

# **Probabilities of Multi-fault Ruptures in the Cajon Pass Region from RSQSim**

**Jacqui Gilchrist**

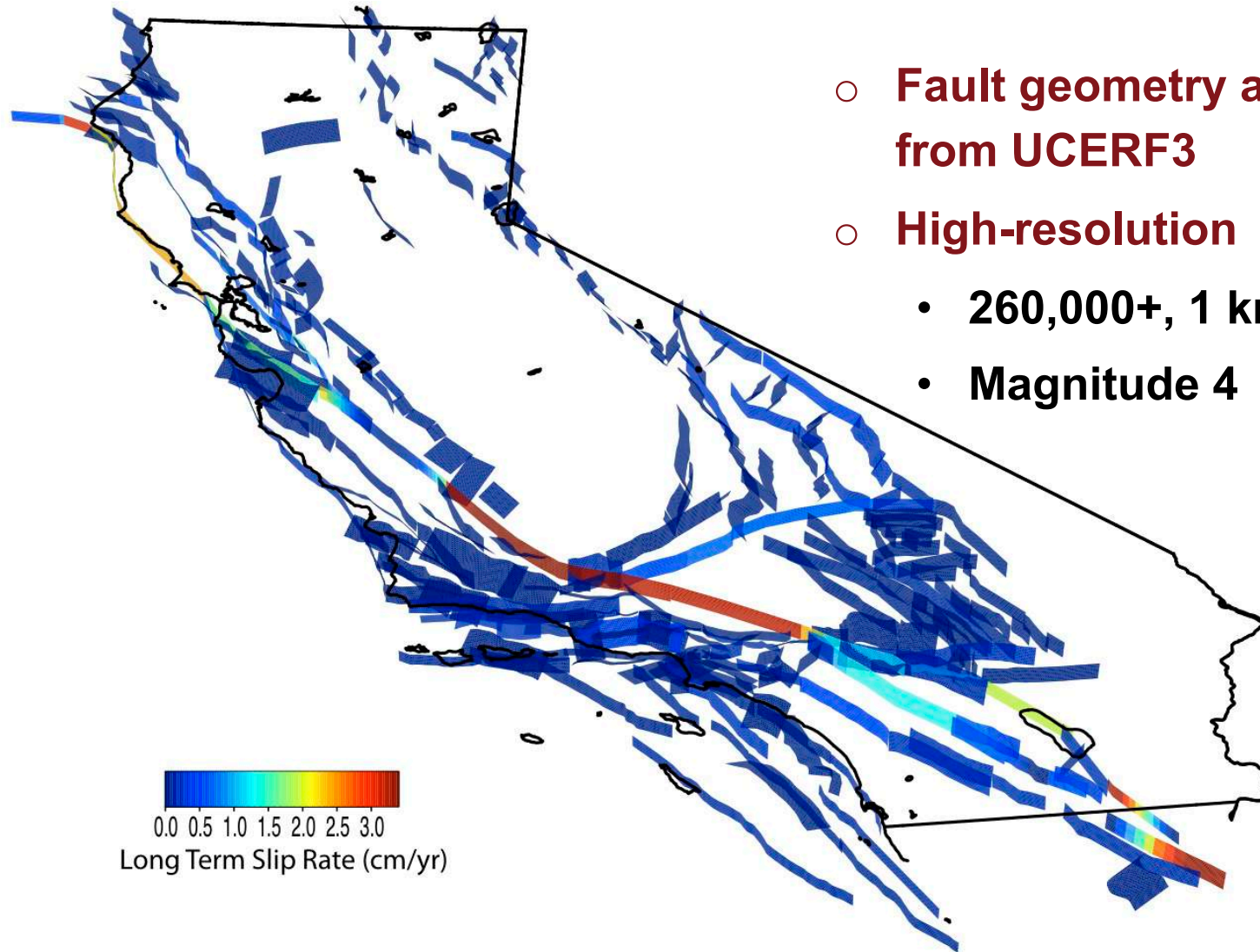
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**Co-authors: Tom Jordan and Keith Richards-Dinger**

