Community Benchmarks
What do we want to determine?

- Code correctness. Is the physics correct?

- Code accuracy.

- Code performance (runtime, memory usage, parallel scalability).

- Code features.

  - Additional physics (e.g., additional bulk and fault rheologies, finite strain, etc.).

  - Ease-of-use, interaction with other packages (e.g., meshing and visualization packages).

Types of Benchmarks

- Core capabilities.
  - Basic problems that can be compared with analytical solution.
  - Relatively simple geometries and BC.
  - Used to test correctness, accuracy, and performance.

- Moderate complexity.
  - May be compared with analytical or semi-analytical solution.
  - May have more complex geometry and/or BC.
  - Used to test correctness, accuracy, performance, and features.

- Complex benchmarks.
  - Generally no analytical or semi-analytical solution available.
  - May involve complex geometry, BC, and physics (e.g., nonlinear rheology, large deformations).
 - Used to test correctness, accuracy, performance, and features.

Strike-slip Benchmark (No Gravity)

- Domain is a cube.

- Strike-slip fault with a region of constant slip bordered by a region with linearly-tapering slip.

- Analytical elastic solution applied to outer boundaries as BC.

- Elastic solution may be compared to Okada analytical solution.
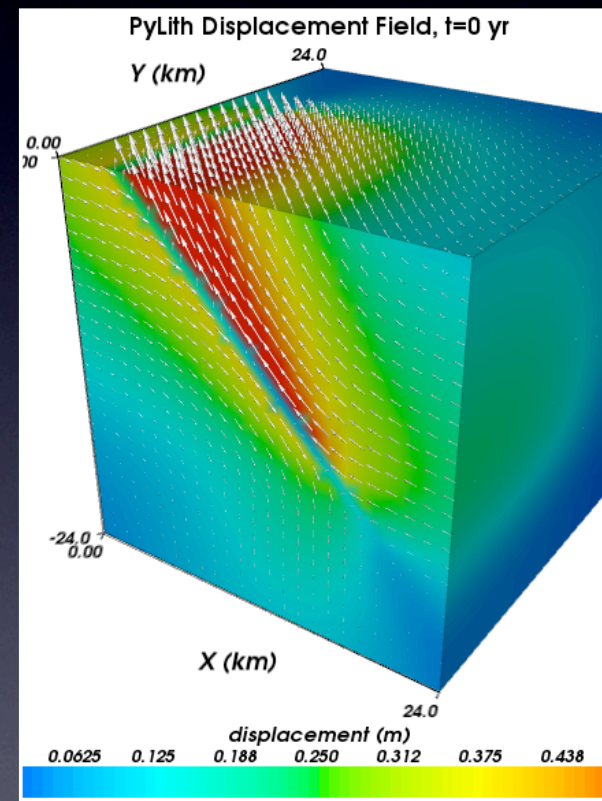

PyLith Displacement Field @ t=0 yr
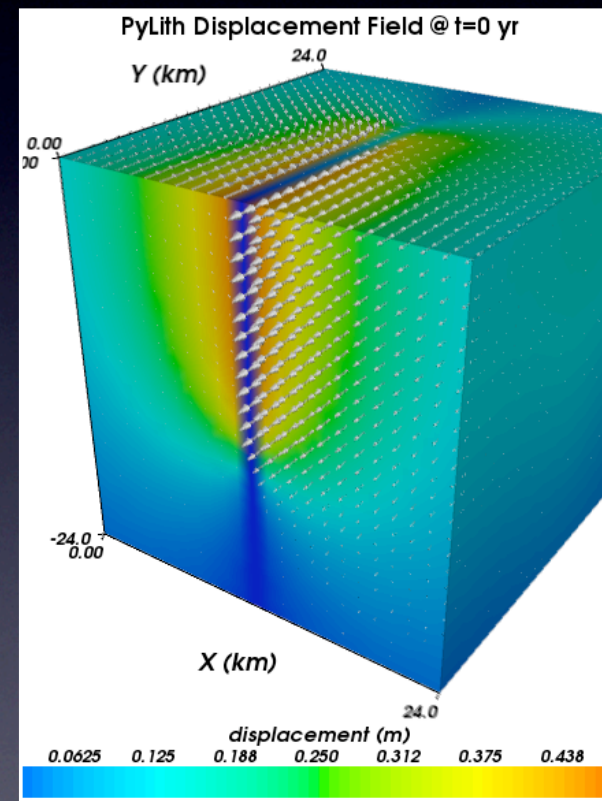
Reverse-slip Benchmark (No Gravity)

- Domain is a cube.

- Reverse-slip fault with a region of constant slip bordered by a region with linearly-tapering slip.

- Analytical elastic solution applied to outer boundaries as BC.

- Elastic solution may be compared to Okada analytical solution.
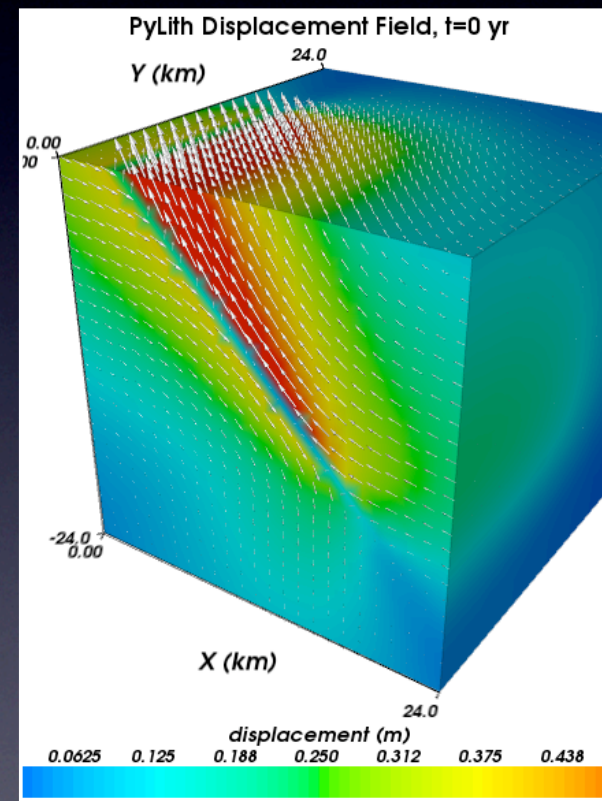
Reverse-slip Benchmark (With Gravity)

- Problem is identical to other reverse-slip benchmark, but the effects of body forces are included.

- True solution requires large deformation formulation. Gravitational effects may also be approximated using Winkler restoring forces.

- Benchmark has not yet been run.

PyLith Displacement Field, t=0 yr
Y (km)
24.0
0.00
-24.0
0.00
X (km)
24.0
displacement (m)
0.0625   0.125   0.188   0.250   0.312   0.375   0.438

Currently Available Analytical/Semi-analytical Solutions

- Okada elastic dislocation solutions.

- Layered elastic model.

- Maxwell viscoelastic model.

- Savage & Prescott strike-slip model (elastic layer over Maxwell viscoelastic half-space).

- Generalized Maxwell models for elastic layer over viscoelastic half-space.

- ???

What Physics Do We Want to Test?

- Bulk and fault rheology?

- Effects of gravity?

- Ability to represent volcanic deformation (e.g., dikes, magma chambers)?

- ???

Some Benchmark Candidates

- Savage & Prescott model.
  - Tests ability to simulate multiple kinematically-specified earthquakes plus steady slip.
  - Tests Maxwell viscoelastic solution.
  - Results could be compared for different rheologies.
- ???