Modelling and Analysis of the Labrador Sea as part of GOAPP

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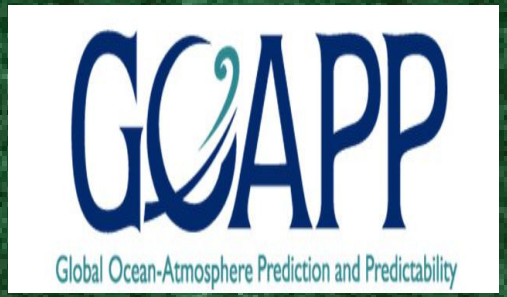


Acknowledgements

- Post-Doc
  - Arjen Terwisscha van Scheltinga
- Graduate Students
  - Nilgun Kulan
  - Sanjay Rattan
  - Mattea Turnbull (GOAPP Funded)
  - Anna Katavouta (GOAPP Funded)
  - Veronique Lago (GOAPP Funded)
  - John Wang
  - Xianmin Hu
- Undergraduate Students
  - Emily Collier

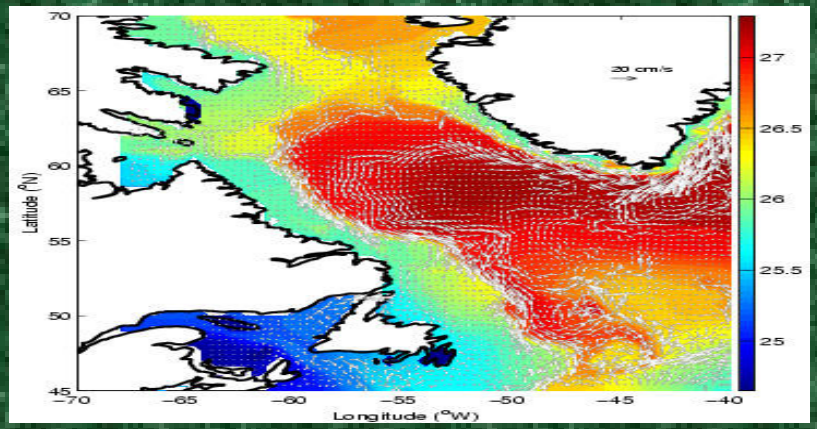
Introduction

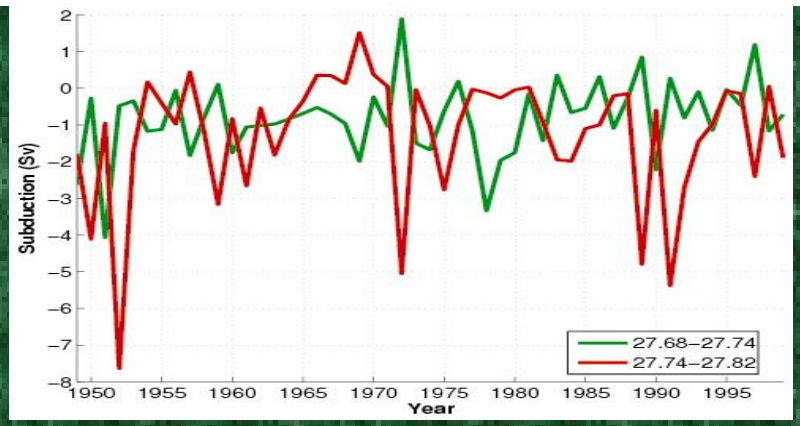
- Historical Reanalysis
  - LSW, DWBC and MOC Variability
- NEMO Based Studies
  - Sea Ice Data Assimilation
  - Resolution and Greenland Melt
  - Arctic/CAA Modelling and FW Fluxes to the Labrador Sea
  - Labrador Sea Drift in Eddy-Permitting Models
  - Recent Spin-Up Analysis
- Summary

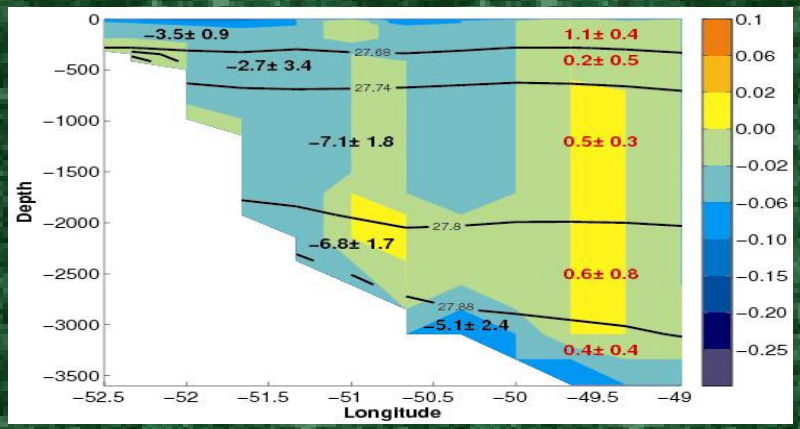

Hudson Strait
GREENLAND
Labrador Sea
Irminger Sea
LABRADOR
Northeast Newfoundland Shelf
Grand Banks of Newfoundland
Flemish Cap

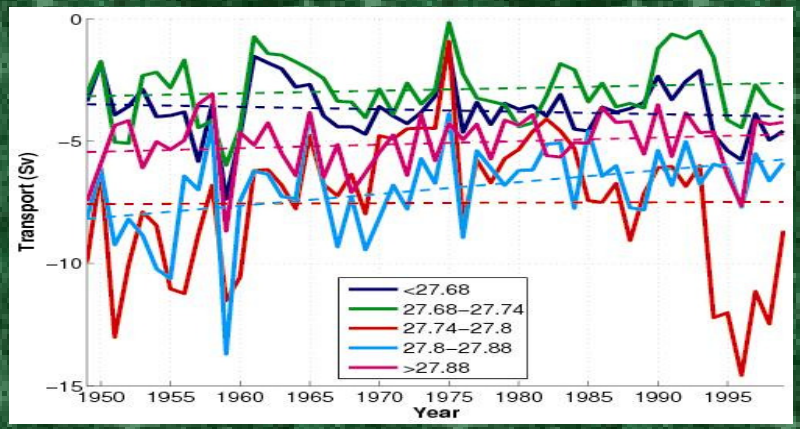
Reanalysis and Labrador Variability

$$\overline{S}(\sigma) = -\frac{1}{\Im}\int_0^{\Im}\left\{\int_{A_S(\sigma,t)}\left[\frac{\partial h}{\partial t} + \nabla\cdot(\mathbf{u}h)\right]dA\right\}dt,$$



