

# “First Do No Harm” Approaches to Restoring Arctic Albedo

Leslie Field<sup>1</sup> and Alexander Sholtz<sup>2</sup>

<sup>1</sup>Ice911 Research; Stanford University

<sup>2</sup>Ice911 Research

November 23, 2022

## Abstract

The Earth’s Arctic ice cover has diminished rapidly. NOAA reported last December 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. We will detail these and further safety considerations in such approaches in our presentation.



# “First Do No Harm” Approaches to Restoring Arctic Albedo

Leslie A Field<sup>1,2</sup> and Alexander Sholtz<sup>1</sup>

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

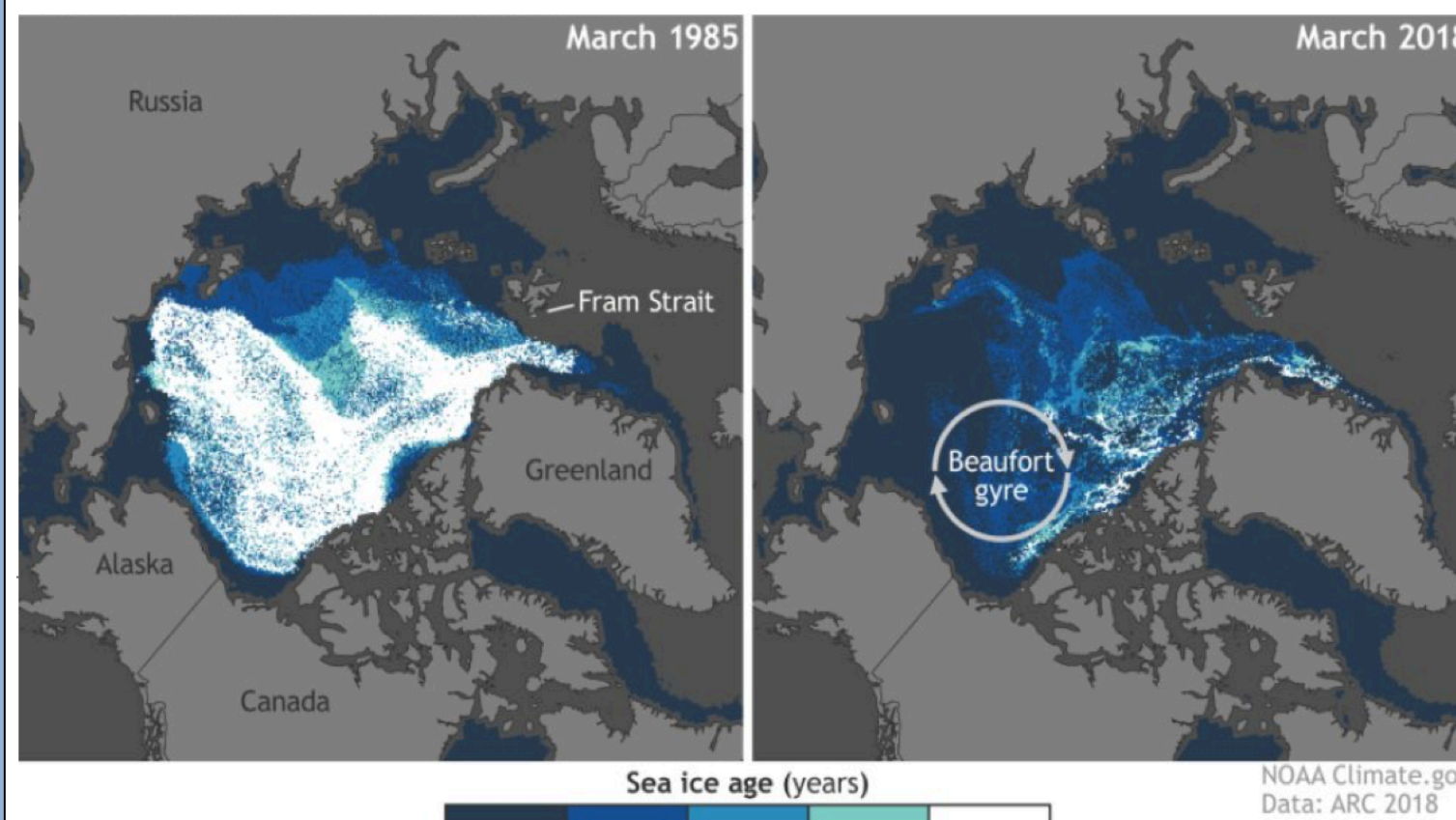
Poster

GC33F-1445

[leslie@ice911.org](mailto:leslie@ice911.org)  
[www.ice911.org](http://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.

