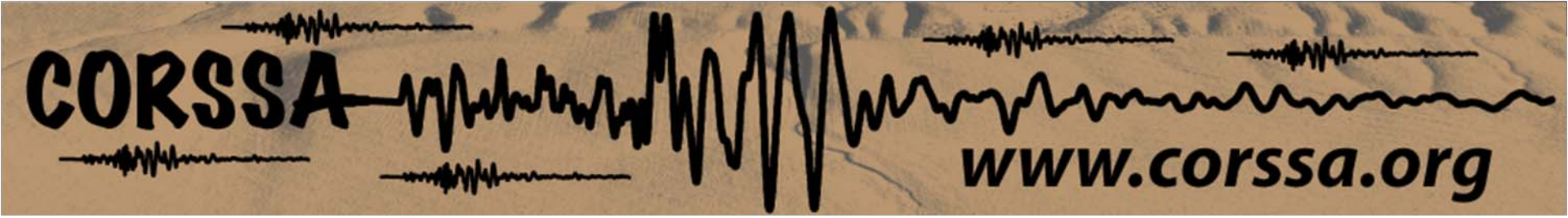


CORSSA: Community Online Resource for Statistical Seismicity Analysis

Jeremy Douglas Zechar[a]

with J. Hardebeck[b], A. Michael[b], M. Naylor[c],

S. Steacy[d], S. Wiemer[a], and J. Zhuang[e], and

the CORSSA Community

a) ETH Zurich, SWITZERLAND

b) USGS Menlo Park, USA

c) University of Edinburgh, SCOTLAND

d) University of Ulster, NORTHERN IRELAND

e) Institute of Statistical Mathematics, JAPAN

Results from the Regional Earthquake Likelihood Models experiment

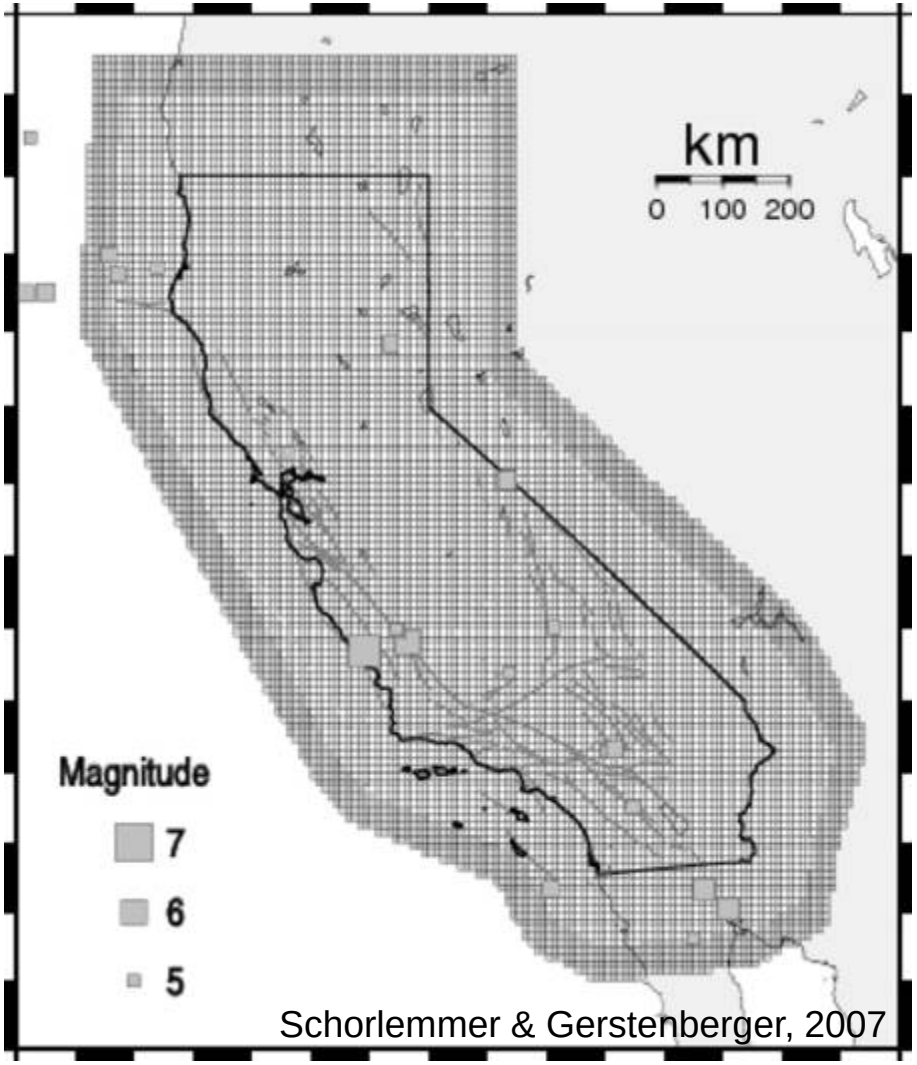
Jeremy Douglas Zechar[a]

with Danijel Schorlemmer[b], Max Werner[c], Matt Gerstenberger[d], David Rhoades[d], and many others

a) ETH Zurich, Zurich, Switzerland
b) GFZ, Potsdam, Germany
c) Princeton University, Princeton, NJ, USA
d) GNS Science, Lower Hutt, New Zealand

Regional Earthquake Likelihood Models (RELM) experiment in California

- Objective: forecast rate of $M_{ANSS} \geq 4.95$ eqks in California for the following five years
- Seventeen *5-year* forecasts
  - 12 mainshock forecasts
  - 5 mainshock+aftershock forecasts
- Forecasts are specified as number of expected eqks in lat/lon/mag bins (0.1° x 0.1° x 0.1).
- Forecasts evaluated for consistency with observations using *likelihood tests*.



