Tulane researcher helps uncover 4,000-year shift in sea-level stability

October 15th, 2025

|

View PDF

Tulane University School of Science and Engineering's Sönke Dangendorf is helping uncover how human-driven sea-level rise and land subsidence are creating risks for coastal megacities unprecedented in the past four millennia.

Dangendorf, the David and Jane Flowerree Professor in Tulane's River-Coastal Science and Engineering Department, joined an international team led by Rutgers University to reconstruct 11,700 years of sea-level history along southeastern China's coast. The research team applied advanced statistical and physical modeling methods to geological records and tide gauge data, producing one of the most comprehensive reconstructions of Holocene and modern coastal sea-level changes to date.

Their work shows that for more than 4,000 years prior to the Industrial Revolution, global mean sea levels remained remarkably stable, fluctuating around zero change per year. That stability ended in the mid-1800s: modern sea levels are now rising at roughly 1.5 millimeters per year –exceeding any century over the past four millennia.

"Sea-level rise today is not part of a natural cycle; it represents uncharted territory," said Yucheng Lin, lead-author, a postdoctoral researcher at Rutgers University and now a research scientist at Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO). "The combination of accelerating global sea-level rise and human-driven land subsidence creates an ever-growing risk for coastal cities."

The study also highlights the role of human activity in compounding risks. Across 20 coastal cities in southeastern China, more than 94 percent of observed subsidence was linked to human activities such as groundwater extraction and urban construction. In some neighborhoods, the land is sinking faster than the sea is rising. Deltaic regions such as the Yangtze and Pearl River deltas, home to tens of millions of people and key economic hubs, are especially vulnerable.

"Shanghai's experience demonstrates that targeted solutions can work," Dangendorf said. "By identifying groundwater withdrawal as the main cause of subsidence, the city was able to implement management strategies that significantly slowed sinking. Local actions like this are crucial, alongside global cuts in greenhouse gas emissions, to protect coastal communities."

The findings underscore the urgent need for action at both global and local scales. International efforts to reduce greenhouse gas emissions remain critical to slowing overall sea-level rise. At the same time, city-level measures such as improved groundwater management, stricter building policies, and nature-based defenses offer immediate and effective ways to mitigate risks.

"Today's coastal flooding threats are not inevitable," Dangendorf said. "They are the result of choices, and better choices can help protect millions of people living in coastal megacities worldwide."