“The ‘Imminent’ Nankai Trough Mega Quake”: Myth or Reality?
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@FCCJ
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Robert J. Geller

• Biography
  – US citizen; permanent resident of Japan
  – First tenured non-Japanese faculty member at Univ. of Tokyo (1984-2017; retired, but continuing research)

• Research interests
  – seismic wave propagation, Earth structure, earthquake sources
  – predictability/non-predictability of earthquakes

• Refereed publications
  – Google Scholar
Part I

SCIENCE
"Prediction" (予知) vs. "Forecast" (予測)

- **Prediction** = a **deterministic** statement that a future earthquake will or will not occur in a particular geographic region, time window, and magnitude range.

- **Forecast** = gives **a probability** (greater than zero but less than one) that such an event will occur.

Examples:

• **Prediction:** The Tokai earthquake (M8) will occur in the next 3 days
  ➔ useful to society if feasible
  unfortunately **not feasible**

• **Forecast:** The “Nankai Trough Mega Quake” (M9) has an 80% chance of hitting in the next 30 years
  ➔ of questionable value to society even if feasible
  unfortunately **not feasible**
Earthquakes Cannot Be Predicted

Robert J. Geller, David D. Jackson, Yan Y. Kagan, and Francesco Mulargia
Tectonophysics 562-563 (2012) 1-25

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Tectonophysics

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Review Article

Why earthquake hazard maps often fail and what to do about it

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Hazard maps are unreliable!
Summary of Part I

• Short-term quake prediction impossible
  – “Chaos,” no reliable precursors
• Long-term quake forecasting impossible
  – Quakes don’t repeat in cycles
• Can’t “prove” impossibility
  – But no progress in the last 130 years
  – As research proceeds, the goal recedes
Part II

JAPANESE GOVERNMENT QUAKE PREDICTION AND FORECASTING PROGRAMS, 1978-PRESENT
“Scenario Quakes”

Figure: Financial Times (https://ig.ft.com/sites/japan-tsunami/)
The “Tokai Earthquake”

- In mid-1970s (based on arguments about quake periodicity) it was asserted that a large quake is imminent in the Tokai region (around Shizuoka).
- A law was passed in 1978 setting up an operational system for issuing a quake alarm (Note: This is not research.)
- Japan Meteorological Agency (JMA) monitors data.
- If a “precursor” is detected, Prime Minister issues an alarm that the quake will hit within 3 days.
Magnitude 8 quake expected in Suruga Bay
Preparation urgently needed
Large-Scale Earthquake Countermeasures Act (LECA) = the law authorizing prediction of “Tokai earthquake” = was enacted in 1978; it’s still in effect.
大規模地震対策特別措置法（抜粋）

第四条 国は、強化地域に係る大規模な地震の発生を予知し、もって地震災害の発生を防止し、又は軽減するため、計画的に、地象、水象等の常時観測を実施し、地震に関する土地及び水域の測量（以下この条及び第三十三条において「測量」という。）の密度を高める等観測及び測量の実施の強化を図らなければならない。

第九条 内閣総理大臣は、気象庁長官から地震予知情報の報告を受けた場合において、地震防災応急対策を実施する緊急の必要があると認めるときは、閣議にかえて、地震災害に関する警戒宣言を発するとともに、次に掲げる措置を執らなければならない。

一 強化地域内の居住者、滞在者その他の者及び公私の団体（以下「居住者等」という。）に対して、警戒態勢を執るべき旨を公示すること。

二 強化地域に係る指定公共機関及び都道府県知事に対して、法令又は地震防災強化計画の定めるところにより、地震防災応急対策に係る措置を執るべき旨を通知すること。

２ 内閣総理大臣は、警戒宣言を発したときは、直ちに、当該地震予知情報の内容について国民に対し周知させる措置を執らなければならない。この場合において、内閣総理大臣は、気象庁長官をして当該地震予知情報に係る技術的事項について説明を行わせるものとする。

３ 内閣総理大臣は、警戒宣言を発した後気象庁長官から地震予知情報の報告を受けた場合において、当該地震の発生のおそれがなくなったと認めるときは、閣議にかけて、地震災害に関する警戒解除宣言を発するとともに、第一項第一号に規定する者に対し警戒態勢を解すべき旨を公示し、及び同項第二号に規定する者に対し同号に掲げる措置を中止すべき旨を通知するものとする。

大規模地震対策特別措置法（抜粋）

Text of LECA:
Prime Minister authorized to declare a state of emergency if advised by the JMA that the Tokai earthquake is imminent (within 3 days).

This law is still on the books.
“There are many different ways that a large Nankai Trough earthquake could occur, so reliable earthquake prediction is impossible.”

The government gave up on earthquake prediction, but tried to fuzz up the issue by using the term “highly accurate forecasting” (確度高く予測) rather than “prediction” (予知).

http://bit.ly/2CJNqRv
The bottom line

• Government and government scientists lied about prospects for quake prediction for 40 years (1978-2018)

• Domestic media, especially NHK, colluded by not clearly exposing the lies

• Even now the government has de facto given up on prediction, but continues to fuzz things up
Long-term forecasts

• In 2002 the government starting issuing its probabilistic ground motion forecasts
  – e.g., “80% chance of the “Great Nankai Trough Quake” in the next 30 years”

• Not successful in Japan

• Also unsuccessful overseas
Base map (Japanese govt. hazard map) vs. actual seismicity since 1979

Regions rated as especially hazardous have been quiet

Regions with damaging quakes (1995 Kobe, 2011 Tohoku, 2016 Kumamoto, etc.) were not rated as at high hazard level
Wenchuan (China, 2008)

USGS seismic hazard map for China prior to 2008
Wenchuan quake on Longmenshan Fault (black rectangle).
Hazard map showed low hazard on Longmenshan fault and higher hazard on other faults.

- The 2003 Ms 6.8 Algeria and 2004 Ms 6.4 Morocco events (stars) occurred in supposedly low hazard regions.
Haiti (2010)

Left: 2001 hazard map (Modified Mercalli Intensity; 10% chance of being exceeded once in 50 years). Right: USGS map of shaking in the 2010 earthquake.
Hazard Maps aren’t Working!

• Bad luck? ➔ probably not
• Bad Physics? ➔ almost certainly

• Hazard maps should not be used in public policy
• Hazard maps should not be reported as fact by the media
• Hazard maps should not be used to set quake insurance rates
What went wrong, scientifically?

• Past hazard map makers used the appealing (but unverified) quake cycle hypothesis
• They issued public forecasts without first conducting an objective hypothesis test
• Objective tests have now shown that hypothesis doesn’t agree with the data, so it should be abandoned
• Thus the “‘imminent’ Nakai Trough Mega Quake” is a myth
Conclusions

• Japan is an earthquake-prone country.
  – Quakes can happen anywhere, at any time, without warning
  – Present science can’t say that one part of Japan (e.g., Nankai) is at either more or less risk than other geologically similar areas
  – Treating the purely conjectural “Nankai Trough Mega quake” as “real” should cease

• The media should inform the public that government quake forecasts are wrong!
Thank you for your attention