Ice911- Restoring Arctic Albedo Through Rebuilding Ice Reflectivity in the Arctic

Leslie A Field[1,2] and Alexander Sholtz[1]

1. Ice911 Research, Menlo Park, CA, United States. 2. Stanford University, Palo Alto, CA, US.

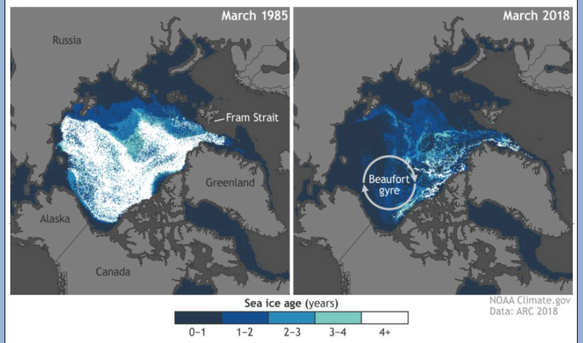
With thanks to Subarna Bhattacharyya, Detelina Ivanova and Velimir Mlaker at Climformatics and Scripps Institute of Oceanography

Polar Technology Conference 2020

leslie@ice911.org
alex@ice911.org
www.ice911.org

Abstract

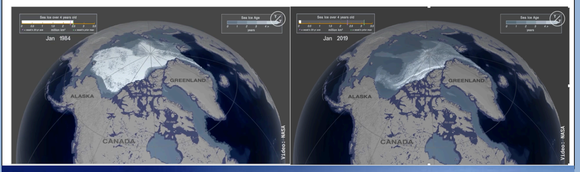
The Earth's Arctic ice cover has diminished rapidly. NOAA reported in December 2018 that 95% of the most-reflective multi-year ice has disappeared over the past 40 years.



The effects of this lost reflectivity in the Arctic is to increase the net energy influx to the Arctic accelerating heating locally and worldwide, as well as affecting the jet stream, all leading to increasing climate-related impacts on populations and ecosystems worldwide.

When considering any interventions to attempt to restore global ecosystems, the safety and reversibility of these interventions must be considered a key metric. As an example, the focus of our work is to restore a natural ecosystem (reflective multi-year ice in the Arctic) that was there until very recently. Our focus is on using a safe material, hollow glass microspheres, made of components (primarily silica) that are ubiquitous in the Earth's ecosystem, and that are not in a respirable range, and that do not have a tendency to take up oil-based or other toxic pollutants.

Jan 1984 **Jan 2019**



No Natural Way Back for Arctic Ice

According to the NOAA Report Card 2019, sea ice extent at end of summer 2019 tied as 2nd lowest in satellite record (1979-2019). Don Perovich has said, "Back in March of 1985, old ice comprised about 30% of Arctic sea ice cover. Now, it's about 1%."

This loss in reflectivity leads to a positive feedback of increased radiative forcing that adds a substantial acceleration to global warming, and there seems to be no prospect of an unaided recovery of multi-year reflective ice under current conditions.

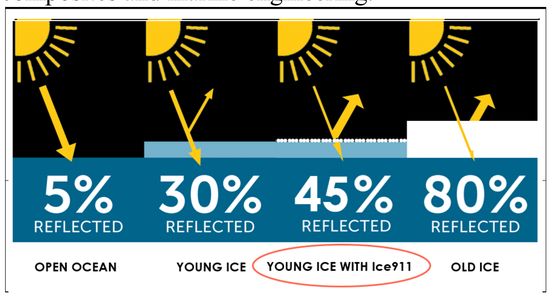
Ice Albedo Restoration

Enhancing ice albedo artificially appears a promising lever to restore Arctic sea ice.

We reported our development (Field et al. 2018, *Earth's Future*, 6, 10.1029/2018EF000820) of an innovative technology using reflective hollow glass spheres (HGMs) with low environmental impact that shows promise to restore Arctic Sea Ice. These HGM's are mostly silica, and can be thought of as a form of floating sand. They are used In buildings, medical composites and marine engineering.

