Globally, atmospheric methane concentrations have more than doubled since the pre-industrial era, to around 1,860 parts per billion (p.p.b.). Methane levels remained fairly constant from 1999 to 2006, averaging 1,774 p.p.b. — but then they started rising again. Many researchers initially thought fossil-fuel emissions could be responsible, but the evidence from subsequent isotope studies[2] suggests that atmospheric methane is getting lighter, not heavier.

"A lot of the extra emissions seem to come from the tropical region, and that points to a larger contribution from wetlands," says Stefan Schwietzke, an atmospheric scientist who is now with the Environmental Defense Fund, an advocacy group based in New York City.

Other studies have suggested that the methane spike could be due to increased emissions from agriculture in southeast Asia[3] or to a subtle shift in the rate at which methane breaks down in the atmosphere[4,5]. And work[6] led by John Worden, an atmospheric physicist at the Jet Propulsion Laboratory in Pasadena, California, indicates that shifts in the amount of methane from sources including fires and fossil fuels could explain the increase, as well as changes in the isotopic signature of the greenhouse gas in the atmosphere.

But the uncertainties in all these analyses are large enough that any of the proposed theories could be at least partially correct, Worden says.

With the isotopic signatures that Nisbet and his team will pull from their air samples from this and related field expeditions, modellers should be able to produce more accurate estimates of global methane emissions, including in the tropics. This should help scientists in their efforts to understand what is happening globally and, ultimately, how climate change will affect the methane cycle in the future.

But Nisbet cautions that campaigns such as the Africa project provide snapshots in time, and partial ones at that. "We're just scratching at the surface with this trip," he says. "We're going to have to go back again." ■

1. Schwietzke, S. *et al. Nature* **538**, 88–91 (2016).
2. Nisbet, E. G. *et al. Glob. Biogeochem. Cycles* **30**, 1356–1370 (2016).
3. Schaefer, H. *et al. Science* **352**, 80–84 (2016).
4. Rigby, M. *et al. Proc. Natl Acad. Sci. USA* **114**, 5373–5377 (2017).
5. Turner, A. J. *et al. Proc. Natl Acad. Sci. USA* **114**, 5367–5372 (2017).
6. Worden, J. R. *et al. Nature Commun.* **8**, 2227 (2017).

GEOLOGY

Quake-prone Myanmar primed for seismic scrutiny

Opening up to the world has helped the country transform its earthquake monitoring.

BY ALEXANDRA WITZE

Just a few years ago, Myanmar's geoscientists still relied on old-fashioned inked tracings to monitor earthquakes. Now they are using a real-time data feed from a high-tech network of seismic-monitoring stations dotted around the geologically active country. The transformation has propelled Myanmar to the forefront of seismic monitoring in southeast Asia — and is revealing its quake risk and speeding up its disaster response.

"It's gone from 0 to 100 in an amazingly short amount of time," says Eric Sandvol, a seismologist at the University of Missouri in Columbia.

Myanmar is perched on a small plate of Earth's crust beneath which the much larger Indian tectonic plate dives into the planet. That makes it geologically active, with six earthquakes of magnitude 7 or greater since 1930. Smaller quakes regularly rattle large parts of the nation.

With the new network, which collects data from 21 stations, scientists at the Department of Meteorology and Hydrology (DMH) in Nay Pyi Taw are issuing earthquake information and tsunami warnings faster and more accurately than ever before, says Yin Myo Min Htwe, a seismologist at the DMH. That means emergency responders can quickly understand where the greatest damage from a quake might be and react accordingly.

KAUNG HTET/GETTY

A monk clears debris from a ruined pagoda in Thabeikkyin, Myanmar, following an earthquake in 2012.

Even as Myanmar is bolstering its own monitoring, scientists from elsewhere are peppering the country with extra stations for research. Data from these will help them to understand the geology of the country, which sits between the Himalayas to the west and the Indonesian tsunami-generating zone to the east.

This month, a team from the German Research Centre for Geosciences (GFZ) in Potsdam is temporarily installing 30 seismic stations in the north-west of the country, to analyse the structure of Earth's crust there. Research groups from China, India, Singapore and the United States have also descended on Myanmar, as the fledgling democracy begins to open up to the rest of the world. International scientists work in the field with DMH researchers, but are barred from the country's areas of ongoing ethnic conflict.

In the past, the monitoring of natural hazards in Myanmar generally focused on extreme weather such as cyclones. Tracking earthquakes was difficult under the former military dictatorship, because of the problems of maintaining stations, which involved travelling around the country and getting reliable enough communications to sustain a real-time data feed. The DMH sometimes had to rely on data from neighbouring countries such as Thailand and India to issue its quake information and tsunami warnings.

STATION UPGRADES

But things began to change in the early 2010s, as the country opened up. "Seismology can play an important role in science diplomacy," says Susan Hough, a seismologist with the US Geological Survey (USGS) in Pasadena, California.

Working with international partners such as the USGS and the US Agency for International Development, the DMH began to upgrade its stations' instruments — most of which were broken or operated only slowly — to newer ones that transmit data in real time. Other new stations came from collaborations with an agency known as the Regional Integrated Multi-Hazard Early Warning System for Africa and Asia, based in Pathumthani, Thailand, and the China Earthquake Administration in Beijing. The bulk of the work was finished in January 2016 (ref. 1), and the DMH has continued to add stations to the network ever since.

The agency now also produces shake maps, which show the parts of the country that are experiencing the most severe ground shaking, so that officials can decide where to respond.

Already, the national network has captured data from three quakes larger than magnitude 6, including a magnitude-6.8 quake in August 2016 that killed four people.

> ***"It's an amazing opportunity for us scientists who have been interested in the area for a while."***

Each month, the network detects an average of two to four quakes of at least magnitude 4.5 — big enough to cause substantial shaking and sometimes damage to buildings. These earthquakes wouldn't have been captured and located nearly as well before the network upgrade, says Emily Wolin, a seismologist with the USGS in Golden, Colorado.

Many of Myanmar's earthquakes are caused by the Indian tectonic plate that is diving beneath the country. Most of the rest come from the enormous Sagaing fault, one of the world's most active. It runs from north to south for more than 1,000 kilometres, through cities such as Mandalay and Yangon, putting more than 17 million people at risk[2].

The burgeoning array of research stations is helping to flesh out understanding of the area's geology. For instance, a team led by Shengji Wei of the Earth Observatory of Singapore, has used its own 30-station network to study the series of sedimentary basins that lie beneath Myanmar, and to help determine how earthquake energy travels through and shakes the ground[3]. The German group that is deploying stations this month aims to understand, among other things, how the crust is deforming near the border with India, says GFZ team leader Frederik Tilmann. And Sandvol and his colleagues are looking at whether the deep-diving India plate is broken or torn, and what that might mean for Myanmar's earthquake risk.

"It's an amazing opportunity for us scientists who have been interested in the area for a while," Sandvol says. ■

1. Thiam, H. N. *et al. Seismol. Res. Lett.* **88**, 926–934 (2017).
2. Xiong, X. *et al. Geophys. Res. Lett.* **44**, 4781–4789 (2017).
3. Wang, X. *et al. J. Geophys. Res. Solid Earth* https://doi.org/10.1029/2018JB016622 (2019).