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GOAPP
Global Ocean-Atmosphere Prediction and Predictability
Canadian Foundation for Climate and Atmospheric Sciences (CFCAS)
Fondation canadienne pour les sciences du climat et de l'atmosphère (FCSCA)

IMPACT OF ATMOSPHERIC FORCING WITH DIFFERENT RESOLUTIONS ON MODEL SIMULATIONS OF THE NORTHWEST ATLANTIC OCEN

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OUTLINE

- Introduction
- Numerical Models and Experimental Design
- Comparison of the Atmospheric Forcing
- Comparison of the Ocean Simulation
- Conclusion

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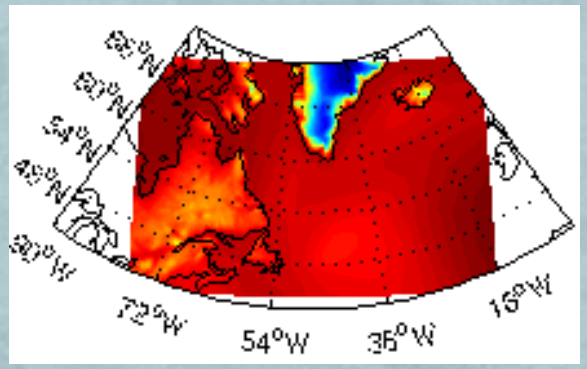
INTRODUCTION

- The Northwest Atlantic Ocean is an essential region for the global climate system.
- The multi-scale topography in Greenland results in a significant low-level flow distortion (*Dolye and Shapiro, 1999*).
- These distortion phenomena are important but underestimated in the global meteorological reanalysis data (*Moore, 2003*).

ATMOSPHERIC EXPERIMENT

- Atmospheric Regional Model
  - Weather Research Forecast Model (WRF) version 3.1.1 (*Skamarock, et al., 2008*)
- Simulation Domain
  - Northwest Atlantic Ocean
- Resolution
  - horizontal: 30 Km*30 Km (150*100 grids)
  - vertical: 27 levels



- Initial and Boundary Data
  - 26-year NCEP/NCAR reanalysis data (2.5° * 2.5°)
- Experimental Design
  - simulation period: 1979-12-31_12:00 – 2006-01-04_00:00
  - integrate for 60 hours, retain the last 48 hours of the output, and re-initialized at 12:00 every two days
  - output every 6 hours

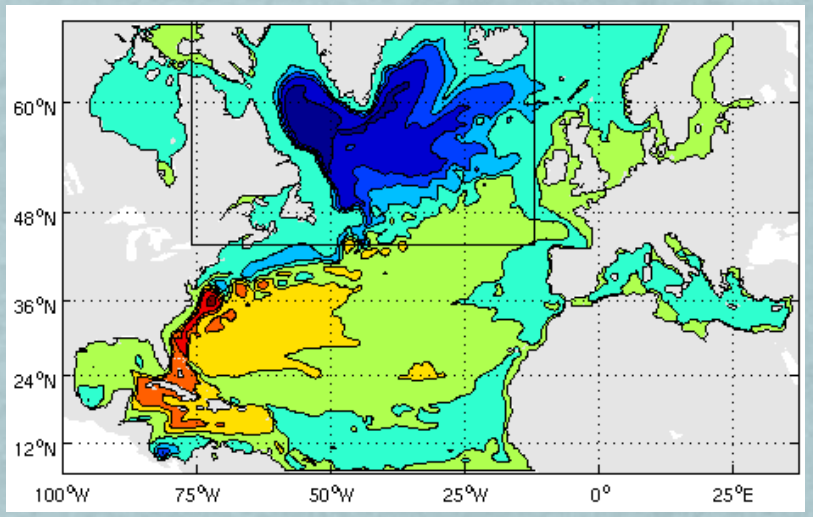
OCEANIC EXPERIMENT

- Ocean Model

  - NEMO ocean model coupled with a sea-ice model (*Madec, 2008*)

