

The role of partial ruptures in the observed moment-recurrence scaling of repeating earthquakes

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Repeating earthquakes represent repeated failure in the same location.

- Repeating earthquakes are thought to be the rupture of locked asperities surrounded by regions that are slipping aseismically.
- They are used to study creep rate on faults and interactions between seismic and aseismic processes.

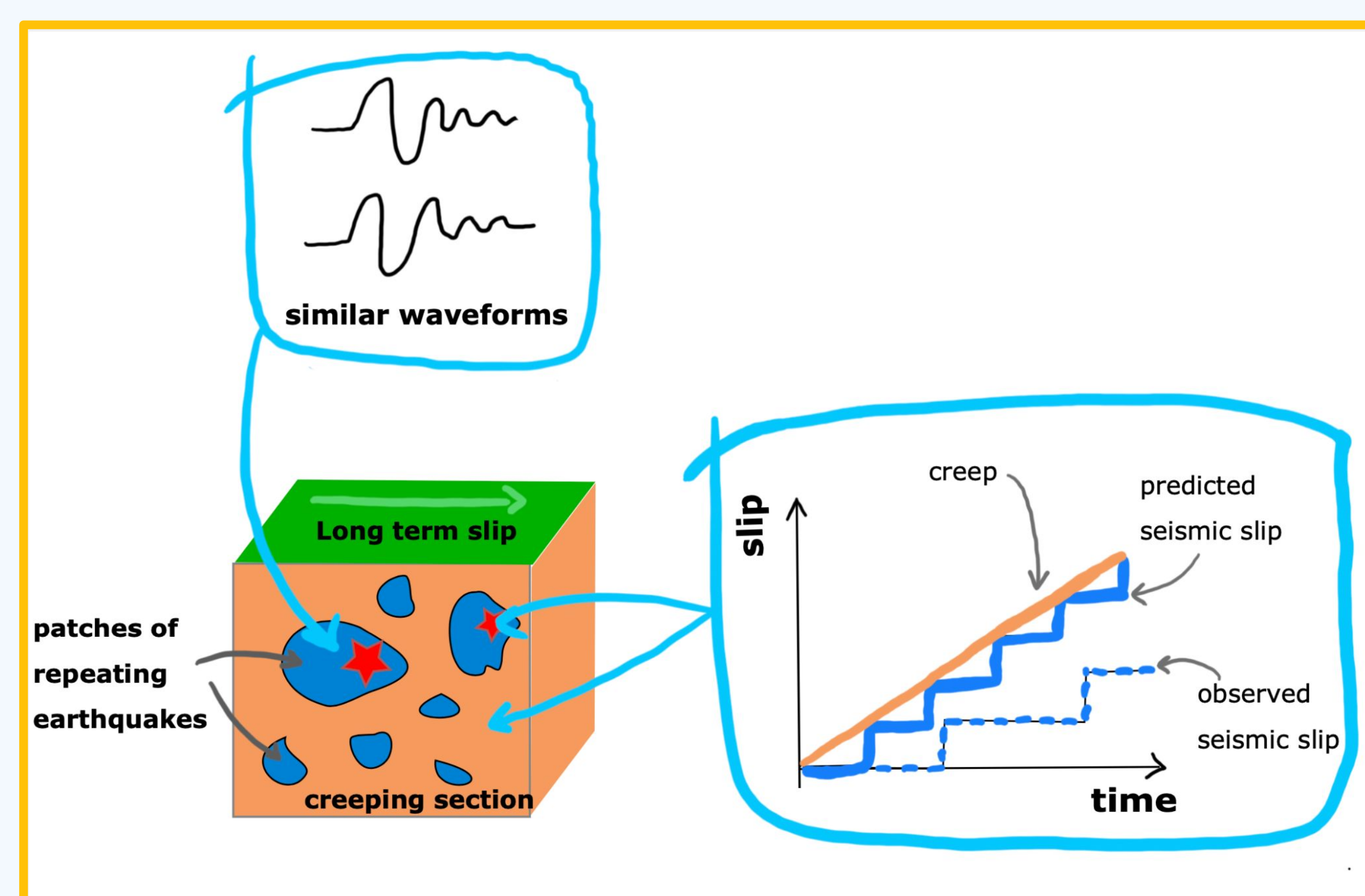


Fig 1: Illustration of repeating earthquake patches within a creeping section.

