Scientists watch giant ‘doomsday’ glacier in Antarctica with concern

Cracks and fissures stoke fears of breakup that could lead to half-metre rise in global sea levels – or more

Satellite view of Antarctica with the Thwaites glacier marked in red. Photograph: UniversalImagesGroup/UIG/Getty Images

John Vidal

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Twenty years ago, an area of ice thought to weigh almost 500bn tonnes dramatically broke off the Antarctic continent and shattered into thousands of icebergs into the Weddell Sea.

The 1,255-sq-mile (3,250-sq-km) Larsen B ice shelf was known to be melting fast but no one had predicted that it would take just one month for the 200-metre-thick behemoth to completely disintegrate.

- Glaciologists were shocked as much by the speed as by the scale of the collapse. “This is staggering. It’s just broken apart. It fell over like a wall and has broken as if into hundreds of thousands of bricks”, said one.

- This week, ice scientists meeting in New Orleans warned that something even more alarming was brewing on the West Antarctic ice sheet – a vast basin of ice on the Antarctic peninsula. Years of research by teams of British and American researchers showed that great cracks and fissures had opened up both on top of and underneath the Thwaites glacier, one of the biggest in the world, and it was feared that parts of it, too, may fracture and collapse possibly within five years or less.

- Thwaites makes Larsen B look like an icicle. It is roughly 100 times larger, about the size of Britain, and contains enough water on its own to raise sea levels worldwide by more than half a metre. It contributes about 4% of annual global sea level rise and has been called the most important glacier in the world, even the “doomsday” glacier. Satellite studies show it is melting far faster than it did in the 1990s.

- Thwaites is worrisome, but there are many other great glaciers in Antarctica also retreating, thinning and melting as the Southern Ocean warms. Many are being held back because Thwaites acts like a cork, blocking their exit to the sea. Should Thwaites fall apart, scientists believe the others would speed up, leading to the collapse of the whole ice sheet and catastrophic global sea level rises of several metres.

- Whether and how quickly they may collapse are some of the most important questions of the age. Sea levels are rising fast: the annual rate of increase more than doubling from 1.4mm to 3.6mm between 2006 and 2015, and accelerating. A few millimetres a year does not sound much but the loss of even a small part of Thwaites would not just help to speed this up further but would likely increase the severity of storm surges.

- Should all West Antarctica’s glaciers ever collapse, there is no coastal city in the world that would not, over time, be swamped at ruinous cost to life and economies.

- The consensus of glaciologists used to be that it would take centuries of global heating before glaciers the size of Thwaites shattered and collapsed, but so rapid and unexpected has been the loss of sea ice at the opposite end of the earth in the Arctic, and so sudden was the loss of Larsen B that it is now considered possible it could happen rapidly in Antarctica, too.
- Ice loss in the Arctic barely affects sea levels because it mostly forms at sea. Antarctic ice, however, is mostly on land so any melting adds to sea levels.
- The tipping point for the Larsen B ice shelf came suddenly. How Thwaites and other glaciers respond to global heating is still not known but these big global physical processes are under way and can be addressed only by global action.
- Yet just one month after Cop26 ended in Glasgow, the warning that the 300-metre thick, 50-mile wide Thwaites glacier has started to crack up has been met with silence from governments preoccupied by Covid-19 and the return of normal politics. The danger is that the many actions pledged in November to address global heating will be shelved for another year, to become just one more risk in an increasingly dangerous world.
- Thwaites underlines that global heating and glaciers do not wait for politicians, and every year action to reduce climate emissions is delayed only accelerates global disaster.
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- 14 December 2021

Giant cracks push imperilled Antarctic glacier closer to collapse

The demise of part of the huge Thwaites Glacier would hasten sea-level rise.

