UCERF3 Task R2-
Evaluate Magnitude-Scaling Relationships and Depth of Rupture

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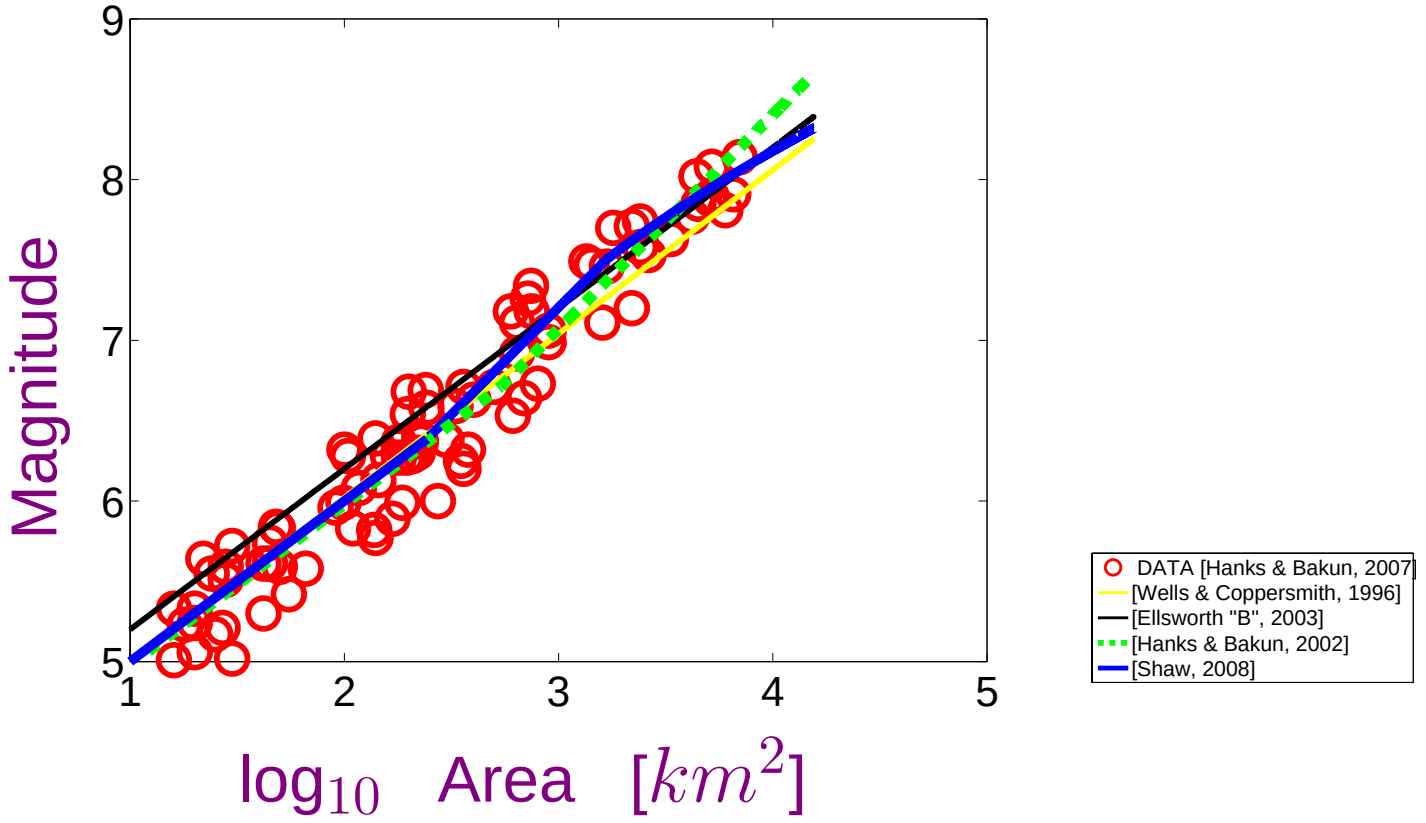
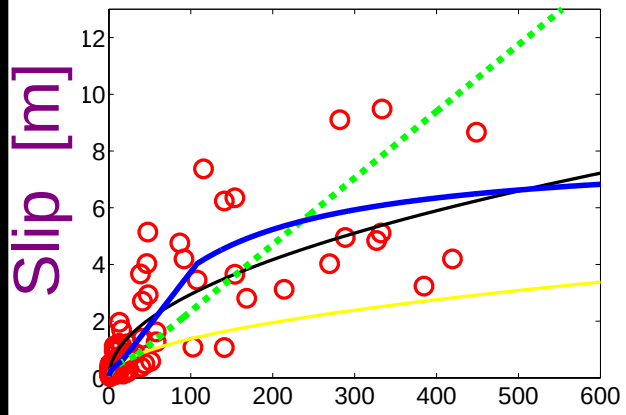
Magnitude-Area Scaling Laws



