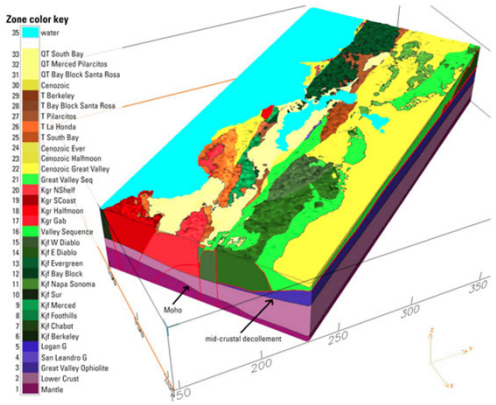
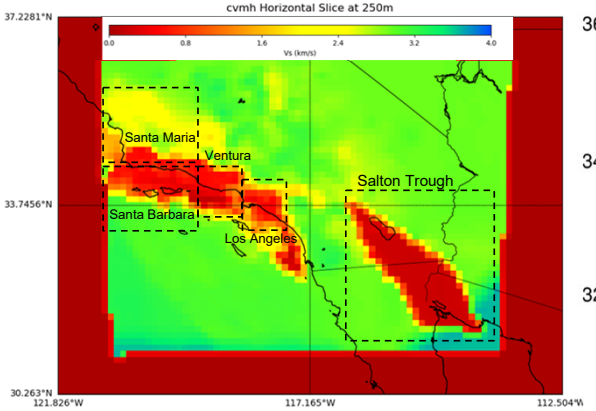
Toward a validated multi-scale seismic velocity model for the SAF system in the Western US

