Evolution of Baffin Bay water masses and transport in a climate change experiment including Greenland runoff

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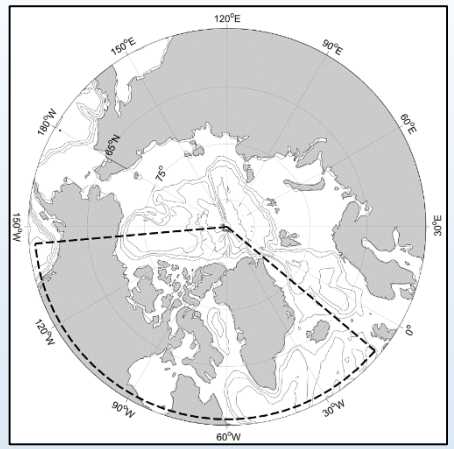
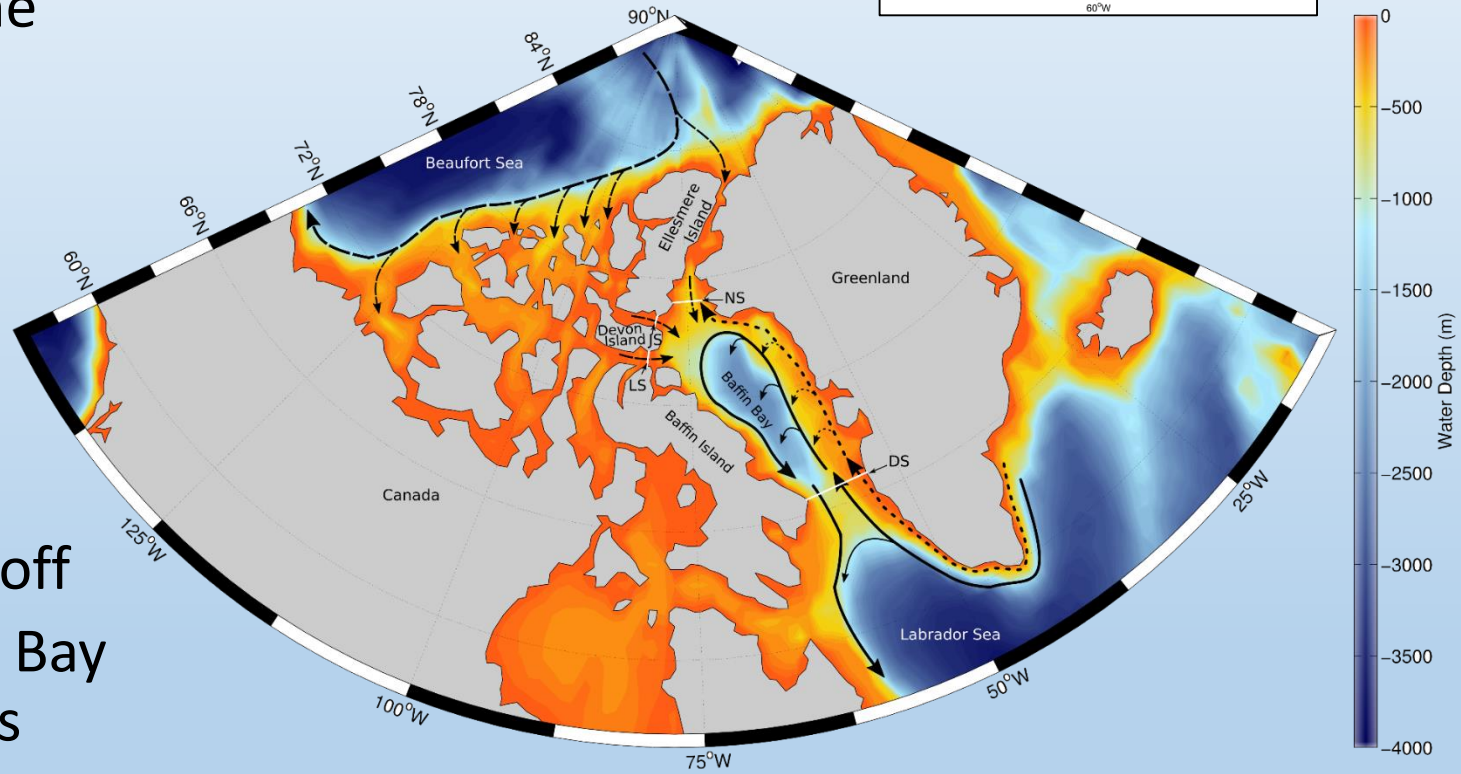
Outline

- Introduction:
  - Baffin Bay and water masses
- Numerical experiments:
  - Domain and forcing
- Results:
  - Heat and Freshwater budget in Baffin Bay
  - Heat and Freshwater transport in and out of Baffin Bay
  - Evolution of Baffin Bay water masses
- Conclusions

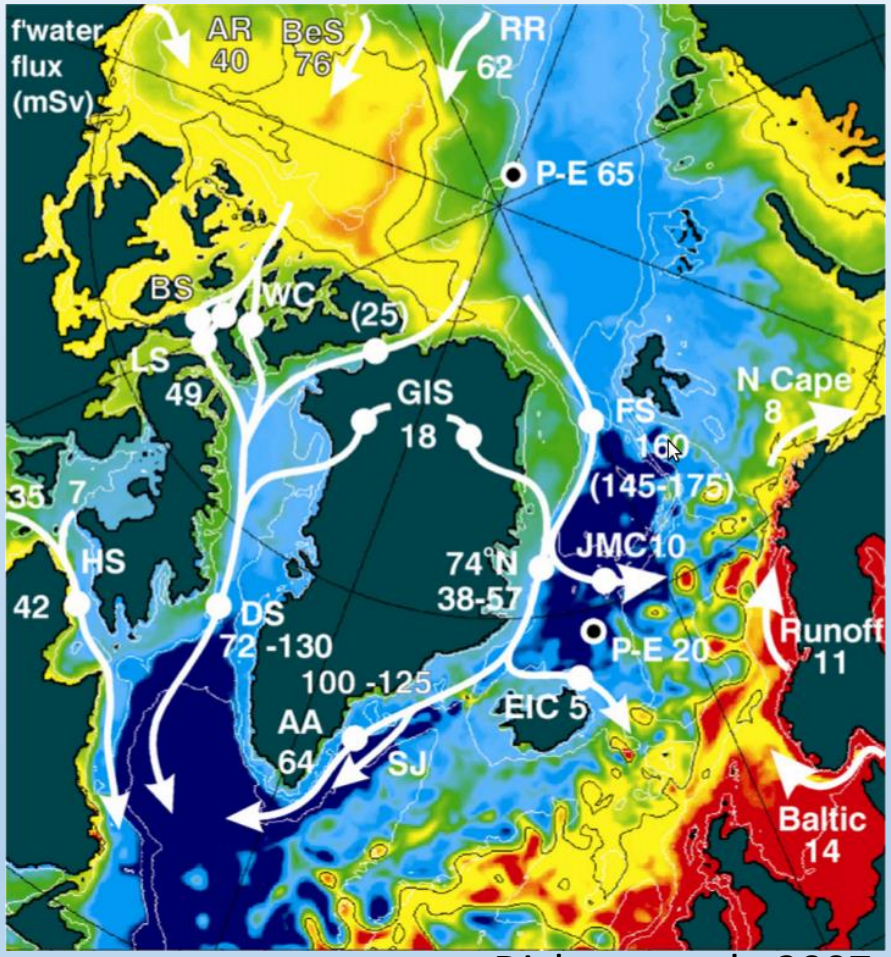
Introduction

- Baffin Bay:
  - Polar water inflow through the Canadian Arctic Archipelago
  - Atlantic water inflow through Davis Strait
  - Gyre in Baffin Bay, mixing
- Aim of this study:
  - Quantify the qualitative importance of Greenland runoff
  - Relate the evolution of Baffin Bay heat content to recent studies

