

The Collaboratory for the Study of Earthquake Predictability: Perspectives on Evaluation & Testing for Seismic Hazard

D. Schorlemmer, D. D. Jackson, J. D. Zechar, T. H. Jordan

The fundamental principle of science, the definition almost, is this: the sole test of the validity of any idea is experiment.

Richard P. Feynman

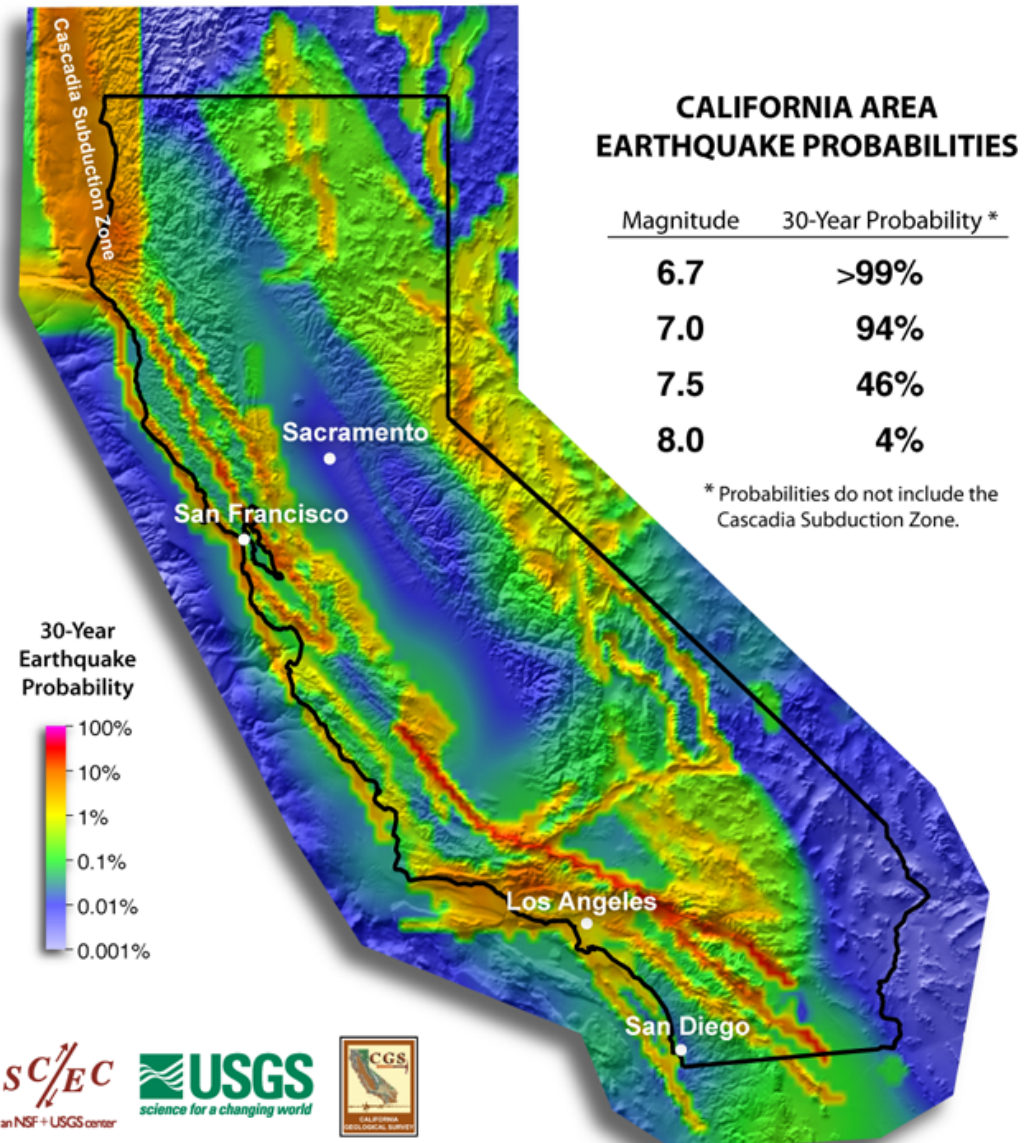
Why Evaluation & Testing?

- Scientific best practice
- Increase acceptance of models and concepts
- Surprises (e.g. Seismic Gap Hypothesis)
- Explore validity of common concepts
- Reduce epistemic uncertainty (Disregard models)
- Extension of the peer-review concept

Evaluation & Testing

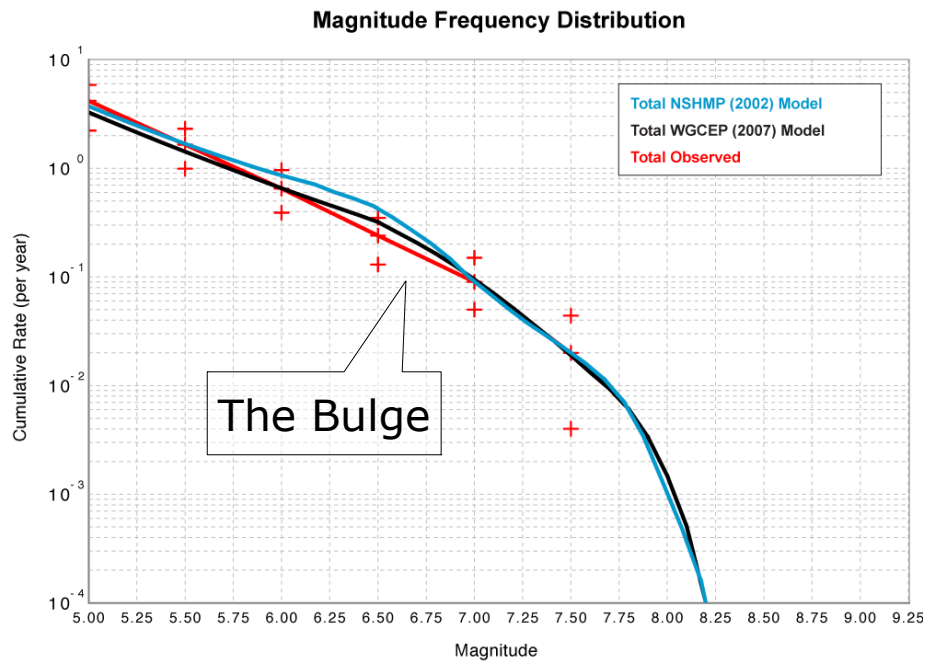
What can be tested?

