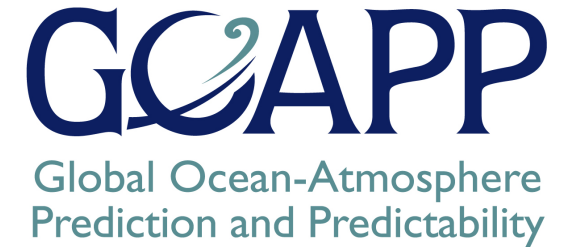




Memorial  
University of Newfoundland



# Model Study of the Labrador Sea Water Formation and Spreading

*Jieshun Zhu, Entcho Demirov*

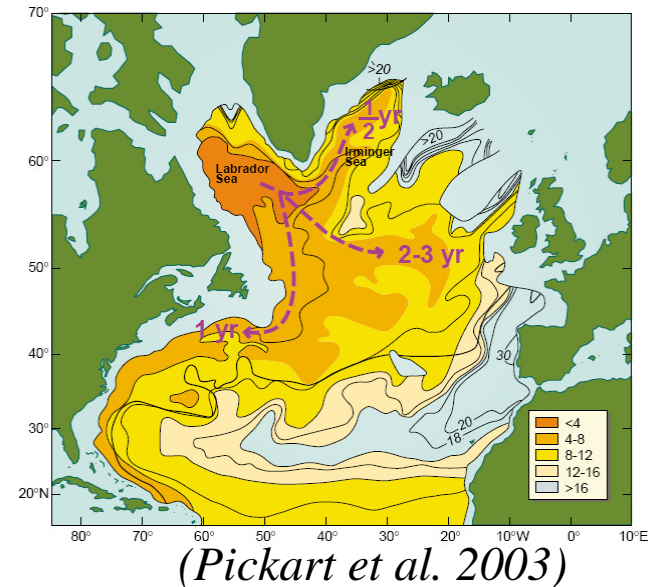
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# Outlines

- **Motivations**
- **Model setup**
- **Interannual and decadal model variability**
- **LSW spreading**
- **Conclusions**

# Motivations

- LSW is an important part of MOC
- There are differences in the spreading time estimated in different studies (Sy et al. 1997; Lavender et al. 2000; Straneo et al. 2003; Yashayaev et al. 2007; Haine et al. 2008)



- Hydrographic condition has changed significantly during the past five decades (Yashayaev, 2007)

# Model Setup

## Ocean Model

- NEMO ocean model coupled with a sea-ice model (Madec, 2008), implemented by Dr. Dan Wright and his group;
- Spectral nudging (Thompson et al. 2006)

## Forcing Data

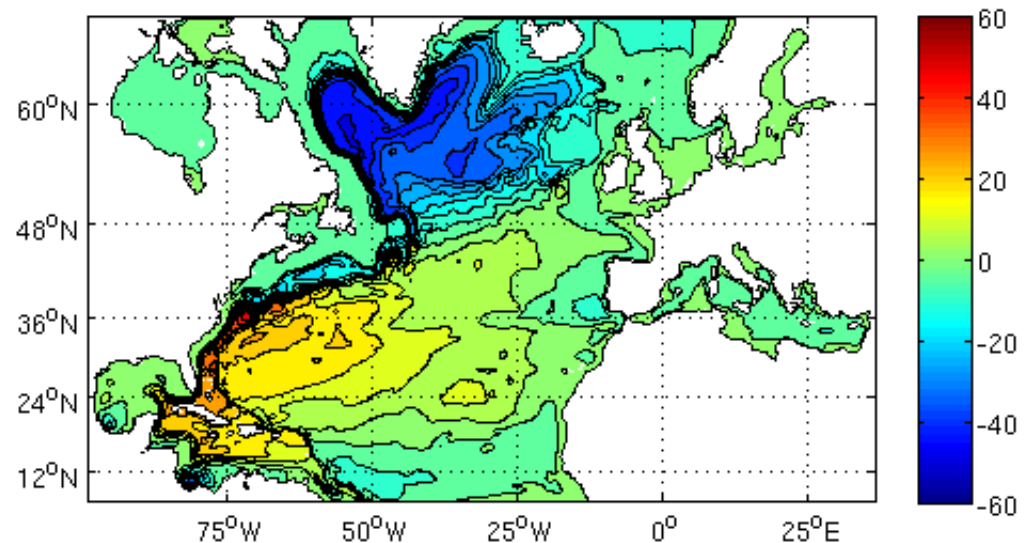
- NCEP/NCAR reanalysis data (1948-2005) for atmospheric forcing;
- SODA data for the northern and southern open boundaries.

