

# NTU team creates damage maps to guide Turkey-Syria rescue work

Proxy maps of extent of damage help identify quake areas most in need of rescue and aid

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A few hours after a deadly earthquake devastated Turkey and Syria earlier in February, a team from Nanyang Technological University's Earth Observatory of Singapore (EOS) began to build maps showing the extent of the damage in the afflicted regions.

Developed from processing raw satellite data, the damage proxy maps can be used to guide local governments and first responders in identifying the areas most in need of rescue and aid.

"Disaster response agencies need to make quick decisions to assess, for example, how many bottles of water and personal hygiene kits need to be shipped to the displaced people and survivors, and where to allocate resources," said Associate Professor Yun Sang-Ho, director of NTU's EOS-Remote Sensing Lab.

The magnitude-7.8 quake that hit south-east Turkey and parts of neighbouring Syria on Feb 6 has killed more than 45,000 people.

After Sentinel Asia – an initiative contributing to disaster management in the Asia Pacific – and the United Nations World Food Programme contacted Prof Yun's lab in the afternoon that day, his team worked round the clock for two days to build the first map.

The team collaborated with the Japan Aerospace Exploration Agency (Jaxa) to access satellite images of the affected region before the earthquake, while the agency's satellite captured the aftermath. It took two days for Jaxa's Advanced Land Observing Satellite-2 to position itself over the Turkey-Syria region on Feb 8.

The satellite uses synthetic aperture radar technology, sending radio waves to the earth's surface and collecting data to form images. The radar can penetrate darkness and clouds to take snapshots of the aftermath.

After receiving the satellite data, the EOS-Remote Sensing team processed them through a software and did statistical analyses to find out how much the area changed after the temblor and aftershocks. It involved hours of keen-eyed, meticulous work, including checking against news reports and videos.

Their first proxy map of the damage was released just after 2am on Feb 9. It covered a 70km by 236km area, which included the earthquake's epicentre in the Turkish town of Pazarcik and majorly affected cities, including Kahramanmaraş in Turkey and Aleppo in Syria.

Red pixels indicate the areas likely to be the most damaged, with buildings reduced to rubble, landslides or soil damage. Each pixel spans a 30m-wide area.

The first map was published on EOS-Remote Sensing Lab's website and as a Twitter post, which received more than 180,000 views within five days, and reached Turkey's director of rescue operations.

The United States' space agency, National Aeronautics and Space Administration (Nasa), also con-

tributed to the map through its Jet Propulsion Laboratory.

But the work of the 10-member EOS team did not end on Feb 9. Since then, the team has created six more maps using data from a European Space Agency satellite and images of the affected regions before the disaster.

To date, the team's maps have covered 204,000 sq km, about 280 times the size of Singapore.

The UN World Food Programme has been using the maps to estimate how many people were impacted by the quake.

Said Prof Yun: "Work has been non-stop, with more and more data coming in. Once an event like

this happens, we often work round the clock for many months, as our maps are also used to track recovery efforts later. We also try different methods to improve the maps and make them more robust."

Later, one of the researchers came across a Wall Street Journal video on a flooded village in Syria after the earthquake damaged a dam. The EOS team then started work on another map to show the extent of damage and inundation caused by the subsequent flooding.

Research assistant Lin Way, whom Prof Yun calls the "mission controller" of the lab, said: "The disasters that we support have wide-ranging and long-lasting impacts on the community. It is reassuring to know that our long-term efforts in developing algorithms for damage mapping could pro-

vide useful information to responders on the ground."

Research fellow Rino Salman, an Indonesian, added: "I'm interested in understanding earthquakes. If earthquakes hit my home country, for example the earthquake in Cianjur in November 2022, I am always eager to do all I can, even if it means I have to sleep less and forgo time with my kids over the weekend."

Prof Yun has been developing the methods for damage mapping for 14 years since he was with Nasa's Jet Propulsion Laboratory. He joined EOS as the founding director of its Remote Sensing Lab in 2021, but his first collaboration with EOS on mapping was after the 2018 Sulawesi earthquake and tsunami.

In early 2022, his team developed damage proxy maps after the

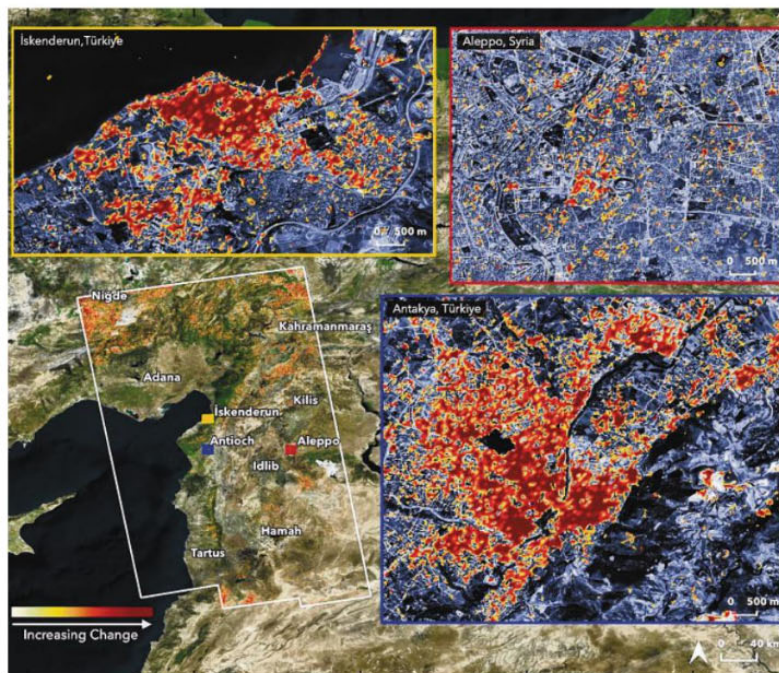
Tonga volcano eruption.

Despite years of mapping natural hazard aftermaths, Prof Yun has to remind himself not to be emotionally affected when he reads about cities in ruins or sees pictures of grieving families.

He was one of many who came across the widely shared photo of a father in Kahramanmaraş holding the hand of his dead teenage daughter, who was sleeping when the building came crashing down on her.

Prof Yun said: "My job is to provide comprehensive observation-based products... we need to remain objective. It is natural to feel emotional when we deal with this kind of events. But we have to transform that into motivation to support disaster relief efforts."

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Left: Portions of the damage proxy maps developed by the NTU Earth Observatory of Singapore's Remote Sensing Lab. This image shows the extent of damage at Iskenderun, Turkey, Aleppo, Syria, and Antakya in Turkey.

Below: The team from the NTU Earth Observatory of Singapore Remote Sensing Lab.

(From left, back row): PhD student Bryan Marfito, research assistant Jay Wong, student assistant Ricky Winarko, research fellows Eleanor Ainscoe, Rino Salman and (inset) Noel Ivan Ulloa.

(Front row, from left) PhD student Cheryl Tay, EOS-RS director Yun Sang-Ho, research associate Shi Tong Chin and research assistant Lin Way. PHOTOS: NANYANG TECHNOLOGICAL UNIVERSITY EARTH OBSERVATORY OF SINGAPORE (NTU EOS)

