U.S. DEPARTMENT OF ENERGY | Office of Science

HiLAT RASM

Arctic Ocean stratification in a changing climate

A possible CAMAS collaboration activity

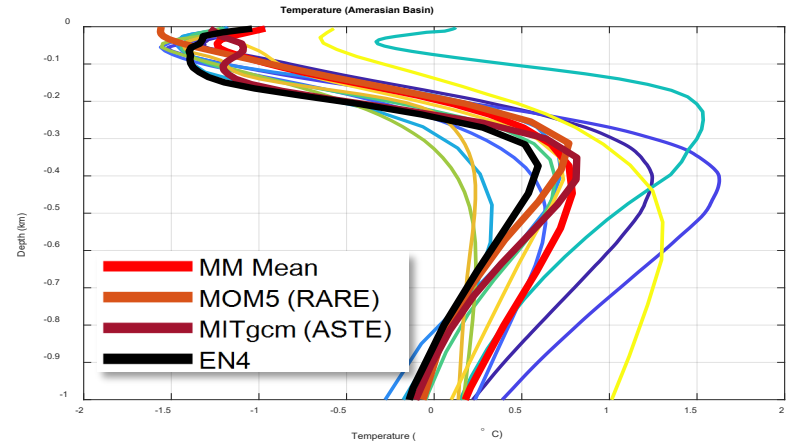
Milena Veneziani (Los Alamos National Laboratory)

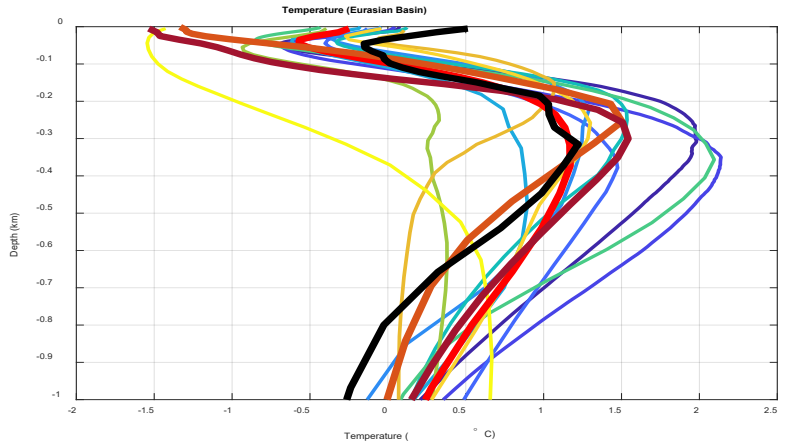
Collaborators: Wilbert Weijer, Wieslaw Maslowsky, Younjoo Lee, hopefully others

