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Cracking up: Ice turning to water, glaciers on the move - and a planet in peril

A new study proves it was global warming that sent an Antarctic ice shelf larger than Luxembourg crashing into the ocean. Geoffrey Lean reports

Nothing else quite like it has happened at any time in the past 10,000 years. In just over a month an entire Antarctic ice shelf, bigger than a small country, disintegrated and disappeared, altering world atlases for ever.

A new study shows that the catastrophic collapse of the Larsen B shelf, four and a half years ago, was man-made, not an "act of God". It is thought to have been the first time that a major disaster has been proved to have been caused by global warming.

Research at the blue-chip British Antarctic Survey in Cambridge, published last week, has identified the causes of "dramatic warming" of the eastern side of the Antarctic peninsula, where the vast, 3,250 sq km expanse of ice used to be. Gareth Marshall, the lead author of the study, says it marks "the first time that anyone has been able to demonstrate a physical process directly linking the break-up of the Larsen ice shelf to human activity".

The research has also linked the collapse to the hole in the Earth's protective ozone layer that opens up over the Antarctic every southern spring. Nasa scientists reported last week that this year's hole, at a massive 10.6m square miles, is bigger than ever.

It was in March 2002 that the ice shelf - thought to have been stable for thousands of years - suddenly gave way. In just over 30 days an unimaginable 500bn tonnes of ice shattered into tens of thousands of icebergs, drifting in the Weddell Sea. This one event dumped more ice into the Southern Ocean that surrounds Antarctica than all the icebergs of the past 50 years combined.

"This is staggering", said the British Antarctic Survey's Dr David Vaughan at the time. "It fell over like a wall and has broken as if into hundreds of thousands of bricks."

But he added that though man-made climate change was "one of the best candidates" for causing the abrupt break-up of the shelf - some 200 metres thick, and larger than Luxembourg - "I can't, with my hand on my heart, link it to global warming."

And a leading sceptic, Professor Philip Stott, emeritus professor of biogeography at the University of London, insisted that the collapse was "only to be expected", adding that "simplistic, apocalyptic statements about 'global warming' have more to do with myth than reality."

Last year, however, American research showed that no other collapse of this size has taken place in the past 10,000 years, and it is becoming ever clearer that the Antarctic peninsula, which juts some 800km from the frozen continent towards the tip of Latin America, is heating up faster than anywhere on Earth.

The new study reports that it has warmed by a relatively large 2.94C since 1951, six times higher than the global average.

The scientists say that the main cause of the exceptional rise in temperature has been a strengthening in warm westerly winds blowing on to the peninsula.

This warmth melted ice on the surface, forming pools. This water then trickled down through the ice, widening crevasses as it went, thus fracturing the shelf and setting it up to shatter.

The collapse of Larsen B, and less dramatic disintegration of smaller shelves on the peninsula over the past decade, has led to some ominous knock-on effects. Glaciers which had been held back by them have begun moving up to eight times more rapidly towards the sea.

Scientists report that this is happening to some 200 glaciers on the peninsula, 87 per cent of the total.

Melting glaciers have much greater consequences than disintegrating shelves. Since the shelves float on the sea, they do not raise its level when they disappear, any more than a melting ice-cube increases the level of water in a glass. But the ice from glaciers does, because it comes off the land.

Worse, the British Antarctic Survey has found that the same thing is beginning to happen to the vast west Antarctic ice sheet, which scientists had thought would not be affected for 1,000 years. Some 250 cubic kilometres of it is disappearing every year; Professor Chris Rapley, the survey's director, calls it "an awakened giant".

Already the frozen continent's melting ice is helping to raise sea levels around the world by some 2 millimetres a year, but this is expected to get far, far worse. If the entire west Antarctic sheet were to disintegrate, the waters would rise by six metres around the globe, submerging the world's coastal cities, including much of London.

It is much the same story in the north. The Arctic ice sheet (there are few ice shelves there since these protrude from land, and the North Pole is covered by sea) is shrinking alarmingly.

By last month, it dwindled by an area the size of Turkey over usual September levels, the fifth successive year that it has melted far more than normal. It reached its second- lowest extent ever, after 2005, and scientists believe that it would easily have set a new record if it had not been for an abnormally cool August.

Even so, a giant patch of open water the size of Indiana opened up in the supposedly permanent ice cover north of Alaska. And at one stage the ice north of Spitzebergen fragmented so much that, for the first time, a ship could have sailed unhindered all the way from there to the North Pole.

In all, the United Nations Environment Programme says, the extent of Arctic summer ice has shrunk by a quarter in the past half-century, and has lost almost half its thickness.

The rate of loss is accelerating rapidly. Since 1979 the ice has been diminishing by about 0.15 per cent a year. But in the past two summers this has jumped to 6 per cent.

Some scientists believe we are approaching the point of no return, where the process feeds upon itself. For as the white ice - which reflects heat - melts, it will be replaced by dark water, and this absorbs heat. So the ocean will get even warmer, causing even greater melting, until all the ice is gone.

At the same time, as *The Independent on Sunday* exclusively reported last year, glaciers in Greenland are melting even faster than in Antarctica.

In the past two years alone, the rate of loss has grown by 250 per cent.

Scientists fear that this too may soon become irreversible, causing the whole Greenland ice cap to disappear, raising sea levels by another seven metres.

The melting ice also sends more fresh water into the North Atlantic, disrupting the huge but delicate system of currents that brings the Gulf Stream to warm Britain and Northern Europe, in winter. Research last year showed that the current, which prevents these places from having the same cold climate as Labrador, has already slowed by 30 per cent.