- Model output

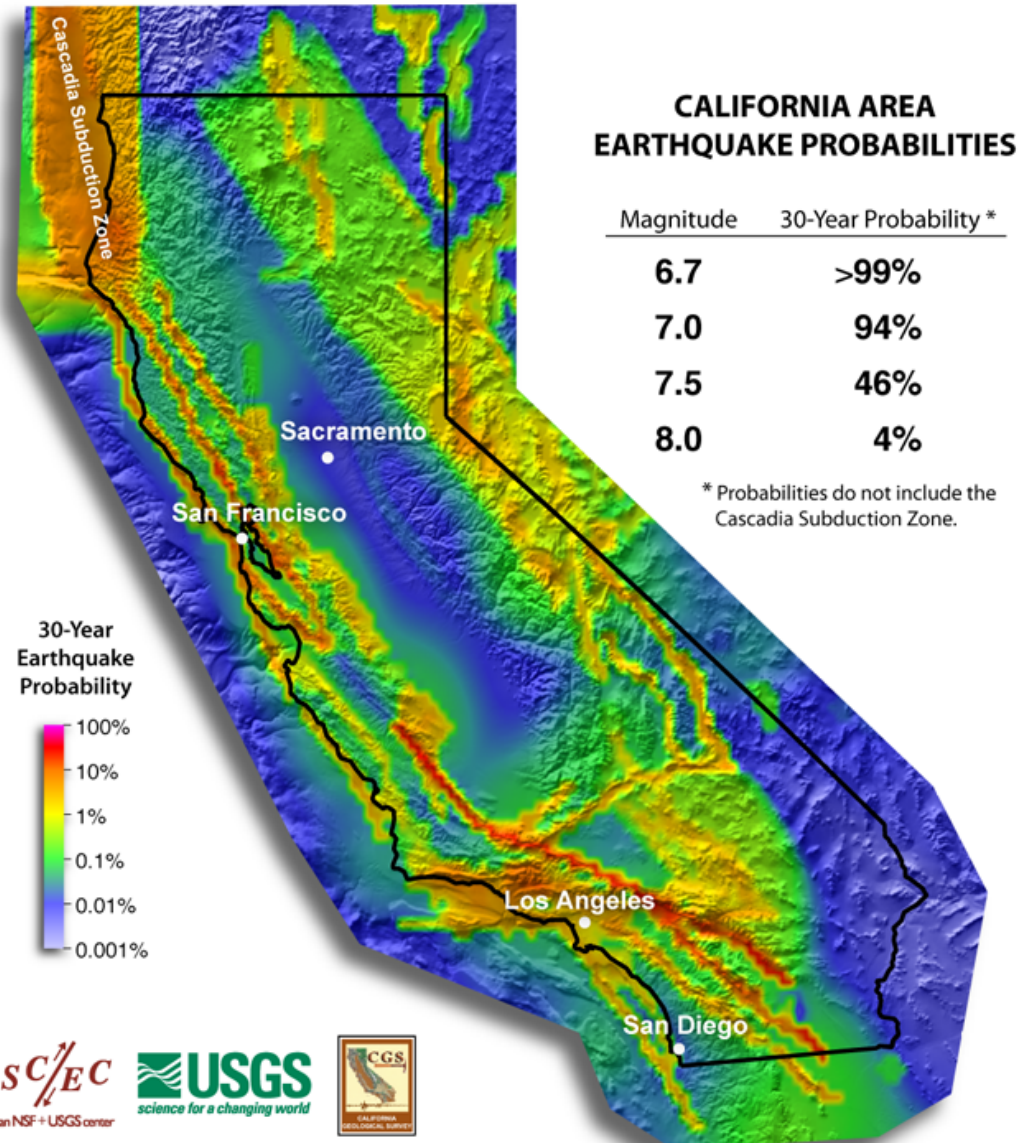


Evaluation & Testing

Uniform California Earthquake Rupture Forecast UCERF2



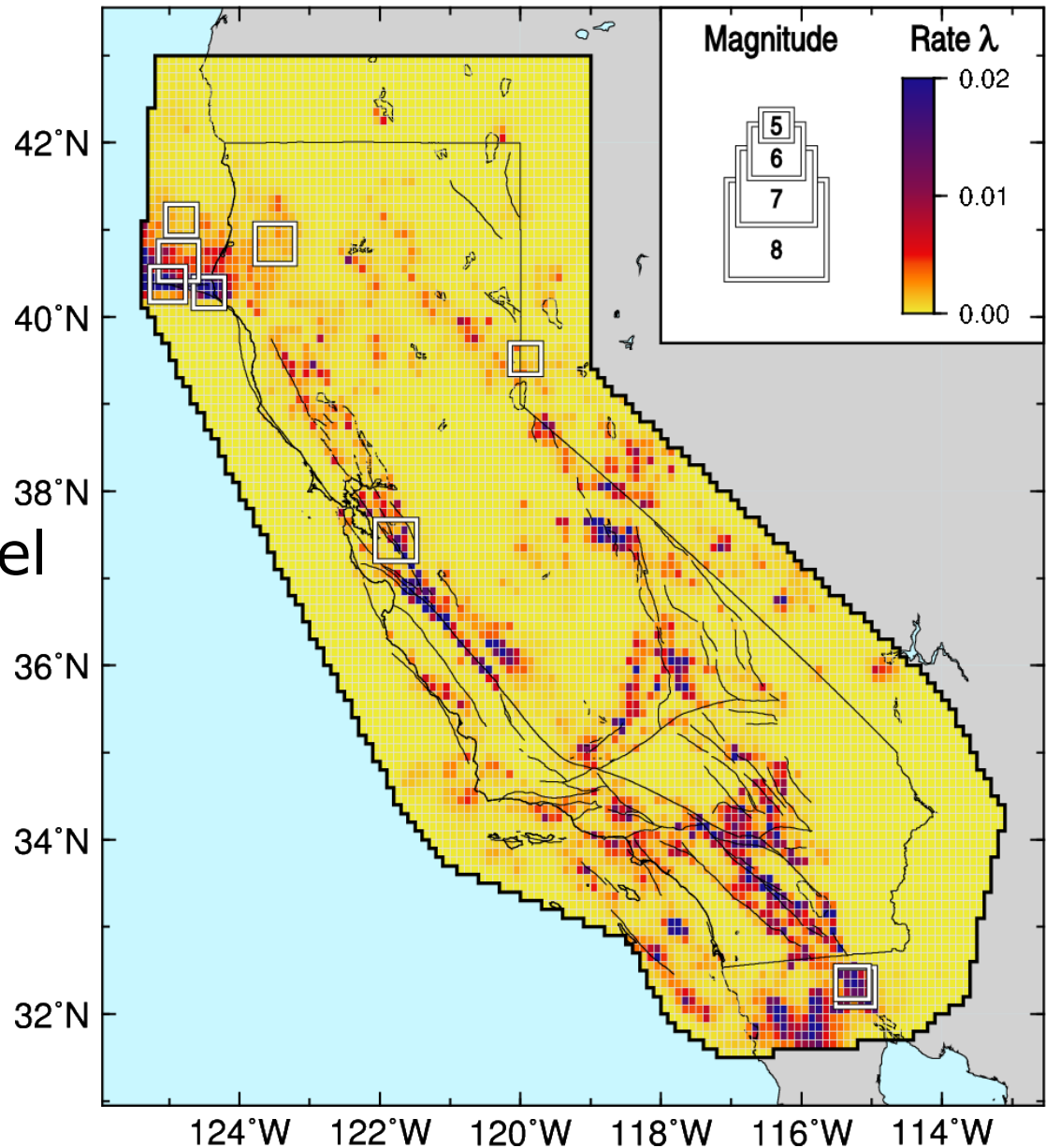
- Ingredients that cause the bulge cannot readily be identified
- No constraints on what went wrong



