

Supporting Information for

The stepwise decrease of 4+ year ice extent and its linked survivability since around 2007

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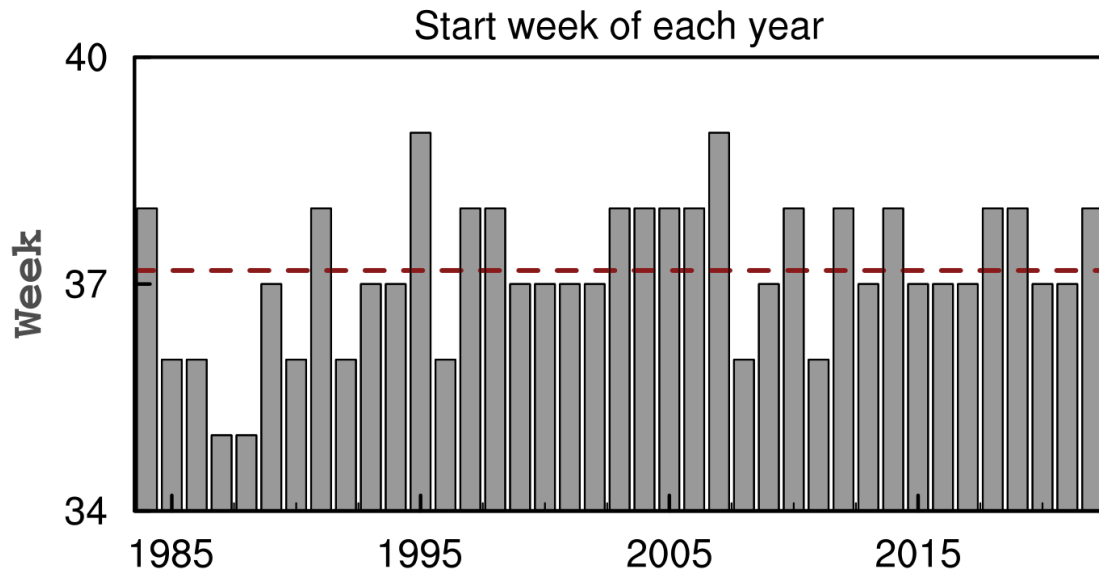


Figure S1. The start week of each year during 1984–2022. See section 2.2 for description.

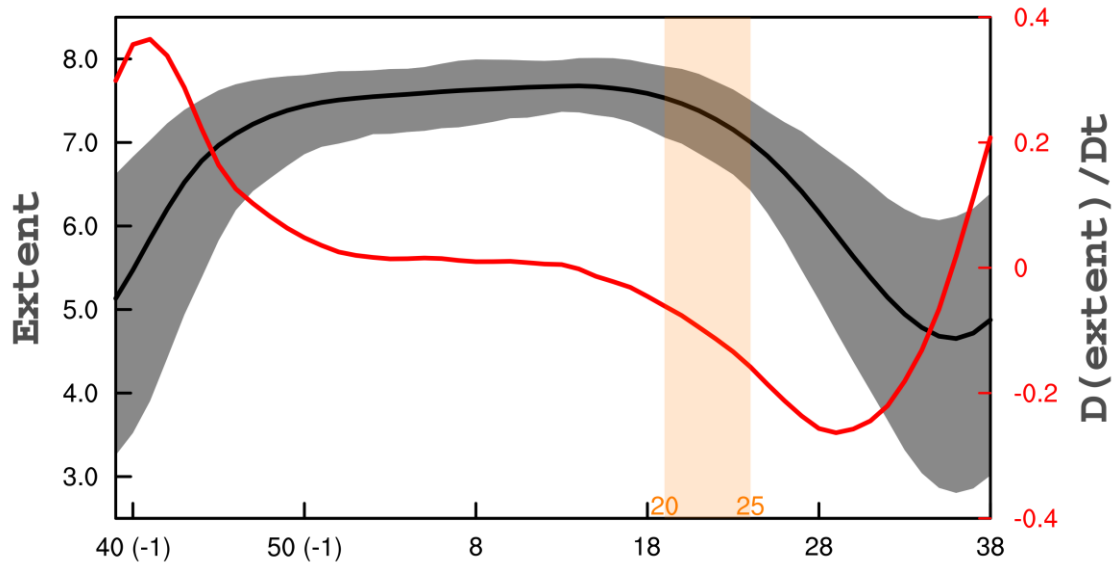


Figure S2. The climatology of the seasonal evolution of total SIE (Black line, corresponding to the left y-axis) in the Arctic Basin. The grey shading represents the range between the maximum and minimum SIE in the climatology. All SIE values above were smoothed using a 5-points running average. The red line indicates the weekly tendency of total SIE (corresponding to the right-y axis). The orange shading region represents the onset of the melt season, that is, from the 20th to the 25th weeks.

