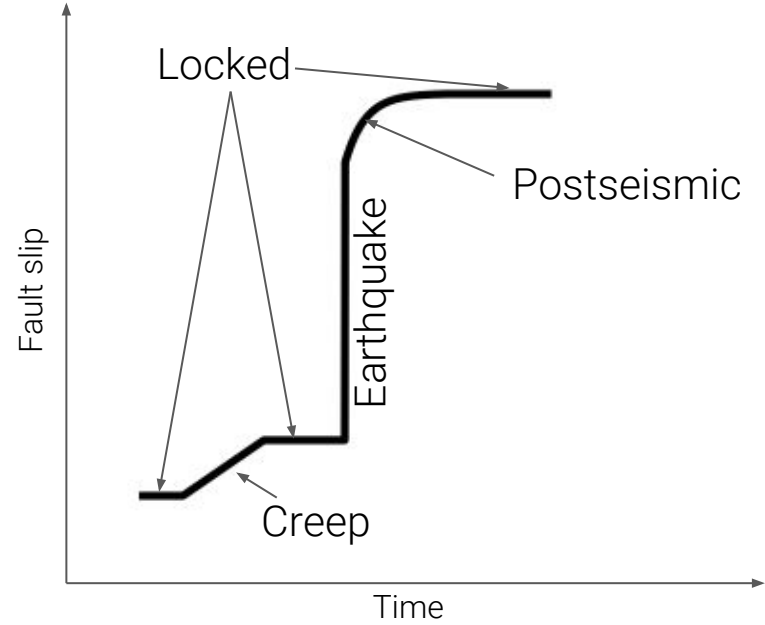
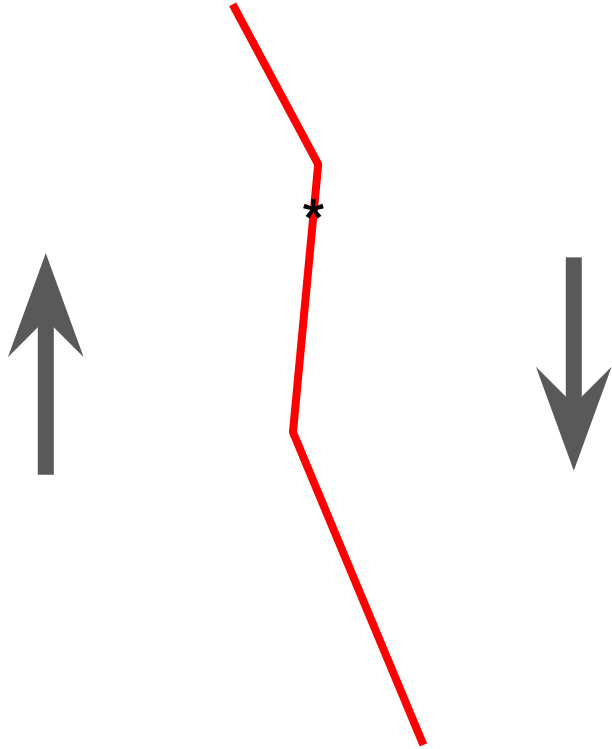


An aerial photograph of a rugged mountain range, likely the Sierra Nevada, showing steep, rocky slopes and deep valleys. A black rectangular text box is overlaid in the center of the image.

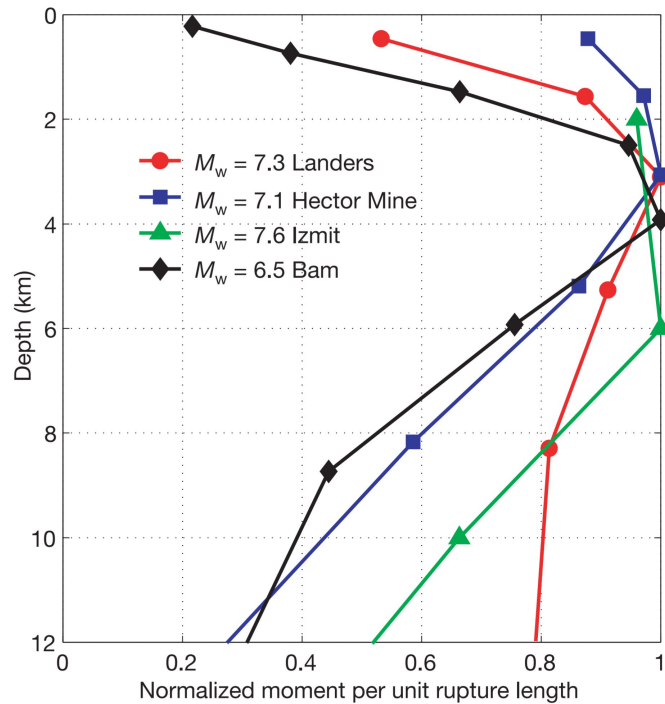
# The Earth isn't flat: The large influence of topography on geodetic fault slip imaging