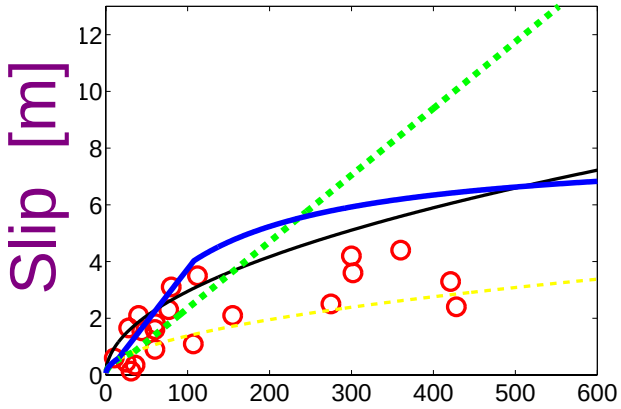
- Use Slip-Length scaling to distinguish between different scaling laws and for alternative logic tree branch for slip rate budgeting

Slip vs Length



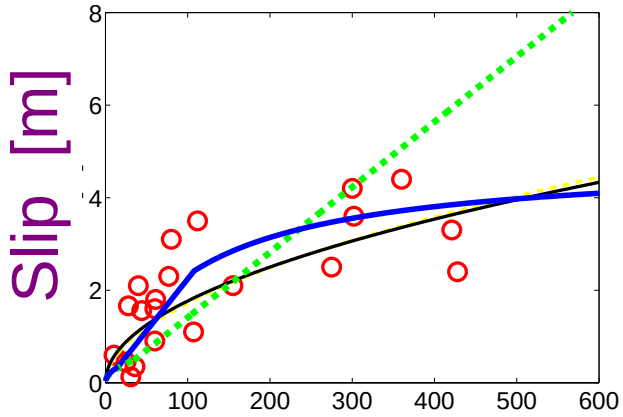
Length [km]

From mag-area data



Length [km]

