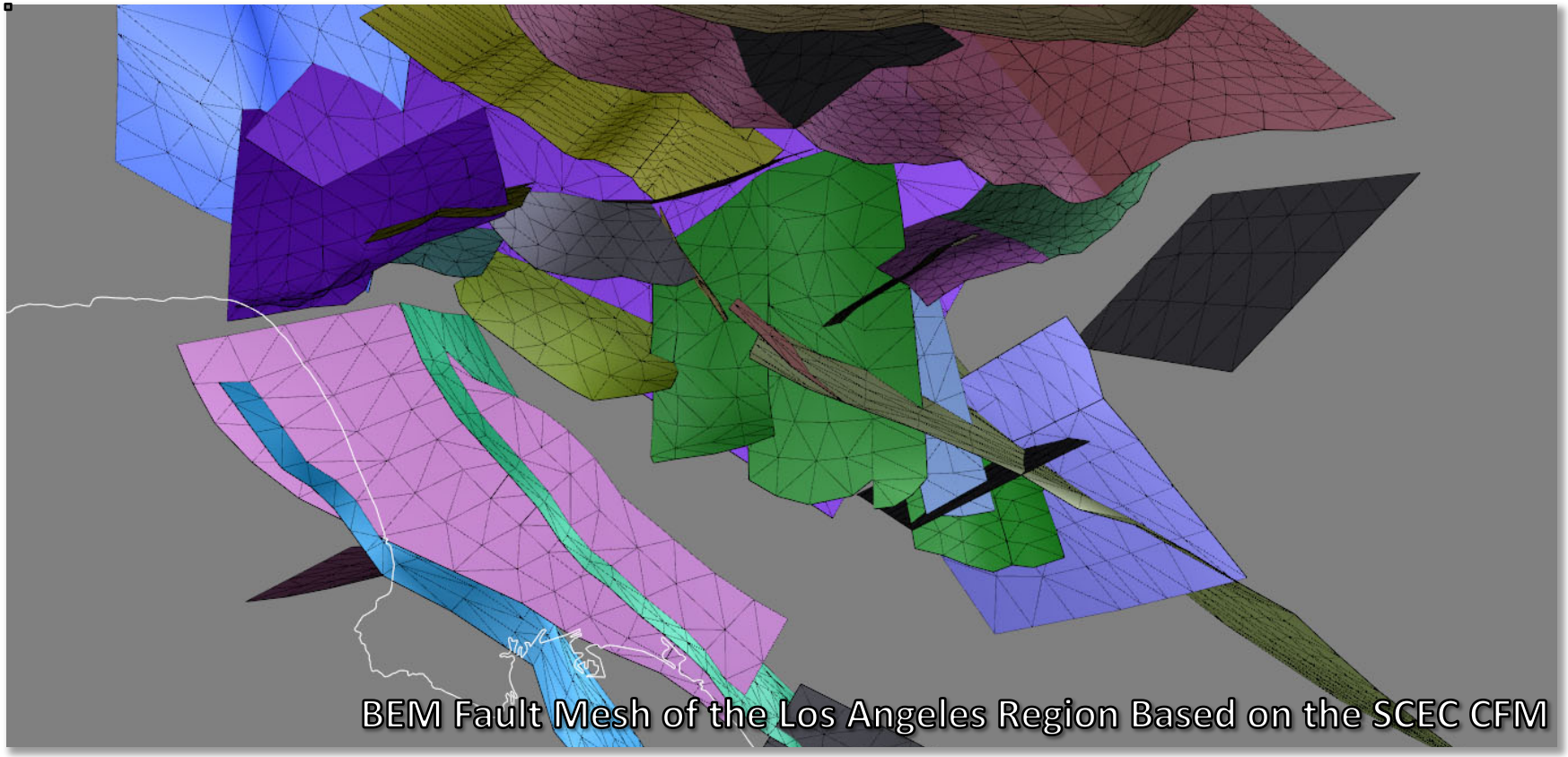
Boundary Element Method Models of Southern California