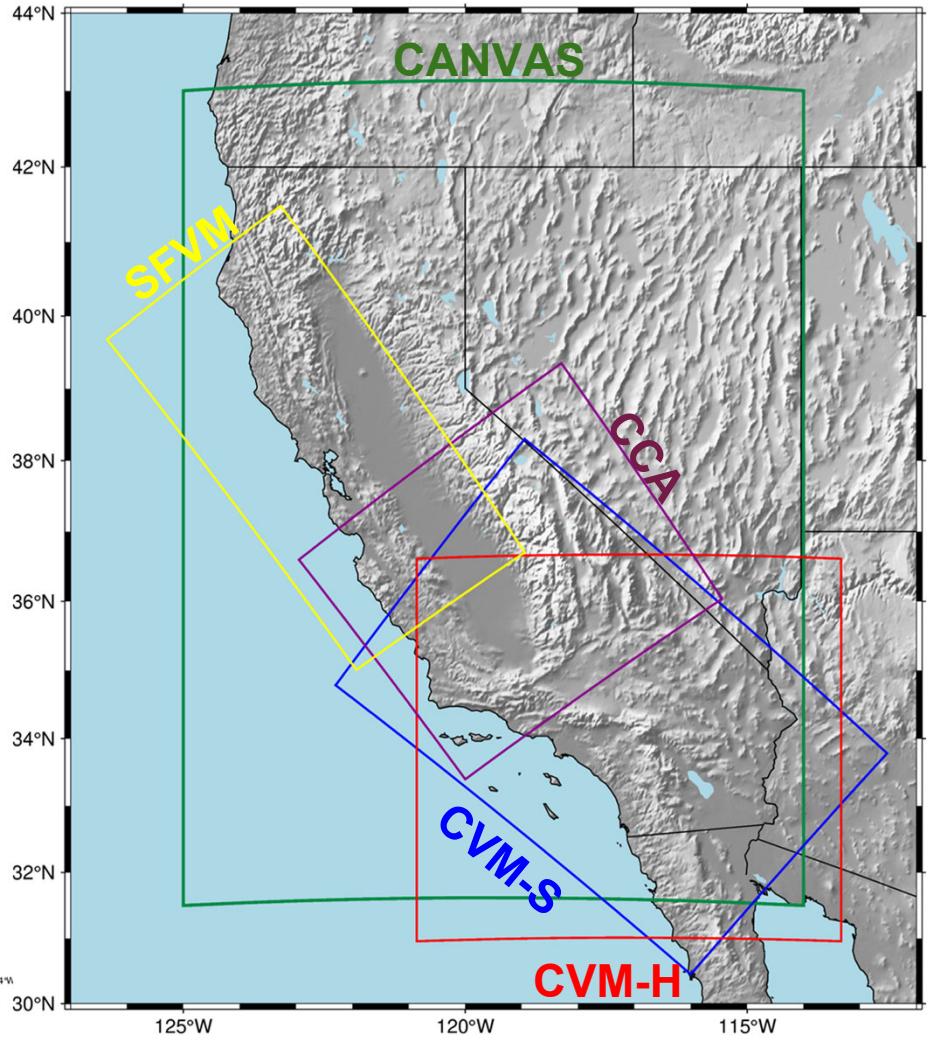
Te-Yang Yeh and Yehuda Ben-Zion

Bay Area

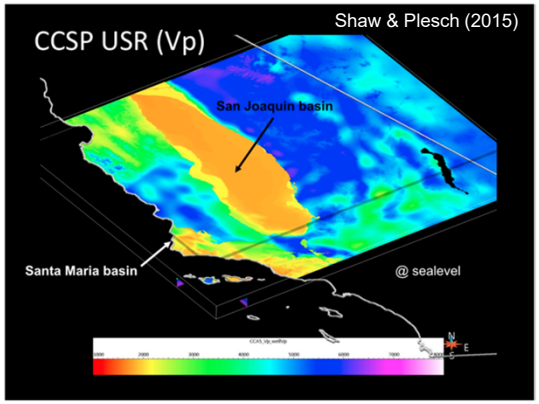


CVM-H Basins

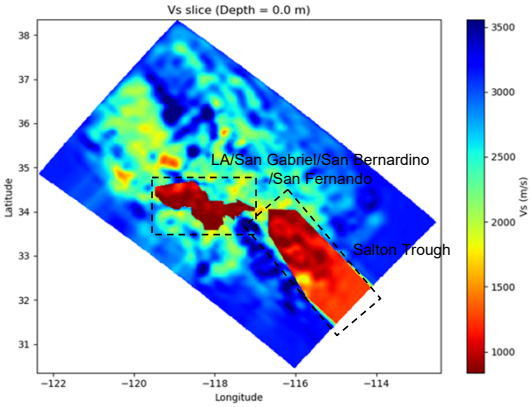




Central Valley

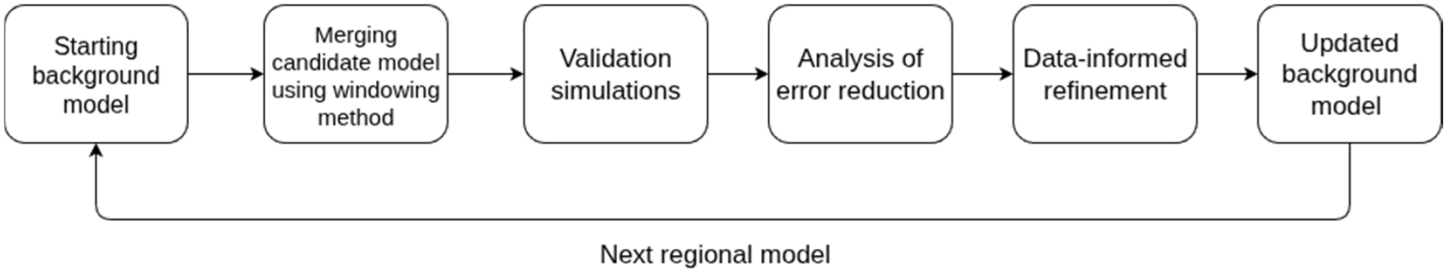


CVM-S Basins



Work flow

Step 1: Creating Best Background Model for the Region



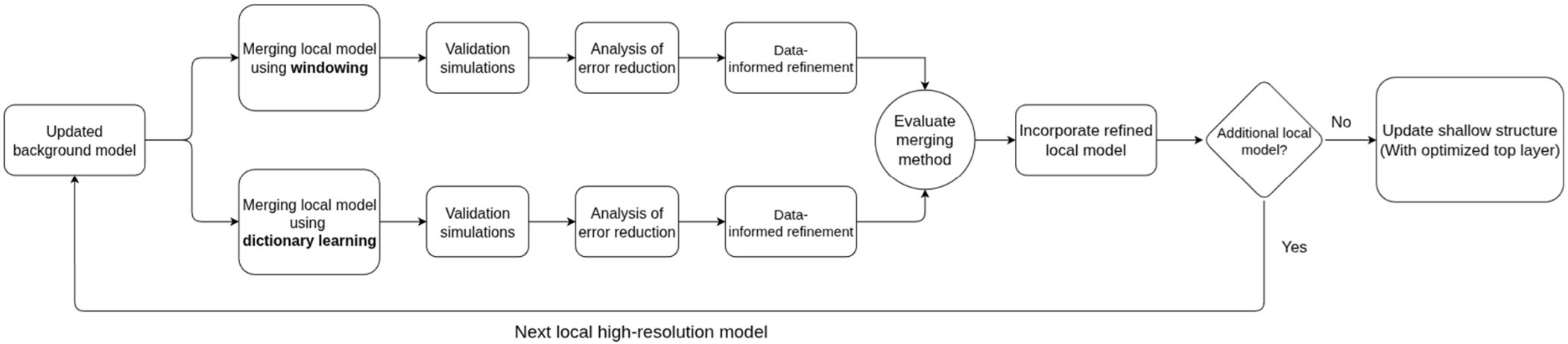
Merging: windowing or dictionary learning followed by validation and updates

$$\xi = \frac{\sum_{i=1}^{12} |e_i| w_i}{\sum_{i=1}^{12} w_i}$$