- Simulation Domain

  - North Atlantic (6.7N – 67N)



- Resolutions

  - horizontal: 0.25° *0.25°

  - vertical: 46 levels

- Experimental Design

  - simulation period: 1980-2005

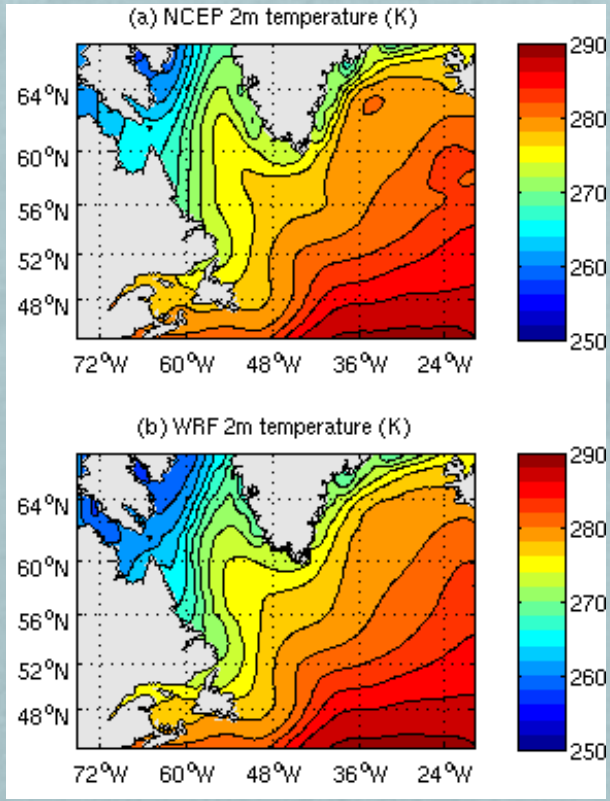
  - atmospheric forcing: precipitation, 2-m air temperature, 2-m relative humidity, 10-m wind speed, 10-m wind stresses, and cloud

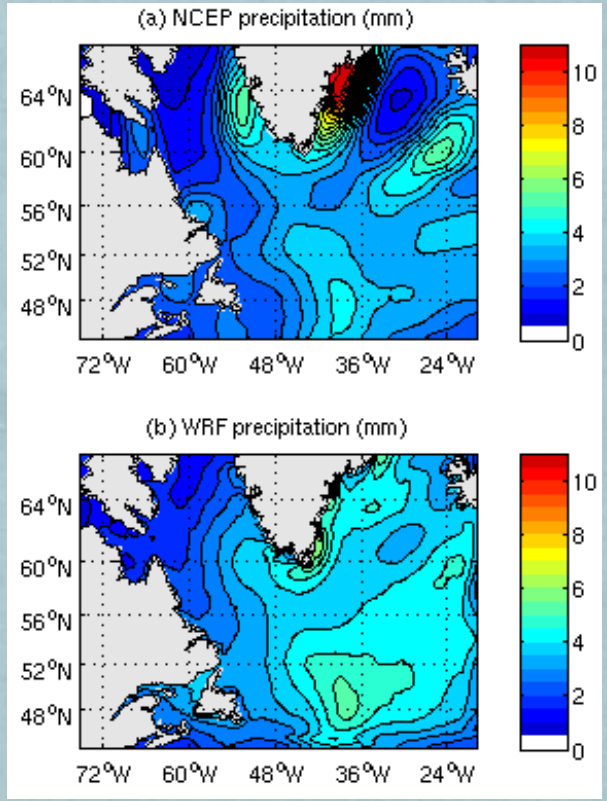
  - use the WRF outputs except cloud over the Northwest Atlantic