- Alexandra Witze

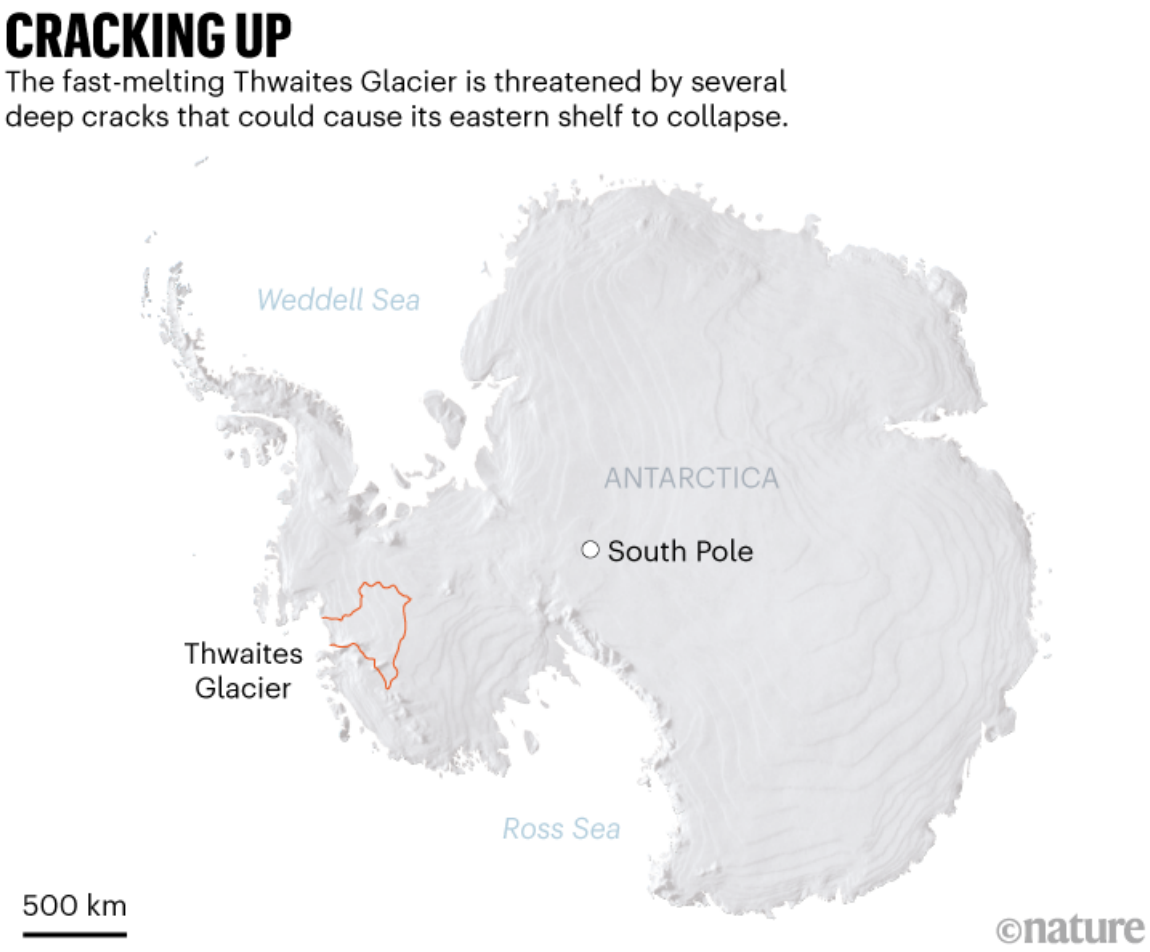
The Thwaites Glacier's fractures were identified in satellite imagery.Credit: NASA

Giant fractures in the floating ice of Antarctica's massive Thwaites Glacier — a fast-melting formation that has become an icon of climate change — could shatter part of the shelf within five years, research suggests. If that happens, in what had been considered a relatively stable part of Thwaites, the glacier could release an armada of icebergs and begin flowing much faster into the ocean, funnelling ice that had been resting on land into the sea, where it would contribute to sea-level rise.

For decades, scientists have carefully tracked changes in the Thwaites Glacier, which already loses around 50 billion tonnes of ice each year and causes 4% of global sea-level rise. The recently identified fractures are deep,

fast-moving cracks in Thwaites's eastern ice shelf (see 'Cracking up'). They have appeared in satellite images over the past few years and their growth seems to be accelerating.

