# #15 Numerical Simulations of the Ocean and Sea Ice in the Canadian Arctic Archipelago with NEMO

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## Introduction

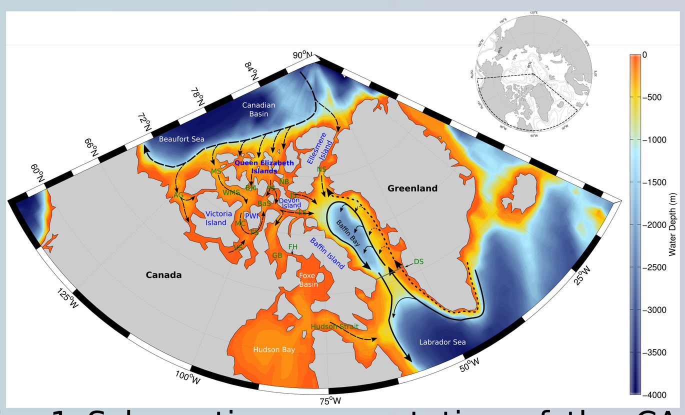


Fig. 1 Schematic representation of the CAA with bathymetry (colour) and circulation (black arrows).

The Canadian Arctic Archipelago (CAA) is a complicated network of narrow straits and shallow basin that connects the Arctic Ocean and North Atlantic Ocean. It is the one of the major pathways delivering cold fresh Arctic Ocean water to the warm salty Atlantic Ocean, potentially influencing deep convection in Labrador Sea and the large scale meridional circulation of the Atlantic Ocean.

The CAA includes the famous Northwest Passage, which may become important for shipping in the near future. Here we show our research based on a numerical modelling approach to examine sea ice processes and ocean circulation in this region.

## Method

We use the ANHA (Arctic and North Hemisphere Atlantic) configuration of the coupled ocean-sea ice model, NEMO (Nucleus for European Modelling numerical framework) to simulate the CAA sea ice and ocean conditions over the period of 2002-2013. The configuration resolution is 1/4° (~ 10 km in the CAA). The atmospheric forcing uses the lastest version of the high spatial and temporal inter-annual Canadian Meteorological Centre's global deterministic prediction system Reforcast (CGRF) atmospheric forcing from Environment Canada.

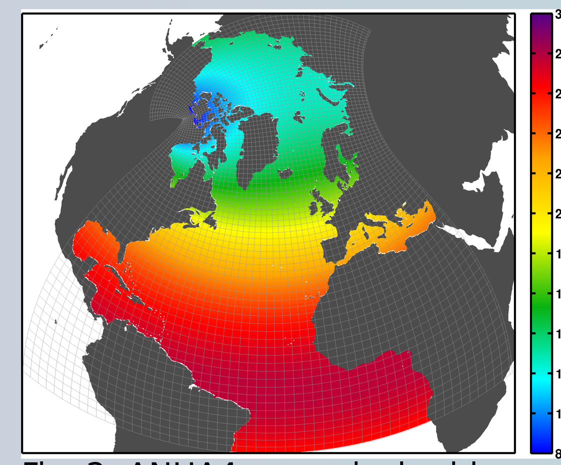

Fig. 2: ANHA4 numerical grid

More informations on the domain are presented on poster #14.

