Sea Ice Concentration Variability in Nares Strait

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Introduction

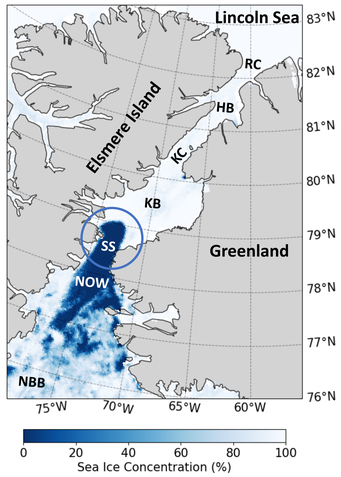

Figure 1. Sea ice concentration in the Nares Strait region on May 11th 2020 as represented in the 3.125 km resolution AMSR2 dataset. Areas of the Nares strait, **RC** (Robeson Channel), **HB** (Hall Basin), **KB** (Kane Basin), **SS** (Smith Sound), **NOW** (North Water Polynya), **NBB** (Northern Baffin Bay) are labelled. The blue circle indicates the sea ice arch that formed in 2020.

- Nares Strait is a pathway, located between Greenland and Elsmere Island, along which multi-year sea ice leaves the Arctic, an ice class which has seen dramatic reduction [1]
- Typically, an ice arch forms in Nares strait during winter, ceasing sea ice transport from the Arctic until it collapses in early July
- The arch is responsible for the North Water, the Arctic's largest and most productive polynya
- It is of interest to characterize the yearly sea ice concentration along the strait

Data

- AMSR daily sea ice concentration (3.125 km and 6.25 km resolution), 2002 – 2021 (Fig 2. a&b)
- C3S Arctic Regional Reanalysis (CARRA) 6-hourly surface wind (2.5 km resolution), 1998 – 2019 (Fig 2. c)

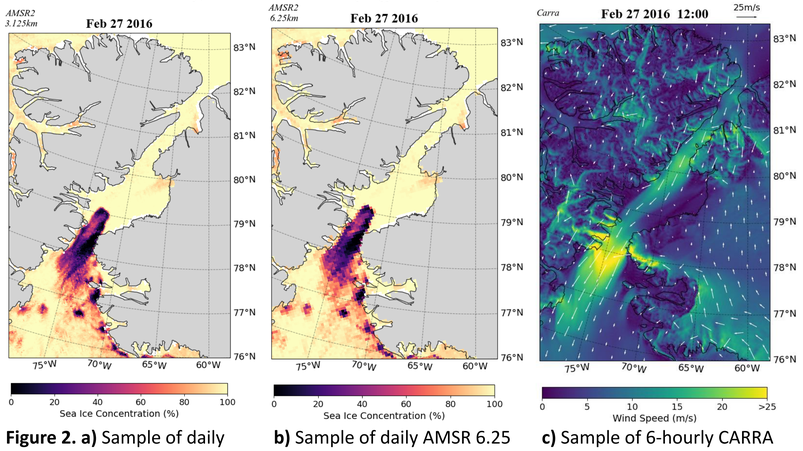

Figure 2. a) Sample of daily AMSR 3.125 km resolution

b) Sample of daily AMSR 6.25 km resolution

c) Sample of 6-hourly CARRA 2.5 km resolution

Results

- Sea ice concentration time series of each "year" (September 1st to August 31st of the following year) were calculated along the center line of Nares Strait (Fig 3. a&b)
- This helps identify events of interest such as arches and transient polynyas

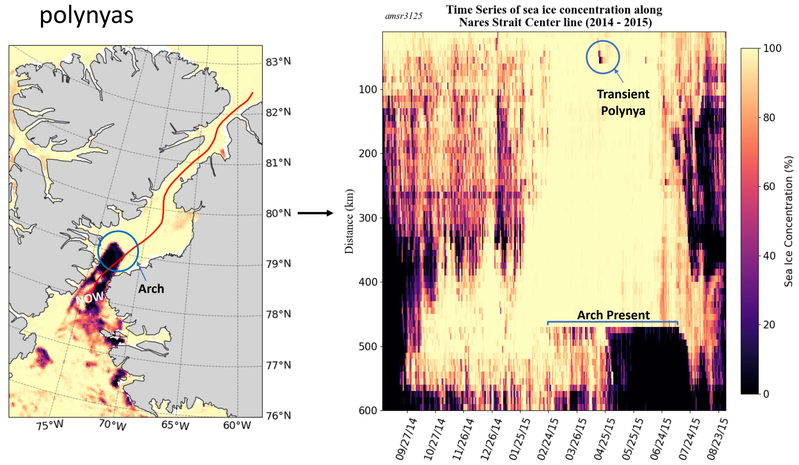

Figure 3. a) The red line represents the center line of Nares Strait

b) Time series of 2014-2015, created by taking the values at the center line for each day of the year