Repeating earthquakes occur less often than we expect

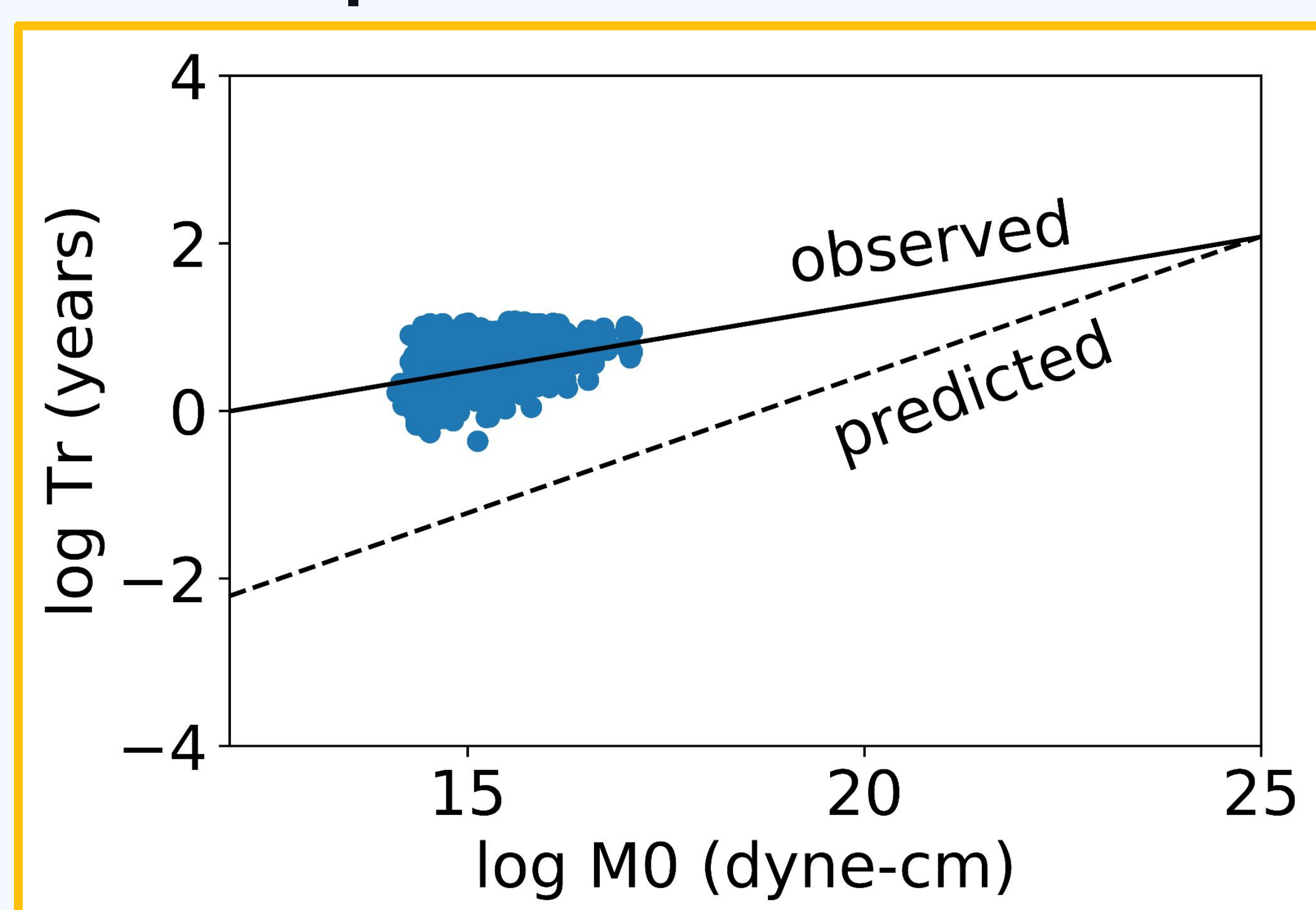


Fig 2: If repeating earthquakes had constant stress drops and experience no aseismic slip, we expect $\text{slip} \sim M_0^{1/3}$ (dashed line) but observations scale $\text{slip} \sim M_0^{1/6}$

Recent crack models suggest a possible explanation for the recurrence scaling of repeating earthquakes

- For small events, a larger amount of the slip budget on the patch is aseismic.
- For large events where most of the slip budget is seismic, the patch experiences **partial ruptures** (Cattania and Segall, 2018).