## Transports Evaluation

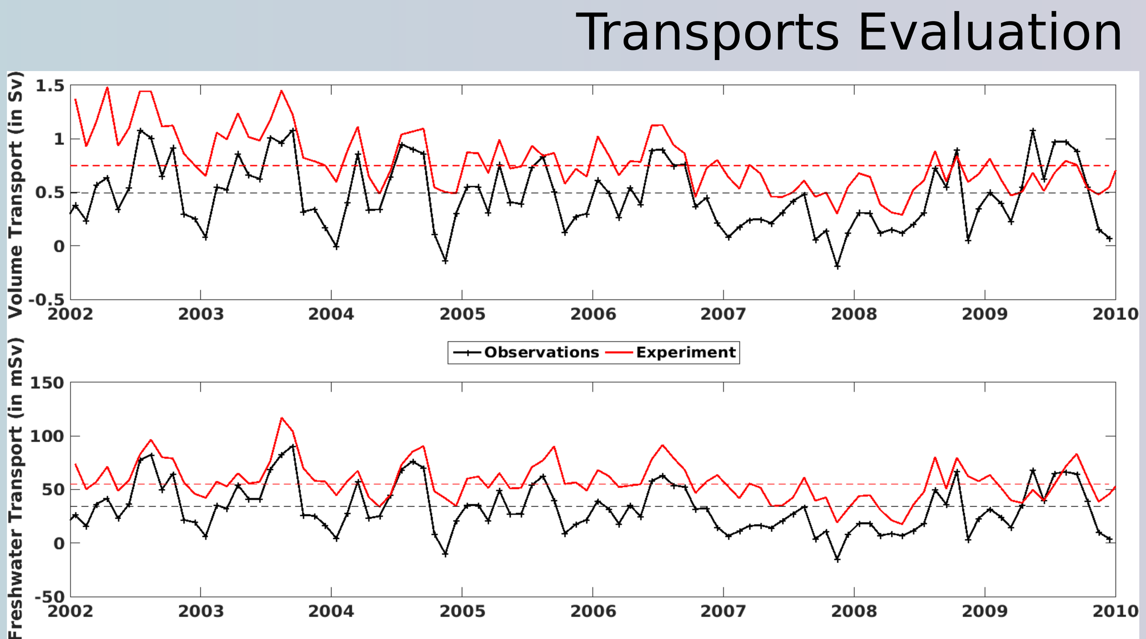


Fig. 3: Volume and Freshwater transport at Lancaster Sound

Correlation between observations and our numerical model:
- Volume transport: **0.79**
- Freshwater transport: **0.85**

## Tranports and oceanic tracers

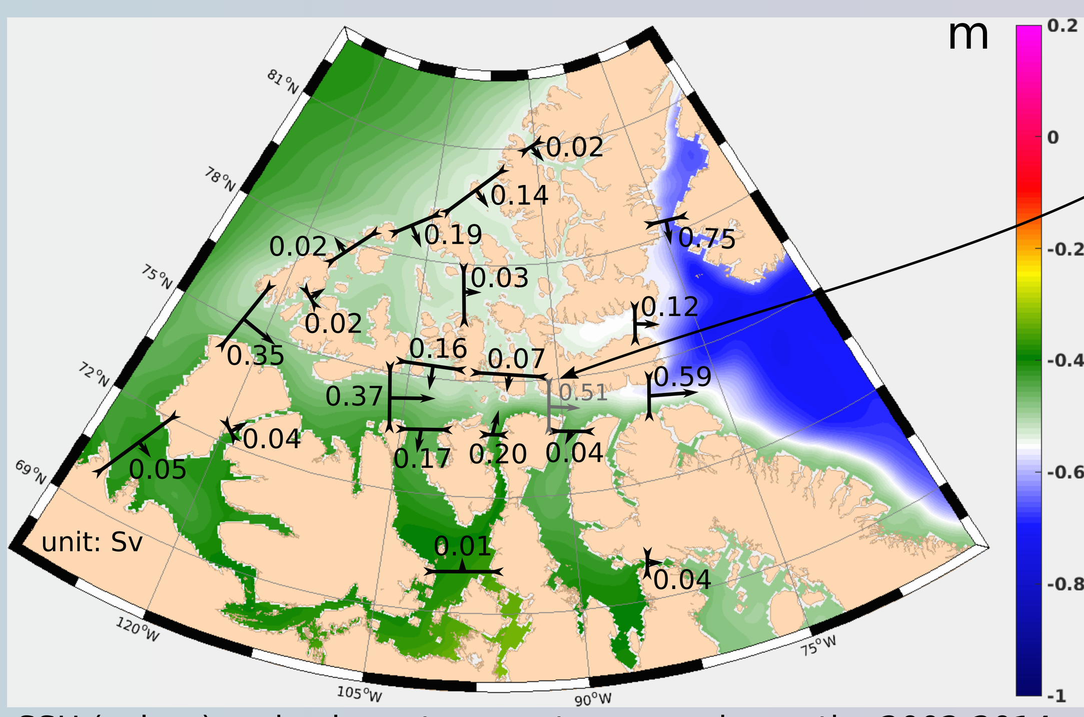


Fig. 4: SSH (colour) and volume transport averaged over the 2002-2014 period. Grey arrow represents the observed mean transport over 1999-2010.