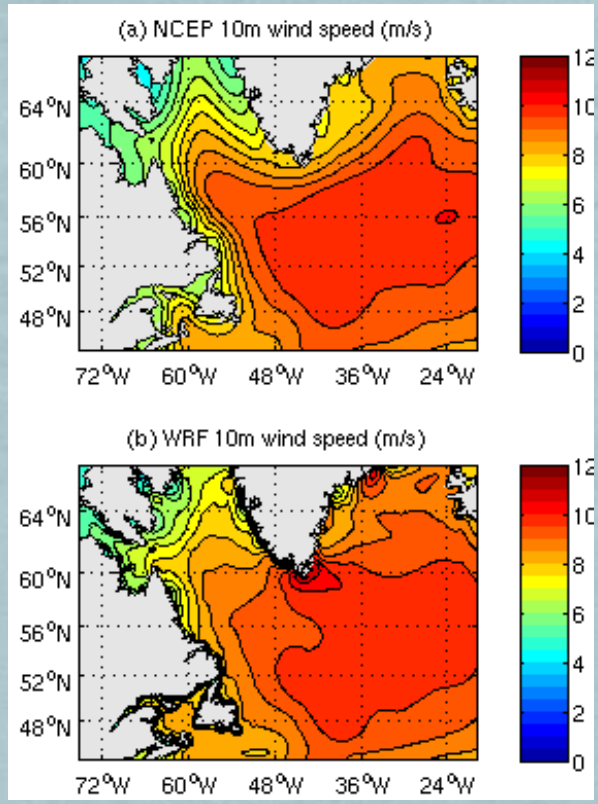
    the NCEP/NCAR reanalysis data over the rest of the North Atlantic