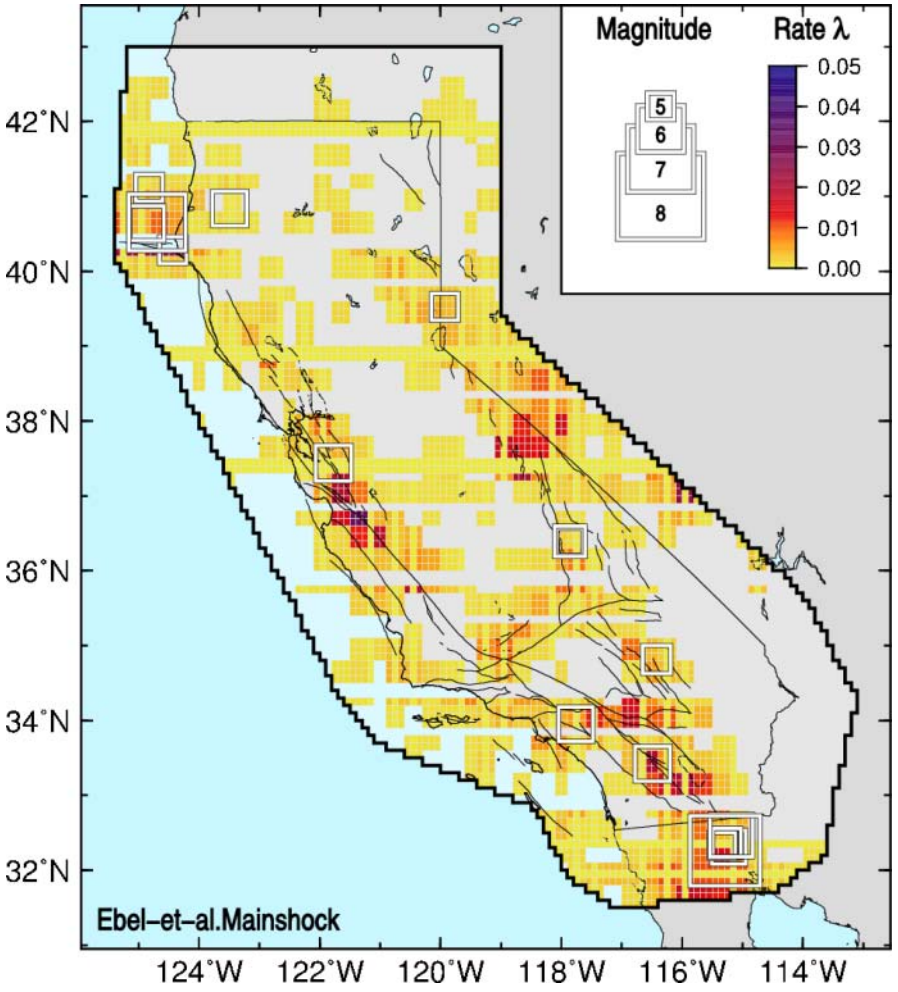
Schorlemmer & Gerstenberger, 2007

(For details, see 2007 special issue of Seismological Research Letters)

MAINSHOCK MODELS

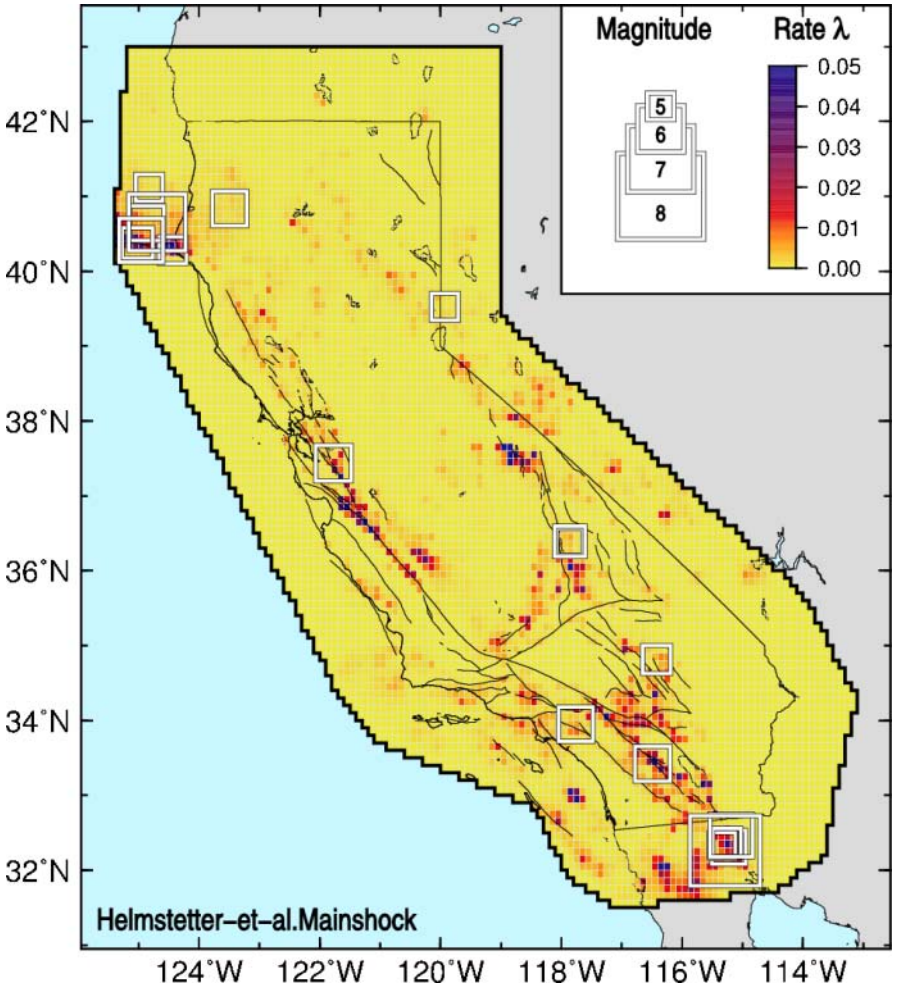
Ebel

- Decluster 1932-2004 catalog
- Determine average 5 yr rate of M5+ events in 0.3°x 0.3° cells
- Use Gutenberg-Richter relation to extrapolate



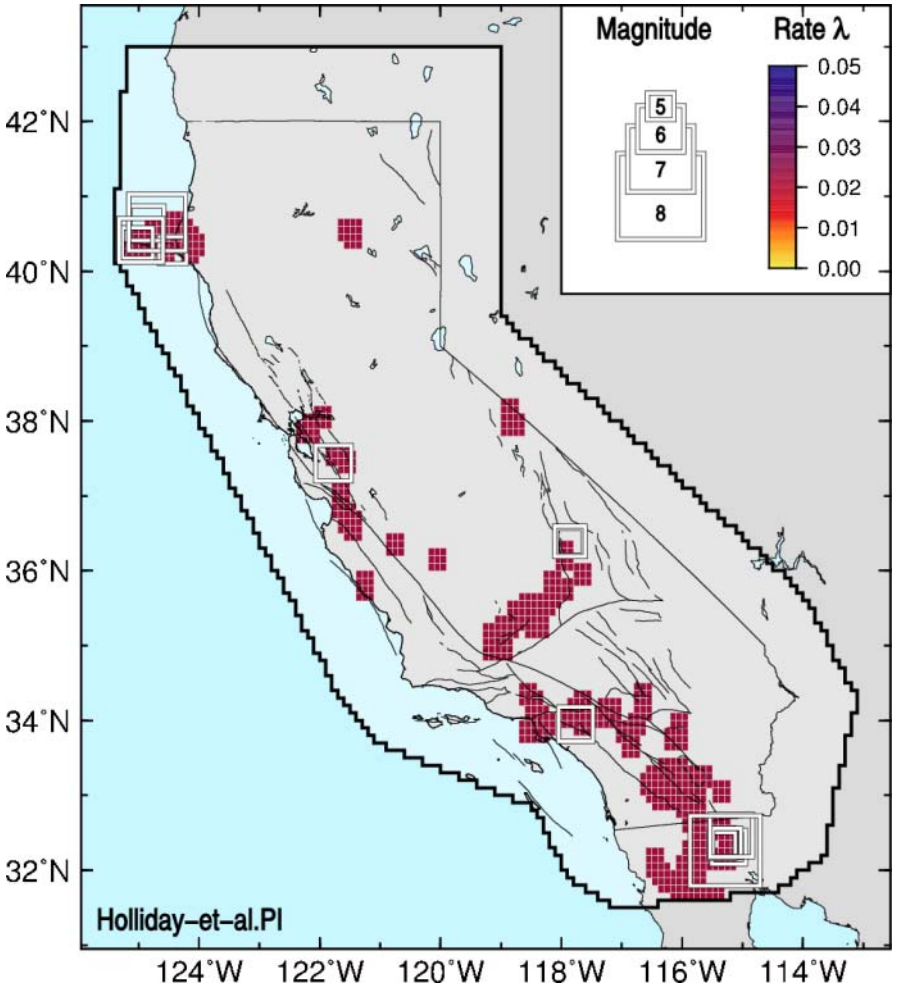
Helmstetter

- Power-law smoothing of **M2+ events**
  - Bandwidth is density-dependent and optimized
- Account for spatially-varying M_c



