Comparison of Different ANHA Simulations and Analysis of Time Series for Straits near Greenland

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Introduction

The Arctic Ocean's surface temperature and salinity vary seasonally as the ice cover melts and freezes.

Due to its relative isolation from other oceans, the Arctic Ocean has a uniquely complex system of water flow.

Figure 1: Schematic ocean circulation pattern in the Arctic and subarctic region.

Water enters from both the Pacific and Atlantic Oceans and can be divided into three unique water masses (Arctic Bottom Water, Atlantic Water and Arctic Surface Water).

Nares Strait is a waterway between Ellesmere Island and Greenland, which has a nearly permanent current from the north, powered by the Beaufort Gyre.

Purpose

Evaluation of model ocean and sea-ice fields in the ANHA configuration of the NEMO model to help understand model sensitivity to issues of initial conditions and forcing.

Upper ocean response to storms and other mesoscale events, focusing on three regions around north Greenland that experience topographically forced wind enhancement.

Model Description and Configuration

- ANHA stands for Arctic and Northern Hemisphere Atlantic and it's based on the Nucleus for European Modeling of the Ocean (NEMO), which is a state-of-art modeling framework widely used for oceanographic research.

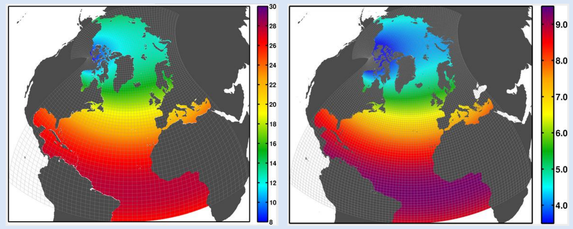

Figure 2: Horizontal resolution of model configurations (left ANHA4, right ANHA12). Colour shows mesh grid size in kilometers.

- Initial conditions and forcings in simulations:

	Initial Conditions	Atmospheric Forcing	Runoff
ANHA4 Reference	GLORYS1v1	CGRF[2]	monthly climatology (on-the-fly)
Greenland Passive Tracer	GLORYS2v3	CGRF[3]	Interannual monthly with Greenland melt (remap-Ⅱ)
ANHA12 Reference	GLORYS1v1	CGRF[2]	Monthly climatology (on-the-fly)

CGRF: Canada Meteorological Center Global Deterministic Prediction System ReForecasts

GLORYS: Global Ocean ReanalYses and Simulations

2. Solid precipitation (snow) taken from inter-annual CORE-Ⅱ (2002-2010)

3. Solid precipitation (snow) computed from CGRF total precipitation based on the 2-m air temperature

Results

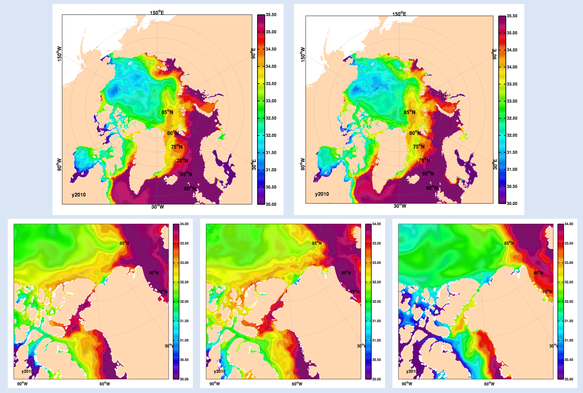

Figure 3: Annual mean sea surface salinity simulated in ANHA4 and ANHA12 simulations in 2010. Upper panels show ANHA4 Reference and ANHA12 Reference. Lower panels show ANHA4 Reference, ANHA12 Reference and ANHA4 Greenland Passive Tracer in Nares Strait.

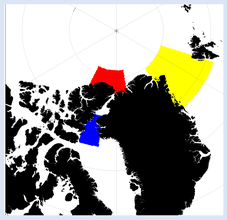

Figure 4: Select regions (red: Ellesmere; blue: Smith Sound; yellow: Fram) to study ocean response to storms and other mesoscale events.

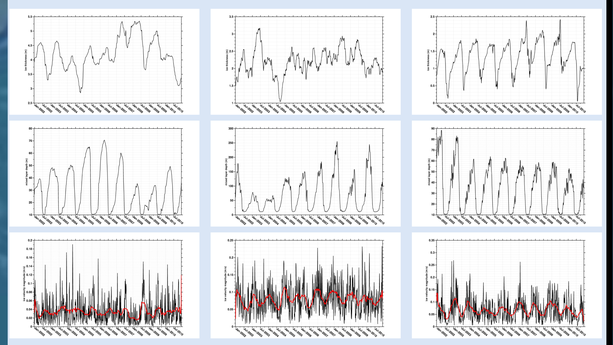

Figure 5: Time series of ice thickness (unit: meter), mixed layer depth (unit: meter) and ice velocity magnitude (unit: m/s) in the three regions. (From left to right: Ellesmere, Fram and Smith Sound) from the Greenland Passive Tracer simulation.

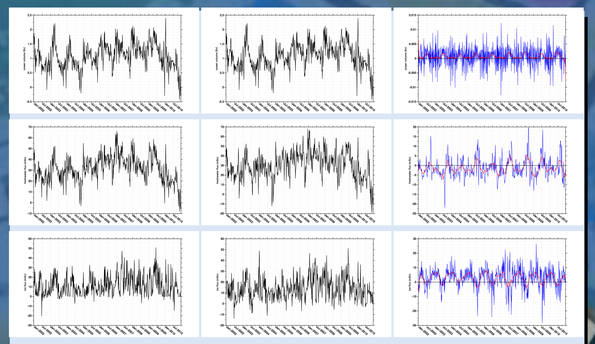

Figure 6: Time series of ocean volume flux (top panel, unit: Sv), freshwater flux (middle panel, unit: mSv) and ice flux (bottom panel, unit: mSv) through the north (left column) gate, south (center column) gate of Nares Strait and their differences (values at the south gate minus values at north gate) in the Greenland Passive Tracer simulation.

Conclusions

Greenland passive tracer run is better suggests that runoff is an important freshwater source in this area.

Though when ice is thicker mixed layer depth is more likely to be thin, the relation between mixed layer depth is not valid all the time and in all the three regions.

According to figure 6, the variation of freshwater flux is associated with ice process and runoff from Greenland, but how to separate the effects of them still needs further analysis.

References

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