$$e_i = \frac{\sum_{k=1}^{N_{evt}} log_{10} \frac{V_{model,k}}{V_{data,k}}}{N_{evt}}$$

Error (e_i)	Weight (w_i)
FAS_E	1
FAS_N	1
FAS_Z	1
CAV_E	1
CAV_N	1
CAV_Z	1
PGA_E	1/3
PGA_N	1/3
PGA_Z	1/3
PGV_E	1/3
PGV_N	1/3
PGV_Z	1/3

Step 2: Including Local High-Resolution Models

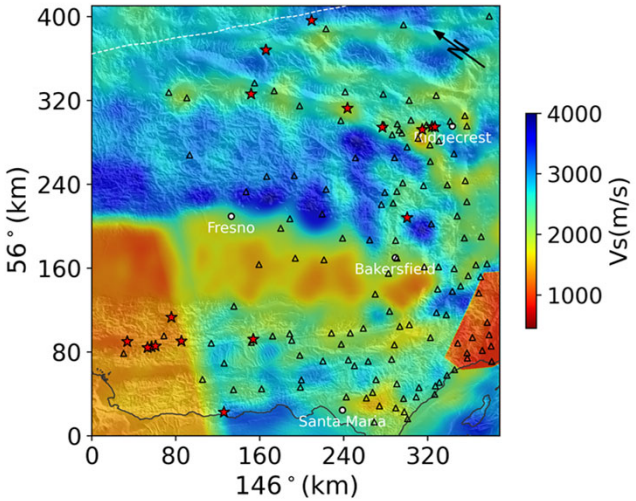


Example from central CA

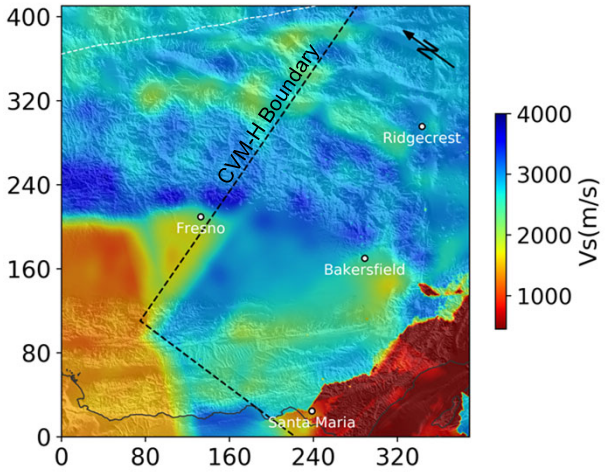
17 events (red stars) with Mw 4.2-4.7 and 130 stations (black triangles) used for validation