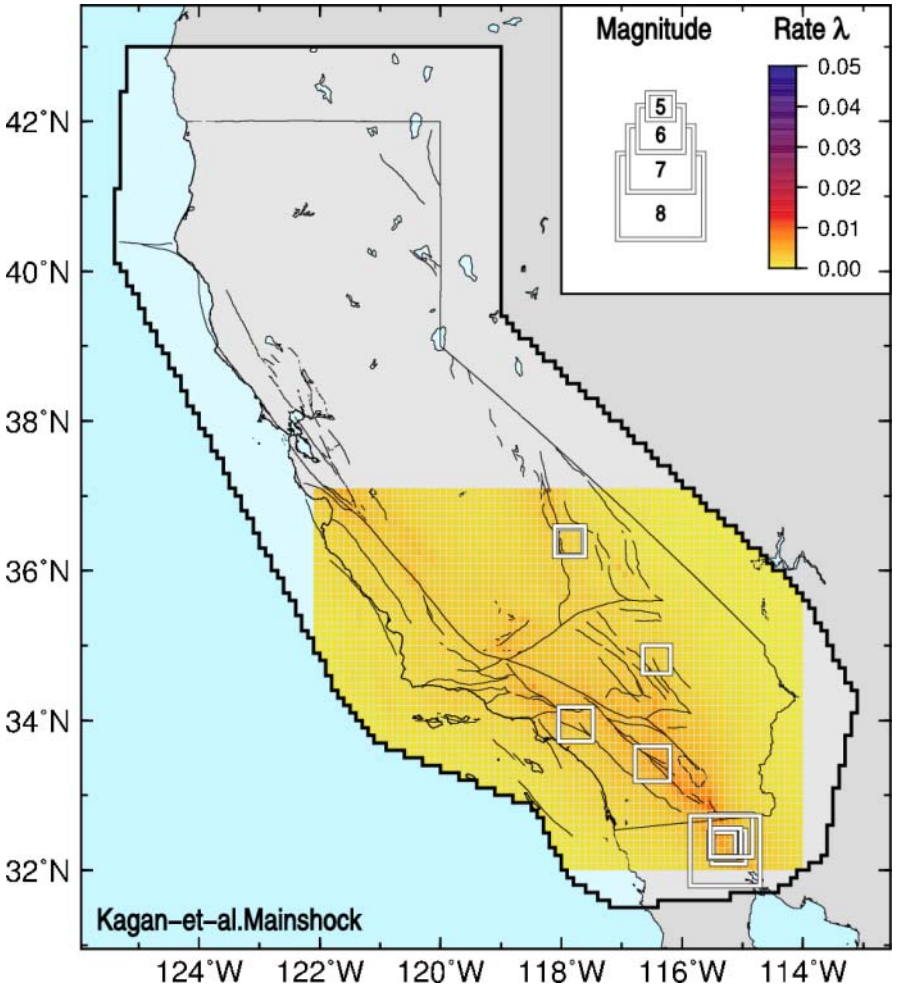
Holliday

- Search for recent changes in seismicity of each cell relative to long-term behavior
  - Activation and quiescence
- One variant of the **Pattern Informatics** method



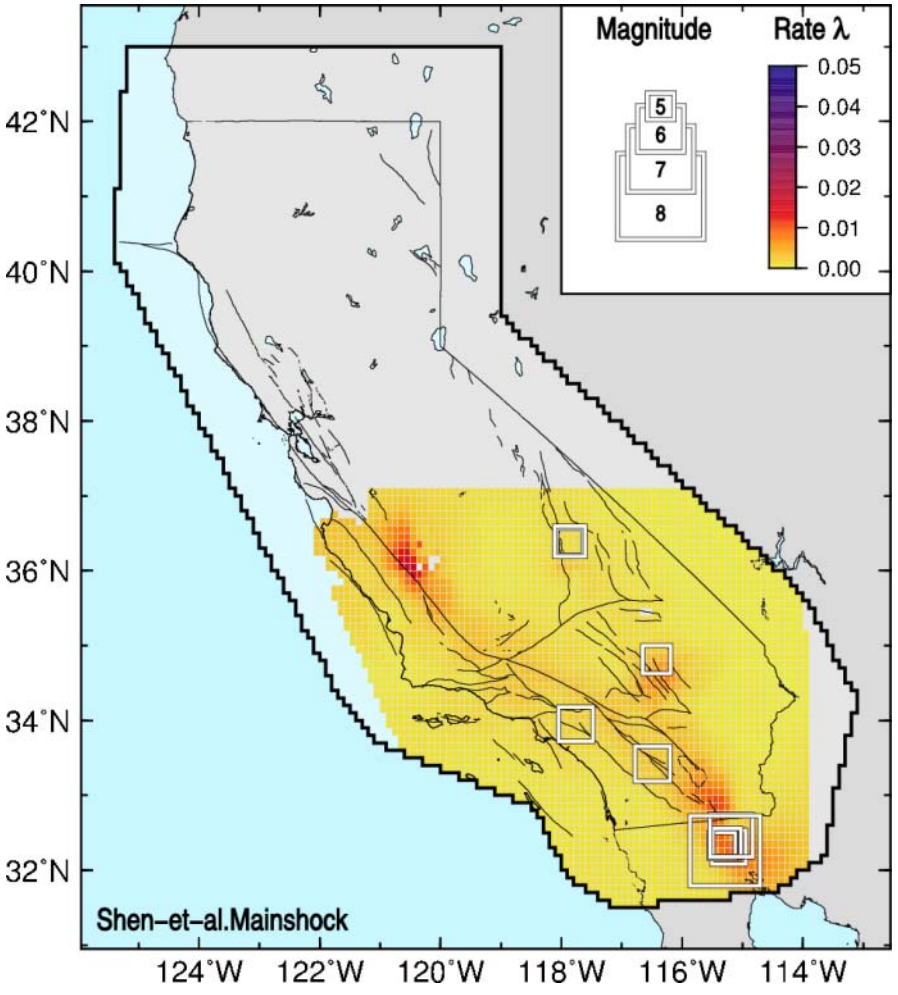
Kagan

- Smooths large events in southern California since 1800
- Includes **spatial anisotropy**, extending the event along the presumed fault



