Earthquake Prediction:
A Third Round of Precursor Evaluation and Discussion

M .Wyss[1] and D. Schorlemmer[2]
[1] WAPMEER, Geneva, Switzerland. [2] University of Southern California, Los Angeles, USA.

USC UNIVERSITY OF SOUTHERN CALIFORNIA

SCEC an NSF+USGS center

Abstract

A breakthrough toward a capability to predict at least some earthquakes would be a boon for mankind. This fact generates in some researchers overly strong hopes to succeed, so they neglect to test their hypotheses, using the full rigor of the scientific method. A rift separates enthusiastic proponents from stern critics of proposed earthquake prediction methods. Little communication flows across this rift. This is unfortunate because the degree of learning correlates with the amount of communication between researchers. Therefore, we will attempt to stimulate discussion among the members of the scientific community interested in earthquake prediction problems. Our aim is to work toward a consensus how prediction research should be conducted. During the 1990s, we published two volumes on evaluating proposals of claims of predictions and methods. The proposed work was placed in three categories: Probably useful, undecided and not adequate. In the new round of evaluations, we will use a rating scheme to indicate the probability that a proposed precursor or method may be useful. Scores will be given on over-all rating and such properties as relevance to real prediction, quality of data, statistical approach, and physical model. We plan to maintain a website, where individuals may voice their opinion on earthquake prediction efforts in general, specific methods, or the evaluation process. We will also post a guide on how to conduct earthquake prediction research, containing elementary general rules to follow, as well as recommendations concerning specific topics. After a period during which changes are introduced, based on critical comments from individuals, the guide may eventually reflect a consensus of the research community. We hope that many will participate in this consensus seeking activity because we know that we do not have all the answers to the many questions that arise.

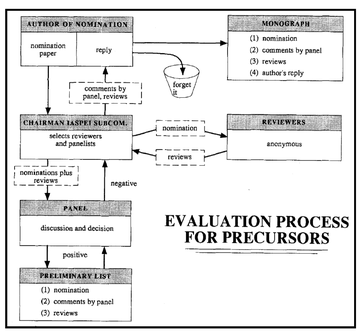


Figure 1: Review process used by the IASPEI Sub-commission on Earthquake Prediction to evaluate nominations for the IASPEI Preliminary List of Significant Precursors. From [*Wyss*, 1997].

History

IASPEI conducted two rounds of eathquake precursor evaluation:

"*Currently this List contains five cases of precursors: (1) foreshocks, (2) preshocks, (3) seismic quiescence before major aftershocks, (4) radon decrease in ground water, and (5) ground water level increase. A list of four cases that could not be accepted nor rejected by the panels reviewing them contains three on crustal deformations and one on seismic quiescence. In the second round 10 nominations were evaluated, nine new ones and one which had been considered previously. Two were accepted for the List, two were placed in the category of undecided cases.*"

Second Round Nominations for the IASPEI List

No.	Authors/Title
1	E. A. Roeloffs and E. G. Quilty Water level changes preceding the 1985 Kettleman Hills earthquake
2	I. R. Bowman A seismicity precursor to a sequence of Ms6.3-6.7 midplate earthquakes in Australia
3	M. Wyss Precursory seismic quiescence
4	H. Sato The Tonankai 1944 precursory tilt revisited
5	Y. Fujii and K. Nakane Reevaluation of anomalous vertical crustal movement associated with the 1964 Niigata, Japan, earthquake
6	A. Zavyalov and R. E. Habermann Application of the concentration parameter of seismoactive faults to Southern California
7	Anonymous Withdrawn
8	T. Yoshino Electromagnetic emissions possibly related to earthquakes in Japan
9	Q. Zu-ji, X. Xiu-deng, and D. Chang-gong Thermal infrared anomaly precursor of impending earthquakes
10	Z. Yulin and F. Qian The relationship between georesistivity precursors and crustal deformation

Evaluation Efforts in the Past

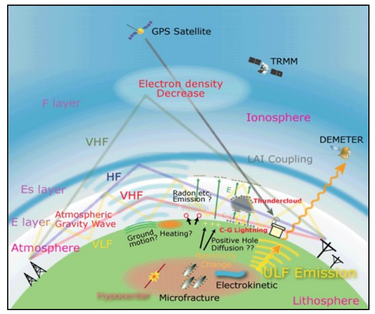
1) Voluntary submission of prediction (method) by author.

2) Review process NSF-style
   (a) anonymous mail reviews,
   (b) panel opinion
   (c) author's rebuttal
   (d) publication/withdrawal (of the entire exchange)

3) Output: 3 categories, yes, perhaps, no

Motivation for a New Round

- Popular request.
- CSEP (Collaboratory for the Study of Earthquake Predictability) exists, has made progress toward building consensus in the scientific community.
- New wave of casual claims.
- An advocate of a prediction method may be least qualified to evaluate his/her hypothesis.



CSEP

Motivation

Earthquake prediction research is hampered by inadequate infrastructure for conducting scientific prediction experiments

Primary goal

Rigorous *comparative* testing of scientific prediction experiments spanning a variety of fault systems to study the physical basis for earthquake predictability **(Evaluate work done outside this framework by standards used here)**

CSEP is building on RELM

International partnerships are establishing natural laboratories for scientific earthquake prediction experiments

Four Essential CSEP Components

Testing regions: active fault systems with adequate, authorized data sources for conducting prediction experiments (Exist)

Community standards: rules for the registration and evaluation of scientific prediction experiments

Testing centers: facilities with validated procedures for conducting and evaluating prediction experiments (Exists)

Communication protocols: procedures for conveying scientific results and their significance

Nominations for the IASPEI List (No Decision Reached)

No.	Authors	Precursor	Earthquake
1	Y. Fujii and K. Nakane	Strain	1 Sept 1923, M 7.9, Kanto
2	Hiroshi Sato	Tilt	7 Dec 1944, M 8.1, Tonanki
3a	H. Ishii, S. Miura, and A. Takagi	Crustal movement	26 May 1983, M 7.7, Japan Sea
3b	A. T. Linde, K. Suyehiro, S. Miura, I. S. Sacks, and A. Takagi	Strain	26 May 1983, M 7.7, Japan Sea
3c	S. Miura, S. Nakao, T. Sato, K. Tachibana, M. Mishina, H. Ishii, and A. Takagi	Strain and tilt	26 May 1983, M 7.7, Japan Sea
4	M. Wyss	Seismic quiescence	Many cases

Proposal

- New evaluation procedure
- Website.
- Rules covering general cases
- Discussion forum
- Submissions of proposed method. Comments on these, and eventual evaluation.
- Evaluation format:
  - Grading on a scale 1 to 5,
  - Several categories (hypothesis, data, testing, physical model, etc.)
- Publication of hard copy volume

Advantages

- Forming a community consensus on work quality
- Eliminating the element of personal attack from criticisms of a particular piece of work
- Discredit inadequate work
- Elevating rigor of prediction research
- Fostering group approaches to specific problems

Difficulties

- Formulating rules succinctly.
- Covering most cases and styles of work.
- Image of evaluators as police and know-it-alls.
- Lack of participation by "outsiders", accusation of being an insider gang.

Conclusions

- I propose we start a discussion by email how to implement a new evaluation procedure of prediction methods and predictions,
- implement it,
- and invite the wider community to contribute to modifying the web-site, until we can consider it a consensus site.