COMPARISON OF ATMOSPHERIC FORCING

- Averaged fields during the whole experimental period



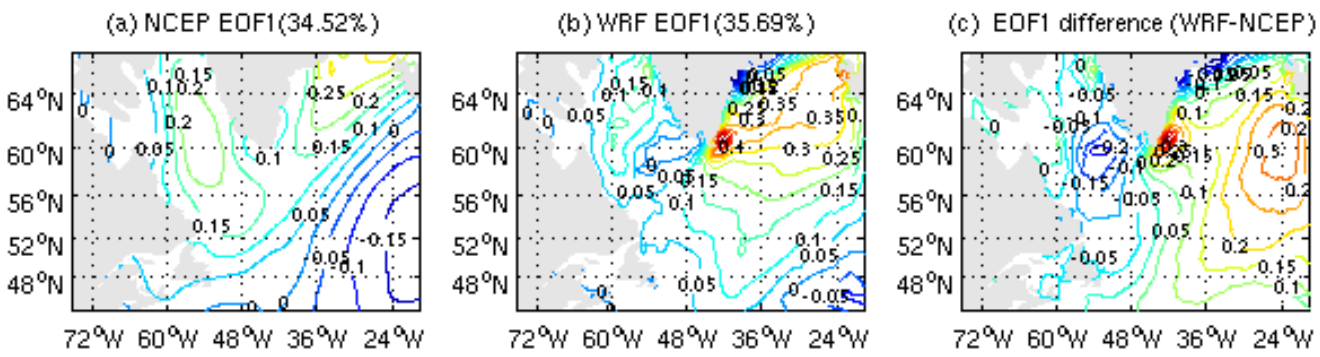


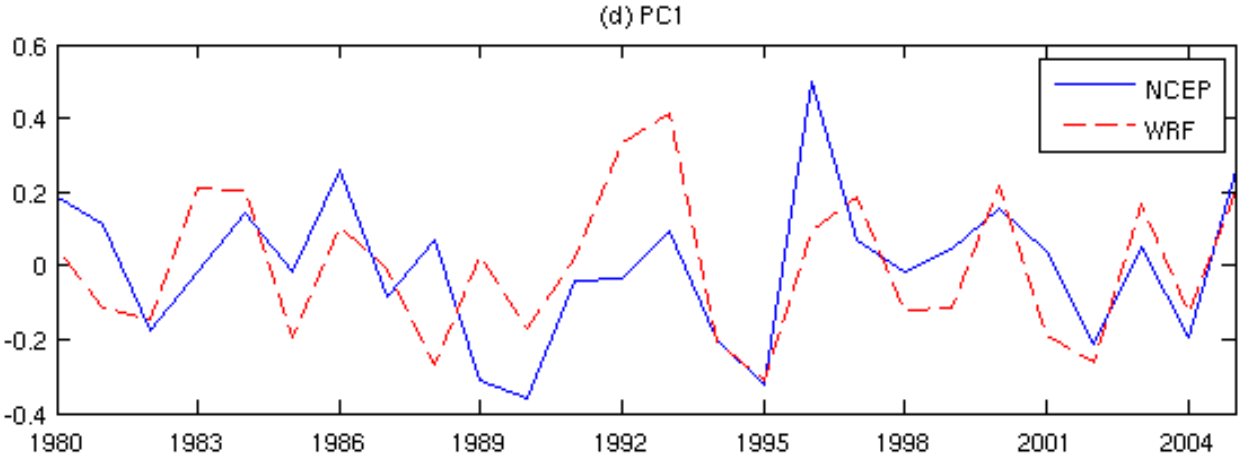


COMPARISON OF ATMOSPHERIC FORCING (CONT')

