

Can Jim Berkland Predict Earthquakes?

ROGER HUNTER



Gerald Fried

Jim Berkland is a retired Santa Clara, California, county geologist who has issued earthquake predictions since 1974. He has a monthly newsletter and a Web site; Berkland was recently featured in a book by Cal Orey titled *The Man Who Predicts Earthquakes* (Orey 2006).

Berkland bases his prediction windows (eight-day time periods) on syzygy, the conjunction or opposition of the sun and moon, which happens once a month (each) for a total of two possible windows. It's possible to have three on occasion, since the lunar cycle is shorter than a month. When perigee occurs close to new moon or full moon it determines the primary window, the one used as a prediction for that month. Tide height at various stations (principally the Golden Gate Bridge) also may enter into the formula. Another factor can be the number of lost pets in whatever newspaper Berkland happens to consult. His final window is a hodge-podge of factors, which makes replication difficult. None of these factors are original with him, but the way he combines them may be.

Analyzing Berkland's Data

In order to study the validity of Berkland's claims, I used searches of the earthquake catalogs of the National Earthquake Information Center (NEIC) and the Advanced National Seismic System (ANSS), both available on the Internet. The NEIC file was taken from the Centennial Catalog (Engdahl 2002) and is the best source for larger global earthquakes from 1900 to 1999. The ANSS file contains all known events for the western United States since 1900 and was chosen for its completeness (including lower magnitude levels) compared to the NEIC catalogs.

I also have compiled a list of all Berkland's newsletter predictions taken in part from copies of the newsletters and from information posted on his Web site. I believe the list to be accurate and have sent it to him for verification, but despite his repeated promises to do so he has never certified it in full. The list starts with 1974 and continues to the present. My analysis ends with 2004.

Procedure

Evaluating the success of a prediction should be a straightforward process. You simply compare the parameters of the prediction (date, location, size) against all the earthquakes and count hits and misses. Unfortunately Berkland has made this nearly impossible by shifting the location from time to time and insisting on getting partial credit for near-misses. The best I can do is to analyze the results he would have obtained had he been consistent. His most recent parameters were used for

Roger Hunter is a former employee of the U.S. Geological Survey, National Earthquake Information Center, in Golden, Colorado, where he created and ran the Earthquake Prediction Monitoring and Evaluation Program. He retired in 1995 and continues his interest in earthquake prediction evaluation.

all windows, since they should be the most accurate.

I wrote a program that compares all the earthquakes to all his predictions and counts all the hits and misses for each area and each target ring individually. These totals are compared to chance by two different methods described below.

The statistical significance of the results can be determined by comparing his results to those that would result by chance. This is best done by the z-binomial test that may be used when all predictions have the same probability. This is true for Berkland's four areas, which are the same every month. In order to meet the z-binomial restrictions I have treated each parameter group individually. I used the calculator published as part of VassarStats by Purdue University (available at <http://faculty.vassar.edu/lowry/VassarStats.html>).

Prediction Parameters

Berkland predicts for four areas, three in the western United States and one global. The bullseye prediction is a 140-mile-radius circle around two particular locations in California, a blanket area covering all of Washington and Oregon, and a global prediction for anywhere on Earth. Each area has an eight-day window and a particular magnitude range.

In addition to the bullseye, he insists on three near-miss rings consisting of an added day at the beginning and end of the date range, a 10 percent increase in the radius and an additional 0.1 unit of magnitude on each end of the magnitude range.

	Ring	Location	Radius	Mag. Range
Mt. Diablo	Bullseye	37.9 N, 121.9 W	140 miles	3.5 to 6.5
	Ring 1		154 miles	3.4 to 6.6
	Ring 2		168 miles	3.3 to 6.7
Los Angeles	Ring 3		182 miles	3.2 to 6.8
	Bullseye	34.0 N, 118.0 W	140 miles	3.5 to 6.5
	Ring 1		154 miles	3.4 to 6.6
WA-OR	Ring 2		168 miles	3.3 to 6.7
	Ring 3		182 miles	3.2 to 6.8
	Bullseye	Anywhere in the two states		3.0 to 5.5
Global	Ring 1			2.9 to 5.6
	Ring 2			2.8 to 5.7
	Ring 3			2.7 to 5.8
Global	Bullseye	Anywhere in the world		7.0 to 9.9
	Ring 1			6.9 to 9.9
	Ring 2			6.8 to 9.9
	Ring 3			6.7 to 9.9

Table 1. Jim Berkland's earthquake prediction chart

Finally, he insists that all times be expressed in Pacific Standard Time, which is confusing to anyone looking at a list of earthquakes in Greenwich Mean Time.