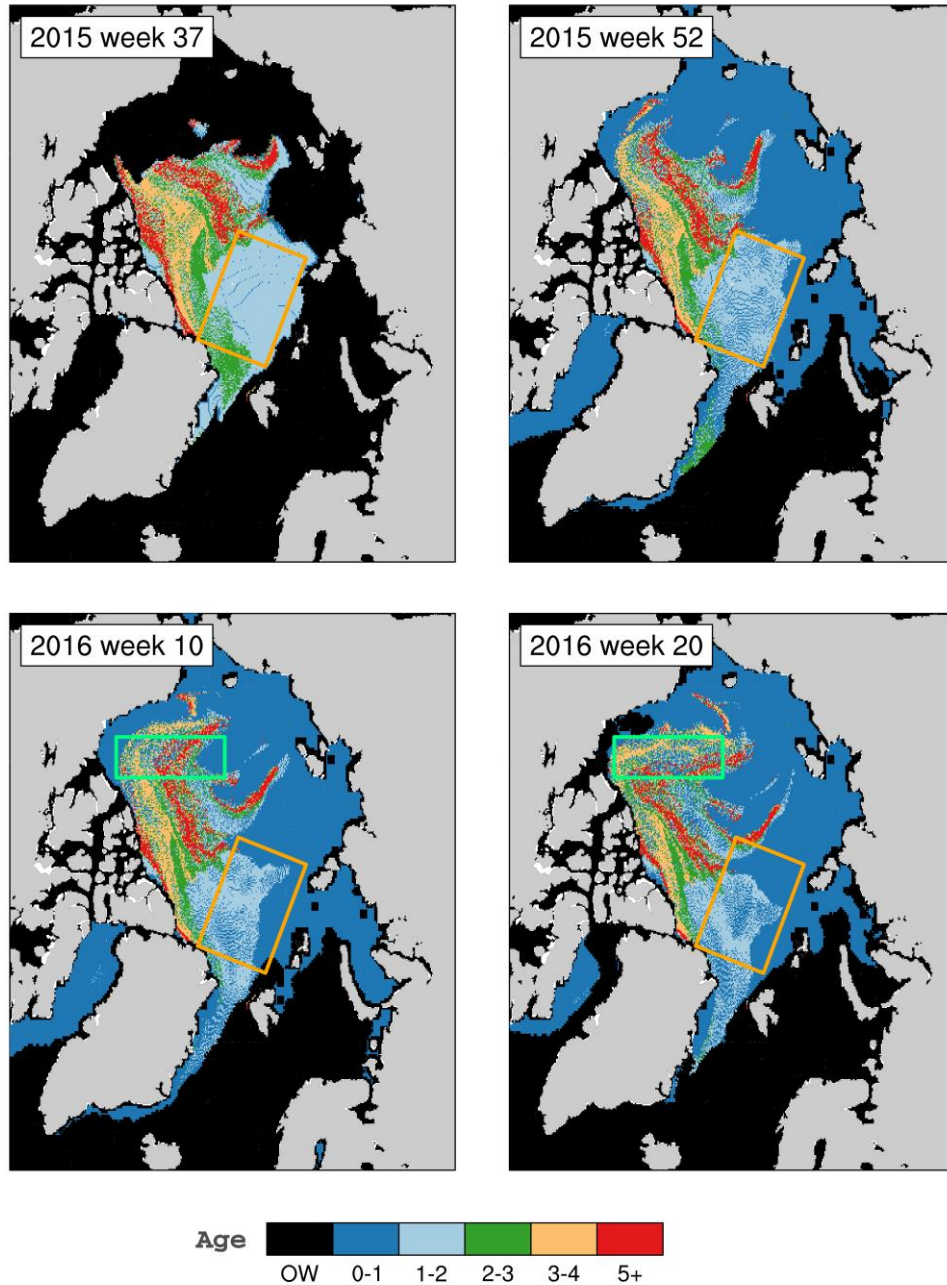


Figure S3. The SIA distribution in 37th week of 2015, 52th week of 2015, 10th week of 2016, and 20th week of 2016. A comparison of SIA between start week (37th week) of 2015 and other weeks reveals obvious production of FYI in the orange box (a region predominately covered by 2 year ice). The production of FYI is also evident in the green box (a region dominated by the Beaufort Gyre system).

