Along-Strike Distribution of Slip

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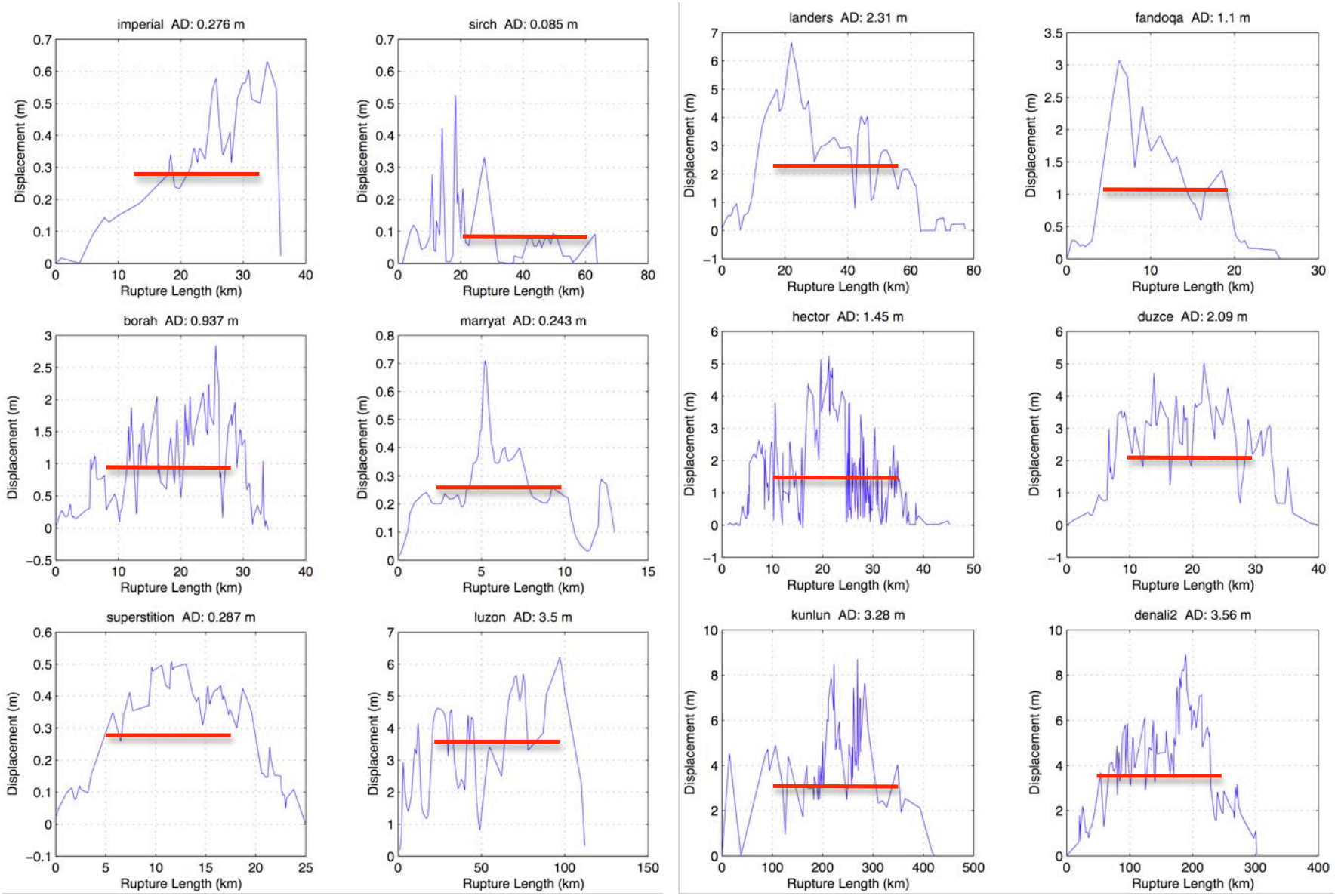
Surface Rupture Data Sets

