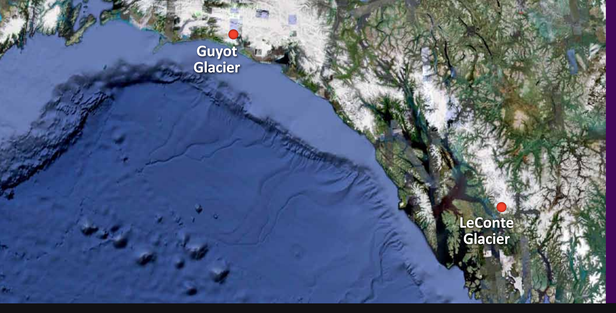

Testing Thermal Detection of Seals on Ice

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GOALS

In August 2010, we tested a thermal (infrared) imager at two sites in Alaska (Guyot Glacier and LeConte Glacier) for airborne detection of harbor seals on ice in glacial fjords. A reliable thermal method would increase the efficiency and accuracy of image analysis of seals on ice. The goals of this pilot study were to determine the thermal resolution threshold for harbor seals on glacial ice in order to establish the most effective survey altitude, and to identify the radiated temperature range of seals and sources of thermal interference for automated image collection.

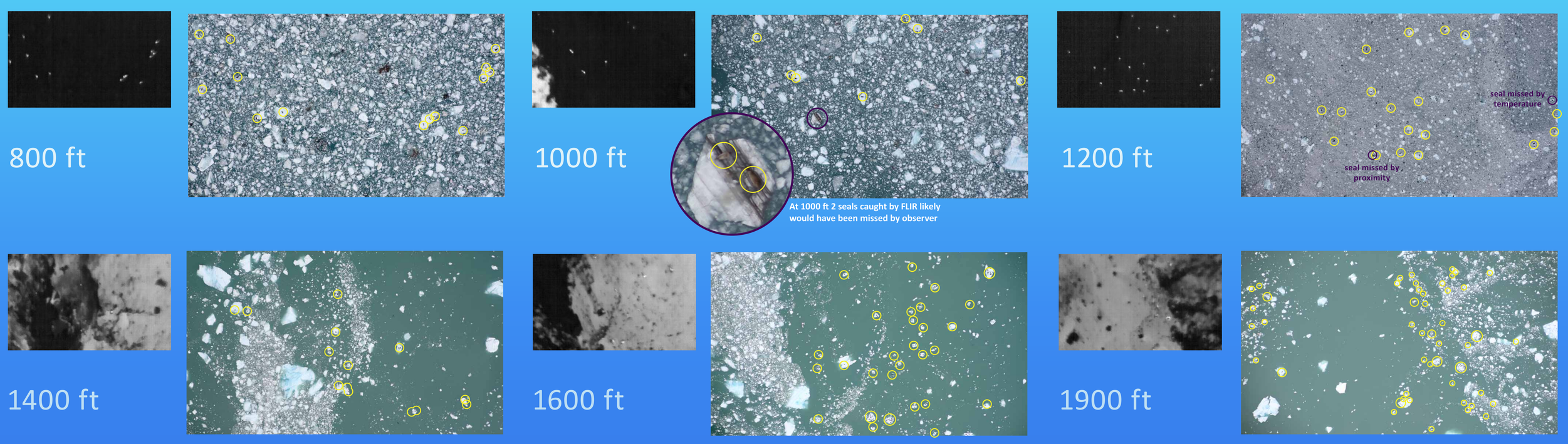
METHODS

The output from the thermal imager (FLIR A325) was used to control the simultaneous collection of thermal and high-resolution visual images whenever a preset temperature threshold was detected. Thermal and visual images were collected at six altitudes between 800 and 1900 feet during standard glacial aerial surveys. The equipment (FLIR A325, Canon 1Ds Mark iii, and custom computer, "Snowflake") was mounted in the belly port of a NOAA Twin Otter aircraft. The thermal and visual cameras shot through small, open air, ports and were aligned to have overlapping footprints. The threshold between seals and background temperatures was determined using the program ImageJ. Both thermal hotspots and total seals in overlapping image footprints were counted manually. Manual thermal counts were compared to Snowflake auto-counts for images with no thermal interference. All data were analyzed using linear models in R.

