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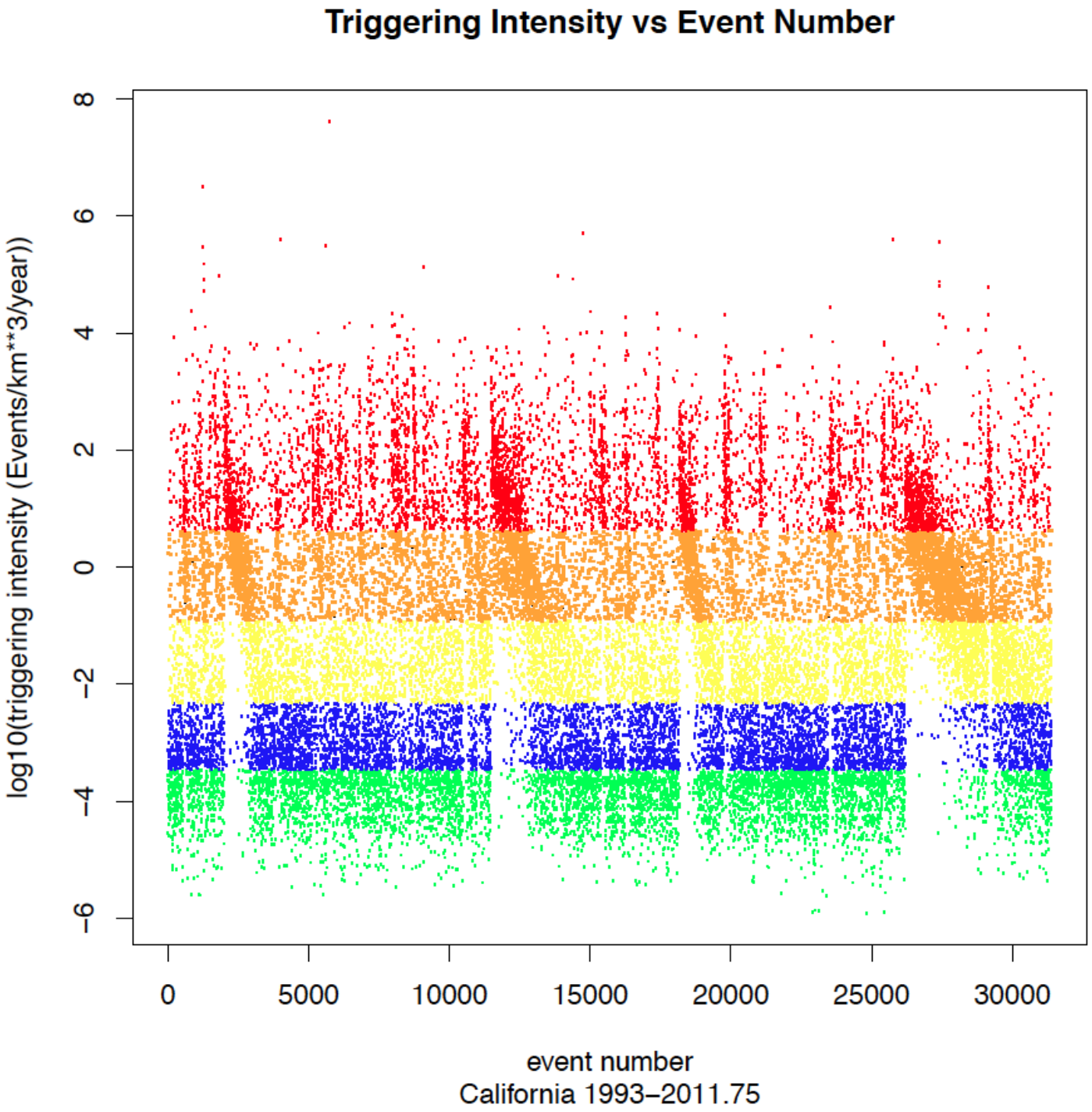
