A third of China's urban population at risk of city sinking, new satellite data shows

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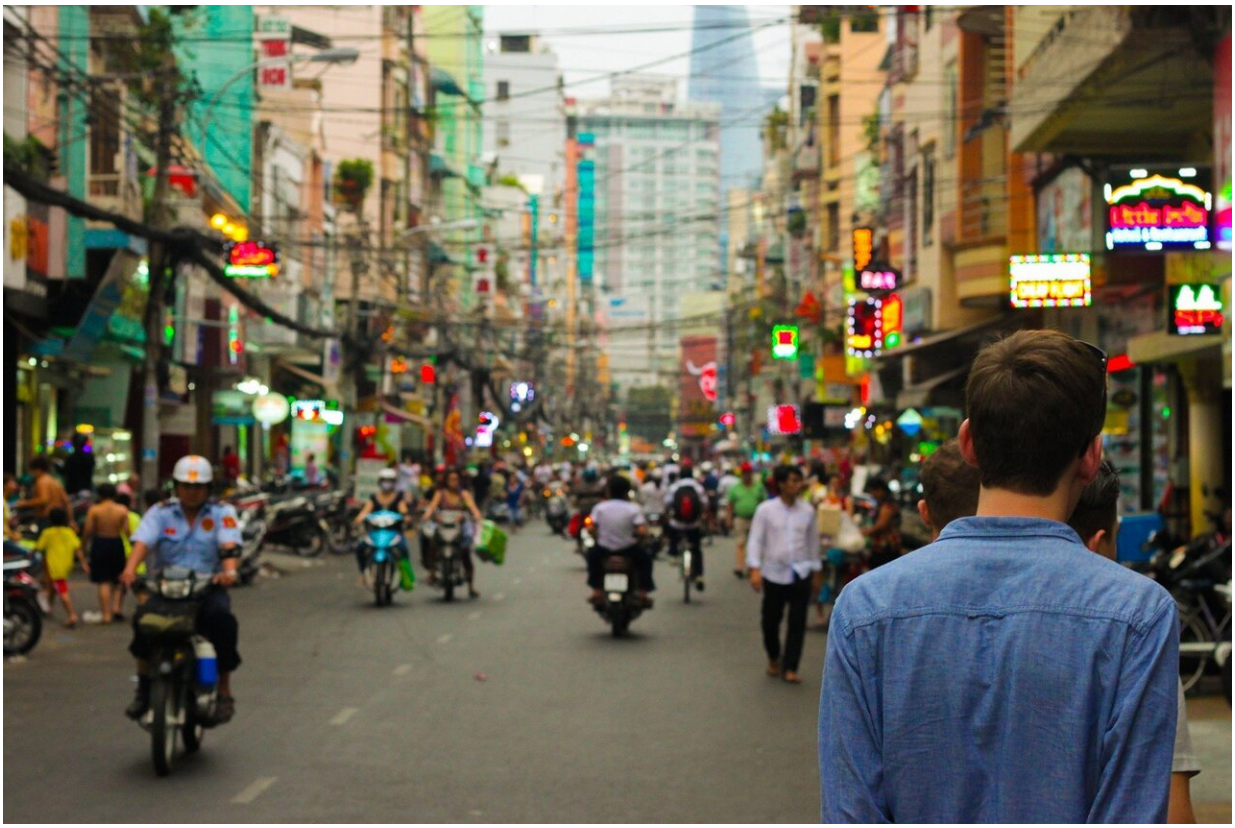

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Land subsidence is overlooked as a hazard in cities, according to scientists from the University of East Anglia (UEA) and Virginia Tech. Writing in the journal *Science,* Prof Robert Nicholls of the Tyndall Center for Climate Change Research at UEA and Prof Manoochehr Shirzaei of Virginia Tech and United Nations University for Water, Environment and Health, Ontario, highlight the importance of a new research paper analyzing satellite data that accurately and consistently maps land movement across China.

While they say in their comment article that consistently measuring subsidence is a great achievement, they argue it is only the start of finding solutions. Predicting future subsidence requires models that consider all drivers, including human activities and climate change, and how they might change with time.

The research paper, published in the same issue, considers 82 cities with a collective population of nearly 700 million people. The results show that 45% of the urban areas that were analyzed are sinking, with 16% falling at a rate of 10mm a year or more.

Nationally, roughly 270 million urban residents are estimated to be affected, with nearly 70 million experiencing rapid subsidence of 10mm a year or more. Hotspots include Beijing and Tianjin.

Coastal cities such as Tianjin are especially affected as sinking land reinforces climate change and sea-level rise. The sinking of sea defenses is one reason why Hurricane Katrina's flooding brought such devastation and death-toll to New Orleans in 2005.

Shanghai—China's biggest city—has subsided up to 3m over the past century and continues to subside today. When subsidence is combined

with sea-level rise, the urban area in China below sea level could triple in size by 2120, affecting 55 to 128 million residents. This could be catastrophic without a strong societal response.

"Subsidence jeopardizes the structural integrity of buildings and critical infrastructure and exacerbates the impacts of climate change in terms of flooding, particularly in coastal cities where it reinforces sea-level rise," said Prof Nicholls, who was not involved in the study, but whose research focuses on sea-level rise, coastal erosion and flooding, and how communities can adapt to these changes.

The subsidence is mainly caused by human action in the cities. Groundwater withdrawal, which lowers the water table is considered the most important driver of subsidence, combined with geology and weight of buildings.

In Osaka and Tokyo, groundwater withdrawal was stopped in the 1970s and city subsidence has ceased or greatly reduced, showing this is an effective mitigation strategy. Traffic vibration and tunneling are potentially also a local contributing factor—Beijing has sinking of 45mm a year near subways and highways. Natural upward or downward land movement also occurs but is generally much smaller than human-induced changes.

While human-induced subsidence was known in China before this study, Profs Nicholls and Shirzaei say these new results reinforce the need for a national response. This problem happens in susceptible cities outside China and is a widespread problem across the world.

They call for the research community to move from measurement to understanding implications and supporting responses. The new satellite measurements are delivering new detailed subsidence data but the methods to use this information to work with city planners to address

these problems need much more development. Affected coastal cities in China and more widely need particular attention.

"Many cities and areas worldwide are developing strategies for managing the risks of climate change and sea-level rise," said Prof Nicholls. "We need to learn from this experience to also address the threat of subsidence which is more common than currently recognized."

More information: Robert J. Nicholls, Assessing and responding to human-induced subsidence, *Science* (2024). DOI: 10.1126/science.ado9986. www.science.org/doi/10.1126/science.ado9986

Zurui Ao et al, A national-scale assessment of land subsidence in China's major cities, *Science* (2024). DOI: 10.1126/science.adl4366 , www.science.org/doi/10.1126/science.adl4366?

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