Volume transport:

$$V_{tr} = \int_z^0 (V \times ds)\, dz$$

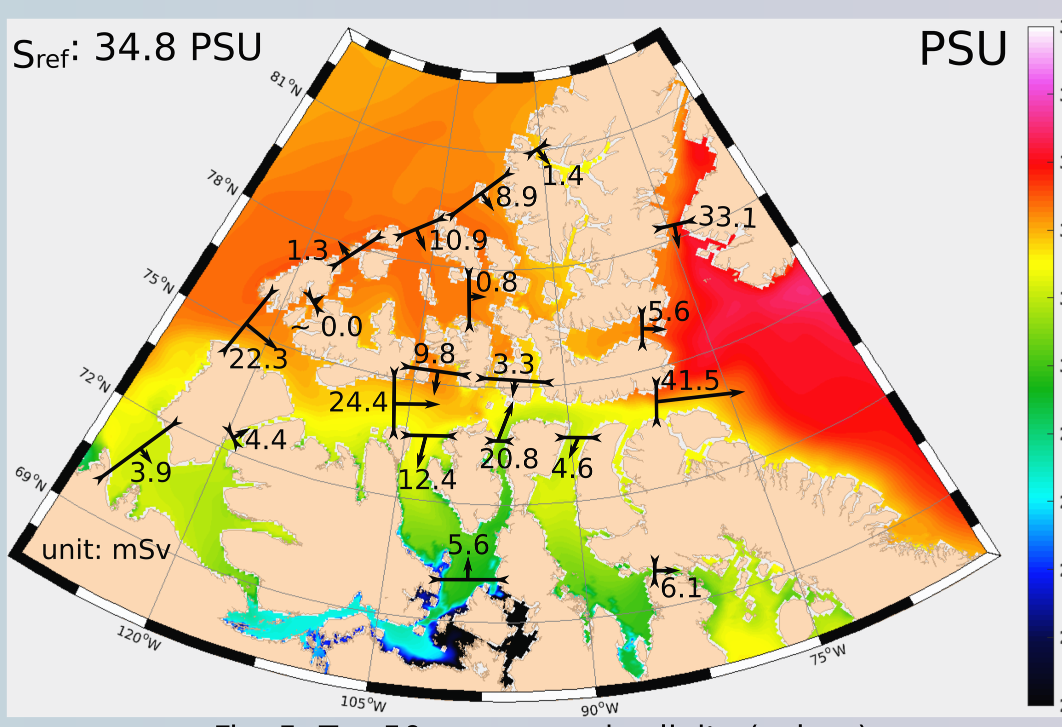


Fig. 5: Top 50m averaged salinity (colour) and freshwater transport averaged over the 2002-2014 period.

Freshwater transport:

$$FW_{tr} = \int_z^0 \left(\frac{S_{ref} - S}{S_{ref}} V \times ds\right) dz$$

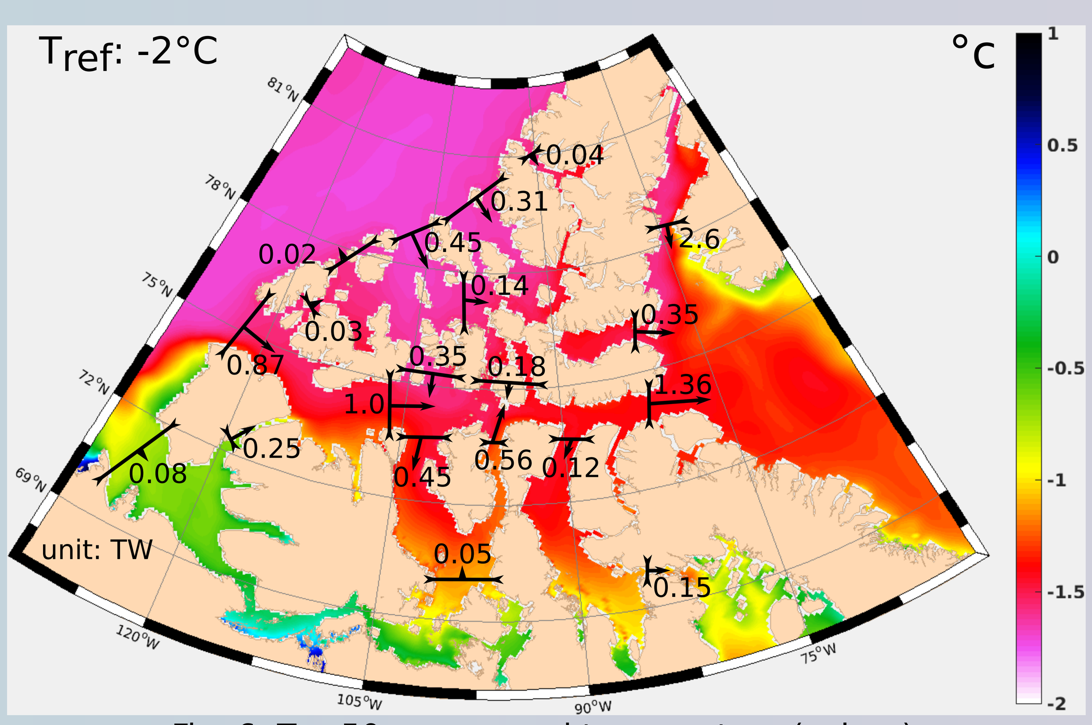


Fig. 6: Top 50m averaged temperature (colour) and heat transport averaged over the 2002-2014 period.

Heat transport:

$$H_{tr} = \int_z^0 ((T_{ref} - T)\, V \times ds)\, dz$$

## Sea ice coverage

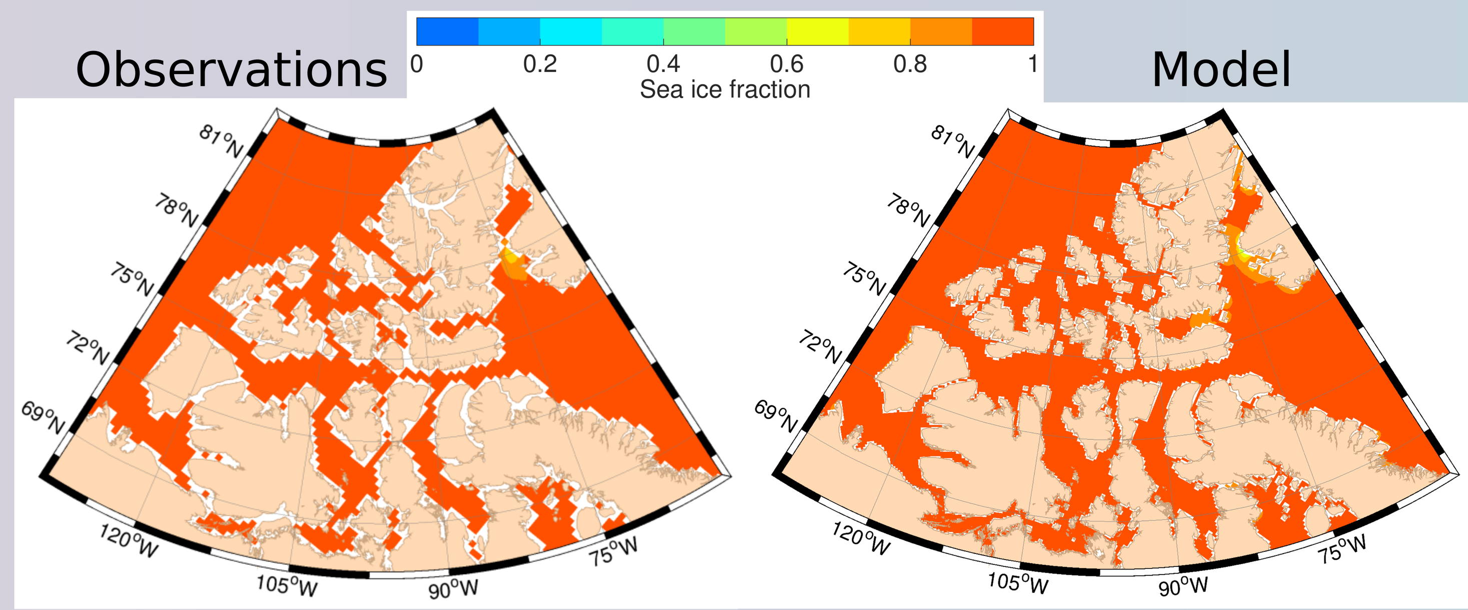


Fig. 7: Sea ice cover (colour) averaged over the 2002-2014 period for March only.

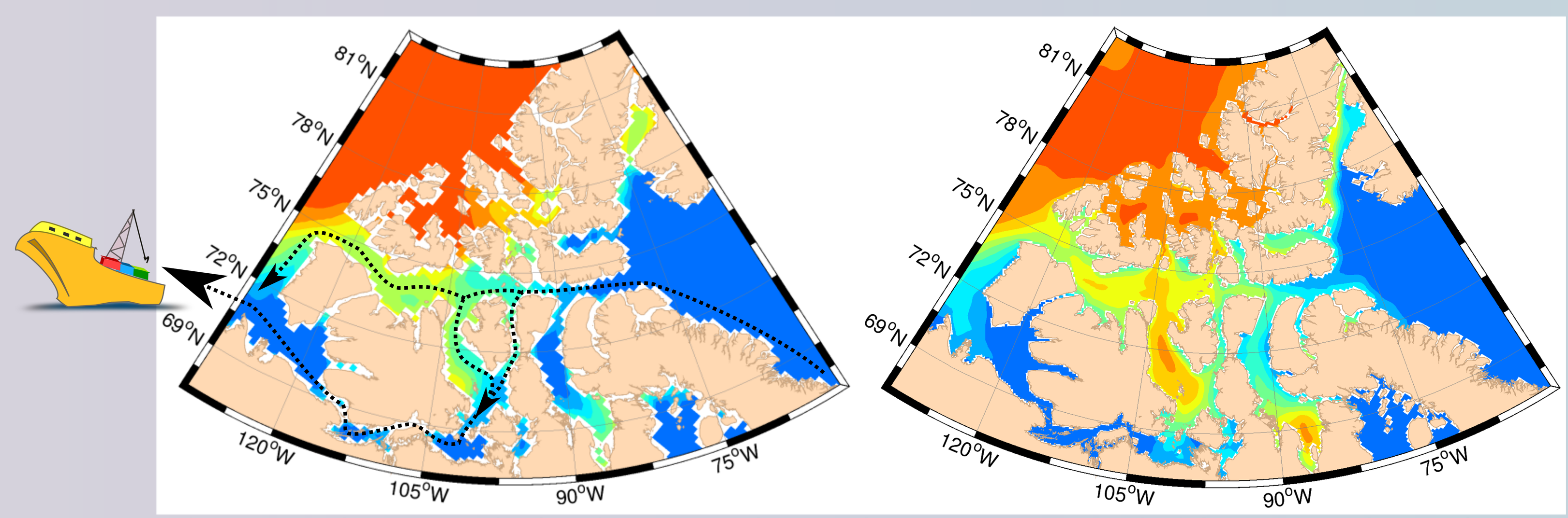

Fig. 8: Sea ice cover (colour) averaged over the 2002-2014 period for September only. Northwest Passage shown by the black arrows.

