USGS Online Short-term Hazard Maps
Experiences in the First Year of Implementation

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Aftershock probabilities

- Probability determined from Omori’s Law and Gutenberg-Richter relation
  – Reasenberg and Jones, 1989
- Rupture forecast, not shaking
- First issued as public statements in 1989
Problems with present system

- Predicting events without spatial information
- Time decay not communicated
  - Message on Internet often days out of date

Short Term Earthquake Probabilities (STEP)

- 24 hour forecast
- Probability of exceeding MMI VI
- Automatic calculations
- Online
- Real-time
- Updated every half-hour
California Seismic Hazard Map

- Default (when no seismic activity)
- Helps communicate real risk
  - One email said “Stop scaring my mother”

The Aftershock Models

Generic California Model

Generic parameters calculated using California aftershock sequences (1932-1987)

Only requires mainshock magnitude as input

Present policy

The Aftershock Models

Sequence Specific Model

needs minimum of 100 aftershocks before estimating parameters

One set of model parameters (Gutenberg-Richter and modified Omori laws) calculated for the entire aftershock sequence

The Aftershock Models

Spatially Varying Model

Gutenberg-Richter and modified Omori law parameters are mapped at 5km spacing
Test ONE: When forecasts are made retrospectively, are they consistent with the observed earthquakes?

When: 1992-1996
Where: southern California
How: Likelihood test. How likely were the observed events and non-events based on our forecast?
What: Earthquake size (M4, M4.1, M4.2, … M8.0); location (5km squares); When (24 time periods).
Our forecasts are consistent with actual earthquakes

Comparison testing

Test TWO: When our model is compared to more simple models, does our more complex model give a better forecast?

When: 1992-1996
Where: southern California
How: Likelihood ratio test. How likely were the observed events and non-events in our forecast as compared to more simple models?
What: Earthquake size (M4, M4.1, M4.2, ... M8.0); location (5km squares); When (24 time periods).
The less complex forecasts:
1. background forecast (no time dependent info)
2. #1 + generic California forecast
3. #2 + sequence specific forecast

*The RESULT??*

In all cases the forecast from our most complex model fits the data better than those of the less complex models.

Public reaction

- You can’t please everyone

“The USGS said there will be a M6.7 by 2018 - we only have 13 years to go.”
Click on the map to zoom in.

This is a time-dependent map giving the probability of strong shaking at any location in California within the next 24 hours. For this purpose, "strong shaking" is defined as Modified Mercalli Intensity (MMI) V, or the level of shaking that causes damage of structural damage.

How Do We Make This Map?
The 24-hour probability of strong shaking is updated every hour and is based on geological and earthquake information (see the USGS National Seismic Hazard Maps website).

Usually, the information is shown for 60 years, we convert it to show 24 hours. The system then considers all the earthquakes, large and small, that are recorded by the California Integrated Seismograph Network (CISN). For each event, the probability that it will be followed by an earthquake large enough to cause strong shaking is calculated from the known behavior of aftershocks. The shaking that would be produced by such an earthquake is then predicted from the known relationship between earthquake size and shaking patterns. The likelihood of that shaking is then added to the background probability on the map.
Three M~5 events since May

STEP for the M5 events
**Most common emails**

- Add my town name
- Extend it to another region of the country
- Make it easier to find
- Requests for supporting curriculum
- What is intensity?
- Everyone knows we have aftershocks so what’s the big deal?
  - We changed the name to “aftershock probability”
- Stop scaring my mother

**Visits to STEP web pages**

![Graph showing visits to STEP web pages with specific dates and magnitudes noted: 5/19 Release of STEP, 6/16 M4.9 Yucaipa, 6/12 M5.2 Anza, 9/1 M5.1 Brawley.](image)

/STEP/
/recenteqs/