"I visualize it somewhat similar to that car window where you have a few cracks that are slowly propagating, and then suddenly you go over a bump in your car and the whole thing just starts to shatter in every direction," said Erin Pettit, a glaciologist at Oregon State University in Corvallis, on 13 December at the American Geophysical Union (AGU) meeting. If Thwaites's eastern ice shelf collapses, ice in this region could flow up to three times faster into the sea, Pettit says. And if the glacier were to collapse completely, it would raise sea levels by 65 centimetres.



Brink of change

Pettit will describe the work on 15 December at the AGU meeting, which is being held in New Orleans, Louisiana. It is the latest finding from the five-year, US$50-million International Thwaites Glacier Collaboration, an initiative funded by the US and UK governments to study how Thwaites might contribute to rising sea levels in a warming world, and to understand the threat that this might pose.

“We have been expecting that ice shelf to fail, and that’s one of the reasons that there has been such a coordinated international effort to study Thwaites — it’s big and important, but it’s also been clearly poised on the brink of change,” says Kirsty Tinto, a geophysicist at the Lamont-Doherty Earth Observatory in Palisades, New York, who has studied the glacier. The latest work, she says, reveals more about how ice shelves fail. “Understanding those processes helps us to understand not just Thwaites, but also all the rest of Antarctica — past, present and future,” she says.

Mountain brace

Thwaites flows off the Antarctic continent into the Southern Ocean. At 120 kilometres across, it is the world’s widest glacier. Across about two-thirds of that expanse, ice flows relatively quickly into the ocean. The remaining one-third is the eastern ice shelf, where ice had been flowing more slowly[1]. In part, that’s because the ice grinds to a halt when it reaches an underwater mountain about 40 kilometres offshore. The submerged mountain holds back the ice flow like a cork in a bottle.

Earlier this year, members of the Thwaites collaboration reported that the glacier is becoming unstuck from that mountain, causing cracking and fracturing across other parts of the ice shelf[2,3]. Previous studies[4,5] have also shown hints of instability across Thwaites’s eastern ice

shelf. “It’s been something to keep an eye on for a long time,” says Matthew Siegfried, a glaciologist at the Colorado School of Mines in Golden.

The fractures caught the attention of Pettit and her colleagues two years ago, as they were looking through satellite images to work out where to set up camp for the season. One crack, nicknamed ‘the dagger’, was even heading straight towards the proposed camp site. It wasn’t moving fast enough for the scientists to relocate their work, but “we actually all just had to take a pause”, said Pettit. “It still was hugely surprising to me that this was changing that fast.”

The fractures are propagating through the ice at speeds of several kilometres per year. They are heading into weaker and thinner ice, where they could accelerate and lead to the demise of this part of the ice shelf within five years, Pettit estimates.

“There’s going to be a dramatic change in the front of the glacier,” said Ted Scambos, a glaciologist at the Cooperative Institute for Research in Environmental Sciences in Boulder, Colorado. “It will accelerate the pace and effectively widen the dangerous part of the glacier.”

Warm-water flows

How exactly the changes might happen isn't clear, says Siegfried, because many factors influence how ice shelves fall apart. They include how rapidly warm water melts the bottom of the floating part of the glacier, and the geometry of how ice, land and water interact.

One of the collaboration's recent discoveries is that ocean tides cause Thwaites's floating part to rise up at high tide and drop down at low tide. That up-and-down 'tidal pumping' — long suspected but rarely observed in detail — causes the glacier to flex farther upstream, including in the region where it flows off land and into the water. Seismic and radar data have shown that because of this flexing, warm water might be able to intrude beneath the glacier more easily, said Lizzy Clyne, a glaciologist at Lewis & Clark College in Portland, Oregon. "The existence and possible rapid formation of these features could have implications for the long-term stability of the ice shelf," they said.

The Thwaites collaboration completed its most extensive field-research season in 2019–20, before the COVID-19 pandemic interrupted the project. This Antarctic winter, which is under way, several research teams are again descending onto the ice to take measurements at various locations across the glacier. And a major research cruise in February aboard the US icebreaker *Nathaniel B.*

Palmer will study the ocean directly in front of the glacier's floating edge.