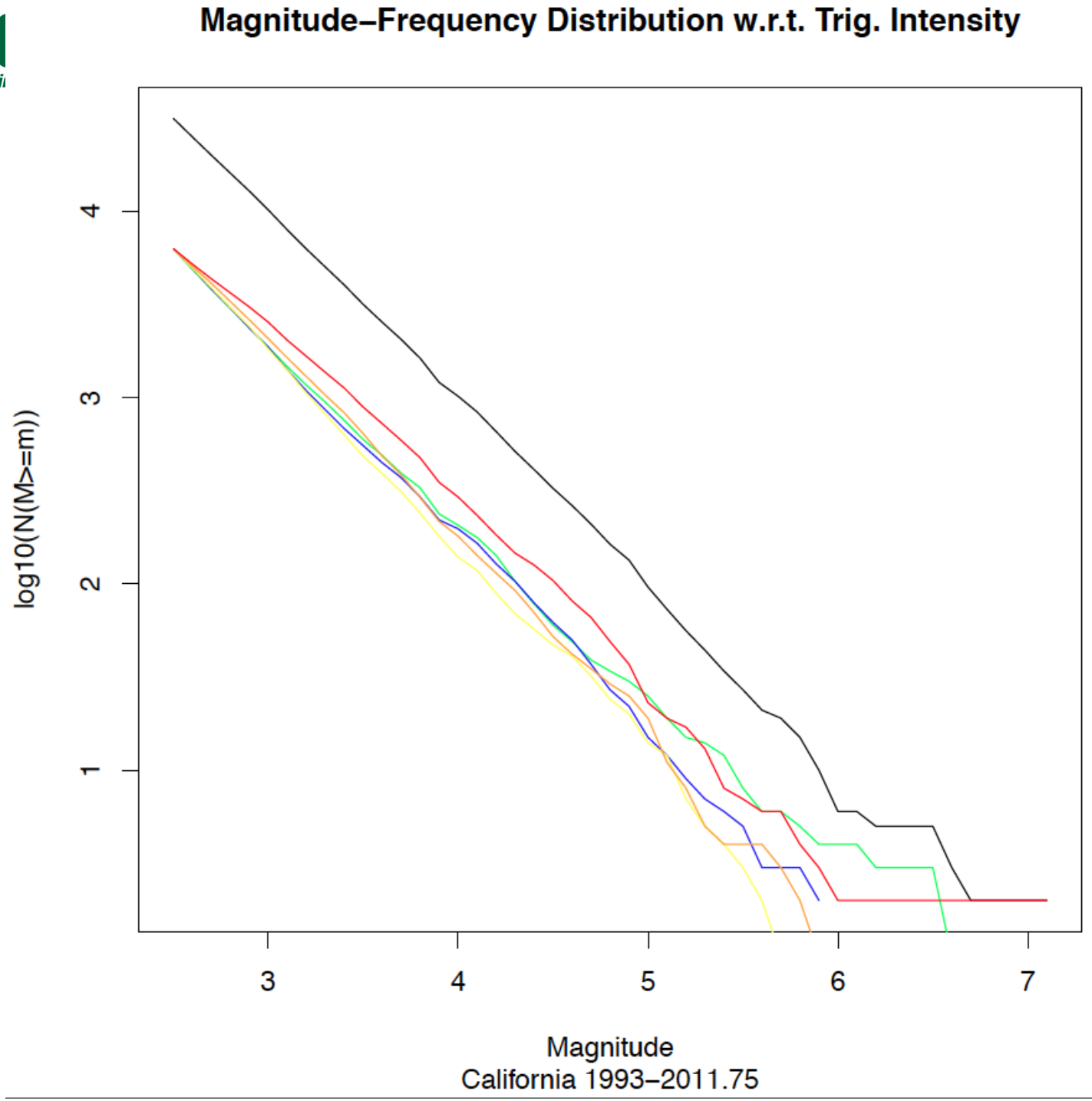
UCERF3 OEF Issues

