USING TWO-EYED SEEING TO DOCUMENT CLIMATE IMPACTS TO SEA ICE IN RESOLUTE BAY, NUNAVUT, CANADA

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INTRODCUTION

One of the most visible impacts of climate change in Arctic environments is declining sea ice. Sea ice is declining in its spatial extent, thickness, and duration of the ice-covered season. Historical trends in sea ice change have been well documented on an Arctic wide scale (Moon, 2021 & Thoman 2020). However, due to the remoteness and a lack of spatially granular quantitative data, far less is understood about declining sea ice on an Arctic Inuit community scale. Often, scientific research is conducted in Arctic environments with little to no involvement of Inuit communities, despite their rights to self-governance and extensive knowledge of the natural environment that has been cultivated through their deep ties to the land and passed down through oral history. Without meaningful partnership, and the centering of Inuit values and community priorities, Arctic scientific research can be exploitative and inequitable (Biermann, 2011).

OBJECTIVES AND NOVELTY

This study seeks to document historical trends in air temperature, sea ice thickness (SIT), break-up dates (BUDs) and freeze-up dates (FUDs), to correlate sea ice behavior to air temperatures, and to document the socio-economic impacts of sea ice change in Resolute Bay Nunavut, Canada using traditional Inuit knowledge (TIK) and scientific methods. This is the first study of its kind conducted in Resolute Bay. Traditional Inuit or Indigenous knowledge have been incorporated into scientific studies using *two-eyed seeing* in other studies seeking to understand the physical and natural environment (Abu 2019 & Michie 2018). This study is the first application of these methods to characterize climate impacts to sea ice in an Arctic Inuit community.

SCIENTIFIC METHODS AND RESULTS

During the scientific portion of this study, several methods such as linear regression, statistical significance, anomaly analysis, and change point detection were used on time series of sea ice concentration (SIC), SIT, and air temperature. Two SIC datasets from 1979-2022 were accessed to characterize BUDs and FUDs. The BUD was defined when SIC fell and stayed below 20%, and the FUD was when SIC returned and stayed above 50%. By applying a statistically significant linear regression to both datasets, the BUD was shown to occur 37.5 days earlier and the FUD occurred 23.4 days later in 2022 than in 1979.

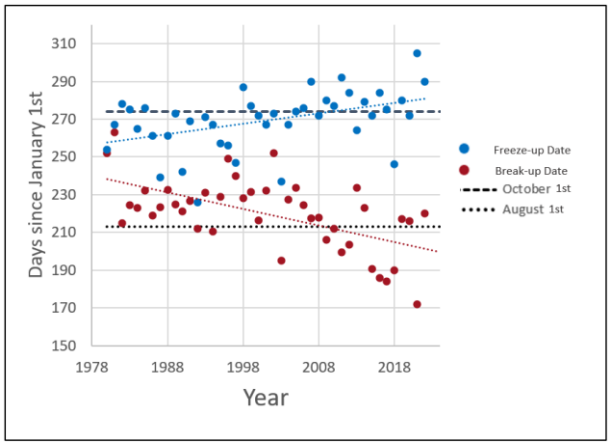

Figure 1 – Linear Trends in BUDs and FUDs in Resolute Bay, Nunavut between 1979 and 2022.

This study accessed two SIT datasets, the first from Environment and Climate Change Canada fast ice measurements for the period of 1947-2022 and the second from satellite derived sea ice freeboard measurements from 2002-2020 at four locations in the Barrow Strait. After applying change point detection algorithms, this study found that the annual maximum fast ice thickness increased 32.5 cm from 1948-1981 and decreased 33.2 cm from 1981-2021.

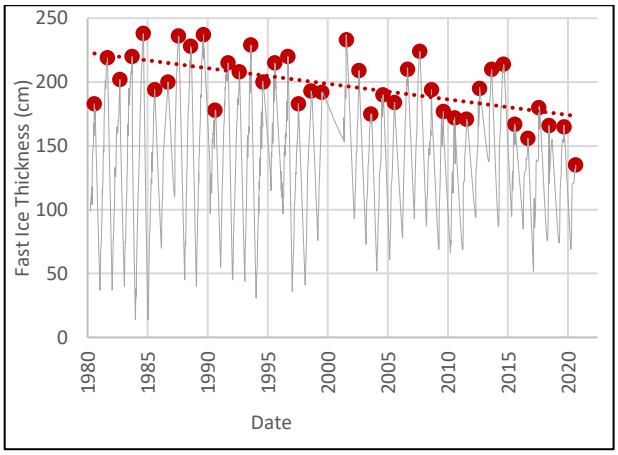

Figure 2 - Linear Trend in Annual Maximum Fast Ice Thickness in Resolute Bay, Nunavut from 1981-2021.