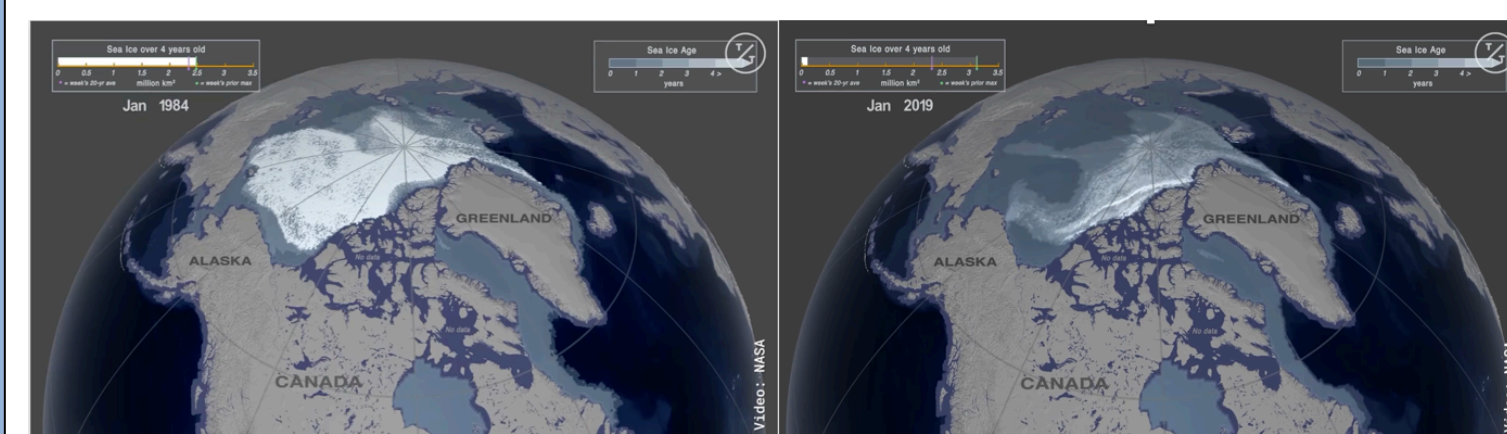


The effects of this lost reflectivity in the Arctic is to increase the net energy influx to the Arctic accelerating heating locally and worldwide, as well as affecting the jet stream, all leading to increasing climate-related impacts on populations and ecosystems worldwide.

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



Cool solutions for a melting world

Ice911 gives the world time to develop and implement longer-term solutions and sustainable energy alternatives.

## No Natural Way Back for Arctic Ice

According to the NOAA Report Card 2019, sea ice extent at end of summer 2019 tied as 2<sup>nd</sup> 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.