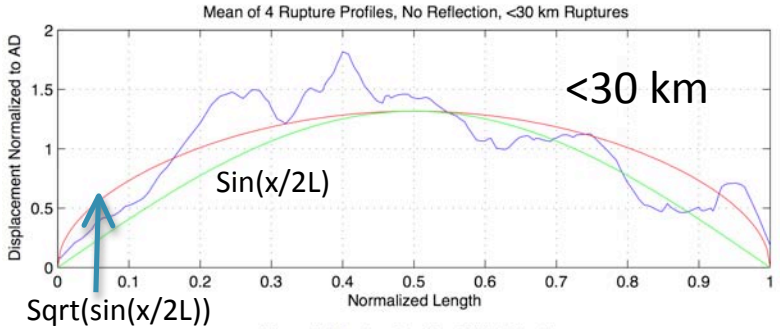
- McCalpin and Slemmons (1998) compiled rupture profiles **D**(x). Results were not widely known.
- Wesnousky (BSSA, 2008) Re-digitized ruptures and standardized format for all documented surface-rupturing events.
  - Slip data compiled for individual strands
  - Map views show step-overs and discontinuities
  - Electronic supplement of digitized **D**(x) data in spread-sheet format.

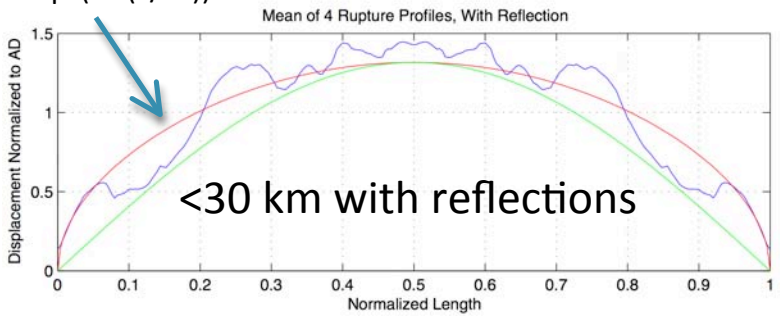


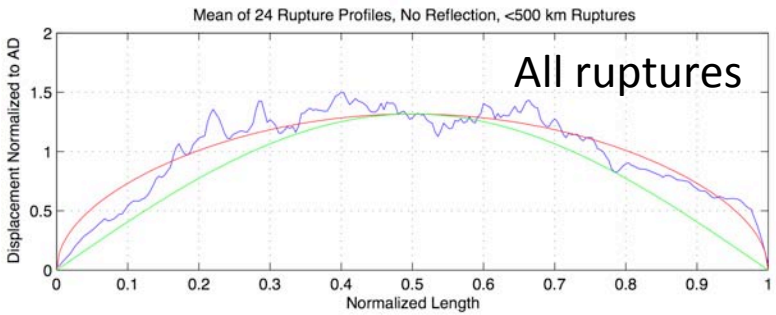
Example rupture profiles from Wesnousky (2008). Red line at average displacement

