An Experimental Design to Assess the Role of Solar Reflectors on Albedo

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Introduction

The purpose of this experiment was to test the effect of solar reflectors on soil temperature.

As seen in **figure 2,** the Earth's temperature has been increasing and **figure 1** shows a correlation with the loss of ice mass in Greenland.

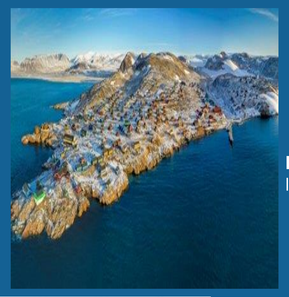

Image 1(1): Greenland Inuit village of Ittoqqortoormiit

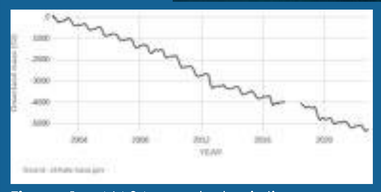

Figure 1(2): NASA graph depicting Greenlands loss of ice mass from 2002 to 2022.

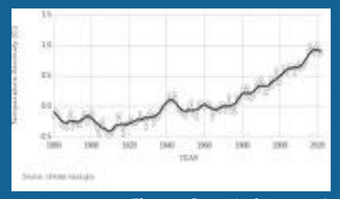

Figure 2(2): NASA graph showing the increase in global temperature above the average sense 1884 to 2020.

Experimental Design

Four plots were measured and setup with reflectors in a 9 x 5 array (**image 2**). The spacing of reflectors was influenced by researcher mobility and minimizing potential interference of shadows (**image 3**).

Each reflector setup had a wood block with a glass rod glued into a hole in the bottom and suction cups used to keep the reflector on it. **Image 4** displays a layout of these materials.

Image 4: Layout of materials used.

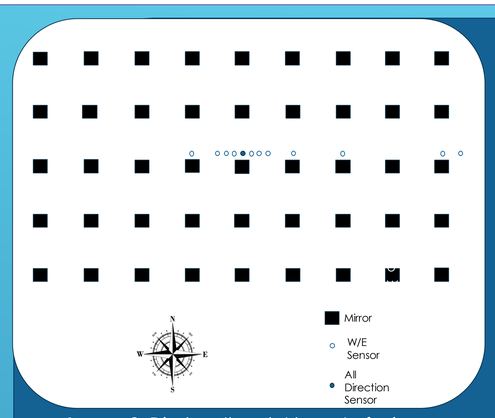

Image 2: Displays the plot layout of mirrors and sensors.

Image 3: Mirror plot setup.

Results/ Discussion

Figure 4 shows that the air and soil follow similar diurnal patterns. The variance in amplitude is greater in air overall, due to its poor heat conductivity. As the temperature approaches freezing, the amplitude of soil decreases, where as air temperature continues to fluctuate.

Figure 5 displays the month of September where the variance in soil amplitude is greater due to the warmer temperatures, roughly 10°C above the month of October.

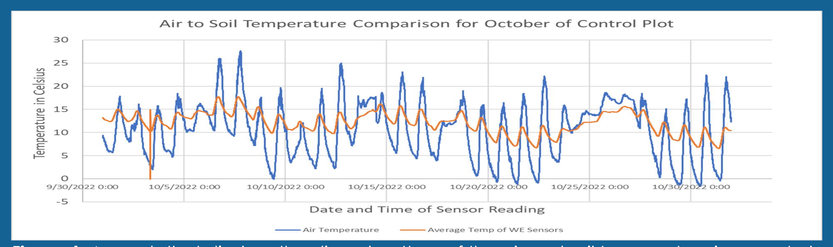

Figure 4: A graph that displays the diurnal pattern of the air and soil temperature in a control plot where there were no mirrors or glass set up.

Figure 3: As depicted below, a timeline of data collected from 3 sensors over a seven month period every five minutes compared to the air temperature in Celsius.

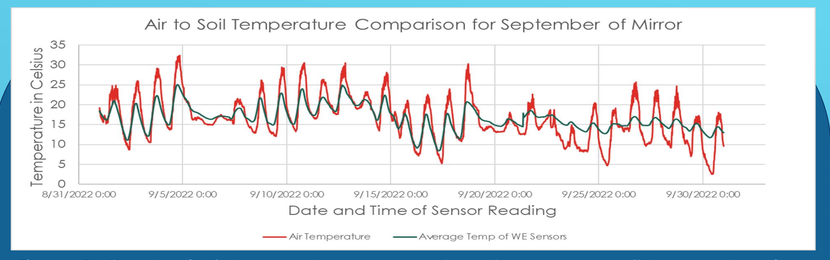

Figure 5: Graph of air temperature compared to the average soil temperature from September 1st at 0000 to September 31st at 2359.

The temperature pattern continued into December. **Figure 6** shows when the soil froze and when it experienced a warming anomaly. As demonstrated in **figure 7** all sensors read a temperature increase likely due to the warmer rain water pooling around the sensors, as the soil was frozen and trapped the water until it too froze.

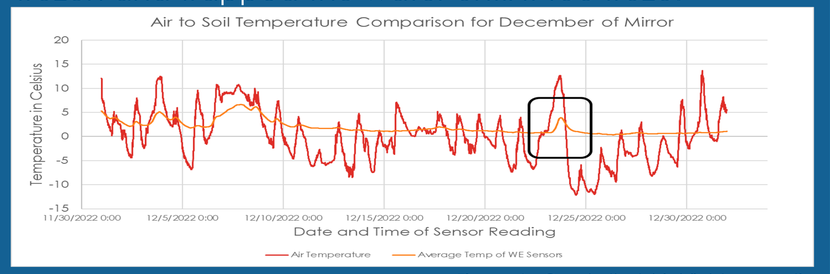

Figure 6: Graph that highlights a section indicating a warming of soil temperature.

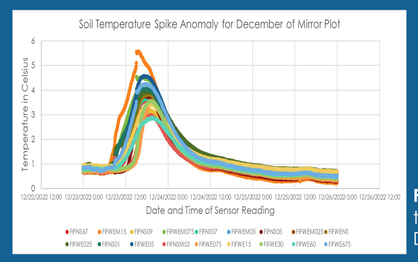

Figure 7: Graph showing a close look at the temperature anomaly from December 23rd to December 25th.

Conclusion

Based on the lack of change in soil temperature once the ground freezes, it is recommended that the reflectors only be placed when the ground is above 0°C.

References

(1)White, S. (2020, March 2). The world's largest island is finally drawing tourists. cnbc.com. cnbc.Greenland

(2)NASA. (2023, April 14). Vital Signs. https://climate.nasa.gov/vital-signs

Figure 3: Air and 3 Central Soil Temperature Sensors Sept 1, 2022 – March 20, 2023