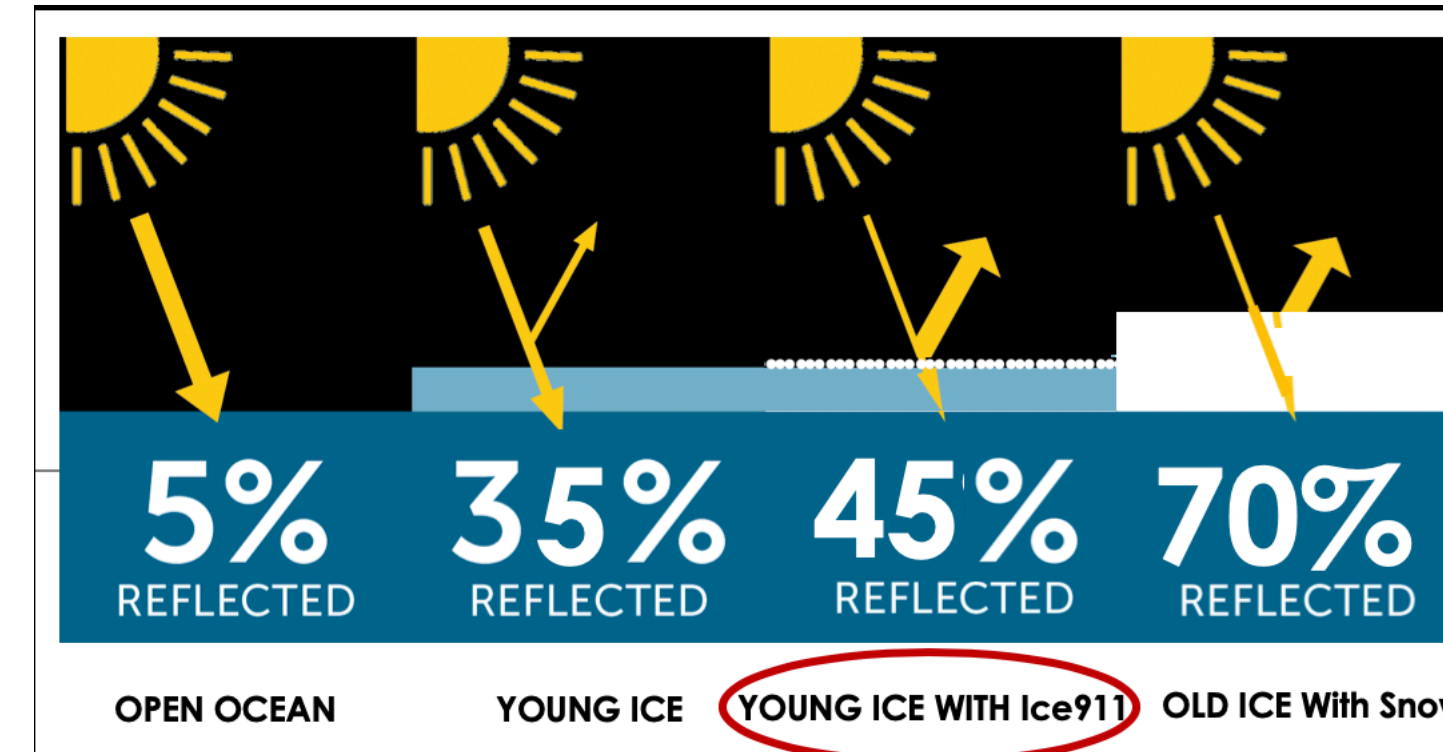
## Ice Albedo Restoration

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

### Hollow glass microspheres

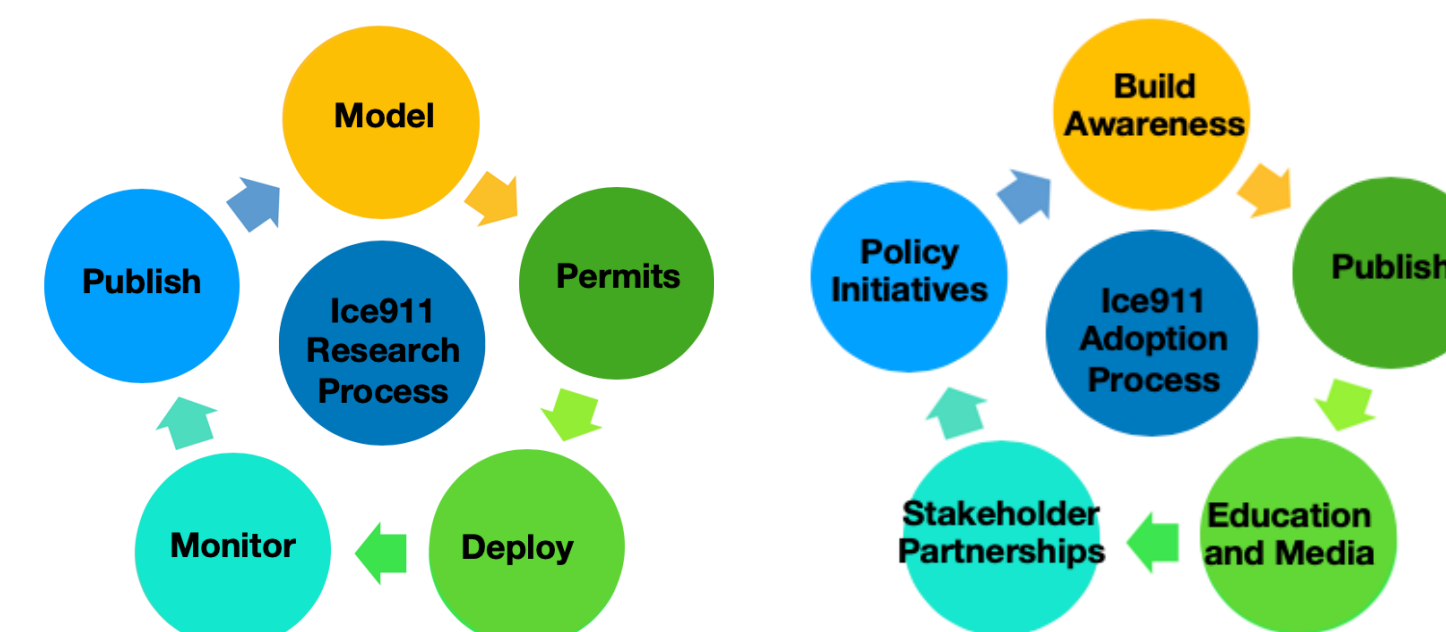
Silica is ubiquitous & hydrophilic (most abundant material on planet, does not bind with oil-based pollutants)