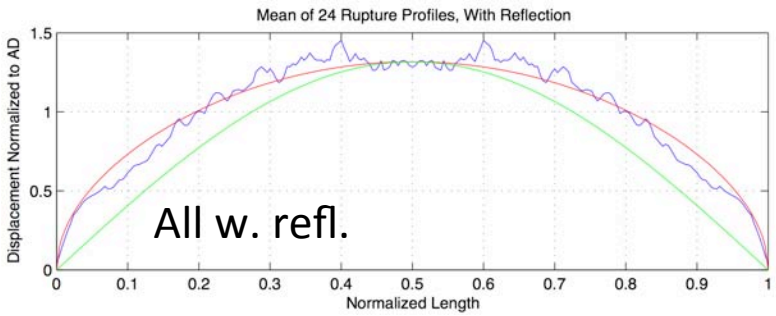
Using Surface Rupture Displacement Data

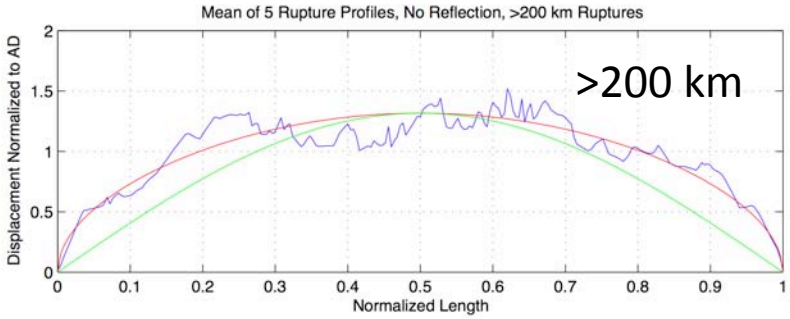
- Data set is small and relatively heterogeneous
- To extract common properties of ruptures, normalize by displacement and length, then stack. (Hemphill-Haley and Weldon, 1999)
  - Result is an “average” rupture displacement
  - Useful when extreme values and variability are not needed; e.g., cases where sum of many rupture displacements is compared to a total.
  - Removes variations in average displacement – maybe not the best thing.