CAMAS
Consortium for the Advancement of Marine Arctic Science
Feb 13-16, 2024

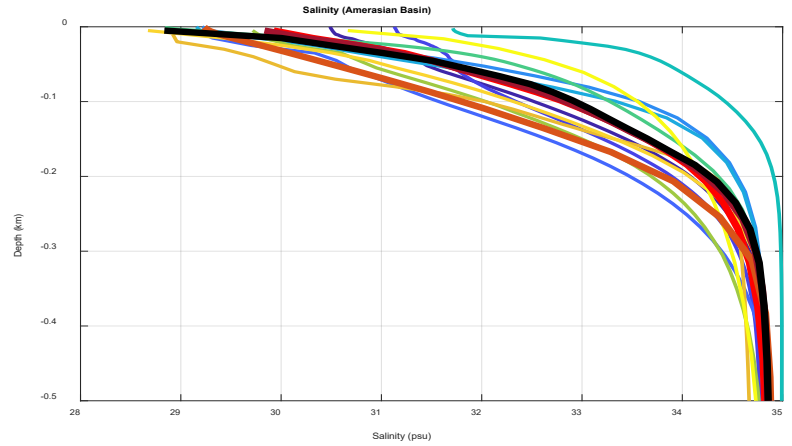
Los Alamos NATIONAL LABORATORY

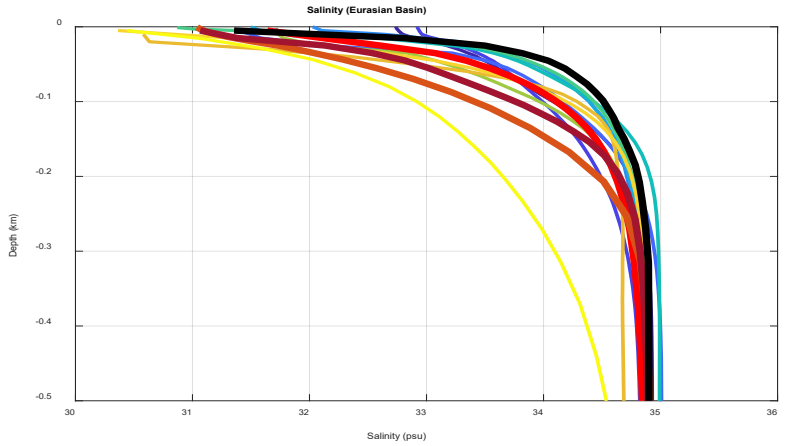
Inspiration: IARPC Modelers and Physical Oceanography Communities of Practice meeting on **Arctic Ocean Stratification Biases in Earth System Models** (Jun 2023)