Michele Cooke – UMass Amherst

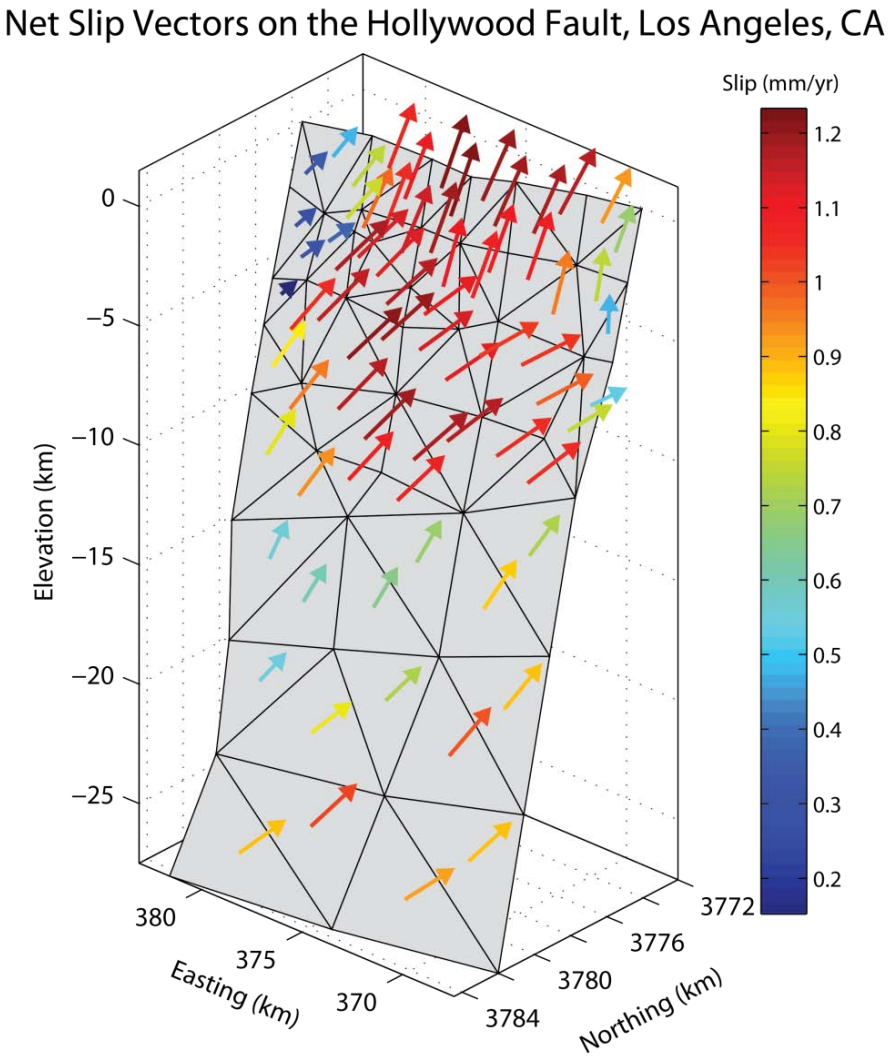
Scott Marshall – Appalachian State



BEM Setup Basics

The BEM Allows the User to:

- Calculate the distribution of slip on finite nonplanar faults
  - Only boundaries (i.e. faults) are meshed
  - User applies BC's on fault elements and far-field loading constraints
- Faults mechanically interact
  - Solutions automatically satisfy the kinematic compatibility equations
- We use the BEM code, poly3D
  - Thomas (1993)

