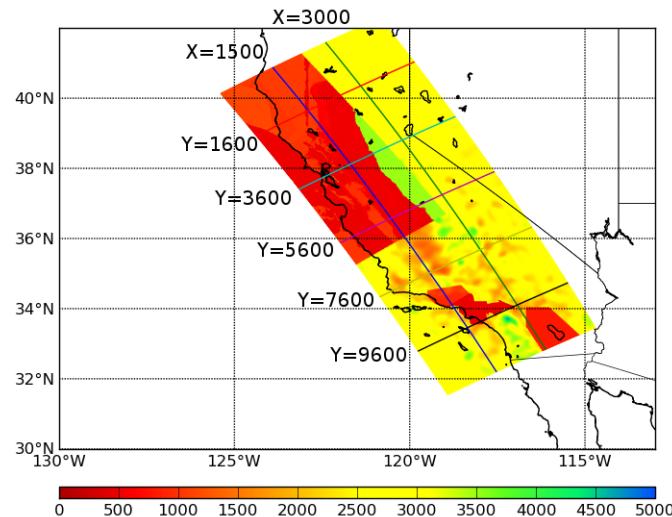
New composite CVM
as starting model

180*390 (km²)
869 simulation stations



For Study 18.3, querying CVMs in this order of precedence:

1. USGS Bay Area model
2. CCA-06
3. CVM-S4.26.M01
4. 1D background model (Lin&Thurber)



End