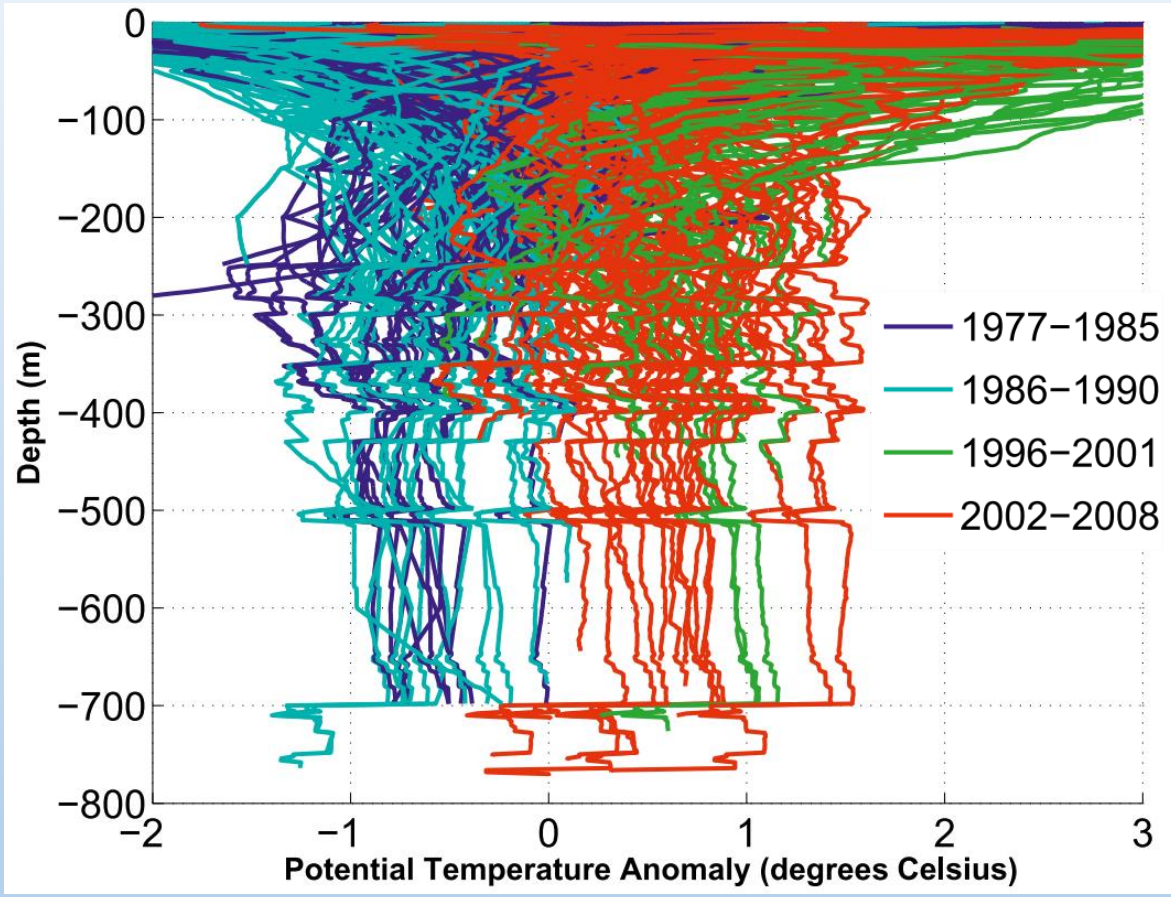




Introduction



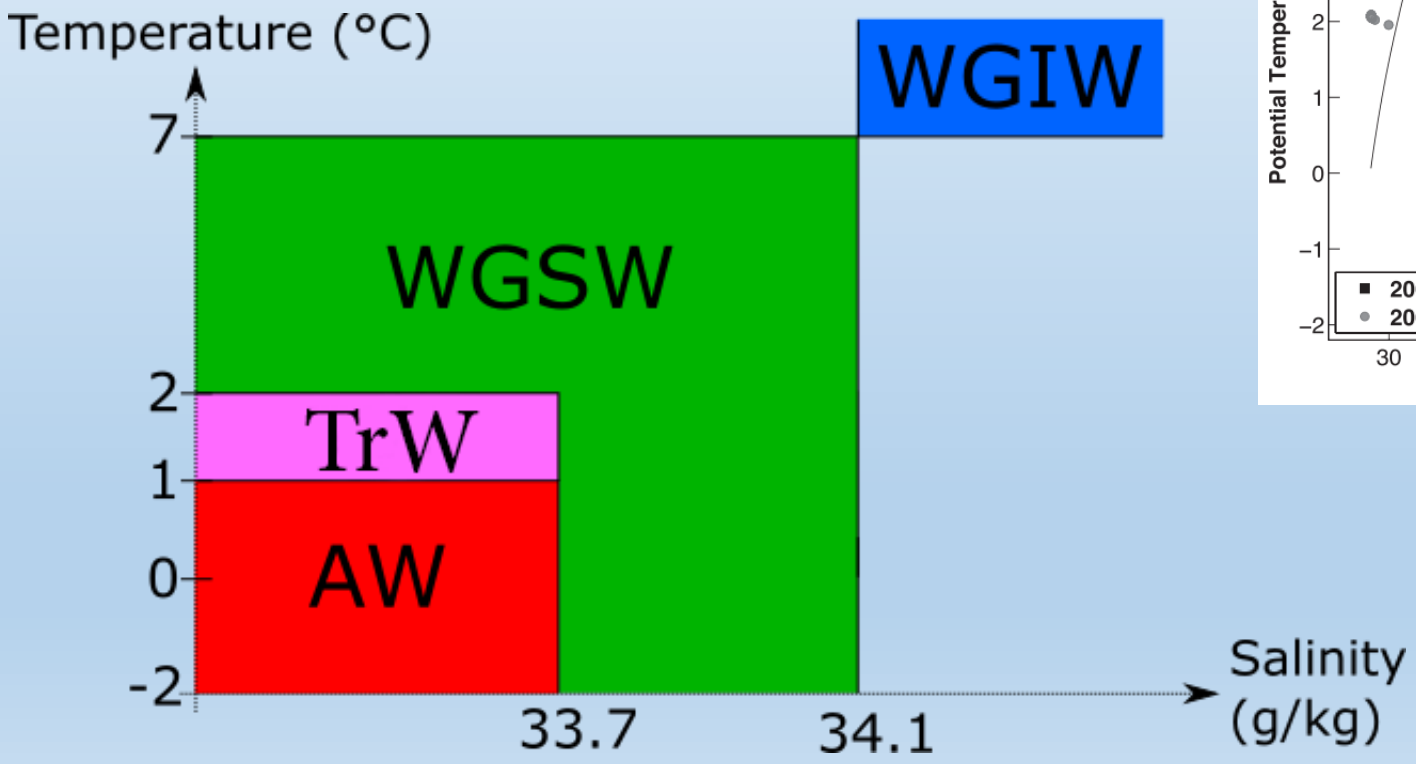
Dickson et al., 2007

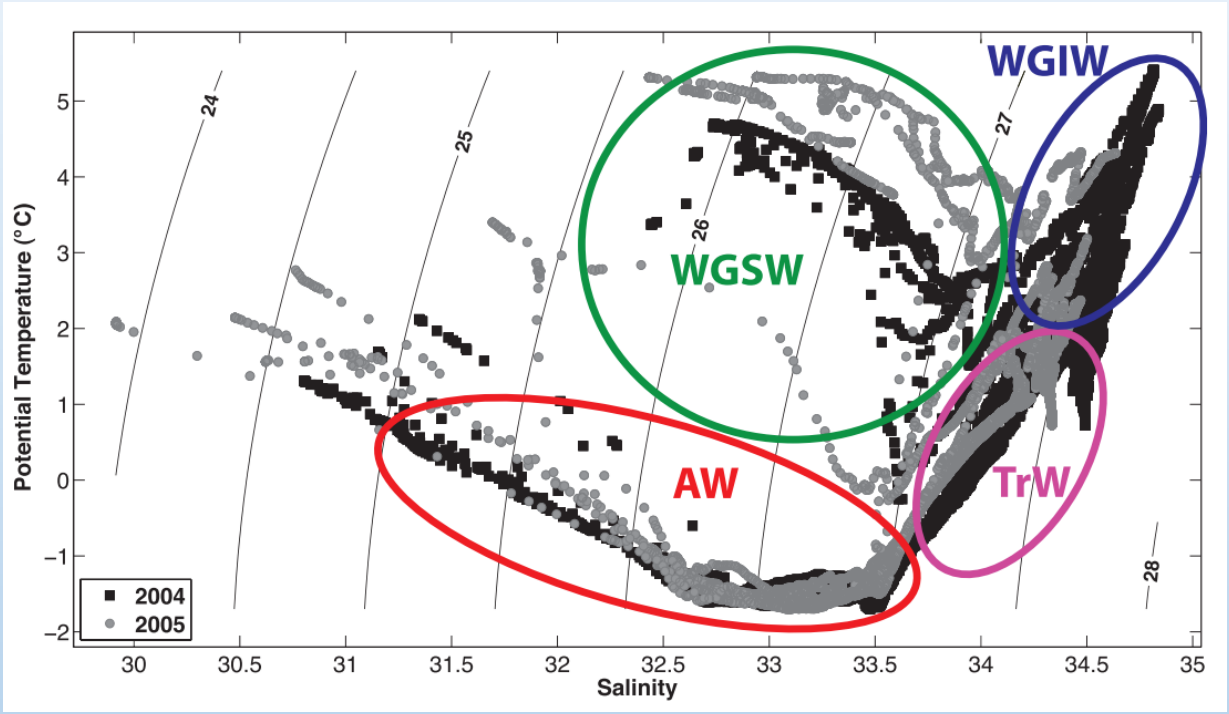


Myers and Ribergaard, 2013

Baffin Bay water masses

- Definition based on the water masses going through Davis Strait (Curry et al., 2011)