Each visit underscores how fast Thwaites is changing. Seeing this huge ice shelf moving towards you at about a mile every year is unsettling, said Scambos. "And all by itself, this one glacier is big enough to impact sea level significantly."

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Scientists warn a critical ice shelf in Antarctica could shatter within the next five years

By Rachel Ramirez, CNN

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Antarctica's Thwaites glacier is known as the "Doomsday glacier," due to the serious risk it poses during its melting process.

(CNN) As the rapidly heating planet alters the landscape of the Arctic region up north, scientists have discovered disturbing and alarming signs

at the southern end of the planet, particularly in one of the ice shelves safeguarding the Antarctic's so-called "Doomsday glacier."

Satellite images taken as recently as last month, which researchers presented at the annual meeting of the American Geophysical Union Monday, suggest the critical ice shelf keeping together the Thwaites glacier in western Antarctica — an important defense against global sea level rise — could shatter within the next three to five years.

Antarctica's Thwaites glacier is known as the "Doomsday glacier," due to the serious risk it poses during its melting process. It has dumped billions of tons of ice into the sea, and its demise could lead to irreversible changes throughout the planet.

- The glacier, which equals the size of Florida or Great Britain, already accounts for about 4% of annual global sea level rise, loses roughly 50 billion tons of ice each year, and is becoming highly vulnerable to the climate crisis. The fall of the ice shelf could bring the impending collapse of Antarctica's critical glacier.
- If the Thwaites collapsed, the event could raise sea levels by several feet, researchers say, putting coastal communities as well as low-lying island nations further at risk.

But Ted Scambos, a glaciologist at the University of Colorado Boulder, and a leader of the International Thwaites Glacier Collaboration, said it will still be decades before the world will see real acceleration and an additional uptick in sea level rise.

"What is attention-getting about Thwaites is that the change will proceed with fairly dramatic, measurable results within the next few decades," Scambos told CNN.

For now, the glacier is being held back by a critical floating ice shelf.

Antarctica's colossal Thwaites Glacier is melting fast -- and scientists may have discovered why

"What's most concerning about the recent results is that it's pointing to a collapse of this ice shelf, this kind of safety band that holds the ice on the land," Peter Davis, oceanographer with the British Antarctic Survey, told CNN. "If we lose this ice shelf, then the glacier will flow into the ocean more quickly, contributing towards sea level rise."

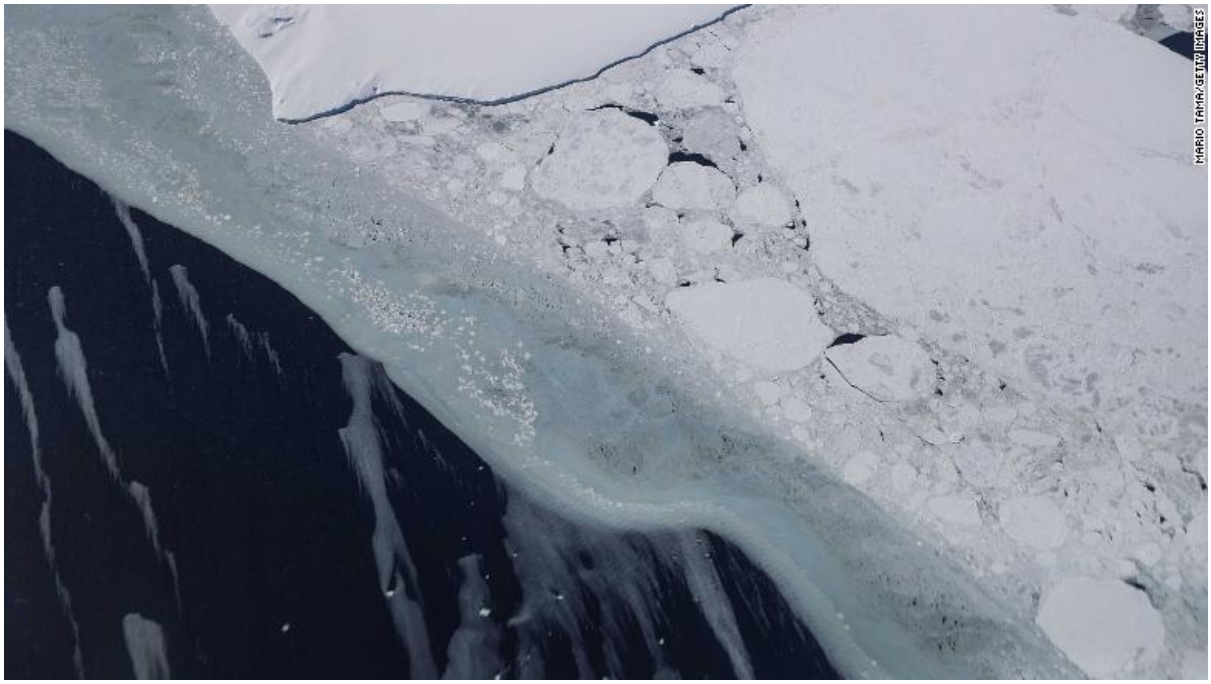
Warming ocean waters play a key role in driving the rapid deterioration. A 2020 study by the International Thwaites Glacier Collaboration, which is currently leading ongoing research in the Antarctic, found the ocean floor is deeper than scientists previously thought, with deep passages allowing warm ocean water to melt the underside of the ice.

