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New Rules for Oregon and Portland

When research is driven by venture capital it is said that making mistakes is not the problem. Those who make mistakes faster are the ones to gain market leverage because they get the right answer sooner.

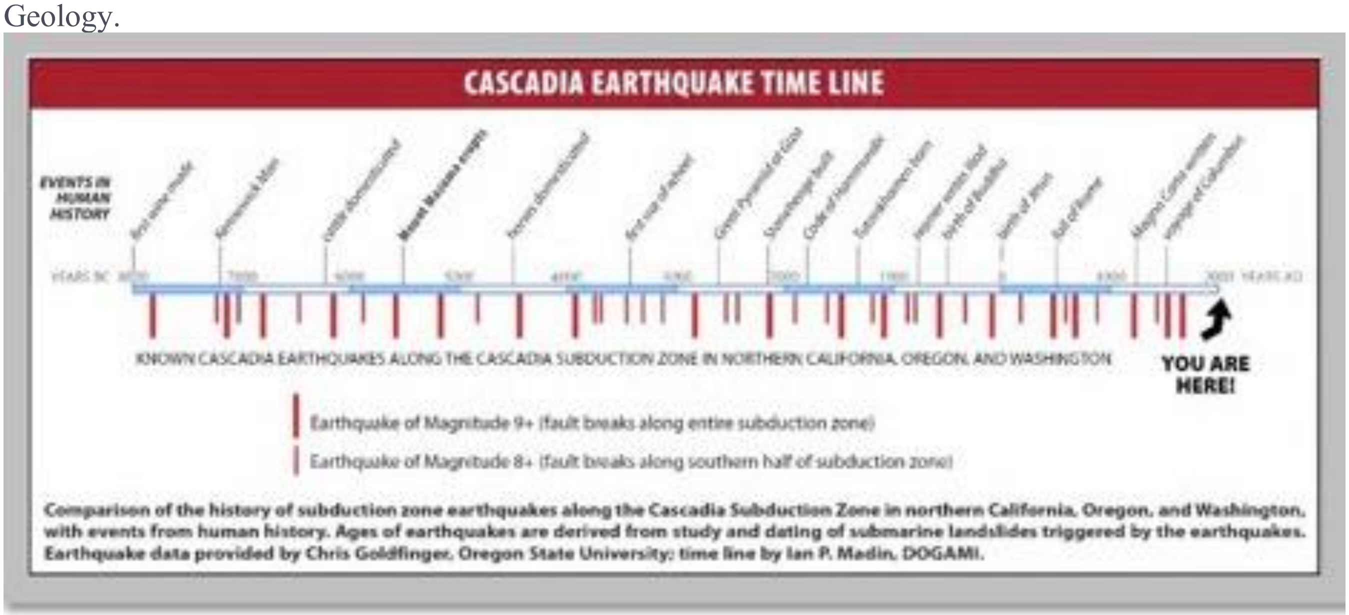
In public life the making of mistakes is a bad idea. But so is getting the right answer too late. With new rules being considered for the Portland riverside infrastructure that handles the petro-fuels that Oregon commerce depends on, the Cascadia Subduction hazard can arrive ahead of the new rules. There is no science to say otherwise. By looking at all the data made available to us by USGS we can get a reasonable idea of when the inevitable M8 or M9 event can be expected. Because of the physical properties of stuck tectonic plates, the longer the wait the worse the outcome.

What We Know

Oregon scientists have been busy answering the essential questions about seismic history. For the patient reader here is the Chris Goldfinger USGS peer-reviewed paper that reports about 40 intervals between events in the last 10,000 years (P97, Table 10). To statisticians, a dataset of 40 numbers is not enough to establish a mathematically supported probability distribution, so there's not enough support for an event prediction. Even so, we can look at tectonic trends.

10,000 year Event Recurrence Intervals

What we know about Cascadia Subduction history has been nicely depicted by Oregon's Department of Geology.



Comparison of the history of subduction zone earthquakes along the Cascadia Subduction Zone in northern California, Oregon, and Washington, with events from human history. Ages of earthquakes are derived from study and dating of submarine landslides triggered by the earthquakes. Earthquake data provided by Chris Goldfinger, Oregon State University; time line by Ian P. Madin, DOGAMI.

This timeline compares the 10,000-year-long history of Cascadia earthquakes to events in human history.

Here are the various quiet times listed for the last 10,000 years, sorted from shortest to longest. Starting from 1700CE, every time we make it through a historic interval with nothing happening, the probability of the pending event goes up. In green is **all we know** about in West Coast subduction event history. The next column shows the corresponding known intervals.