Slip-length data

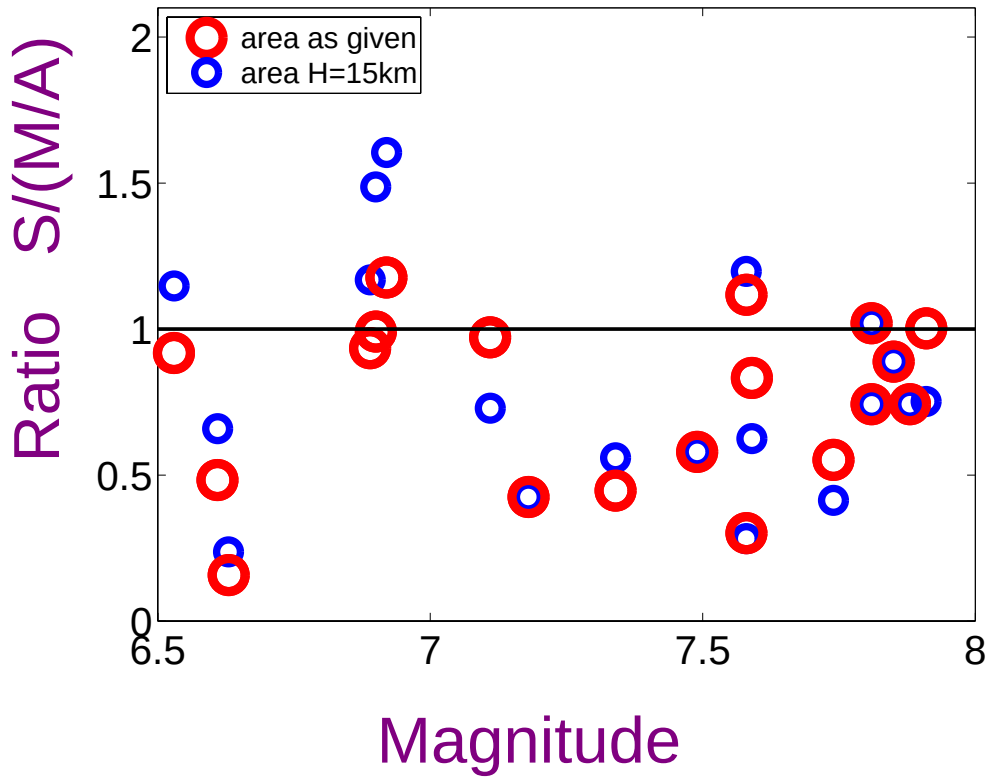


Length [km]

Rescaled fit by .6

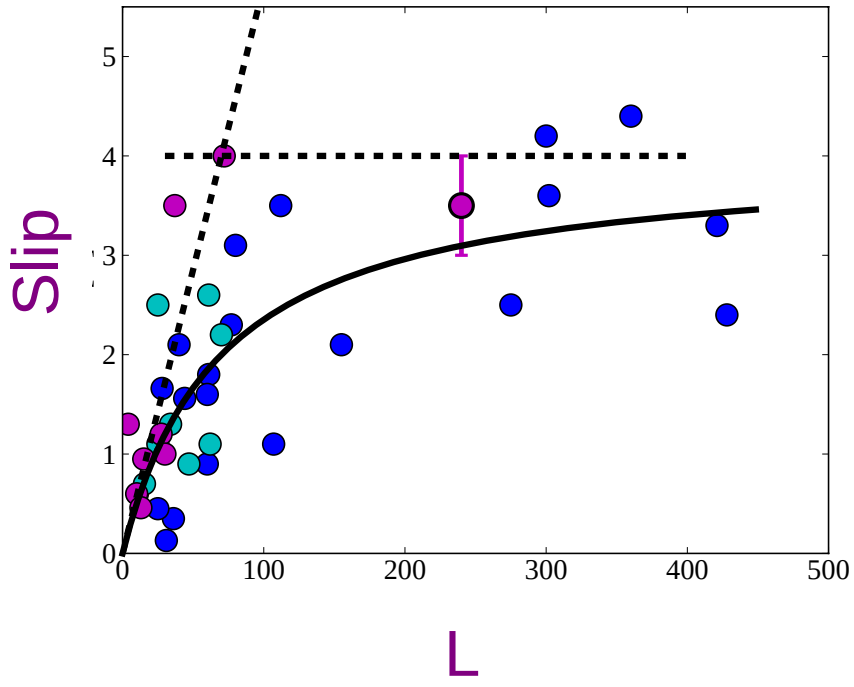
- Magnitude-area scalings used in hazard overpredict surface slip
- Linear fit inconsistent with slip data
- Other functional forms ok, but amplitude different
- Sources of differences?