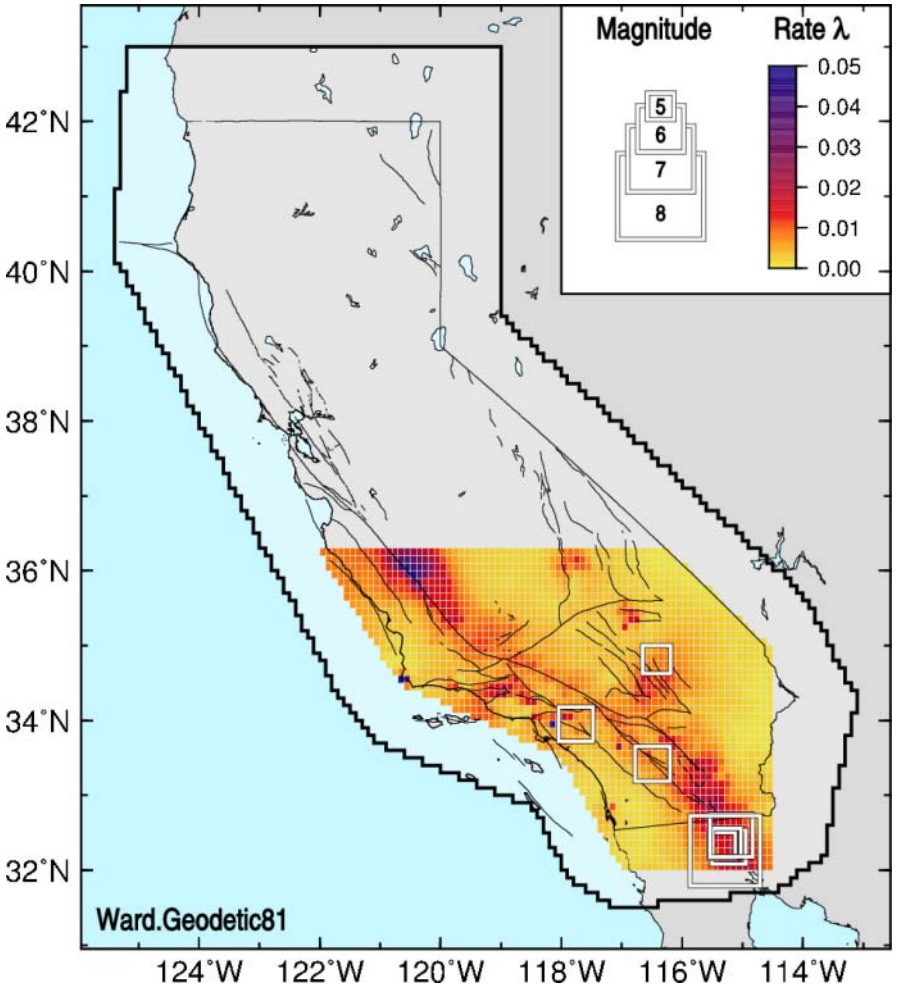
Shen

- Uses **GPS data**
- Assumes seismicity rate is proportional to horizontal maximum shear strain rate
- Uses tapered Gutenberg-Richter relation for extrapolation



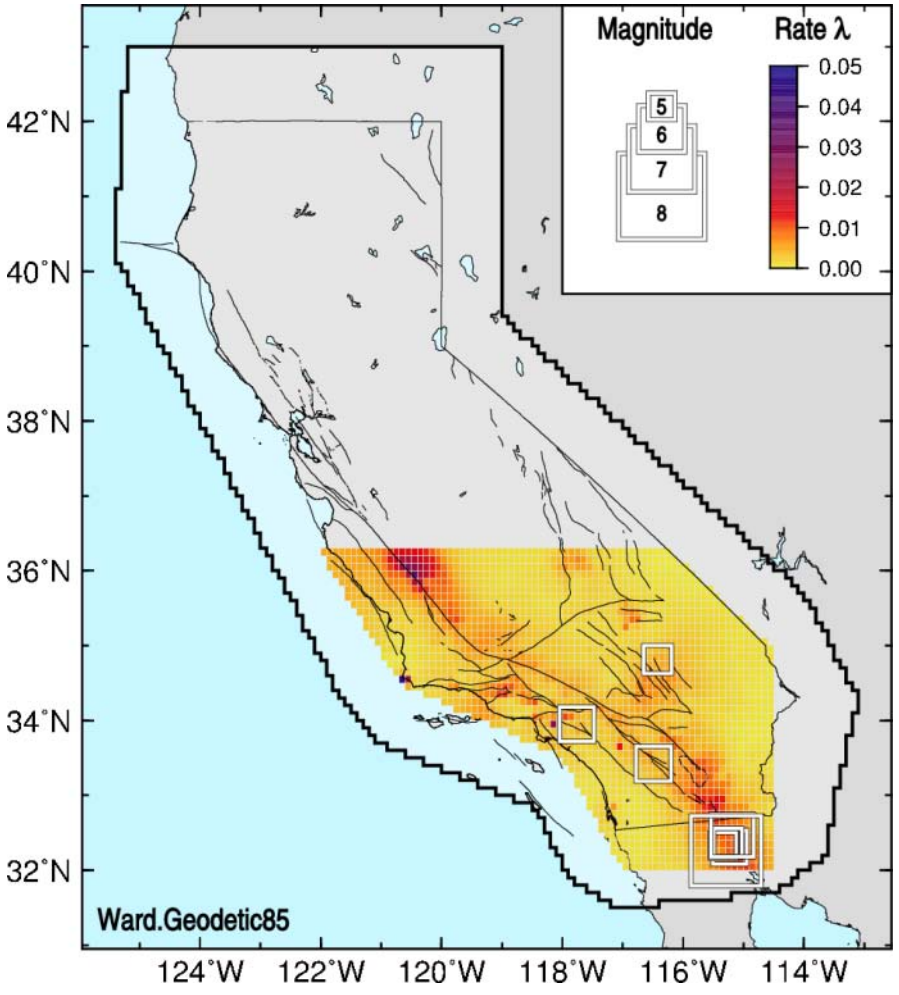
Ward's geodetic forecast

- Uses **larger GPS dataset**
- Slight variation on mapping strain rate to seismicity rate
- Assumes maximum magnitude $\mathbf{M_{max} = 8.1}$



