# Comparison of Natural Factors Leading to Ice Arch Formation in Nares Strait

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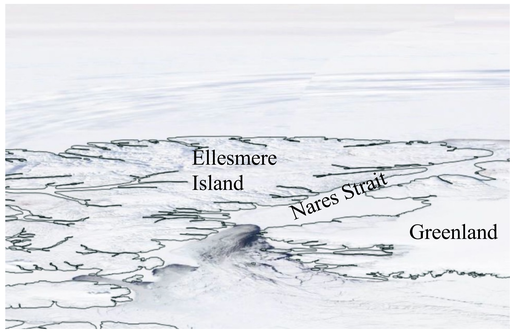
Nares Strait is a narrow pathway between Ellesmere Island and Greenland, where a large percentage of the sea ice annually leaves the arctic. Arch formation in Nares Strait create productive regions of water important to the region's ecosystem. We analyse the latest ice arch formed at the end of March of 2023 at Smith Sound and evaluate the trend of these arches over the past couple of decades.




NASA Worldview image of the Nares Strait on 8th of April 2023.

## Objectives

1. To analyse and visualise the annual Nares Strait wind and ice concentration data and understand the causes leading to the late march arch formation in the region.

2. Compare the 2023 data with the available historic data to understand the trend of the stability and formation of sea arches.

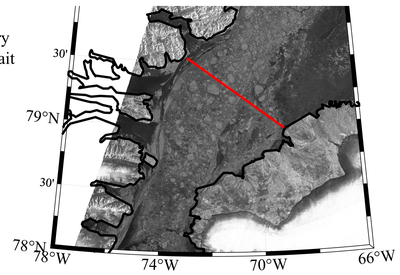
## Method

There are 3 sources of data for the project. The sea ice concentration data is gathered from AMSR data catalog with a resolution of around 3km. The wind data comes from the ERA5 and CARRA databases with the horizontal resolution of about 30 and 2.5km respectively.

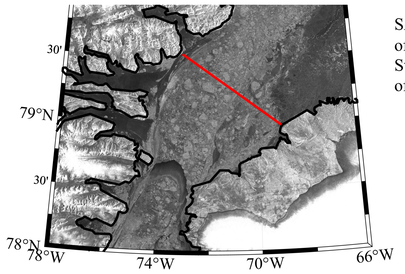
The majority of the data processing were done over python and the data and graphs were cross checked with the NASA worldview earth data.

The ice arch formed on the 31st of March and lasted until the middle of June, the arches usually form during January and February and last through summer.

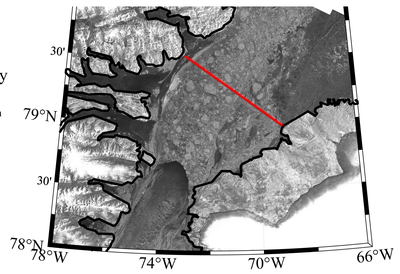
SAR Imagery of Nares Strait on 28th of March