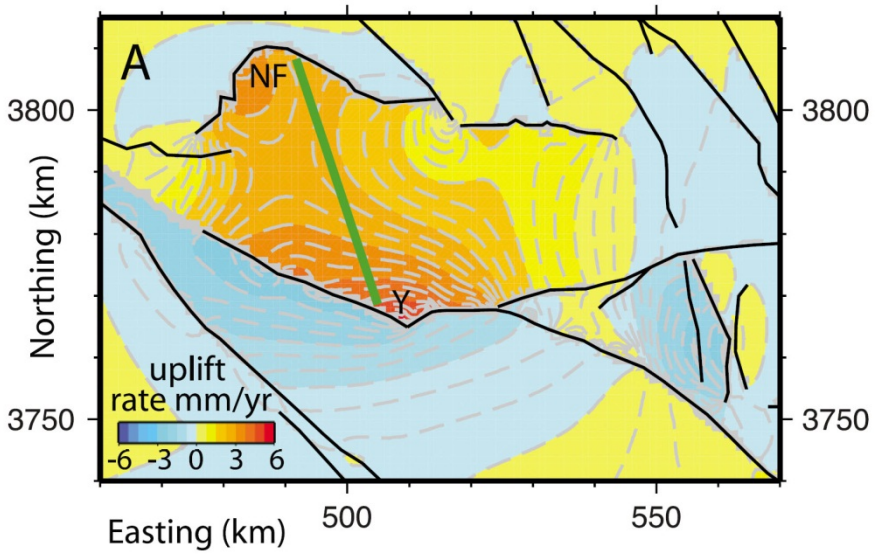


poly3D Basics

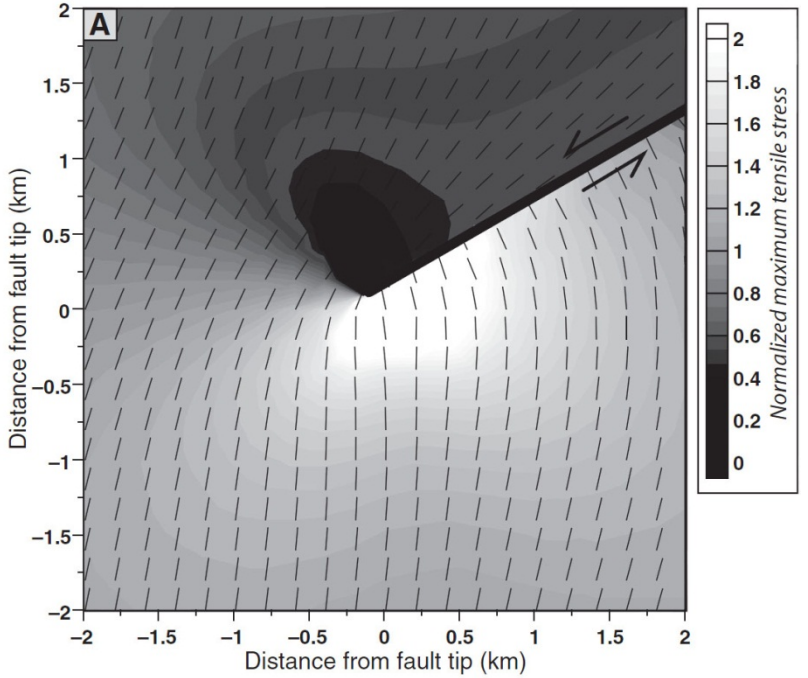
Once the distribution of slip is known:

- Can calculate useful quantities anywhere in the model
  - Displacements
  - Strains
  - Stresses

- Assumptions
  - Quasi-static
  - Homogeneous/Isotropic Linear-elastic half space
    - Faults locally perturb stresses