Berkland's areas are seen in table 1, taken from his Web site:

Results

Each ring of the predictions for each area was analyzed separately so that the restrictions of the z-binomial test were met. The results are listed in table 2. Any value in the significance row smaller than 0.010 can be considered significant. If the probability is smaller than the success rate, the results are better than chance. If larger, the results are worse than chance.

The results in table 2 are for simple probability, which is determined by the fraction of time covered by the windows. It tells us what percentage of the quakes should be captured by that number of days. It is strongly affected by clustering in the dataset caused by swarms (a group of related quakes unassociated with a large quake) or aftershocks. If a cluster hits a predicted window, the apparent success is boosted; if the cluster misses the windows, the success is lowered. This is exactly the case with the extremely high significance of the Los Angeles area and the extremely low significance of the Washington-Oregon areas.

In the Los Angeles area there was a swarm of earthquakes in mid-1992. 353 of these small quakes were in the June window. If they are removed from the totals the apparent significance reverses and the result becomes significantly below chance.

In the Washington-Oregon area there was a swarm of small quakes in March, April, and May 1980 that could have reversed the significance to positive had they been in windows. A similar swarm happened in 2004 and was also missed. An earlier version of this table is included in Orey's *The Man Who Predicts Earthquakes*.

A better estimate of actual results is obtained by using the Jones Observed Probability method, which was designed by Alan Jones (Jones 1964) to greatly reduce the effect of clustering without needing to remove the clusters from the datasets. The Jones method examines the historical catalog and determines how many windows of a given size contained one or more suitable earthquakes. Table 3 shows these results.

With this analysis, the results are much clearer. In the case of bullseye hits, 25.99 percent of them should be in windows by chance alone, but Berkland's windows had 34.13 percent hits, making him appear much better than chance. The ten-day Ring 1 does the same. But this is just a statistical anomaly because none of the other areas or rings do significantly better than chance (by the z-binomial test of significance, when, again, significance requires a value smaller than 0.010). If his method was valid, all of his results would be better than chance.

	Global 7.0+ Quakes	Los Angeles Area	Mt. Diablo Area	Washington-Oregon Area
Bullseye				
Probability	20.70%	20.70%	20.70%	20.70%
Number of quakes	447	1,824	964	1,529
Number of hits	124	463	235	213
Success rate	27.74%	25.38%	24.38%	13.93%
z-binomial single-tail signif.	0.00015	<0.000001	0.0027	<0.000001
Ring 1				
Probability	25.88%	25.88%	25.88%	25.88%
Number of quakes	559	2,634	1,555	1,530
Number of hits	182	873	422	255
Success rate	32.56%	33.14%	27.14%	16.67%
z-binomial single-tail signif.	0.00019	<0.000001	0.136	<0.000001
Ring 2				
Probability	31.05%	31.05%	31.05%	31.05%
Number of quakes	689	3,645	2,776	1,531
Number of hits	247	1,294	877	304
Success rate	35.85%	35.50%	31.59%	19.86%
z-binomial single-tail signif.	0.0037	<0.000001	0.274	<0.000001
Ring 3				
Probability	36.23%	36.23%	36.23%	36.23%
Number of quakes	864	4,847	4,431	1,532
Number of hits	358	1,946	1,524	351
Success rate	41.44%	40.15%	34.39%	22.91%
z-binomial single-tail signif.	0.00082	<0.000001	0.0057	<0.000001

Table 2. Summary of results—simple probability

While the current work is sufficient to establish that Berkland is not actually predicting quakes, I have attempted to find windows similar to his that work better. I have examined windows of different length and different placement with regard to syzygy. Some are better than his, some are worse, but none show significant results compared to chance.

It just doesn't work.