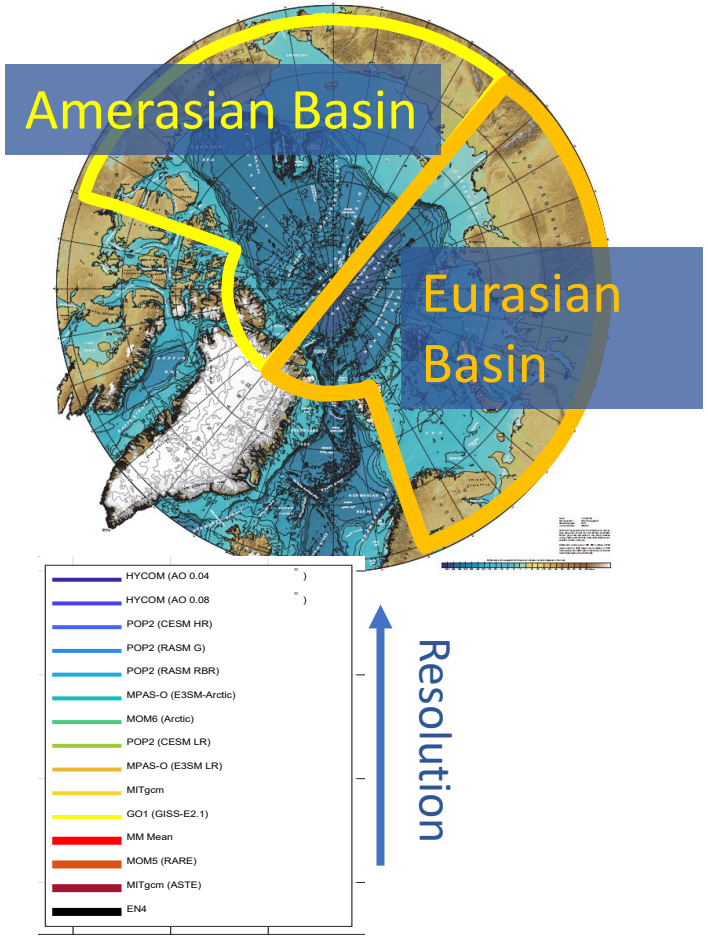


Upper 1000 m Temperature





Upper 500 m Salinity



Questions that were raised at IARPC

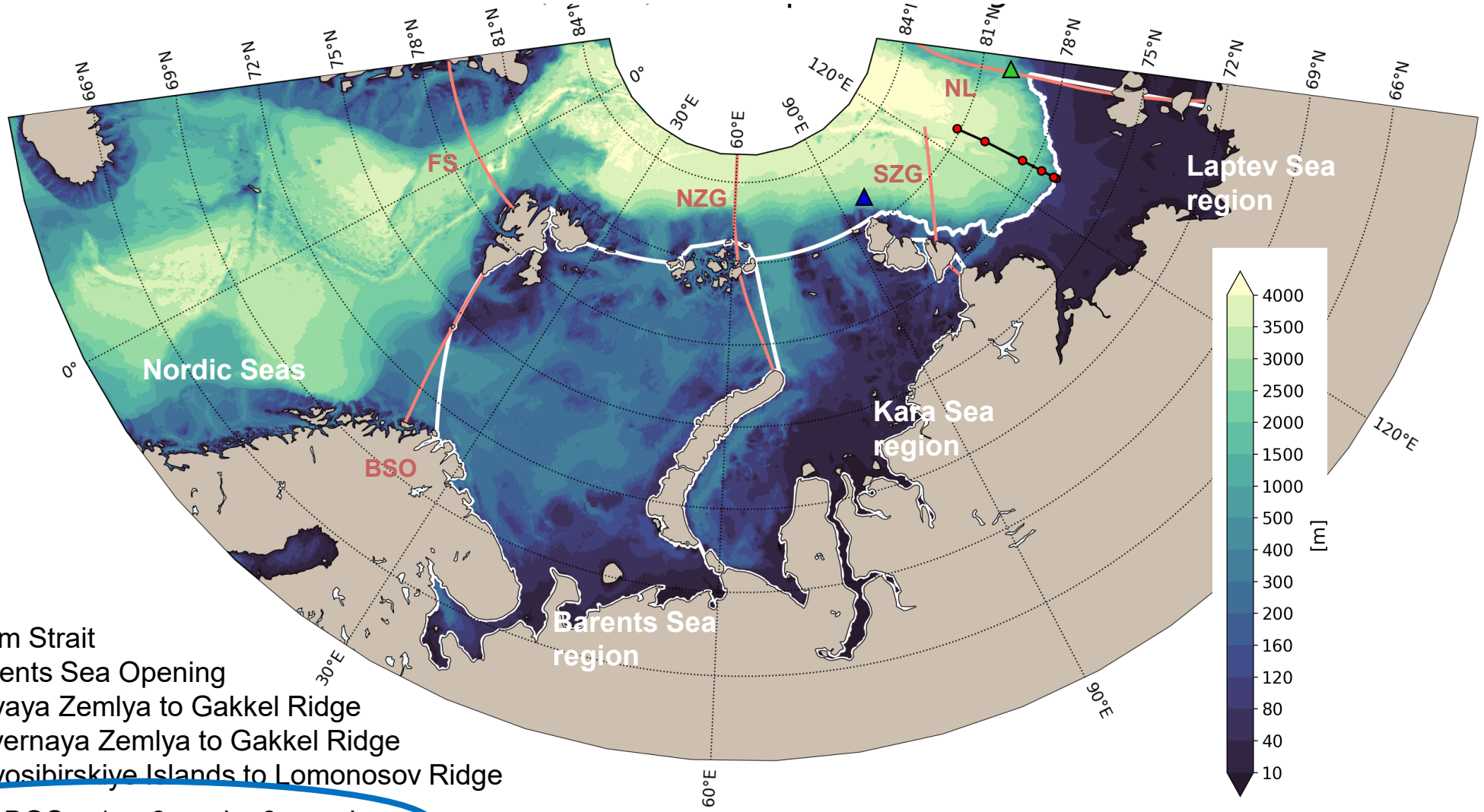
- What are the main processes responsible for controlling the Arctic Ocean stratification?
- Which processes are the most likely cause for the biases in Arctic Ocean stratification in ESMs?
- How can these processes be improved?
- Could a collaborative effort between the modeling centers be helpful?