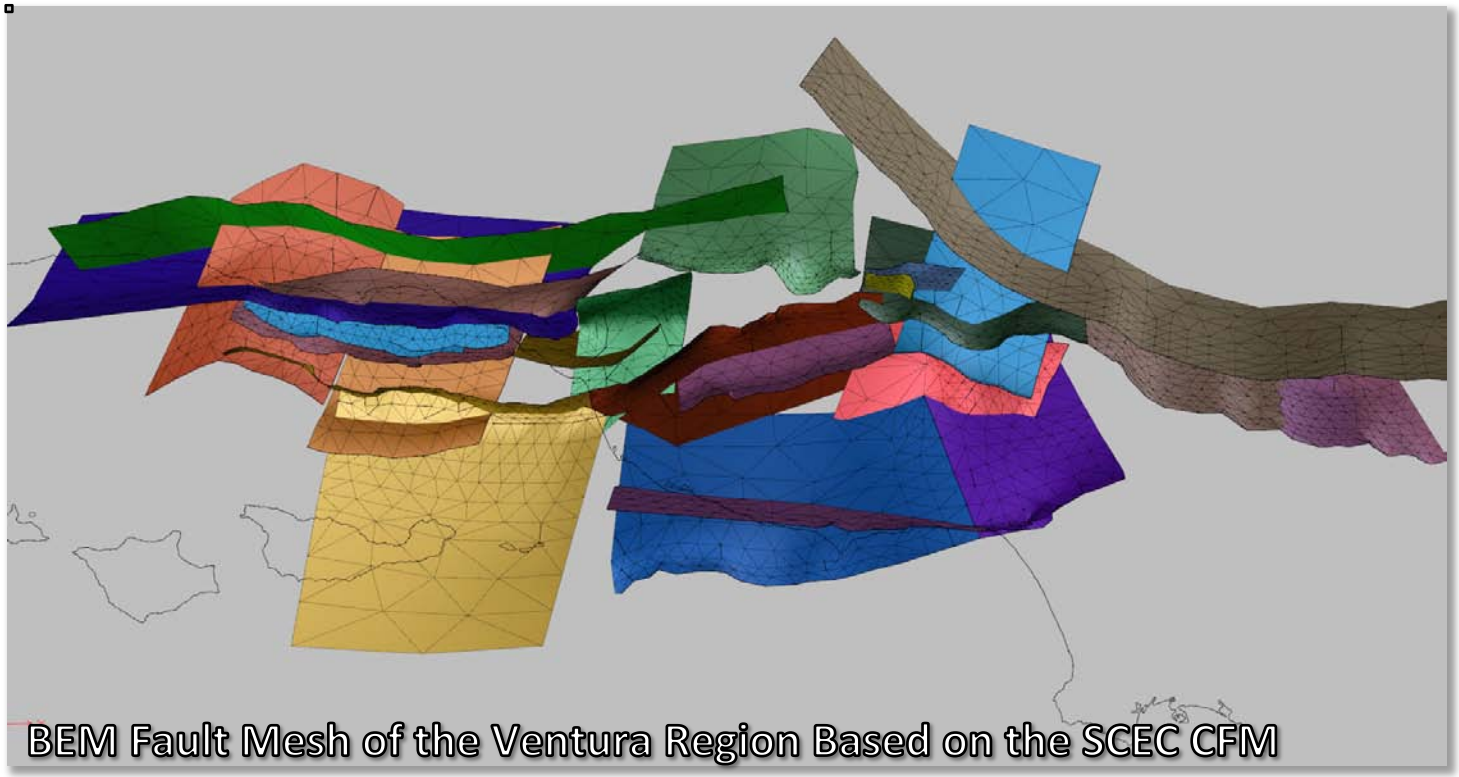
Model-calculated uplift rates (Cooke & Dair 2011)



Model-calculated stress field around fault tip (Marshall et al. 2010)

Modeled Geometry: The SCEC CFM

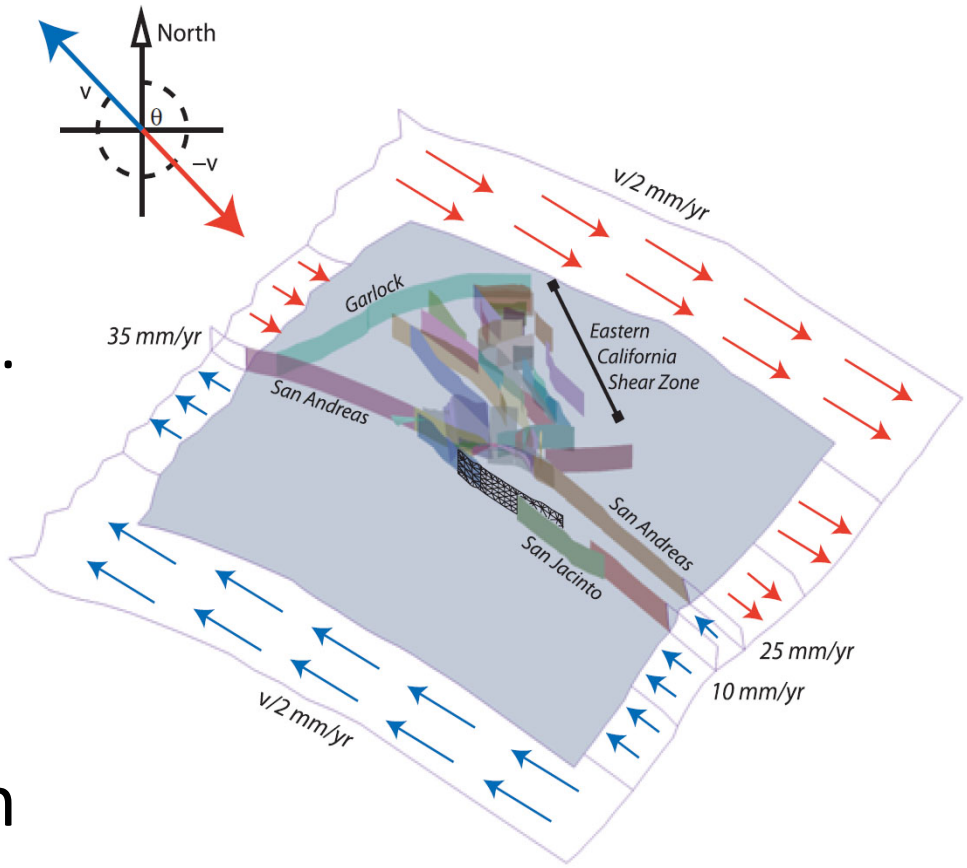
- Fault mesh is based on the SCEC CFM
  - Re-meshed for numerical stability
  - Typical element size ~2km