## Sea ice thickness

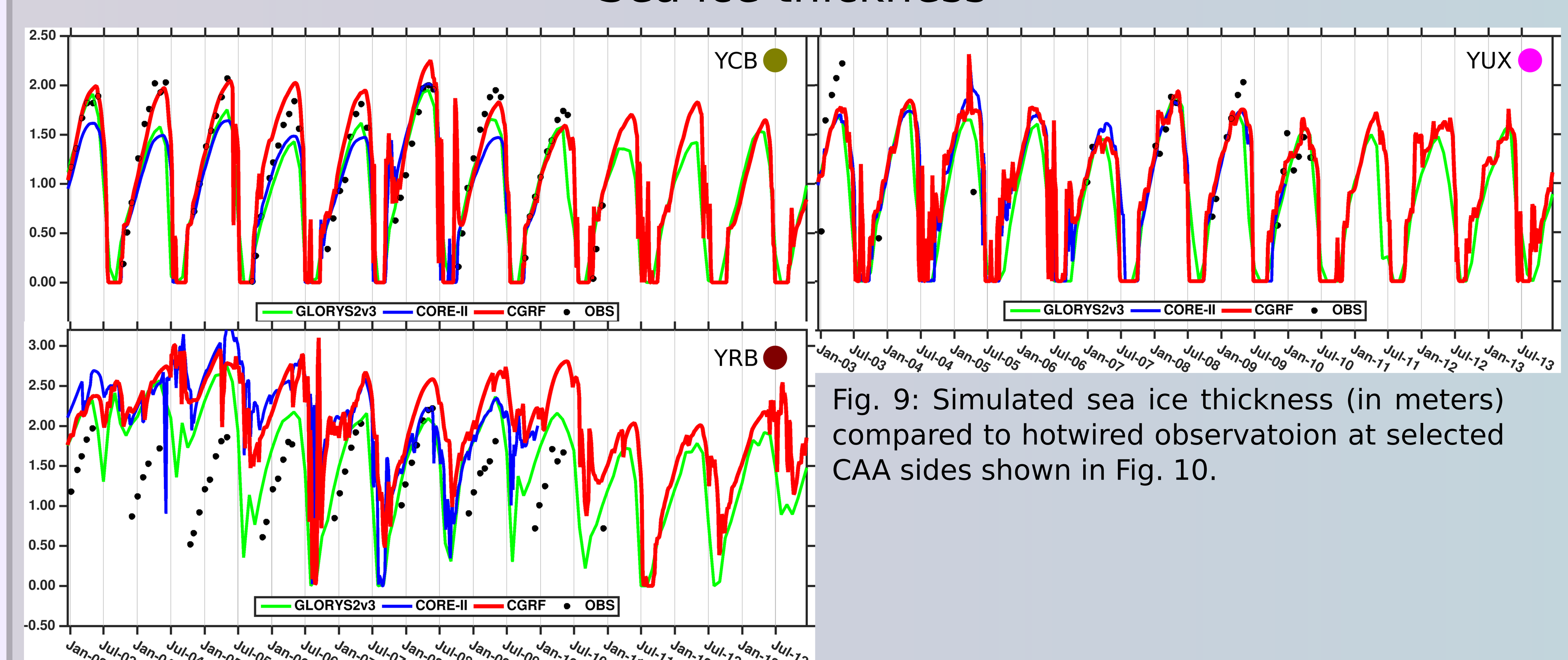


Fig. 9: Simulated sea ice thickness (in meters) compared to hotwired observatoion at selected CAA sides shown in Fig. 10.

