

Bridging the Gap: Examining Climate Change in Hudson Bay with High- Resolution Numerical Modelling and Indigenous Knowledge

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(photo credit: Pat Kane)

Outline

- I. Positionality Statement
- II. Introduction
- III. Climate Change in the North
- IV. Overview of Hudson Bay Complex (HBC) Physical Oceanography
 - I. Freshwater – Sea Ice
 - II. Ocean Changes
- V. Numerical Modelling
- VI. Indigenous Scientific Knowledge as a Framework of Knowledge

Positionality Statement



Introduction

- Hudson Bay climate change in the late 1990s
 - Highly unusual sea ice conditions
 - Drastic decline in eelgrass
 - Polar bears and seals in poor physical condition
 - Increase in erratic weather patterns
- Lack of scientific research and observation data

"It is now impossible to predict our weather; our ancient methods of forecasting weather are no longer yielding the predicted patterns."
- Joe Arragutainaq, Sanikiluaq [1]

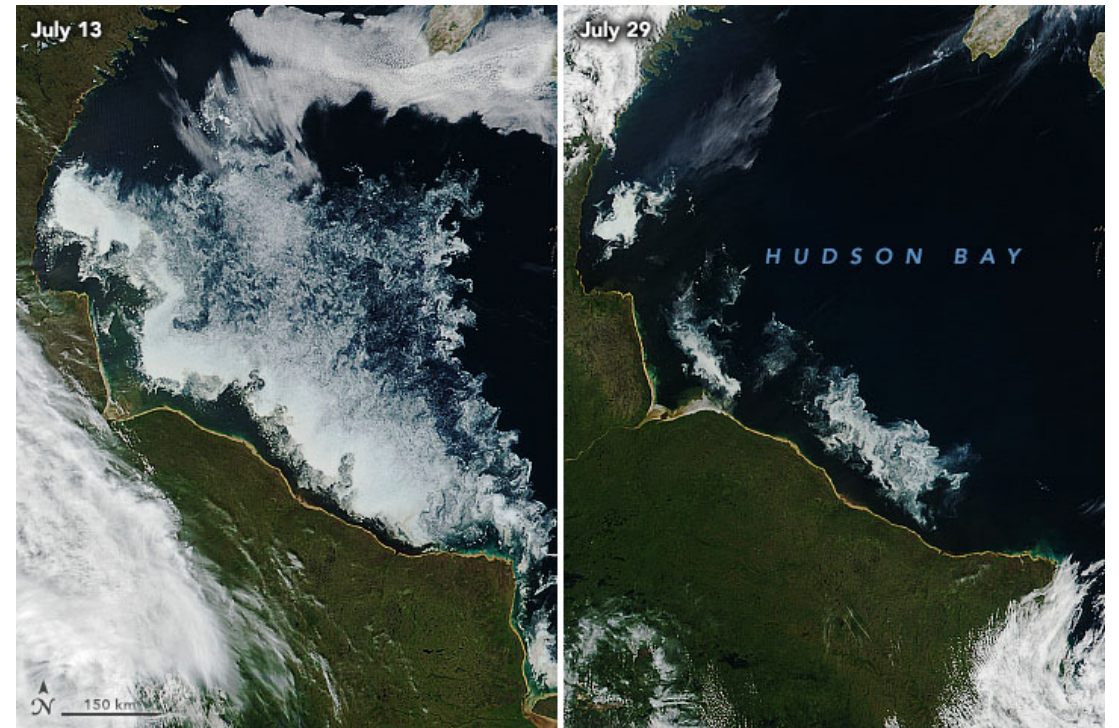


[2]

