Pattern analyses suggests it's possible to predict minimum quake size at its outset

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(Phys.org)—A trio of researchers with the California Institute of Technology has found evidence that suggests it might be possible to calculate a minimum peak quake size during the onset of an earthquake. In their paper published in the journal *Science*, the group describes their study of subduction earthquakes and the application of pattern analysis to eventual quake size.

One thing that virtually all scientists agree on is that no one has figured out a way to predict when destructive earthquakes will occur. Much progress has been made, of course, in identifying places at risk, but little progress has been made in figuring out when they will occur. Some places, such as Mexico City, have installed earthquake warning systems, but they are only able to detect an earthquake in progress some distance away—they typically give people in imminently impacted areas a few seconds to react. One of the problems of such warning systems, unfortunately, is that they cannot tell people how strong the quake is going to be—thus, such systems run the risk of being ignored if they're triggered by every little tremor (something the Japanese are trying to fix). But that may partially change—the team with this new effort reports that it might be possible to calculate a minimum quake size after the quake has started—if the minimum is small, the warning system would calculate the necessity of initiating an alarm. Conversely, a large minimum would suggest an extremely destructive peak.

To learn more about the factors that contribute to the peak size of a quake, the researchers analyzed 116 of the largest earthquakes that have occurred over the past 30 years. In so doing, they report, they found a pattern—the peak size of a quake that is still growing in strength will be at least double that size at its peak. This pattern, the researchers found, showed that it should be possible to calculate the minimum size of a quake while it is gaining strength. This means that if a quake is detected, a monitoring device could track its strength and calculate the minimum size it will be at its peak, offering at least some degree of early prediction regarding how destructive it might be.

More information: M.-A. Meier et al, The hidden simplicity of subduction megathrust earthquakes, *Science* (2017). DOI: 10.1126/science.aan5643

Abstract
The largest observed earthquakes occur on subduction interfaces and frequently cause widespread damage and loss of life. Understanding the rupture behavior of megathrust events is crucial for earthquake rupture physics, as well as for earthquake early-warning systems. However, the large variability in behavior between individual events seemingly defies a description with a simple unifying model. Here we use three source time function (STF) data sets for subduction zone earthquakes, with moment magnitude Mw ≥ 7, and show that such large ruptures share a typical universal behavior. The median STF is scalable between events with different sizes, grows linearly, and is nearly triangular. The deviations from the median behavior are multiplicative and Gaussian—that is, they are proportionally larger for larger events. Our observations suggest that earthquake magnitudes cannot be predicted from the characteristics of rupture onsets.

minimum-quake-size.html