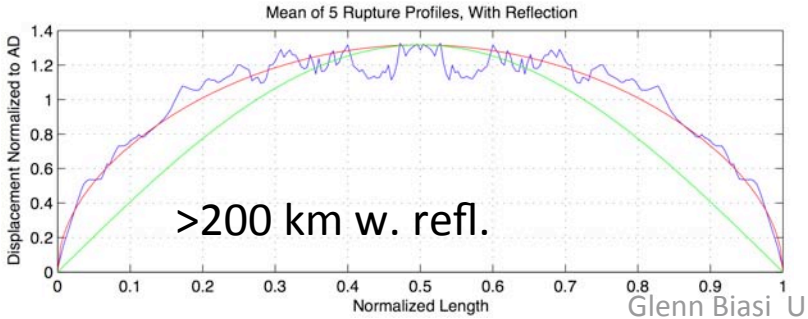












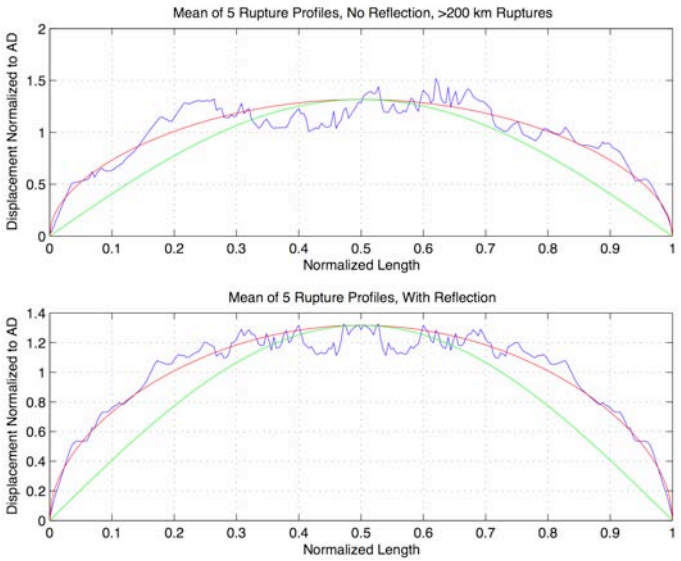
Wesnousky dataset, normalize and stack…

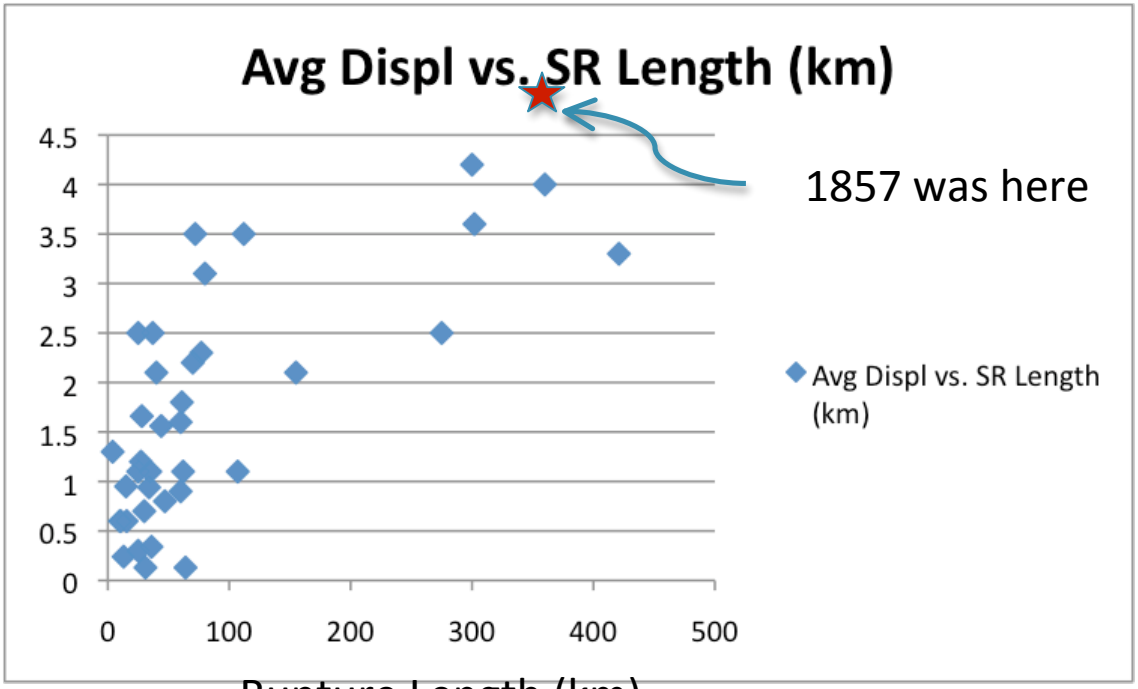
- <30 km ruptures
- >200 km ruptures
- All available

Average unreflected profiles are similar to the case including reflected profiles.

Notes on Averaged Rupture Shapes

- Sinesqrt shape is not an artifact of the smaller Hemphill-Haley and Weldon data set.
- Normalization may tend to hide the real rupture shape for longest ruptures. Fixing this could reduce the bulge.

