

Earthquake hazards map study finds deadly flaws, researcher suggests improvements

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(Phys.org)—Three of the largest and deadliest earthquakes in recent history occurred where earthquake hazard maps didn't predict massive quakes. A University of Missouri scientist and his colleagues recently studied the reasons for the maps' failure to forecast these quakes. They also explored ways to improve the maps. Developing better hazard maps and alerting people to their limitations could potentially save lives and money in areas such as the New Madrid, Missouri fault zone.

"Forecasting earthquakes involves many uncertainties, so we should inform the public of these uncertainties," said Mian Liu, of MU's department of [geological sciences](#). "The public is accustomed to the uncertainties of [weather](#) forecasting, but foreseeing where and when earthquakes may strike is far more difficult. Too much reliance on earthquake hazard maps can have serious consequences. Two suggestions may improve this situation. First, we recommend a better communication of the uncertainties, which would allow citizens to make more informed decisions about how to best use their resources. Second, seismic hazard maps must be empirically tested to find out how reliable they are and thus improve them."

Liu and his colleagues suggest testing maps against what is called a null hypothesis, the possibility that the [likelihood](#) of an earthquake in a given area – like Japan – is uniform. Testing would show which mapping approaches were better at forecasting earthquakes and subsequently improve the maps.

Liu and his colleagues at Northwestern University and the University of Tokyo detailed how hazard maps had failed in three major quakes that struck within a decade of each other. The researchers interpreted the shortcomings of hazard maps as the result of bad assumptions, bad data, bad physics and bad luck.

Wenchuan, China – In 2008, a [quake](#) struck China's Sichuan Province and cost more than 69,000 lives. Locals blamed the government and contractors for not making buildings in the area earthquake-proof, according to Liu, who says that hazard maps bear some of the blame as well since the maps, based on bad assumptions, had designated the zone as an area of relatively low earthquake hazard.

Léogâne, Haiti – The 2010 earthquake that devastated Port-au-Prince and killed an estimated 316,000 people occurred along a fault that had not caused a major quake in hundreds of years. Using only the short history of earthquakes since seismometers were invented approximately one hundred years ago yielded hazard maps that were didn't indicate the danger there.

Tōhoku, Japan – Scientists previously thought the faults off the northeast coast of Japan weren't capable of causing massive quakes and thus giant tsunamis like the one that destroyed the Fukushima nuclear reactor. This bad understanding of particular faults' capabilities led to a lack of adequate preparation. The area had been prepared for smaller quakes and the resulting tsunamis, but the Tōhoku quake overwhelmed the defenses.

"If we limit our attention to the earthquake records in the past, we will be unprepared for the future," Liu said. "Hazard maps tend to underestimate the likelihood of quakes in areas where they haven't occurred previously. In most places, including the central and eastern U.S., seismologists don't have a long enough record of earthquake

history to make predictions based on historical patterns. Although bad luck can mean that quakes occur in places with a genuinely low probability, what we see are too many 'black swans,' or too many exceptions to the presumed patterns."

"We're playing a complicated game against nature," said the study's first author, Seth Stein of Northwestern University. "It's a very high stakes game. We don't really understand all the rules very well. As a result, our ability to assess earthquake hazards often isn't very good, and the policies that we make to mitigate earthquake hazards sometimes aren't well thought out. For example, the billions of dollars the Japanese spent on tsunami defenses were largely wasted.

"We need to very carefully try to formulate the best strategies we can, given the limits of our knowledge," Stein said. "Understanding the uncertainties in [earthquake](#) hazard maps, testing them, and improving them is important if we want to do better than we've done so far."

More information: The study, "Why earthquake hazard maps often fail and what to do about it," was published by the journal *Tectonophysics*.

Provided by University of Missouri-Columbia

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