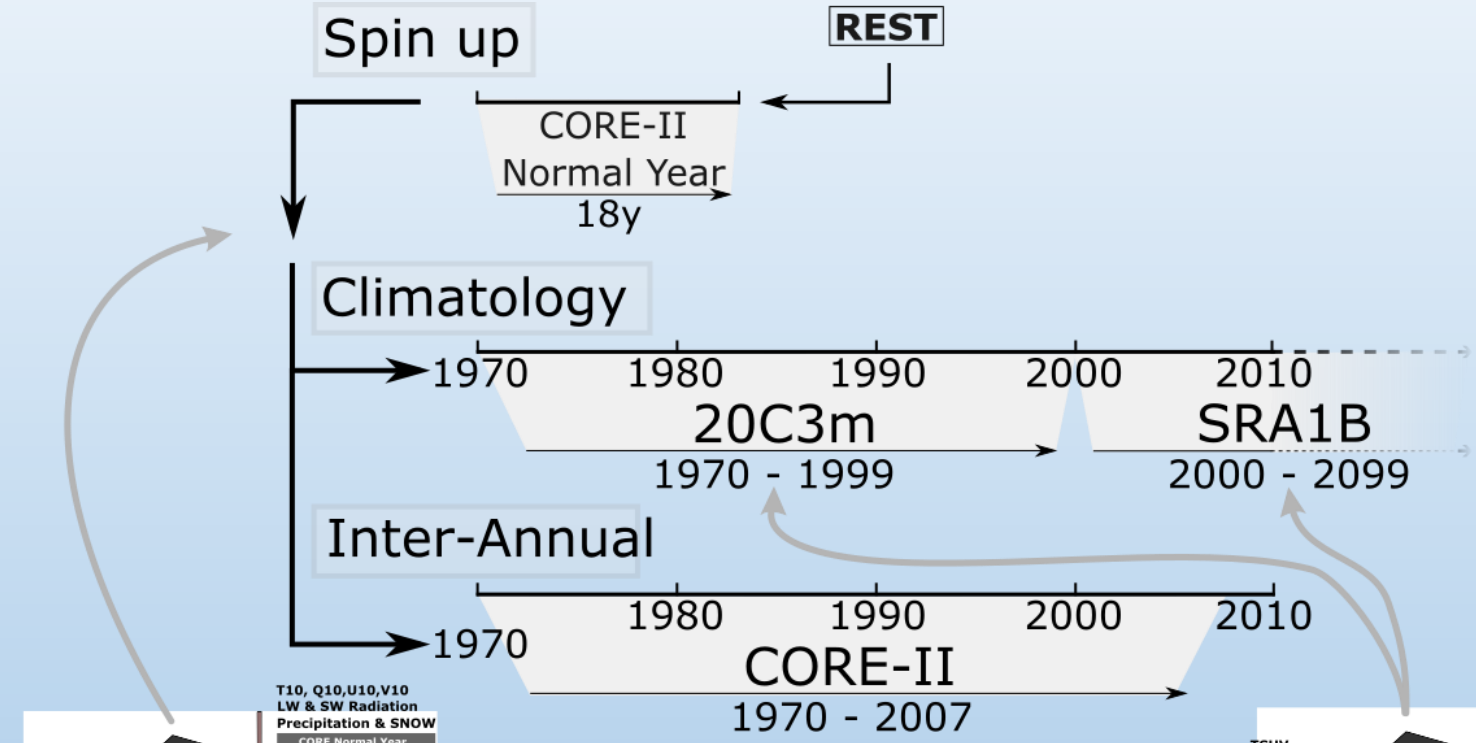


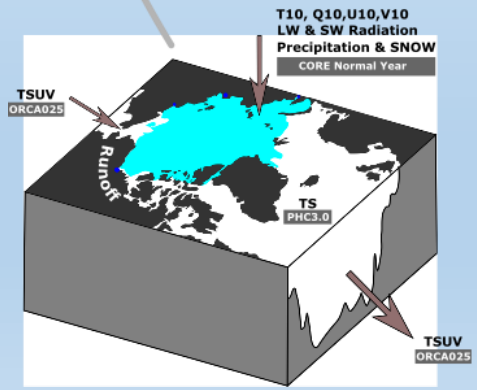


Curry and Lee, 2011

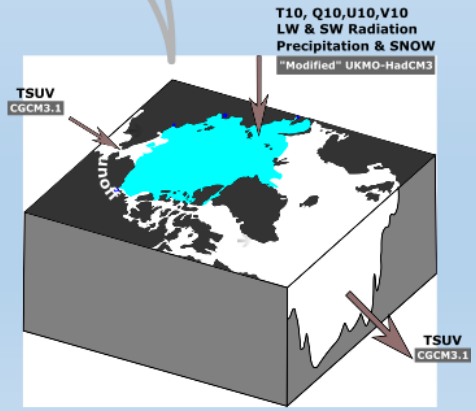
WGIW: West Greenland Irminger Water
WGSW: West Greenland Slope Water
TrW: Transitional Water
AW: Arctic Water

