

Review of the September 2009 SIV Workshop

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Use of dynamic models

- Can inversions resolve questions in earthquake physics?
- Does slip penetrate below the seismogenic layer in big earthquakes?
- Cracks vs. pulses
- Collaboration opportunity with other groups in SCEC (dynamic code validation, UCERF)
- Everyone wanted a simple, but dynamic model for the first SIV inversion problem.

CSEP-style testing center

- Allows us to run many “experiments” with little additional effort
- All codes set up similarly:
 - Same station locations (many stations, experiments may only use a subset)
 - Same Green’s function & fault geometry
 - Input and output files in standard format
- Testing center developer (\$) makes python wrappers for each code
 - Validate that code produces expected answer on simple test problem

Testing Metrics

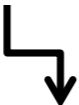
- Modelers wanted to see many metrics used
 - Metrics for each source parameter (slip, rupture time, etc.)
 - Metrics that combine multiple source parameters (e.g. 3D correlation of slip velocity field in time)
- Modelers want to know testing metrics ahead of time

Source Model Format

Graves' format is a good start, but...

- Proposed formats: plain ascii files, following **exactly** specified requirements

- Source model files 

- Seismogram files 

```
Synthetic Seismograms for model SIVps1
Observer # 8, Station s25
XPOS = -15.0000, YPOS = 40.0000
NPTS = 4096, DT = 0.0200
Velocity seismograms in cm/sec
  X (EW)      Y(NS) comp      U-D comp
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    -0.00000    -0.00000
-0.00000    0.00000    0.00000
0.00000     0.00000    0.00000
0.00000     0.00000    0.00000
0.00000     0.00000    0.00000
```

```
% -----
% POINT-SOURCE MODEL 1
% used as input for Source Inversion Validation (SIV)
%
% XPOS       ZPOS       ZABS       YPOS       TON       RISE       SS-AMP       DS-AMP
% km         km         km         km         sec       sec        cm          cm
% -----
-1.00,      9.00,      9.0000,    0.0000,    0.4714,    0.100,    0.0140,    0.0000
-0.50,      9.00,      9.0000,    0.0000,    0.3727,    0.100,    0.0290,    0.0000
0.00,       9.00,      9.0000,    0.0000,    0.3333,    0.100,    0.0370,    0.0000
0.50,       9.00,      9.0000,    0.0000,    0.3727,    0.100,    0.0290,    0.0000
1.00,       9.00,      9.0000,    0.0000,    0.4714,    0.100,    0.0140,    0.0000
-1.00,      9.50,      9.5000,    0.0000,    0.3727,    0.100,    0.0290,    0.0000
-0.50,      9.50,      9.5000,    0.0000,    0.2357,    0.100,    0.0610,    0.0000
0.00,       9.50,      9.5000,    0.0000,    0.1667,    0.100,    0.0780,    0.0000
0.50,       9.50,      9.5000,    0.0000,    0.2357,    0.100,    0.0610,    0.0000
1.00,       9.50,      9.5000,    0.0000,    0.3727,    0.100,    0.0290,    0.0000
-1.00,     10.00,     10.0000,    0.0000,    0.3333,    0.100,    0.0370,    0.0000
-0.50,     10.00,     10.0000,    0.0000,    0.1667,    0.100,    0.0780,    0.0000
0.00,      10.00,     10.0000,    0.0000,    0.0001,    0.100,    0.1000,    0.0000
0.50,      10.00,     10.0000,    0.0000,    0.1667,    0.100,    0.0780,    0.0000
1.00,      10.00,     10.0000,    0.0000,    0.3333,    0.100,    0.0370,    0.0000
-1.00,     10.50,     10.5000,    0.0000,    0.3727,    0.100,    0.0290,    0.0000
-0.50,     10.50,     10.5000,    0.0000,    0.2357,    0.100,    0.0610,    0.0000
0.00,      10.50,     10.5000,    0.0000,    0.1667,    0.100,    0.0780,    0.0000
0.50,      10.50,     10.5000,    0.0000,    0.2357,    0.100,    0.0610,    0.0000
1.00,      10.50,     10.5000,    0.0000,    0.3727,    0.100,    0.0290,    0.0000
-1.00,     11.00,     11.0000,    0.0000,    0.4714,    0.100,    0.0140,    0.0000
-0.50,     11.00,     11.0000,    0.0000,    0.3727,    0.100,    0.0290,    0.0000
0.00,      11.00,     11.0000,    0.0000,    0.3333,    0.100,    0.0370,    0.0000
0.50,      11.00,     11.0000,    0.0000,    0.3727,    0.100,    0.0290,    0.0000
1.00,      11.00,     11.0000,    0.0000,    0.4714,    0.100,    0.0140,    0.0000
```

