



The North Cove, in Antarctic. A sizable chunk of Antarctica is doomed to an 'unavoidable' melt. Photograph: Michael Shortt/AP

Environment

Earth on verge of five catastrophic climate tipping points, scientists warn

Humanity faces 'devastating domino effects' including mass displacement and financial ruin as planet warms

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Many of the gravest threats to humanity are drawing closer, as carbon pollution heats the planet to ever more dangerous levels, scientists have warned.

Five important natural thresholds already risk being crossed, according to the Global Tipping Points report, and three more may be reached in the 2030s if the world heats 1.5C (2.7F) above pre-industrial temperatures.

Triggering these planetary shifts will not cause temperatures to spiral out of control in the coming centuries but will unleash dangerous and sweeping

damage to people and nature that cannot be undone.

“Tipping points in the Earth system pose threats of a magnitude never faced by humanity,” said Tim Lenton, from the University of Exeter’s Global Systems Institute. “They can trigger devastating domino effects, including the loss of whole ecosystems and capacity to grow staple crops, with societal impacts including mass displacement, political instability and financial collapse.”

The tipping points at risk include the collapse of big ice sheets in Greenland and the West Antarctic, the widespread thawing of permafrost, the death of coral reefs in warm waters, and the collapse of atmospheric circulation in the North Atlantic.

Unlike other changes to the climate such as hotter heatwaves and heavier rainfall, these systems do not slowly shift in line with greenhouse gas emissions but can instead flip from one state to an entirely different one. When a climatic system tips – sometimes with a sudden shock – it may permanently alter the way the planet works.

Scientists warn that there are large uncertainties around when such systems will shift but the report found that three more may soon join the list. These include mangroves and seagrass meadows, which are expected to die off in some regions if the temperatures rise between 1.5C and 2C, and boreal forests, which may tip as early as 1.4C of heating or as late as 5C.



Mangrove forests can protect land areas from rising sea levels and coastal abrasion, but they

are at risk. Photograph: Hotli Simanjuntak/EPA

The warning comes as world leaders meet for the Cop28 climate summit in Dubai. On Tuesday, Climate Action Tracker estimated that their emissions targets for 2030 put the planet on track to heat 2.5C by the end of the century, despite promises from countries at a previous summit to try to limit it to 1.5C.

The tipping point report, produced by an international team of 200 researchers and funded by Bezos Earth Fund, is the latest in a series of warnings about the most extreme effects of climate change.

Scientists have warned that some of the shifts can create feedback loops that heat the planet further or alter weather patterns in a way that triggers other tipping points.

The researchers said the systems were so tightly linked they could not rule out “tipping cascades”. If the Greenland ice sheet disintegrates, for instance, it could lead to an abrupt shift in the Atlantic Meridional Overturning Circulation, an important current that delivers most of the heat to the gulf stream. That, in turn, can intensify the El Niño southern oscillation, one of the most powerful weather patterns on the planet.

The co-author Sina Loriani, from the Potsdam Institute for Climate Impact Research, said tipping-point risks could be disastrous and should be taken very seriously, despite the remaining uncertainties.

“Crossing these thresholds may trigger fundamental and sometimes abrupt changes that could irreversibly determine the fate of essential parts of our Earth system for the coming hundreds or thousands of years,” he said.

In its latest review of climate change science, the Intergovernmental Panel on Climate Change found that tipping thresholds were unclear but the dangers would grow more likely as the planet heats up.

It said: “Risks associated with large-scale singular events or tipping points, such as ice-sheet instability or ecosystem loss from tropical forests, transition to high risk between 1.5C to 2.5C and to very high risk between 2.5C to 4C.”

The tipping point report also looked at what it called “positive tipping points”, such as the plummeting price of renewable energy and the growth in sales of electric vehicles. It found that such shifts do not happen by themselves but need to be enabled by stimulating innovation, shaping markets, regulating business,

and educating and mobilising the public.

A study from the report's co-author Manjana Milkoreit last year warned against overusing the label of social tipping points by promising solutions that did not exist at scale or could not be controlled.

“While scholarship benefits from hope, we need to exercise caution when offering social tipping points as potential solutions to the temporal squeeze of climate change,” she wrote.