Numerical experiments

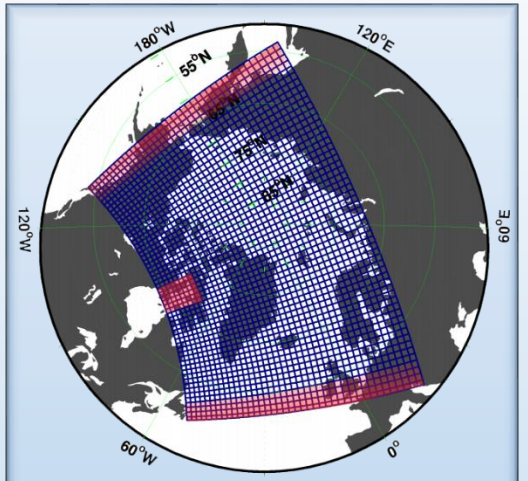




NEMO: Nucleus for European Modelling of the Ocean
PHC: Polar science center Hydrographic Climatology (v3.0)
CORE: Common Ocean-ice Reference Experiments
UKMO: UK Met. Office
CCCma: Canadian Centre for Climate Modelling and Analysis



Model configuration

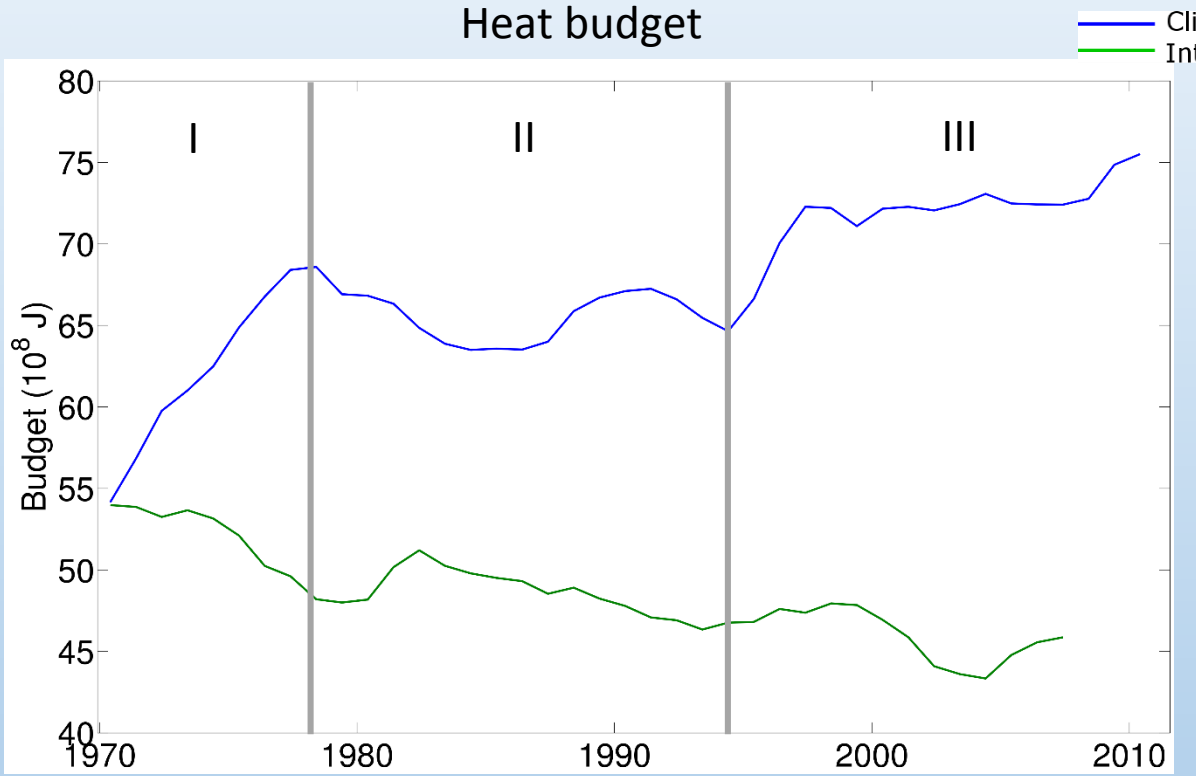


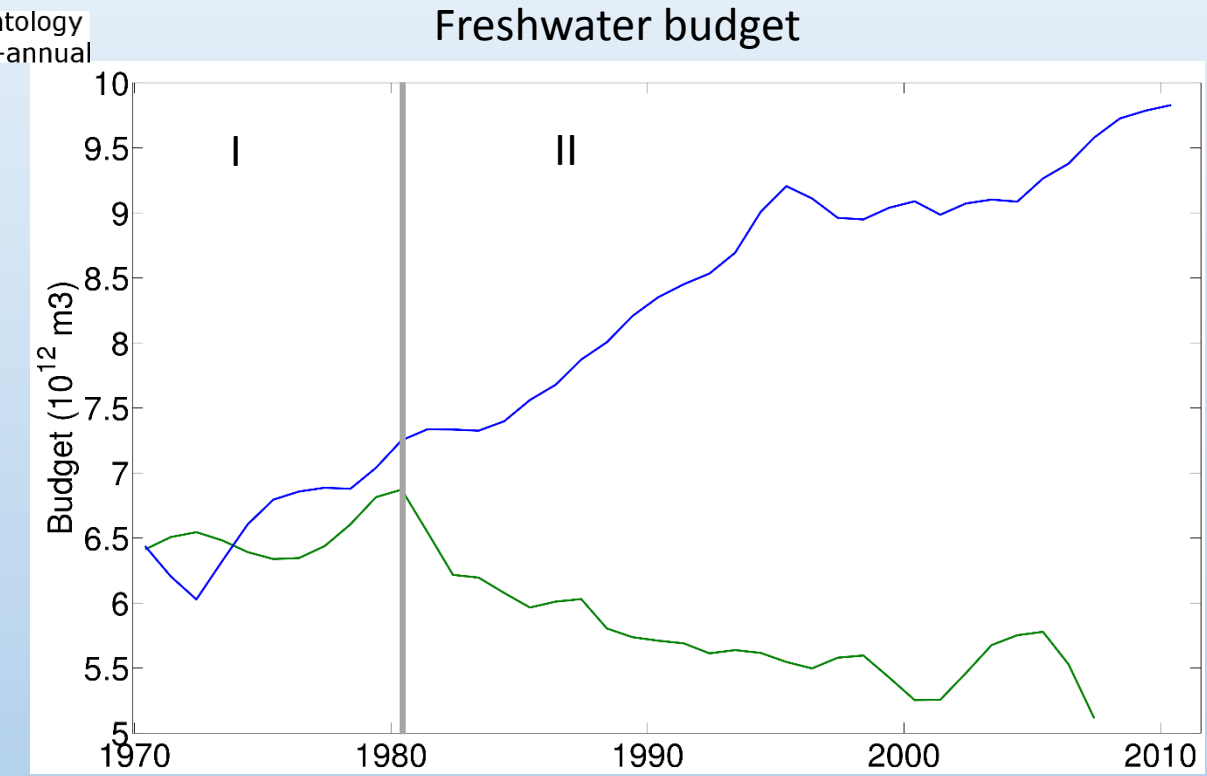
NAA

Model	: NEMO v3.1
Sea Ice	: LIM2-EVP
OBC	: East & West
H. Grid	: 568x400
V. Levels	: 46
H. Res.	: 11 – 15km
T. Step	: 800s