1. Time-varying completeness model.
2. Testing a model that is 1000 simulations rather than a mean rate.


Triggering Intensity vs Event Number
log10(triggering intensity (Events/km**3/year))
8
6
4
2
0
−2
−4
−6
0
5000
10000
15000
20000
25000
30000
event number
California 1993–2011.75


Magnitude–Frequency Distribution w.r.t. Trig. Intensity
log10(N(M>=m))
1
2
3
4
3
4
5
6
7
Magnitude
California 1993–2011.75

Do Aftershock Probabilities Decay with Time?

Andrew Michael

SRL June 2012

Urban planners divide disaster recovery into a series of overlapping stages:

(1)Emergency consisting of search and rescue, fire fighting, emergency shelters, and damage assessment;

(2)Restoration consisting of the restoration of utility services, debris removal, and temporary repairs to structures to make them usable for the short-term;

(3)Reconstruction during which structures are replaced to predisaster levels;

(4)Betterment during which major redevelopment projects improve the community to a new standard;

(5) the *Long-Term* future.

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Stages of Disaster Recovery and Aftershock Probabilities

Stage	Dominant Time Period post-Mainshock	Probability of an Aftershock with $M_a \geq M_m - 1$			Probability of an independent event with a rate of 0.01 events/year
		RJ89 Generic Model, p=1.08	RJ89 Generic Model modified to p=1	Felzer, 2003, multi-window model, p=1.34	
1 - Emergency	0 – 14 days	61%	61%	35%	0.04%
2 - Restoration	14 days – 1 year	33%	43%	10%	1%
3 - Reconstruction	1 – 3 years	11%	17%	2%	2%
4 - Betterment	3 – 10 years	11%	19%	1%	7%
5 – Long-Term	10 – 50 years	13%	24%	1%	33%

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Testing Window Issues?

Does the algorithm that does best at 1-day do best at 1 or more years?

The longer forecasts will have more uncertainty because

- they will use more simulated parents in an ETAS process and/or
- less data to update parameters.

When would we submit longer time period forecasts?

- Perhaps near end of each planning period for next planning period.

How often would we update shorter forecasts?

- Daily
- Event-by-Event

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Retrospective Testing Strategy For Optimized Models

When models are optimized based on the data it is hard to test them retrospectively if all of the data has been used in the optimization.

Better to use training and test data sets.

Also, reverse training and test data sets.

Problem: data quality changes with time so using early period as training and late period as testing may introduce problems by optimizing on data that isn't as good as the data used for the test.

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Retrospective Testing Strategy For Optimized Models

Consider developing and testing a simple ETAS model.
Assume functional forms for temporal and spatial intensity functions.
Determine parameters from training data.
Test fit to test data.

Use non-contiguous training and test data sets.

E.g. Odd years are in training set (2001, 2003, 2005, 2007,…)
Even years are in test sets (2002, 2004, 2006, 2008, …)

Now data quality changes are similar for both training and test sets.

Retrospective Testing Strategy For Optimized Models

Strategy 1:

Odd years are in training set (2001, 2003, 2005, 2007,…)

Even years are in test sets (2002, 2004, 2006, 2008, …)

Strategy 2:

Training set is all earthquakes but weighted by a smoothly varying function of time, e.g. $W_{training} = (1+\sin(t))/2$

Test set is all earthquakes weighted by $W_{test} = 1-W_{training}$

Now there are no sharp boundaries but key sequences could be heavily weighted in one set or the other.

Strategy 3:

Number earthquakes i=1, 2, 3, …. N

Odd earthquakes have $W_{training} = 1$, $W_{test} = 0$

Even earthquakes have $W_{training} = 0$, $W_{test} = 1$

Now all sequences are represented in both training and test data sets.

Retrospective Testing Strategy For Optimized Models

If models can be set up as optimization procedures then we can test retrospectively in a meaningful way.

Meaningful retrospective tests could lead to faster adoption of models in OEF while also doing prospective tests.

If a model can't be set up as an optimization procedure then it might have to wait for validation in a prospective test which will be a much slower procedure.

Can we set up our models as optimization procedures?

- Hybrid model combinations
- Matt's STEP+ Coulomb %X in Red, %Y in Blue
- Margaret's models with COV as a parameter