T. Ben Thompson and Brendan J. Meade  
Department of Earth & Planetary Sciences  
Harvard University

# When and how do faults slip?

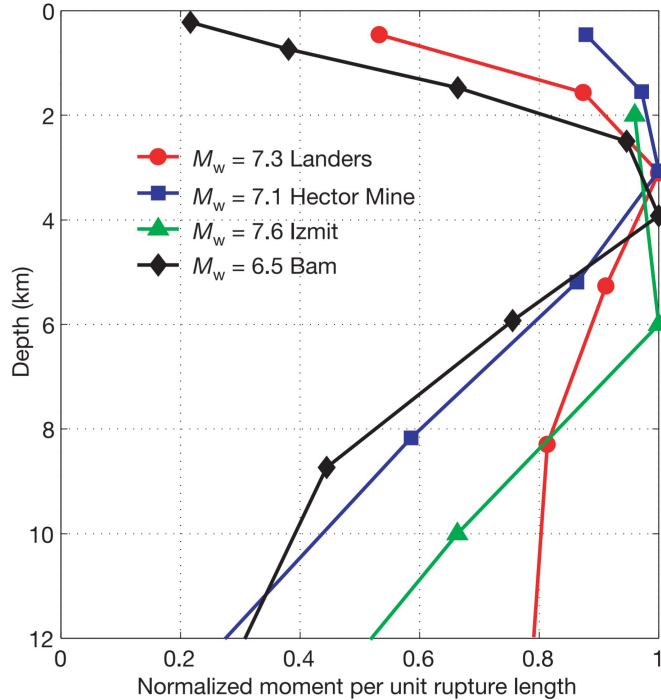


# Is there a shallow slip-deficit?



Fialko et al. 2005

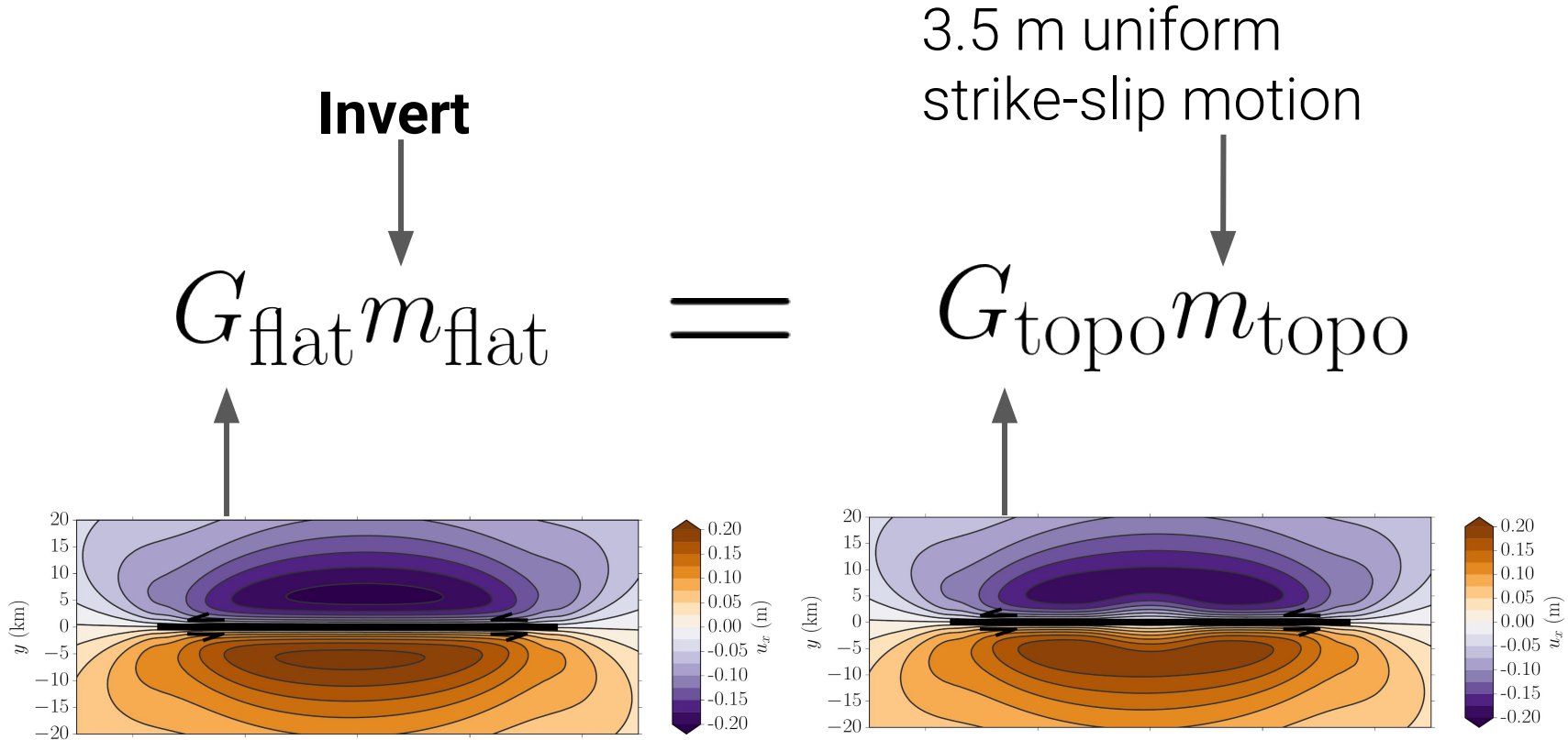
# Is there a shallow slip-deficit?



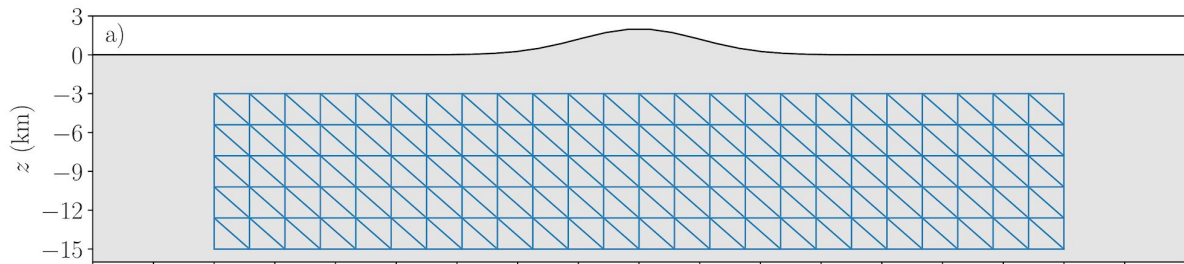
Near-surface fault modeling is missing a key component:

Topography

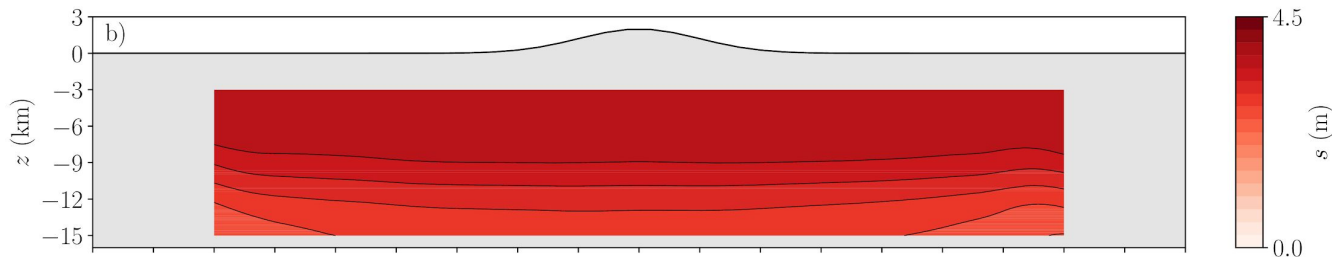
# How does topography influence slip inversion?