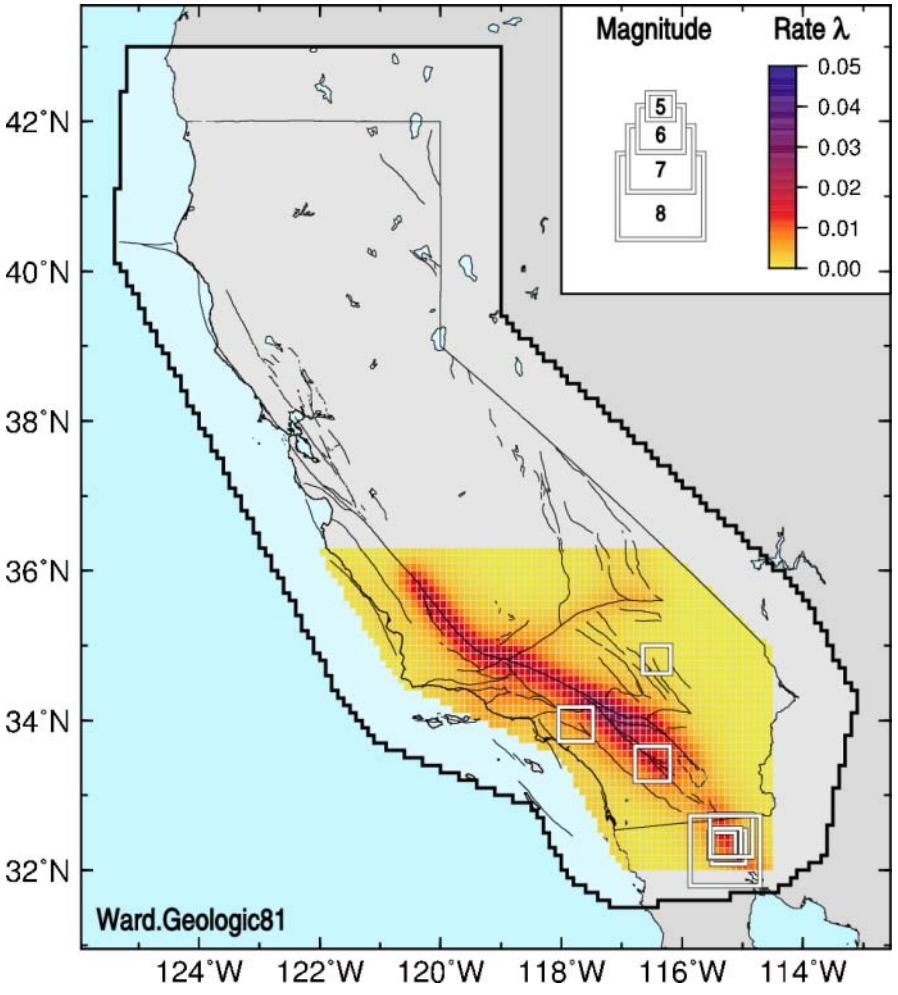
Ward's geodetic forecast

- Same as previous, except assuming $\mathbf{M_{max} = 8.5}$



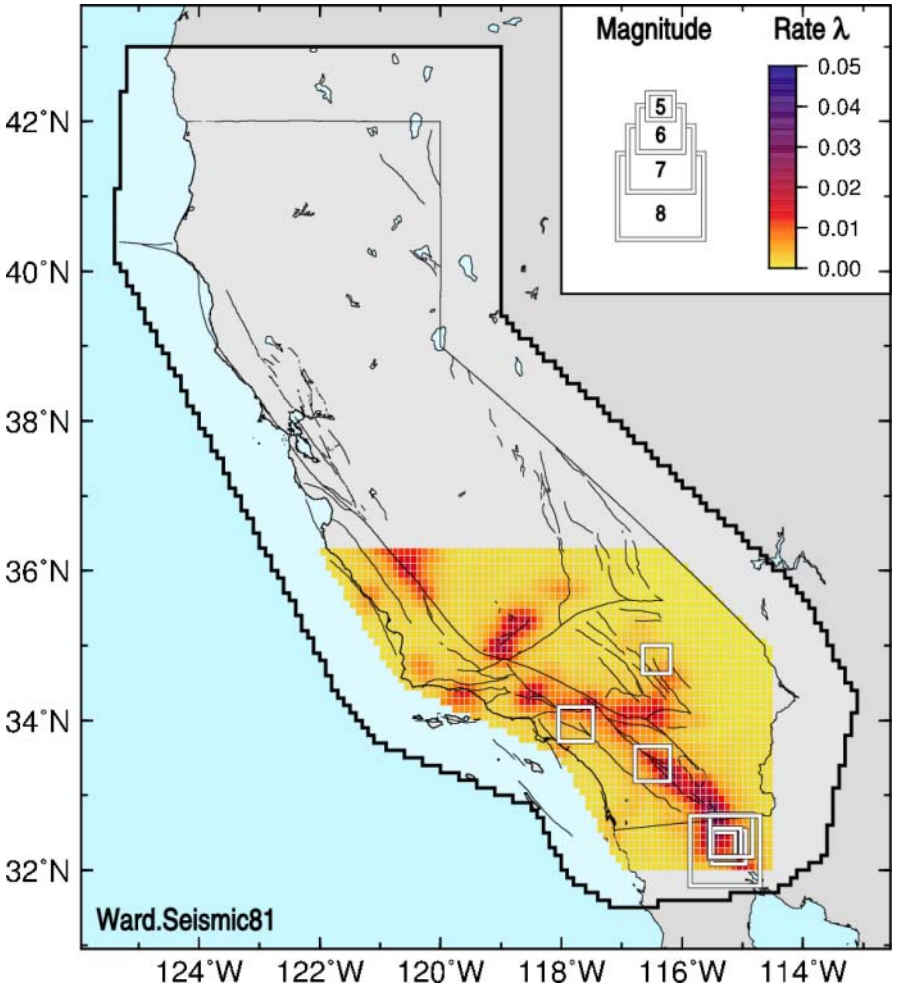
Ward's geologic model

- Uses **geologic data**
- Maps slip rates to smoothed moment rate density, then to seismicity rate



