Understanding the Evolution of Summer and Winter Polynyas Along Northern Greenland

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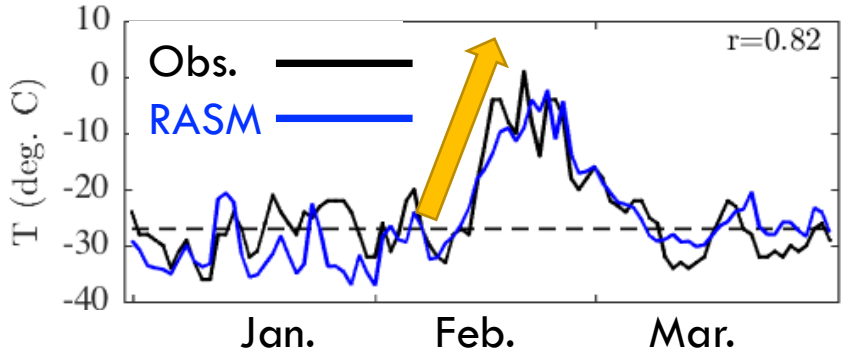
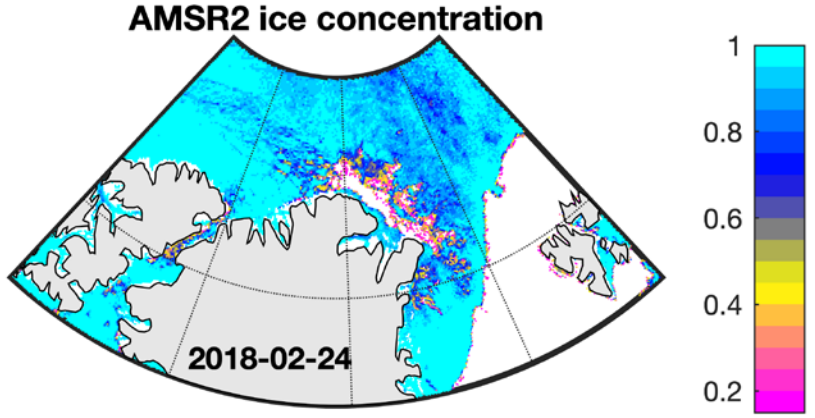
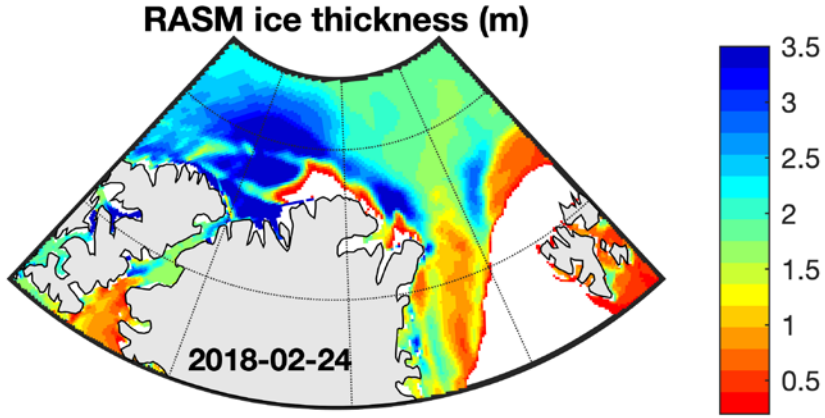
Winter Polynya



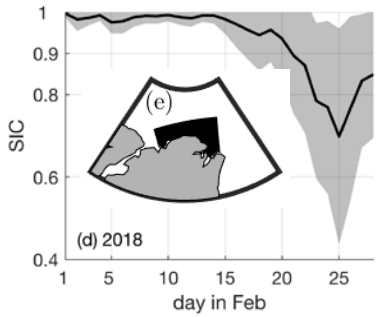


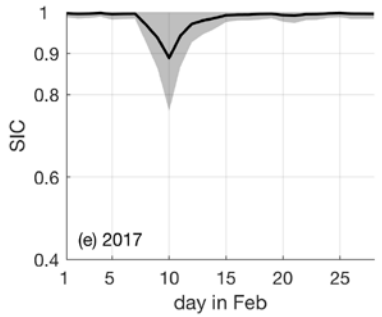
- *Negligible sea ice melt*
- *Positive thermodynamic ice growth regardless of warming*
- *Significant ice loss due to dynamic transport (200 km^3)*

