Scientists call for 'major initiative' to study whether geoengineering should be used on glaciers

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A group of scientists have released a landmark report on glacial geoengineering—an emerging field studying whether technology could

halt the melting of glaciers and ice sheets as climate change progresses.

The white paper represents the first public efforts by glaciologists to assess possible technological interventions that could help address catastrophic sea-level rise scenarios.

While it does not endorse any specific interventions, it calls for a "major initiative" in the next decades to research which, if any, interventions could and should be used.

"Everyone who is a scientist hopes that we don't have to do this research," said Douglas MacAyeal, a professor of geophysical sciences with the University of Chicago who has studied glaciers for nearly 50 years and is a co-author on the white paper. "But we also know that if we don't think about it, we could be missing an opportunity to help the world in the future."

The paper is the result of two recent conferences at the University of Chicago and Stanford University on geoengineering—catalyzed and encouraged by the newly formed Climate Systems Engineering initiative at UChicago, which seeks to understand the benefits, risks, and governance of technologies that might reduce the impacts of accumulated greenhouse gases.

Tipping points

Scientists have documented major changes in every major glacier system worldwide. As climate change continues, these massive ice sheets will release more and more water, which will lead to rising global sea levels—the oceans have already risen by 8 to 9 inches since the late 1800s.

Most of the ice that would affect global sea levels is concentrated in a

few areas in the Arctic and Antarctic. This has prompted speculation about whether it would be possible to slow or halt this melting, such as by installing walls around ice sheets to insulate them from warming ocean water.

But any such intervention could have major consequences, ranging from costing large amounts of money for little effect to majorly disturbing Arctic ecosystems and livelihoods—and there are many questions to answer before any such effort could be undertaken.

"It will take 15 to 30 years for us to understand enough to recommend or rule out any of these interventions," said co-author John Moore, a professor with the Arctic Center at the University of Lapland.

"Our argument is that we should start funding this research now, so that we aren't making panicked decisions down the road when the water is already lapping at our ankles," said MacAyeal.

The report is also clear that the first order of business is to stop emitting carbon into the atmosphere. "We can never say often enough that that is the first priority," said Moore.

But it is also possible that ice sheets have a tipping point for collapsing—and that we have already passed it.

"Humans have already released so much carbon dioxide that we are seeing profound changes in every glacier system around the world," said MacAyeal. "Many of these are likely to have a tipping point where even if we were to stop emitting all carbon worldwide tomorrow, the system would still collapse. And we are not in a position now to say that we haven't already crossed those points."

Types of interventions

The two conferences, one held at the University of Chicago last October and the other at Stanford University in December, brought together dozens of glaciologists, engineers and related disciplines.

The participants summarized our current knowledge of glacier science, and discussed two major categories of glacier interventions that have been proposed to date.

The first category consists of some type of berms or fiber-based "curtains" moored on the seabed around the feet of ice shelves, which would prevent warm water from undermining them. (The biggest threat to ice sheets is actually warmer ocean water, rather than hotter air temperatures.)

"From preliminary studies, the actual engineering required might be smaller than you might think," said MacAyeal. "For example, the Thwaites Glacier in Antarctica might require as little as 50 miles of seabed nets and curtains to make a difference."

The other major category of intervention is trying to slow the flow of streams that carry meltwater off the ice sheets. As an ice sheet melts, streams form and carry that melting water to the sea; the hypothesis is that reducing the amount of that water would cause the ice stream to freeze up and halt melting.

One way to reduce the flow might be to drill holes down to the glacier bed—to either drain water from below the ice before it affects the glacier, or to try to artificially freeze the glacier bed.

But both benefits and drawbacks remain unclear for both sets of approaches, scientists said. It's possible that seawalls could simply deflect warm water to nearby ice shelves; the installation also would disrupt local sea life and the lives of people who live nearby. Meanwhile,

the drilling approach might be less harmful to ecosystems, but it might also not be very effective, and would require a lot of engineering under harsh conditions.

The report also emphasizes that any such interventions would need to be conducted with input from nations worldwide, not just the wealthiest. It calls for "robust participation of sociologists, humanists, ecologists, community leaders, scientific and engineering governing bodies, international treaty organizations, and other relevant stakeholders in guiding the research."

In particular, testing these approaches is most likely to be done in the Arctic, which is orders of magnitude easier to access than the Antarctic. But thousands of people live in and depend on the Arctic, including many Indigenous peoples. "It is imperative that any of these interventions be done in concert with these voices," Moore said.

'Vigorous debate'

The report identifies major areas of research for the future, including identifying what natural processes might limit ice sheet deterioration and human interventions that could enhance those processes; and what the window of opportunity for implementing interventions might be.

The group called for a major initiative which would conduct "vigorous debate" of the ethical, social justice, and governance of glacial interventions, recommend areas of immediate research need, and engage local and international stakeholders.

"We want to give future generations as much glaciological knowledge as possible in case they need it," said MacAyeal.

More information: The full white paper is available online.

Provided by University of Chicago

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