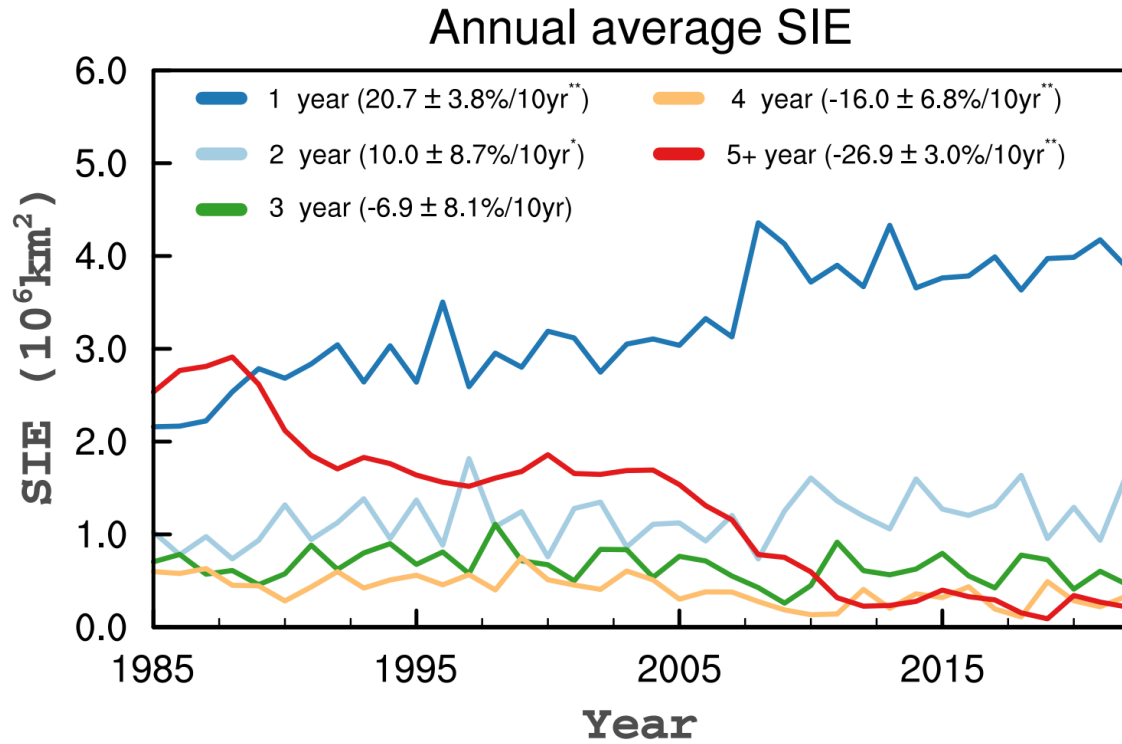


Figure S4. Similar to Figure 2a but for individual SIA. The brackets indicate the slopes and their 95% significance limits, but expressed as percentiles relative to the averaged SIE of corresponding ages during 1985–1989. One and two asterisks represent the slopes exceeding 95% and 99% significance levels, respectively.