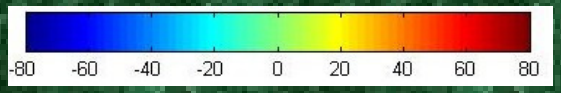


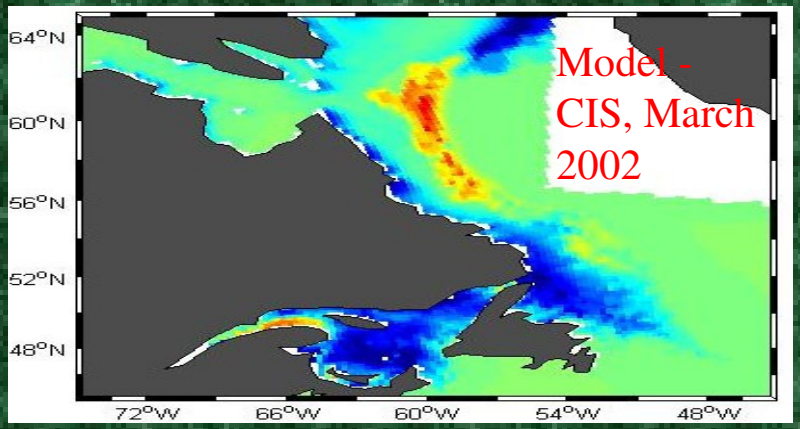


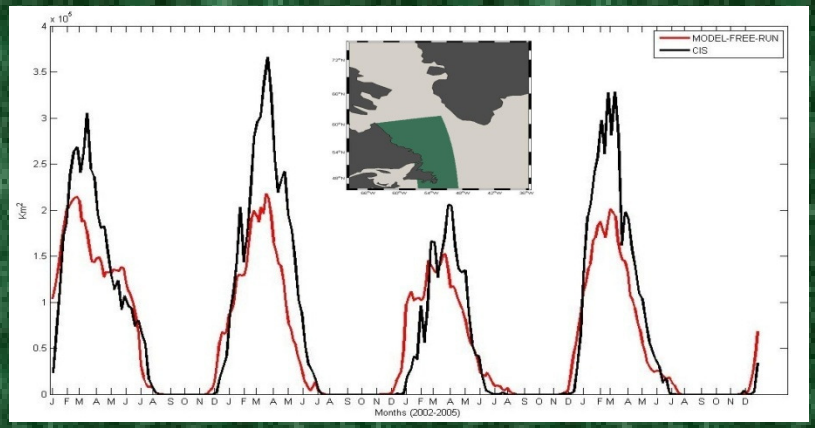


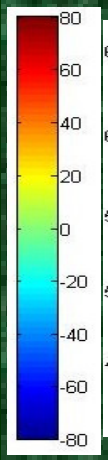
Myers and Kulan, 11:30 am Wednesday - Richelieu

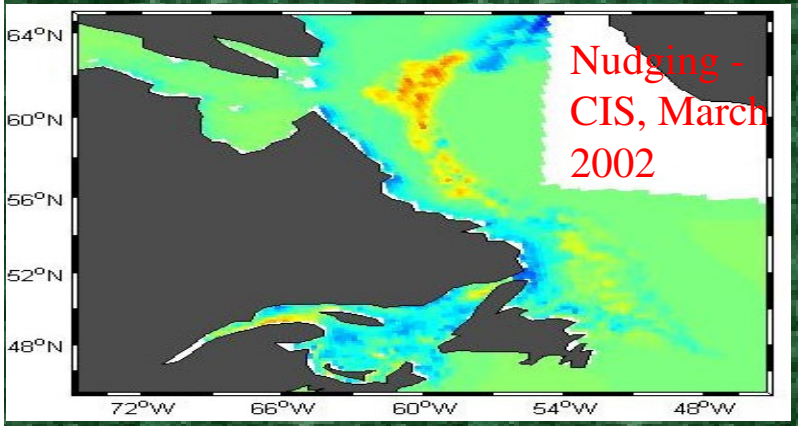
Sea Ice Representation and Data Assimilation