Evaluation & Testing

What can be tested?

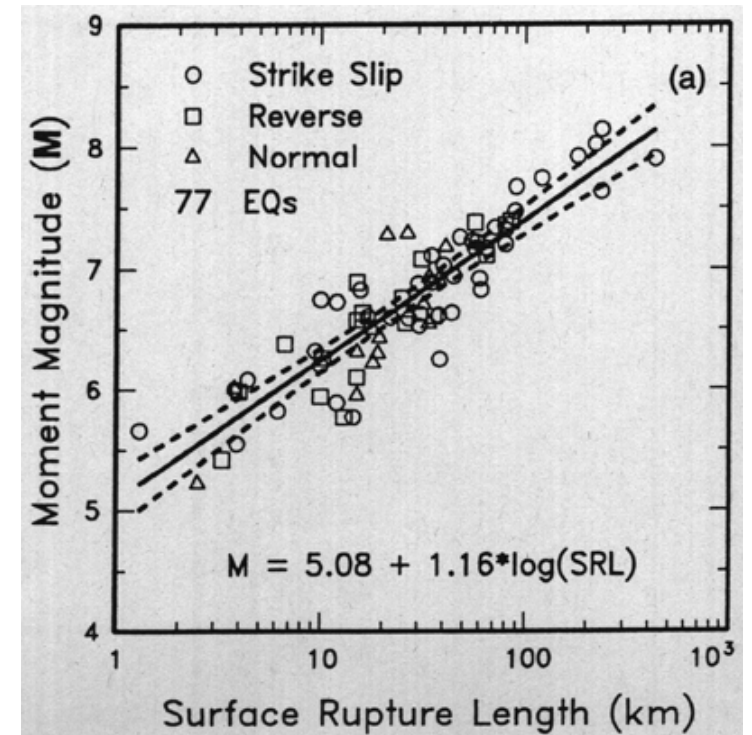
- Model output
- Outputs of components
 - Fault model
 - Deformation model
 - Earthquake-rate model
 - Probability model



Evaluation & Testing

What can be tested?

- Model output
- Outputs of components
 - Fault model
 - Deformation model
 - Earthquake-rate model
 - Probability model
- Scientific hypotheses
 - Magnitude-area (-fault length) relationships
 - Frequency-magnitude distribution
 - ...



[Wells & Coppersmith, 1994]

Evaluation & Testing

What can be tested?

- Model output
- Outputs of components
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 - Deformation model
 - Earthquake-rate model
 - Probability model
- Scientific hypotheses
 - Magnitude-area (-fault length) relationships
 - Frequency-magnitude distribution
 - ...
- Make the model as testable as possible