## *RSQSim: Rate-State earthQuake Simulator*

- **Multi-cycle earthquake simulations (full cycle model)**
  - Interseismic period > nucleation and rupture propagation
- **Long catalogs**
  - Tens of thousands to millions of years with millions of events
- **Complicated model geometry**
  - 3D fault geometry; rectangular or triangular boundary elements
- **Different types of fault slip**
  - Earthquakes, slow slip events, continuous creep, and afterslip
- **Physics based**
  - Rate- and State-dependent friction
- **Foreshocks, aftershocks, and earthquake sequences**
- **Efficient algorithm**
  - Event driven time steps
  - Quasi-dynamic rupture propagation

# UCERF3 California Fault Model



- **Fault geometry and geologic slip rates from UCERF3**
- **High-resolution**
  - 260,000+, 1 km<sup>2</sup>, triangular patches
  - Magnitude 4 to Magnitude 8

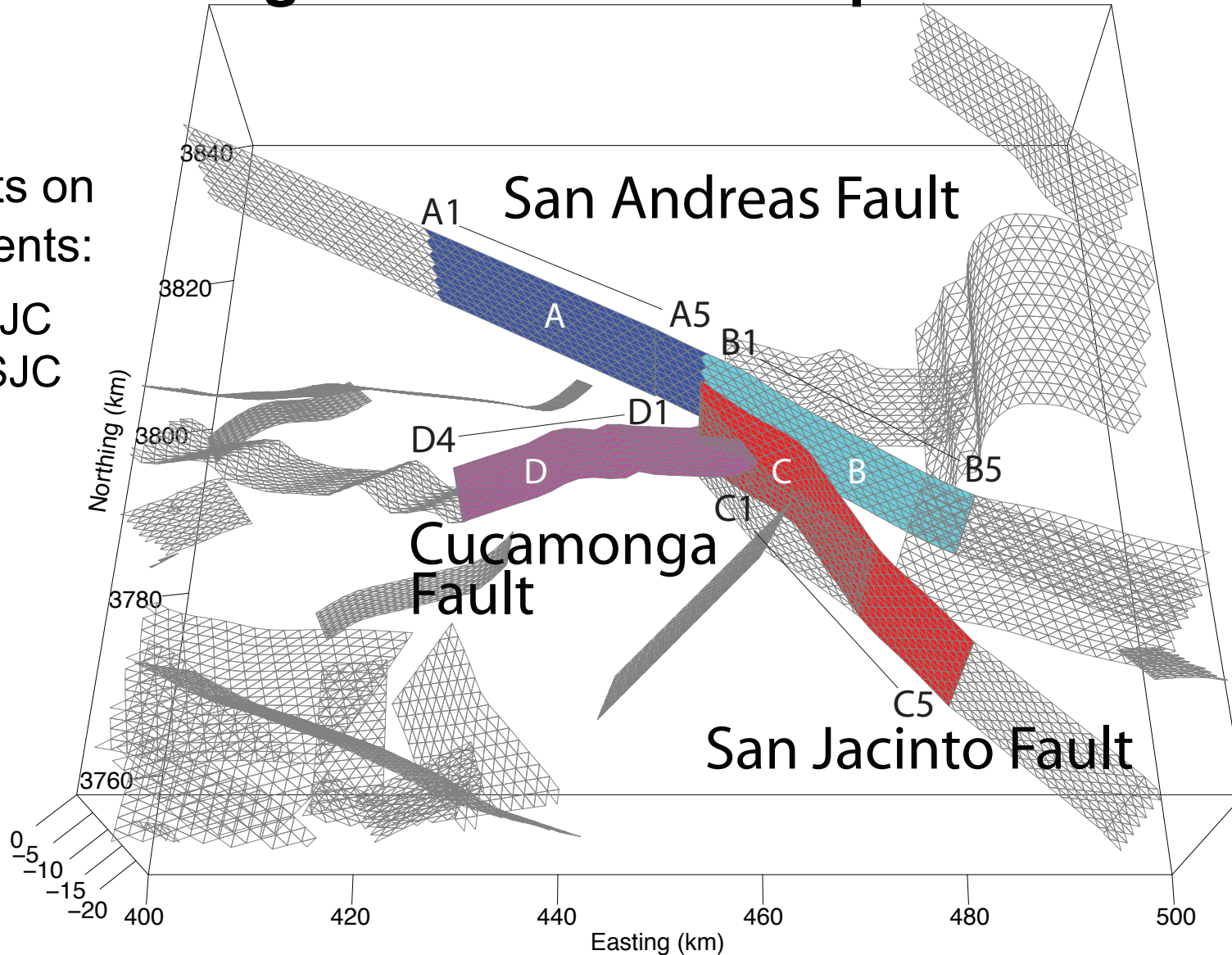
# Fault Segments Used for Rupture Search