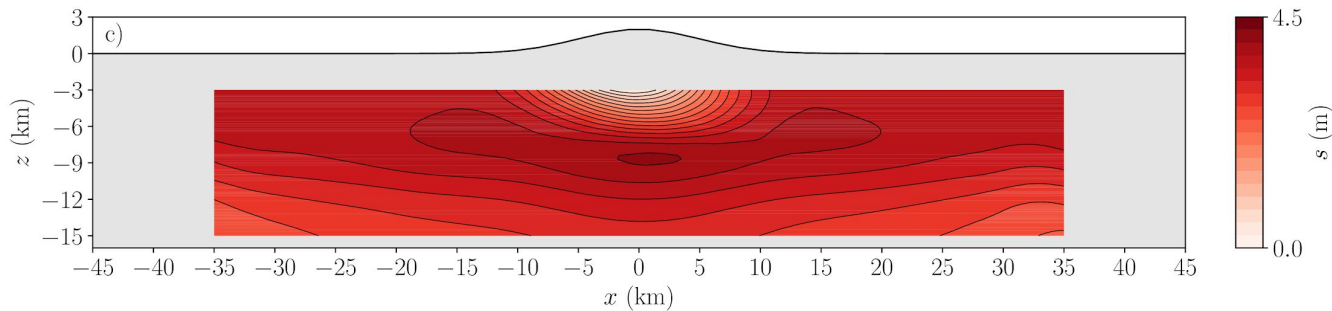
# Ignoring topography → shallow slip-deficit



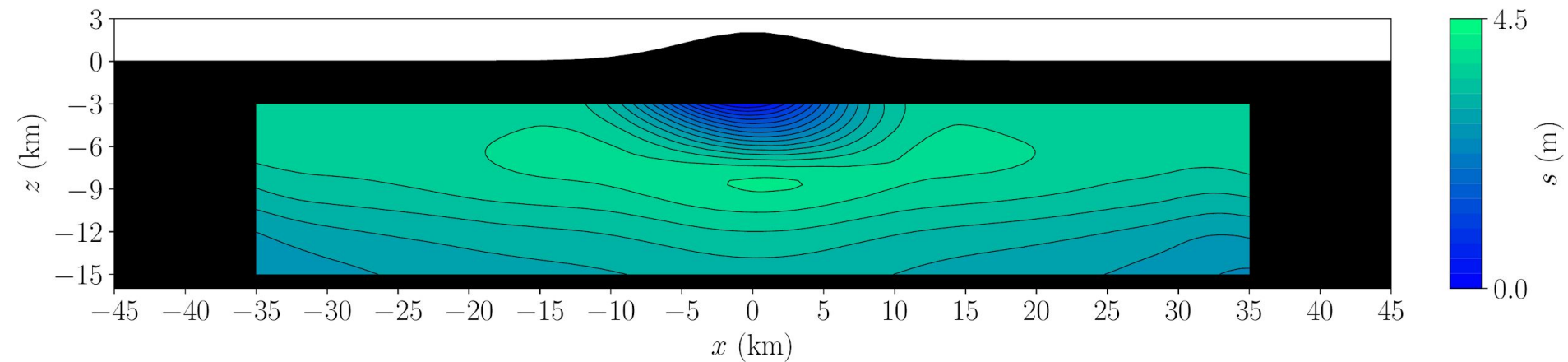
With topography:



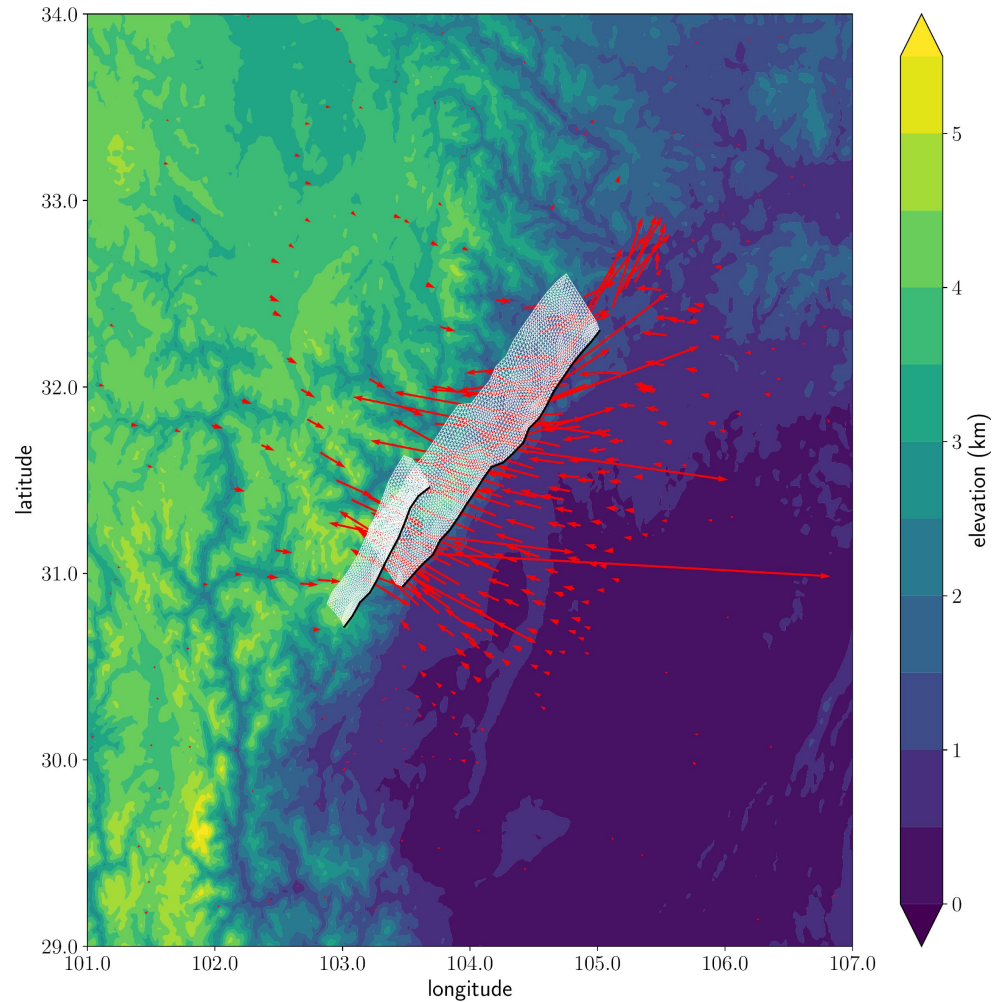
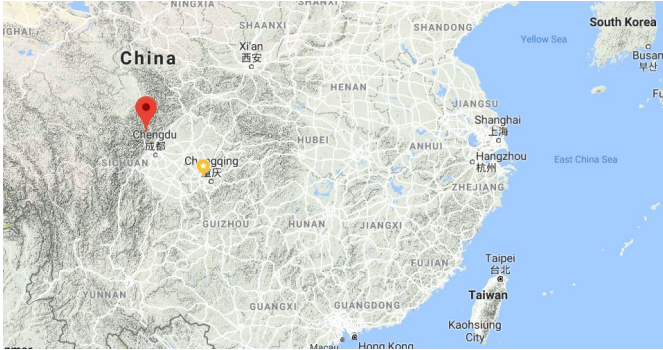
Without topography:



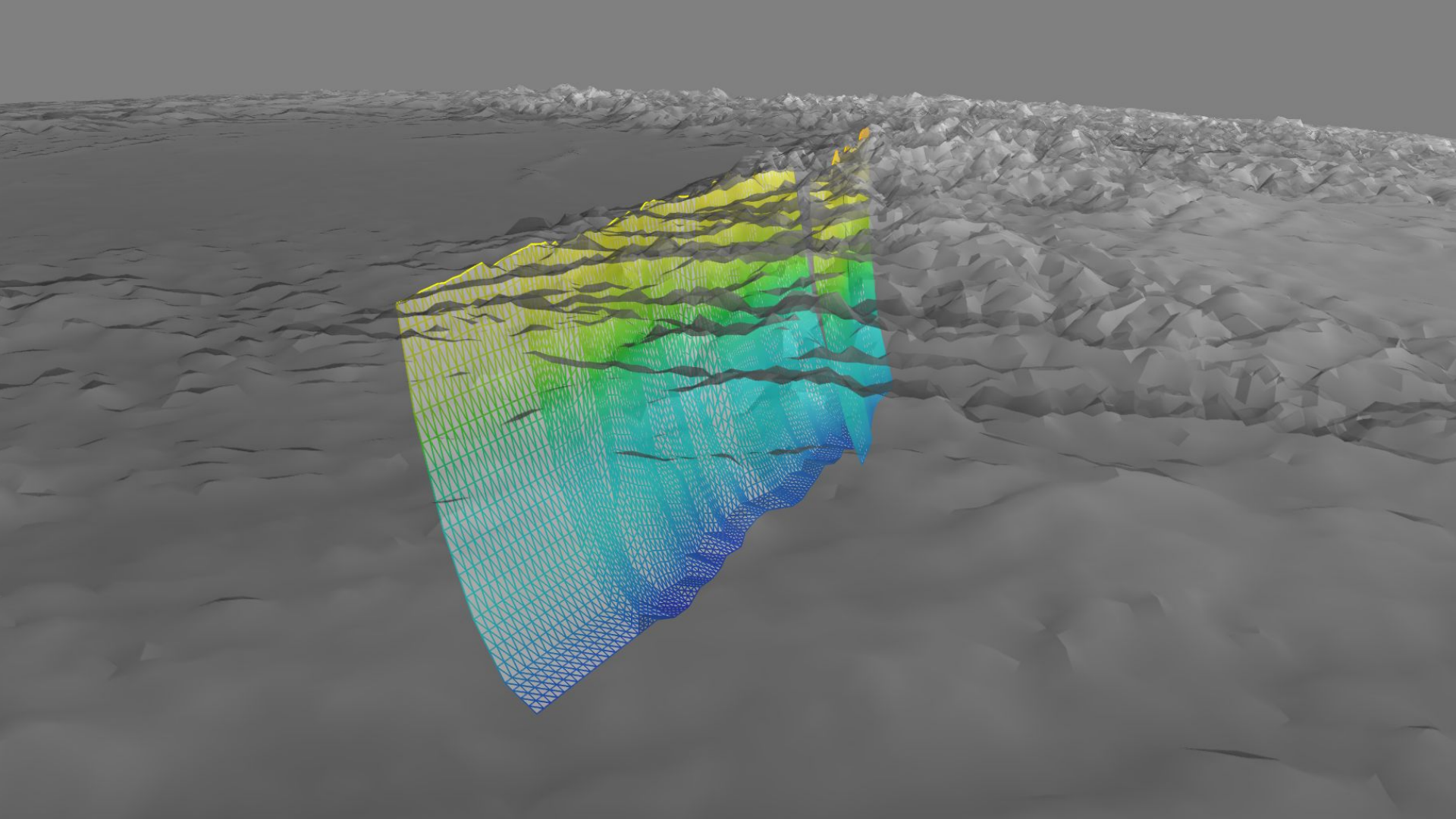
Ignoring topography  $\rightarrow$  shallow slip-deficit