Merging CVM-H

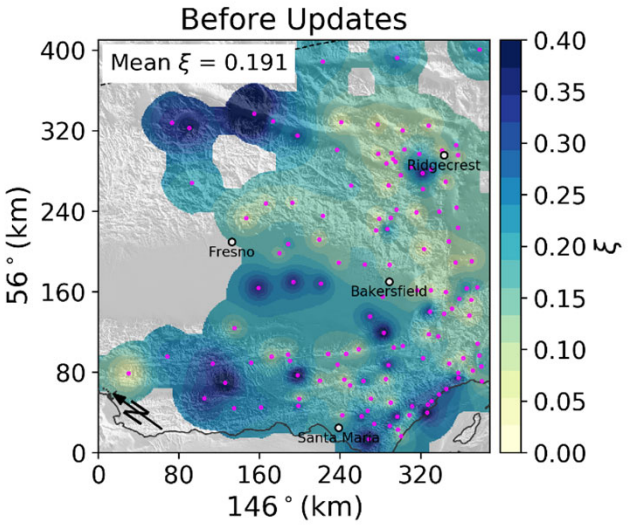
Starting model (CANVAS+CCA)



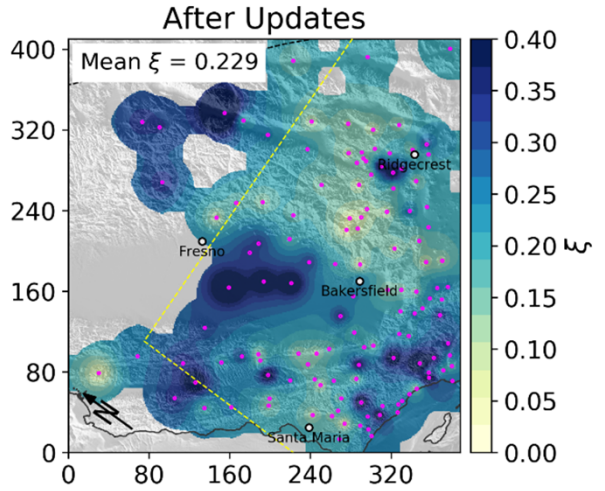
Starting+CVM-H merged



Before Updates

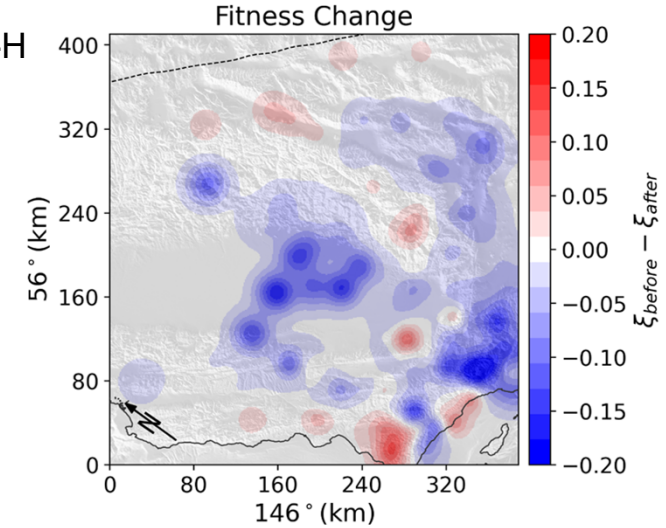


After Updates

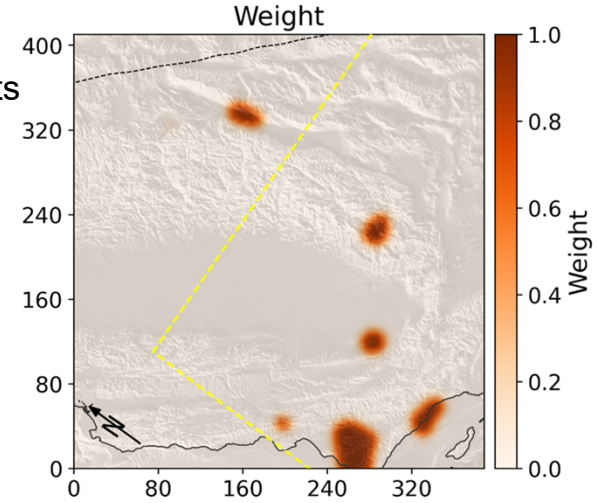


Data-informed Refinement

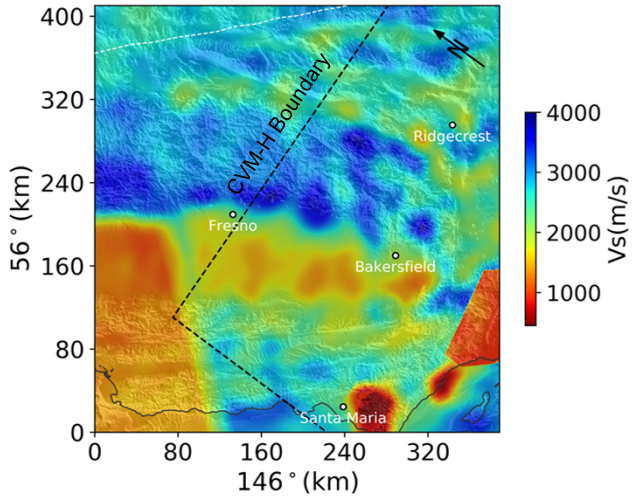
(a) Merging CVM-H Fitness change