BEM Fault Mesh of the Ventura Region Based on the SCEC CFM

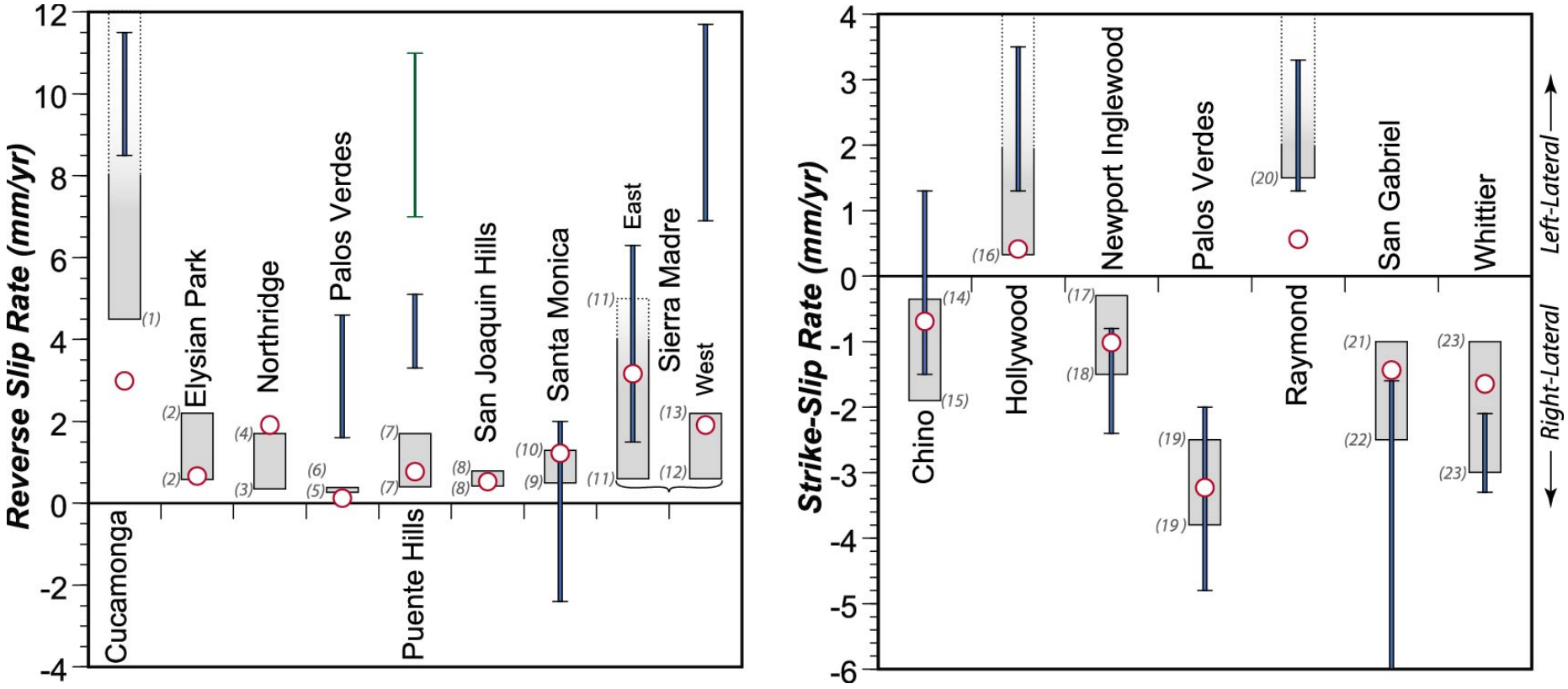
Model Setup

- Fault slip is driven by deep slip on a basal crack
  - Reproduces standard Savage & Burford (1973) model (e.g. Marshall et al. (2009)
- Coseismic slip is removed to simulate interseismic deformation
  - Same as back slip method (Savage 1983)