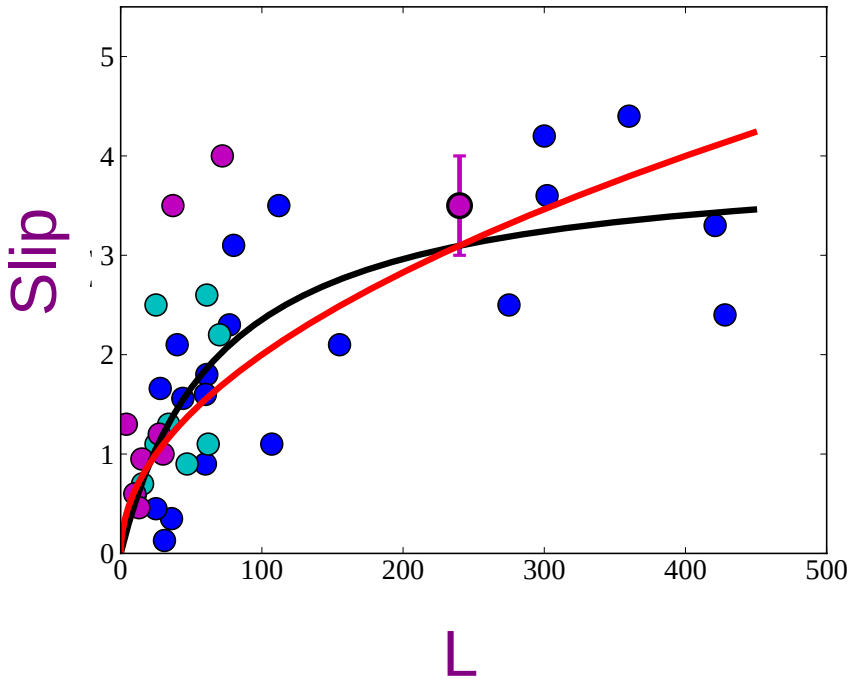
Differences in Estimates: $S/(M/A)$



- Lack of obvious magnitude dependence in difference
- mean: $\sim 30\%$ reduction
- another $4/\pi \sim 30\%$ increase expected for surface vs average
- Deep slip correction ($\sim 30\%$) the other way?
- Modulus uncertainty? (used 30Gpa)
- Enveloping? Distributed deformation in unconsolidated layers?

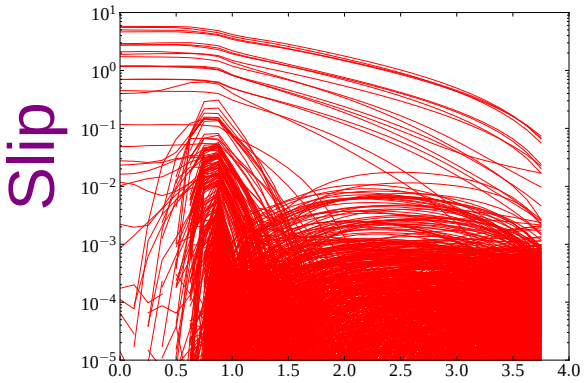
Slip-Length Scaling



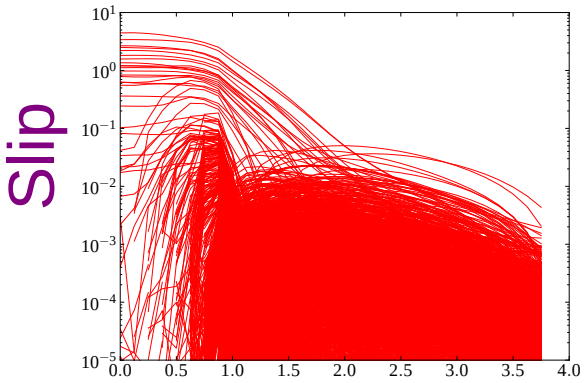


- Constant stress drop scaling fits well: $S = \frac{\Delta\sigma}{\mu} \frac{1}{\frac{7}{3L} + \frac{1}{2W}}$
- $L^{1/2}$ scaling fits well and is simple
- No obvious focal mechanism dependence for subareal events