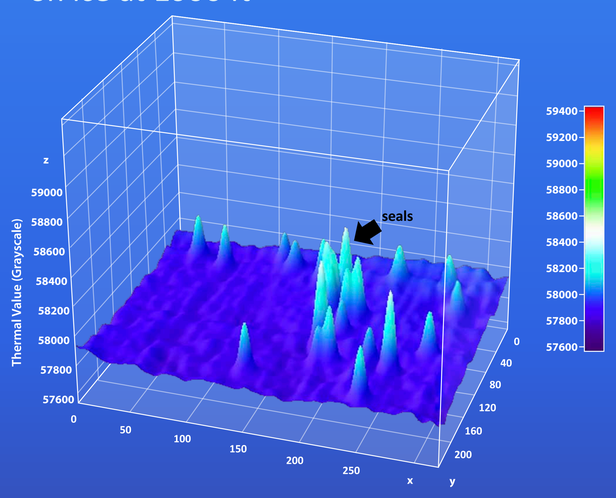
RESULTS

Thermal hotspots corresponding to seals were identifiable at all altitudes, though the accuracy of thermal detection significantly dropped between 1200 and 1400 feet. These results are complicated by the fact that the higher altitude flights took place at LeConte glacier while lower altitude flights were conducted at Guyot. All thermal images from LeConte displayed interference that appeared to be caused by fine glacial silt that apparently reflected infrared radiation or warmed the water, reducing the contrast with seals. This interference was observed at every altitude; examples can be seen at 1000, 1400, 1600, and 1900 ft and in the 1000 ft surface plot. The limited resolution of the A325 restricted accurate auto-counting of seals to the 800 ft altitude. This could be improved with a higher resolution thermal imager. Thermal threshold of seals on ice was consistent between all altitudes tested. Reliable thermal triggering of image collection can be achieved at 1200 ft altitude with a low resolution (240 x 360) thermal imager.

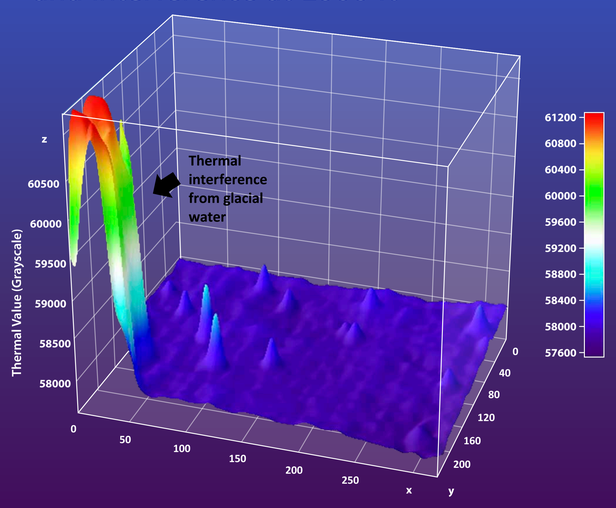
Paired Thermal and Visual Images of Seals on Glacial Ice



Thermal surface plot of seals on ice at 1000 ft

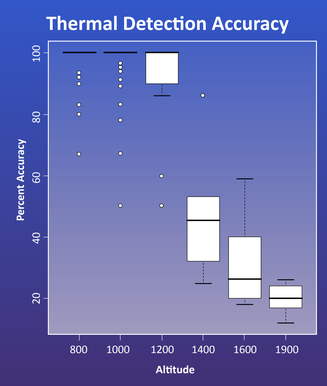


Thermal surface plot of seals and interference at 1000 ft

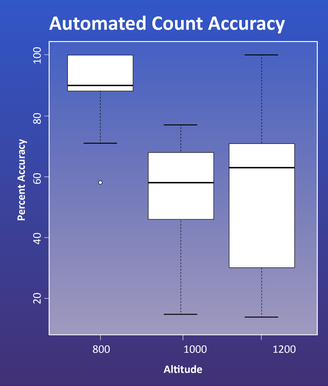


Mean (SE) of thermal detection accuracy, automated count accuracy and thermal threshold of Harbor seals on glacial ice. Images with thermal interference from glacial water were excluded from the automated count accuracy and thermal threshold analyses. All images at LeConte glacier had interference from warm glacial melt.

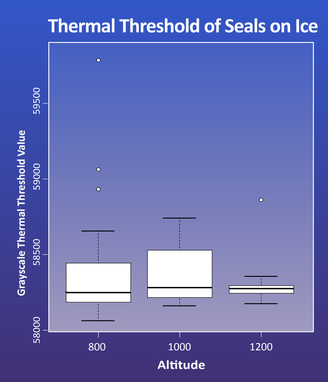
	Guyot Glacier			LeConte Glacier		
	800 ft	1000 ft	1200 ft	1400 ft	1600 ft	1900 ft
Thermal Detection Accuracy	97.5% (1.5)	98.3% (1.4)	92.6% (2.3)	45.8% (3.5)	30.5% (3.5)	20.0% (3.5)
Automated Count Accuracy	91.4% (3.4)	54.7% (5.7)	56.1% (4.2)	NA	NA	NA
Thermal Threshold, Grayscale	58308 (34.3)	58378 (56.7)	58292 (41.0)	NA	NA	NA



There was no significant difference between the accuracy of the thermal imager at 800, 1000, and 1200 ft. The marked decline at altitudes of 1400 ft and above may be due to increased thermal interference at LeConte glacier.



The custom computer, Snowflake, was able to provide accurate seal counts real-time at an altitude of 800 ft (> 90%). Images with thermal interference were excluded from this analysis.



There was no significant difference between the thermal threshold separating seals from the background ice at altitudes tested. Images with thermal interference were excluded from this analysis.

ACKNOWLEDGMENTS:

The camera mount system was designed and constructed by Mike Borden. Thanks also to John Jansen for his support and allowing this project to piggyback on his glacial surveys, and to NOAA pilots Jason Mansour, David Cowan, and mechanic Rob Miletic for the safe completion of our flights.

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