

Geoengineering Delay of Climate Change Sea-Level Rise?

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1. Introduction

This is not my problem, but a major problem for much of humanity:

At current rates, global warming will force coastal cities to contend with about 1 meter of sea level rise by 2100, according to a 2021 report from the Intergovernmental Panel on Climate Change. But some researchers predict worse, warning that the ice sheets on top of Greenland and Antarctica, which store enough water to cause many more meters of global sea level rise, are already past tipping points. Even if humanity curbs emissions and warming slows, they say, these ice sheets may still collapse in the coming centuries. Better to begin research now on how to staunch sea level rise at its source, rather than spending billions to wall off coastal cities, says John Moore a glaciologist at the University of Lapland and an author of a white paper sponsored by the University of Chicago (UC) that proposes a radical solution...¹

The Whitepaper, released last week by glaciologists after a series of workshops and town halls, calls for boosting research into daring plans that would protect vulnerable ice sheets by building flexible barriers around them or drilling deep into them to slow their slippage into the sea.

2. The Larger Problem

As I said above, this is not (directly) my problem. My primary residence (Livermore, CA) is approximately 400 ft above sea level, and my mountain home (Arnold, CA) is at 4,000 ft. However, a large percentage of humanity has settled on the coasts for many very good reasons:

- Coastal areas are homes to large metropolitan regions due to ocean commerce
- Coastal areas are also tourist areas due to beaches and other attractions
- Inland transportation networks also use these areas as hubs due to the first bullet and their large populations

Furthermore, because of the very cold off-shore California Current System, California has (to date) not seen any significant damage from tropical storms. However, that brings up another issue for other coastal areas.

Ocean temperatures have been heating up over the past century, and hitting record highs for much of the past year, driven primarily by the rise in greenhouse gas emissions from burning fossil fuels. Scientists estimate that more than 90% of the excess heat produced by human activities has been taken up by the ocean.²

¹ Hannah Richter, Science Magazine (on-line), "Scientists at odds over wild plans to slow melting glaciers," July 19, 2024, <https://www.science.org/content/article/avoid-sea-level-rise-some-researchers-want-build-barriers-around-world-s-most>

² The Conversation, via WLRN Public Media and WFIT, "The warming ocean is leaving coastal economies in hot water," June 25, 2024, <https://www.wfit.org/environment-and-science/2024-06-25/the-warming-ocean-is-leaving-coastal-economies-in-hot-water>

That warming, hidden for years in data of interest only to oceanographers, is now having profound consequences for coastal economies around the world...

Warmer ocean water fuels tropical storms. It's one reason forecasters are warning of a busy 2024 hurricane season.

Author's Comment: As of early August, the U.S. has already had one major hurricane, Debbie. This hurricane came ashore in the Florida Big Bend area, then went northeast and headed up the east coast, producing record rainfall and flooding.

Also, as of August 10, *"Elsewhere in the tropics, a new tropical wave in the Atlantic is likely to become a tropical depression early next week as it approaches the Lesser Antilles and Caribbean Sea. If it does become a named storm, it will be Ernesto."*

August 28 Update on Hurricane Ernesto from Wikipedia:

Ernesto caused significant flooding in Puerto Rico before striking Bermuda as a hurricane. Ernesto developed east of the Leeward Islands. The storm moved towards the Antilles, impacting several nations. Ernesto then turned north, where it reached Category 2 strength, before making landfall in Bermuda as a Category 1 hurricane on August 17. Ernesto then weakened back to a tropical storm before intensifying back into a hurricane and brushing Atlantic Canada, becoming extratropical by August 20.

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Tropical storms pick up moisture over warm water and transfer it to cooler areas. The warmer the water, the faster the storm can form, the quicker it can intensify and the longer it can last, resulting in destructive storms and heavy downpours that can flood cities even far from the coasts.

When these storms now come in on top of already higher sea levels, the waves and storm surge can dramatically increase coastal flooding...

The accumulated ocean heat and greenhouse gases in the atmosphere will continue to affect ocean temperatures for centuries, even if countries cut their greenhouse gas emissions to net zero by 2050 as hoped. So, while ocean temperatures fluctuate year to year, the overall trend is likely to continue upward for at least a century.

3. Potential Solutions

One idea is to build buoyant "curtains," moored to the sea floor beyond the edge of ice shelves and glaciers, to block currents of warm water that erode ice sheets from below. (Especially in Antarctica, warm ocean water is a bigger threat to glaciers than warm air.) Early curtain designs called for plastic, but natural fibers such as canvas and sisal are now being considered to avoid pollution concerns. According to the white paper, initial modeling studies show that curtains reaching only partway up from the sea floor off the coast of western Antarctica could reduce glacial melting by a factor of 10 in some locations. Another possible intervention is to slow slipping ice sheets by drilling holes to their bases and pumping out water or heat.¹

Such massive engineering efforts would surely be some of the most expensive ever undertaken by humanity. At a UC workshop in October 2023, researchers suggested it might cost \$88 billion to build 80 kilometers of curtains around Antarctic glaciers. Such projects would require fleets of icebreakers, extensive shipping and supply chain needs, and significant personnel to construct, maintain, and guard the final structures in harsh ocean conditions. The projects could also have unintended consequences, such as disrupting ocean circulations or endangering wildlife. Furthermore, it would take decades to find out whether the interventions were working.

Even if the engineering and logistics were possible, that “does not answer the question of whether it should be pursued,” says Twila Moon, a glaciologist at the U.S. National Snow and Ice Data Center who opposes even preliminary studies on the concepts.

The white paper acknowledges some of the common arguments against glacial geoengineering, including that it might disincentivize reducing carbon emissions. The report takes pains to say it “does not advocate for intervention; rather, it advocates for research into whether any interventions may be viable.” The distinction is crucial, says David Keith, faculty director of UC’s Climate Systems Engineering initiative and a leading voice on solar geoengineering. Just as more researchers have come to accept the validity of solar geoengineering research, if not its implementation, so, too, will they eventually be OK with glacial geoengineering research, he predicts.

4. Let Climate Change Have Its Way?

The looming disasters described above operate on very long time-frames. It is already too late to mitigate much of this disaster, given the long times to reach a consensus, engineer solutions and manufacture the machinery to implement those solutions. But of course, the longer we wait, the worse the impact will be. For low-lying areas like much of the southeastern and Gulf coasts, even one meter of sea-level rise coupled with intensifying tropical storms will initially require many miles of inland retreat.

Also, how many years would an initial retreat buy the residents, before they needed to retreat again? And then there is the anticipatory disaster: once it becomes evident what is happening, forget getting home loans, homeowner’s insurance, or any type of government investments in areas to be impacted.

I believe that it is just a matter of time until the current, and perhaps immediate future population in these areas become generally aware of the above issues. Then there will be a period where this population starts unloading their investments, but those early escapees will probably not lose a huge percentage of their investments. However, eventually the average price of these assets will start declining at an accelerating rate.

The one group that may be able to both slow this decline and make some money in the process are short-term rental landlords. Even though potential investors of most types will shy away from these properties, they will still be very desirable vacation rentals, and probably will rent for a premium. However, these landlords should keep in mind the risks highlighted above, and also spread their investments geographically to avoid being wiped out by one major storm.