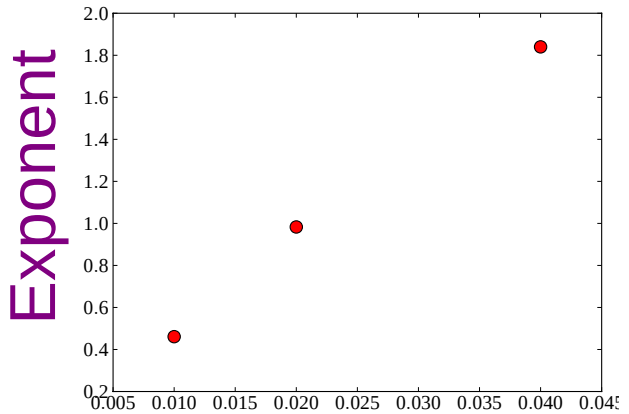
Deep Slip Possibility seen in Models



$a = .03$



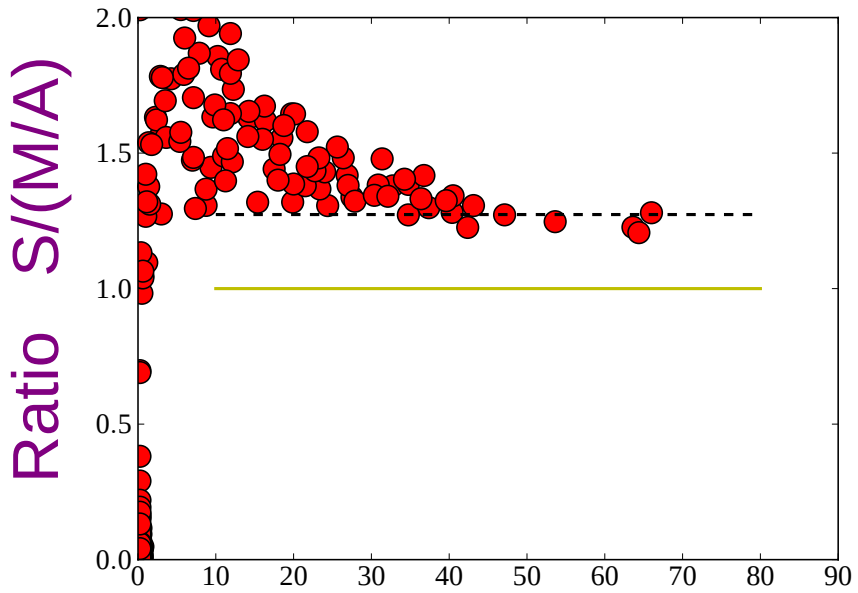
$a = .1$



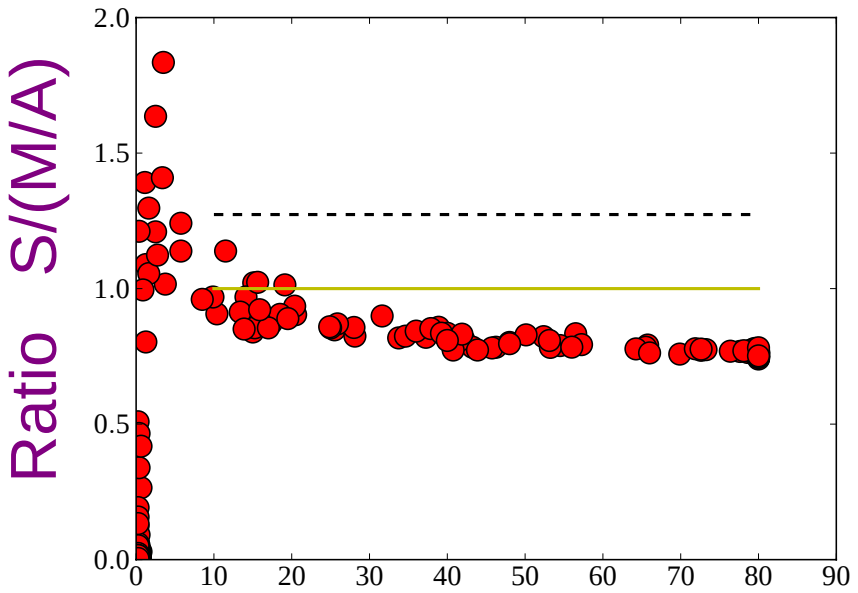
Exp dependence on a

- Exponential falloff in slip in deep fault strengthening layer
- Exponent has $\approx$linear dependence on a for deep fault $a \ln V$