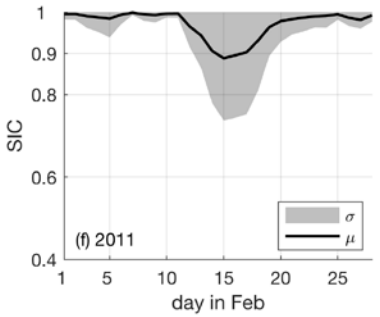


Winds in February

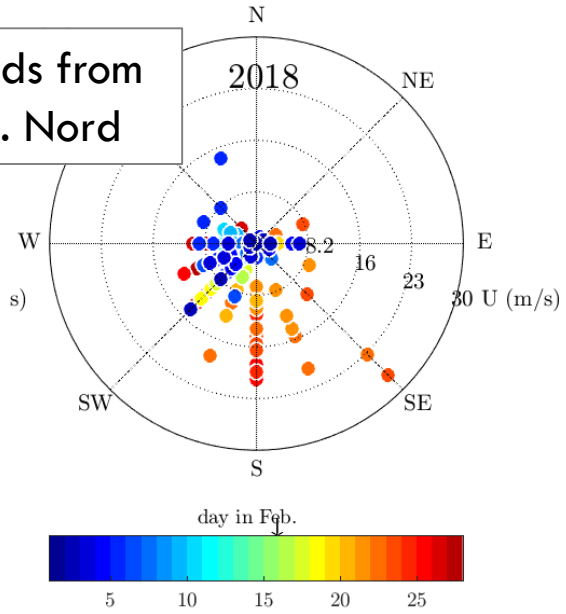
Satellite Sea Ice Concentration





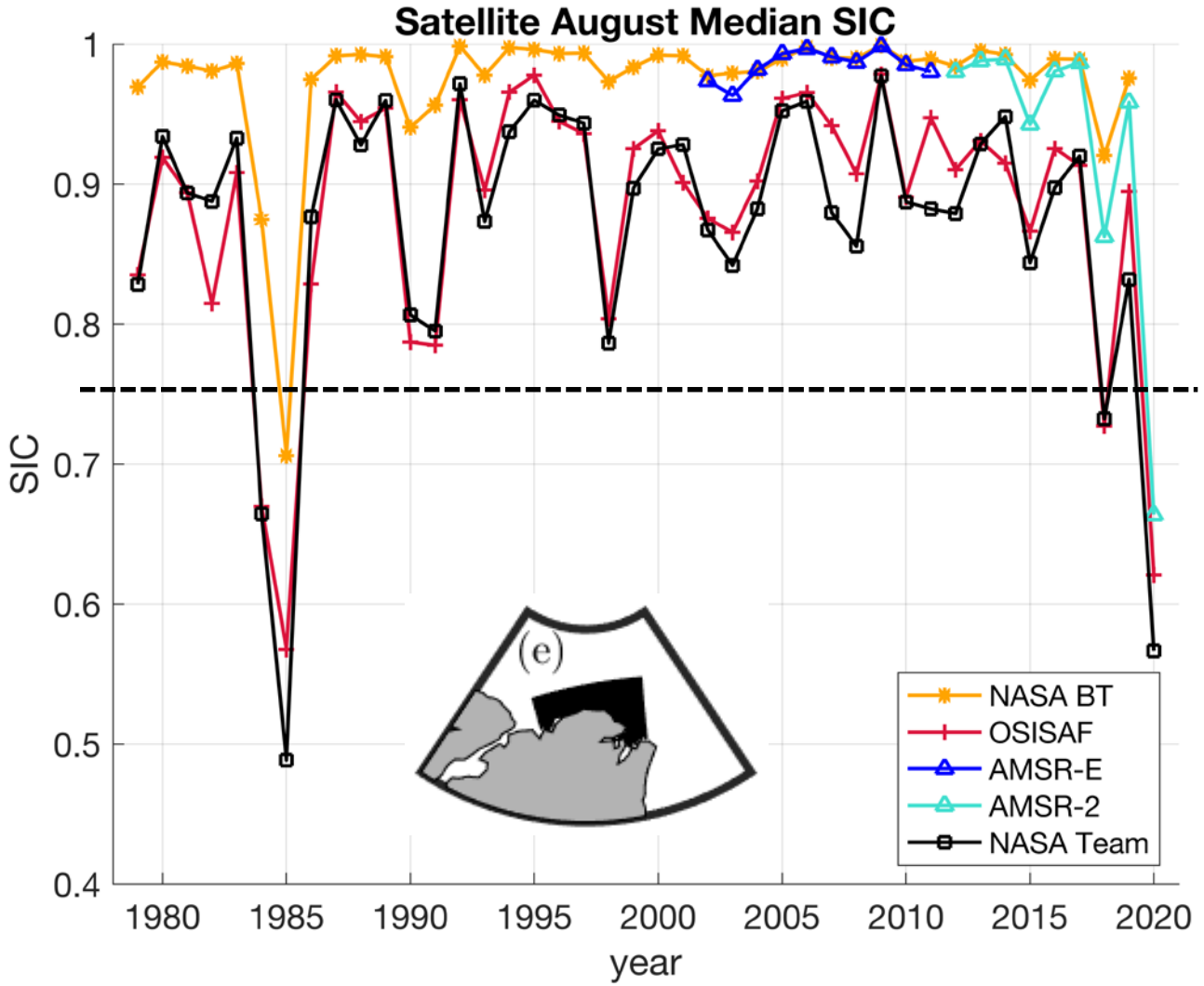


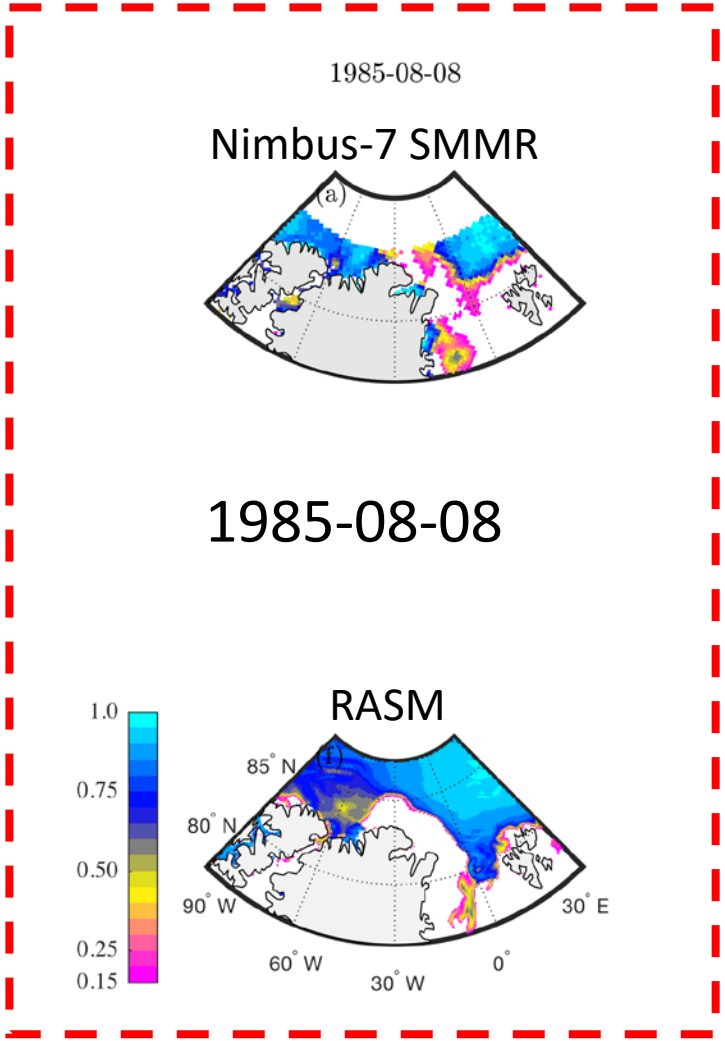
Winds from Stn. Nord



- *Three polynya events occurred in 2011, 2017, and 2018*
- *No winter polynya (median SIC<90%) observed before 2010*
- *Based on the RASM simulation, southerly winds has become stronger and more persistent since 2011*