Prior Event Sequence, from 1700CE looking back in time	Age, years before 1700CE	Interval in years
1 (1700)	0	
2	265	265
3	481	216
4	548	67
5	796	248
6	1066	270
7	1243	177
8	1422	179
9	1554	132
10	1820	266
11	2040	220
12	2317	277
13	2536	219
14	2730	194
15	2822	92
16	3028	206
17	3157	129
18	3443	286
19	3599	156
20	3890	291
21	4108	218
22	4438	330
23	4535	97
24	4770	235
25	5062	292
26	5260	198
27	5390	130
28	5735	345
29	5772	37
30	5959	187
31	6466	507
32	6903	437
33	7182	279
34	7625	443
35	7943	318
36	8173	230
37	8459	286
38	8906	447
39	9074	168
40	9101	27
41	9218	117
42	9795	577
		9795

The average interval is 9795/41 = 239 years. This figure characterizes 10,000 years of history. If we want to know about the how a 50-year period of interest compares with the whole set of intervals, we get 50/239 = 0.21. This can be thought of as 21%, and of course this applies to any 50-year window in the last 10,000 years, because that's where the numbers came from. Does it apply today? Yes, but tells us nothing of the trend in increasing probability if, like today, nothing has happened in the 323 years since 1700. How can we validly coax information from this dataset about the increasing likelihood while tectonic stress increases?

One way is to start with identifying all the quiet times in history that have been exceeded to finally get to our 323 years of nothing happening. Here is the same set of intervals ordered from shortest to longest. We can see all the historic intervals exceeded, added to the last event in 1700.

Sorted	Calendar year
	1700
27	1727
37	1737
67	1767
92	1792
97	1797
117	1817
129	1829
130	1830
132	1832
156	1856
168	1868
177	1877
179	1879
187	1887
194	1894
198	1898
206	1906
216	1916
218	1918
219	1919
220	1920
230	1930
235	1935
248	1948
265	1965
266	1966
270	1970
277	1977
279	1979
286	1986
286	1986
291	1991
292	1992
318	2018
330	2030
345	2045
437	2137
443	2143
447	2147
507	2207
577	2277

It is easy enough to identify the percent of the whole known set represented by each year nothing has happened. For example, in 1728 the first interval exceeded was 27 years. This is the first of 41 intervals that can be exceeded. So as a percent of total observed intervals, this is 1/41 = 0.024 or 2%. Expecting a seismic event in the next interval? Not really. But the expectations add up.

	Sorted	Calendar year	Percent
		1700	0%
1	27	1727	2%
2	37	1737	5%
3	67	1767	7%
4	92	1792	10%
5	97	1797	12%
6	117	1817	15%
7	129	1829	17%
8	130	1830	20%
9	132	1832	22%
10	156	1856	24%
11	168	1868	27%
12	177	1877	29%
13	179	1879	32%
14	187	1887	34%
15	194	1894	37%
16	198	1898	39%
17	206	1906	41%
18	216	1916	44%
19	218	1918	46%
20	219	1919	49%
21	220	1920	51%
22	230	1930	54%
23	235	1935	56%
24	248	1948	59%
25	265	1965	61%
26	266	1966	63%
27	270	1970	66%
28	277	1977	68%
29	279	1979	71%
30	286	1986	73%
31	286	1986	76%
32	291	1991	78%
33	292	1992	80%
34	318	2018	83%
35	330	2030	85%
36	345	2045	88%
37	437	2137	90%
38	443	2143	93%
39	447	2147	95%
40	507	2207	98%
41	577	2277	100%

Despite the approximations involved, we can at least see we are well past the 83% of known intervals in 2018, and a few years away from the 2030 mark at 85%. This is accomplished without invoking statistical distributions to try to see the future, thus setting aside the math assumptions that produce widely varying views of the future with each different assumption made.

Green array indicates best current science, limiting our interest to the most recent 6,000 years. Percent column is the percent of intervals currently exceeded in our history. We are looking at exceeding 97% of this set of intervals in 2030. Today this basic analysis says we are at 93% exceedance.

Prior Event Sequence, from 1700CE looking back in time	Age, years before 1700CE	Interval in years		Sorted	Calendar year	Percent
1 (1700)	0				1700	0%
2	265	265		37	1737	3
3	481	216		67	1767	7
4	548	67		92	1792	10
5	796	248		97	1797	14
6	1066	270		129	1829	17
7	1243	177		130	1830	21
8	1422	179		132	1832	24
9	1554	132		156	1856	28
10	1820	266		177	1877	31
11	2040	220		179	1879	34
12	2317	277		187	1887	38
13	2536	219		194	1894	41
14	2730	194		198	1898	45
15	2822	92		206	1906	48
16	3028	206		216	1916	52
17	3157	129		218	2097	55
18	3443	286		219	1919	59
19	3599	156		220	1920	62
20	3890	291		235	1935	66
21	4108	218		248	1948	69
22	4438	330		265	1965	72
23	4535	97		266	1966	76
24	4770	235		270	1970	79
25	5062	292		277	1977	83
26	5260	198		286	1986	86
27	5390	130		291	1991	90
28	5735	345		292	1992	93
29	5772	37		330	2030	97
30	5959	187		345	2045	100