Possible collaborative efforts

between modeling centers **and** between modelers & observationalists

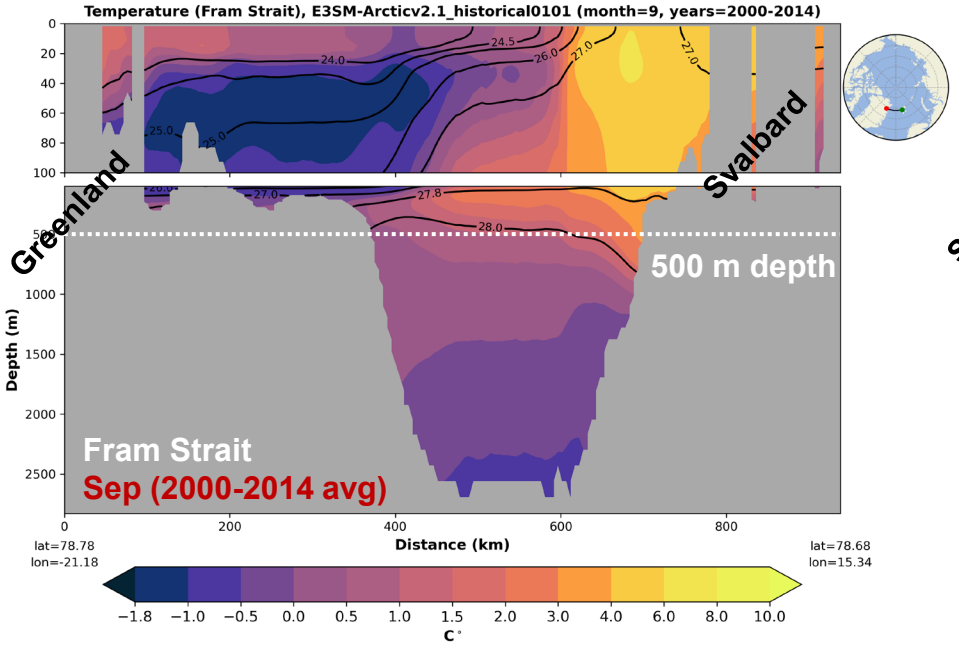
- Regional heat and freshwater budgets in keys regions of the Arctic:
  1. the gateway through the North Atlantic: Fram Strait and Barents Sea Opening, Barents/Kara Seas, Laptev Sea, East Siberian Sea (with extensions into the Nansen, Amundsen, and Makarov Basins)
  2. the gateway through the Pacific Ocean: Bering Strait, Chukchi Sea, Beaufort Sea and Canada Basin
- Tracers tracking freshwater origin due to different sources (advective, precipitation, sea ice formation, river runoff). Ideas by Carlyn Schmidgall
- Others?

