

Major earthquakes may worsen coastal flooding in Southeast Asia, study finds

Major earthquakes may worsen coastal flooding across Southeast Asia by causing land to sink for decades, a study led by Nanyang Technological University in Singapore has found.

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(Photo by Yusuke FUKUHARA / Yomiuri Shimbun / AFP)

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The researchers said current sea-level projections could underestimate risks in low-lying areas because they may not fully account for long-term ground movement after major earthquakes.

The study examined up to two decades of ground movement data from Singapore, Malaysia, and Thailand following the 2004 Sumatra-Andaman earthquake and the 2012 Wharton Basin earthquakes.

It found that the ground continued to move in areas more than 600 kilometers from the earthquakes.

Scientists traced the movement to a weak layer of hot rock in the upper mantle beneath the Sumatran backarc, the region behind Sumatra's chain of volcanoes.

Although the layer is solid, it can deform slowly over time, allowing the land above it to continue shifting and sinking years after a major tremor.

"Most current sea-level projections focus primarily on climate factors like ice-sheet melting and ocean warming, but we must also look at how the Earth moves beneath our feet," said Emma Hill, senior author of the study and chair of NTU's Asian School of the Environment.

"Our new study shows that post-earthquake land sinking is an important factor in regional relative sea-level change. Incorporating these deep geological movements into our models will help us improve coastal planning for low-lying cities," she added.

Global sea-level rise is driven by climate factors such as melting ice sheets and ocean warming. Relative sea level, however, also depends on whether the land at a particular location is rising or sinking.

When land subsides, the sea rises faster in relation to the coast, increasing the risk of flooding.

The researchers said long-term ground movement after earthquakes has become better understood only in the past decade and may not be fully reflected in existing sea-level estimates.

"When massive earthquakes strike, they do not just shake the ground for a few minutes. They set off a slow adjustment deep within the Earth that can continue for years," said Grace Ng, lead author of the study and a research fellow at NTU's Earth Observatory of Singapore.

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"Our study shows that a weak layer of hot rock beneath the Sumatran backarc can slowly deform after major earthquakes. This helps explain why the land above can continue to shift and sink across areas hundreds of kilometres away from the earthquake," she added.

The team used computer models of the Earth's layers and compared them with ground movement recorded by GPS stations across the region.

The researchers found that the observed movement could be explained only if the upper mantle beneath the Sumatran backarc was weak enough to flow slowly over time.

Lujia Feng, a co-author of the study and an assistant professor at NTU, said long-term monitoring was essential to the research.

"This study would not have been possible without more than a decade of continuous observations from ground-based GPS networks across the region. Such long-term geodetic records are vital for revealing how the solid Earth responds to great earthquakes, and how these processes evolve over time," Feng said.

The study said similar post-earthquake movement could occur in other subduction zones, where one tectonic plate is forced beneath another.

The findings could help improve coastal risk models and guide planning for flood defenses, drainage systems, and other infrastructure in vulnerable parts of Southeast Asia.--[licas.news](#)