(b) CVM-H refinement weights

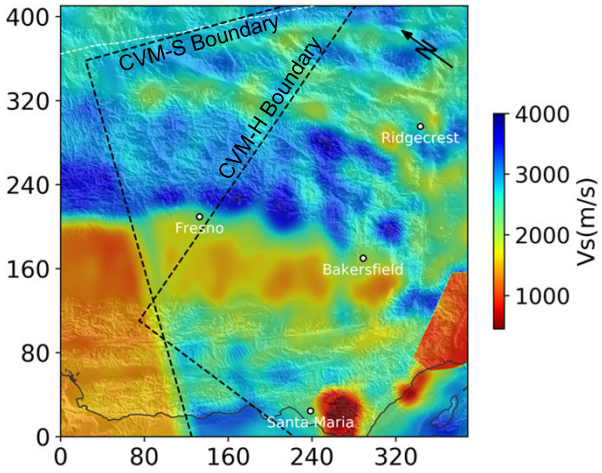


(c) CVM-H merged with refinement weighting



ξ=0.179 (down from 0.191)

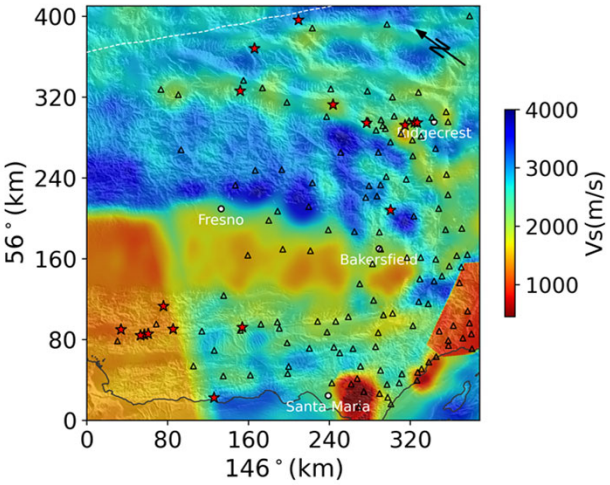
(c) CVM-H + CVM-S merged with refinement weighting



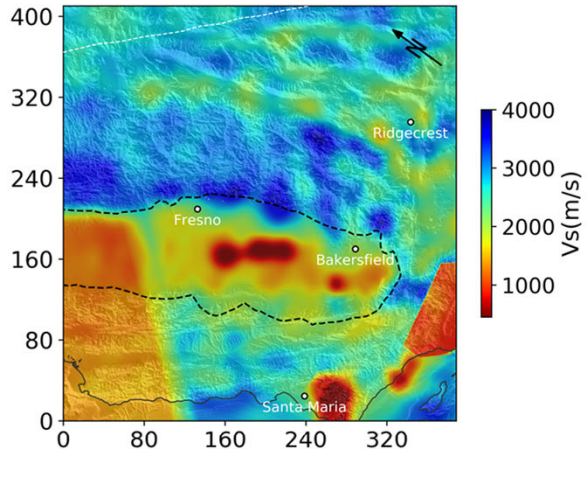
ξ =0.174

Merging San Joaquin Basin Model (from Plesch, Shaw et al.)