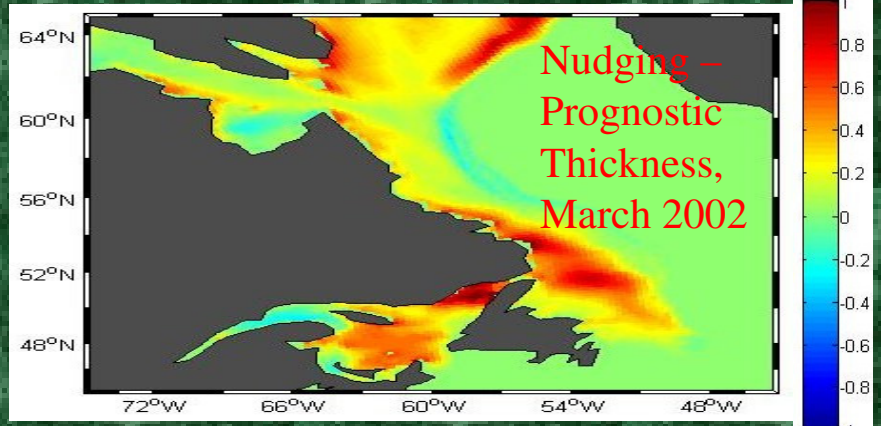








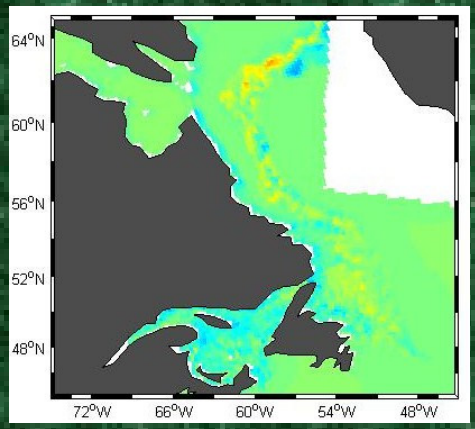


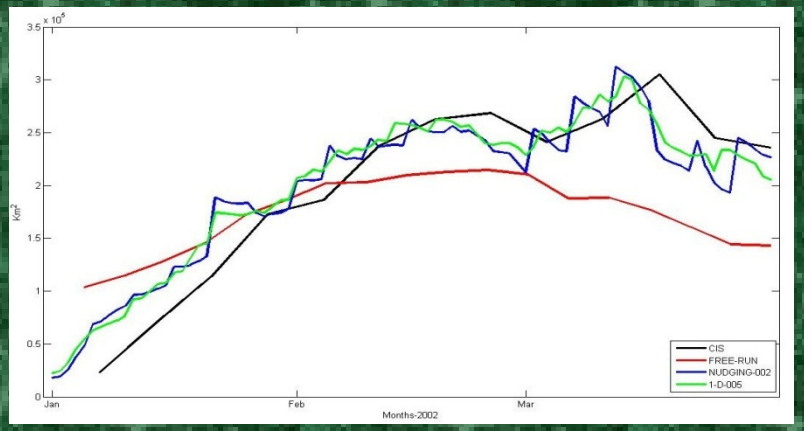


Katavouta and Myers , 16:15 Friday - Pinnacle

Sea Ice Representation and Data Assimilation

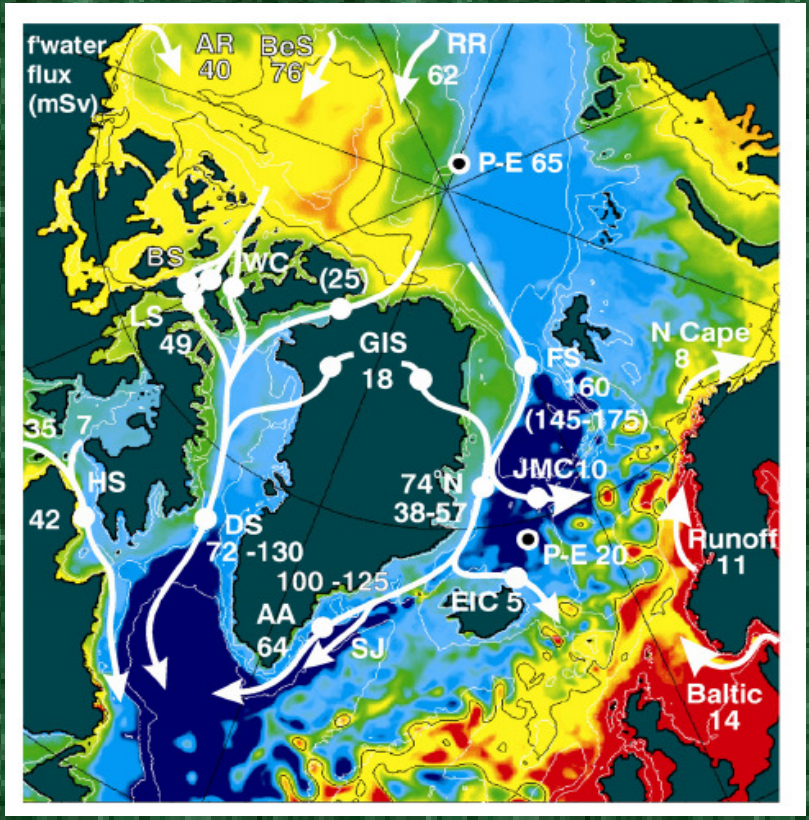
- 1-D Assimilation
  - 10 member ensemble based on random perturbation of CORE forcing fields
  - Ran for 1st 15 days of January 2002
  - Find the cross-covariances between ice concentration, ice thickness, temperature and salinity at each grid point and each depth





Katavouta and Myers , 16:15 Friday - Pinnacle

Impact of Greenland Ice Sheet Melt on Ocean Models of Different Resolutions



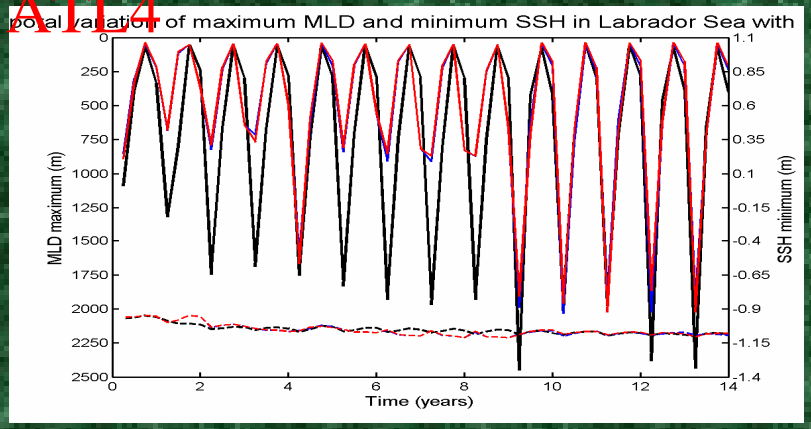
Dickson et al., 2007

- 3 Resolutions
  - ORCA2 (2 degrees)
  - ORCA05 (1/2 degree)
  - NATL4 (1/4 degree)
  - Note: Issues of initial runoff masks and inter-annual vs perpetual year experiments
- 3 Sensitivity Experiments
  - Control (no additional runoff)
  - Runoff (+550 $km^3\ yr^{-1}$ = 17.4 mSv), equally distributed around Greenland (space and time)
  - Summer (+550 $km^3\ yr^{-1}$) – south of 70N, only in summer

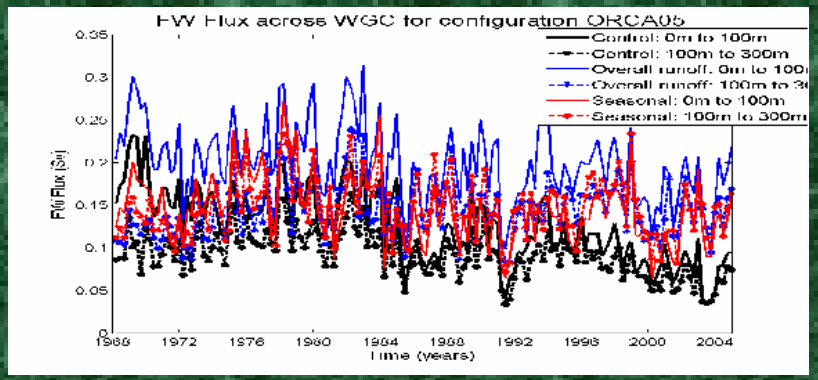
Lago and Myers , 12:15 Tuesday - Panorama