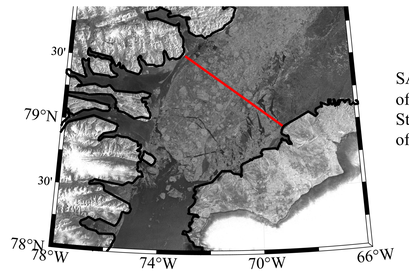

SAR Imagery of Nares Strait on 31st of March



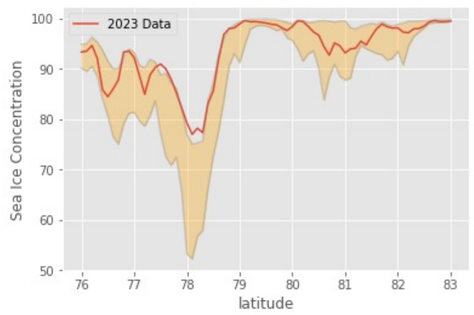

SAR Imagery of Nares Strait on 15th of April



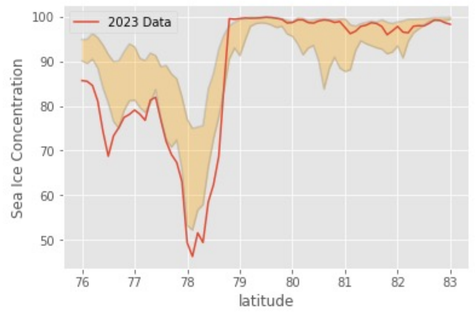

SAR Imagery of Nares Strait on 11th of June



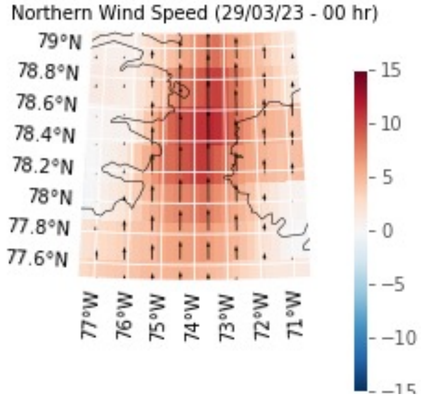

Average March Sea Ice Concetration since 2003




Average April Sea Ice Concetration since 2003



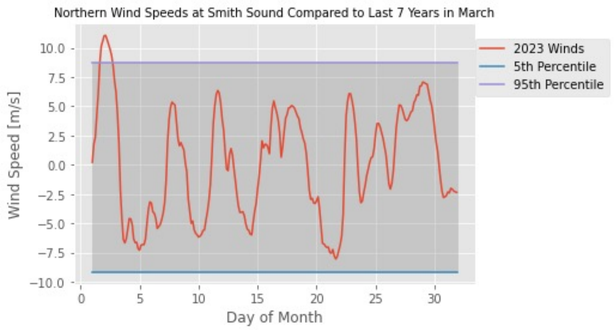

Northern Wind Speed (29/03/23 - 00 hr)




The figure above shows the magnitude of the vertical wind over smith sound a day before the arch formation. The right figure compares the March wind to the 5th and 95th percentile wind. From the winds we see instances of extreme northern wind and regular winds exceeding 7.5m/s.

The figures above shows the average longitudinal ice concentration over the Nares Strait compared to the first and third quartile since 2003 in both March and April. The April plot shows an arch ice concentration lower than the average over the past 2 decades.

Northern Wind Speeds at Smith Sound Compared to Last 7 Years in March




The Nares Strait ice arch formed at the end of March was preceded with strong northern winds concentrated at Smith South at the south of the arch along with a large differential in the sea level pressure in the same region around the 29th of March. The narrow topology of the region creates instances of high wind along the strait allowing for the transport of ice during the year.

Through the data from the past 2 decades, there has been a trend towards instability for the ice arches formed in the Nares Strait. 2023 saw a late ice arch formation in March with a relative fast collapse in 2 months. The higher winds this year also contributed to the collapse of the in June, with some historically fast winds specifically along north of the strait.

The arch formed at the south of Nares Strait allows for a productive polynya to be created due to the reduced ice covers. This polynya supports the ecosystem and species in the region. With the trend of instability and decrease in the ice concentration, it will limit the ability of species like polar bears to be able to gather nutrients through the year.

The instability of the arch and the extreme winds also lead to an increase in the ice flux out of the arctic, allowing for ice export through more of the year compared to the years past.

## References

Moore, G.W.K., Howell, S.E.L. & Brady, M. Evolving relationship of Nares Strait ice arches on sea ice along the Strait and the North Water, the Arctic's most productive polynya. Sci Rep 13, 9809 (2023). https://doi.org/10.1038/s41598-023-36179-0

Moore, G.W.K. Impact of model resolution on the representation of the wind field along Nares Strait. Sci Rep 11, 13271 (2021). https://doi.org/10.1038/s41598-021-92813-9

"Worldview: Explore Your Dynamic Planet." NASA Worldview.

## Acknowledgment

I would like to thank Professor Moore for the assistance and guidance through the project and the mentorship. Also, I want thank Romina Piunno for the technical help.