Biodegradable Solutions for Ice Sheet Restoration

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I. Abstract

Glacial melt has greatly impacted coastal communities and animal habitats of many regions. As greenhouse gas emissions increase each year causing higher global temperatures, the shrinking of polar ice caps continues to influence a variety of factors across a multitude of ecosystems. Scientists estimate that glacial melt can cause extreme winters (caused by the destabilization influence of warmer air on polar jet streams), intense heat waves coastal flooding, food crises, wildlife endangerment, and permafrost loss (causing trapped potent methane to release into the atmosphere, exacerbating greenhouse gas emissions) (Hancock 2019). We propose a dispersal method of reflective biodegradable sheets ("plastic" made of cassava starch, which is compostable, non-toxic, and edible) across glacial areas (Antarctic, Arctic, Glacial regions in Iceland, etc.), acting as a sunlight reflectors to restore ice reflectivity (which prevents Earth from absorbing sunlight and heat, regulating temperatures) and lower global temperatures. This will be accomplished using solar-powered drones.

II. Summary

1. Our proposal aims to influence a decline in global temperatures by slowing the melting of polar ice caps. This will be accomplished through boosting ice reflectivity through the use of biodegradable reflective sheets dispersed across glacial areas using drones. Our method has the potential to reduce temperatures by up to 1.5 degrees celsius or more.
2. Glacial melt, as discussed in the abstract, is a highly impactful issue causing various ecosystems and communities to suffer. The process is largely attributed to overreliance

on fossil fuels, the subsequent exponential growth in greenhouse gas emissions, and warming global temperatures.

3. Glacial melt is an incredibly problematic issue with the potential to impact billions of people if left unchecked. This continued process can exacerbate all climate change related issues, triggering more extreme weather situations, droughts (and starvation caused by food crises), and mass extinctions of species, among other effects (Harlock 2019). In the interest of resolving/mitigating some of these issues, it is crucial to implement solutions immediately. For context, if solutions like ours were not implemented as soon as possible, we would be facing a world in which sea levels would rise up to 62 meters (203 ft). Millions of coastal inhabitants would be displaced, billions of refugees and internally displaced peoples would be forced to compete for limited land, and areas of agricultural productivity would decrease (triggering mass starvations) (Hamill 2019).

III. Other solutions & insufficiencies

1. One relevant solution to glacial melt is Ice911's silica beads method: similar to our proposal, Ice911 involves dispersing small amounts of reflective silica across glacial areas to increase reflectivity.
2. The aforementioned solution is extremely new (first tested in 2018), and has not yet been put into use at a large scale. According to the founder of the company, Leslie Field, it is still in its "field-test stage."

3. Ice911's technology was developed for the same purpose as our proposal. Field reports that the creation process involved grinding silica and oxygen compounds into reflective glass "beads."
4. Ice911's mechanism is simple- the glass beads are dispersed across Arctic areas (the method of dispersal is **not** specified on their website), and the beads accomplish the same goal as our biodegradable sheets. The beads boost ice reflectivity, decreasing the impacts of greenhouse gasses and global warming within the region.
5. Ice911's ideas closely correlate to ours. Strengths of their research include strong monitoring technology (drones, buoys, etc.) and satellite use to study success. However, there are few factors which make Ice911's solution problematic.
    a. First, Ice911 uses silica beads. On their website, the researchers claim that silicate glass is harmless to marine animals and humans. This is not true. Silicate glass (This material can be found in both a crystalline and amorphous form. Ice911 does not disclose which form of silica their product uses. However, they do mention that their form of silica is highly abundant in Earth's crust. This indicates that their solution uses crystalline silica, which is significantly more dangerous, and more abundant in Earth's crust-see "Eurosil" study.) can be highly toxic and dangerous to breath in, causing silicosis, lung cancer, and other respiratory diseases. It is also a carcinogen to humans. Ice911 notes that their silica beads are too large to inhale, but they cite **no research** against the idea that large agglomerated amounts of silica can combine with other materials (forming polymers and even plastics), which can be ingested by marine animals at toxic

levels. This is especially concerning, because this method of scattering large quantities of beads across the Arctic could easily accumulate (Weber 2001). Furthermore, regardless of whether or not Ice911's beads are "too large" to breath in, repeated exposure to silica can cause chronic/classic silicosis in mammals, which can be triggered by low exposure to the compound. Last, crystalline silica has **not been proven to be biodegradable** (due to contradictory evidence of the quality, see "The Enzymes" Study), and there is little current research on the long-term effects of ingesting it, **regardless of whether or not it is a "naturally occurring substance" according to Ice911.**

6. Our solution improves upon Ice911's ideas in a few ways.
    i. First, our sheets are biodegradable, edible, and non-toxic. Unlike Ice911 which uses speculative data (not based on true empirics or long term longitudinal studies), our solution is 100% safe for marine life.
    ii. Second, we detail the dispersal process. Unlike Ice911, which does not explain how beads will be scattered, we detail that solar-powered drones will be utilized in our mission.
    iii. Third, using sheets instead of beads will not only prevent choking hazards among marine animals, but also increase the effectiveness of the solution. This is because sheets have larger surface areas, and therefore higher potential to reflect sunlight than spheres (beads).

IV. Our solution

7. Previously stated, our solution shall influence a decline in global temperatures by delaying the deterioration of the polar ice caps. We propose the use of biodegradable reflective sheets dispersed across glacial areas using drones. Our method has the potential to reduce temperatures by up to 1.5 degrees celsius or more. The Ice911 solution involves dispersing small amounts of reflective silica across glacial areas to increase reflectivity. However, this method is harmful to the environment and the life forms of the arctic. Our biodegradable, edible, marine-safe and non-toxic sheets mitigate this insufficiency. Other research groups have not specified how they bring their idea to the glaciers; however, our theory is to utilize solar-powered drones to disperse the sheets. Using sheets instead of beads will not only prevent choking hazards among marine animals, but also increase the effectiveness of the solution. This is because sheets have larger surface areas, and therefore higher potential to reflect sunlight than spheres (beads).

V. Anticipation of any obstacles

The technology that this research requires is very feasible, seeing as it already exists. We suppose that it could be a struggle to find drones that are powerful enough to carry these sheets across large landmasses and spread them out evenly and effectively. We would also have to take caution when approaching the ecosystems of the arctic and be sure not to cover up any main food sources to the animals, or access to shelter/water. Other than that, we believe that this method could be highly beneficial to our earth's glacial habitats. By covering areas that are not highly

populated by any endangered or other arctic species, this solution should not harm any animals or take away any means of survival.

VI. Bibliography

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