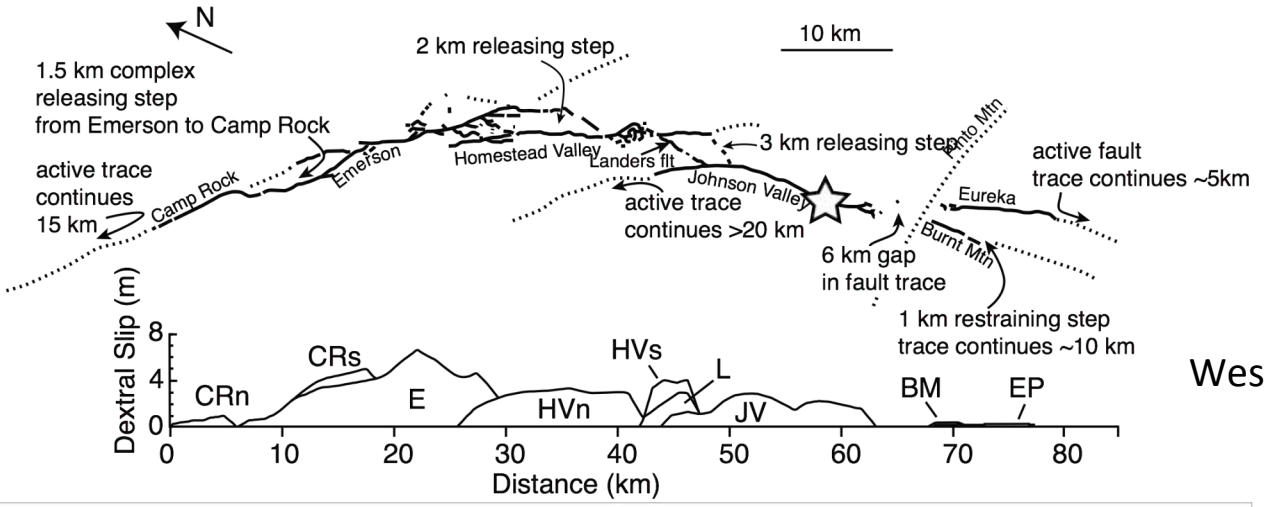




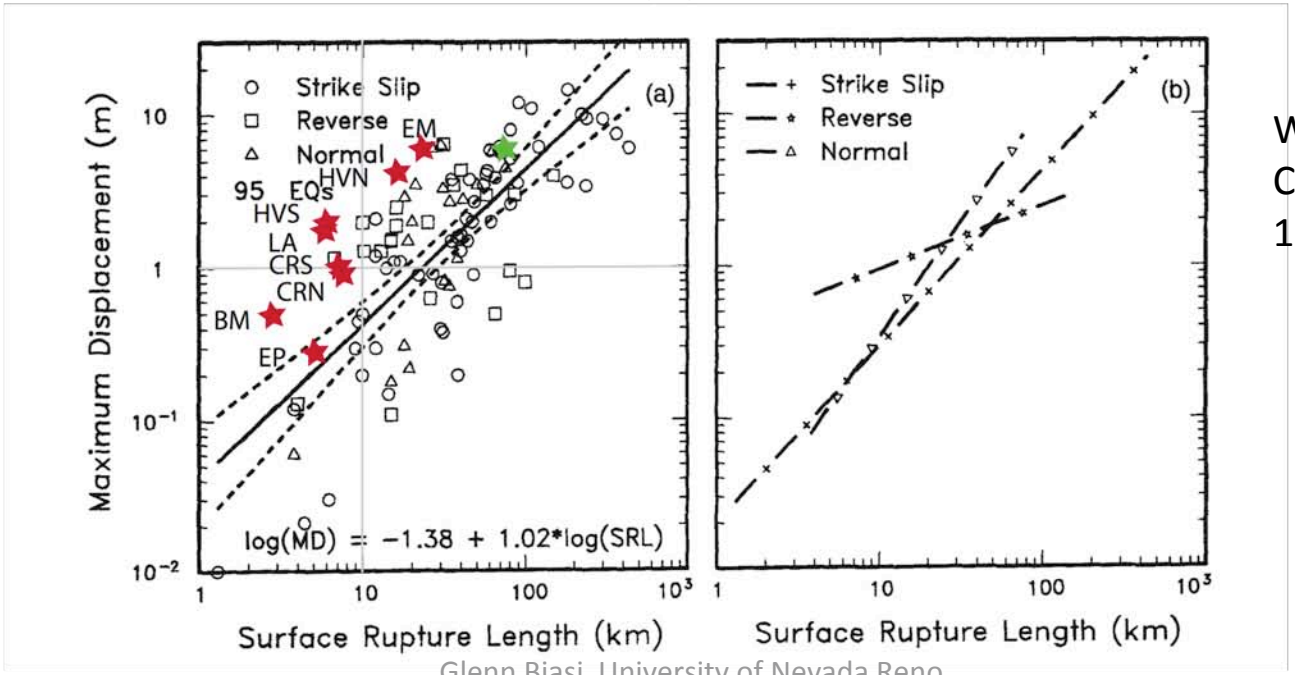
Multiple-Fault Ruptures

- Average displacement – length regressions use full rupture length, ignoring discontinuities
- When multiple faults are involved
  - Greater degrees of distributed displacement
  - Rotation and extension are allowed at ends for kinematically admissible models
  - This can exaggerate displacement gradients - how quickly displacements die out.
  - Geologic assessment of step-overs should give clues to the mechanical linkage of faults.

Event 30
Jun 28 1992 Landers, California



Wesnousky, 2008



Wells and Coppersmith 1994

Considerations for UCERF-3

- Displacements on shorter faults are out of proportion to their lengths.
  - Is this a general feature when Type B or C faults link?
  - How do short faults "know" what displacement to have?
  - If displacements on short faults reflect the final event magnitude, and not some more natural size scaled by their length, might the rupture be driven from below rather than triggered from the sides?
- Systematize slip gradients as inputs to other models.
- Need to resolve whether $D_{average}$ tends to some upper limit with increasing rupture length, and the shape of the $D_{average}(L)$ function. Flattening of $D_{average}(L)$ should decrease the bulge.