Ice911 Research: A Reversible Localized Geo-Engineering Technique to Mitigate Climate Change Effects: Field Testing, Instrumentation and Climate Modeling Results

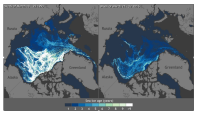
Leslie A Field[1, 2], Alexander Sholtz[1], Satish Chetty[1,4], Tony Manzara[1], Doug Johnson[1], Evangelos Christodoulou[1], Roman Decca[1,2], Paul Walter[1,2], Kalyan Katuri[1], Subarna Bhattacharyya[3], Detelina Ivanova[6], Velimir Mlaker[3], Donald Perovich[5]

ICE911

CLIMFORMATICS

Why High-Albedo Arctic Ice Loss Matters

The situation in the Arctic is urgent. Roughly 75% of Arctic ice has melted over the past several decades from warming global temperatures and the Ice-Albedo Feedback Effect. The new ice that grows each winter has low albedo (reflectivity) and melts quickly during the next warm season, and little of the high-albedo multi-year ice remains.



These realities lead to increased risks from tipping points already underway, including rapid oceanic warming (17°C sea surface Temp in Chuckchi Sea Aug. 2014[6]) and methane released from melting permafrost and frozen sediments[6], which can lead to further heating and increased sea level rise.

Rebuilding Arctic Ice and Albedo

One way to locally increase ice albedo is to spread a thin layer of materials on top of the ice. Always with appropriate permits, we have tested various safe materials including various types of sheets and hollow glass spheres, and an evolving array of monitoring instrumentation on sections of small ponds in locations in California's Sierra Nevada Range, Alberta, Canada, Minnesota, and the BEO area in Barrow, AK.

We've modestly scaled up our deployment methods and ruggedized our monitoring and communications methods for our work in the Arctic. In various field test locales, we've observed a delay in ice melt beyond that seen in surrounding untreated control areas. For small areas of shallow ponds influenced by untreated control pond areas, surrounding shores and pond bottoms, this delay is a significant result. To move beyond showing feasibility, and to make an impact on Arctic ice and climate stabilization, we will need to move beyond small-scale tests. Before scaling up in the field, climate modeling is required. We're working w/ Climformatics to study the effect of raising sea ice albedo. We've asked them to help evaluate specific areas of the Arctic that could have the most leveraged impact for the greatest positive effect with the least treatment, such as the Fram Strait.

Climate Modeling

Objective: **To investigate the regional and large scale climate impact of local changes in the Arctic sea ice albedo.**

We study how the changes in sea ice albedo impact:

- Sea ice concentration
- Sea ice area
- Sea ice volume
- Sea ice thickness
- Sea ice export
- Arctic temperature
- Global temperature

Modeling & Simulation: Simulate the effect of Ice911 material by perturbing the sea ice albedo in key Arctic regions using climate model.
We use the NCAR Community Earth System Model (CESM) - fully coupled climate model which consists of atmospheric, ocean, land and sea ice components interacting and exchanging water and energy fluxes via coupler.

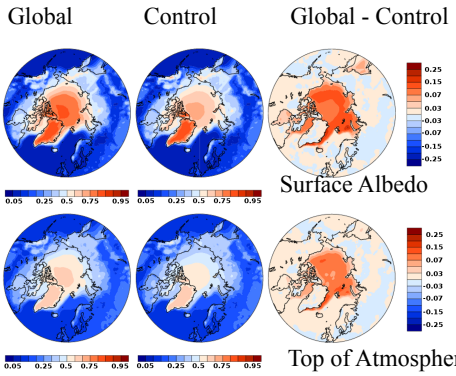
In Conclusion

Increasing Arctic albedo can reduce polar ice melt. Brightening specific target areas can be accomplished within a reasonable time to lessen the risks of Arctic tipping points, at a cost much lower than the climate impacts that seem likely with no intervention. We have been asked to lead the Arctic Restoration Action Group, and to carefully evaluate the proposed options to increase Arctic albedo. We invite serious collaborations in this important work.

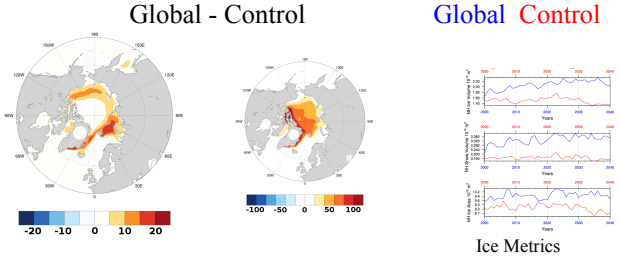
Leslie Field Phd- leslie@ice911.org

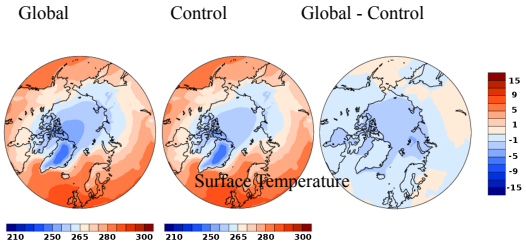
www.Ice911.org

Results Show Impact of Increasing Albedo

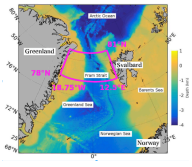


Albedo Modification Increases Ice Metrics

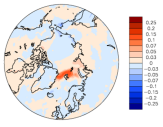




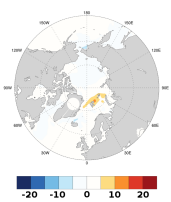
Preliminary Target Deployments



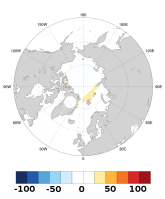
Fram - Control



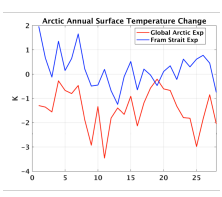
Surface Albedo increase over Fram



Ice Concentration
% Increases



Ice Thickness
cm Increases



Arctic Temperature
Decreases