CLIMATE

Geoengineering debate revives

UN group hosts high-level talks on controversial topic.

BY JEFF TOLLEFSON

The United Nations Environment Assembly is debating this week whether to launch a study of geoengineering technologies, which aim to cool the planet by reflecting sunlight away from Earth or sucking carbon dioxide out of the atmosphere.

A proposal backed by Switzerland and ten other countries would require the UN Environment Programme to prepare a comprehensive assessment of geoengineering by August 2020. The report would examine the underlying science and technology, and how to govern research and large-scale use.

"In principle, it's a big deal," says Ted Parson, who studies environmental law and policy at the University of California, Los Angeles. "This could be the start of the serious international deliberation on governance that has been needed for years."

A final decision by government ministers could come at the end of the UN assembly's meeting, which runs from 11 to 15 March in Nairobi. The resolution faces opposition from countries such as the United States and Saudi Arabia, and scepticism from non-governmental groups that oppose geoengineering.

Other UN bodies have considered geoengineering in the context of specific treaties. In 2010, the 196 member countries of the Convention on Biological Diversity called for a moratorium on geoengineering technologies; the non-binding decision includes exceptions for research. And in a series of decisions over the past decade, parties to the London Convention on ocean pollution have banned the commercial use of ocean fertilization — in which iron is released into the ocean to spur the growth of CO_2-absorbing algae — while laying out criteria for research.

But concerns about the global nature of solar geoengineering — the injection of reflective particles into the stratosphere — in particular have spurred efforts to give the governance debate more prominence within the UN. A fleet of high-flying aircraft could pump enough sulfur into the stratosphere to offset around 1.5 °C of warming for between US$1 billion and $10 billion annually, according to the Intergovernmental Panel on Climate Change. The relatively cheap price has spurred concerns that individual countries could eventually pursue such a programme on their own, with global consequences. ■

Agung volcano on the Indonesian island of Bali erupts in November 2017.

EARTH SCIENCE

AI could help to predict eruptions

Satellite data and machine learning allow researchers to keep an eye on unmonitored volcanoes around the world.

BY ALEXANDRA WITZE

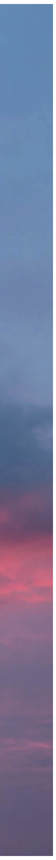
Volcanologists are combining satellite measurements of ground movements with artificial intelligence to more accurately monitor — and eventually predict — volcanic eruptions.

Although about 800 million people live within 100 kilometres of a volcano, very few of these potential natural hazards are monitored consistently. But emerging methods are now enabling researchers to keep a constant eye on volcanoes, says Juliet Biggs, a volcanologist at the University of Bristol, UK.

Her team will present its work, which uses machine learning to spot ground distortion around volcanoes, on 20 March at a conference in Santa Fe, New Mexico.

Biggs and her colleagues use radar observations from two satellites that make up the European Sentinel-1 mission. Depending on their location as they orbit Earth, the craft collect data on the world's volcanoes every 6, 12 or 24 days. As they repeatedly pass over the same spot, the satellites measure the distance between themselves and the ground. This can indicate whether that distance has changed over time — which can happen when the ground lifts or drops as magma shifts beneath a volcano.

But interpreting such data is not always straightforward. Water vapour in the atmosphere can mimic the signal of shifting ground, and researchers must account for this when looking at radar observations. These atmospheric distortions are particularly problematic when scientists are trying to work in near-real time.


DONAL HUSNI/ZUMA

Biggs and her team got an early glimpse of these challenges when they started studying Sentinel-1 images of the Agung volcano on the Indonesian island of Bali, in the lead up to a November 2017 eruption. Hundreds of small earthquakes had started shaking the region 2 months beforehand, forcing the evacuation of 140,000 people.

Atmospheric distortions around Agung complicated the team's efforts to study ground distortions around the volcano. But once Biggs and her colleagues had devised a way to correct for the atmospheric signals, they found that the ground had lifted by up to 10 centimetres on Agung's northern flank, towards a neighbouring volcano. That movement was a sign that magma was probably shifting in a natural plumbing system that connects the two volcanoes, the team reported[1] last month.

The researchers hadn't tried to predict the Agung eruption, but they "learned a lot by looking at this one example", Biggs says.

Team member Fabien Albino, a geophysicist at the University of Bristol, is now developing ways to correct for atmospheric distortions quickly, with the help of a weather model that runs in near-real time.

If it predicts atmospheric disturbances in a given area, then he can identify unusual signals in the satellite radar data that might be caused by water vapour rather than volcanic unrest. The work is still in its early stages, Albino says — but it could eventually provide a way to speed up assessments of what's happening in situations such as that at Agung.

Biggs and her colleagues are now aiming to monitor volcanoes more rapidly all around the globe. They have created a neural network that has churned through more than 30,000 Sentinel-1 images of more than 900 volcanoes, and has flagged about 100 images for closer examination. Of those, at least 39 were accurate detections of actual ground distortions, the team reported[2] last year. By getting an algorithm to do the initial work of sorting through the data, researchers save time that they can spend following up on volcanoes of interest, Biggs says.

The team is also training its neural network on synthetic data generated from simulated eruptions. That work roughly doubled the precision of the algorithm, says Pui Anantrasirichai, an electrical engineer at the University of Bristol who will present the work at the Santa Fe meeting.

ALTERNATIVE METHODS

At the University of Leeds, UK, a group led by geophysicist Andrew Hooper is developing another way to detect potential signs of unrest automatically. If the ground is already deforming at a volcano, his method will flag if that distortion starts to speed up, slow down or change in some other way[3]. That would allow researchers to detect even small ground alterations over long periods of time.

Both teams' ultimate goal is "to process data for all of the volcanoes, all of the time", says Hooper.

Other scientists, such as Matt Pritchard, a volcanologist at Cornell University in Ithaca, New York, are trying to develop algorithms that can spot changes in volcanoes using other satellite data, such as measurements of surface temperature, ash or gas emissions[4]. Working with Biggs and others, Pritchard hopes to use machine-learning techniques to sift through 17 years of data from NASA's Terra and Aqua satellites, which measure heat coming off erupting volcanoes on Earth.

But he and his colleagues are just getting started with their algorithms, which have a long way to go. For now, at least, undergraduate students are much better than the machines at picking out eruptions. ■

1. Albino, F., Biggs, J. & Syahbana, D. K. *Nature Commun.* **10**, 748 (2019).
2. Anantrasirichai, N., Biggs, J., Albino, F., Hill, P. & Bull, D. *J. Geophys Res. Solid Earth* **123**, 6592–6606 (2018).
3. Gaddes, M. E., Hooper, A., Bagnardi, M., Inman, H. & Albino, F. *J. Geophys. Res. Solid Earth* **123**, 10226–10251 (2018).
4. Furtney, M. A. *et al. J. Volcanol. Geotherm. Res.* **365**, 38–56 (2018).