Present-day Shortening and Uplift Across the Western Transverse Ranges

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Geodetic and Geologic Observations

Objectives:

- Use horizontal and vertical geodetic data and SCEC VMM to estimate distribution of slip rates on faults
- Identify signature of tectonic loading in the vertical signal.
Geodetic and Geologic Observations
**Plate Flexure Model**

**Kinematic Model**

- Elastic plate over inviscid substrate
- Gravitational restoring forces
- Impose uniform slip rate on segments
- Backslip to simulate interseismic coupling
- NOT a block model
Plate Flexure Model

North

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35 mm/yr

S. San Andreas extension

10 mm/yr

Borderlands extension

45 mm/yr

N. San Andreas extension

elastic crust

inviscid mantle

buoyancy forces

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velocity/slip rate

interseismic

horizontal

long-term

vertical

D=10 km

D=20 km

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D

depth (km)

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distance along profile (km)
Fault Geometry

SCEC CFM5

- Alternative geometries for Ventura-Pitas Pt. fault
- Include Pitas Pt. West and North Channel Faults (Sorlien et al.)
• Sense of slip constrained based on UCERF3 “geologic” model.
• Conservative upper bounds based loosely on UCERF3
Water Mass Removal
e.g. (Amos et al., 2014)

• Water withdrawal can produce uplift of
  ~2 mm/yr rimming the San Joaquin Valley
• Water withdrawal cannot explain broad
  uplift across Transverse Ranges
Southern California Earthquake Center

Slip Rate Estimates

dip-slip rates

strike-slip rates

9/20/16
Fit to Horizontal GPS Data

A. Total velocity field (relative to Santa Rosa Island)

B. Velocity field due only to thrusting in Transverse Ranges
Fit to Vertical Geodetic Data

a. observed interseismic vertical

b. model interseismic vertical

c. residual (observed minus predicted)

Broad uplift pattern is reproduced by the model
Fit to Long-term Vertical Data

Broad patterns of uplift and subsidence pattern are reproduced by the model.
 Contribution From Ventura-Pitas Pt. System

interseismic = long-term + backslip

uplift (mm/yr)

-1.5 -1.0 -0.5 0 0.5 1.0 1.5
Contributions From Ventura-Pitas Pt. System

\[
\text{interseismic} = \text{long-term} + \text{backslip}
\]
Fit to Data in Profile

Key:
- fault
- Ventura Basin

A. Ventura Ave. Anticline (VAA)
- horizontal velocity (mm/yr)
- vertical velocity (mm/yr)

B. interseismic horizontal

C. interseismic vertical

D. long-term vertical

Distance along profile (km)