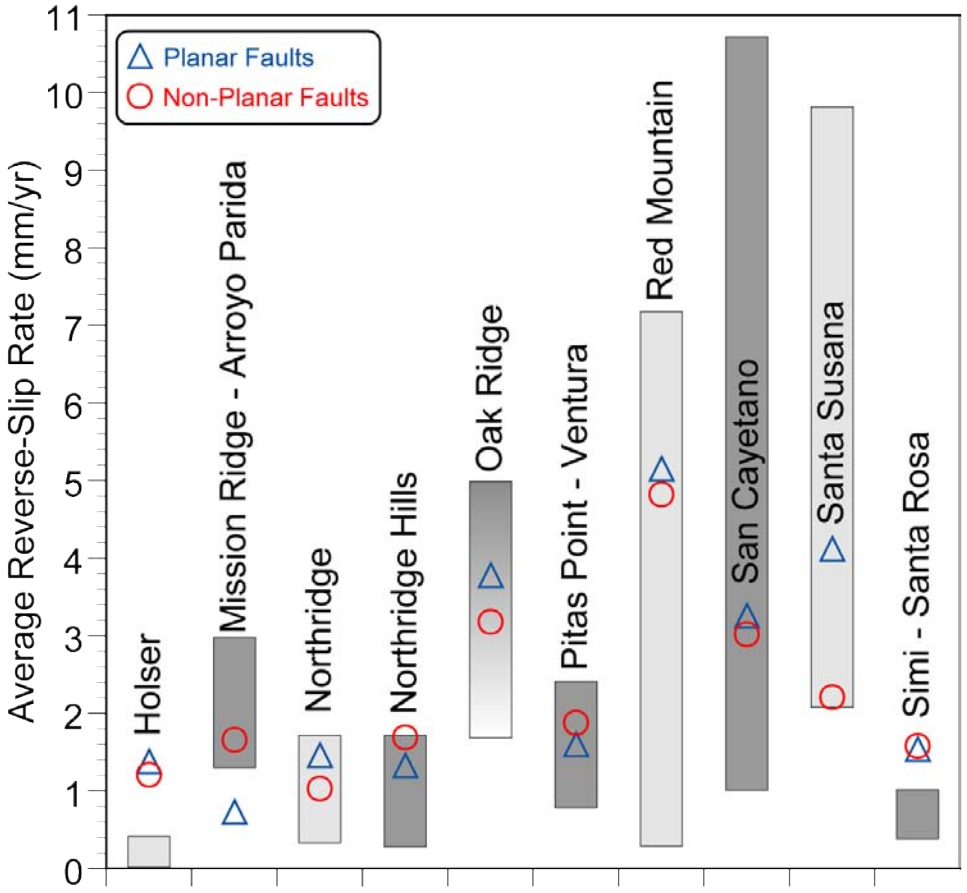
Model setup of Herbert and Cooke (2012) BSSA

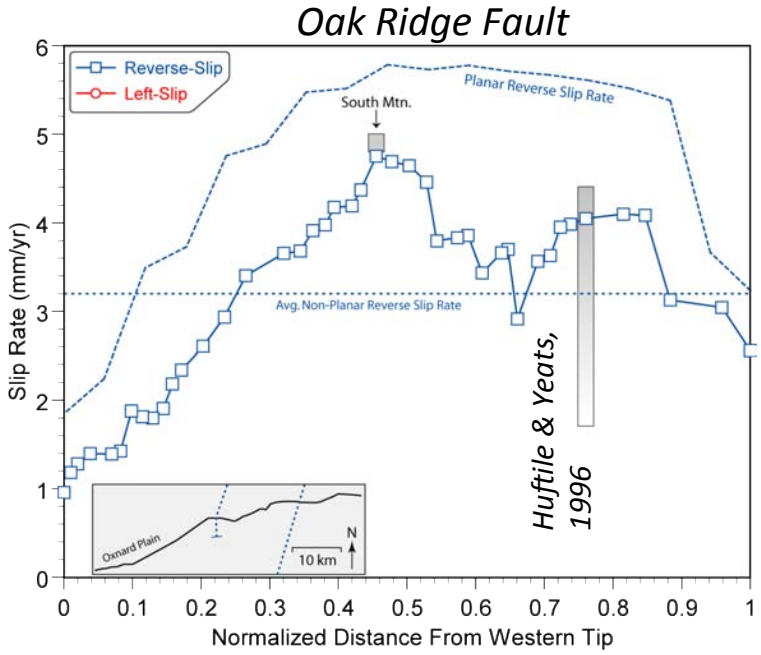
Model Slip Rates Match Observations: The Los Angeles Basin