We search for partial ruptures in Northern California

- A partial rupture happens in the same place but has a smaller magnitude than a full rupture.

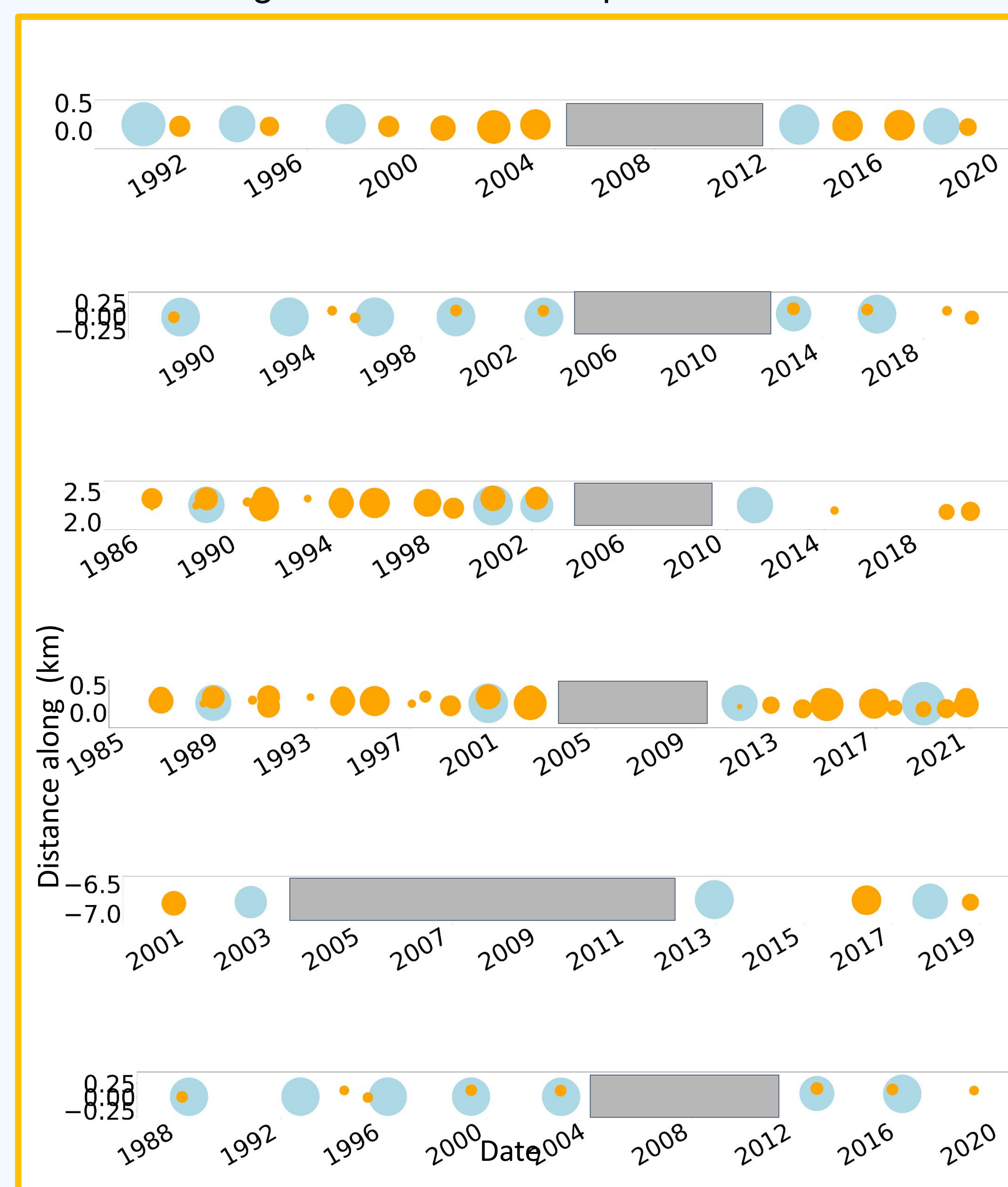


Fig 2: Example repeating earthquake (blue) and partial rupture (orange) sequences. Grey box shows time after Parkfield earthquake.