The observations show the critical ice shelf keeping the Thwaites together is loosening its grip on the underwater mountain, or the seamount, which acts as a reinforcement against the ice river from flowing into the warm ocean. Researchers also found the so-called "ice

tongue" of the Thwaites Glacier is simply now a "loose cluster of icebergs," which no longer influences the stable part of the eastern ice shelf.

Warm water also threatens the so-called "grounding zone," where the ice meets the seabed. Davis and his team used hot water to drill access holes from the surface of the ice shelf and deep into the ocean cavity underneath. In doing so, they discovered not only are the ocean waters in the grounding line warm, by polar standards, but it is also salty, priming the landscape for further erosion.

Peter Washam, a research associate at Cornell University, who is also involved with the research, said the physical features of the grounding zone shows signs of chaos, such as warm water, rugged ice, and a steep, sloping bottom that allows the water to rapidly melt the ice sheet from below.



Sea ice floats as seen from NASA's Operation IceBridge research aircraft in the Antarctic Peninsula region, on November 4, 2017, above Antarctica.

"In the coming years, we expect the Thwaites grounding line in the region to slowly retreat up the seabed slope that it currently rests on as the warm ocean eats away at its underside," Washam told CNN. His team used an underwater vehicle called Icefin that makes it easier to study ice and water around and beneath ice shelves.

The bottom line, according to Davis, is Antarctica's Thwaites Glacier is rapidly deteriorating. The warm ocean water is slowly erasing the ice underneath, causing water to flow faster, fracturing more of the ice, and bringing the looming threat of a collapse even closer.

"From the satellite data, we're seeing these big fractures spreading across the ice shelf surface, essentially weakening the fabric of the ice; kind of a bit like a windscreen crack," he said. "It's slowly spreading across the ice shelf and eventually it's going to fracture into lots of different pieces."

An iceberg 80 times the size of Manhattan could destroy a fragile South Atlantic ecosystem

Scambos said while the process is extremely slow-moving and real impacts won't be felt until several decades later, it is nearly impossible to stop it.

"This is a geologic process, but happening at almost a human-lifetime scale," he said. "As a disaster for people alive today, it is extremely slow-

moving. The best path is to try to slow the forces that are pushing the ice in this direction."

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And as the ramifications of the climate crisis spread around the globe, the researchers say expanding scientific research to understand changes in both the Arctic and Antarctic regions is critical to planning mitigation strategies such as coastal defenses in vulnerable communities.

"We can't really do anything to stop this from happening," besides slowing it down, Davis said. "The way that we've gone with our carbon emissions so far has caused these changes to occur — and essentially, we're taking the consequences of what we've been emitting over the last couple of decades, if not longer."