Multifault interactions in SEAS models

12:00	Modeling of Multifault Systems	Federico Ciardo
12:15	Multicycle Code Comparisons and Complex Attractors	Bruce Shaw
12:25	Overview of New Plans	Mohamed Abdelmeguid
12:35	Discussion and wrap-up	All participants



Statewide California Earthquake Center

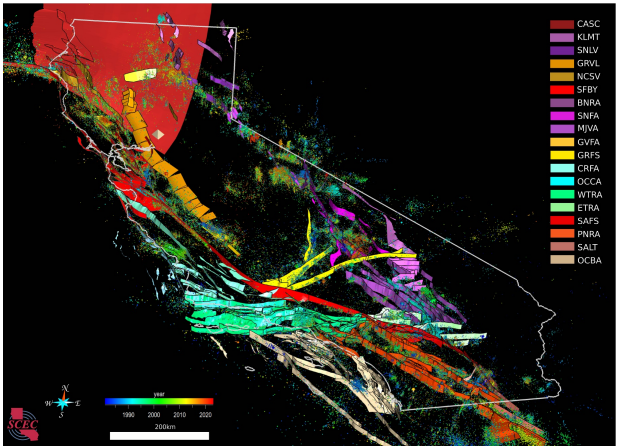
Overview of New Plans

Mohamed Abdelmeguid

SEAS TAG work plan

1. Compare BP8 and BP9 results and publish the findings.
2. **Design benchmarks toward CFM-informed fault systems.**
3. **Develop shared measures for comparing earthquake catalogs.**
4. Future workshop on accelerated modeling using SciML and RoM.

Toward CFM-informed fault systems



California Community Fault Model 7.0 | Plesch et al. (2024), Fig. 1

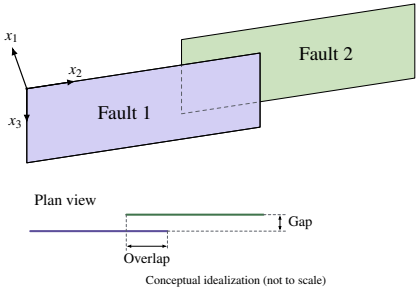
Objectives throughout

Verify codes on increasingly complex faults.

Study how ruptures start, stop and cascade across faults.

Make sequence comparisons reproducible.

First step: Step-over benchmark



Tensile or Compressive

Loading
Far-field, creeping boundaries, stressing rate.

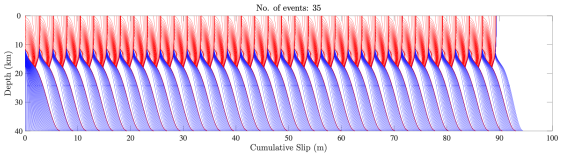
Geometry
3D vs 2D idealizations
Different choices of gaps and overlaps?

Inertia
What is the impact of quasidynamic approximation versus fully dynamic?

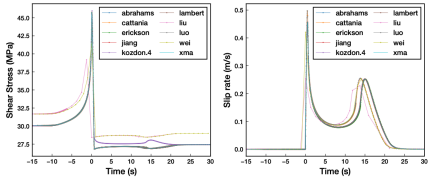
Stress buildup near the fault tips
Fully elastic response, stress relaxation, or off-fault plasticity.

Deterministic comparisons

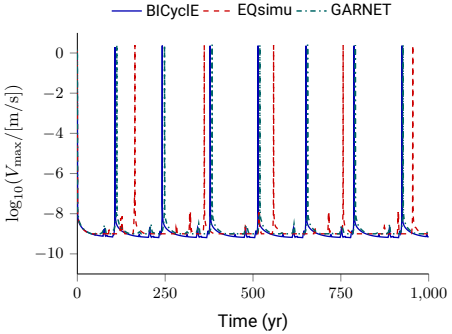
Slip catalog



Shear stress and slip rate at one station



Maximum slip rate over time



BP4-QD, velocity-weakening patch and transition zone.

Comparing complex earthquake sequences

What can we compare across catalogs?

- Event sizes: magnitude–frequency slope.
- Source scaling: seismic moment versus event duration.
- Stepover behavior: fraction of ruptures that cross the gap.

Test slow-event scaling at several slip-rate cutoffs.

When sequences diverge, how to distinguish numerical robustness from sensitivity to small perturbations?

- Dramatic change in trajectory due early differences
- Potentially ask for model convergence

Potential next steps: from step-over to CFM

Idealized geometries

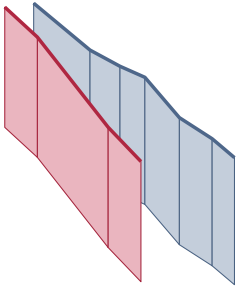


How does obliquity affect rupture transfer at a fixed gap?



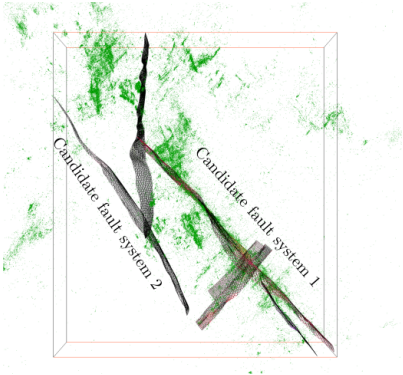
How should we model a junction?

UCERF3 fault sections



OpenSHA, Fault Model 3.1

CFM candidate systems



Plesch et al. (2024).

Designing the next SEAS benchmark

The SEAS TAG is moving toward CFM-informed fault systems as part of SCEC's objectives on time-dependent earthquake forecasting.

1. What are the strengths of a two-fault stepover as a first benchmark? What concerns would you raise?
2. Is a quasi-dynamic approximation sufficient, or do we need full dynamics? Should we assume a fully elastic medium or include stress relaxation?
3. Beyond event sizes, source scaling and rupture-jump frequency, which metrics would help us compare sequences across codes?
4. Any additional thoughts?