Hu and Myers, 2013

Heat and Freshwater Budgets





Tref: - 2°C

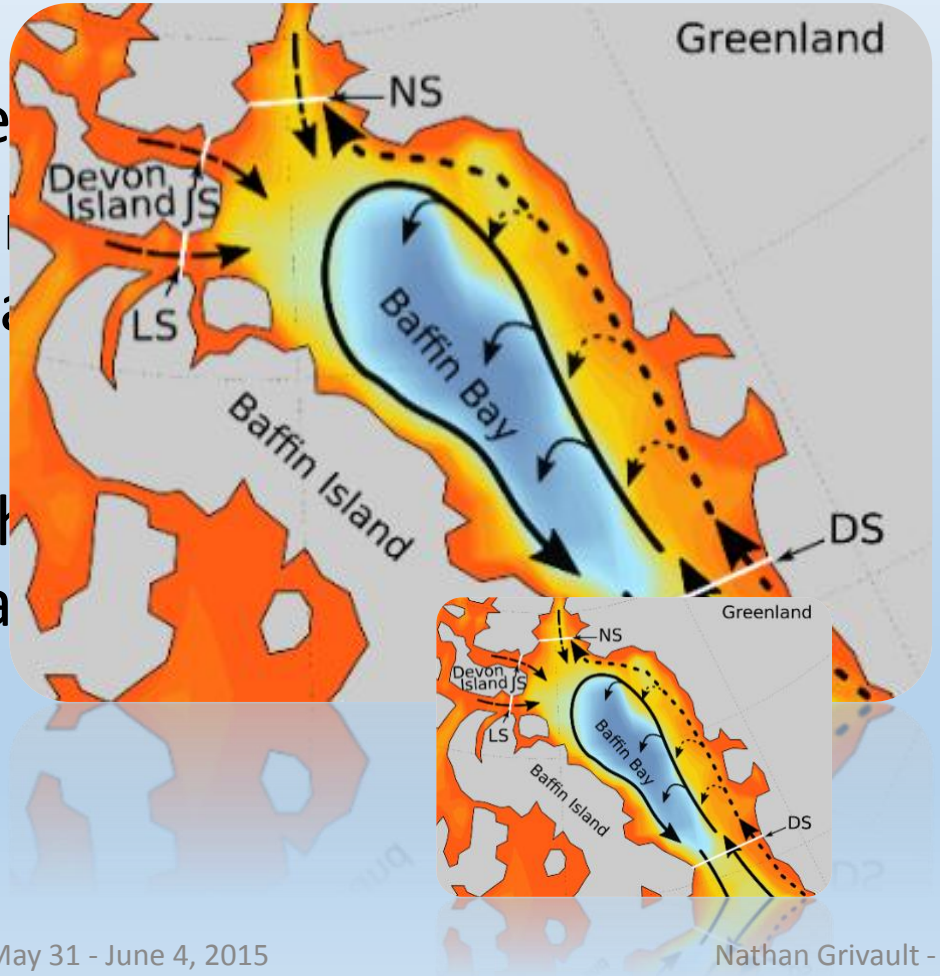
Sref: 34.8 g/kg

Budget = In – Out + Surface flux + Storage

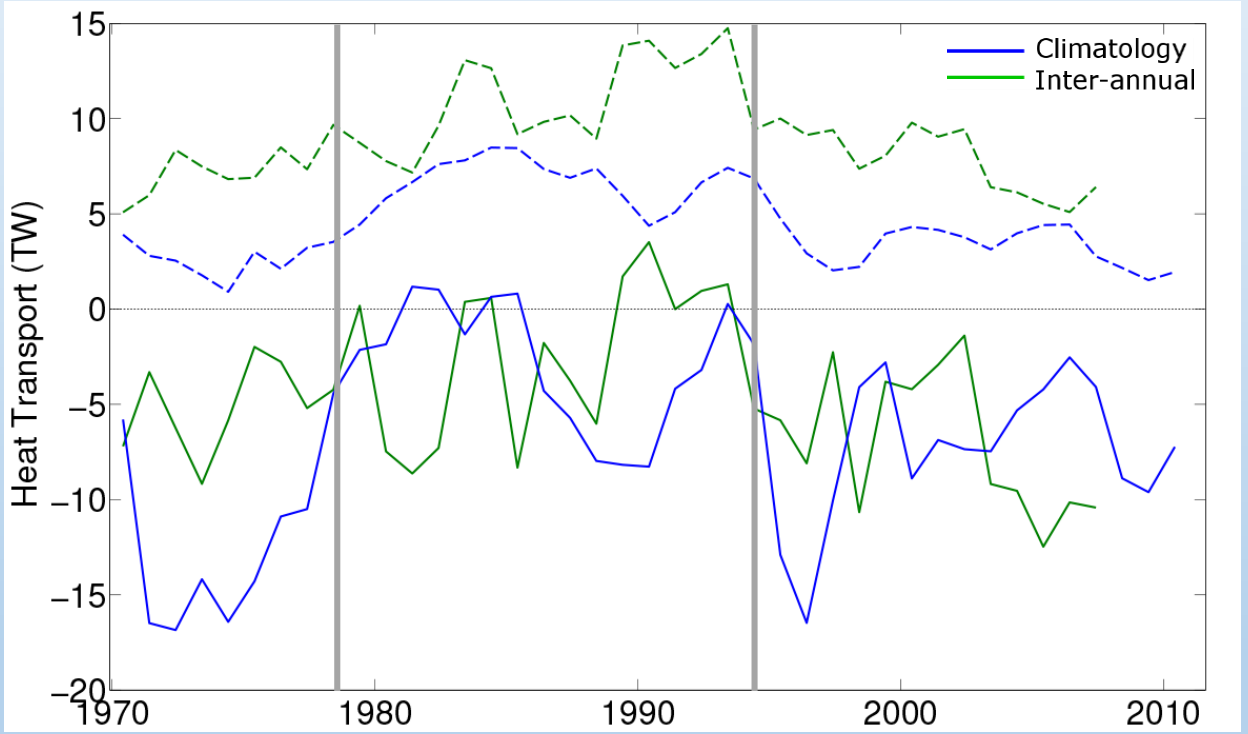
All output data are yearly averaged

Heat transport at the domain boundaries

- He
- Va
  cha
- Wh
  tra



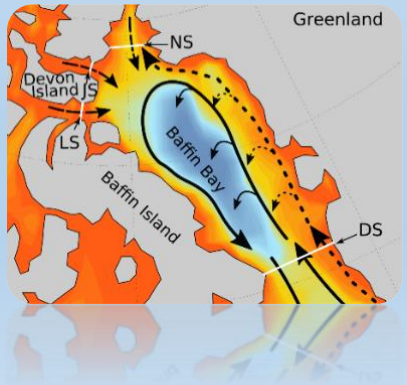
Solid line: South transport
Dashed line: North transport