Scientific Process

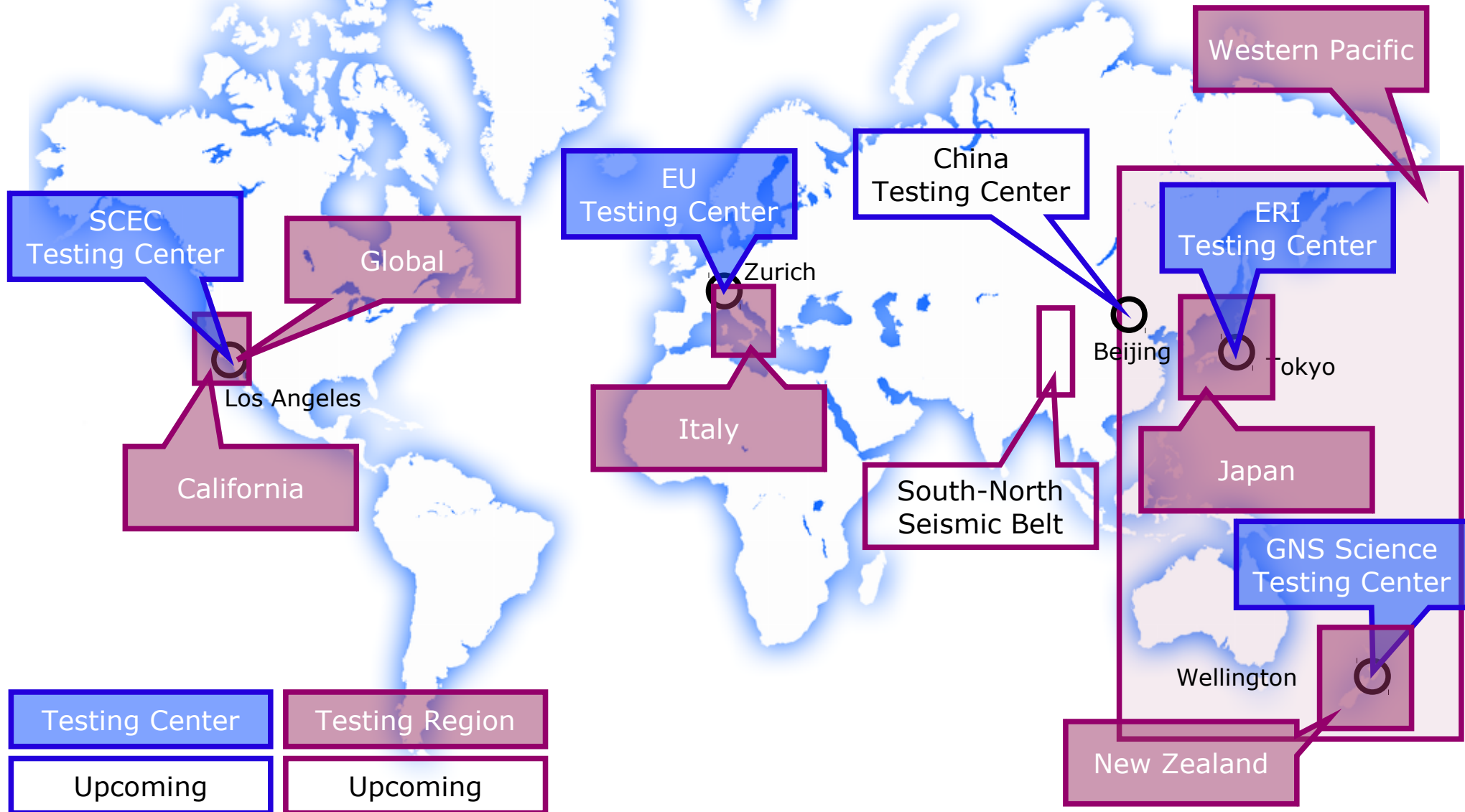
What does Evaluation & Testing do differently than the process of peer reviewed publications?

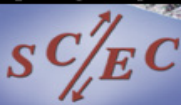
- Standardization & Formalization
- Nomenclature
- Agreement between scientists
- Rigor
- Reproducibility
- Tests involve researchers but are conducted independently

What Evaluation & Testing is NOT

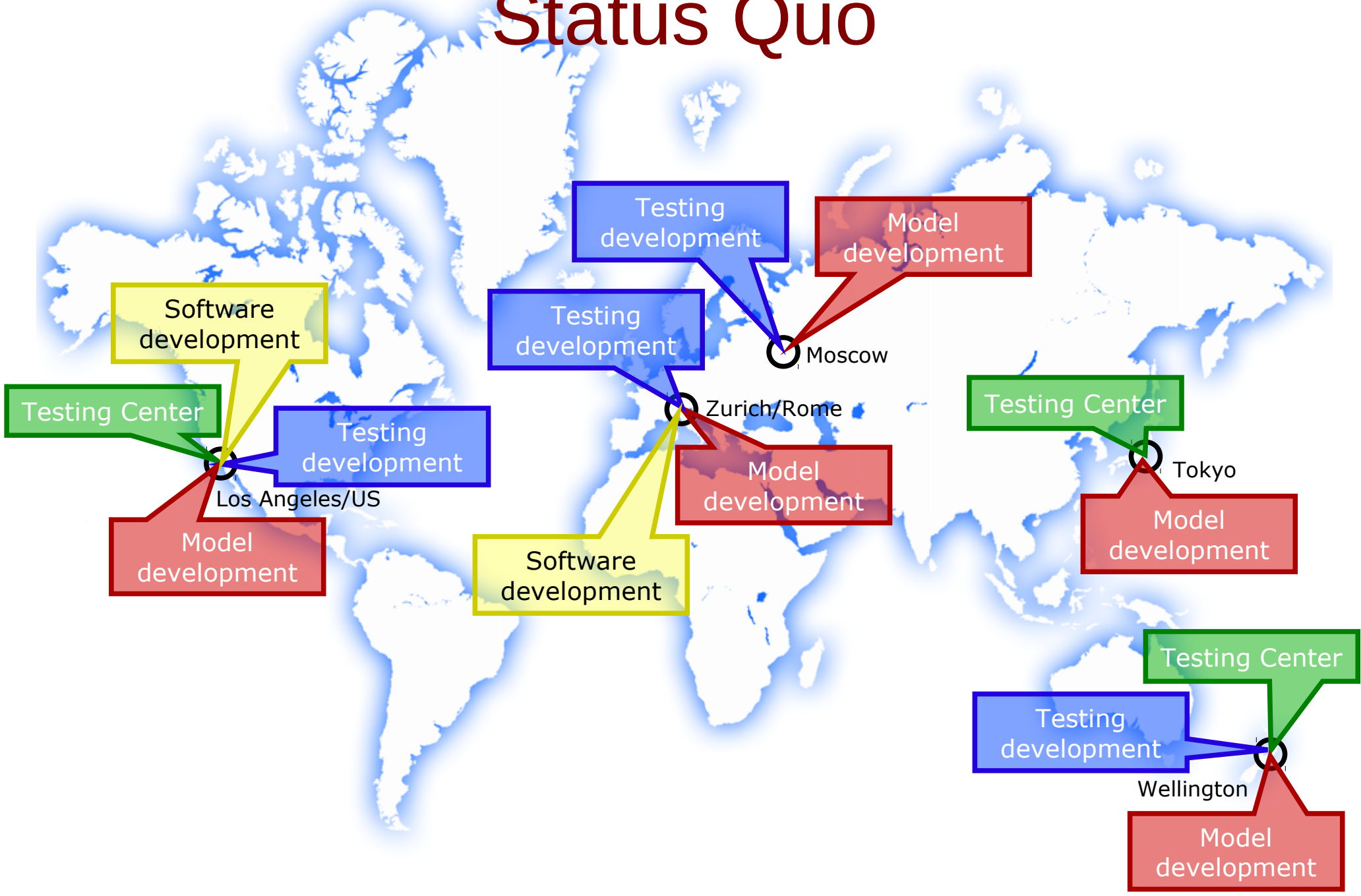
- Testing software codes
- Evaluating input data and their generation (catalogs, various databases, etc.)
- Evaluation & testing targets scientific not technical problems