Hollow glass microspheres

Silica is ubiquitous & hydrophilic (most abundant material on planet, does not bind with oil-based pollutants)

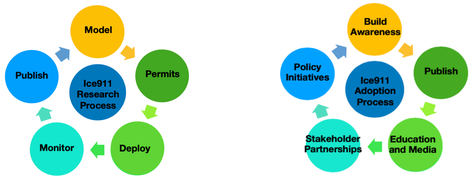


By applying a thin layer of HGM's on thin young ice, we could boost its reflectivity enough to help delay its melt, and over time, restore Arctic reflectivity.

We have conducted small field tests and climate modeling studies to research and develop the method.

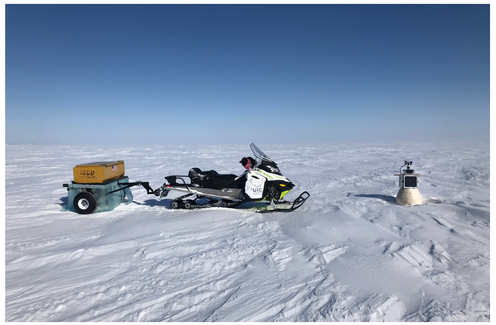
Controlled Tests

Ice911 is undertaking controlled tests of the performance of the material on sea ice conditions at the Sea Ice Environment Research Facility (SERF) at the University of Manitoba as well as tests in Utqiagvik at the Barrow Naval Arctic Research Lab, in parallel with additional laboratory testing for materials parameter optimization. We have done eco-toxicological lab testing of the materials on representative fish and bird species, and are seeking partners to extend these assessments. Below is a representation of our parallel efforts in assessing technical and safety performance, as well as the needed safety, governance and regulatory work.



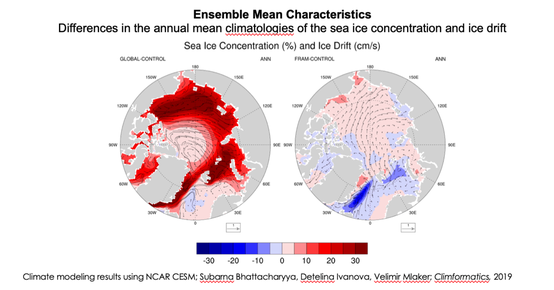
Small-Scale Field Tests

Field tests of the materials on snow and lake ice, have been done in 4 main test locations, always with permissions and transparency.



Potential Impact of Albedo Modification

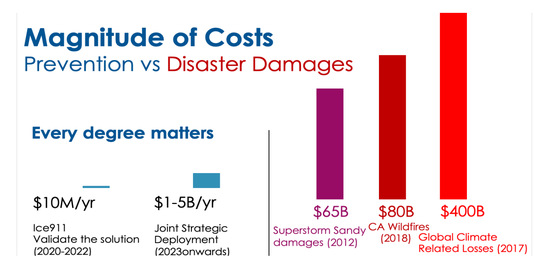
Extensive climate modeling and impact assessment of this technology has shown the potential to restore reflective Arctic ice. Recent results focus on a proposed localized targeted treatment deployed regionally in the Fram Strait. The results show leveraged beneficial impact, Arctic-wide, of albedo modification in the Fram-Strait in the neutral phase of the Arctic Oscillation.



Climate modeling results using NCAR CESM; Subarna Bhattacharyya, Detelina Ivanova, Velimir Mlaker; Climformatics, 2019

This result indicates a potentially profound impact on ice restoration using albedo modification, over limited areas of the Arctic such as the Fram Strait and potentially the Beaufort Gyre.

The approach shows a great potential to reduce climate devastation while humanity makes urgently needed transitions to a sustainable economy, at a modest cost, compared to the savings from averted disaster and loss of life by rebuilding Arctic albedo.



We seek further collaboration to accelerate the work in field testing, modeling, biogeochemical aspects, and policy and governance outreach.

CLEAN TECH OPEN 2013 SEMIFINALIST

SUSTAINABLE SILICON VALLEY

NEX NASA Earth Exchange