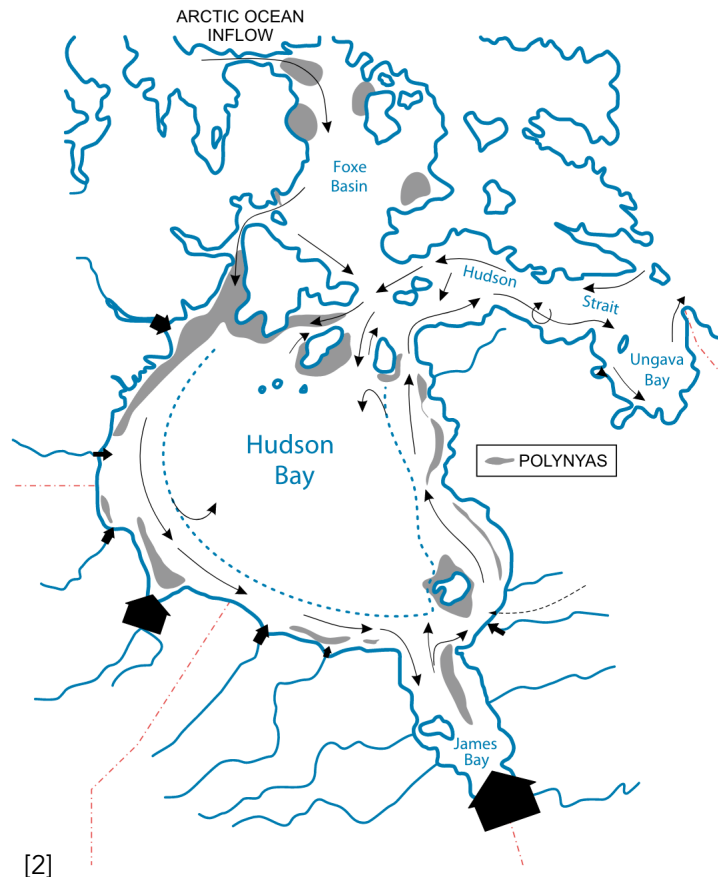
Climate Change in the North

Research Questions

1. How will increasing air temperature affect the overall dynamics of the HBC?
2. What are the relative contributions of the processes that control the dynamics of the HBC?
3. Which processes are responsible for the reported abrupt ecological changes?



Overview of Hudson Bay Physical Oceanography



- Hudson Bay Complex
 - Hudson and James Bay, Hudson Strait, Foxe Basin, Ungava Bay
- Seasonally ice-covered inland sea
- Intense stratification, described as "dynamically dead" [2]
- Behaves like a large estuary but not very biologically active [3]
 - Freshwater hinders fresh and saline waters from mixing

Freshwater — Sea Ice



(Toronto Star)

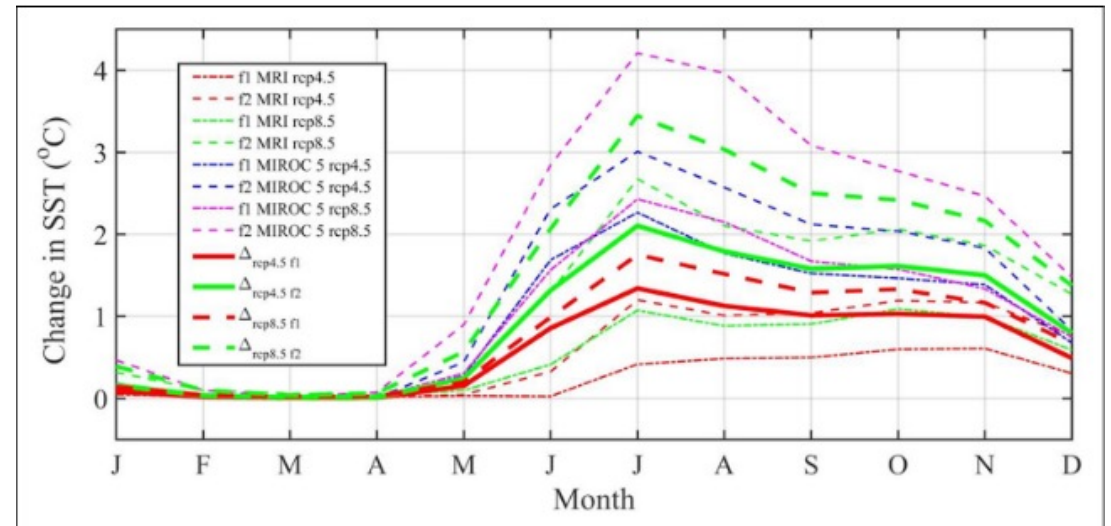
be covered in snow, prior to the
er. Now, the land is barely
prior to the sea-ice freezing and
er freezes around October. Now
he middle of December. It seems
er every year, the land fast ice
t."

ermone Tattuinee, Rankin Inlet [5]