Status Quo

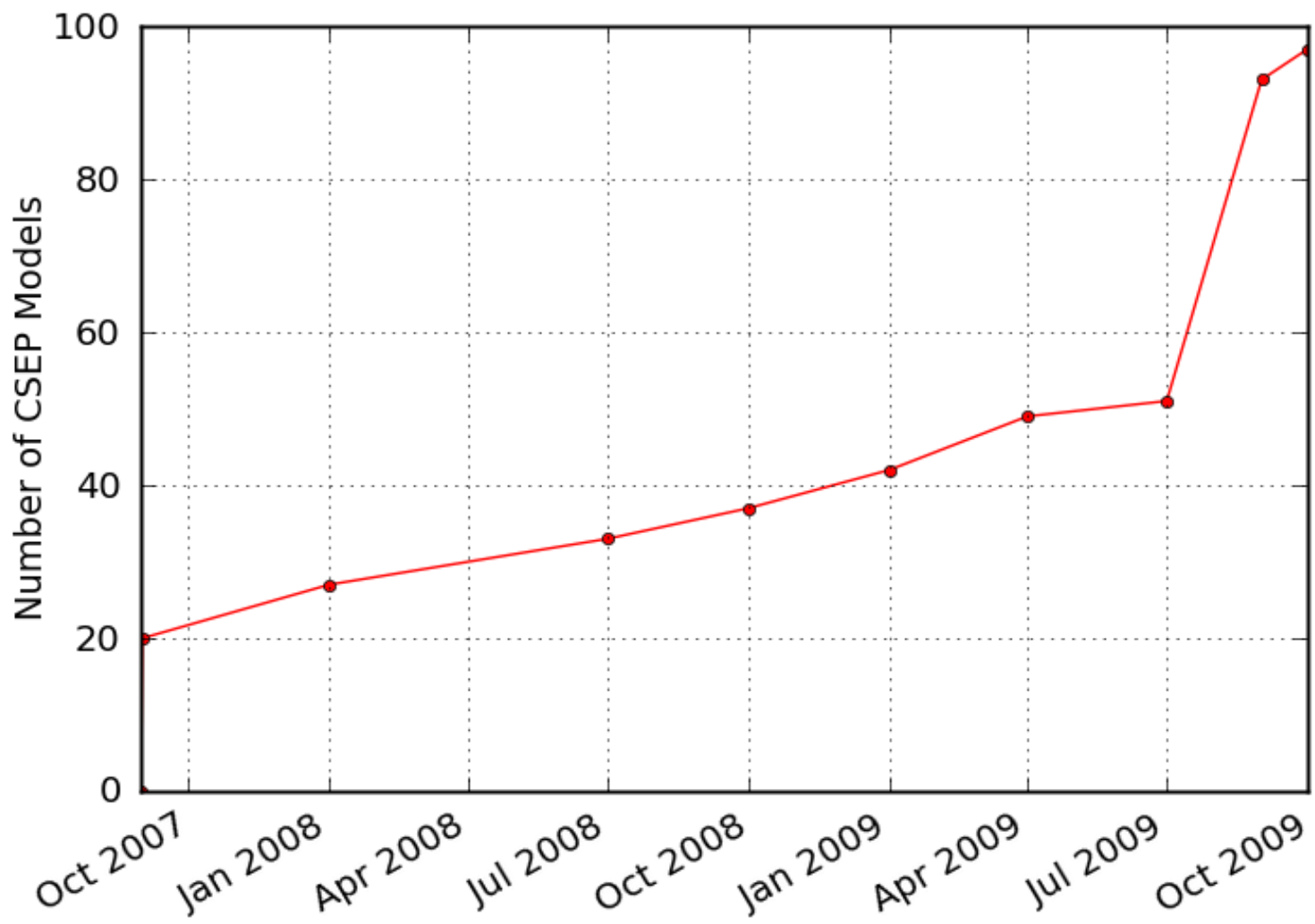




Status Quo



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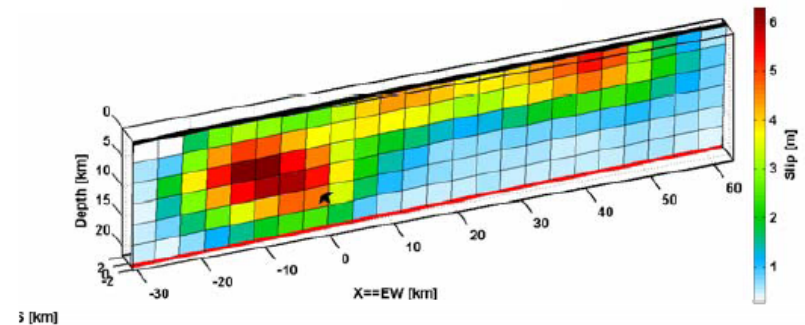
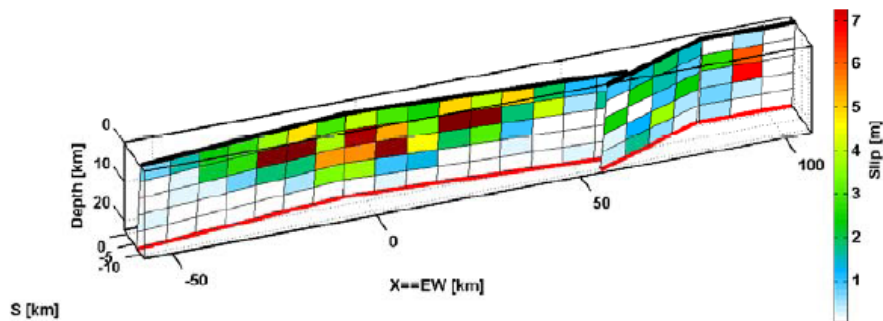
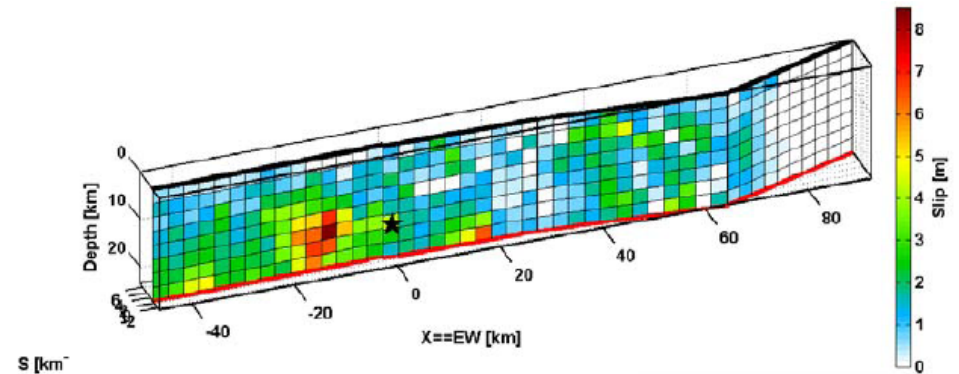
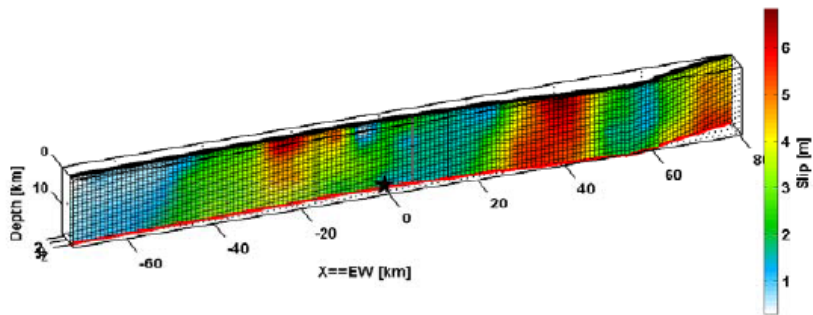