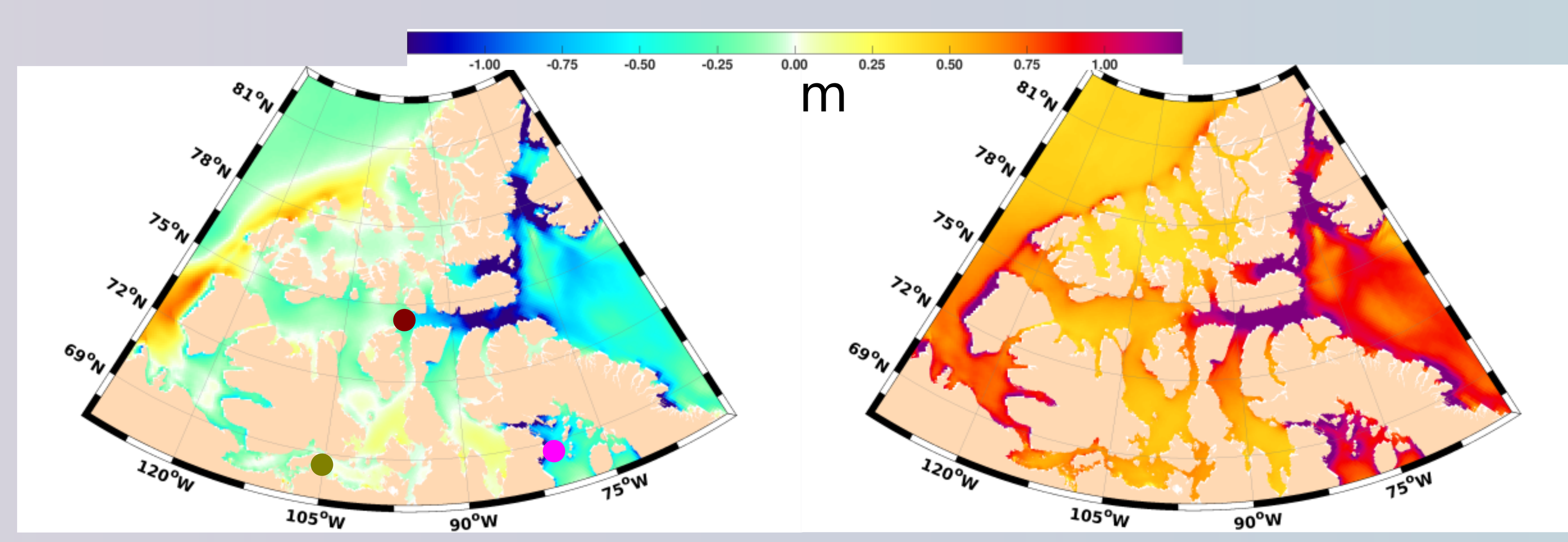


Fig. 10: Dynamical (left) and Thermodynamical (right) sea ice growth from January to March averaged from 2003 to 2013. Colored dots represent the location of the cases studies shown in Fig. 9.

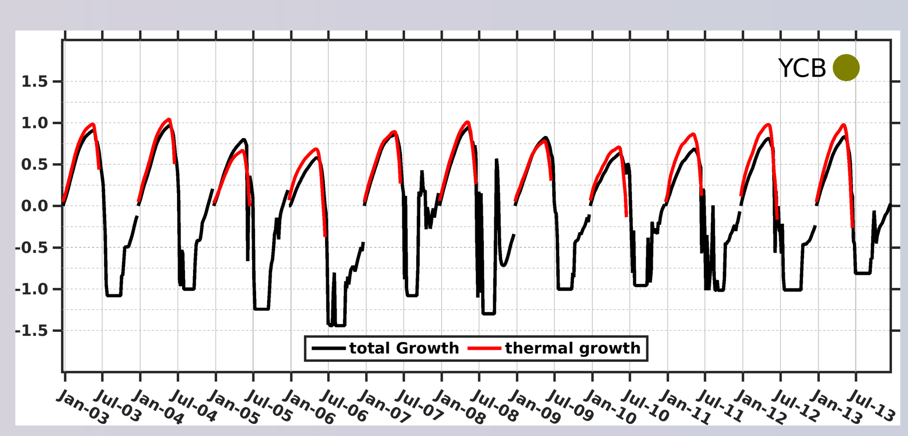


Fig. 11: Detailed sea ice growth at Cambridge Bay.

## Acknowledgements

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Observational data at Lancaster Sound provided by S. Prinsenberg and his group.
Sea ice observed data provided by the NASA Distributed Active Archive Center at the National Snow & Ice Data Center.

## Conclusions

A comparison between the numerical model and observations show that the model represents well the oceanic transports in the CAA and highlight the relative importance of the QEI in the Arctic water inflow inside of the CAA.
The sea ice fraction and thickness is also well represented, particulary where ice growth is dominated by thermodynamic processes.