Scientists detect new landslides on U.S. West Coast

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SMU geophysicists have used satellite imagery to identify more than 600

slow-moving landslides occurring near the U.S. West Coast

Fewer than 5% of these landslides in California, Oregon and Washington state had been previously identified.

Geophysics professor Zhong Lu and his team at SMU (Southern Methodist University) were awarded nearly $1 million over the past 4 years from the NASA Interdisciplinary Research in Earth Science Program and the NASA Earth Surface and Interior Focus Area to study landslides on the West Coast.

Most of the large landslides they found were in the mountain ranges of western Washington, southwestern Oregon and northwestern California. In some cases, the identified landslides were within 0.5 to 5 kilometers of multiple towns and roads.

"These landslides are currently moving slowly. But they're already in a state of force imbalance. So some other external forces, like earthquakes or rainfall, could shift them into a disaster," said Yuankun Xu, a postdoctoral researcher who works in Lu's SMU Radar Laboratory and lead author of a study published in the journal *Landslides*.

Co-author Lu, Shuler-Foscue Chair at SMU's Roy M. Huffington Department of Earth Sciences, said, "We don't want to give the impression that these landslides are in trouble tomorrow. No, these landslides have a life expectancy ranging from years to a thousand years."

Still, the researchers urged policymakers in these western states to monitor the movement of the now-identified landslides so they can prevent a catastrophe from happening.

"I would be very concerned if living, working or commuting upon or

near any of the landslides," said study co-author William H. Schulz, a research geologist in the USGS' Landslide Hazards Program. "However, humans can and have successfully dealt with individual landslides and potentially unstable slopes in the past. Detailed studies performed by professionals involving engineering geologic characterization and modeling are needed for any landslide to accurately estimate and mitigate potential future hazards."

Other scientists who helped with this study were Jinwoo Kim, SAR/InSAR Research Scientist at the SMU Radar Laboratory and Kelli Baxstrom, a research geologist in the USGS Landslide Hazards Program.

Landslides kill thousands of people every year worldwide

Landslides occur when masses of rock, soil or earth fall down a slope because of gravity. They cause thousands of deaths each year around the world, and in the United States alone, damage exceeds $2 billion annually from these slides.

Yet, landslides can be hard to spot before they become a danger, when heavy rainfall suddenly causes the land to shift quickly.

Of the 617 landslides detected in western US states, only 29 of them were already included in the national landslide database. These landslides are typically found through human-reported events and geological maps.

"The landslides that we previously knew about are ones that people can easily spot from the highway or in city areas," Lu said. "Those are very rapid-moving landslides."

Other landslides, however, are harder to identify due to tree cover or

because there is no obvious crack in the topography, he explained.

Xu, Lu and the rest of the research team used radar satellite images to unravel previously unidentified landslides from space. These images, taken from 2007 to 2011 and 2015 to 2019, came from radar instruments called Phased Array type L-band Synthetic Aperture Radar (PALSAR) mounted on the Japan Aerospace Exploration Agency's Advanced Land Observing Satellites.

With this interferometric synthetic aperture radar technology (called InSAR, for short) the satellite images allow scientists to detect changes that aren't visible to the naked eye. The satellite technology can capture ground motion with a precision of sub-inches or better, at a spatial resolution of a few yards over thousands of miles, say the researchers.

Essentially, any movement of the ground surface toward or away from the satellite can be measured and depicted as a "picture." This picture shows how much the surface has moved or deformed during the time between images.

Lu, a leading scientist in InSAR applications, used the same method to reveal in 2018 that sinkholes are expanding and forming in oilfield-dominated West Texas at a startling rate.

In this current study, the geophysicist team collected a total of 7,073 images of the western US states from 2007 to 2011 and from 2015 to 2019 to see whether the land had shifted from previous images. The team focused on finding large, slow-moving landslides because these had the most potential to cause significant damage.

They found that 70 percent of the landslides they identified moved at a consistent pace, sliding further down a slope from where they had been the year before. These landslides moved at rates of tens of centimeters to

a few meters per year on average, Lu said.

But Lu noted that climate change could accelerate how quickly these landslides become catastrophic, as "climate change is producing abnormal climate situations." For instance, it's possible that record rainfall, similar to what was seen in Europe and China this year, could make some of the landslides on the West Coast worse.

Those landslides ranged in size from the equivalent of 7 to 2,400 football fields.

Though InSAR has been highly effective at detecting landslides, Lu said there are likely still more unidentified slow-moving landslides on the U.S. West Coast because extremely dense forests may hinder InSAR's capability to spot them. The InSAR satellite images are also less able to reveal landslide motions that are oriented perpendicular to the radar sensor's "line of sight."

SMU's high performance computer was critical to this study

Xu said SMU's supercomputer was essential to analyzing at high speed the mammoth amount of data inherent in using the InSAR technique.

"It's the 'unsung hero,'" Lu said. "Without it, we wouldn't have been able to do this research."

You can see where the slow-moving landslides were found here.

More information: Yuankun Xu et al, Geologic controls of slow-moving landslides near the US West Coast, *Landslides* (2021). DOI: 10.1007/s10346-021-01732-3

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