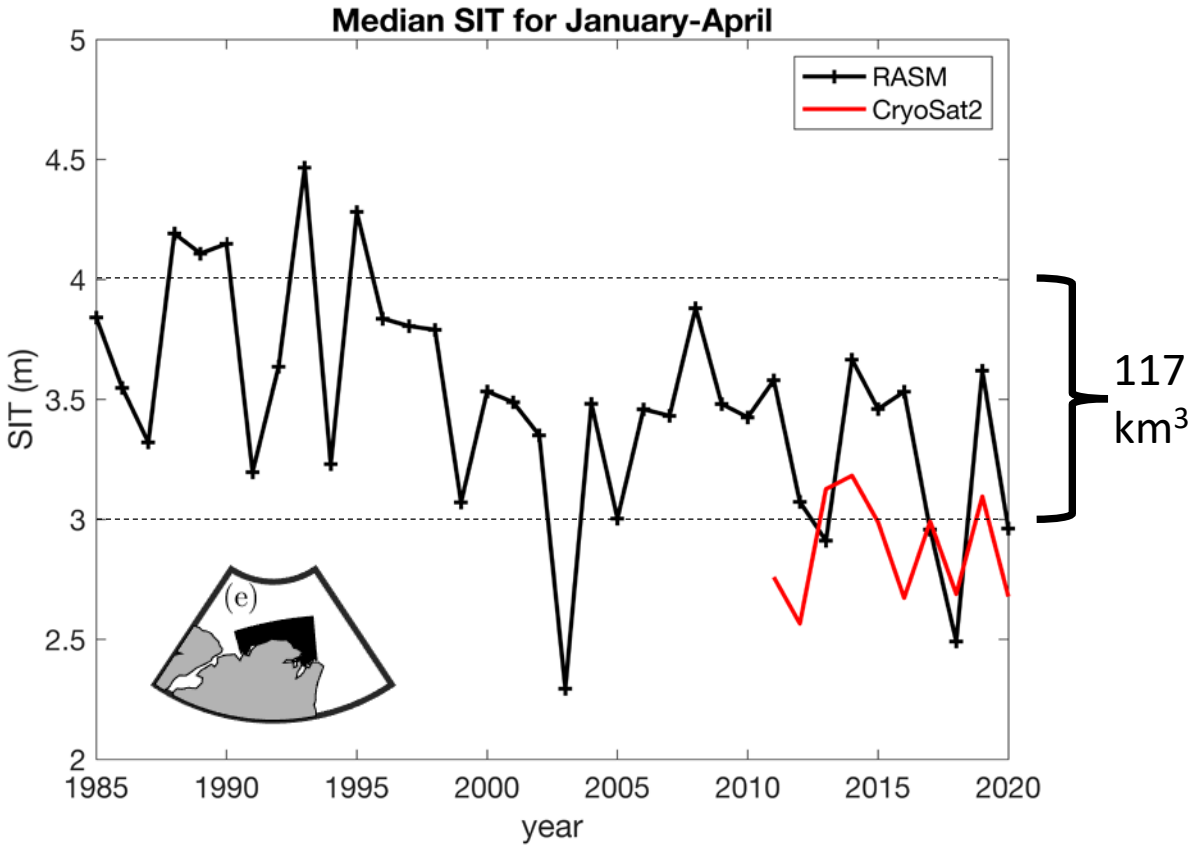
Summer Polynya





Changing Arctic Sea-ice

Year	Ice Vol. Loss due to thermo-dynamics (km^3): July to mid-August	Ice Vol. Loss due to dynamics (km^3): July to mid-August
1985	65	268
2018	86	150
2020	93	138



Summary

Winter

- Latent heat polynya in February 2018, 2017, & 2011
  - Negligible thermodynamic sea-ice melting
  - Strong sea-ice divergence due to southerly wind
- Occurrence of winter polynya events in 2010s
  - Southerly (including SW & SE) winds have become more prevalent, persistent, and stronger.
  - Partly due to thinning of sea ice in the region

Summer

- Dynamic contribution to sea ice loss decreased
  - 268 km^3 (80% in 1985) to 138 km^3 (60% in 2020)
- But, thermodynamic sea-ice melting increased
  - 65 km^3 (20% in 1985) to 93 km^3 (40% in 2020).
- Thinning of sea-ice may not result in more frequent polynya formation, but less mechanical divergence of sea-ice is required to create a polynya.

Future Research

- Continue to enhance high resolution (~2 km) model simulations
- Evaluate similar polynya events elsewhere under changing Arctic climate conditions
  - frequent storms/hurricane activities
  - thinning of sea ice cover
- Study their contribution to the Arctic regional climate
  - heat and moisture transport
- Explore impacts of polynya events
  - marine BGC