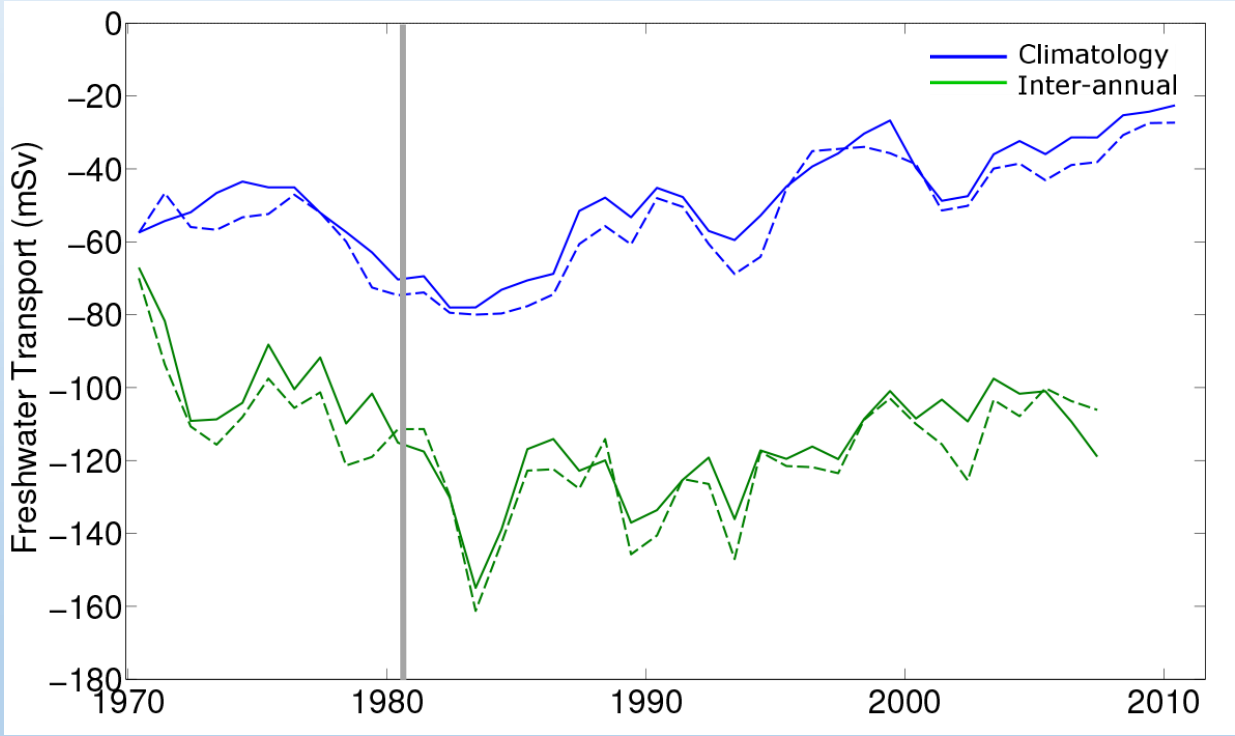
Heat transport (Tref: -2°C)
Negative: southward transport

Freshwater transport at the domain boundaries

- Impact of the forcing:
  - Less transport in and out Baffin Bay
- Cannot explain the changes in the freshwater budget



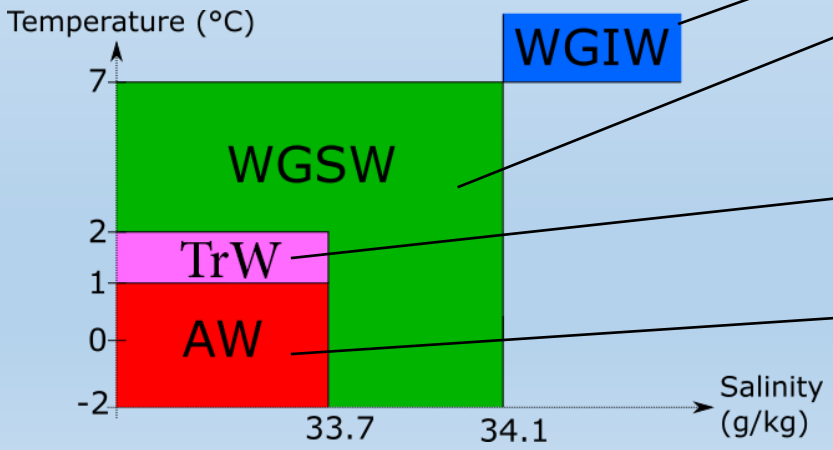
Solid line: South transport
Dashed line: North transport