Fast ice decreased most substantially in the months of April and May. Sea ice freeboard decreased by 260.8 cm on average between 2002-2020 in Barrow Strait. Freezing degree days (FDDs) were used to correlate sea ice behavior to air temperature. As FDDs decreased, sea ice

freeboard was the most rapidly changing sea ice parameter and fast ice thickness was most strongly correlated to FDDs. Both these results indicate that air temperature has a greater effect on SIT than the BUD and FUD. Air temperature data were also used to conduct anomaly analysis in Resolute Bay and compare Resolute Bay to global surface air temperature anomalies. **This study found that Resolute Bay is warming at twice the rate of the global average.**

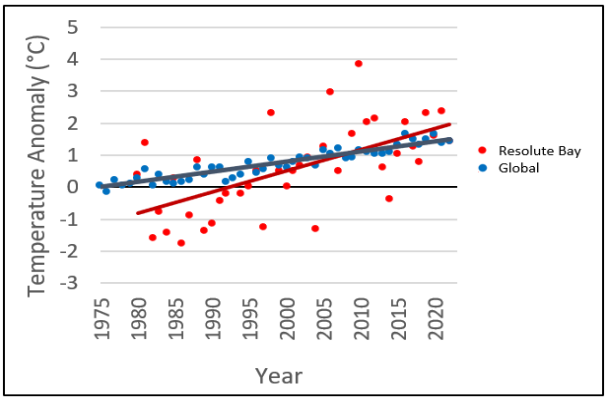

Figure 3 - Linear Trends in Surface Air Temperature Anomalies in Resolute Bay, Nunavut and Globally Between 1969 and 2023.

TRADITIONAL INUIT METHODS AND RESULTS

During the TIK investigation of this study, seventeen community members from Resolute Bay ranging from age 19 to 81 were interviewed about their perception of changes in SIT, BUD, FUD, and seasonal weather patterns. Participants were interviewed about the socio-economic impacts of sea ice change, traditional Inuit methods of determining thickness, and asked to indicate typical areas of thin and thick ice, areas that break-up and freeze-up first, and hunting and travel routes on printed maps. The interviews described a decline in sea ice thickness, areas of thin ice in Barrow Strait, north of Cornwallis Island, and between Bathurst and Devon Island, less frequent use of the sea ice, less traditional food available in the community, increased vessel traffic, a decrease in seal population, new species and birds in the area, and detailed traditional methods of determining ice thickness through observation of color and use of the harpoon.

DISCUSSION

Agreement between traditional knowledge and the scientific data was present in typical break-up and freeze-up patterns, and annual maximum thickness decreasing over time. While most respondents indicated FUD was later and BUD earlier, more participants responded there have been changes to the FUD than the BUD, whereas the scientific data showed more severe changes to the BUD than FUD.

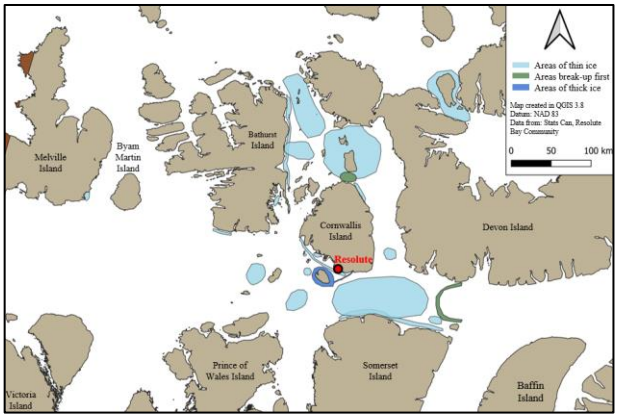

Figure 4 - Areas of Thin Ice, Thick Ice, and Areas the Break-up First Near Resolute Bay, Nunavut as Identified by Traditional Inuit Knowledge during Community Interviews.

During interviews, there was consensus that summer temperatures are getting warmer but there was variability in responses when interviewees were asked about winter temperatures. The scientific results showed less warming in the summer (Jun-Aug) than winter months (Jan-Mar) with the most warming in the fall (Sept-Nov). The lack of consensus between these results could be attributed to local perceived changes to winter weather referring to storminess rather than strictly temperature. TIK provided small scale information about the sea ice that the current state of scientific observation cannot.

CONCLUSION

Using a new research approach, by including traditional Inuit knowledge and working with communities to have self-governance over the research conducted in and on their lands, a more holistic understanding of the physical and natural environment can be accomplished in equal partnership with Inuit communities and western, colonial, scientific research.

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