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.

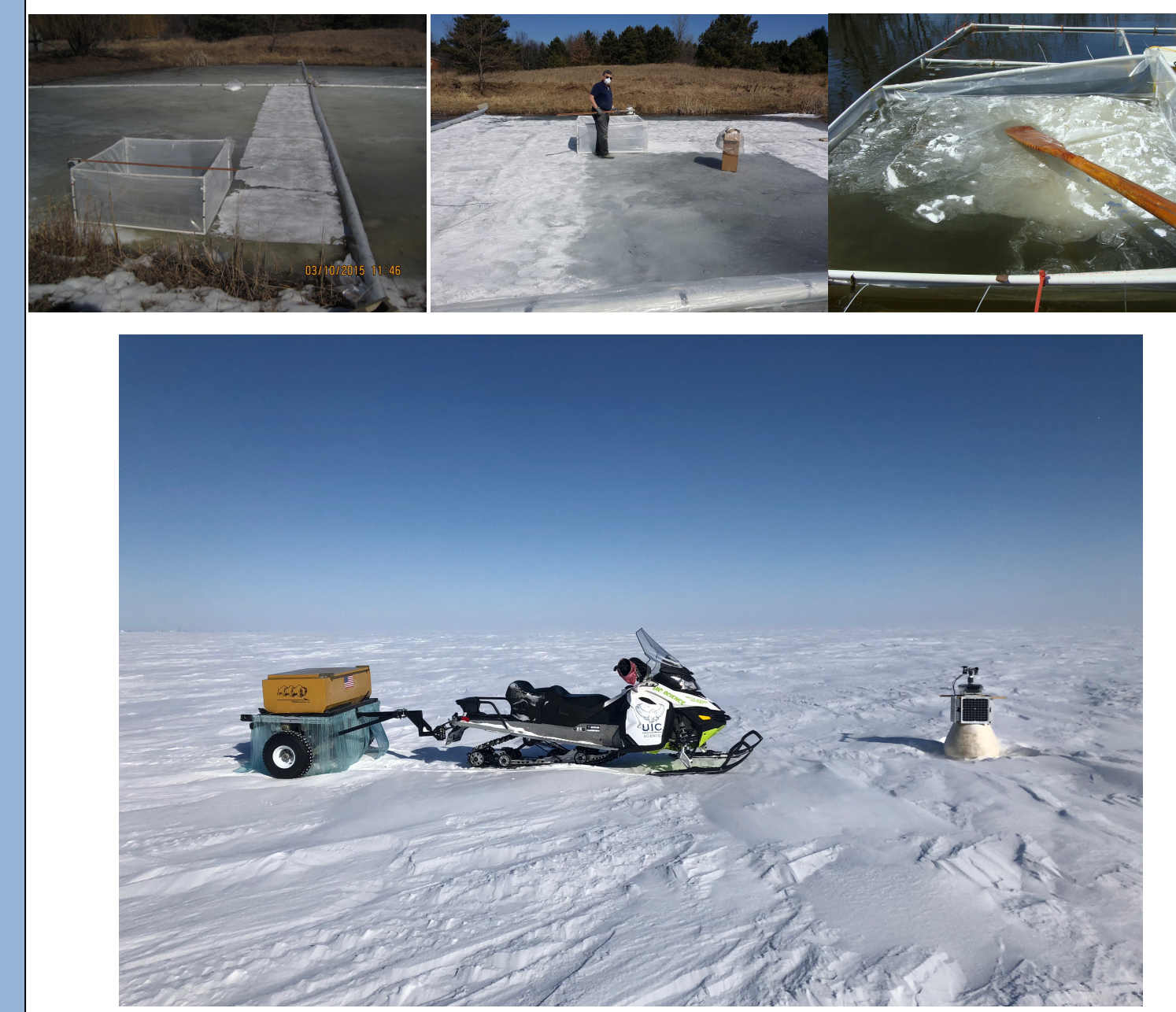
## Ice911’s 2-Thread Approach

As important as developing and vetting the technical approach, with full feedback of laboratory tests and materials characterization, climate modeling, gaining permissions to do small field tests, deploying and monitoring those tests for effectiveness and safety, and publishing the results - is the parallel work of helping to develop local collaboration, policy, permitting and governance structures, and building awareness and transparency through collaborative partnerships, education, social media, and non-technical publications and presentations.



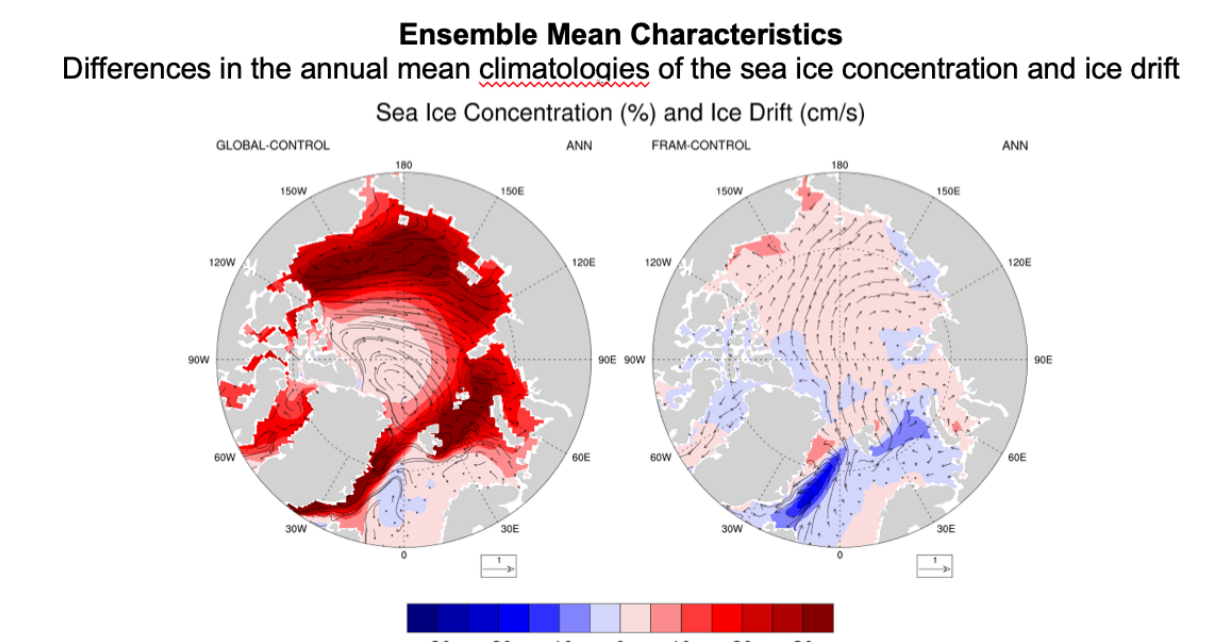
## Small-Scale Field Tests

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. More modeling details are in Poster GC33F-1444 in this conference.



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 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.

## Magnitude of Costs

Prevention vs Disaster Damages

Every degree matters

\$10M/yr

Ice911  
Validate the solution  
(2020-2022)

\$1-5B/yr

Joint Strategic  
Deployment  
(2023onwards)

\$65B

Superstorm Sandy  
damages (2012)

\$80B

CA Wildfires  
(2018)

\$400B

Global Climate  
Related Losses (2017)

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



Ice911 Research invites you to an AGU Town Hall Meeting!

Friday, December 13<sup>th</sup> 12:30 - 1:30 pm Moscone West - 3014, L3

TH53L - Panel Description: “Climate Restoration Solutions”