## Resolution

- $\frac{1}{4}$  degree horizontal resolution and 46 vertical levels

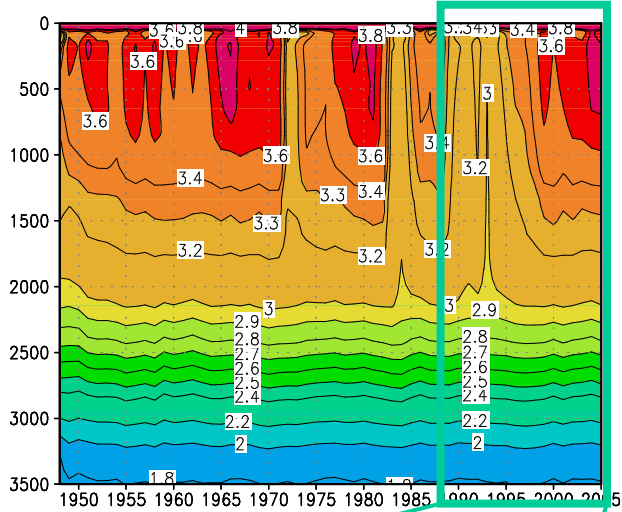
## Basin

- North Atlantic (6.7N-67N);

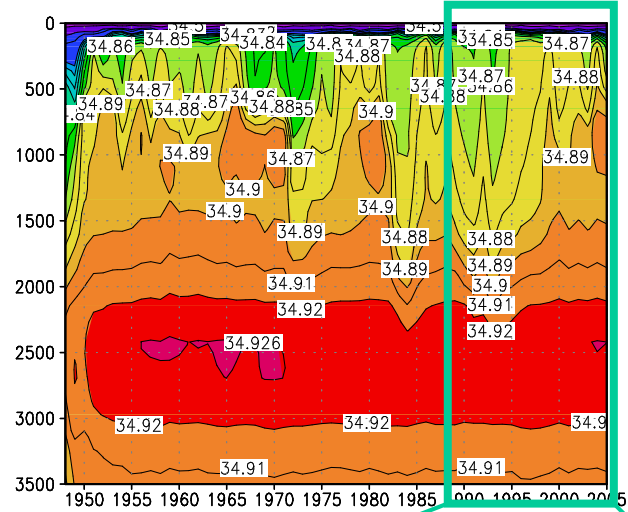


Over the  
Central  
Labrador  
Sea

Potential Temperature

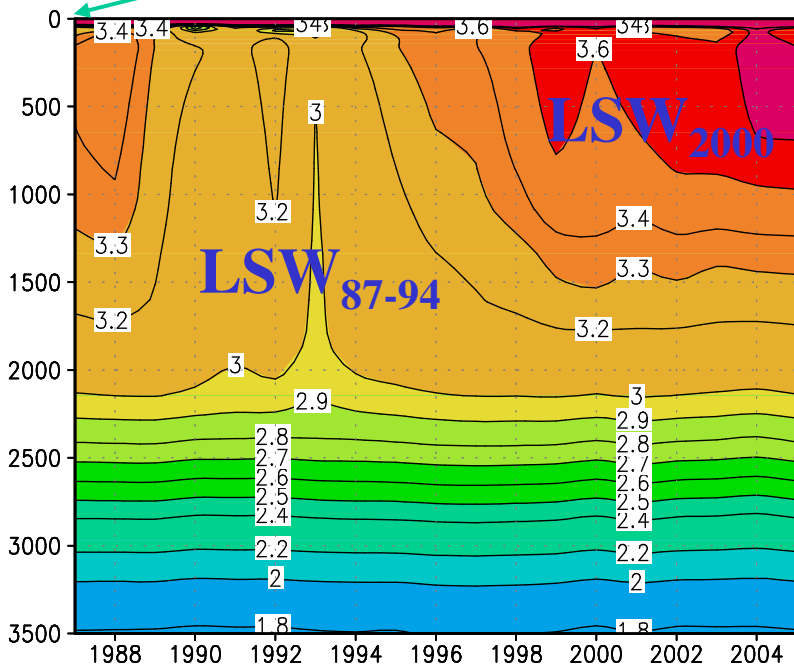


