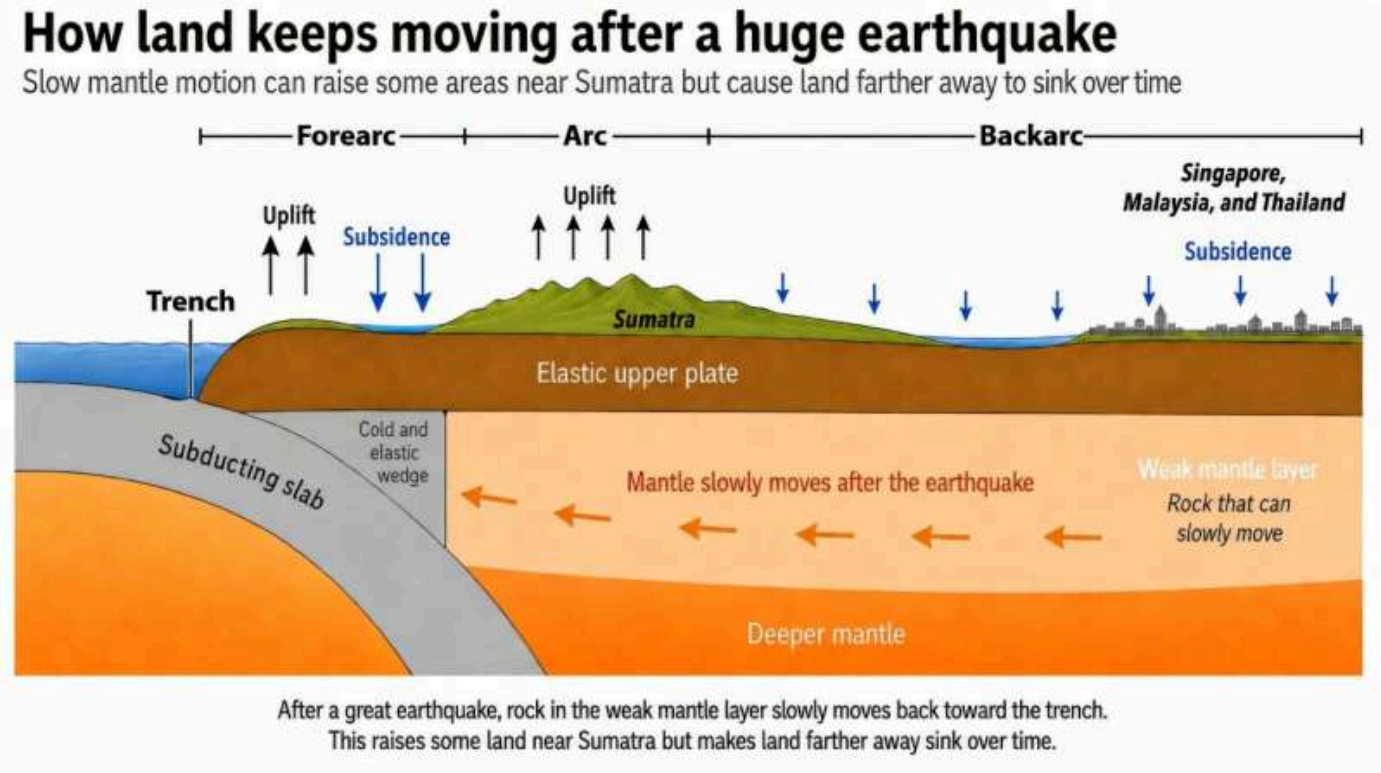
PHYS.ORG

JULY 13, 2026

Major earthquakes can affect Southeast Asia sea-level projections

by Nanyang Technological University

edited by Gaby Clark, reviewed by Andrew Zinin



How land keeps moving after a huge earthquake. Credit: Graphic created using tools that include generative AI

Earth scientists at Nanyang Technological University, Singapore (NTU Singapore) have published an international study showing that major earthquakes in Southeast Asia can affect regional relative sea-level projections.

The findings show that large tremors can trigger long-term sinking of the land. If this post-earthquake ground movement is not accounted for in sea-level modeling, coastal flood risks in low-lying areas could be underestimated.

The team found that a weak layer of hot rock in the upper mantle beneath the Sumatran backarc—the region behind Sumatra's chain of volcanoes—deforms after major earthquakes.

Although this layer is solid, it can move slowly over time. This allows the ground above to keep shifting and sinking years after a major tremor.