SIE export through the FS

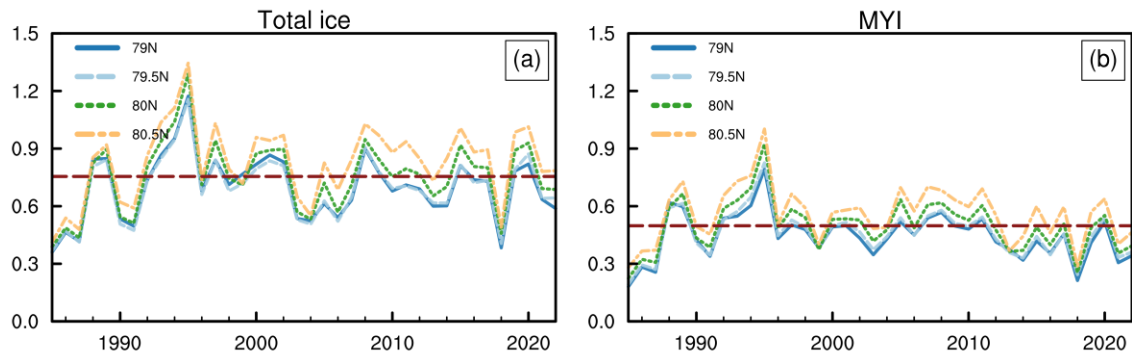


Figure S5. (a) Annual export of total extent (including FYI and MYI) through the FS. The results are presented for gates at four different latitudes (79.5°N, 79.5°N, 80°N, and 80.5°N, see the bottom right corner of Figure 1). (b) similar to (a), but for MYI extent. The red dashed lines represent the average SIE export over 1985–2022.

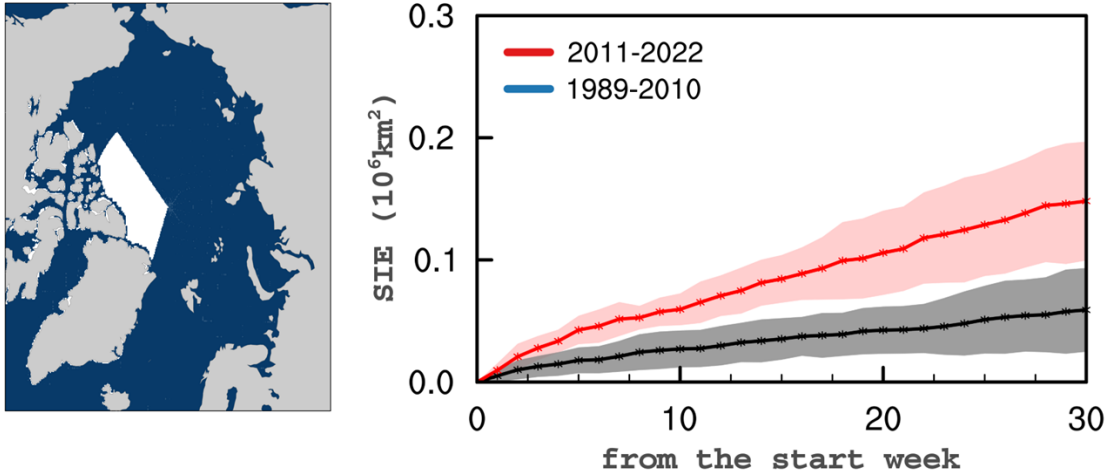


Figure S6. The left panel indicates north of Canadian Arctic Archipelago (white shading). The right panel illustrates the increase of FYI extent from the start week averaged over 2011–2022 (red line) and 1989–2010 (black line). The asterisks indicates where their difference is significant ($p < 0.1$, two-sample t-test). The shadings represent the range of range of one standard deviation.

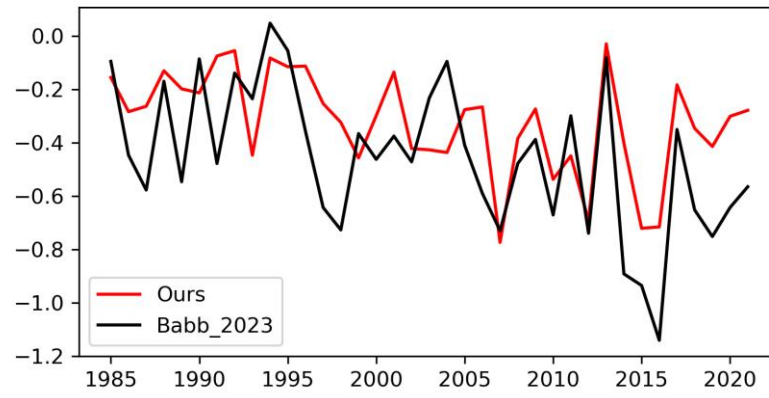


Figure S7. The melt MYI extent in our paper (red line) and the melt MYI area in B23 (black line).