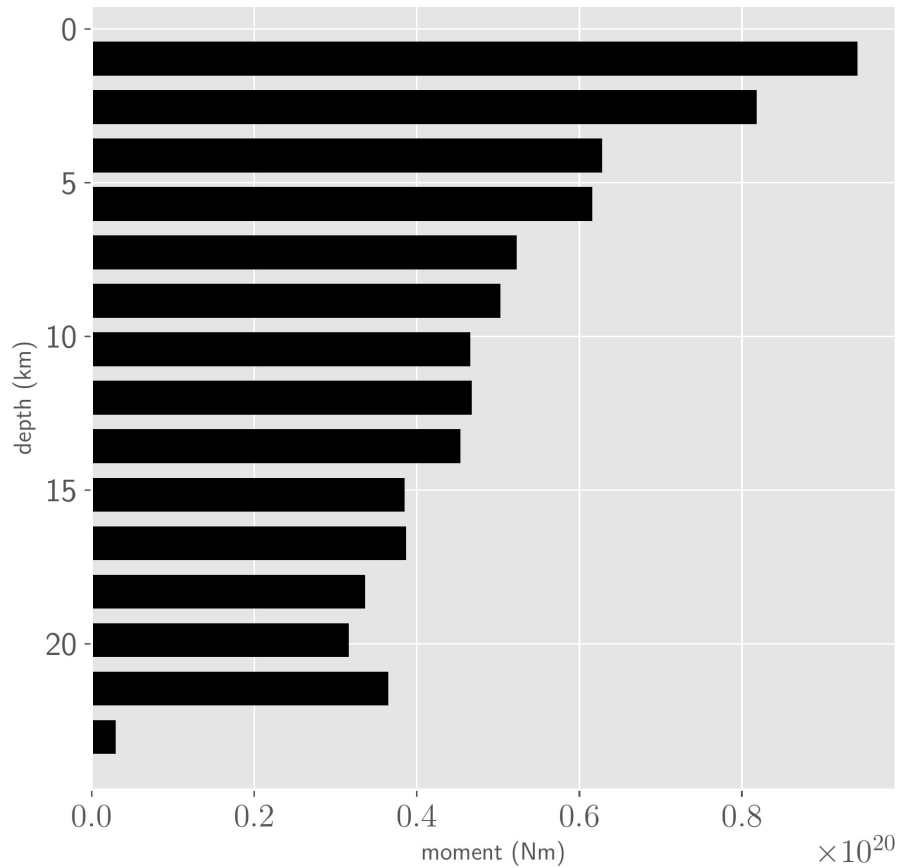
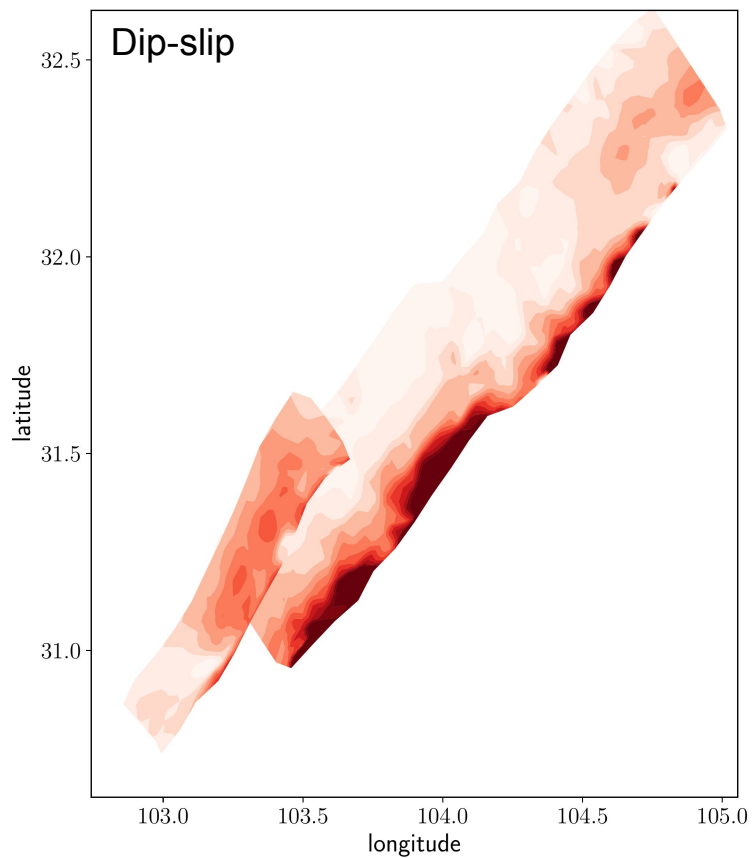
# 2008 Wenchuan very steep topography!