Salinity

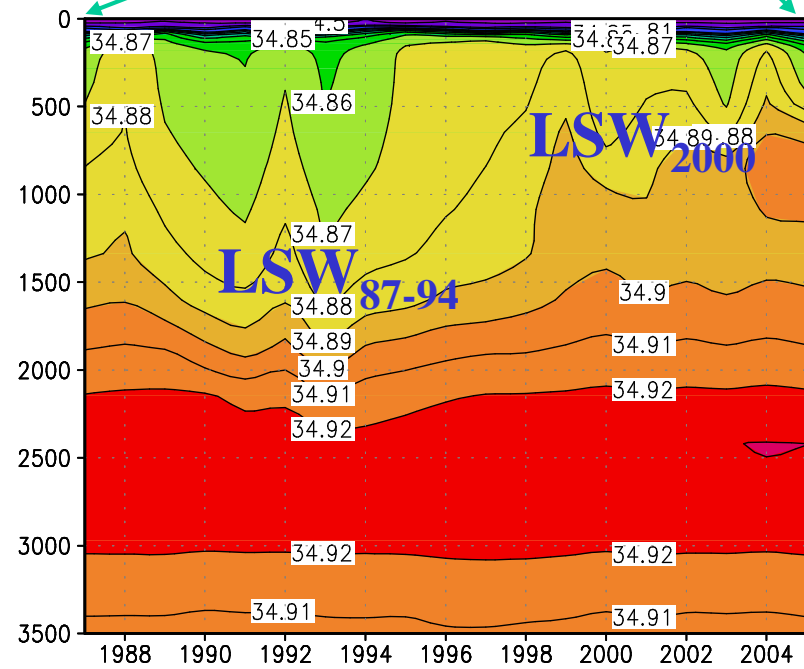


Averaged for  
June-July

Potential Temperature

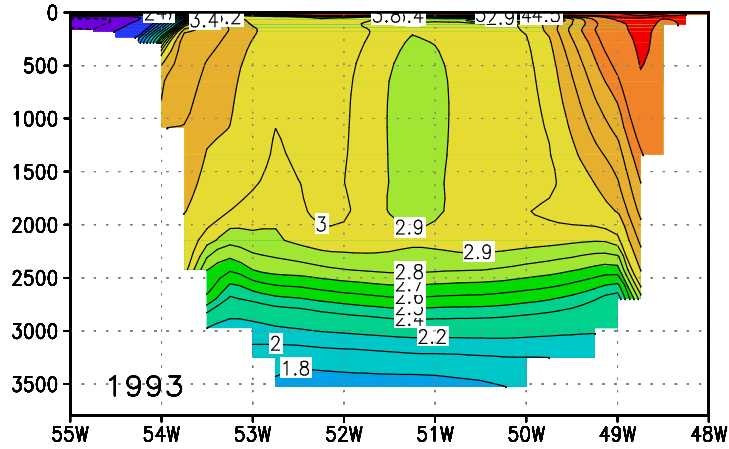


Salinity

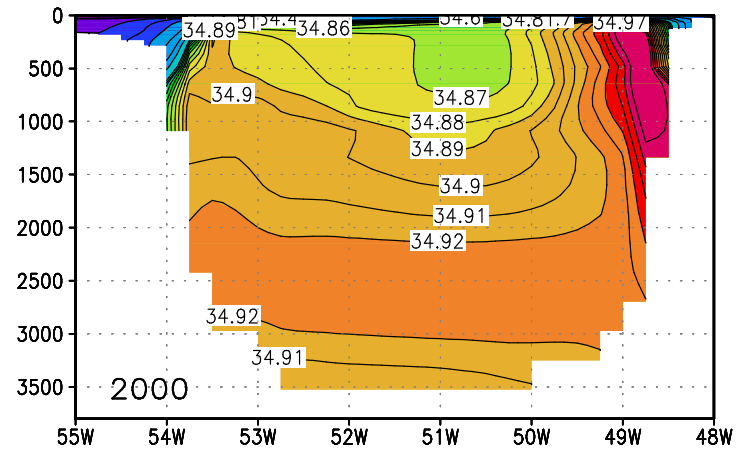
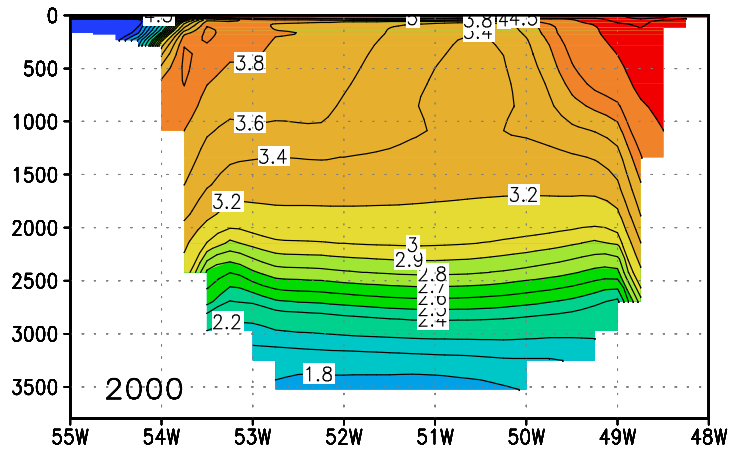
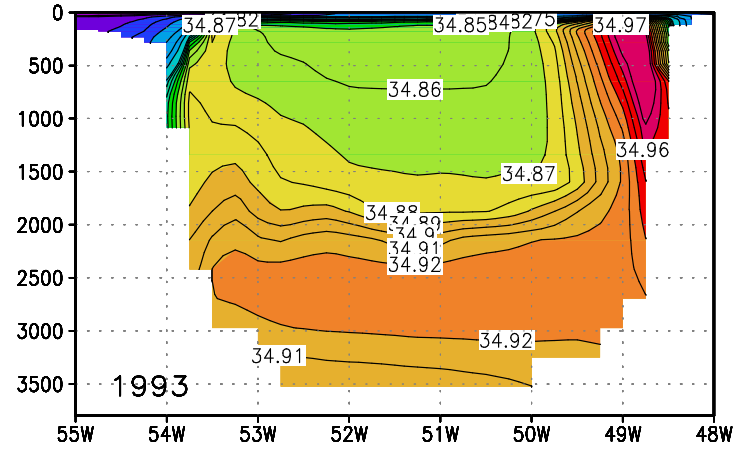