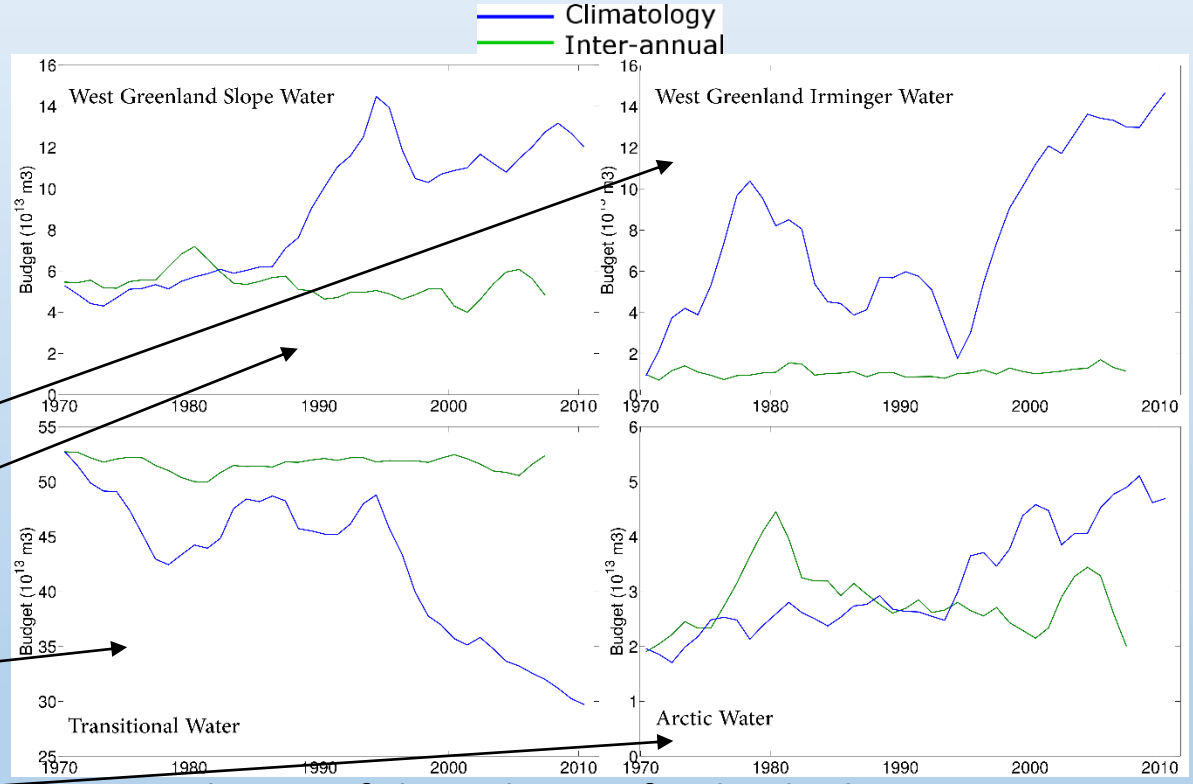


Freshwater transport (Sref. 34.8 g/kg)
Negative: southward transport

Water masses evolutions

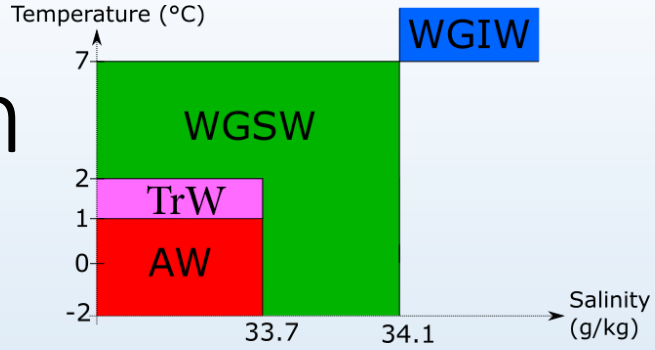
- Changes may come from:
  - More inflow/outflow from a particular water mass
  - Change in the surface fluxes
  - Change of the water proprieties in the Bay



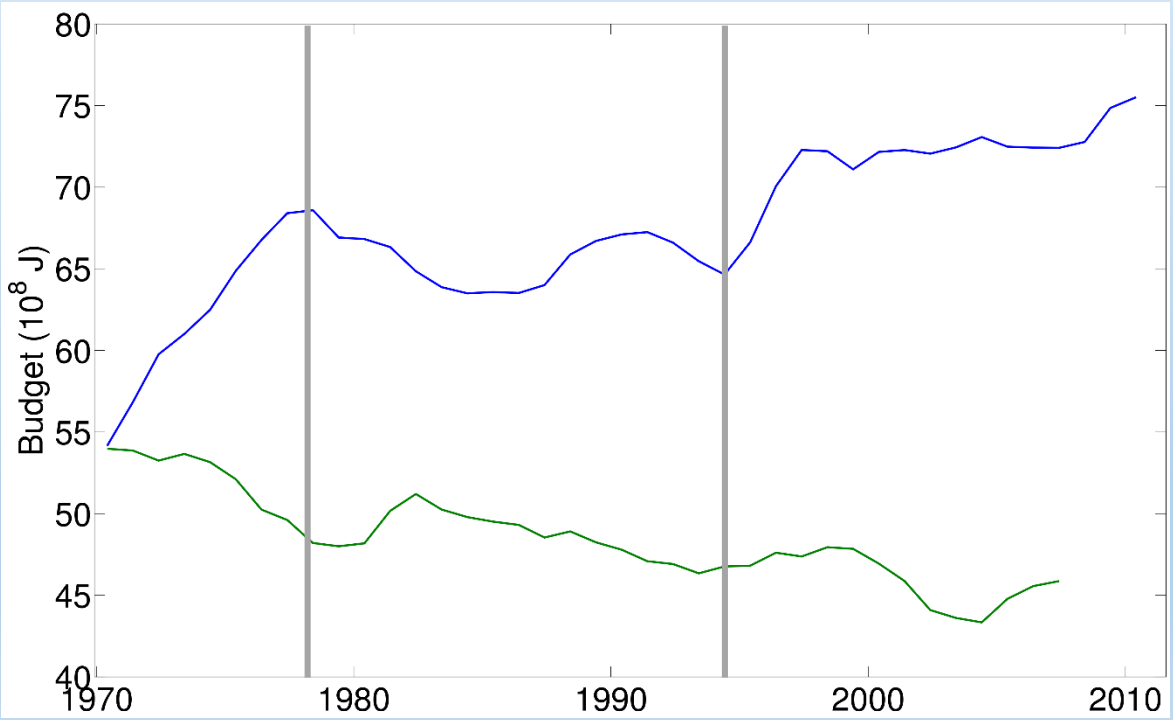


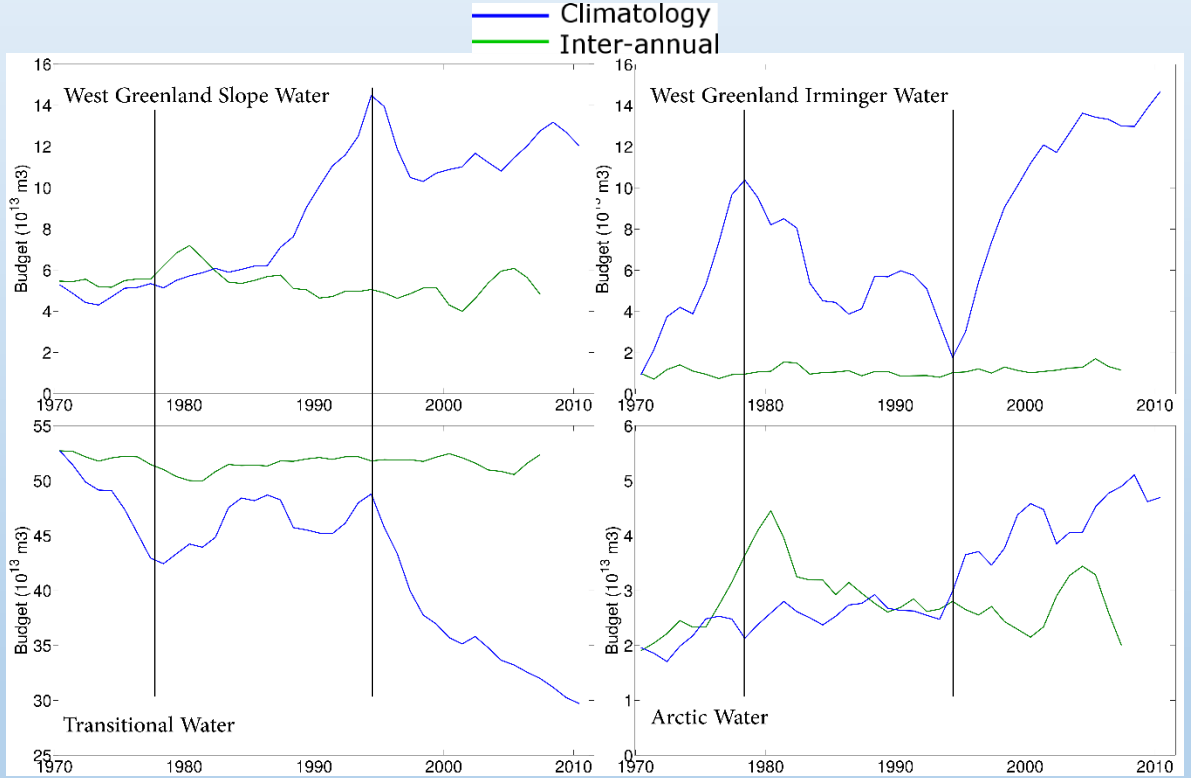
Evolution of the volume of individual water mass in Baffin Bay