Ocean Changes

HBC Future Projections

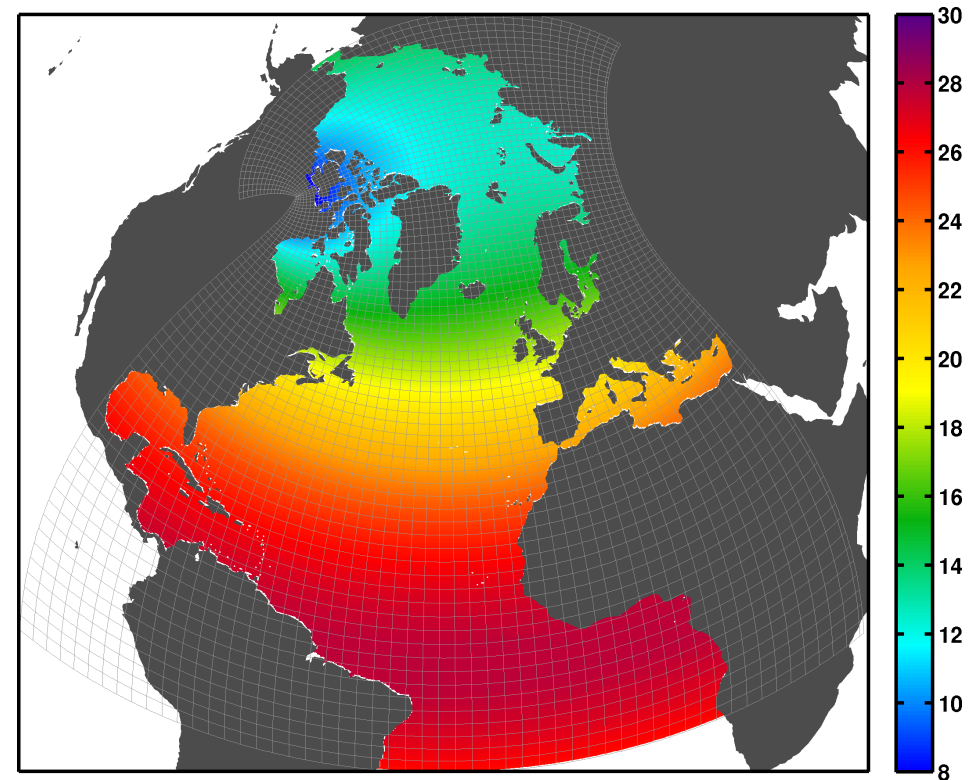
- Sea level rise will erode the Manitoba and Ontario coastlines
- Increase frequency of storm surges along eastern Hudson Bay and Hudson Strait [2][6][7]
- Increase in SST of $\sim 2^{\circ}\text{C}$
- Sea Surface Salinity (SSS) future projections are ambiguous
 - Different and opposing processes influence SSS



