An Airborne Sunshade for the Arctic

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SkyScroll
skyscroll.earth

INTRODUCTION

- Repairing the Arctic is the most urgent problem in geoengineering [1]
- The best-understood approach, SAI, cannot easily target the Arctic [2]
- Other approaches to refreezing the Arctic are unproven [2,3]
- Reflecting sunlight directly would work, i.e. a "space sunshade"
  - Space sunshade "mass at least 100,000 times as much as the ISS" [4]
- *Proposition*: A lighter-than-air **airborne sunshade**[5] would be quicker, cheaper & more targeted then a space sunshade

SPACE OR AIRBORNE SUNSHADE

	Space	Airborne
Position	L1 Lagrange point	Lower stratosphere
Altitude	1,500,000 km	10 km - 20 km
Cost	$ trillions[3]	$ billions
Coverage	global	targeted
Impact	constant	controllable
Current Tech?	No [3]	Yes
Timescale	~50 years[3]	~10 years

PROPOSED PLATFORM

Figure 1: An Example AI Rendering of a "SkyScroll" in Operation
Actual width could be ~10km

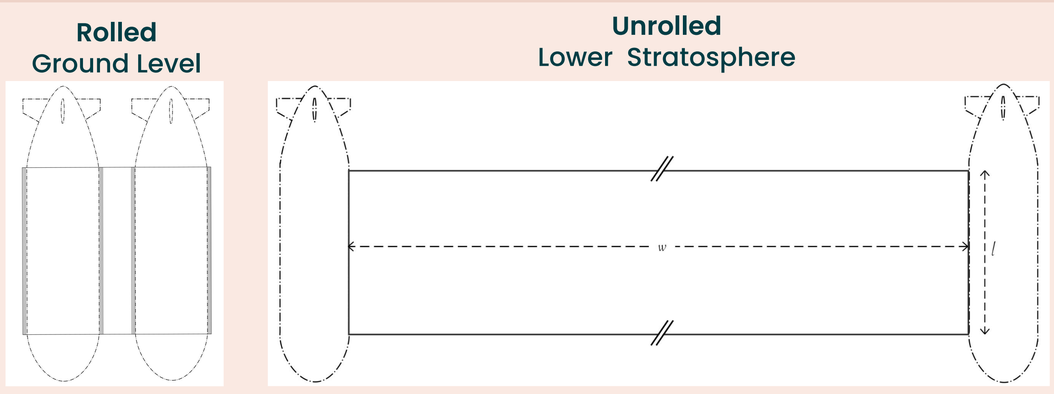


Figure 2: SkyScroll [6] Rolled and Unrolled
In a full-scale example, $\boldsymbol{l}$ = 200m, $\boldsymbol{w}$ = 10km

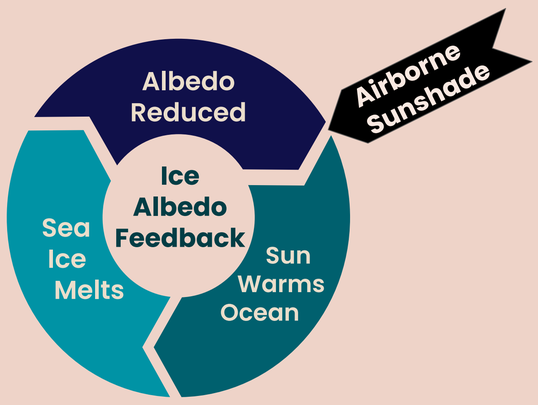
- A reinforced flat envelope, deployed by two cylindrical guide airships,
- The guide airships are autonomous and solar powered
- Manufacturing could be carbon neutral

	At Take-Off	During Ascent	At Target Altitude
Guide Airships	Filled with lifting gas (LG)	• Rotating to unroll • LG expanding	• Steering & maintaining tension • Could be detached
Flat Envelope	Empty and rolled	• Being unrolled • Filling with LG	• Fully unrolled & filled with LG • Neutrally buoyant & horizontal

ARCTIC TARGETS

Time of Year	Targetting Scenarios
May - July	A: Open sea exposed as the sea-ice retreats from northern coasts (see *Ice-Albedo Amplifier*)
July - Aug	B: Sea-ice with a high melt pond fraction. Melt ponds are a key factor in accelerated ice loss
Aug - Sept	C: Open water in the Beaufort Gyre, potentially helping to preserve multi-year ice
Oct - Apr	D: No targets or access. Polar night, and. high winds from polar vortex. Antarctic summer.

ICE-ALBEDO AMPLIFIER?



- The ice-albedo feedback is natural cycle of warming
- Decrease in SIE leads to ocean warming and further ice melt.
- Solar heating June-Aug, explains ~70% of variability in min. SIE [7]
- An *airborne sunshade* could shade open water in this period
- Interrupting the feedback, would *amplify* the impact of shading

PREDICTED IMPACTS

To test *scenario A*, a simple empirical model of the ice-albedo feedback in the central Arctic, was fitted to MASIE-NH 4km data on sea-ice extent (SIE)[8]. The model was re-run with additional shading, simulating the airborne sunshade.

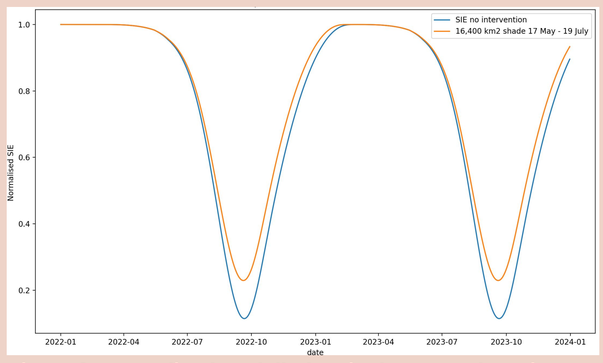


Figure 3: Normalised Modelled SIE in the Central Arctic

As shown in Figure 3, in this simple and idealised model, the impact of shading ~16,000 km^2 of open sea May-July increases minimum SIE by ~800,000km^2. The area of sea-ice preserved could be up to ~50 times the area shaded.

CONCLUSION & IP STATEMENT

- There is significant potential for using an airborne sunshade to help preserve Arctic sea-ice
- Initial empirical modelling suggests the area of sea-ice preserved could be up to 50 times the area shaded
- More realistic physical modelling is required, using a high-resolution regional model

SkyScroll

The SkyScroll platform is being patented in Europe, USA, China & India. This IP will be licensed **at zero cost** to *non-commercial* entities, including universities & NGOs.

REFERENCES

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