# Along AR7W Section

## Potential Temperature



## Salinity



Averaged for June-July

# Spreading of LSW

- **LSW definition** (Haine et al. 2008) :

$$\sigma_{\theta} = 27.74 - 27.80$$

- **Method:** Ideal Passive Tracer Simulation

$$\frac{\partial C}{\partial t} = S(C) - U(x, t) \cdot \nabla C(x, t) + D^{lC} + D^{vC}$$

$C(x, t)$  -- the tracer concentration per unit volume

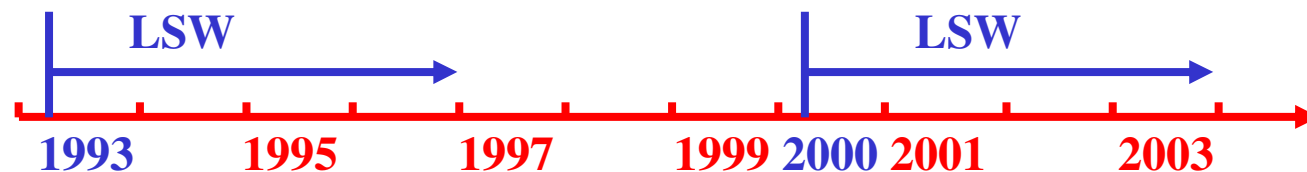
$S(C)$  -- Source Minus Sink (SMS) term

$U(x, t)$  -- velocity

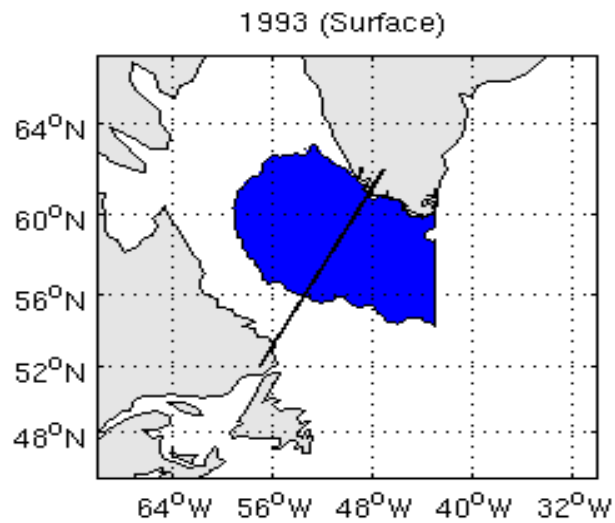
$D^{lC}$  -- lateral diffusion term

$D^{vC}$  -- vertical diffusion term

- **Experiments:**

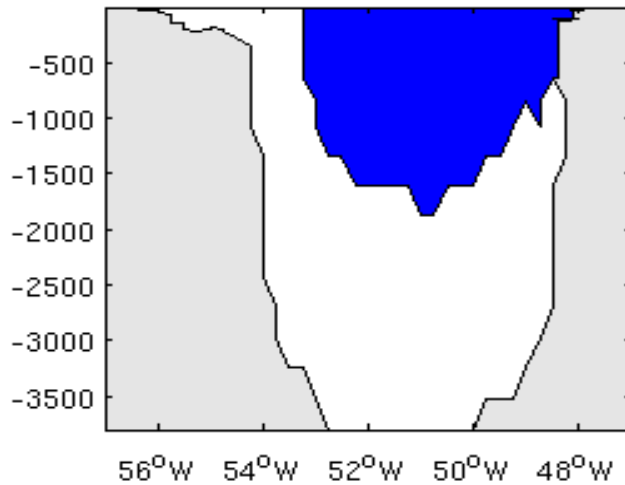


# Ventilated LSWs

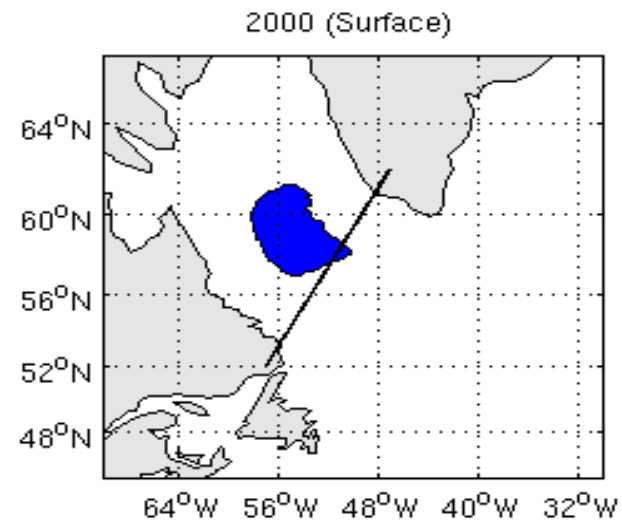


**1993**

1993 (AR7W)

