UC Irvine scientists discover how fast the world's deltas are sinking

The work reveals which human-driven activities are the main drivers.

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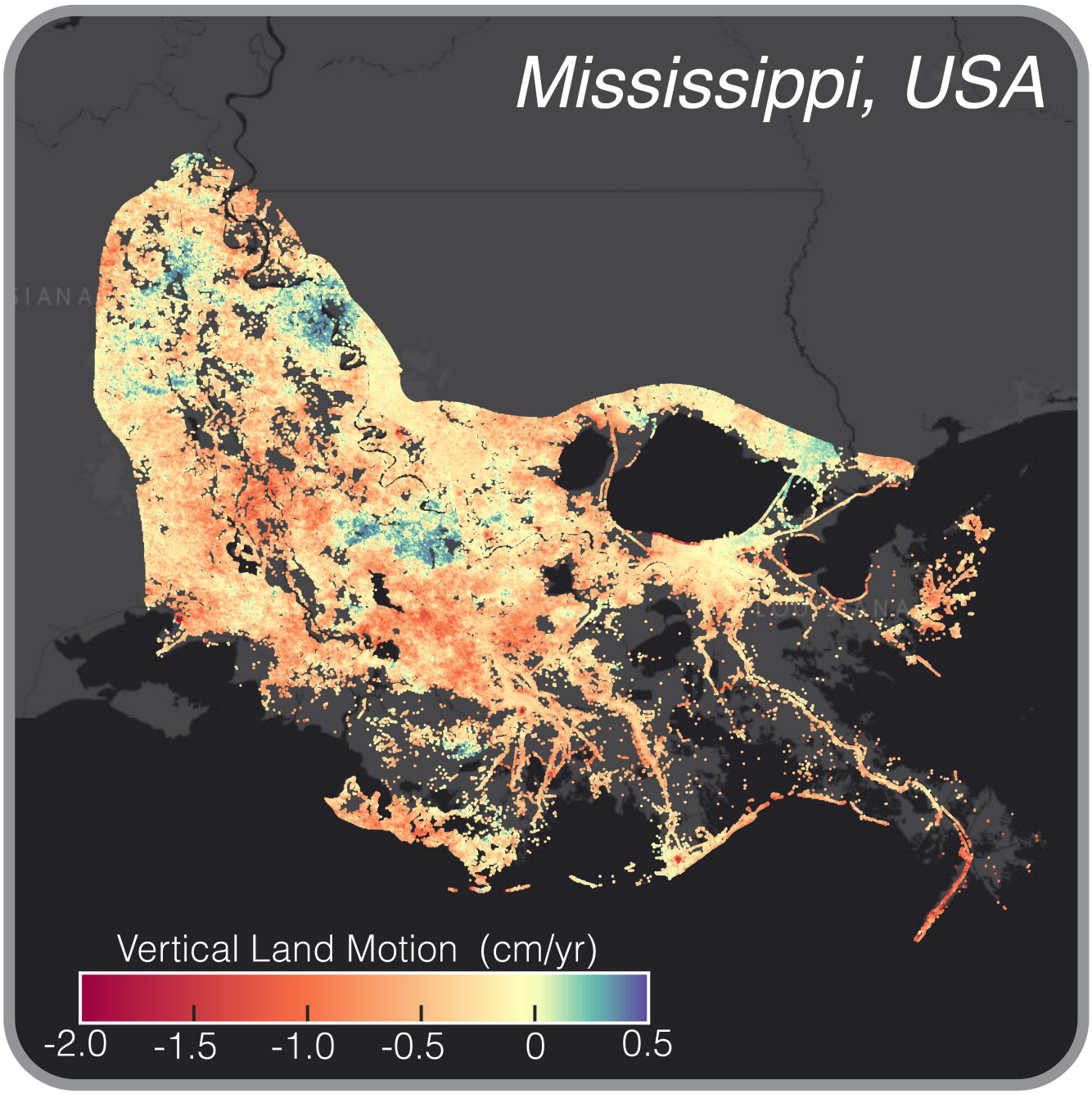


Pattern of land subsidence over the Mississippi River delta. More than half of the land measured on the Mississippi delta is sinking at a rate faster than four millimeters per year, with a maximum sinking rate exceeding 30 millimeters per year.

Picture Credit:
Adapted from Ohenhen et al., Nature, 2026

- The sinking is placing more than 236 million people at increased flooding risk in the near future.
- The findings could help communities residing in deltas better prioritize immediate local interventions alongside climate adaptation efforts.
- Funding was provided by NASA and the United States Department of Defense.

Irvine, Calif., Jan. 14, 2026 — The world's deltas are home to hundreds of millions of people – but there's a problem: New research from the University of California, Irvine shows that these deltas are sinking. Until now, it was unclear what the rate of delta elevation loss has been, or what's driving delta subsidence, but in a new study in *Nature*, scientists report that land subsidence caused by humans is the main culprit.

"Our study provides the first delta-wide, high-resolution subsidence observations across 40 major river delta systems, revealing not just where land is sinking, but quantifying how much," said Leonard Ohenhen, UC Irvine professor of Earth system science and lead author of the study. "We also quantified the relative contributions of specific human drivers: groundwater extraction, sediment starvation and urbanization across these deltas, which allows us to identify the dominant driver of the sinking."