From: Marshall, Cooke and Owen 2009

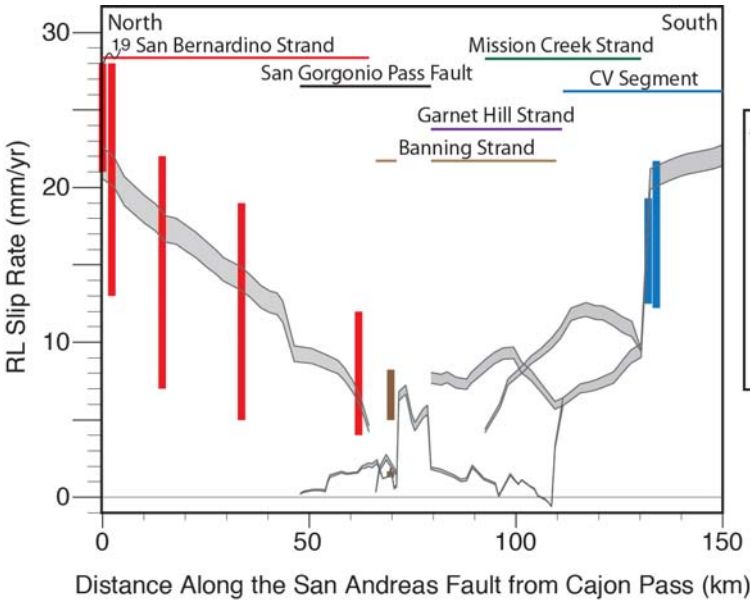
Strike-Slip Rates Match Observations: The Ventura Basin Region

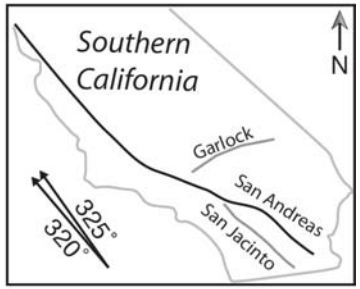


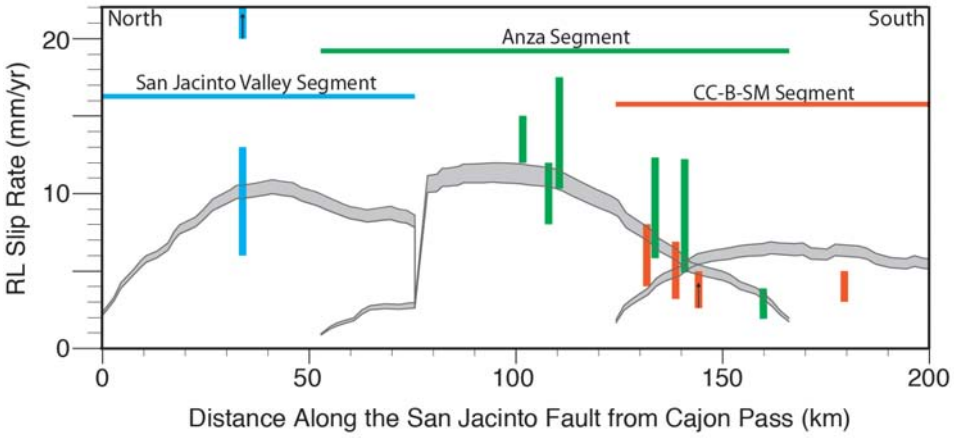


From: Marshall, Cooke and Owen, 2008 BSSA

Strike-Slip Rates Match Observations: Major SoCal Strike-Slip Faults







(Herbert and Cooke. 2012)

Strike-slip rates within the Eastern California Shear Zone