Ward's seismic forecast

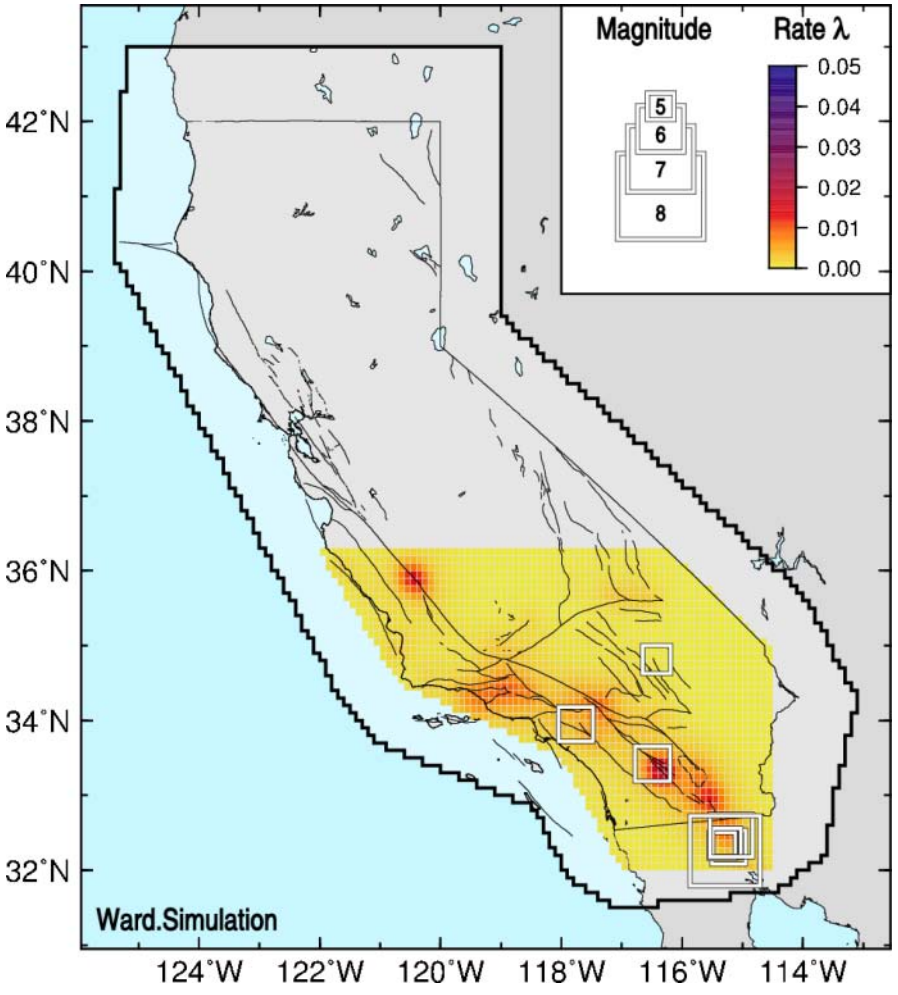
- **Smoothed** large events since 1850



Ward's simulation forecast

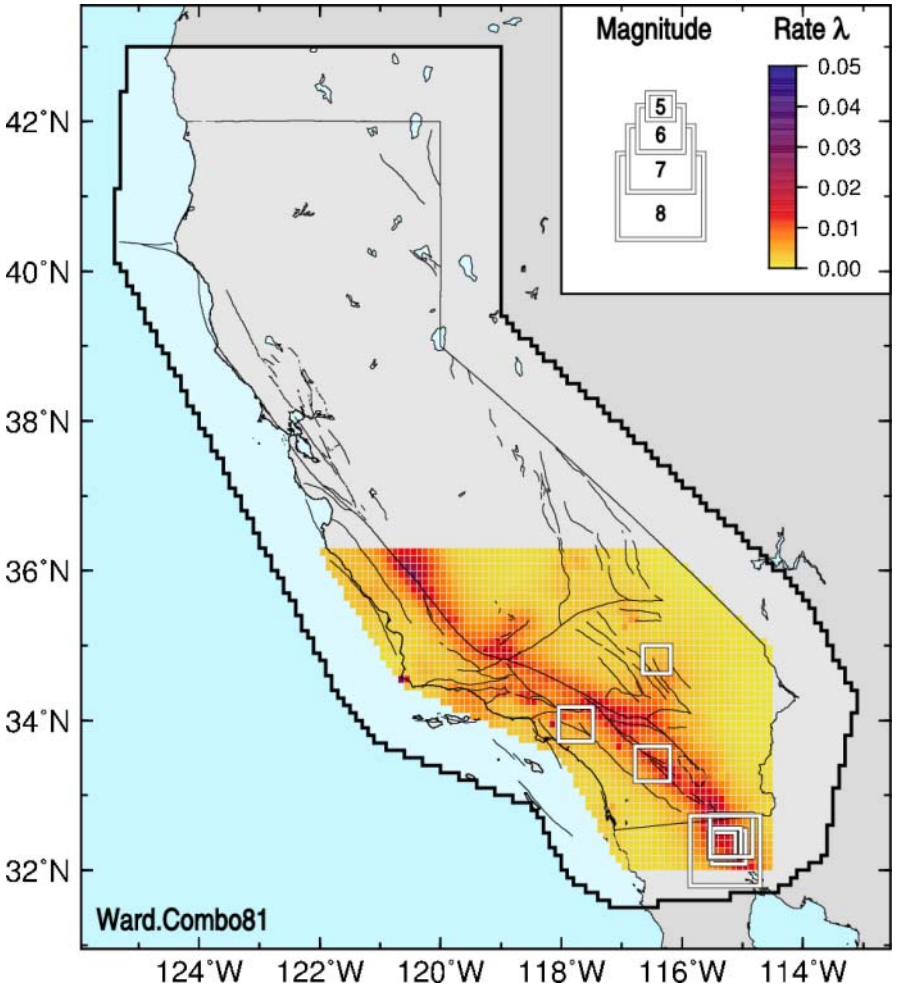
- Derived from "physics-based" simulations of velocity-weakening friction on a prescribed fault network

- One variant of the **ALLCAL eqk simulator**



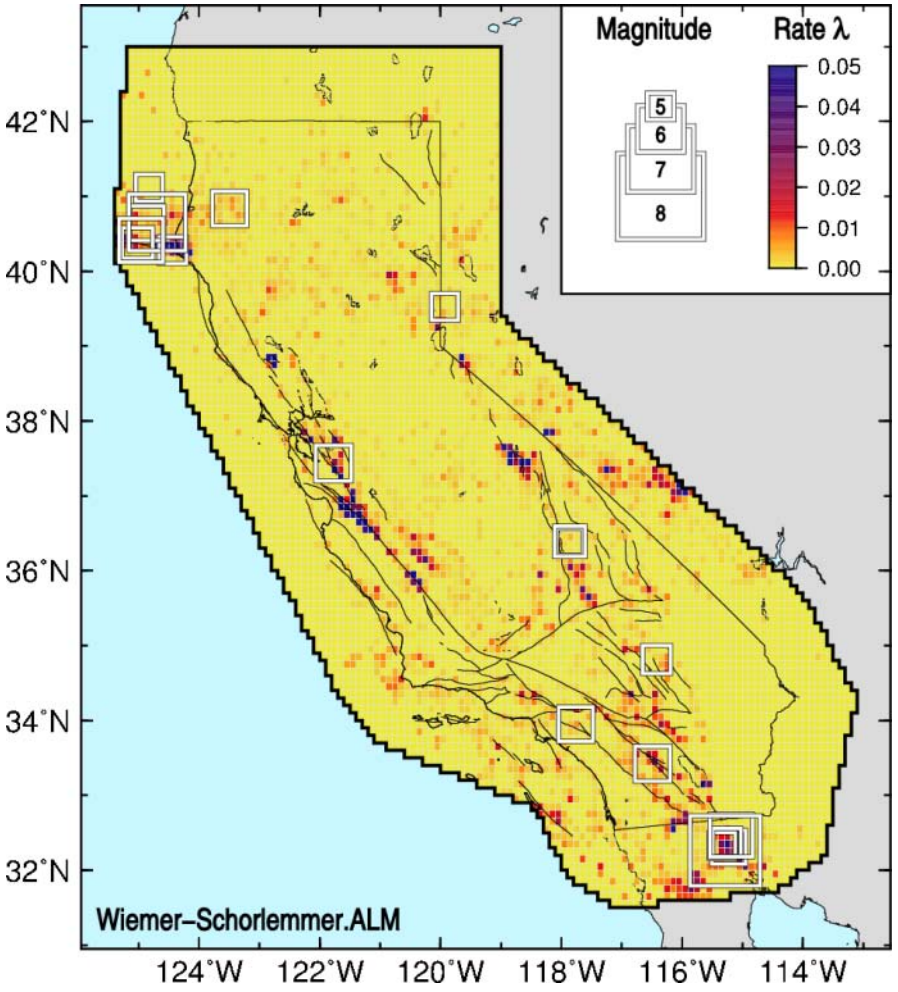
Ward's combination

- **Average** of Ward's forecasts



Wiemer

- Estimates Gutenberg-Richter ***a*- and *b*-values in every cell**
- Variations in these parameters are assumed to indicate presence of asperities