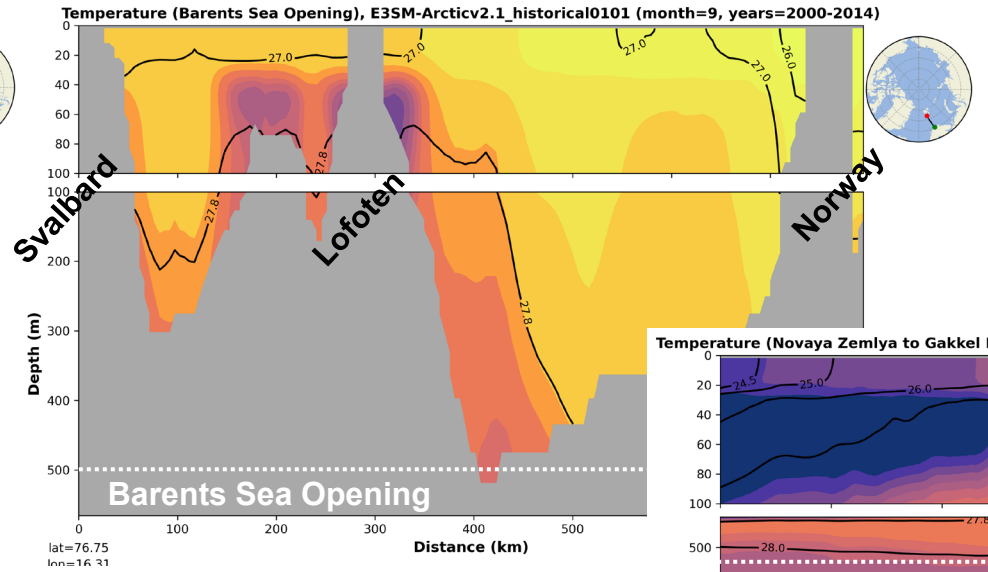
1. Gateway through the North Atlantic

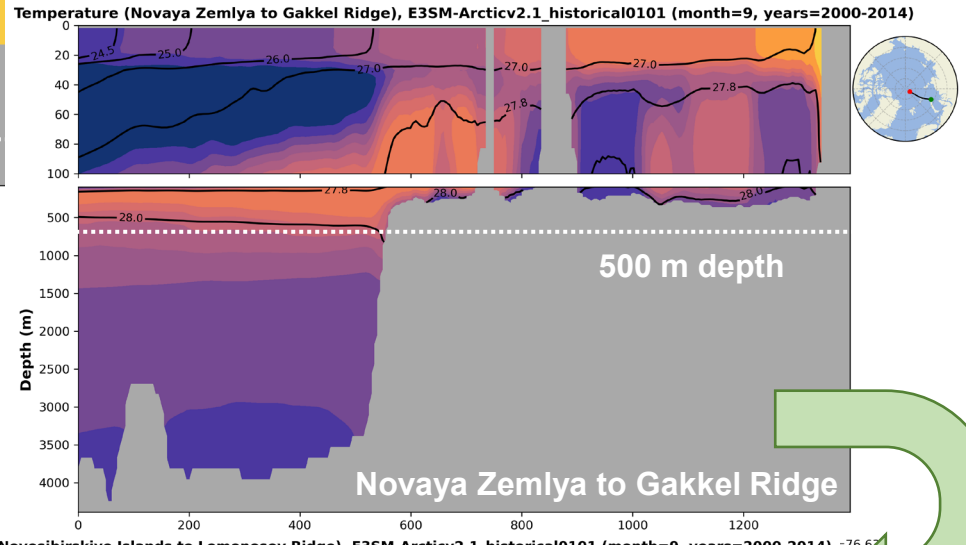


FS Fram Strait
BSO Barents Sea Opening
NZG Novaya Zemlya to Gakkel Ridge
SZG Severnaya Zemlya to Gakkel Ridge
NL Novosibirskiye Islands to Lomonosov Ridge