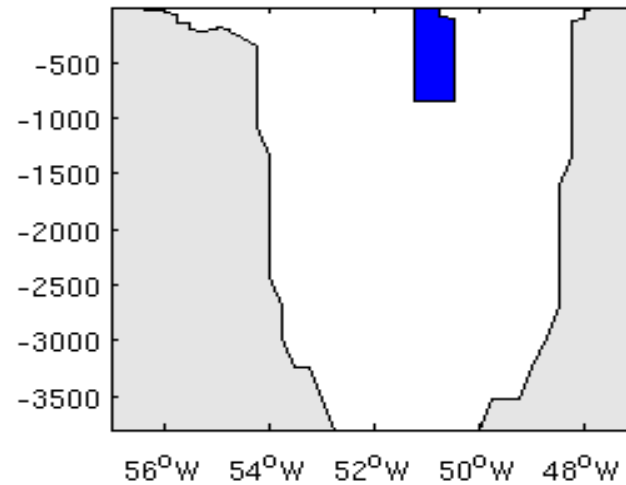


$8.5 \cdot 10^5 \text{ km}^3$



**2000**

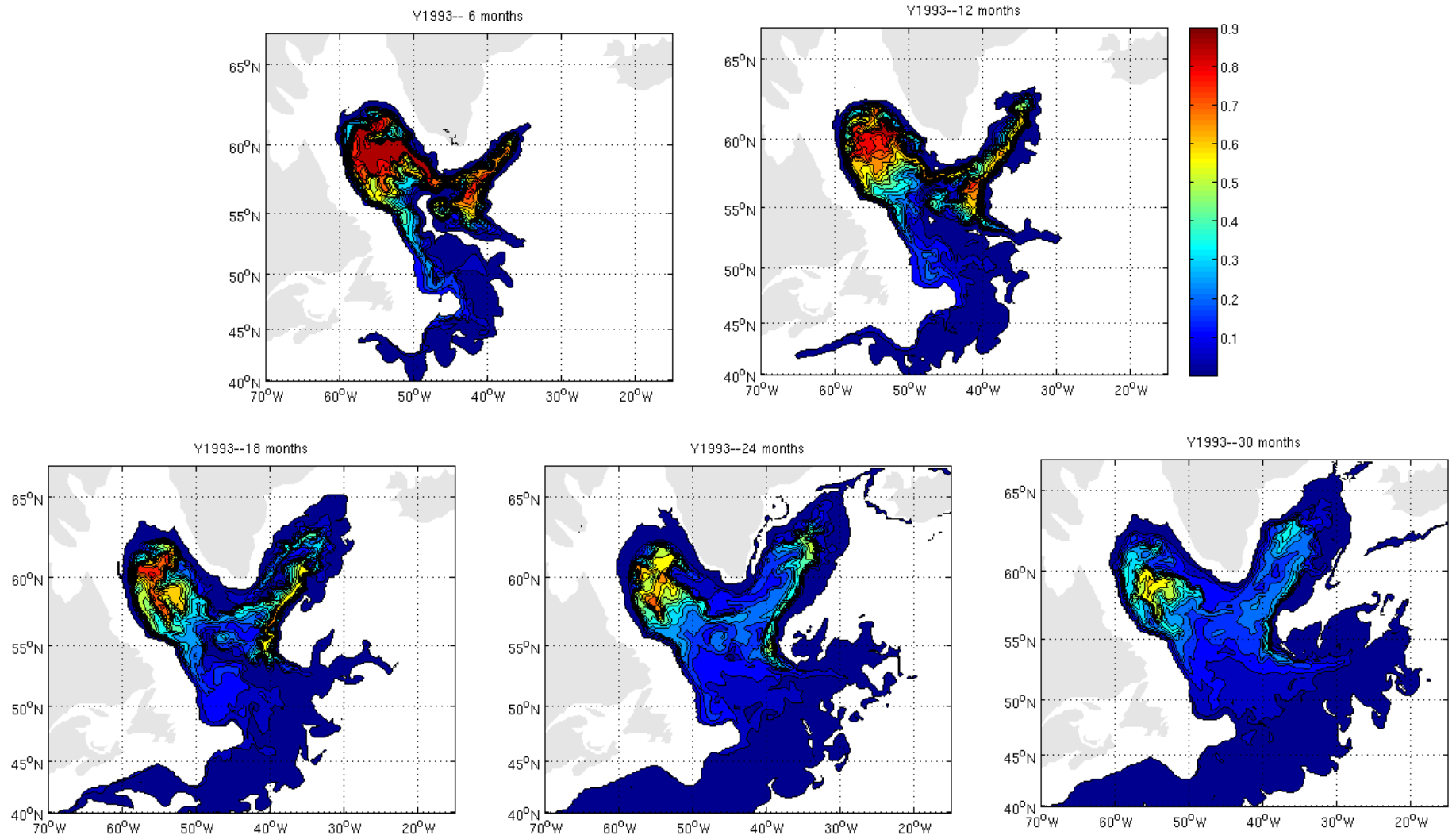
2000 (AR7W)