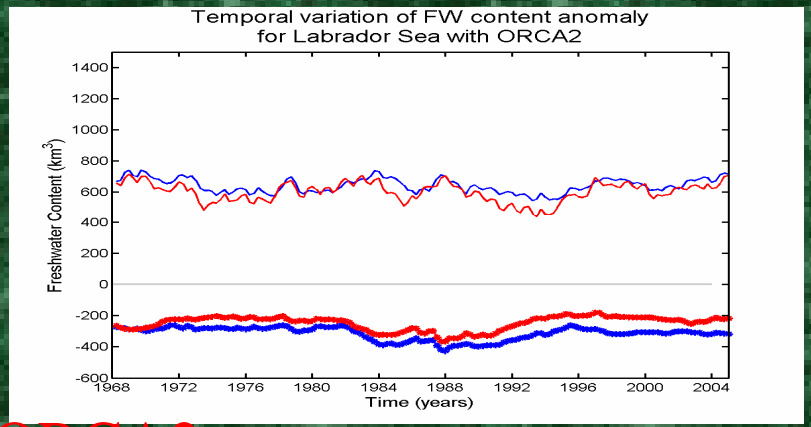
Impact of Greenland Ice Sheet Melt on Ocean Models of Different Resolutions

NATL4

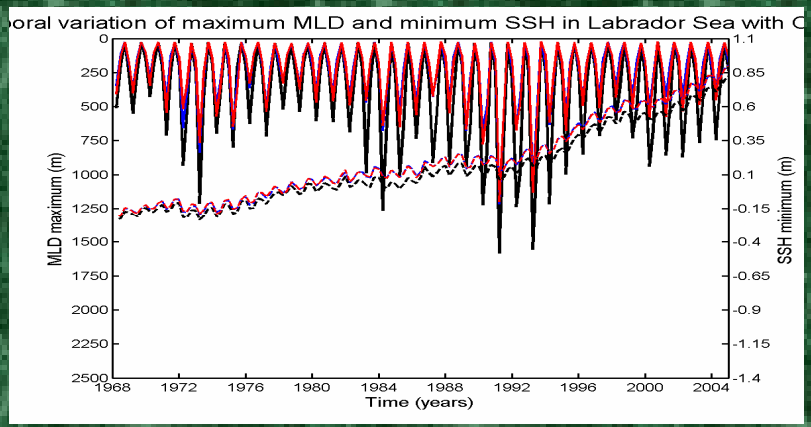


ORCA05





ORCA2



ORCA05

Lago and Myers , 12:15 Tuesday - Panorama

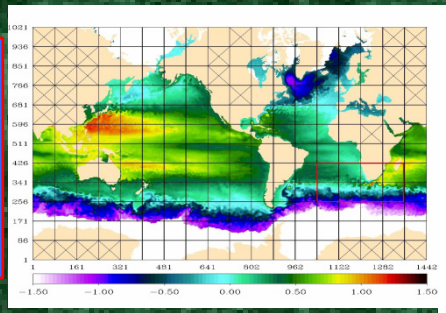
Arctic/CAA Modelling Framework

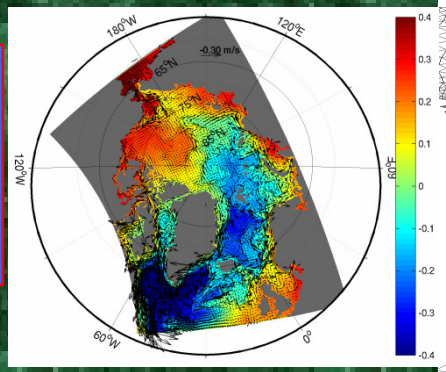
Structured - NEMO **Unstructured - FESOM**

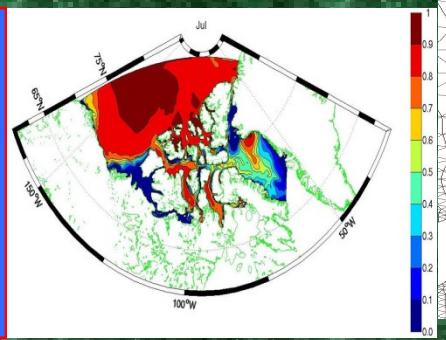
ORCA025
Global ¼ Degree

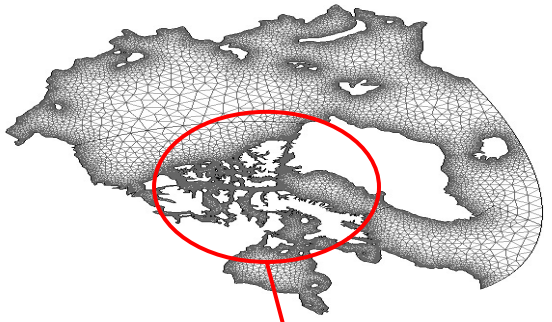
ARC
Pan-Arctic: 10-15 Km resolution

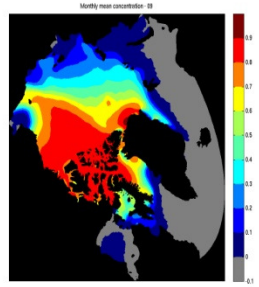
CAA
Canadian Arctic Archipelago: 6.5-9.5 km resolution