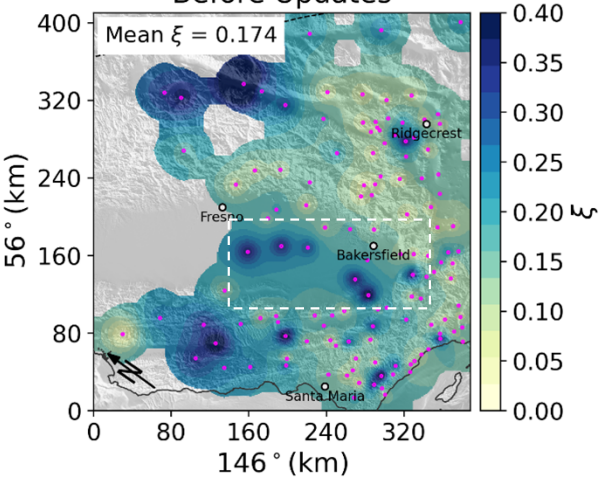
Improved background model



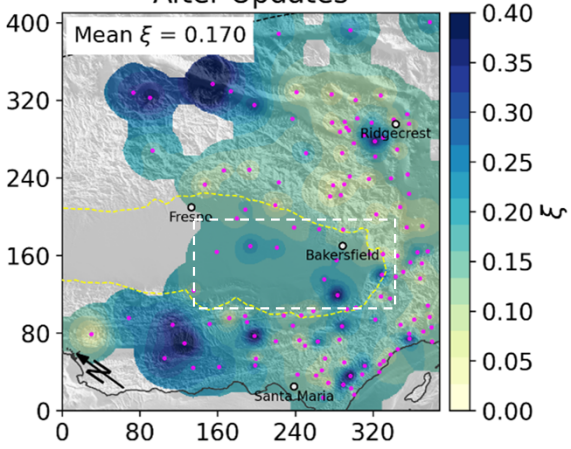
Basin model merged using DL (refined)