Deep Slip and Scaling Estimates



$a = .3$



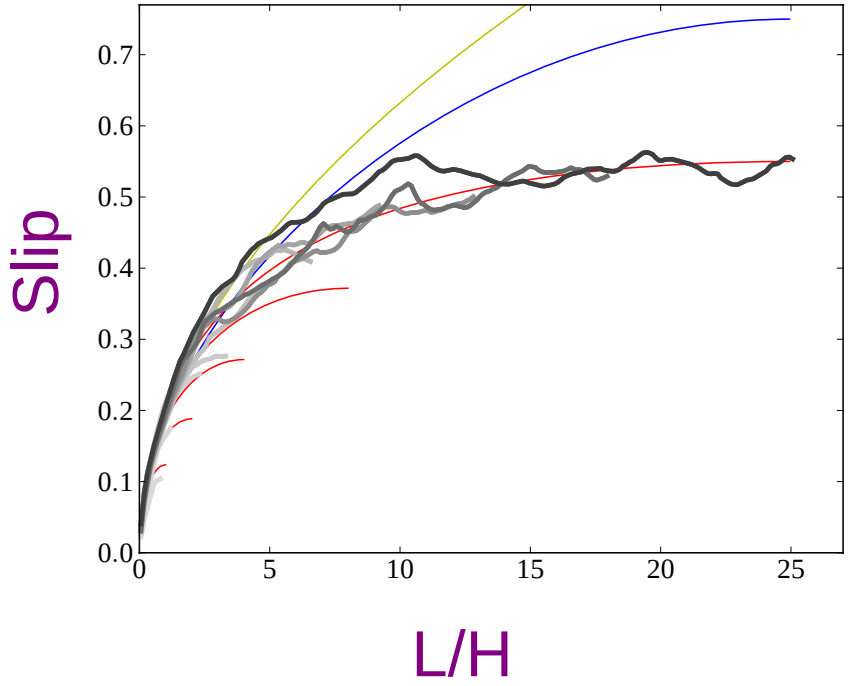
$a = .03$

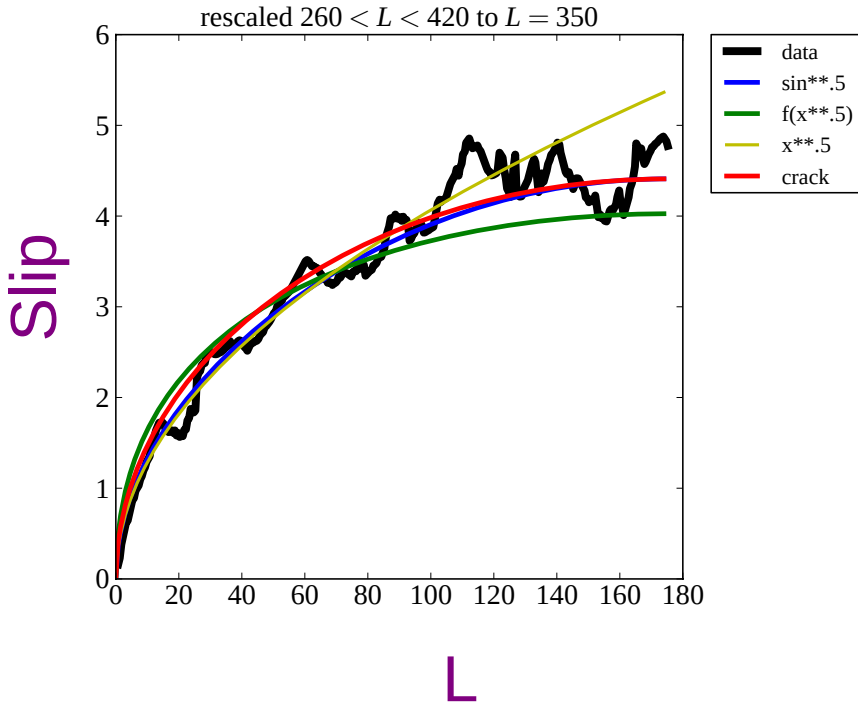
- Two effects of deep slip: M_{deep} and $M_{seismogenic}$ increased

Proposed Solutions

- One logic tree branch: Use magnitude-area for size and rate as in UCERF2
- Second logic tree branch: Use magnitude-area for size and use Slip-Length for rate
- For Magnitude-Area scaling use EllsworthB and Shaw09
- For Slip-Length scaling use EllsworthB-Wesnousky $L^{1/2}$ and Shaw11 $\Delta\sigma = const$
- Deep slip and/or missing surface slip can reconcile estimates
- For use in models, exponential or linear falloff in deep slip good approximation of dynamic model behavior

Average Slip Along Strike





- Model data eventually saturates at really large lengthscale
- But $\sin^{1/2}$ still fits $300 - 400km$ smoothed surface data well