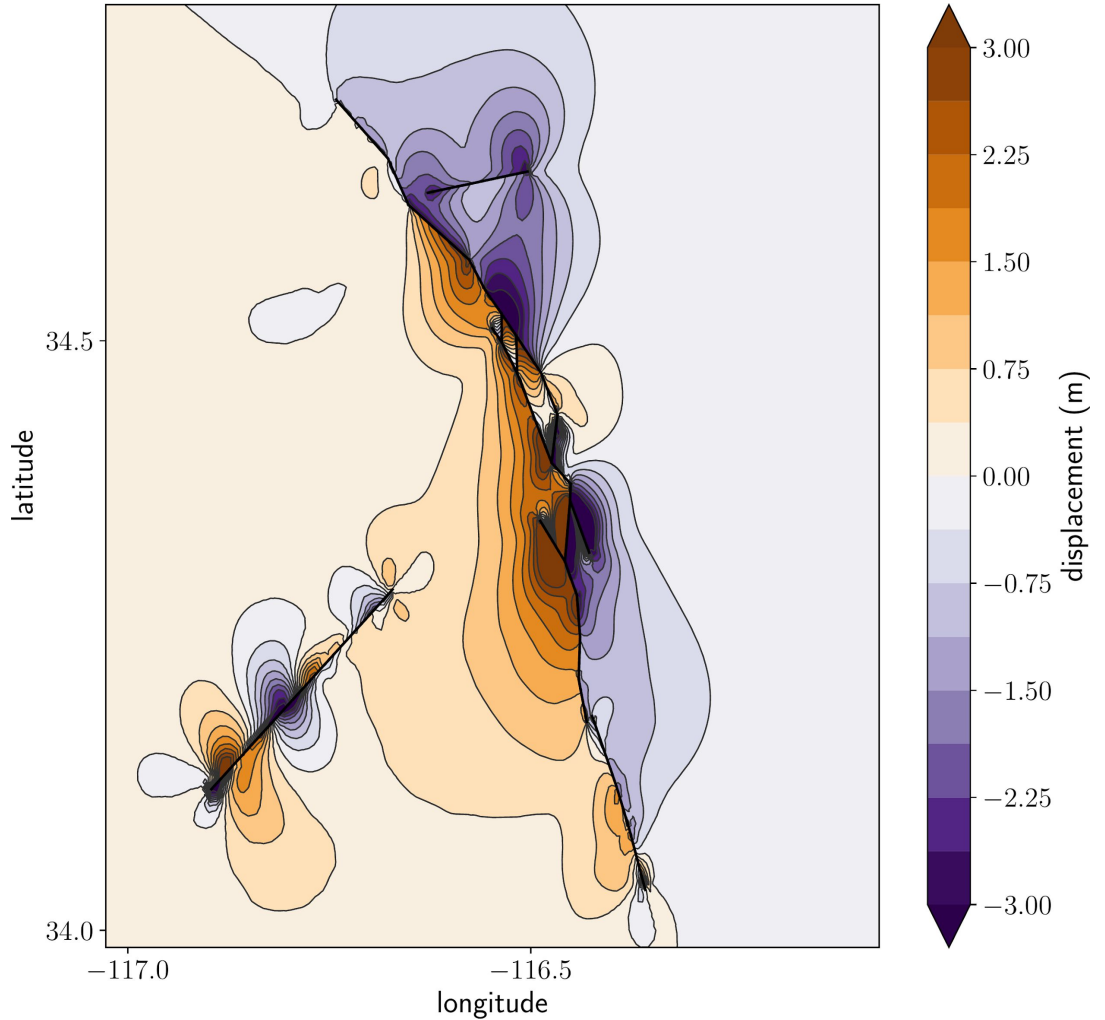




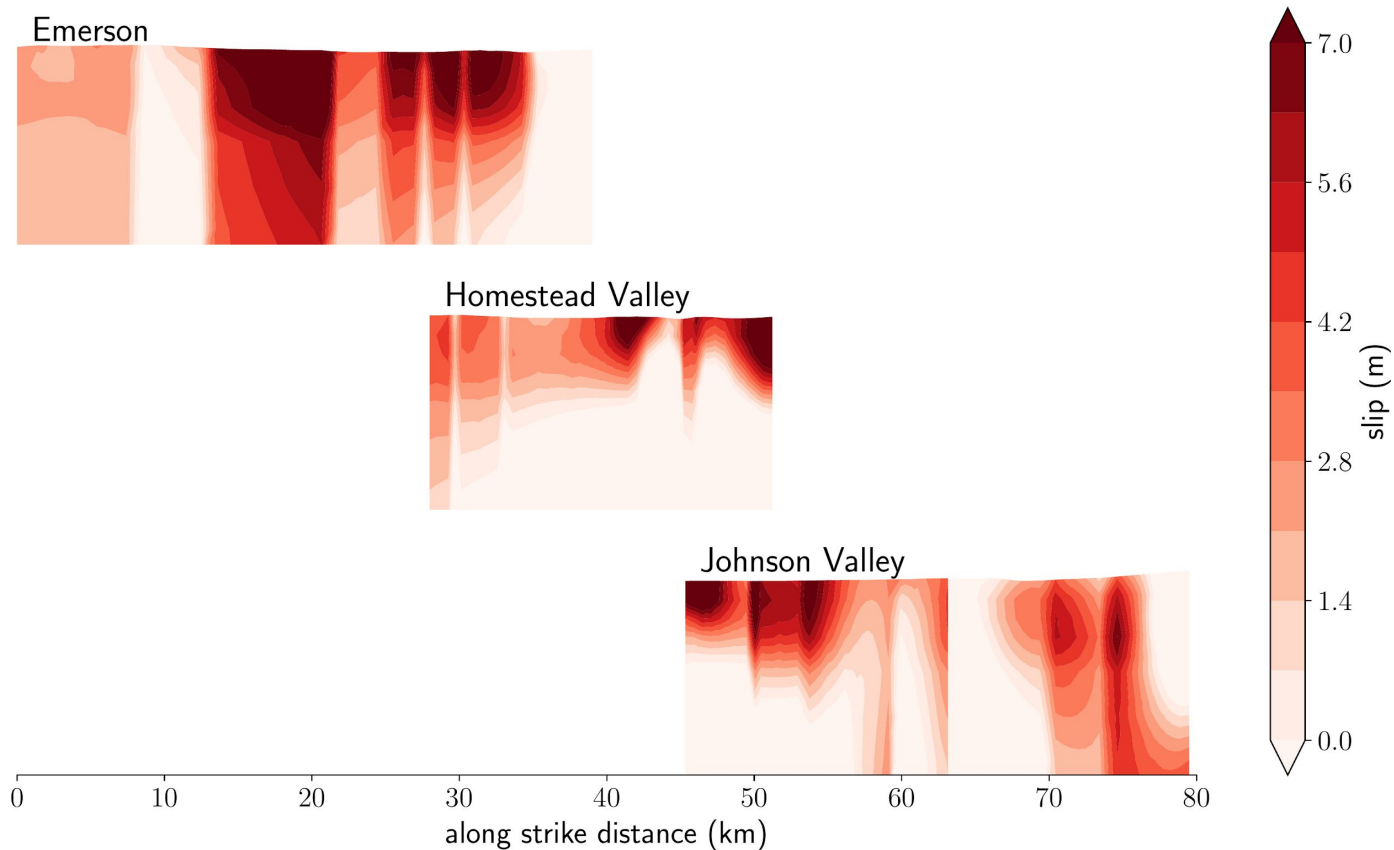
# Wenchuan: Dominantly shallow slip