In Progress

- Earthquake Early Warning testing center

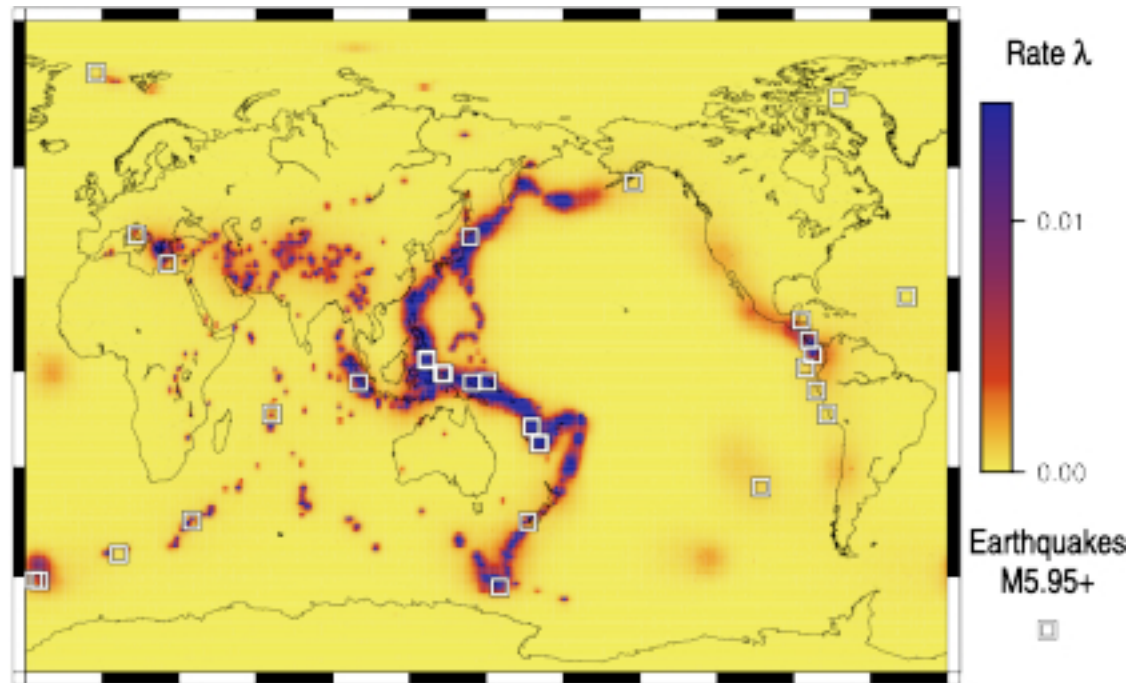
In Progress

- Earthquake Early Warning testing center
- Source Inversion Validation project with testing center



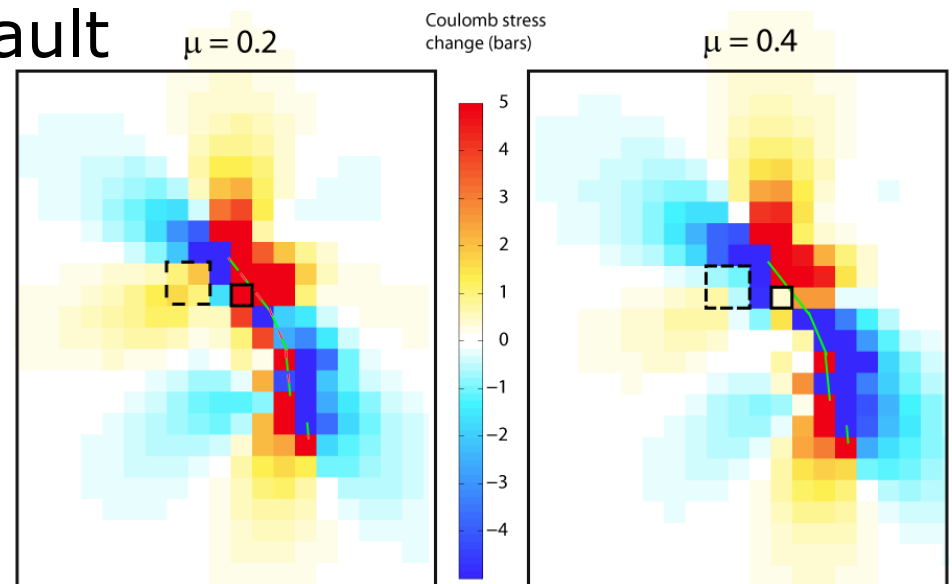
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- Reference models for all CSEP testing centers