Count M7+ events on these fault segments:

- A = SAF north of SJC
- B = SAF south of SJC
- C = San Jacinto
- D = Cucamonga

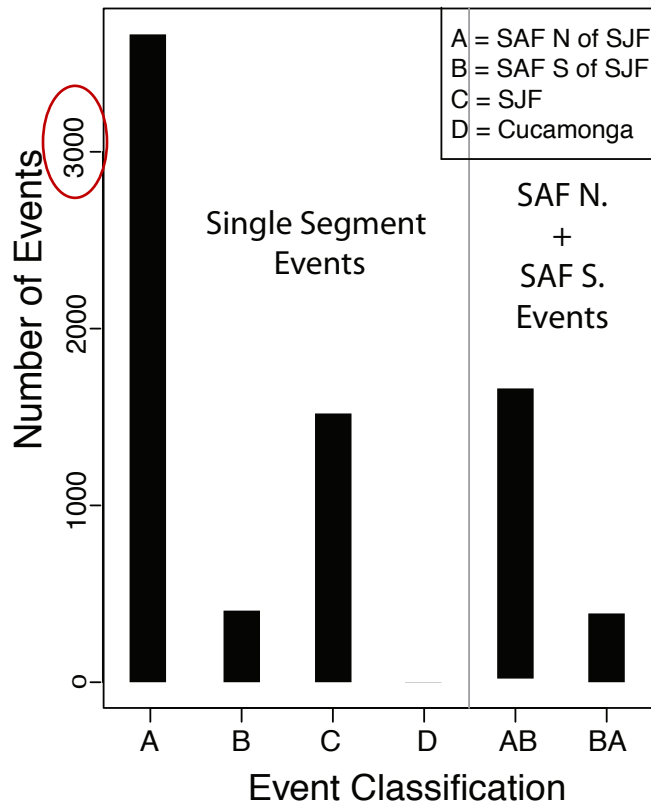
Classify events by rupture order:

- ABC = SAF N  
SAF S  
SJF
- DCB = Cucamonga  
SJF  
SAF S

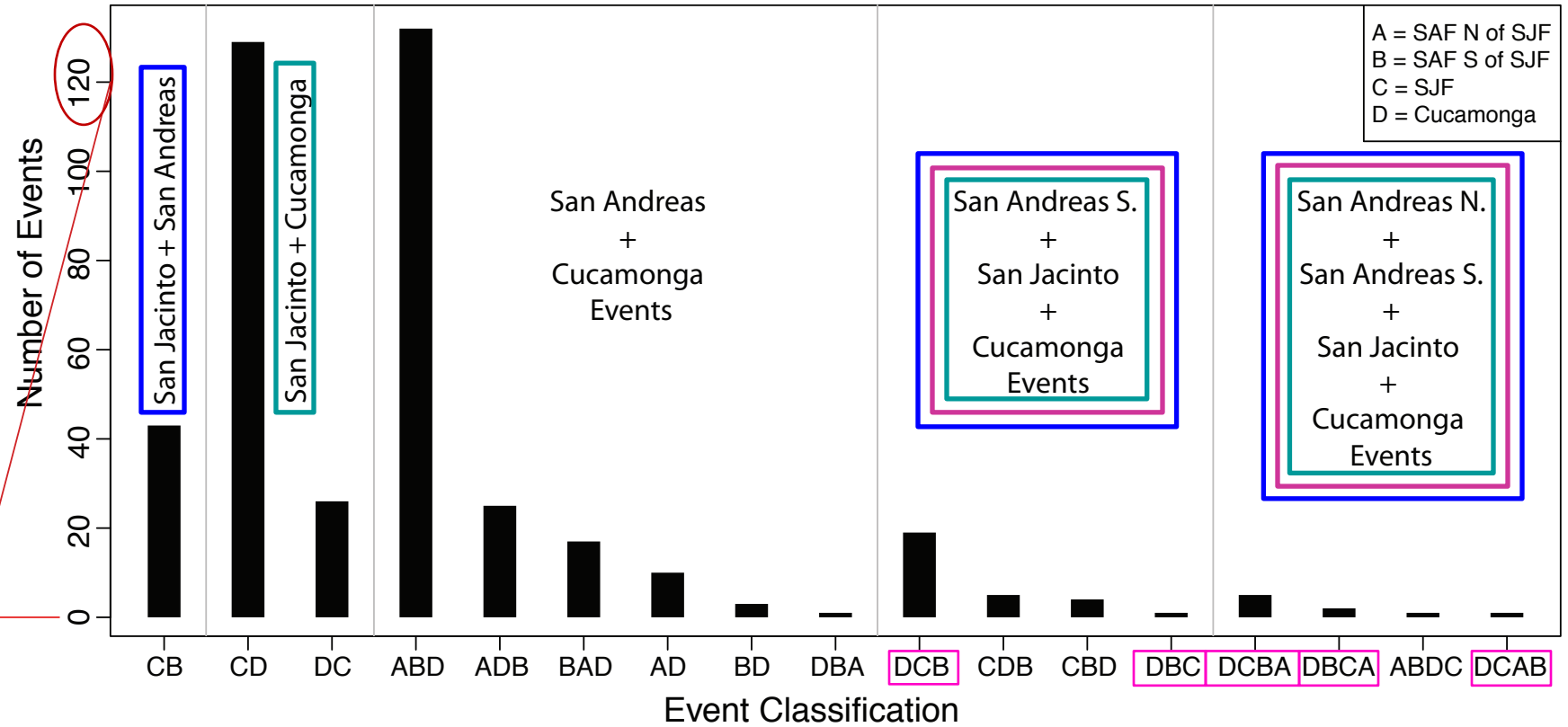


# Ruptures Near Cajon Pass in the World of RSQSim

Single Fault Events in Cajon Pass



Rupture Order of Multi-fault Events in Cajon Pass



- ❖ 30-50% of San Andreas ruptures go through Cajon Pass (AB/BA style ruptures)
- ❖ The San Jacinto ruptures alone 86% of the time

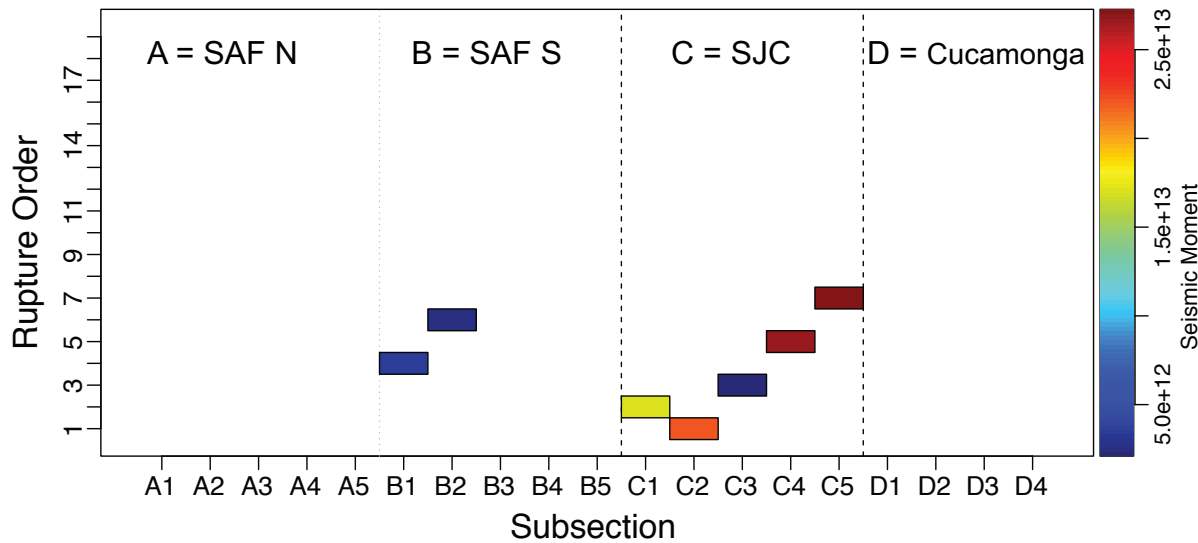
- ❖ 4.6% of San Jacinto ruptures include the San Andreas
  - 47% also rupture Cucamonga
  - 36% nucleate on the Cucamonga
- ❖ 11% of San Jacinto ruptures include the Cucamonga