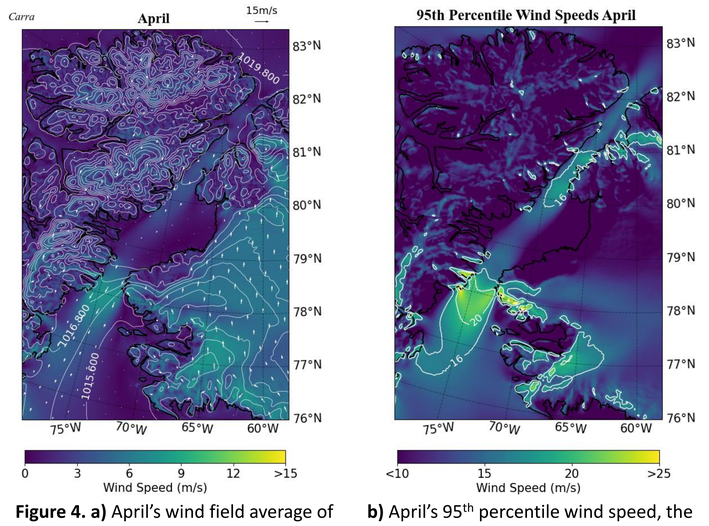

Figure 4. a) April's wind field average of 1998 to 2019, the contours represent the pressure

b) April's 95th percentile wind speed, the contours represent areas with wind speed of 16 m/s and 20 m/s

- Winds are the main forces responsible for sea ice motion [2], thus, we sought to understand the wind field in the Nares Strait
- To understand a typical wind event for each month, all the days in a month for all years were averaged (Fig 4. a)
- Areas of high winds for each month were located using composite maps of the 95th and 99th percentile winds (Fig 4. b)

Discussion

- Using the sea ice concentration and winds data, we can draw some relationship between the two
- Transient polynya in Robeson Channel and Hall Basin are usually caused by extreme winds events blowing northwards
- In 2015, a transient polynya was formed in Robeson Channel from April 18th to April 22nd (Fig 5). This was associated with unusually strong winds that blew northwards from April 16th to April 19th (Fig 5)
- Similar events were observed in 2003, 2005, 2006, 2011, 2021

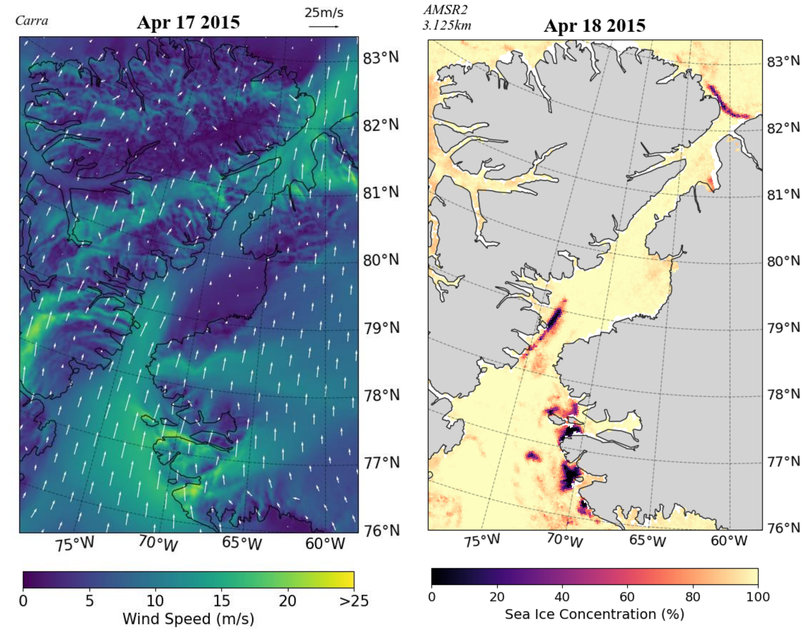

Figure 5. a) Winds on April 17th 2015 blowing northwards with speed above 18 m/s

b) The resulting polynya (above 82° N) that formed on April 18th 2015 due to the strong winds on April 17th 2015

Future Direction

- Characterize winds as northerly or southerly winds as wells as by speed and pressure
- Validate the CARRA data with weather stations in and around the Nares Strait Region
- Investigate the relationship between high winds and the formation of transient polynya in the Nares Strait
- Investigate the role of winds in the variability of the North Water Polynya's size

References

[1] 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

[2] M. C. Serreze and R. G. Barry, "Arctic Ocean–Sea Ice–Climate Interactions," in The Arctic Climate System, 2nd ed., Cambridge: Cambridge University Press, 2014, pp. 209–248.