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- Scientific hypotheses:
 - Characteristic Earthquake
 - Predictive power of Coulomb stress
 - Maximum magnitude per fault



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- Earthquake Early Warning testing center
- Source Inversion Validation project with testing center
- Reference models for all CSEP testing centers
- Scientific hypotheses:
 - Characteristic Earthquake
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 - Maximum magnitude per fault
- Evaluation and Testing for
 - Global Earthquake Model (GEM)
 - UCERF3

GEM & UCERF3

First testing targets discussed for GEM & UCERF3:

- Maximum magnitude per fault in the fault model

GEM & UCERF3

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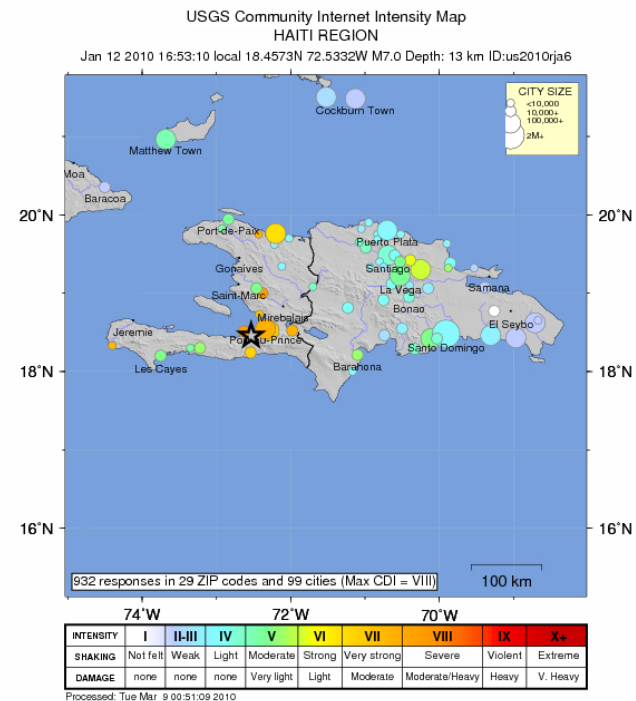
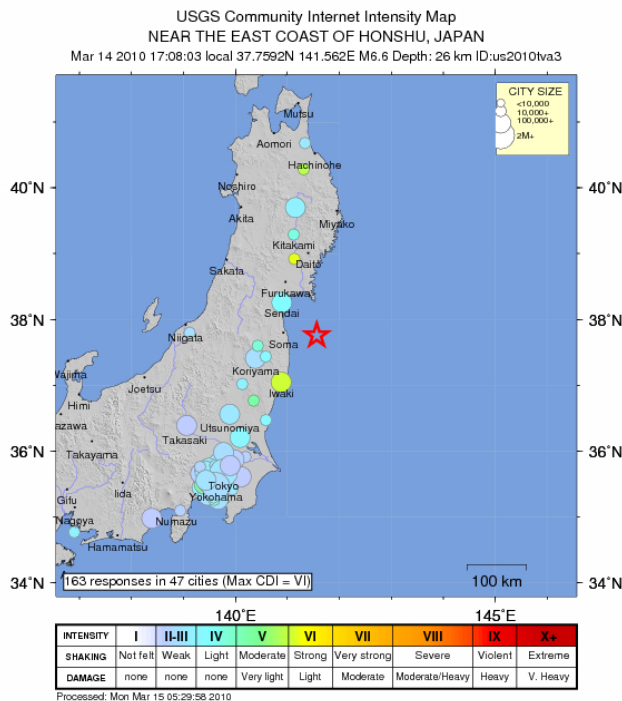
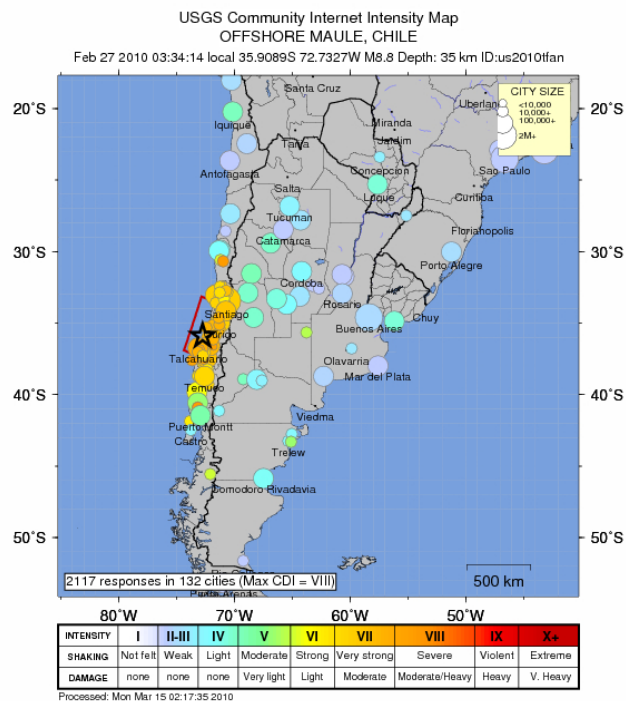
- Maximum magnitude per fault in the global fault model
- Moment balance



GEM & UCERF3

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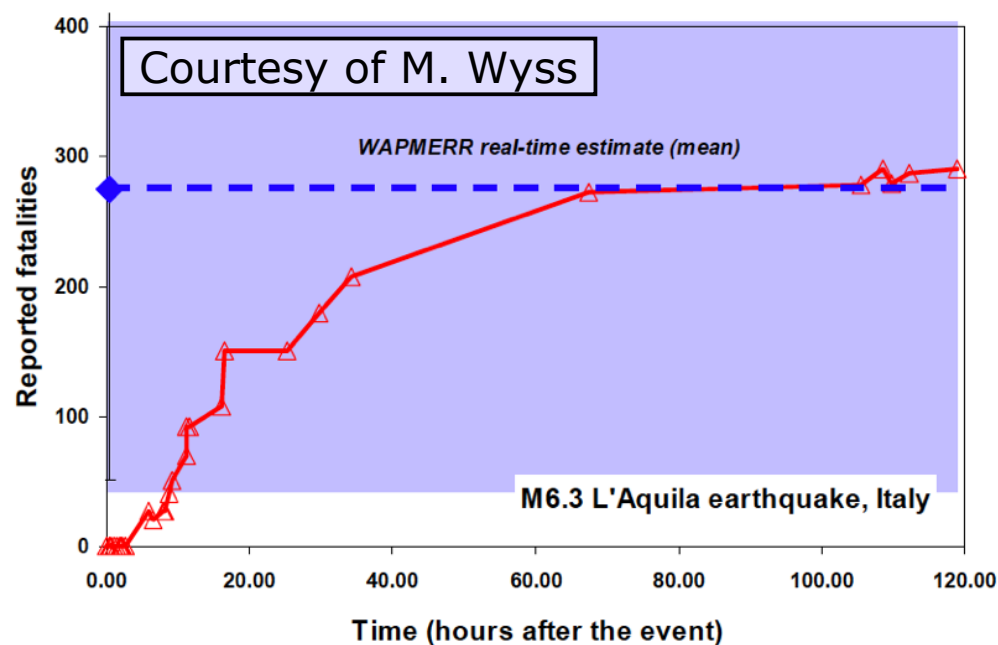
- Maximum magnitude per fault in the global fault model
- Moment balance
- Ground-motion prediction equations