	Global 7.0+ Quakes	Los Angeles Area	Mt. Diablo Area	Washington-Oregon Area
Bullseye				
Probability	25.99%	42.16%	35.73%	31.14%
Number of windows	293	293	293	293
Number of hits	100	128	114	87
Success rate	34.13%	43.69%	38.91%	29.69%
z-binomial single-tail signif.	0.000935	0.319	0.142	0.319
Ring 1				
Probability	36.80%	62.58%	55.52%	35.92%
Number of windows	293	293	293	293
Number of hits	130	181	166	103
Success rate	44.37%	61.77%	56.66%	35.15%
z-binomial single-tail signif.	0.0043	0.413	0.371	0.417
Ring 2				
Probability	49.58%	77.75%	77.86%	41.31%
Number of windows	293	293	293	293
Number of hits	160	226	231	118
Success rate	54.61%	77.13%	78.84%	40.27%
z-binomial single-tail signif.	0.048	0.428	0.371	0.382
Ring 3				
Probability	63.54%	91.59%	91.47%	46.97%
Number of quakes	293	293	293	293
Number of hits	199	270	268	132
Success rate	67.92%	92.15%	91.47%	45.05%
z-binomial single-tail signif.	0.067	0.405	0.460	0.274

Table 3. Summary of results—Jones probability

Note

All information used in this article can be requested from the author via e-mail at: rogerh@basicisp.net.

References

- Engdahl, E.R., and A. Villasenor. 2002. Global seismicity: 1900–1999. In W.H.K. Lee, H. Kanamori, P.C. Jennings, and C. Kisslinger (editors), 2002, *International Handbook of Earthquake and Engineering Seismology*. Academic Press: part A, chapter 41, pp. 665–690. Also available online at: <http://earthquake.usgs.gov/scitech/centennial>.

so that the public knows not to expect too much from scientists. Jones, Alan. 1964. *Purdue University, Science 1: G60B*. West Lafayette, Indiana.

Finally, we need to encourage and promote more ethical behavior among scientists. Even if we had them, to more human standards. While we cannot expect them to be super-

human, we should expect them to be capable of good moral judgment, and to put the truth above their own interests. There should be better self-regulation in science. There is every reason to think that future high-profile failures, frauds, cheats, or lies could continue to undermine the system and be used by the enemies of science to ensure that its basic assumptions, and the underlying methodology of scientific naturalism, are undone.

We need to prevent this possibility, through realism and prag-

matism, and of course, good basic-research ethics.

ANSS Web site: <http://quake.geo.berkeley.edu/cnss/catalog-search.html>

NEIC Web site: <http://neic.usgs.gov/neis/epic/epic.html>

We need to prevent this possibility, through realism and prag-

Ethics as Part of the Methodology of the Sciences

Scientists should not be held by the public to an unreasonably high standard, and we who are promoters of science must not encourage a godlike view of scientists or their achievements. On the other hand, part of the proper methodology of science in its ideal form includes some ethical principles. Among them are “equipoise” (see my article, *The Ethics of Investigation*,” *SKEPTICAL INQUIRER*, January/February 2006) and fidelity. Fidelity, or truth telling, is perhaps the most fundamental ethical principle that is inextricable from the methodology of science itself. The purpose of science is itself truth. Hypotheses and theories are only valuable for the aims of understanding, prediction, and control if they are substantiated by evidence. Experimental verification, or falsification, are the only means we have of tying hypotheses and theories to the evidence. Scientists cannot therefore manipulate data to support theories they aesthetically like, or that promise personal glory or career advancement. Rather, they must accept dispassionately the evidence that derives from testing. They must remain dispassionate and report the truth.

The object of truth is inherent in the subject of science itself. Although it is an ongoing process, and ultimate truths are only approached and never proven, they come to be verified and accepted over time through mounting evidence. Scientists understand this concept, and must incorporate it into their behaviors not just as a necessary component of the methodology and institutions of science but as an ethical precept as well that guides their individual relation to the data they gather and report.

The future of the public perception of science is at stake, and together with scientists, we must encourage a better general understanding and appreciation of its methods, as well as greater institutional and personal appreciation of research ethics within the sciences and among scientists.

References

- Broad, William, and Nicholas Wade. 1982. *Betrayers of the Truth*. New York: Simon & Schuster, Inc.
- Choe Sang-Hun. 2006. South Korea scientist contrite for stem cell fraud. *The New York Times*. January 12, 2006.