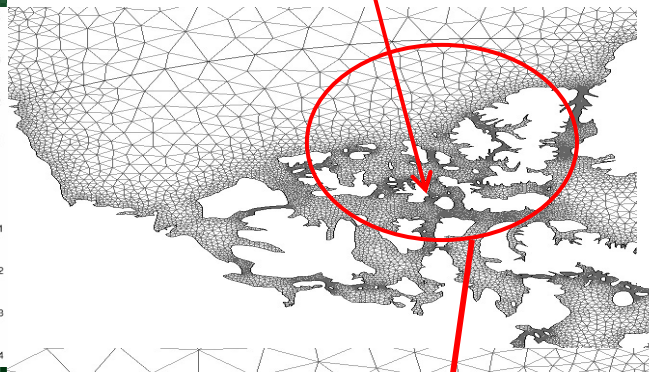


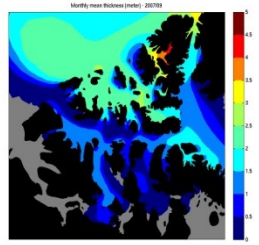


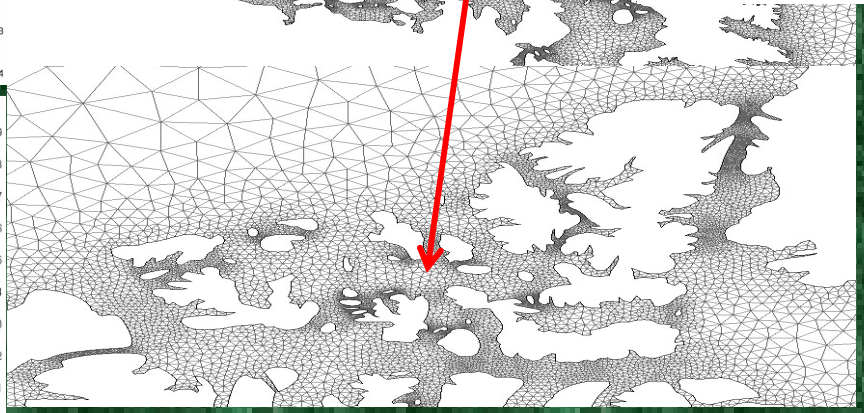






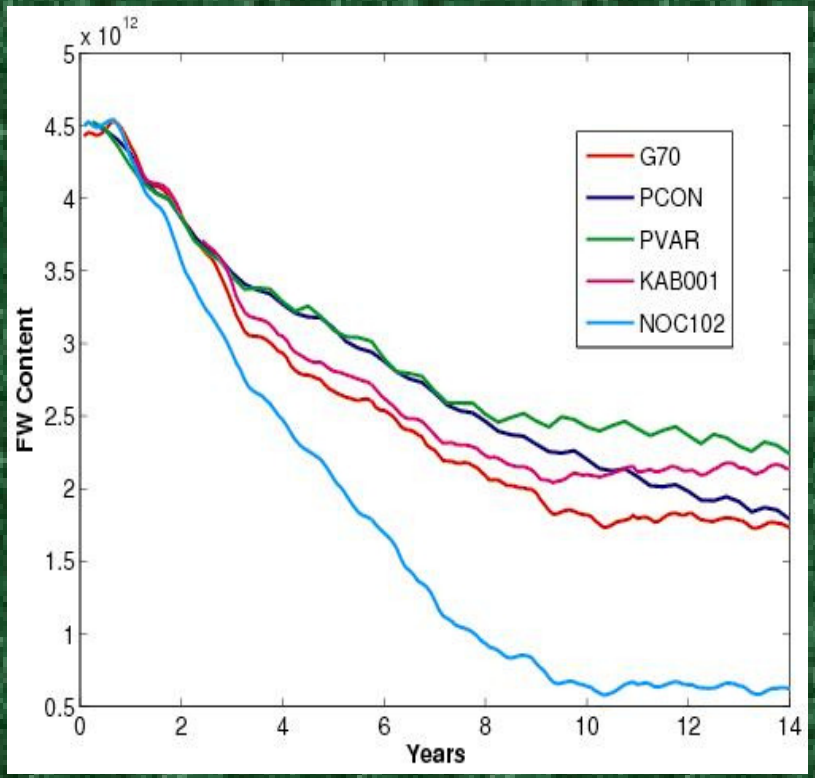






Myers et al. , 11:15 Friday - Richelieu

Drift in NEMO Configurations

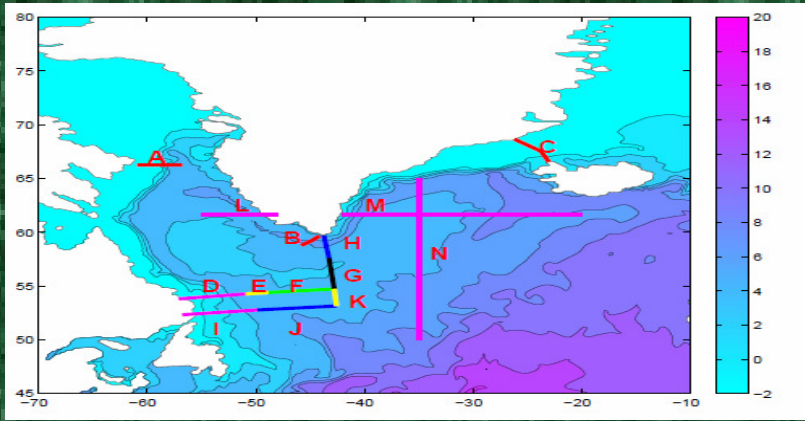


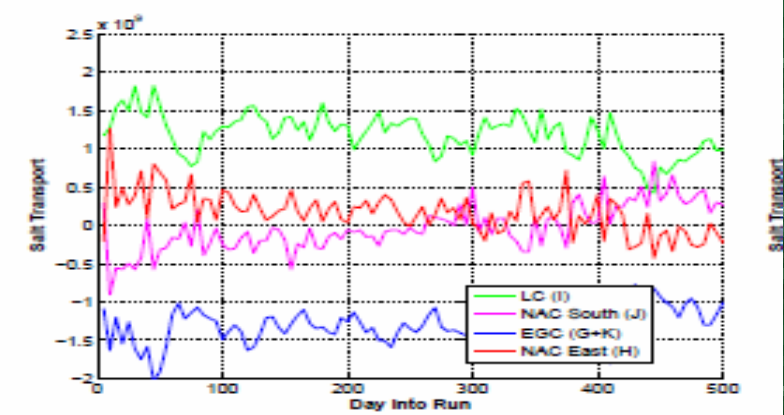
- Still significant drift in ice-ocean models
- Regional/global configurations – same behavior
- Perpetual Year/Inter-annual forcing – same behavior
- 2 Stages
  - I) First 2-3 years – same in all experiments – probably related to inconsistencies with initial conditions
  - II) 3-15 years – significant differences between runs

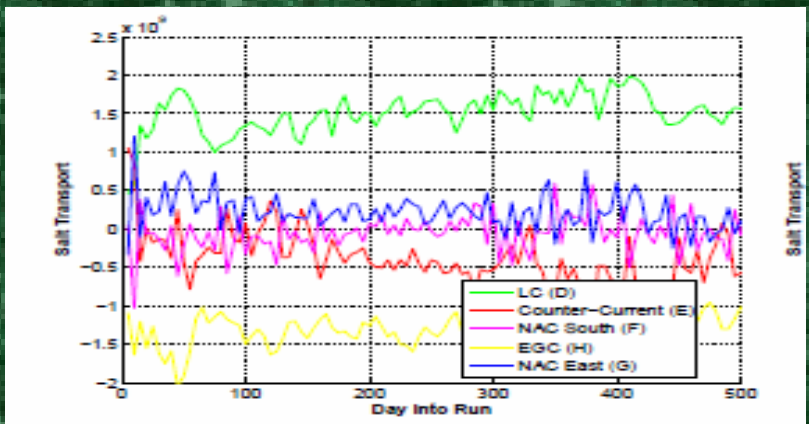
Rattan et al. , Ocean Modelling, under review