The team found that, across deltas, land is sinking at an average rate ranging from less than one millimeter per year in deltas like the Fraser Delta in Canada, to more than one centimeter per year in China's Yellow River Delta, with many deltaic areas sinking more than double the rate of global sea-level rise.

In coastal and deltaic regions around the world, the lack of high-resolution elevation change measurements has long hindered efforts to distinguish the severity of land subsidence and sea-level rise.

Using satellite radar data, Ohenhen's team measured surface elevation loss across 40 deltas. The analysis revealed that in 35 percent of them, extraction of groundwater by humans is the main driver of land subsidence.

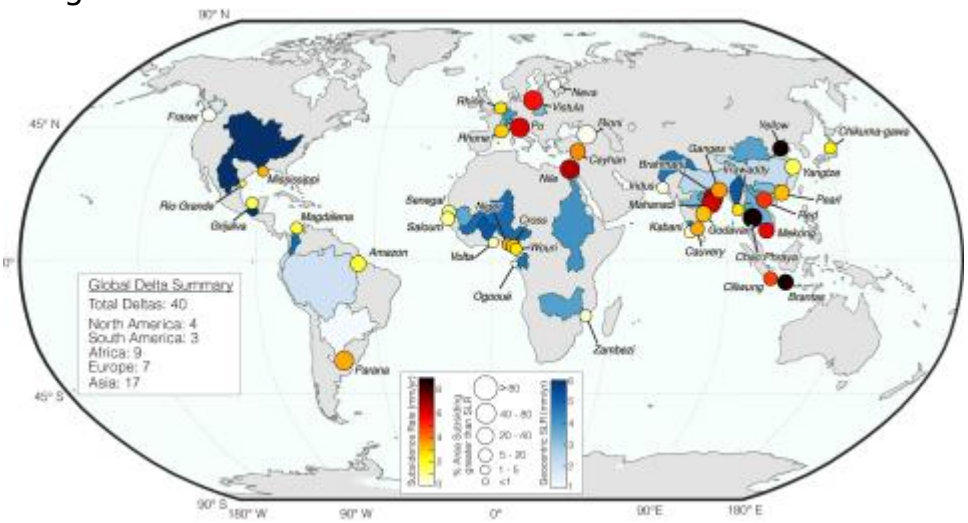
"The dominance of subsidence over sea-level rise was more pervasive than anticipated, and in every delta we monitored, at least some portion is sinking faster than the sea surface is rising," said Ohenhen. "While this affects less than one percent of the area in deltas like the Rio Grande, in others like the Mekong, Chao

Phraya and Nile, vast areas encompassing much of the delta area are sinking faster than current sea-level rise rates.”

In the United States, for example, the Mississippi River Delta has a long-documented history of subsidence, and the new analysis confirms that this trend remains pronounced.

“The Mississippi Delta is sinking at an average rate of 3.3 millimeters per year, compared with the regional Gulf Coast sea-level rise of 7.3 millimeters per year – though substantial areas are subsiding faster than this local sea level rise, in some areas more than 89 millimeters (3.5 inches) per decade,” said Ohenhen. “These patterns reinforce ongoing land-loss concerns in coastal Louisiana from both the land and the seas.”

Image



Land subsidence in global river deltas. The average rate of land subsidence for 40 deltas as evaluated in this study. Each circle is color-coded to the respective average land subsidence rate for each delta. The circle size represents the percentage of delta area subsiding faster than sea level rise (SLR). The rate of SLR for each region is displayed as the color gradient over entire delta watersheds/basins (please note that the watershed/basin boundaries does not represent the extent of SLR exposure). Adapted from Ohenhen et al., Nature, 2026

While land subsidence often dominates present-day exposure in most deltas, climate-driven sea-level rise remains a fundamental long-term threat. Melting polar

ice and warming ocean temperatures are currently causing global sea levels to rise by four millimeters every year – a rate that's expected to accelerate throughout the coming century.

Ohenhen explained how the findings should help populations inhabiting deltaic regions better prioritize mitigation and choose adaptation strategies.

"These results give delta communities a clearer picture of an additional threat, which can cause increased flood exposure, and that clarity on the hazard facing them matters," Ohenhen said. "If the land is sinking faster than the sea is rising, then investments in groundwater management, sediment restoration and resilient infrastructure become the most immediate and effective ways to reduce exposure."

Collaborators include Manoochehr Shirzaei and Susanna Werth of Virginia Tech, Jim Davis and Austin Chadwick of Columbia University, Robert Nicholls of the University of East Anglia and University of Southampton in England Philip Minderhoud of Wageningen University and Research in the Netherlands, and Julius Oelsmann of Tulane University. Funding was provided by NASA and and the United States Department of Defense.

About the University of California, Irvine: Founded in 1965, UC Irvine is a member of the prestigious Association of American Universities and is ranked among the nation's top 10 public universities by *U.S. News & World Report*. The campus has produced five Nobel laureates and is known for its academic achievement, premier research, innovation and anteater mascot. Led by Chancellor Howard Gillman, UC Irvine has more than 36,000 students and offers 224 degree programs. It's located in one of the world's safest and most economically vibrant communities and is Orange County's second-largest employer, contributing $7 billion annually to the local economy and $8 billion statewide. For more on UC Irvine, visit www.uci.edu.

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