- **EOFs of atmospheric fields averaged in winter months (JFM)**

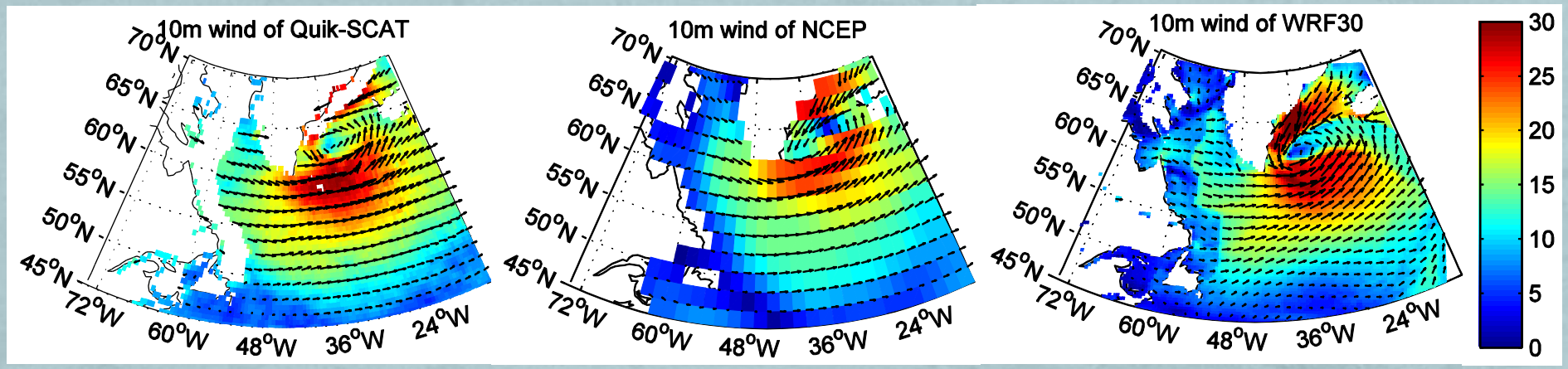
- 10-m meridional wind stress



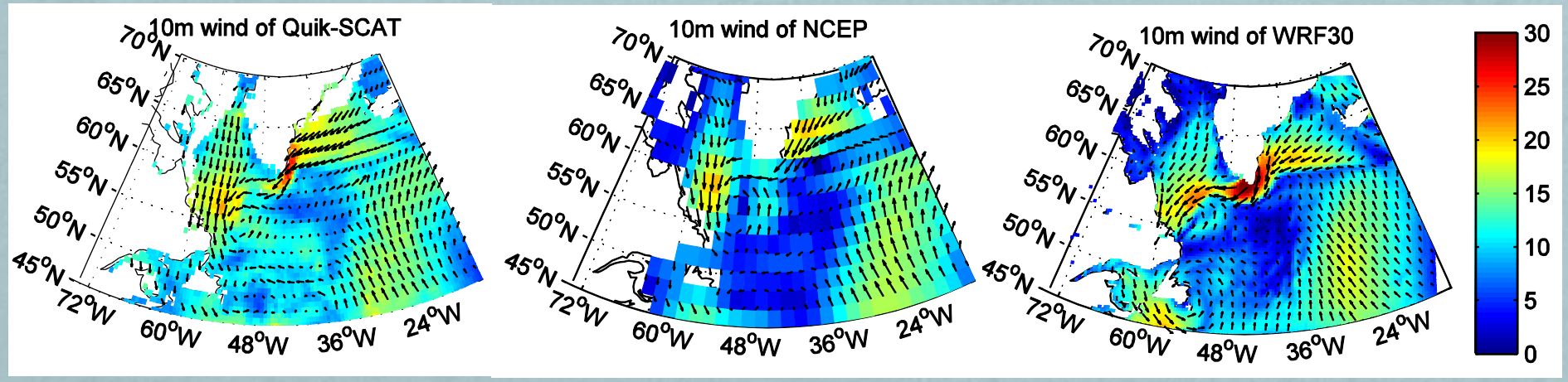


COMPARISON OF ATMOSPHERIC FORCING (CONT')

