Sea Ice and Ocean Evolution of the NORTHERN CANADIAN ARCTIC ARCHIPELAGO SHELF

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BACKGROUND

- The Arctic is experiencing four times the average global warming rate – driven by Arctic Amplification and ice-albedo feedbacks (Rantanen et al., 2022).
- Sea ice loss of -12.8% per decade and ocean Mixed Layer warming of 0.5°C per decade (IPCC, 2019).
- The northern Canadian Arctic Archipelago (CAA) shelf is expected to have the last perennial sea ice in the Arctic, making it an important ecological refuge.
- This region is covered in year-round thick sea ice, limiting *in situ* observations.
- Models are the most effective tools to understand the processes driving the rapidly changing Arctic climate.

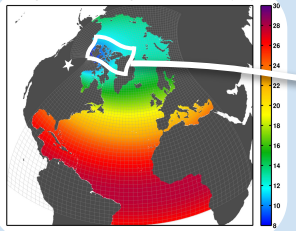
MODEL

NEMO
Nucleus for European Modelling of the Ocean

ANHA
Arctic and Northern Hemisphere Atlantic

- 3D coupled model
  - Ocean-sea-ice-biogeochemical
- 1/4° resolution
- Atmospheric forcing: CORE-IA and NCEP
  - Interannual reanalysis data
- LIM2 sea ice model
- 60-year hindcast 1958-2021

Figure 1: Horizontal grid cell resolution (km)



References
IPCC (Intergovernmental Panel on Climate Change). (2019). *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*, 203-320. doi:10.1017/9781009157964
Rantanen, M. et al. (2022). The Arctic has warmed nearly four times faster than the globe since 1979. *Communications Earth & Environment* 3, 168. doi:10.1038/s43247-022-00498-3

Fig. 3a: Decreasing summer sea ice concentration.

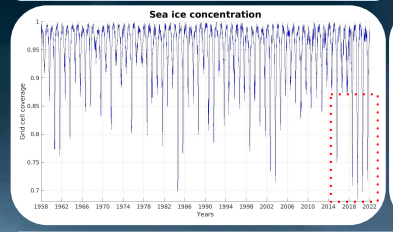


Fig 3b: Decreasing year-round ice thickness.

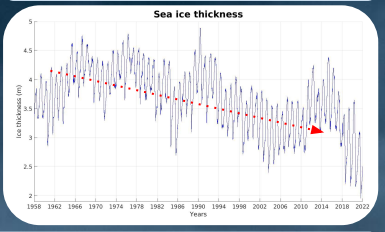
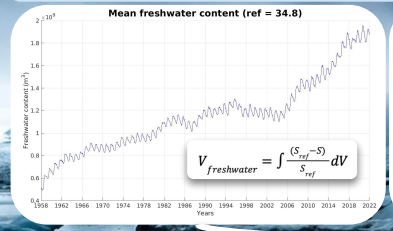
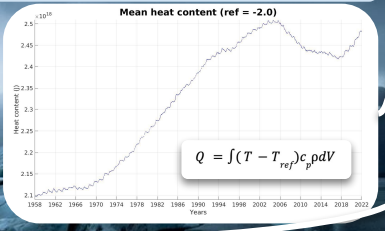


Fig. 3c,d: Increasing ocean heat and freshwater content over water column.





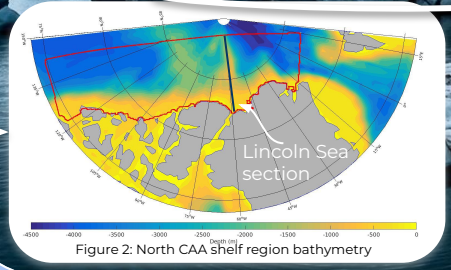


Figure 2: North CAA Shelf region bathymetry

Increased heat
⇩
Greater ice melt
⇩
More freshwater

RESULTS

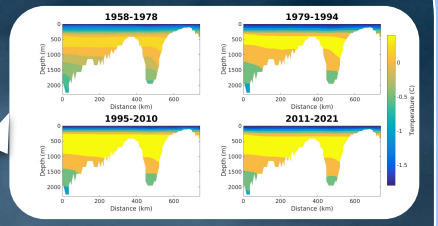


Fig 4a: Lincoln Sea section. Warm intermediate layer increasing in temperature and thickness.

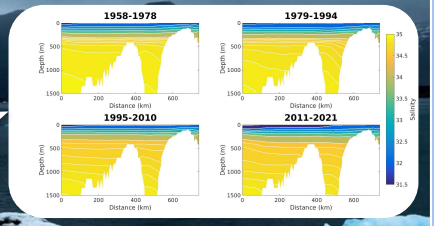


Fig 4b: Lincoln Sea section. Freshwater layer increasing in thickness and pushing down high salinity water.

Background image: https://rare-gallery.com/106201-sea-winter-4k-hd-wallpaper-ice.html

KEY POINTS

- Model demonstrates expected sea ice changes in response to a warming climate
- Intermediate Atlantic layer experiences the most pronounced changes in temperature and structure

NEXT STEPS

- Understand specific freshwater sources including sea ice melt, continental runoff, and ocean transport
- Explore the role of the prominent Atlantic Water layer in the changing Arctic
- Quantify the degree at which ice melt it caused by atmospheric warming versus provision of heat from ocean circulation