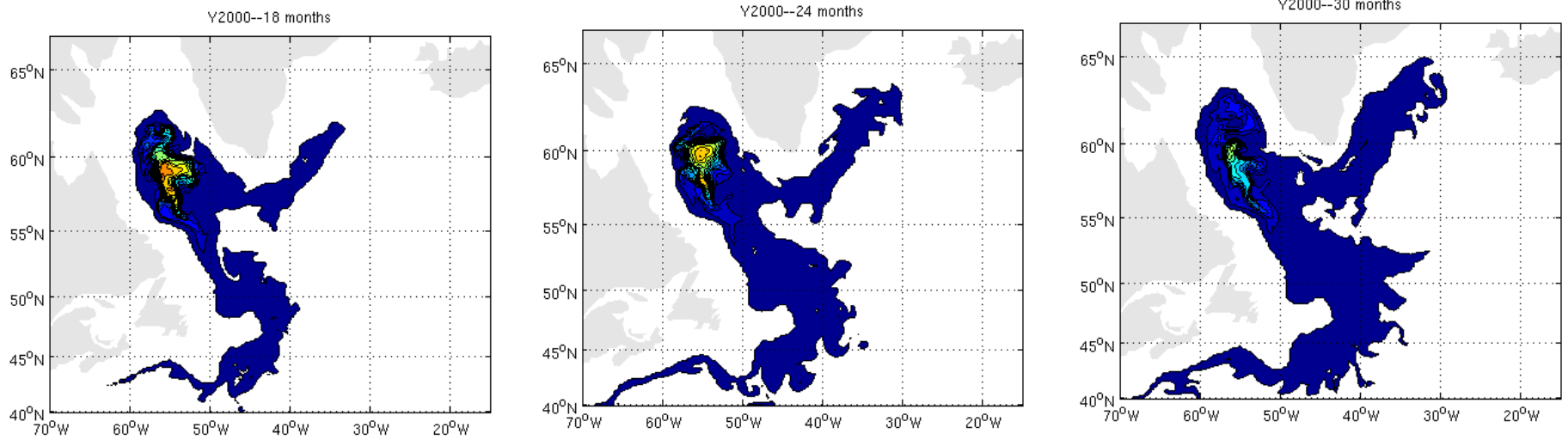
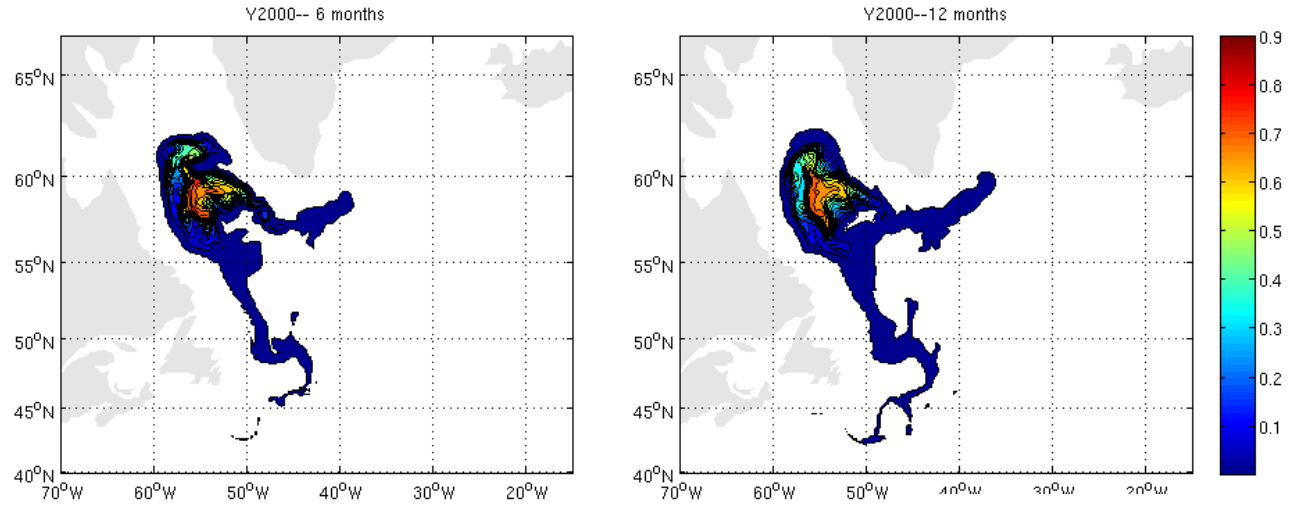
$1.8 \cdot 10^5 \text{ km}^3$