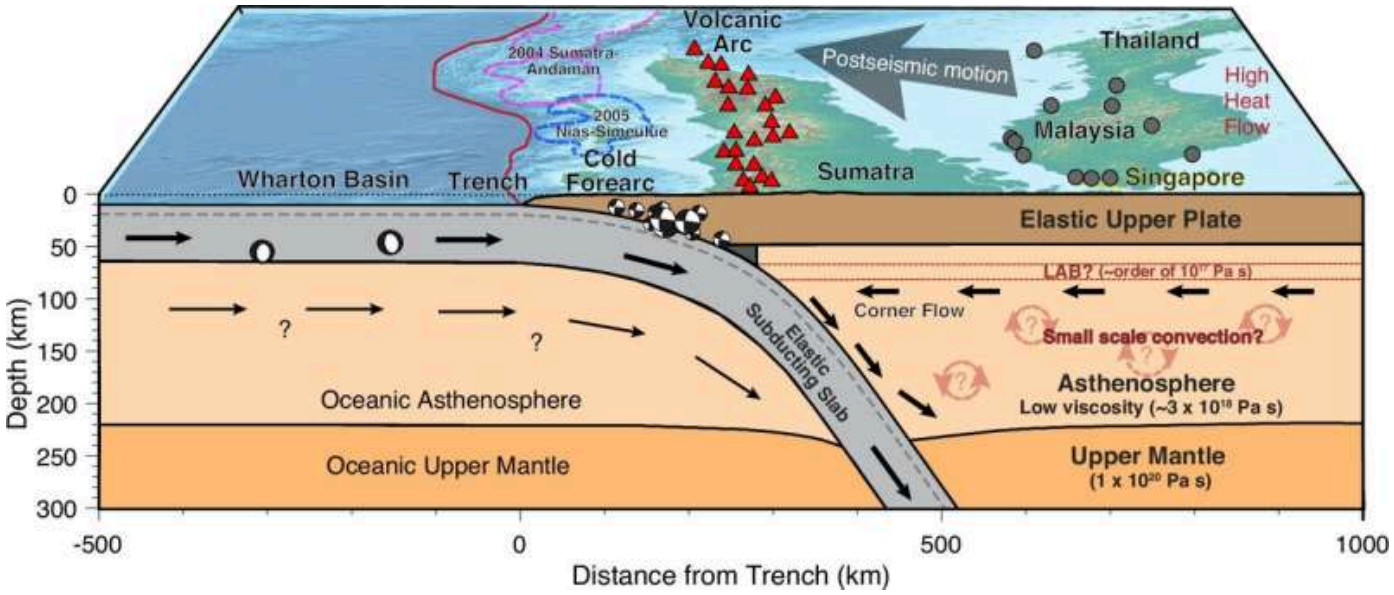
The study, published in *Communications Earth & Environment*, was led by NTU's Earth Observatory of Singapore (EOS) Research Fellow Dr. Grace Ng, Asian School of the Environment (ASE) Asst Prof Lujia Feng, and Chair of ASE Professor Emma Hill, who is also the interim director of EOS.

Sinking land affects sea-level estimates

While global sea-level rise is driven by climate factors like melting ice sheets and ocean warming, relative sea level is determined by how the local land moves. When the land sinks, local relative sea level rises faster.

This study shows that major earthquakes do not just cause temporary shaking but also initiate decades-long land sinking—known as land subsidence—across Southeast Asia.

As these long-term ground movements have become better understood only in the past decade, they may not be fully included in existing sea-level estimates. This means future coastal flood risks for low-lying regions could be underestimated.



Schematic illustration of the Sumatran subduction zone with the slab-driven corner flow and small-scale convection in the asthenosphere. Credit: *Communications Earth & Environment* (2026). DOI: 10.1038/s43247-026-03561-5

This phenomenon could also occur in other subduction zones, where one tectonic plate is forced beneath another, in other parts of the world.

The paper's senior author, Hill, who is the AXA–Nanyang Professor in Earth and Environmental Science, said, "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.

"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."

What happens beneath Sumatra after major earthquakes

The NTU-led team studied up to two decades of ground movement data from Singapore, Malaysia and Thailand to understand how the region continued to move after major earthquakes.

These included the 2004 Sumatra–Andaman earthquake and the 2012 Wharton Basin earthquakes.

The data showed that the ground continued to move even in places more than 600 kilometers (370 miles) from where the earthquakes occurred.

This long-distance movement suggests that a weak layer deep below the region is allowing the Earth's surface to keep adjusting after major earthquakes.

Ng said, "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.

"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 kilometers (hundreds of miles) away from the earthquake."

To test what was happening below the surface, the researchers used computer models of the Earth's layers and compared them with ground movement recorded by GPS stations.

They 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.

This gives scientists a clearer picture of how major earthquakes can continue to affect land height long after the shaking has stopped.

Co-author Feng, an expert in using satellite positioning data to study the Earth's crustal motions and natural hazards, added, "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."

Improving coastal planning

The study highlights why sea-level projections in Southeast Asia should account for both rising seas and moving land.

For coastal planners, relative sea level matters most. This refers to how high the sea is compared with the land at a specific location.

If land is sinking, water levels can rise faster relative to the coast, increasing flood risks for low-lying areas.

By showing how post-earthquake land movement can affect relative sea levels, the NTU study provides data to improve future coastal risk models, which can then inform and support longer-term planning for flood defenses, drainage systems and coastal infrastructure in Southeast Asia.

Publication details

Grace Ng et al, Weak asthenosphere of Sumatran backarc revealed by long postseismic geodetic records, *Communications Earth & Environment* (2026). DOI: 10.1038/s43247-026-03561-5

Journal information: Communications Earth & Environment

Key concepts

subsidence **tremor** **sea-level change**

Provided by Nanyang Technological University

Citation: Major earthquakes can affect Southeast Asia sea-level projections (2026, July 13) retrieved 13 July 2026 from https://phys.org/news/2026-07-major-earthquakes-affect-southeast-asia.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.