Before Updates



After Updates

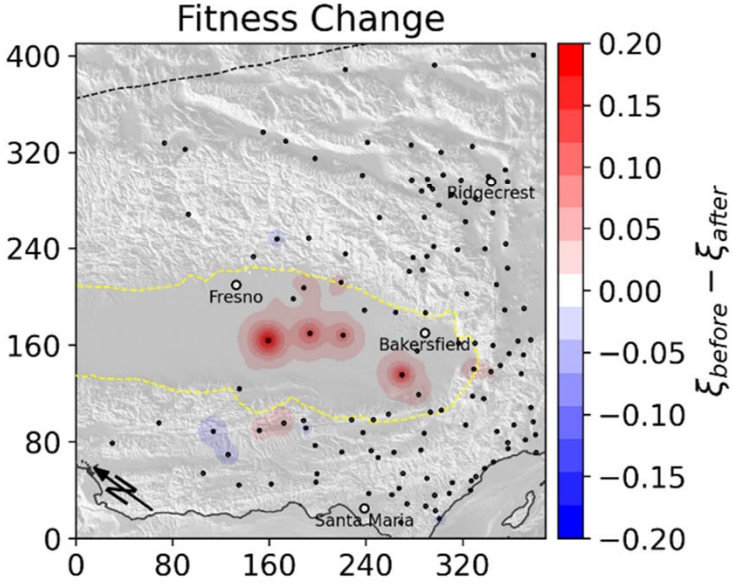


Merge + Refinement

↓

Improvement inside the basin

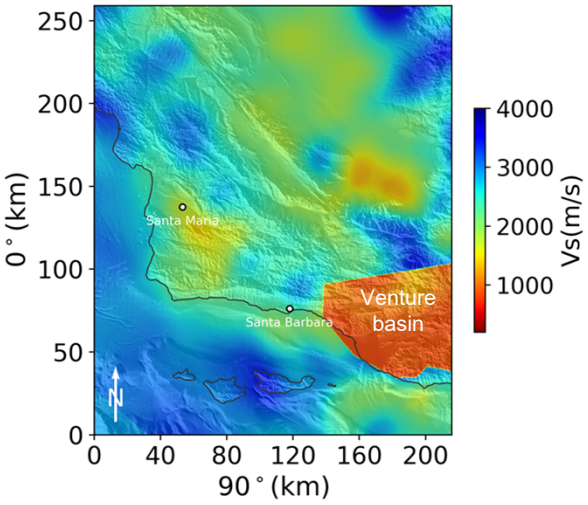
Fitness Change



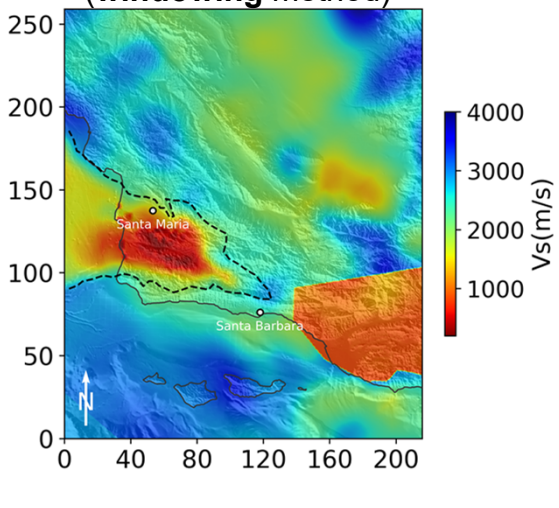
Example from SoCAL

Merging Santa Maria Basin (from CVM-H)

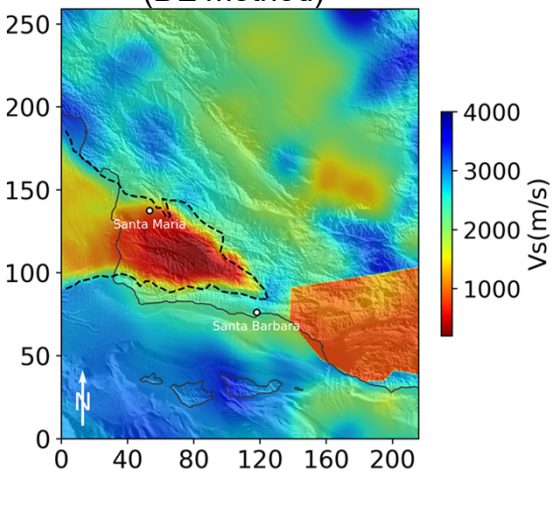
CVM-S4.26



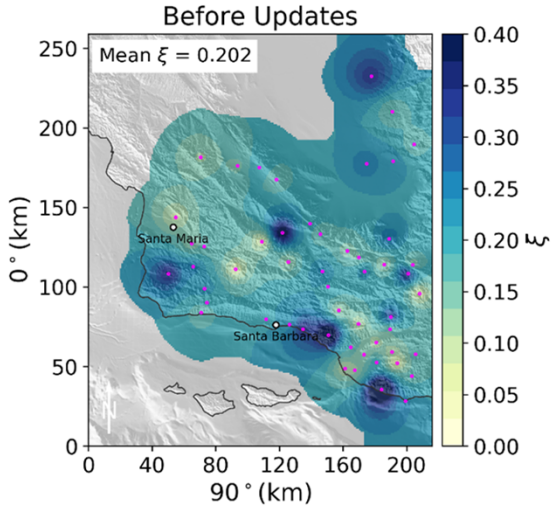
CVM-S4.26+SM basin (**windowing** method)



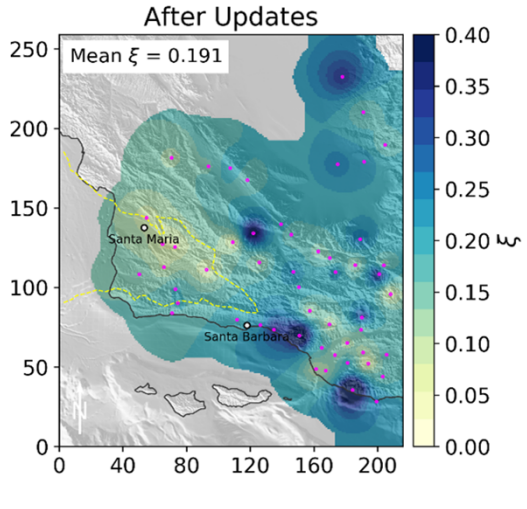
CVM-S4.26+SM basin (**DL** method)