Early Stages of the Model Drift

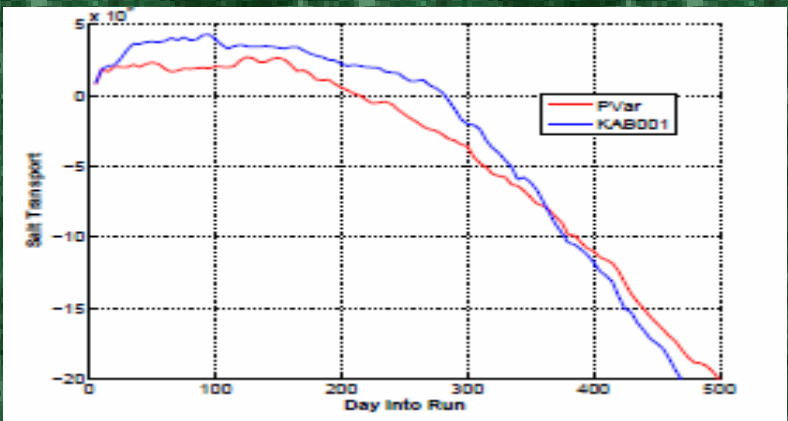
Outer Domain







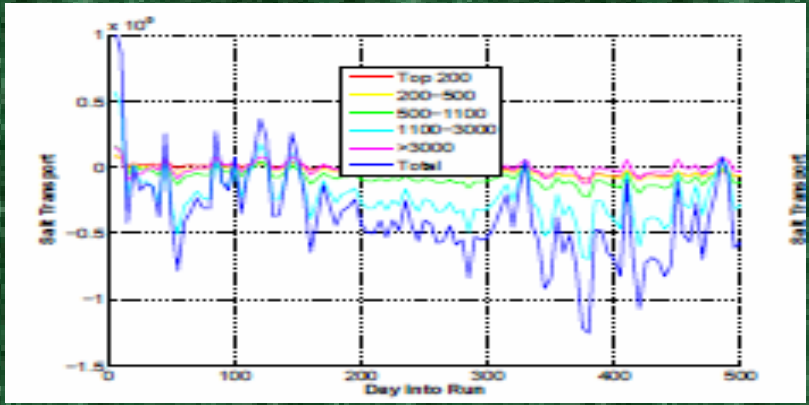
Inner Domain

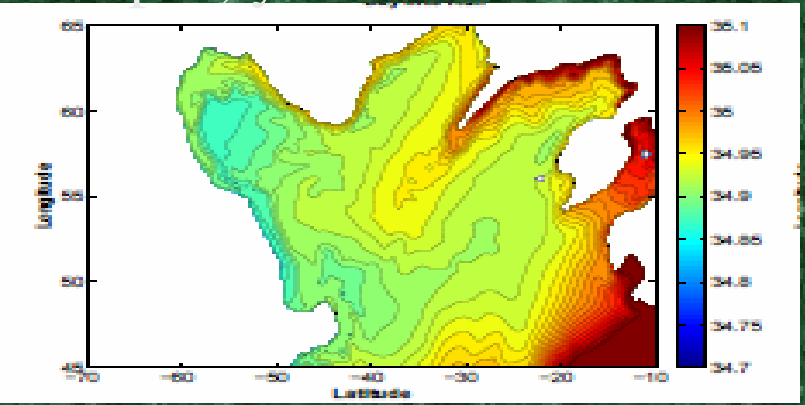


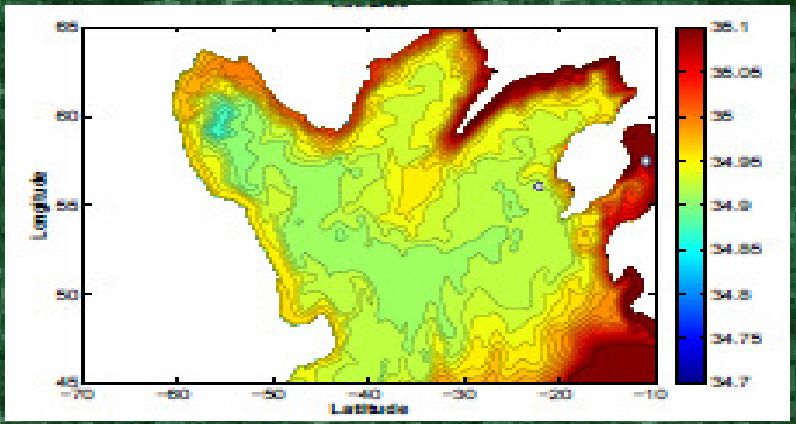
Cumulative salt transport into interior

Early Stages of the Model Drift

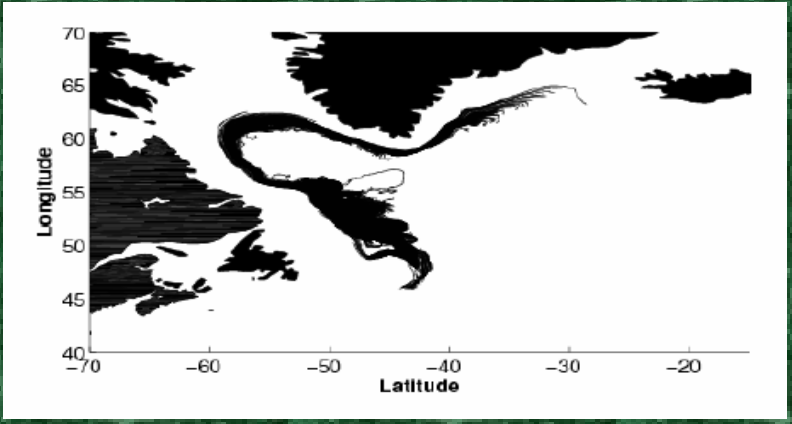
April, year 1







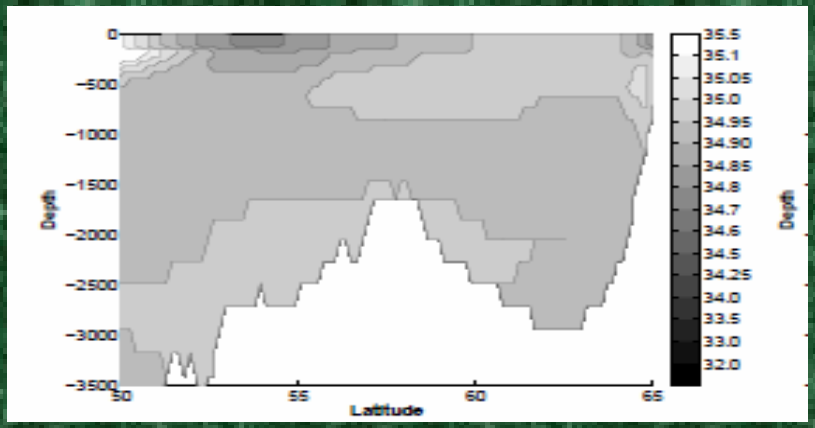
August, year 2



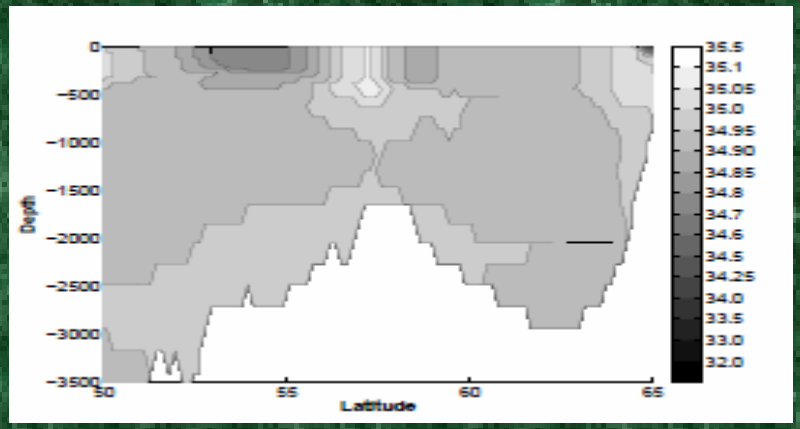
Reverse float trajectories, year 1

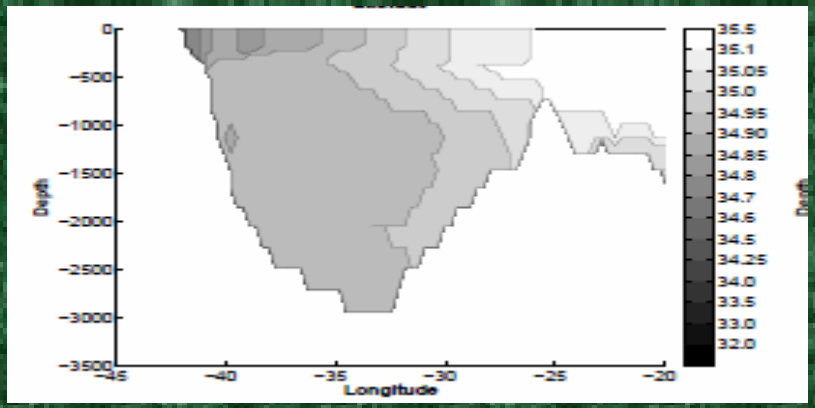