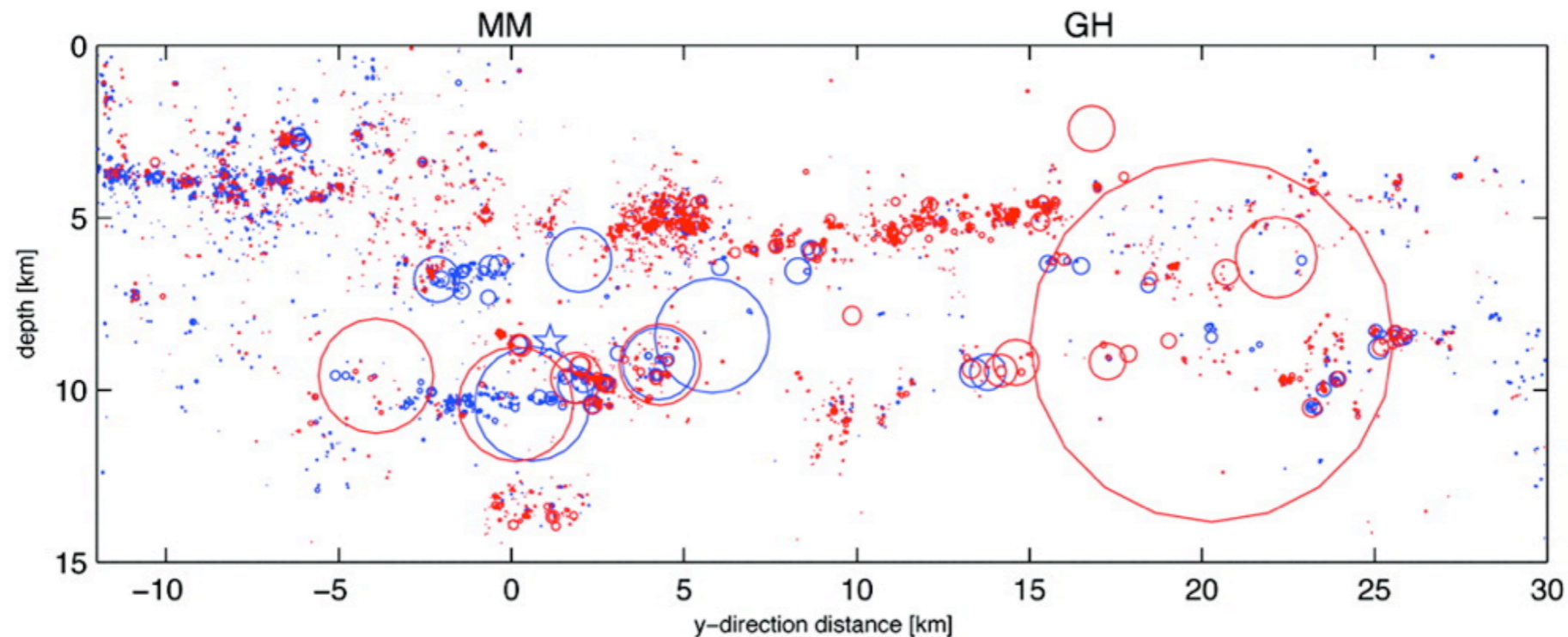
Source Model Format

Graves' format is a good start, but...

- Want everything on a fine grid (250 m?)
- Modelers should interpolate onto the grid, not the testing center
- Grid should be fine enough so as not to give away the grid spacing used in forward model
- Should handle arbitrarily complex source-time functions

For the future... real earthquakes?

Could build a source model using small earthquakes as empirical Green's functions (Parkfield would be a good location)



For the future... realistic errors?

Errors are not necessarily nice & Gaussian.
We can model them better:

- Perturb velocity layers
- Perturb fault geometry
- Site effects

Is one model sufficient?

- Many models may fit the data equally well (data fit not a good measure of model fit)

Our problem is fundamentally different from dynamic code validation (one right answer)

- Submission of multiple models, or error bars/pdfs of source parameters (not popular)
- Synthetics for stations not used in inversion