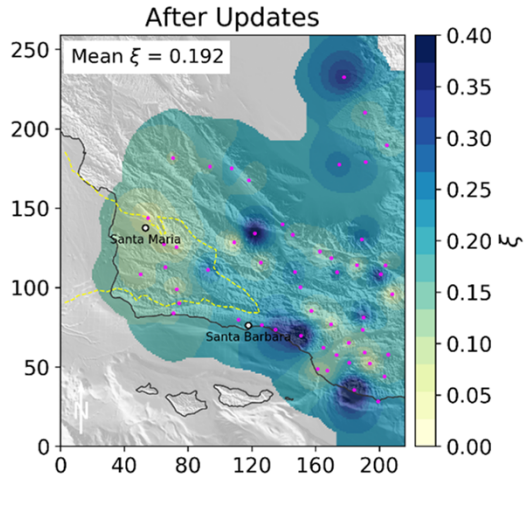
Before Updates



After Updates

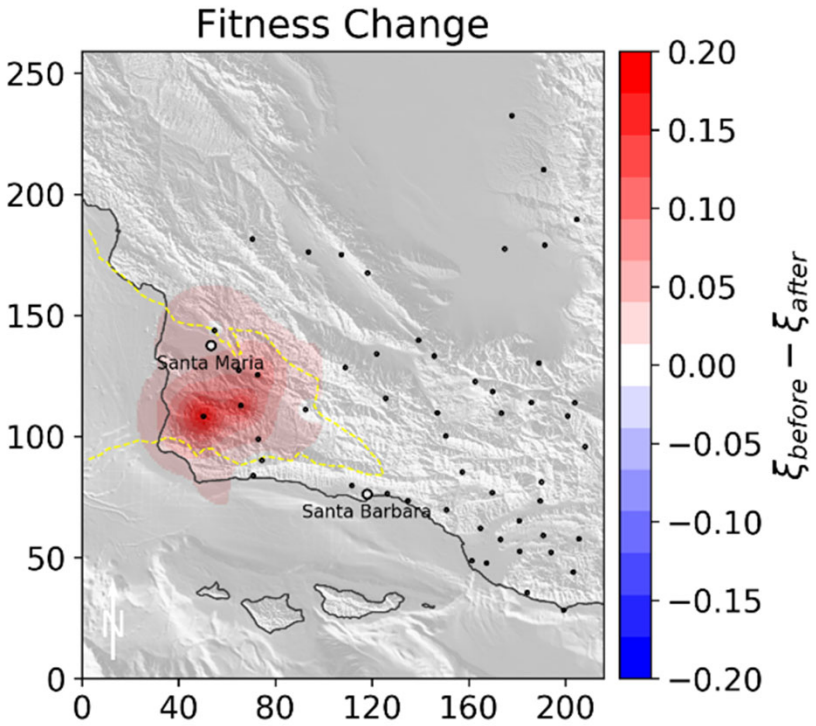


After Updates

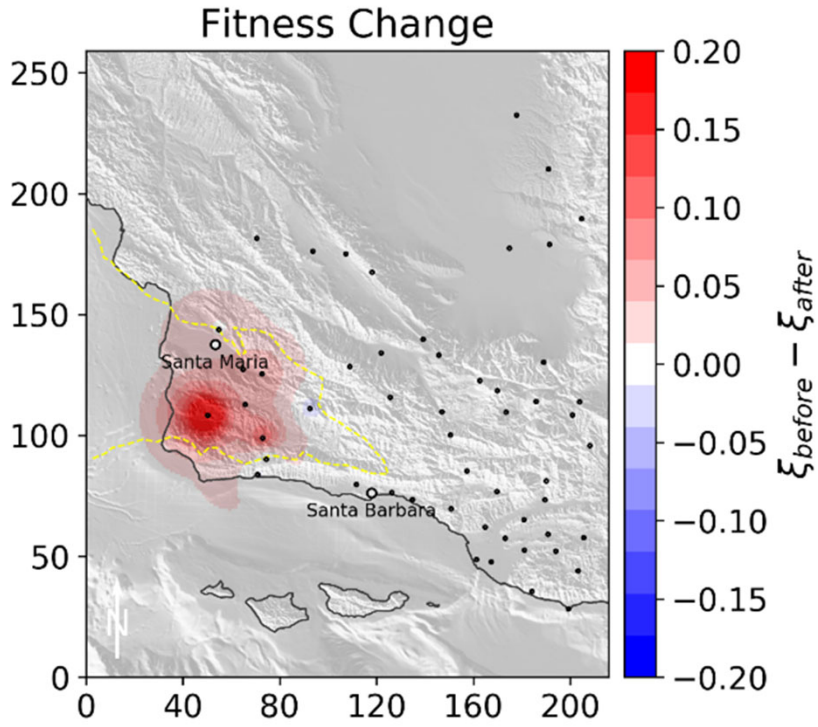


Comparison of Fitness Change

Windowing method



DL method



Next steps: merging best model for the SF bay area, NorCal, and additional local high-resolution models

Thank you