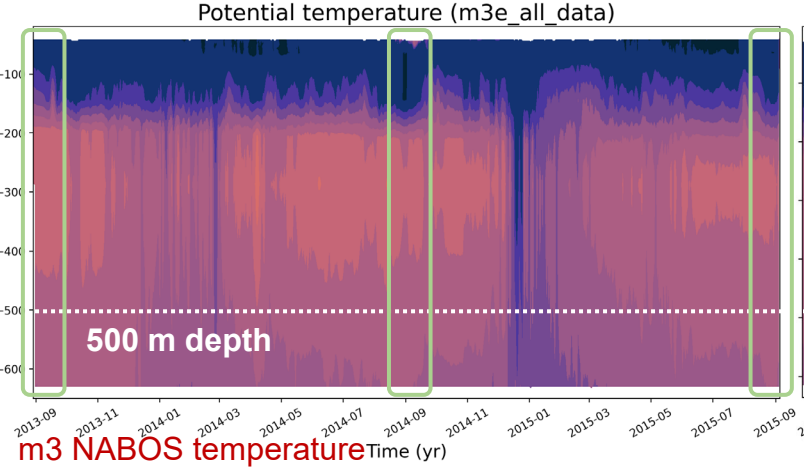
● ▲ ▲ NABOS m1, m3, and m6 moorings

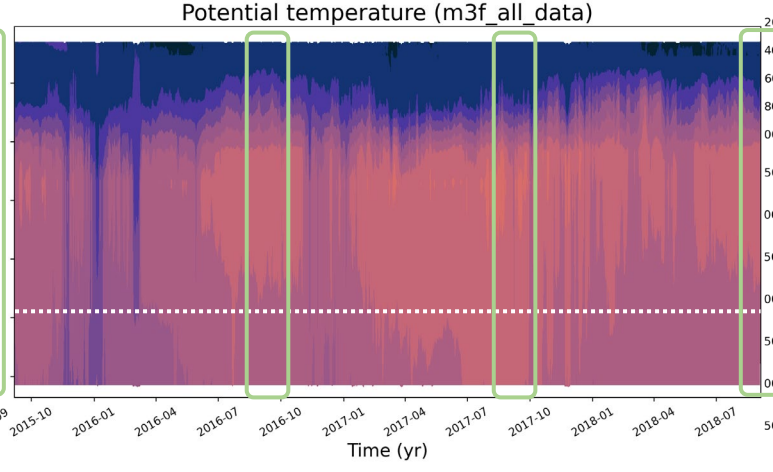




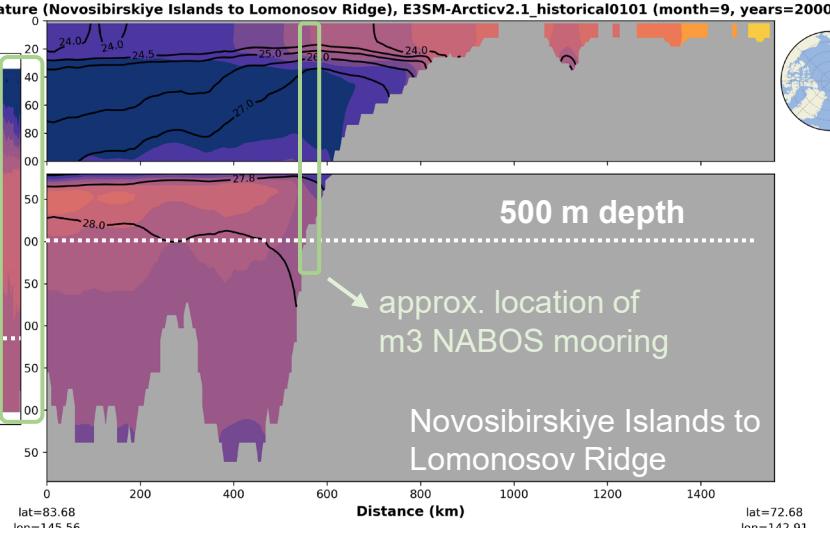


Temperature cross-sections from a E3SM-Arctic historical simulation

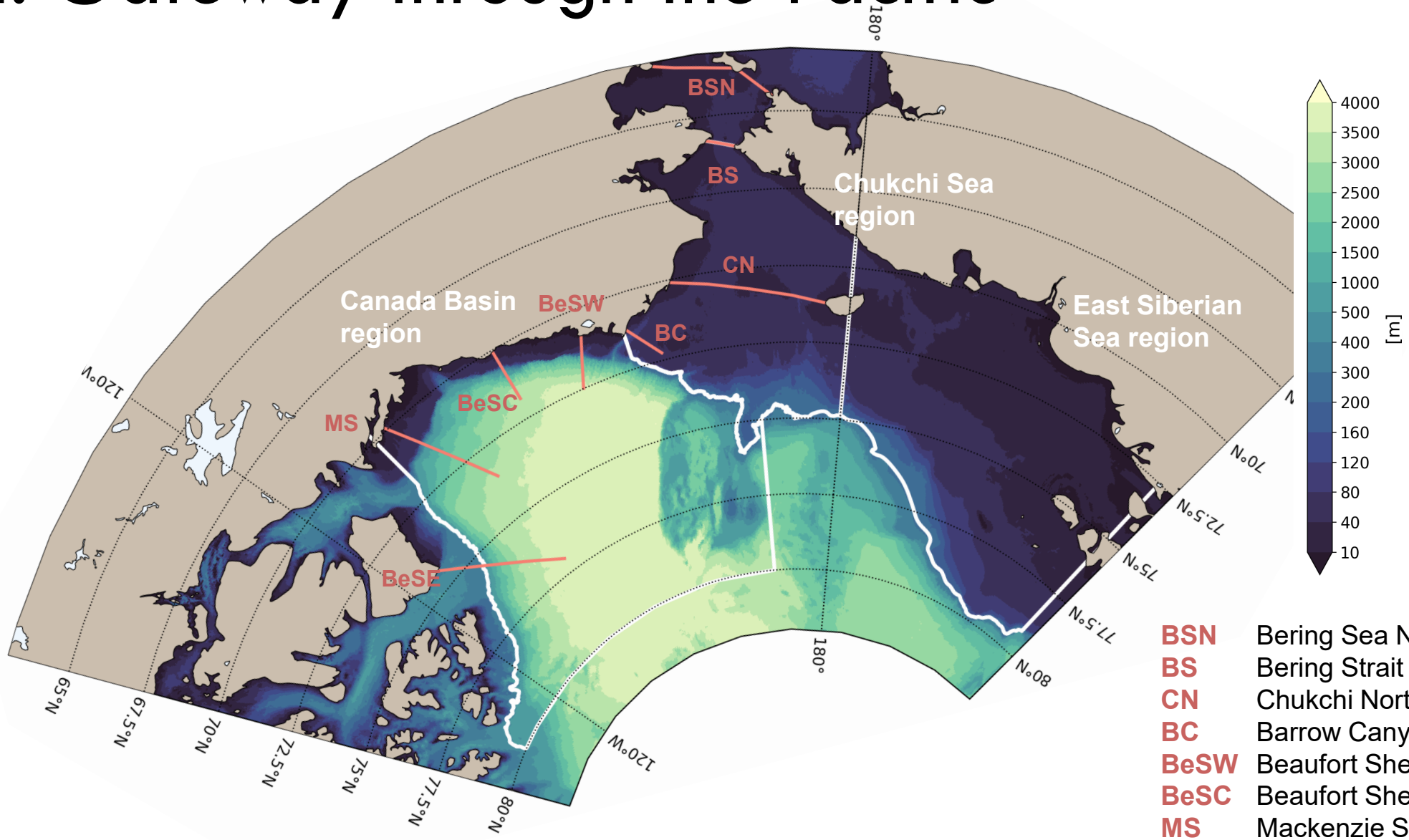




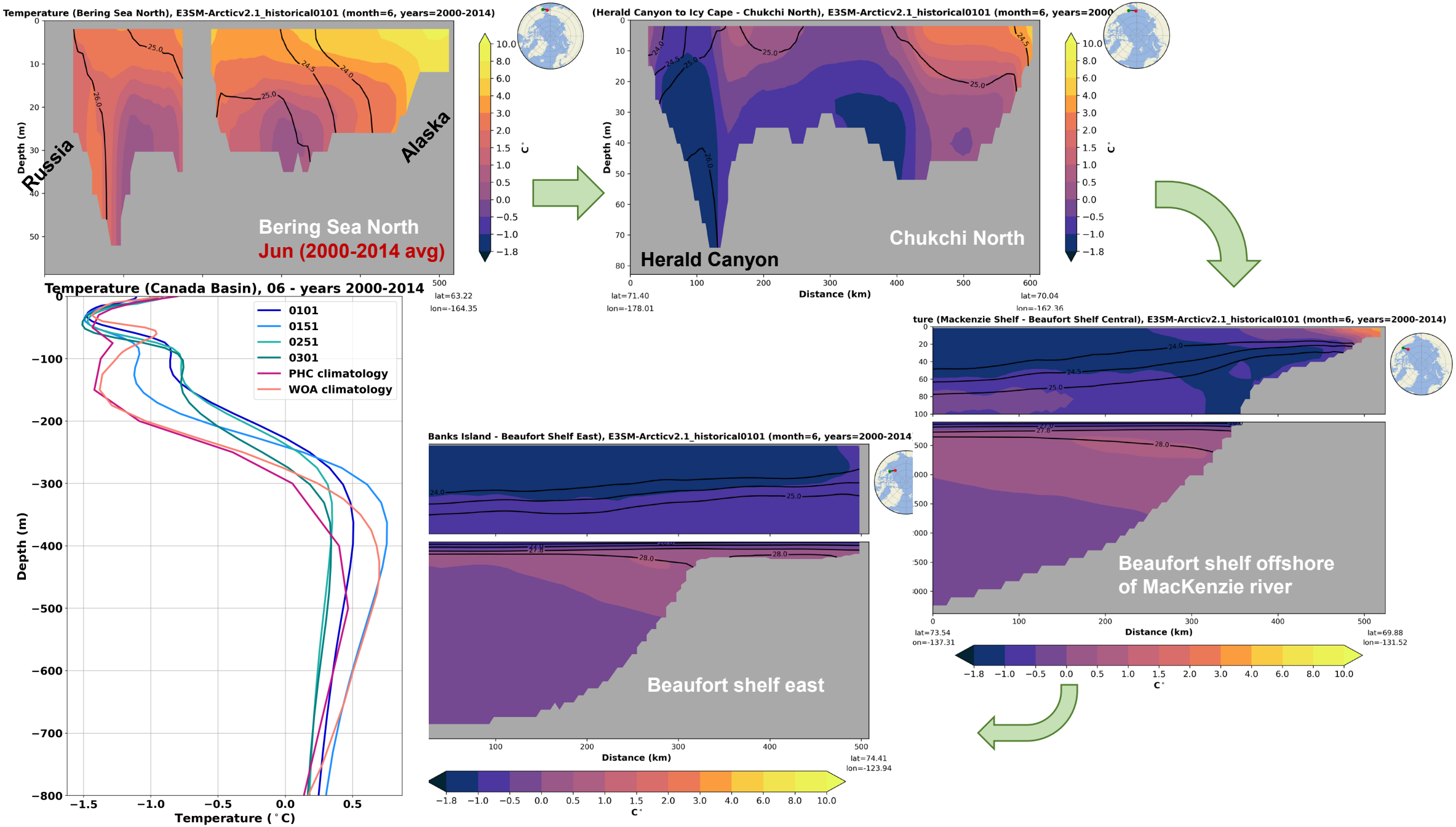
m3 NABOS temperature (21013-2018)



2. Gateway through the Pacific



BSN	Bering Sea North
BS	Bering Strait
CN	Chukchi North
BC	Barrow Canyon
BeSW	Beaufort Shelf West
BeSC	Beaufort Shelf Central
MS	Mackenzie Shelf
BeSE	Beaufort Shelf East


