

Operational Earthquake Forecasting

Authoritative information about the time dependence of seismic hazards to help communities prepare for potentially destructive earthquakes.

- **Statistical models of earthquake interactions capture many of the short-term temporal and spatial features of natural seismicity**
 - **Excitation of aftershocks and other seismic sequences**
- **While the short-term probability gains can be high (> 100 relative to long-term forecasts), the large-event probabilities typically remain low (< 1% per day)**
 - **Preparedness actions appropriate in such high-gain, low-probability situations have not been systematically investigated and benefits have not been convincingly demonstrated**

Operational Forecasting in California

1991 Notification Protocols

Level	$P (M \geq 7.5)$ in next 3 days	Notification action	Expected frequency	Instances 1992 - 2011
D	0.1 – 1%	Local USGS & CalEMA offices	6 months	Many
C	1 – 5%	Also USGS OEVE & CalEMA Director	5 years	~10
B	5 – 25%	Also USGS Director & State Geologist; start intensive monitoring	27 years	2
A	> 25%	“Go to war”	Very rare**	0

Southern San Andreas Working Group, *Short-Term Earthquake Hazard Assessment for the San Andreas Fault in Southern California*, USGS OFR 91-32, 1991.

** SSAWG stated that it was “not possible to forecast at this probability level with existing knowledge.”

Forecast Validation

ICEF Criteria for “Operational Fitness”

- **Quality of the forecast**
 - Reliability and skill
 - Retrospective and prospective testing
- **Consistency among forecasts**
 - Across temporal and spatial scales
 - Need for integrated model development
- **Value of the forecast to users**
 - Relative to already available information
 - Actions based on economic cost/benefit analysis, psychological value
 - Transparency, regularized communication, education

CSEP Support/Drivers

- **SCEC base program**
 - Support of SCEC4 science plan
- **NSF RAPID grant**
 - Collaboration with Japan (Tohoku) and NZ (Canterbury)
- **USGS OEF grant**
 - Support of USGS OEF program
- **DHS S&T grant**
 - External forecast testing
- **USGS EEW grant**
 - Support of EEW demonstration project

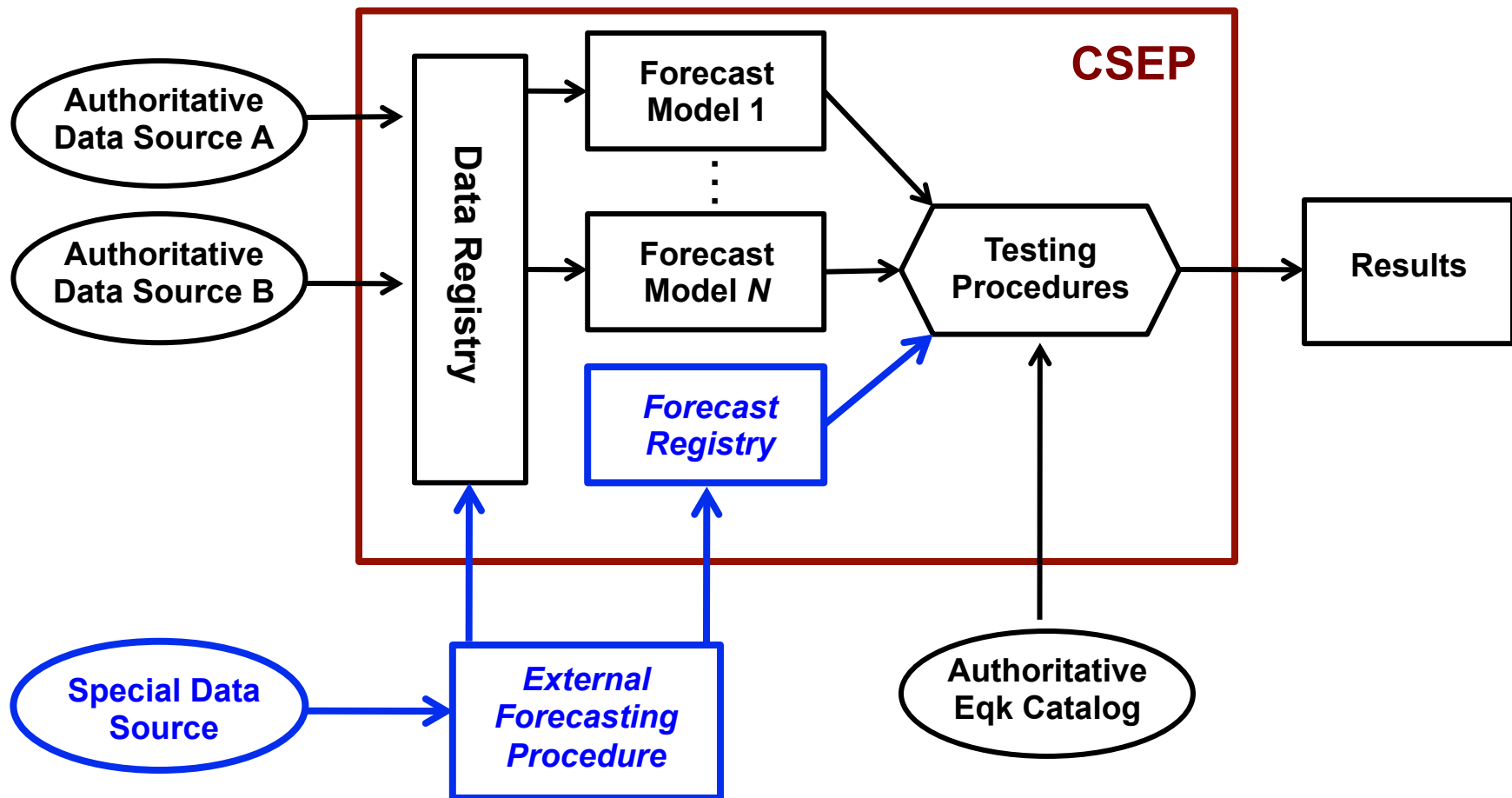
Collaboratory for the Study of Earthquake Predictability: Research and Development to Support USGS Operational Earthquake Forecasting

USGS project funded under an 18-month, \$200K grant. Work statement comprises six tasks:

1. ***SCEC-USGS CSEP Working Group.*** Establish a SCEC-USGS Working Group to guide project activities. This working group will establish a timeline for activities and tasks for both SCEC and EHP to serve as a CSEP work plan
2. ***Reduction of Testing Latency.*** Reduce the updating interval of the short-term forecasting models (e.g., STEP and ETAS) from 1 day to 1 hour or less, in order to fully explore the information gain that can be attained in aftershock sequences
3. ***Reference Models.*** Establish seismicity-based reference models as norms against which the skill of candidate models can be evaluated, including time-independent models (e.g. NSHMP), as well as short-term models (e.g. STEP)
4. ***Reduction of Catalog Latency.*** Given that OEF will have to be based on immature, real-time catalogs that are incomplete and have larger errors in source parameters, develop testing procedures that account for the deficiencies of the real-time catalogs.
5. ***UCERF Testing.*** Work with WGCEP to develop testable versions/components of the Uniform California Earthquake Rupture Forecast (UCERF)
6. ***Retrospective Testing.*** Expand CSEP activities to include retrospective testing of earthquake forecasting models.

CSEP Structure

Accommodation of External Forecasting



End