Action: Reducing Global Sea Level Rise by Ice Sheet Conservation Using Seabed Anchored Curtains

Sea level rise is probably the single biggest impact of global warming, with effects on the majority of the world's nations and their inhabitants. As temperatures rise globally, existing sea water expands in volume. This part of sea level rise is difficult to prevent given the huge reservoir of heat in the ocean. More critically, the warming climate causes ice sheets and glaciers in Greenland and Antarctica to lose billions of tons of mass, adding significant amounts of water to the ocean.

The consequences will be severe: increased flooding, coastline erosion, damage to key infrastructure, lost habitat for plants and animals. Within the next eighty years, the World Economic Forum estimates around 400 million people to be at risk because of sea level rise. Limiting the collapse of Antarctic and Greenland ice sheets would benefit both rich and poor countries alike and provide transgenerational benefits far into the future. It is thus the most ethical and egalitarian way of tackling sea level rise.

Sea level rise by the Antarctic and Greenland ice sheet collapse could be reduced if the ice sheets could be conserved. The largest concern for rapid sea level rise is the collapse of parts of the West Antarctic ice sheet where ocean melting has already destabilized ice so much that, when released, it will raise the ocean by a meter or more globally. The Thwaites Glacier (a.k.a. the "Doomsday Glacier") is likely already in an unstable regime as its protecting ice shelf is thinned by deep intruding currents of relatively warm seawater.

To counteract the melting, our group of internationally renowned glaciologists, oceanographers and engineers propose a system of flexible barriers – curtains – to limit access of warm deep ocean currents that would allow the vulnerable ice shelves to thicken, reground and buttress the inland ice. Modelling indicates that this idea is not only implementable, but also immensely less costly than the alternative – to wait and face the sea level rise. While we know this is doable, there are still needs for testing, modelling, finding optional solutions, and, importantly, ensuring political support for a functional solution.

We are looking to raise $3 million for activities to remove risks, and prepare for full scale implementation of this concept.

When funded, we aim at completing the following steps over four years that prepare the idea for full scale:

1) Build a north-south **partnership** among nations with common interest in stopping and delaying sea-level rise:
   a) Ensure Greenlandic and other Arctic Indigenous peoples' leadership
   b) Develop partnership with a group of concerned nations to identify a global financing mechanism
   c) Ensure buy-in by Antarctic Treaty and other relevant bodies

2) **Document** beyond doubt the effect on sea level rise effect:
   a) Quantify the impact of targeted ice sheet conservation engineering on the Amundsen Bay region in Antarctica
   b) Produce optimized engineering designs, and a step-by-step progression ladder of learning from demonstration, through Greenland to Antarctica for targeted ice sheet conservation

3) **Prepare** for full scale test:
   a) Create a demonstration of a seabed curtain efficacy at one-kilometre scale in a safe Arctic marine environment
   b) Ensure full reversibility of the curtain
   c) Ensure curtain design has minimal environmental impact (use degradable materials, minimizing impact on local ecosystem etc.)

The research on this concept is advanced, and ready to move closer to implementation.

Political anchoring:

The key to success is to remove remaining uncertainties, and have strong leadership for this project concept by countries like Greenland which is a natural test bed before implementation in Antarctica. Further, Small Island States will be natural stakeholders in this project. Implementation on full scale will also require support from influential developed nations. The project group includes partners with long-term experience in building partnerships among the above.

Legal and treaty experts say early research into ice-sheet stabilization could readily proceed under the present Antarctic Treaty system and operation may even benefit Antarctic governance. Economists have proposed financing instruments – but much is still uncertain, such as ecosystem impacts and how to actually make a financing system operational. Despite the difficulties and risks resulting from severe ice conditions, these barriers could be installed with existing technology at lower cost, manageable impact, and better global equity than coastal protection.

Technology:

Simulations of our proposed barrier system help restabilize the Thwaites and Pine Island Glaciers and slow down/stop their melting. We have illustrated the technical viability of this approach by considering curtain design concepts that should withstand oceanographic forces, and plausible methods of installation.

Installing in polar waters presents severe challenges from icebergs, harsh weather, and brief working seasons, which can, however, be overcome with present-day and widely used deep-sea construction techniques. An 80-kilometre-long curtain installed over a decade in 600-meter-deep waters could help stabilize Pine Island and Thwaites Glaciers at much lower cost ($40-80 billion once + $1-2 billion/year maintenance) than the global coastline protection needed due to their collapse (~$40-50 billion/year).

Using state-of-the-art ice/ocean computer models, we will examine the impacts of installing seabed curtains on ocean circulation, ecology, and ice sheet. We need to verify that the curtains do their job and are reliable in various conditions using high resolution simulations of curtains and ocean currents. We will also examine the acceptability of conserving the ice sheets with respect to the public's ideas of nature and Antarctica, Antarctic Treaty, and Greenlandic legal protocols, impacts on tourism, shipping safety, and the blue economy. We will utilize the extensive new datasets being gathered by the International Thwaites Glacier project; deepening the on-going collaborations with international modelling, physical experiments, engineering, legal and governance expertise will add to design competence.

Designs will also be tested in tank or river experiments, and, assuming no red flags, finally outdoors testing in a stratified ocean environment with currents similar to those in the Amundsen Sea, not necessarily in a glaciated fjord, but to test curtain durability and effectiveness over a period of one year.

Learn more and find out how you can contribute:

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