EARTH

Dispelling the Doomsday Myth: New Research Reveals There Is No Global "Ticking Time Bomb" in Permafrost Thaw

BY ALFRED WEGENER INSTITUTE, HELMHOLTZ CENTRE FOR POLAR AND MARINE RESEARCH — JUNE 12, 2024 4 COMMENTS

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Permafrost, often viewed as a ticking timebomb for climate change, actually thaws in response to numerous local and regional tipping points rather than a singular global one, a study by the Alfred Wegener Institute reveals. Immediate action is vital to mitigate the cumulative effects of these tipping points and preserve permafrost as a significant carbon reservoir. Credit: SciTechDaily.com

Experts from AWI have not discovered any evidence of a global climate tipping point related to permafrost; instead, they observe that permafrost soils are thawing in alignment with global warming trends.

Permafrost soils contain substantial amounts of organic carbon and are frequently described as a crucial tipping point in the Earth system, potentially collapsing suddenly and globally once a certain degree of global warming is reached. However, this portrayal of permafrost as a ticking timebomb that activates abruptly at a specific warming threshold is contentious among researchers. A recent study led by the Alfred Wegener Institute reveals that this depiction is misleading, according to the latest scientific evidence.

According to their findings, there is no single global tipping point; rather, there are numerous local and regional ones, which "tip" at different times, producing cumulative effects and causing the permafrost to thaw in step with climate change. As such, taking decisive action today is all the more important if our goal is to preserve as much permafrost as possible. The study was just released in the journal *Nature Climate Change*.

Permafrost ground covers roughly a quarter of the landmass in the Northern Hemisphere and stores tremendous quantities of organic carbon in the form of dead plant matter. As long as it remains frozen, this matter remains intact – but when permafrost thaws, microorganisms begin breaking it down, releasing large amounts of carbon into the atmosphere as CO_2 and methane. Accordingly, rising temperatures worldwide could activate this massive reservoir and substantially worsen climate change through additional emissions. Consequently, in the public debate, you'll frequently encounter the idea of a "ticking carbon timebomb."

The eroding cliffs at Herschel Island. The Alfred Wegener Institute Helmholtz Center for Polar and Marine Research (AWI) commenced research in the western Canadian Arctic with the funding of the young researcher project titled Coastal ***Permafrost*** *Erosion. Credit: Alfred Wegener Institute / Boris Radosavljevic*

This is based on the assumption that the permafrost, like the Greenland Ice Sheet, is one of several tipping elements in the Earth system. In this view, permafrost will initially experience only gradual thawing in response to global warming; then, once a critical threshold value is surpassed, the thawing processes will suddenly begin amplifying one another, leading to the rapid and irreversible collapse of permafrost across the Arctic. Though many have speculated that this type of thawing scenario is possible, to date it has remained unclear whether there really is any such threshold value, and if so, what the corresponding temperature limit is.

Research Findings on Permafrost Thawing

An international research team led by Dr Jan Nitzbon from the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI) has now gotten to the bottom of this question. “In fact, the idea of permafrost being a global tipping element is a controversial one in the research community. The IPCC also pointed out this uncertainty in its latest Assessment Report,” says the AWI expert. “Our goal was to close this gap in our knowledge. For our study, we compiled the available academic literature on those processes that can influence and accelerate the thawing of permafrost. Combining it with our own data analysis, we

assessed all current findings on thawing processes in terms of whether and, if so, on which spatial scale – local, regional, global – they could lead to self-perpetuating thawing and therefore to a 'tipping' in connection with a given level of warming."

The study's findings are clear: there are indeed geological, hydrological, and physical processes that are self-amplifying and, in some cases, irreversible; however, these are acting only locally or regionally. One example: the formation of what are known as thermokarst lakes. Here, the ice inside permafrost soils melts, creating depressions. The meltwater collects at their surface, producing a dark lake that absorbs large quantities of solar energy. This in turn intensifies the warming of permafrost underneath the water, creating a self-sustaining thawing process in and around the lake. They also found similarly amplifying feedback in other permafrost-relevant processes, like the loss of boreal conifer forests due to fire – but here, too, only at the local to regional scale.

"There is no evidence of self-amplifying internal processes that, from a certain degree of global warming, affect all permafrost and accelerate its thawing globally," Jan Nitzbon explains. "Moreover, the projected release of greenhouse gases wouldn't lead to a global upsurge in warming by the end of the century. As such, portraying the permafrost as a global tipping element is misleading."

But that doesn't mean Arctic permafrost is nothing to worry about – on the contrary, the study clearly shows that the permafrost zone is very heterogeneous. Consequently, numerous small, local tipping points will be exceeded at different times and warming levels, accumulating over time. As a result, the global thawing of permafrost will not constitute a gradual increase followed by a sudden surge; rather, it will intensify in step with global warming, ending with the total loss of the permafrost once global warming reaches 5 to 6 degrees Celsius.

"That means more and more regions are already or soon will be inevitably affected by thawing," says the AWI researcher. "In other words, there is no safety margin of warming – as the image of the tipping point suggests – that we can still exploit as long as we don't exceed the threshold value. That's why we need to keep a close eye on the permafrost regions through even better monitoring, gain a better grasp of the processes involved, and

represent them in climate models to further reduce the sources of uncertainty. And one more thing is clear with regard to the greenhouse-gas emissions-based permafrost loss: the sooner that humankind can achieve net-zero emissions, the more regions can be preserved as unique habitats and carbon reservoirs."

Reference: "No respite from permafrost-thaw impacts in the absence of a global tipping point" by Jan Nitzbon, Thomas Schneider von Deimling, Mehriban Aliyeva, Sarah E. Chadburn, Guido Grosse, Sebastian Laboor, Hanna Lee, Gerrit Lohmann, Norman J. Steinert, Simone M. Stuenzi, Martin Werner, Sebastian Westermann and Moritz Langer, 3 June 2024, *Nature Climate Change*.
DOI: 10.1038/s41558-024-02011-4

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4 COMMENTS

Clyde Spencer on June 13, 2024 10:17 am

“A recent study led by the Alfred Wegener Institute reveals that this depiction is misleading, according to the latest scientific evidence.”

The descriptor, “tipping point,” is pejorative as it conjures up images of a falling tree or tower, never to be upright again. That is improbable on geologic time scales. The choice of its use raises questions about the motives of those using it because there are more accurate descriptions such as an accelerated or abrupt change in rate. Therefore, my ‘BS detector’ is activated. When I read a paper using the term “tipping point,” what immediately comes to mind is that the author(s) don’t have strong evidence and use words that appeal to the reptilian part of the brain to disguise the fact that their evidence is weak. I expect better from those who call themselves scientists. At the very least, it is actually a poor analogy.

REPLY >

Harry P on June 13, 2024 11:08 am

They didn’t intentionally sensationalize the risk, did they?

REPLY >

Clyde Spencer on June 13, 2024 4:07 pm

I won’t claim to know what they are thinking. However, it seems to me that the two most probable explanations are that 1) they aren’t thinking about the impact of their words, or 2) they are purposely using words to scare the public. Neither explanation makes them look particularly competent.

REPLY >

r on June 13, 2024 6:18 pm

The article is saying basically,”Mony a mickle maks a muckle”. Rather like playing Bridge; the laydown “No Trumps” hand is extremely rare. CS can probably work out the numerical odds against that occurring, even though at some time it is likely to occur, and even then it has to be bid and indeed played correctly if it is to be achieved.

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