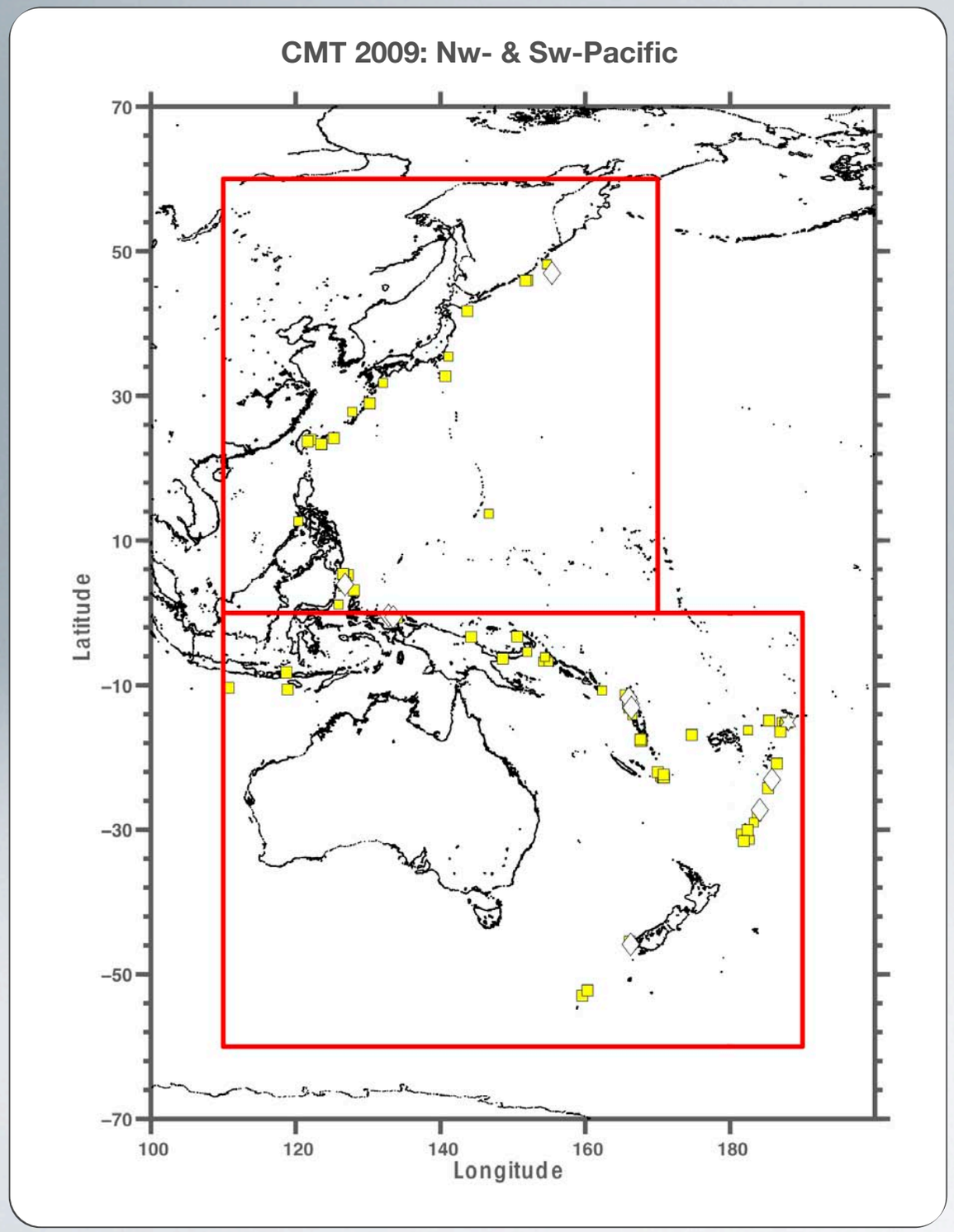


A Prospective Earthquake Forecast Experiment In The Western Pacific

David Eberhard, J. Douglas Zechar
and Stefan Wiemer

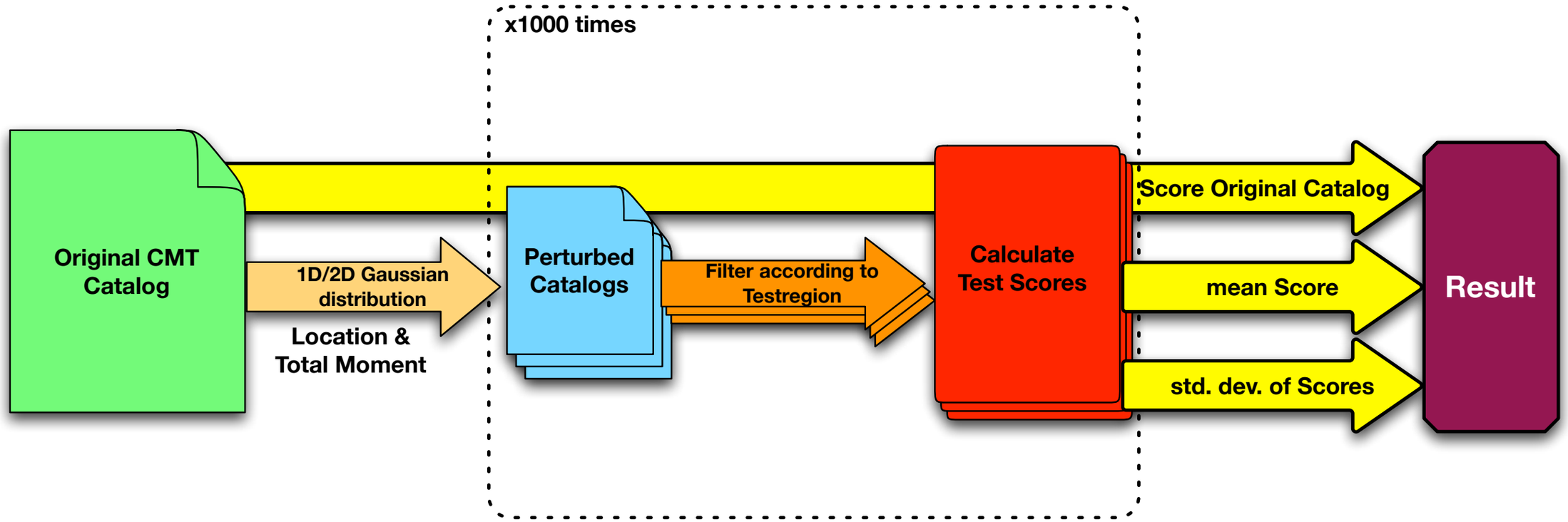
SED ETH Zurich

Test Region: NW & SW Pacific



- Global CMT catalog, 2009
- One year period
- Centroid Location & Mw
- Mw>5.8 & Depth<70km
- „Undeclustered“ catalog
- Two study regions
  - **NW**: 32 Eq for 2009
  - **SW**: 63 Eq for 2009