Early Stages of Model Drift

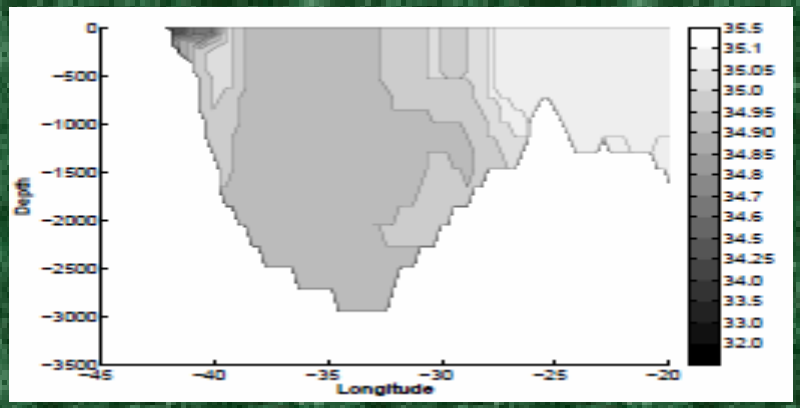
January 15, year 1



April 5, year 1



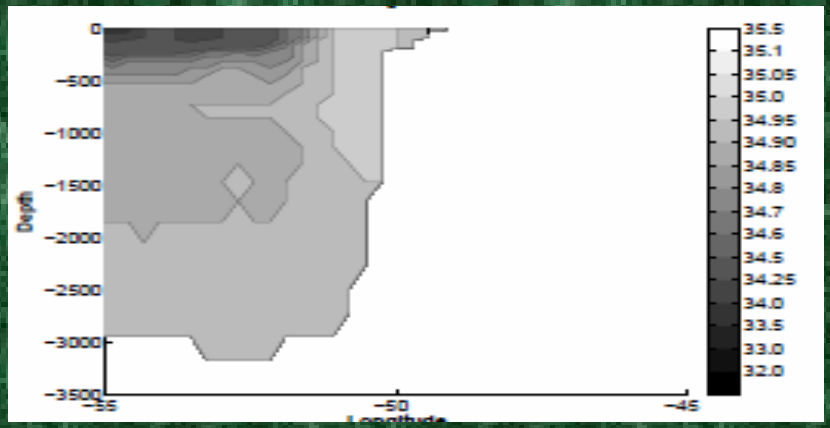


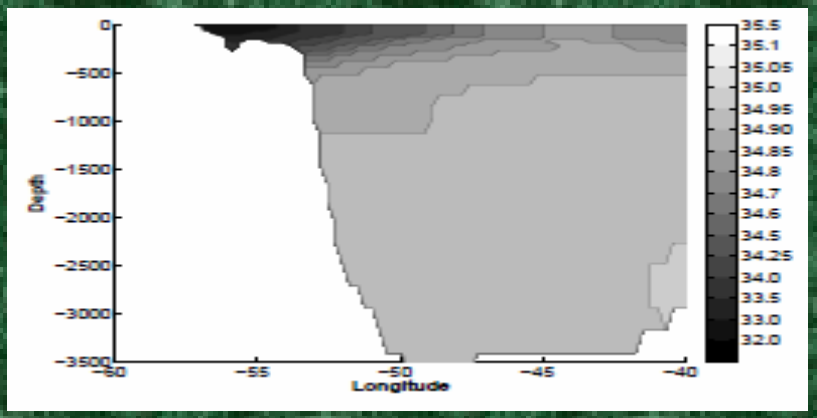


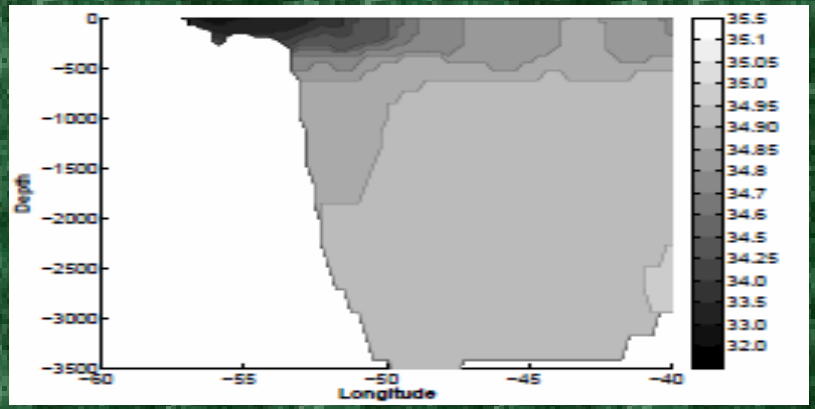
Early Stages of Model Drift

January 15, year 1

April 5, year 1

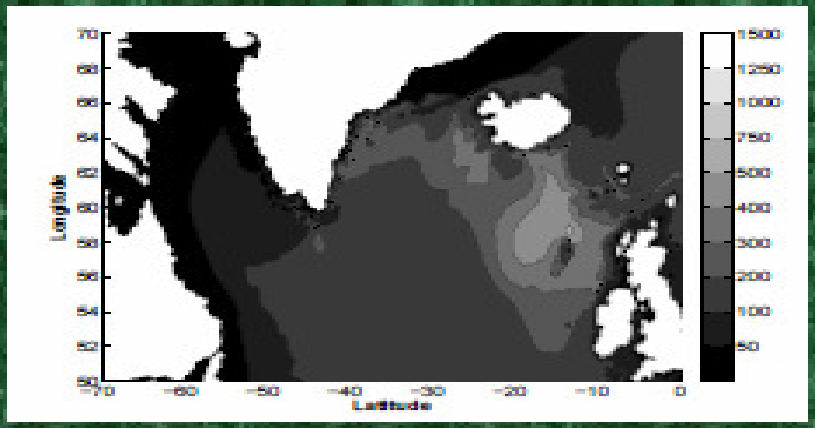




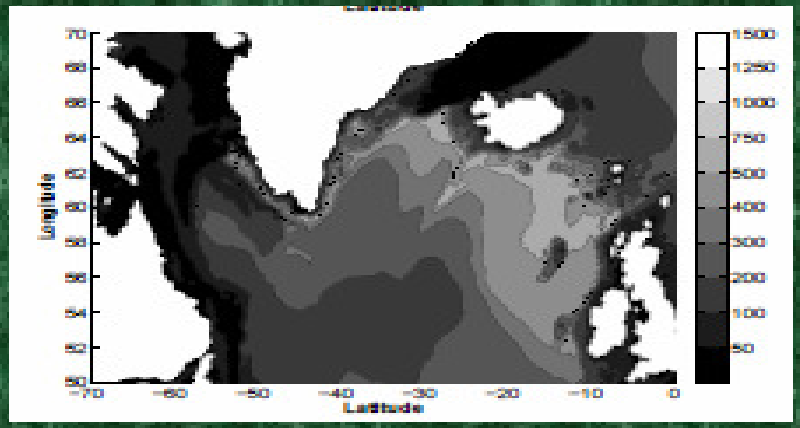


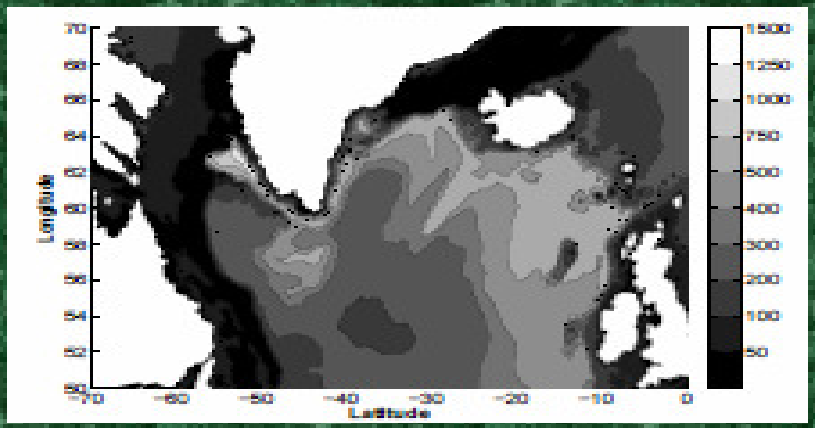
Early Stages of Model Drift

January



Febuary





