Using satellite data to help direct response to natural disasters

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Researchers have developed a way to use satellite imaging data to create 3D images that could quickly detect changes on the Earth's surface, a new study says.

The tool could be used to detect significant natural disasters in remote regions of the globe soon after they happen, giving first responders accurate information about the needs of the region affected.

The Planetscope satellite constellation, operated by the satellite data company Planet, collects weekly and sometimes even daily images of the entire globe. On average, its fleet of Cubesats, or miniature satellites, has about 1,700 images of every location on Earth. The data they capture has been used to monitor the spread of wildfires, detect changes in crop health and survey areas of deforestation.

That kind of global coverage is unprecedented, said Rongjun Qin, co-author of the study and an associate professor of civil, environmental and geodetic engineering at The Ohio State University.

"There are a lot of great benefits in terms of having satellites cover the globe very quickly," said Qin, who is also a core faculty member of Ohio State's Translational Data Analytics Institute. "We're focused on informing the community about changes to our cities, forests and ecosystems."

The study, published in the Journal *GIScience and Remote Sensing*, found that Planetscope's vast datasets could be used to create 3D reconstructions, or digital surface models, of any given area.

"Remote sensing could help us estimate the area impacted by a natural disaster," Qin said. "We could figure out how many people to send over for rescue operations, and observe the level of damage these events actually create."

Previous remote-sensing-based disaster studies have been limited by their lack of available data and coverage and their resolution, or how frequently images are collected or updated.

For instance, many people are familiar with Google Earth, a computer program that renders a 3D representation of the globe using satellite images and aerial photography. But the popular program is one of the reasons why Qin's team wanted to create a model capable of a much higher resolution, or update rate.

"Some places on the site have very nice 3D reconstructions," Qin said. "But there are a lot of places where those images attached to the Earth are distorted."

Purely flat images overlaid on a globe can make objects or locations on the map appear out of scale with each other, and negatively influence the entire program's accuracy.

However Qin's 3D reconstructions, which take into account different elevation levels and landscapes, are accurate down to about 6 meters from the ground. In terms of mapping data, he said it's akin to achieving "almost approximately one pixel accuracy."

And because Planetscope's data is open access to educators, other scientists can use the same datasets the study used to create their own simulations. According to Qin, for an area as big as Ohio State's Columbus campus (1,600 acres), it would take less than an hour to turn satellite images into an accurate 3D reconstruction of the region.

But to put their method to the test, Qin's team devised three different case studies, or experiments using thousands of Planetscope images collected between 2016 and 2021.

One test case showed that they could use the satellite images to make a 3D reconstruction of an urban and a rural area in Spain. A second test case showed that they could detect 3D changes over time in an urban and a forested area near Allentown, Pennsylvania.

To determine how good their model was at post-disaster assessment, one experiment investigated a glacial area in Chamoli, India.

Last year, the area around the region experienced a devastating flood that killed hundreds of people and destroyed two nearby power plants. Advances in satellite technology later revealed that the flood was caused by a rock and ice avalanche.

Their results showed that their model could not only recreate the changed topography that led to the disaster, but account for the volume of the rocks and ice in the avalanche. "We verified that Planetscope's digital surface model can be used to evaluate mass changes for similar global natural disasters to the avalanche event," said Qin.

Qin's findings will help engineer better ways to utilize satellite data, especially as the number of satellites and their various applications grow.

"This is still in its incubation stage and will still require some engineering efforts," he said, "but I think it's going to be a big deal in the industry and for scientists interested in combating climate change."

Research co-authors include Debao Hung and Yang Tang of Ohio State.

More information: Debao Huang et al, An evaluation of planetscope images for 3D reconstruction and change detection—experimental validations with case studies, *GIScience & Remote Sensing* (2022). DOI: 10.1080/15481603.2022.2060595

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