Water masses evolutions: impact on the heat budget



- Difference in heat content
  - WGSW → WGIW → TW → AW





Evolution of the volume of individual water mass evolution in Baffin Bay

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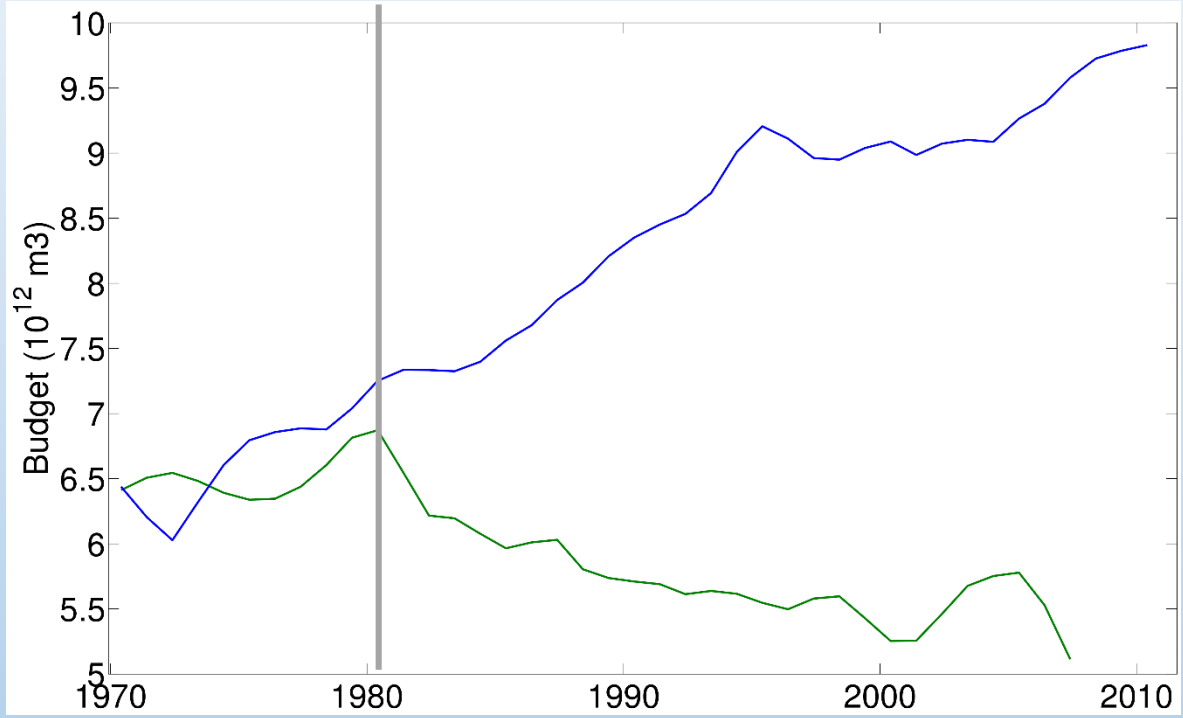
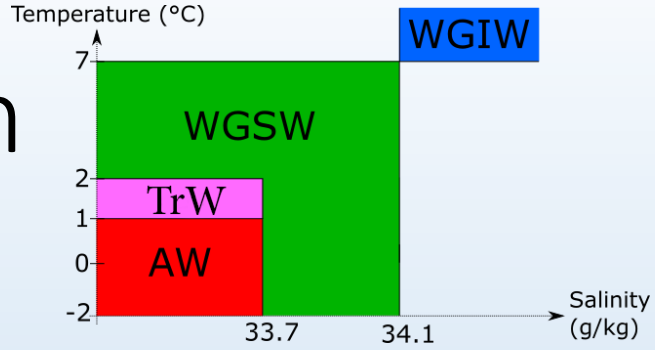
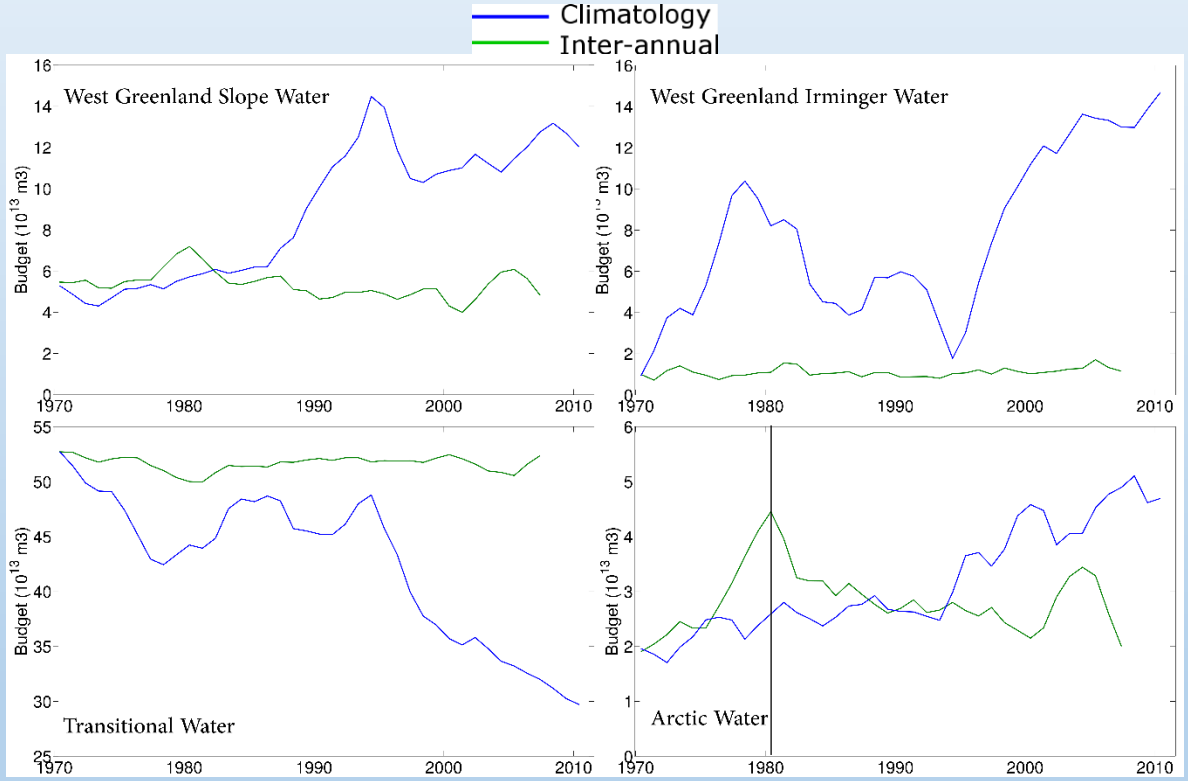
Water masses evolutions: impact on the freshwater budget







Evolution of the volume of individual water mass evolution in Baffin Bay

- Difference in freshwater content
  - AW → TW → WGSW → WGIW

Conclusions

- Impact of the runoff in your numerical simulation: numerical output closer to measurement data
- The warming since the 90s is driven by the WGIW
- The freshening driven by a combination of all water masses
- The potential impact of heat/freshwater changes on:
  - Circulation? Geostrophic current?
  - West Greenland glaciers
  - Deep convection in Labrador Sea?

Questions?