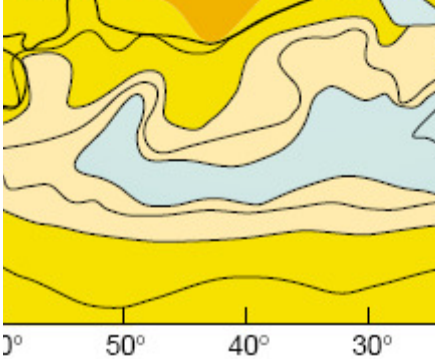
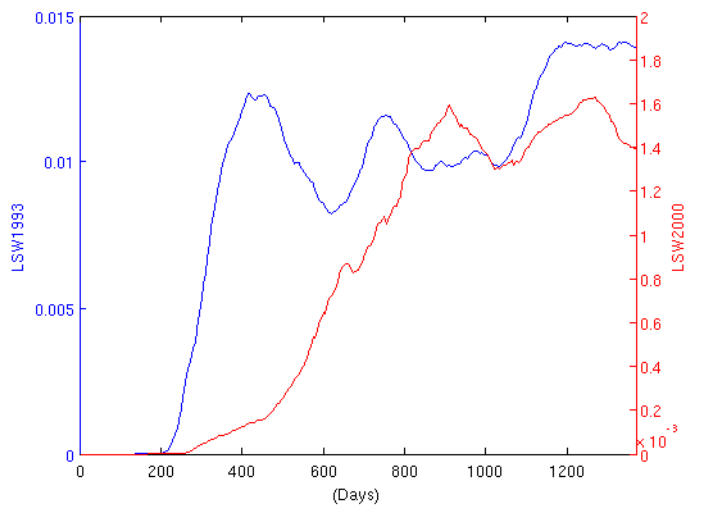
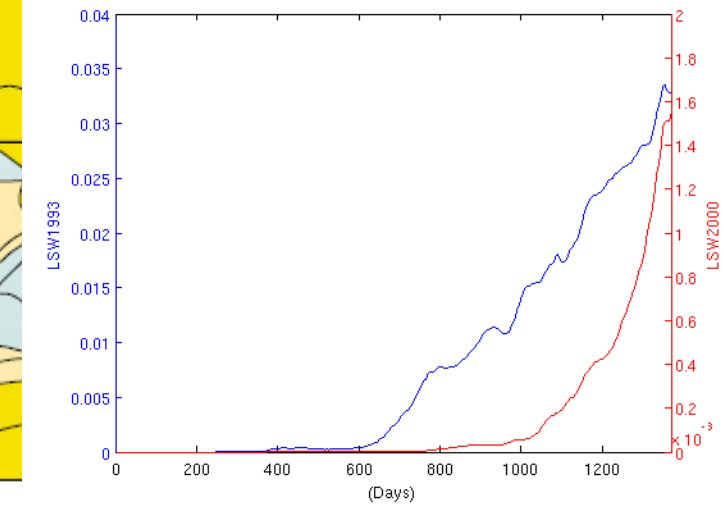
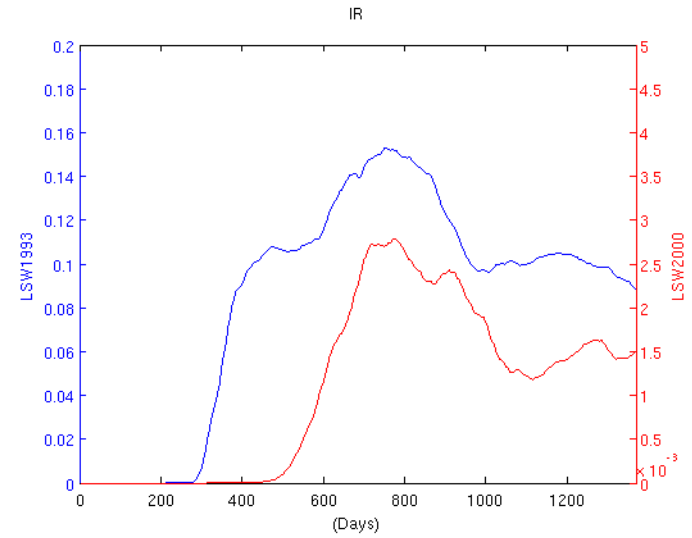
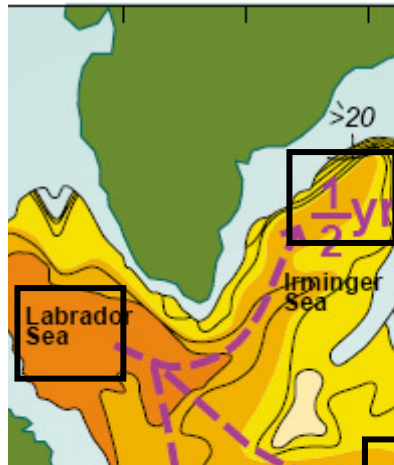
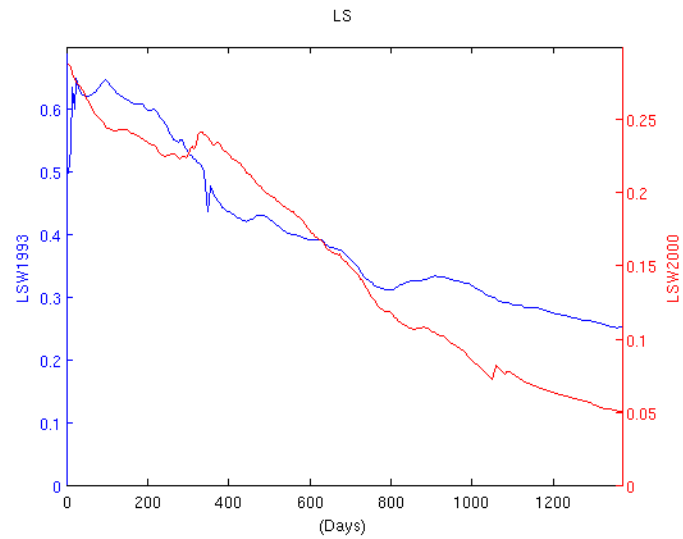
# Spreading of LSW1993



# Spreading of LSW2000



# Time series of Tracer Concentration



# Conclusions

- Ocean model simulated the observed T/S interannual/decadal variability successfully;
- Both LSW1993 and LSW2000 spread in three pathways;
- The residence time for LSW1993 is longer than that for LSW2000;
- The arrival time is different from the peak time. The arrival time for LSW2000 is longer than that for LSW1993.

*Thank you !!!*