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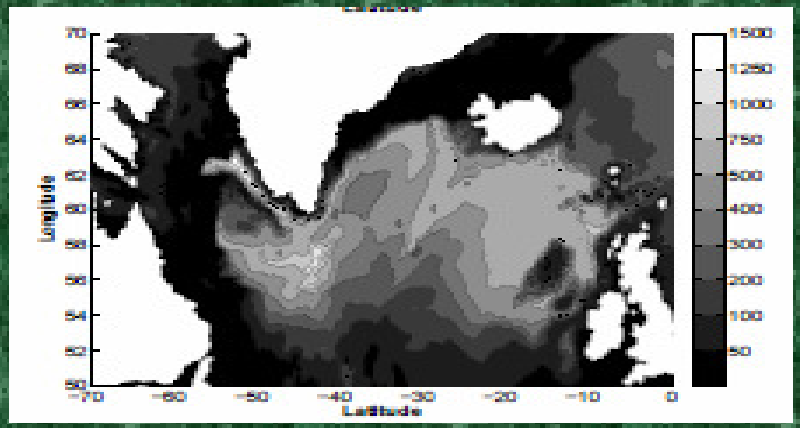

April

Summary

- Reanalysis provides useful data to try to understand LSW, DWBC and MOC variability
- Improving sea-ice concentration does not necessarily improve other fields without additional considerations
- Proper representation of melt from Greenland may be important, but behavior is resolution dependent
- Arctic/CAA configurations developed
- Model drift occurs at the very start of the runs, and may be related to stratification issues and the initial conditions