Method: Error Estimation



- Location uncertainty: $\sigma_x = \sigma_y = 30km$ (M. Nettles personal communication)
- Moment uncertainty: $\sigma_{M0} = 0.2 * M_0$ (M. Nettles personal communication)
- 1000 perturbed catalogs were used

Consistency results

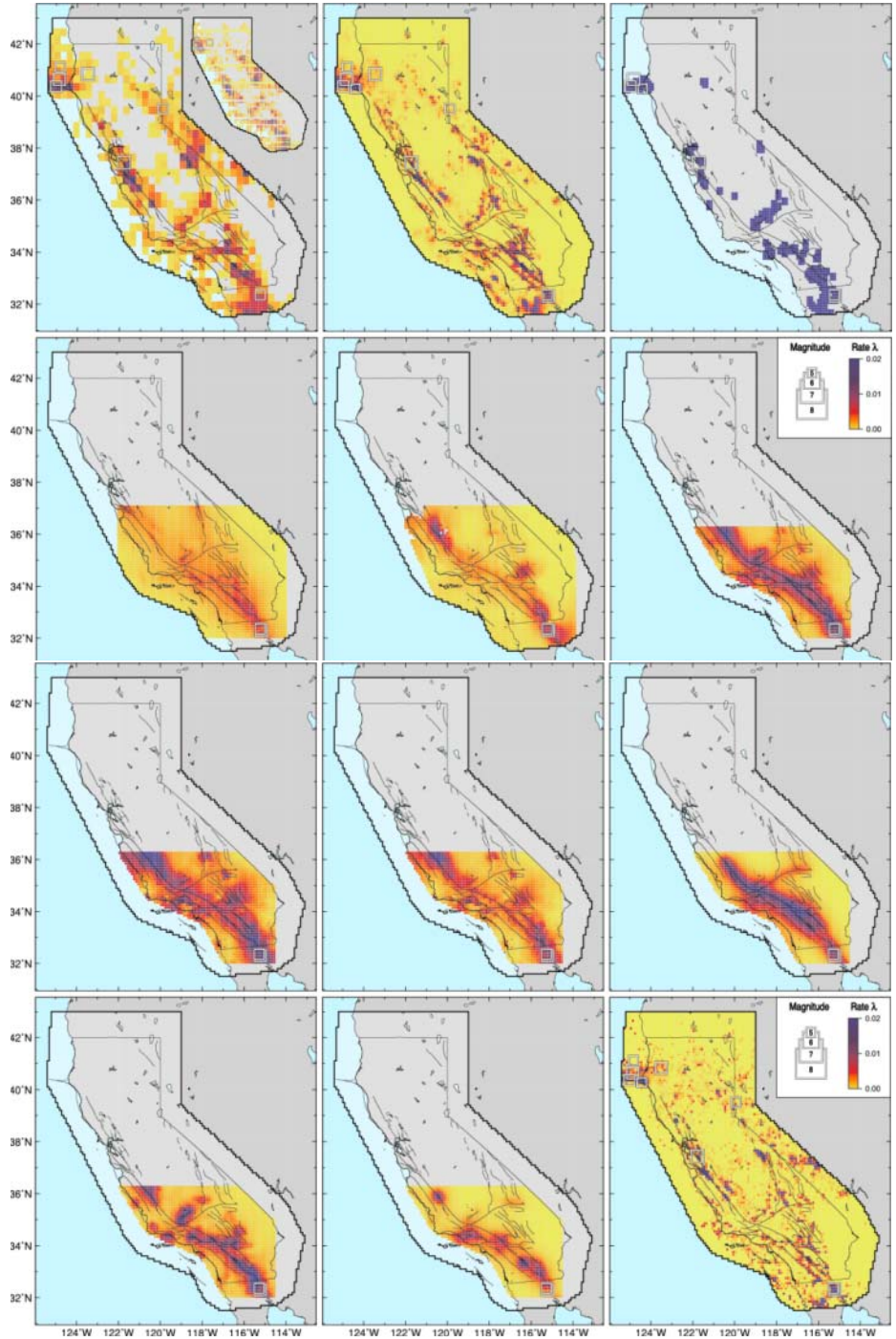
Model	N-test	L-test	S-test	M-test
Ebel	☑	☒	☒	☑
Helmstetter	☑	☑	☑	☑
Holliday	☒ (high)	☑	☒	☑
Kagan	☑	☑	☑	☑
Shen	☑	☑	☑	☑
Ward Combo	☒ (high)	☑	☑	☑
Ward Geodetic 8.1	☒ (high)	☑	☑	☑
Ward Geodetic 8.5	☑	☑	☑	☑
Ward Geologic	☑	☑	☑	☑
Ward Seismic	☑	☑	☑	☑
Ward Simulation	☑	☑	☑	☑
Wiemer	☑	☑	☒	☑

95% confidence

Comparison results

	jee	hkj	jrh	yyk	she	com	d81	d85	geo	sei	sim	alm
jee		↑	↑	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧
hkj	←		←	←	←	←	←	←	←	←	←	⇦
jrh	←	↑		⇧	⇧	↑	↑	↑	↑	⇧	⇦	⇧
yyk	⇦	↑	⇦		⇧	⇦	←	⇧	⇦	⇧	⇦	⇧
she	⇦	↑	⇦	⇦		←	←	←	⇦	⇦	⇦	⇧
com	⇦	↑	←	⇧	↑		←	⇧	⇧	↑	⇦	↑
d81	⇦	↑	←	↑	↑	↑		↑	⇧	↑	⇦	↑
d85	⇦	↑	←	⇦	↑	⇦	←		⇦	⇧	⇦	↑
geo	⇦	↑	←	⇧	⇧	⇦	⇦	⇧		⇧	⇦	↑
sei	⇦	↑	⇦	⇦	⇧	←	←	⇦	⇦		⇦	↑
sim	⇦	↑	⇧	⇧	⇧	⇧	⇧	⇧	⇧	⇧		↑
alm	⇦	⇧	⇦	⇦	⇦	←	←	←	←	←	←	

Arrow points to the “winner,” colored arrows indicate statistical significance (95% confidence)



Conclusions & Outlook

- Most forecasts are consistent with observations, but some forecasts are better than others. Helmstetter *et al*. smoothed seismicity seems to be the best.

- We are conducting a comprehensive analysis of these results, with an emphasis on stability and uncertainties.