GEM & UCERF3

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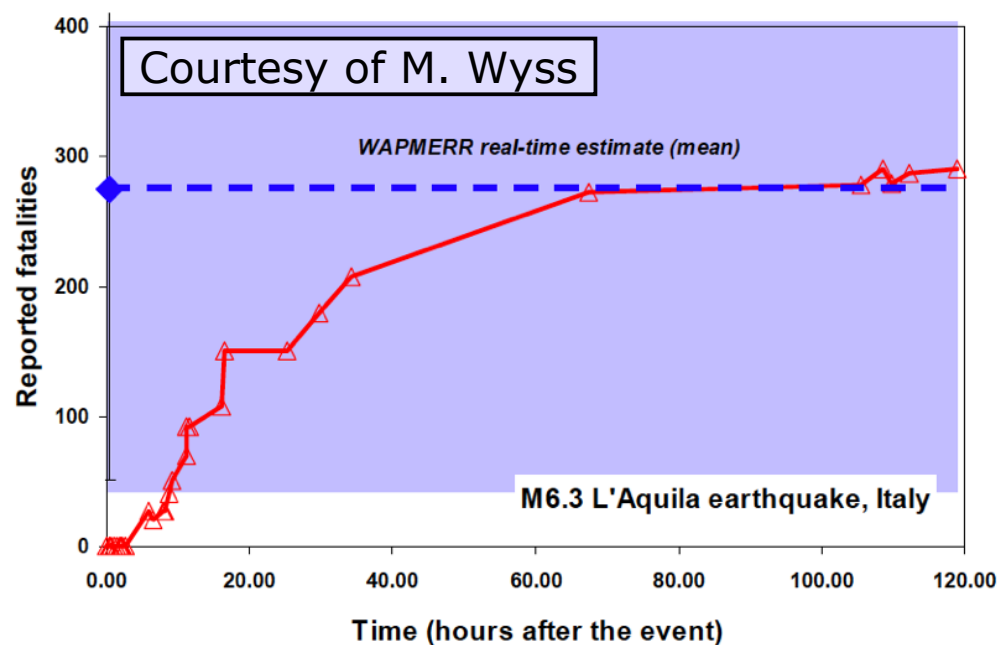
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EM-DAT
The International Disaster Database
Centre for Research on the Epidemiology of Disasters - CRED

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Search Details Disaster List

Published by admin

Dates		Geo		Disaster			Numbers			
Start	End	Country	Location	Type	Sub-Type	Name	Killed	Tot. Affected	Est. Damage (US\$ Million)	DisId
17/11/2008	17/11/2008	Indonesia	Gerentale, Buol district ...	Earthquake (seismic activity)	Earthquake (ground shaking)		6	10077		2008-0536
09/09/2008	09/09/2008	Indonesia	Lahat (Bengkulu province, ...	Earthquake (seismic activity)	Earthquake (ground shaking)		2	625		2008-0403
20/02/2008	20/02/2008	Indonesia	Simeulue (North Sumatra) ...	Earthquake (seismic activity)	Earthquake (ground shaking)		3	25		2008-0071
26/11/2007	26/11/2007	Indonesia	Sumbawa district (Ilesa Te ...	Earthquake (seismic activity)	Earthquake (ground shaking)		3	21800		2007-0565
09/09/2007	09/09/2007	Indonesia	Situbondo (Java Isl.)	Earthquake (seismic activity)	Earthquake (ground shaking)			469		2007-0485
12/09/2007	12/09/2007	Indonesia	Bengkulu, Jambi, West Sum ...	Earthquake (seismic activity)	Earthquake (ground shaking)		25	459567	500	2007-0440
06/03/2007	06/03/2007	Indonesia	Tanah Datar, Solok, Solok ...	Earthquake (seismic activity)	Earthquake (ground shaking)		67	137660	200	2007-0087
01/12/2006	01/12/2006	Indonesia	Bitma (Sumbawa region)	Earthquake (seismic activity)	Earthquake (ground shaking)		1	114		2006-0705
18/12/2006	18/12/2006	Indonesia	Mandailing Natal district ...	Earthquake (seismic activity)	Earthquake (ground shaking)		8	1200		2006-0678
17/07/2006	17/07/2006	Indonesia	Tasikmalaya, Ciamis, Suka ...	Earthquake (seismic activity)	Tsunami		802	35543	55	2006-0372

GEM & UCERF3

First testing targets discussed for GEM & UCERF3:

- Maximum magnitude per fault in the global fault model
- Moment balance
- Ground-motion prediction equations
- Number of fatalities/injured

Making the model testable:

- Ground-motion intensities should always be expressed in MMI to be tested against “Did You Feel It?” data with each earthquake

Long-term Goals

- Make GEM & UCERF3 as testable as possible
- Test as many ingredients to the models as possible
- Explore the uncertainties and the validity of ingredients
- Create simple reference models to test GEM & UCERF3 and selected ingredients against
- Employ methods of the Collaboratory for the Study of Earthquake Predictability (CSEP)

Thank You!

If you're doing an experiment, you should report everything that you think might make it invalid — not only what you think is right about it... Details that could throw doubt on your interpretation must be given, if you know them.

Richard P. Feynman