Partial ruptures do not make up a large amount of the slip budget in Parkfield

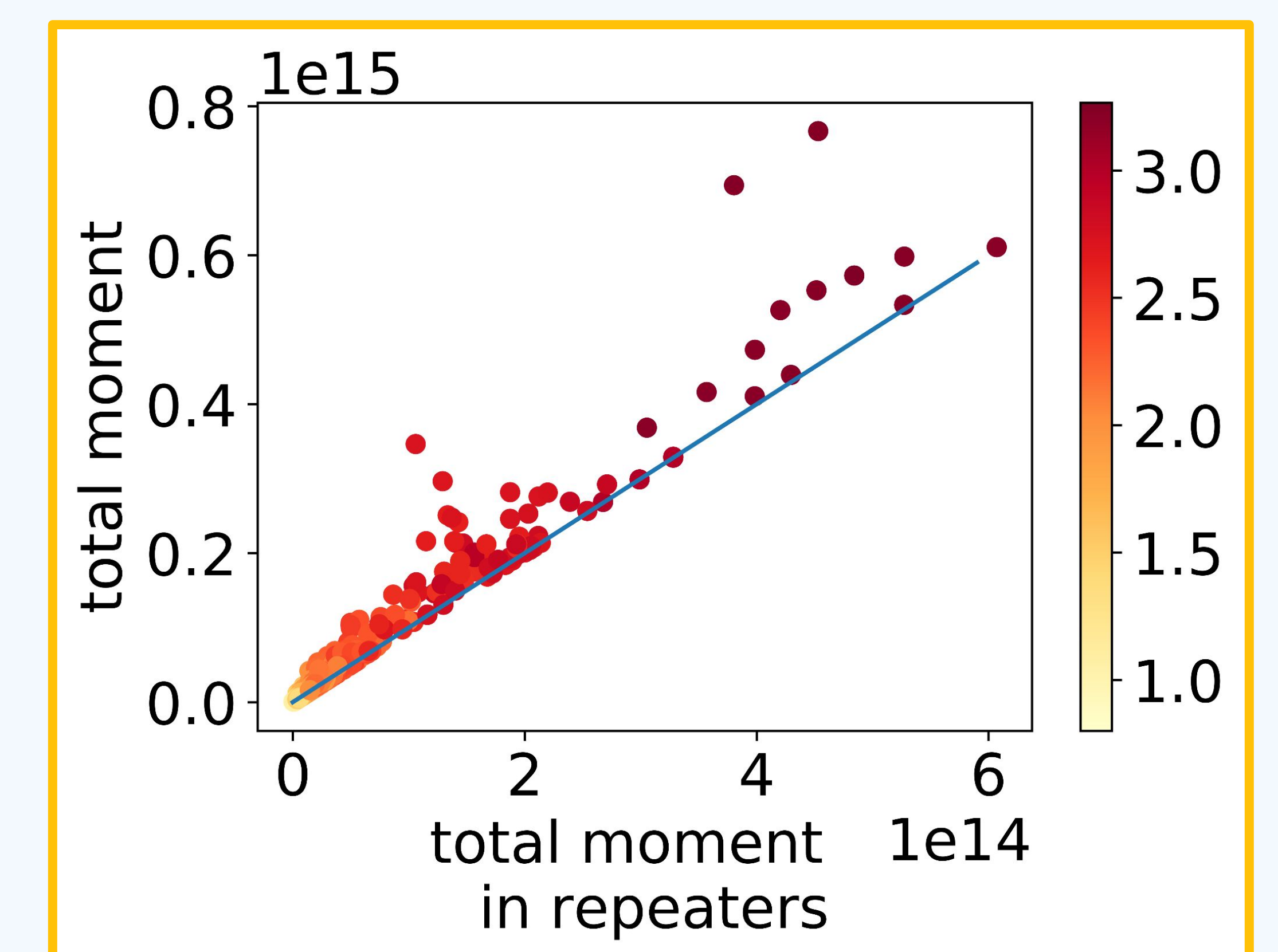


Fig 3: Total moment in repeating earthquakes vs total moment in the whole sequence. Points are coloured by the average magnitude of the repeating sequence.