# Typical RSQSim Ruptures Near Cajon Pass

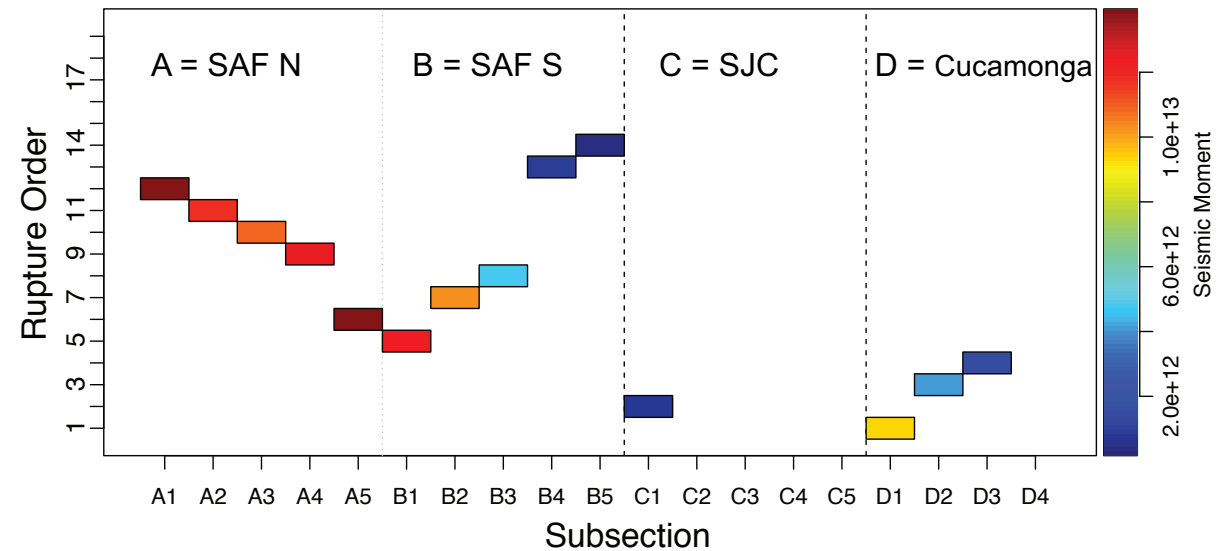
*San Jacinto – San Andreas*

*Cucamonga – San Jacinto – San Andreas*

**Seismic Moment on Each Subsection for Event 7546**



**Seismic Moment on Each Subsection for Event 1913**



- Most of the moment released in multi-fault ruptures occurs on a single fault, even when events below a minimum rupture area per fault section (10%) are filtered out.

## *Conclusions from this RSQSim model:*

- ❖ **San Andreas ruptures go through Cajon Pass**
  - **Up to ~half the time**
  
- ❖ **San Jacinto + San Andreas ruptures are very rare**
- ❖ **Cucamonga Fault (and perhaps others) seem to modulate these multi-fault events**