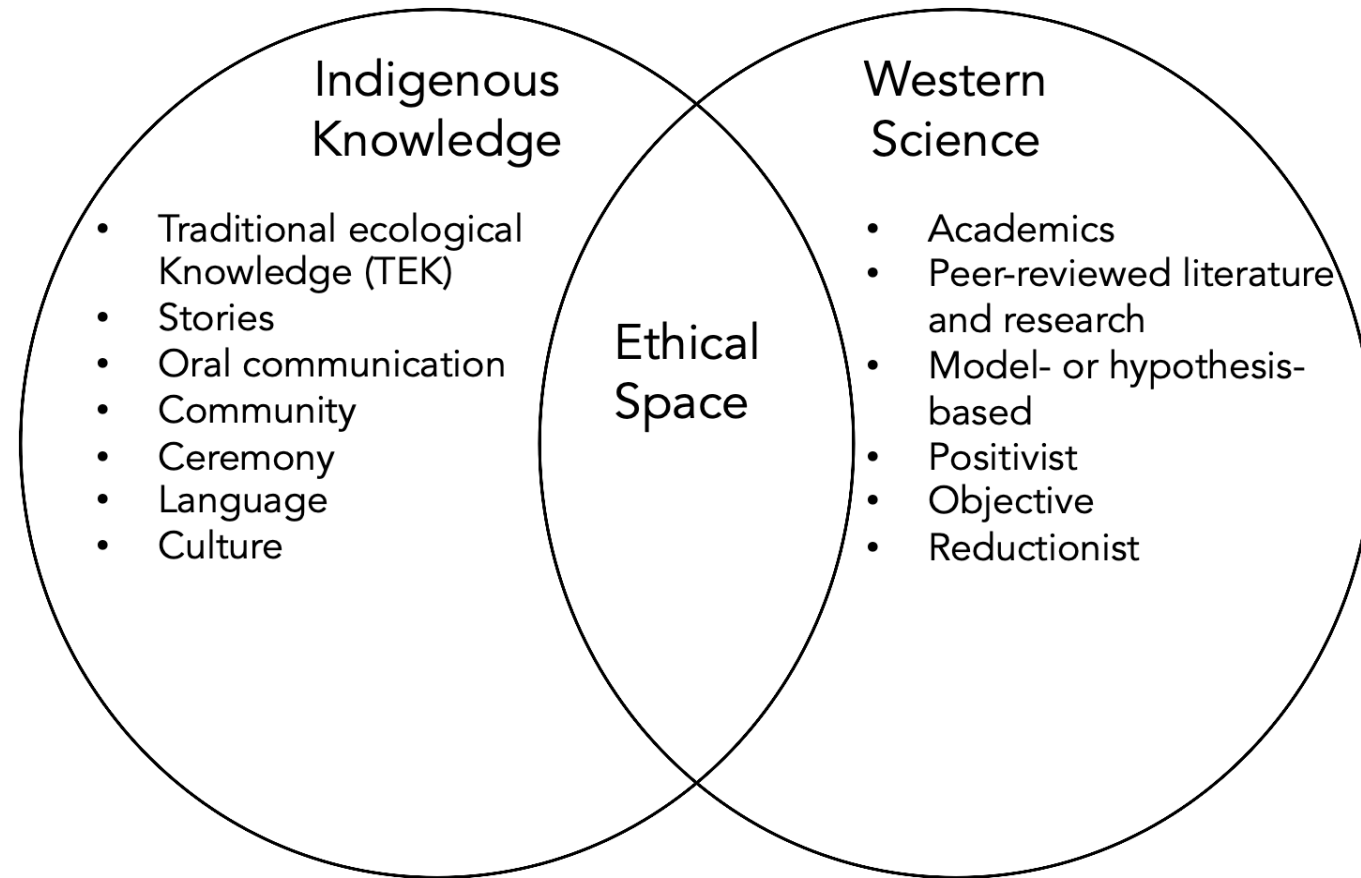
Numerical Modelling

Nucleus for European Modelling of the Ocean (NEMO)

- Analyze model output
 - Configuration: Arctic and the Northern Hemisphere Atlantic, $\frac{1^0}{4}$ resolution (ANHA4)
- Model validation with two approaches
 - Western science (e.g., satellite observations, historical databases)
 - Indigenous scientific knowledge



What are Knowledge Systems?



Indigenous Observation as a Framework for Scientific Knowledge



(Richard Harrington, Library and Archives Canada)



(Scott Paradis, Timmins Daily Press)

References

- [1] Elder's Report of Climate Change 2001
- [2] ZA Kuzyk and LM Candlish. "From science to policy in the greater Hudson Bay marine region: An integrated regional impact study (IRIS) of climate change and modernization". In: ArcticNet, Quebec City (2019), p. 424.
- [3] RG Ingram and S Prinsenberg. "Coastal oceanography of Hudson Bay and surrounding eastern Canadian Arctic waters". In: The sea 11.29 (1998), pp. 835–859.
- [4] Peter S Galbraith and Pierre Larouche. "Reprint of "Sea-surface temperature in Hudson Bay and Hudson Strait in relation to air temperature and ice cover breakup, 1985–2009"". In: Journal of Marine Systems 88.3 (2011), pp. 463–475.
- [5] Elder's Conference on Climate Change.
- [6] CD Smith et al. "CanCoast: A national-scale framework for characterizing Canada's marine coasts". In: 11th International Symposium for GIS and Computer Cartography for Coastal Zone Management. 2013.
- [7] A-M Hayden et al. "Multi-Century Impacts of Ice Sheet Retreat on Sea Level and Ocean Tides in Hudson Bay". In: Journal of Geophysical Research: Oceans 125.11 (2020), e2019JC015104.