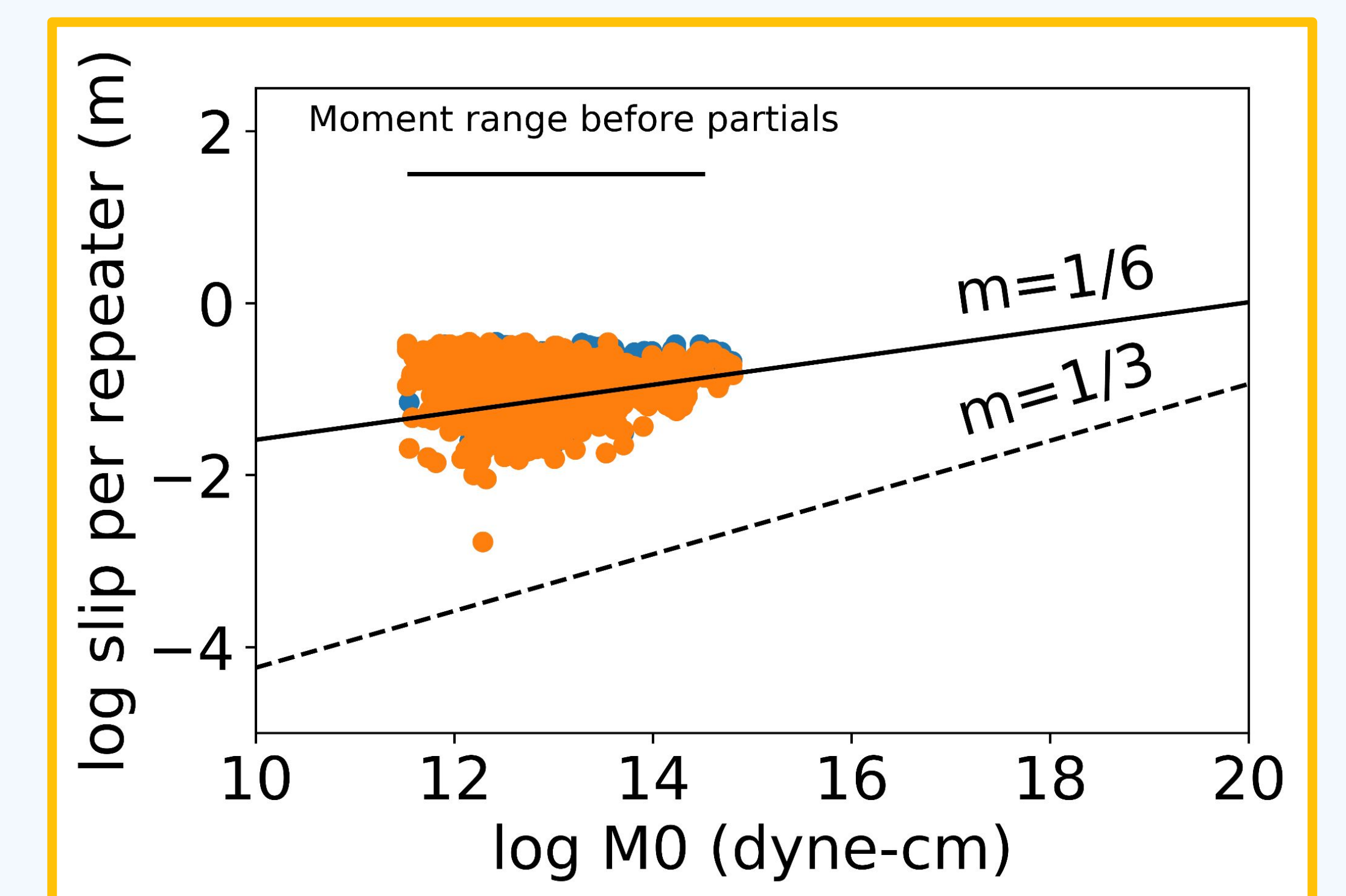


Fig 4: Scaling of slip per event (with long-term slip of 30 mm /year) with moment corrected for moment in repeaters. The moment in repeaters alone is not enough to recover the theoretical scaling (dashed line).

- Could we be on the edge of where partial ruptures are important?
- Could another model be required to explain the recurrence scaling of large repeating earthquakes in Parkfield.