CSEP Progress and Plans

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Original CSEP Objectives

**O1.** Establish rigorous procedures for registering and evaluating prediction experiments

**O2.** Construct community standards and protocols for comparative testing of predictions

**O3.** Develop an infrastructure that allows groups of researchers to participate in prediction experiments

**O4.** Provide access to authorized data sets and monitoring products for calibrating and testing prediction algorithms

**O5.** Accommodate experiments involving fault systems in different geographic and tectonic environments
Project Timeline

Proposed
- Register prototype prediction experiments into CSEP, drawn from the RELM Project

Achieved
- Complete main phase of collaborative development; open collaboratory to other researchers
- CSEP fully operational, hosting full range prediction experiments from U.S. and other countries

2006
- NEPEC presentations
- Liukis Schorlemmer
- Rüshlikon meeting

2007
- Software updates
- Collaboratory operational
- California New Zealand
- NEPEC AC reviews

2008
- Alarm-based testing
- Japan W. Pacific
- Global
- NEPEC review

CSEP Progress

- Achieved 3-year project objectives
  - Reviewed by W. M. Keck Foundation in Dec ’08
- Continued global expansion
  - Italy
  - Japan
  - China
- In 4th year of development, using residual funding
  - Personnel: D. Schorlemmer, M. Liukis
  - Highly leverage within SCEC and internationally
- Preparing USGS proposal
  - NEPEC review completed in May, 2009
  - Developments now oriented toward facilitating NEPEC/CEPEC evaluations and operational earthquake forecasting
The Collaboratory for the Study of Earthquake Predictability (CSEP) is a virtual, distributed laboratory that supports a wide range of scientific prediction experiments in multiple regional or global natural laboratories. The CSEP system science approach seeks to provide answers to the questions: (1) How should scientific prediction experiments be conducted and evaluated? and (2) What is the intrinsic predictability of the earthquake rupture process?

A major focus of CSEP is to develop international collaborations between the regional testing centers and to accommodate a wide-ranging set of prediction experiments involving geographically distributed fault systems in different historic environments.

CSEP Current Status

- SCEC Testing Center
- EU Testing Center
- China Testing Center
- Western Pacific Testing Center
- New Zealand Testing Center
- North-South Seismic Belt
CSEP Development Objectives

• Expand testing methods
  – Alarm-based testing ✔
  – Scoring methods based on contingency tables

• Test forecasts at larger magnitudes
  – Expanded set of natural laboratories ✔
  – Global testing program ✔
  – Model classes for legacy methods; e.g., M8/MSc
  – Testing of fault-based models

• Establish reference models to quantify skill
  – Long-term time-independent models
  – Short-term ETES models

• Testing of U.S. operational models
  – STEP(✔), NSHMP, UCERF3

ICEF Findings & Recommendations

• Verification of Earthquake Forecasting Methods
  – Forecasting models considered for operational purposes should demonstrate reliability and skill with respect to established reference forecasts, such as long-term, time-independent models.

  – Recommendation F1: Forecasting methods intended for operational use should be scientifically tested against the available data for reliability and skill, both retrospectively and prospectively. All operational models should be under continuous prospective testing.

  – Recommendation F2: The international infrastructure being developed to test earthquake forecasting methods prospectively should be used as a tool for verifying the forecasting models for Italy.
Operational Earthquake Forecasting

• Criteria for the “operational fitness” of earthquake forecasts:
  – Consistency: correspondence of forecasts in one range of spatiotemporal scales with those in another
  – Quality: correspondence of forecasts with observations
  – Value: incremental benefit of forecasts to users

• CSEP’s primary role is to evaluate forecast quality
  – There are many aspects of forecast quality
    • Absolute verification: accuracy, reliability, resolution, sharpness, discrimination
    • Relative verification: skill (of various types)

• CSEP reference models will also promote consistency
  – Unification across temporal and spatial scales (e.g. UCERF3)

CSEP Development Objectives

• Support for UCERF3 development
  – Build testability into UCERF3 (retrospective and prospective)
  – Establish UCERF3 as California reference model

• Test scientific hypothesis that underlie forecasting methods
  – Maximum magnitude based on fault geometry
  – Characteristic earthquakes; rupture arrest by identified segment boundaries
  – Modulation of earthquake rates by Coulomb stress
  – Ability of rupture to jump fault gaps
  – Stress renewal
CSEP Development Objectives

• Expand prospective testing to models based on non-seismic data
  – Continue to accept time-independent models ✔
  – Black-box testing of time-dependent models, including predictions based on diagnostic precursors
  – Develop authoritative data streams for time-dependent models (e.g. geodesy, tidal loading)

• Expand retrospective testing over the entire history of instrumental catalogs
  – Characterize catalog non-stationarity

• Test in real-time
  – Reduce testing latency by modeling catalog completeness and accuracy as a function of time

CSEP Development Objectives

• Develop tools to help NEPEC and CEPEC deal with seismic crises and emergent situations
  – “Evaluate now” function for immediate evaluation of forecast probabilities during crisis
  – Rapid-response Content Management System for posting results and sharing information

• Expand to include the testing of ground-motion predictions
  – Retrospective and prospective testing
  – NGA and CyberShake predictions

• Support other prospective testing activities
  – Earthquake early warning
  – Geodetic transient detection
End