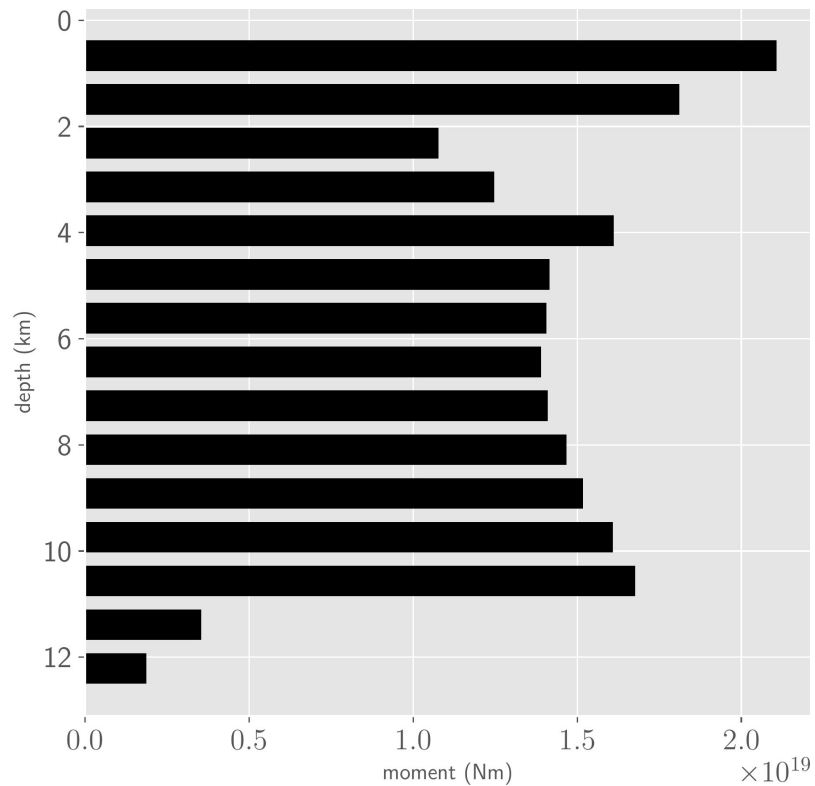
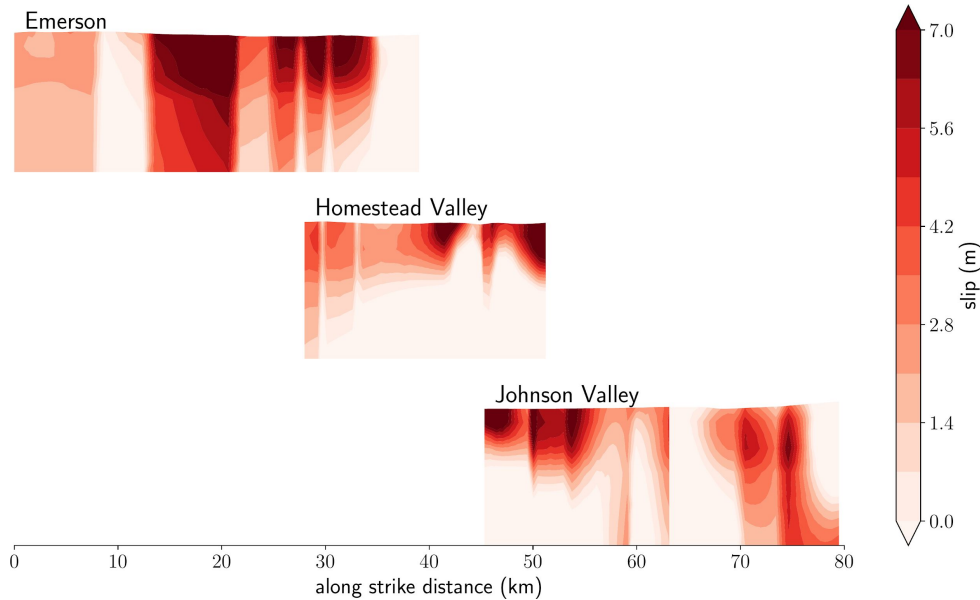
# 1992 Landers: small ranges, San Bernardin