Temperature (Bering Sea North), E3SM-Arcticv2.1_historical0101 (month=6, years=2000-2014)
Russia
Alaska
Bering Sea North
Jun (2000-2014 avg)
Depth (m)
°C
(Herald Canyon to Icy Cape - Chukchi North), E3SM-Arcticv2.1_historical0101 (month=6, years=2000
Herald Canyon
Chukchi North
Distance (km)
lat=63.22
lon=-164.35
lat=71.40
lon=-178.01
lat=70.04
lon=-162.36
Temperature (Canada Basin), 06 - years 2000-2014
0101
0151
0251
0301
PHC climatology
WOA climatology
Temperature (°C)
ture (Mackenzie Shelf - Beaufort Shelf Central), E3SM-Arcticv2.1_historical0101 (month=6, years=2000-2014)
Banks Island - Beaufort Shelf East), E3SM-Arcticv2.1_historical0101 (month=6, years=2000-2014
Beaufort shelf east
Beaufort shelf offshore
of MacKenzie river
lat=74.41
lon=-123.94
lat=73.54
lon=-137.31
lat=69.88
lon=-131.52

Conclusions

- Multi-model comparisons/studies of ocean stratification in the two mentioned regions would help improve model simulations
- If we can improve simulation of present day conditions, we may have higher confidence in simulating climate change conditions
- Most importantly, we can learn something about processes
- Last but not least, we can build connections between modelers and observationalists!