# Landers: No shallow slip-deficit



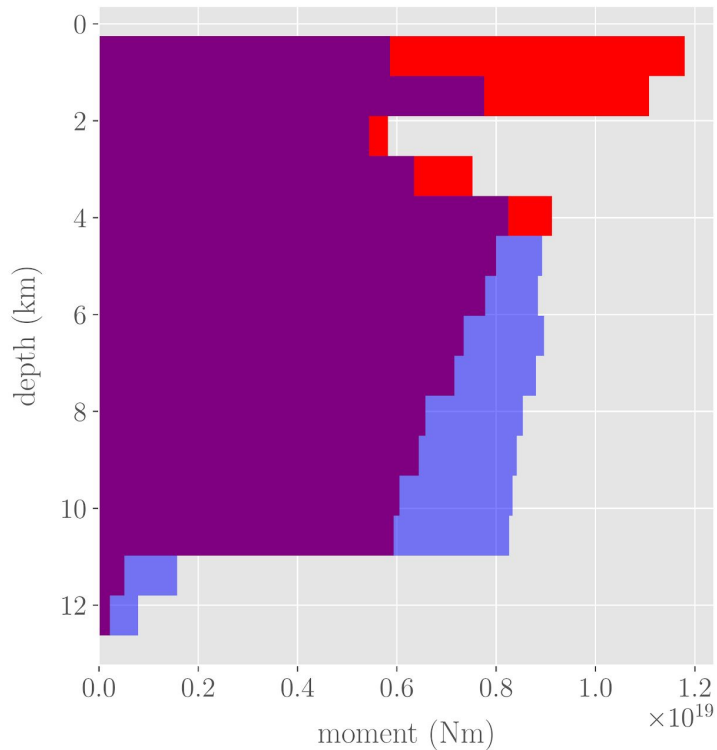
# Landers: No shallow slip-deficit



# Is there a shallow slip-deficit?

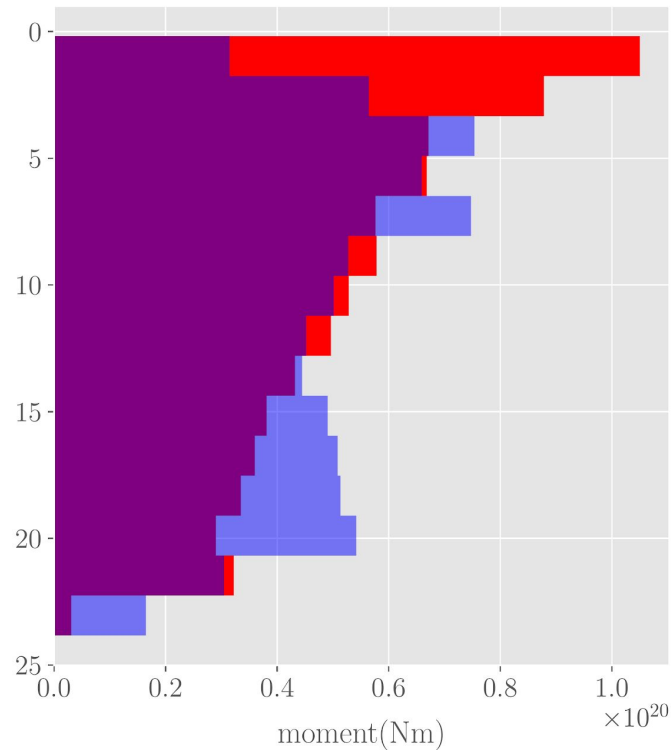
**Blue:** Fialko 2005  
**Red:** With topography

a) Landers

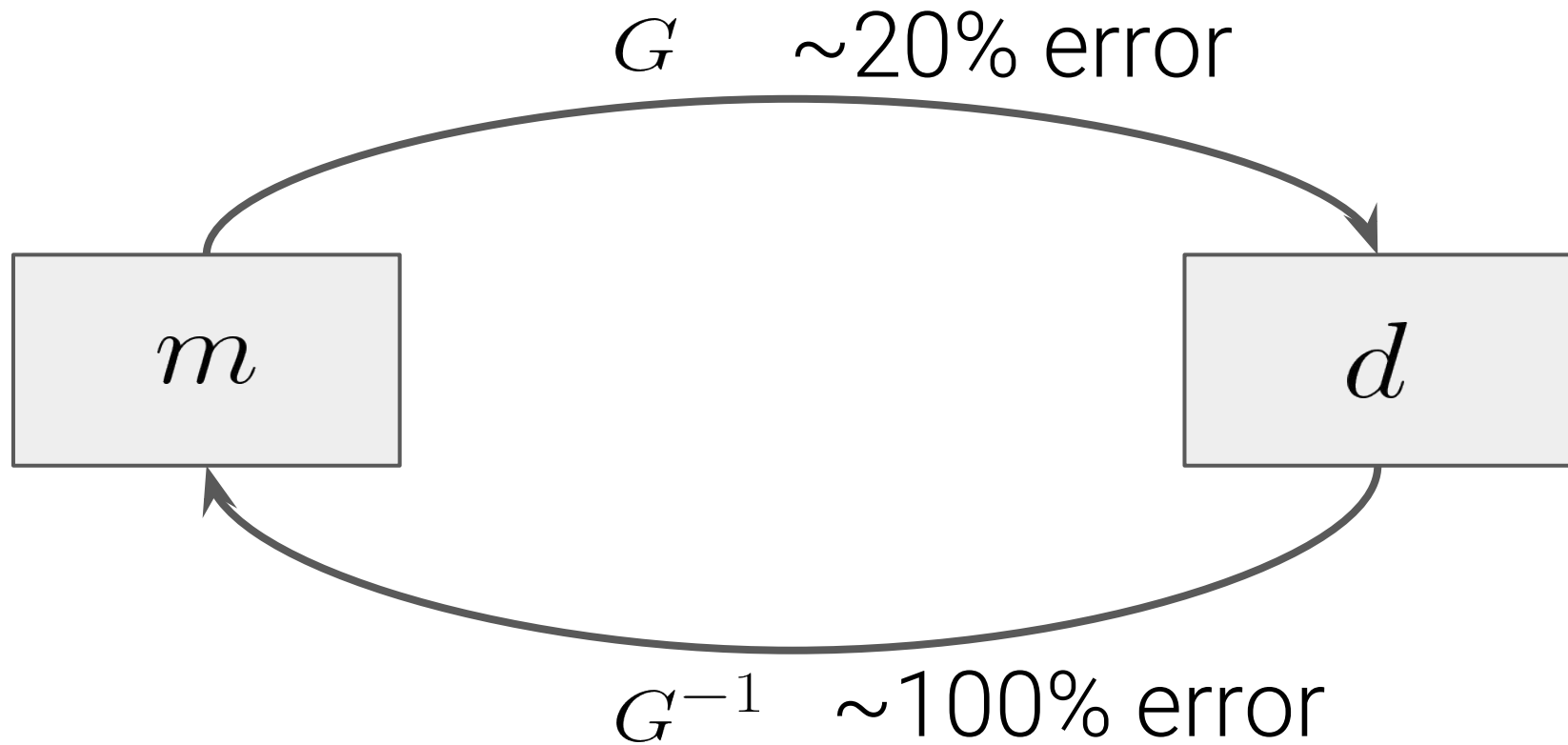


**Blue:** Fielding 2013  
**Red:** With topography

b) Wenchuan



Inversion amplifies forward model errors



# Tectosaur: a new tool for high-fidelity fault modeling

## Now:

topography  
earth curvature  
material contrasts

millions of elements  
no volumetric meshing  
rapid model iteration

Boundary element methods are not as limited as once thought

**Future BEM:** mesh-free nonlinearity, dynamic rupture/waves!



How to explain shallow slip-deficits?

Inelastic near-surface deformation?

Interseismic/postseismic near-surface creep?

**An artefact of ignoring free-surface effects of topography**