- A forward Greenland tip jets on Feb. 14, 2000

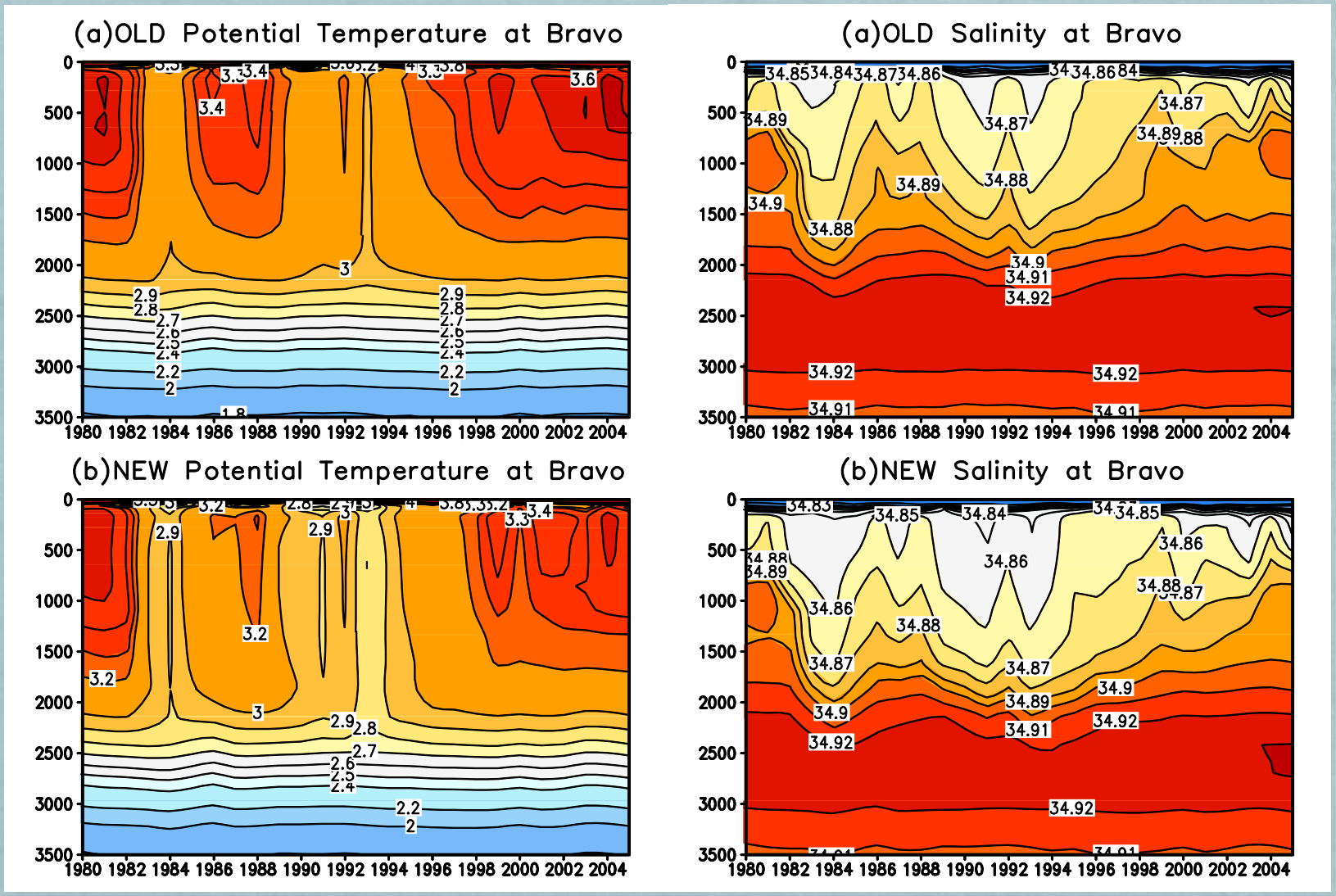


- A reverse Greenland tip jets on Jan. 17, 2004



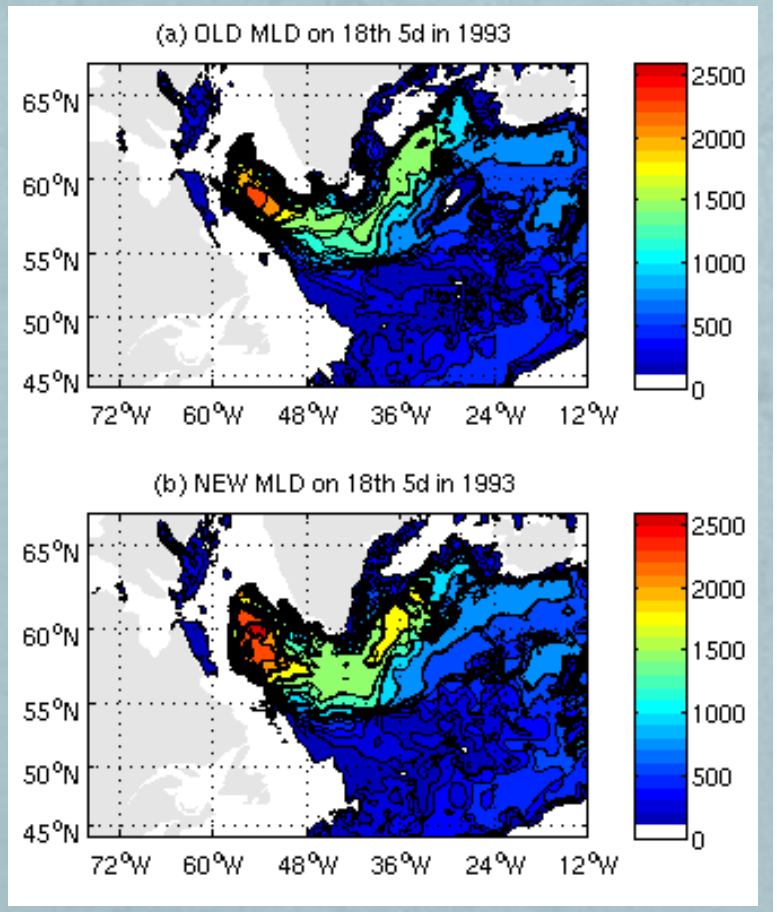
COMPARISON OF THE OCEAN SIMULATION

- averaged in May and June, over the Central Labrador Sea

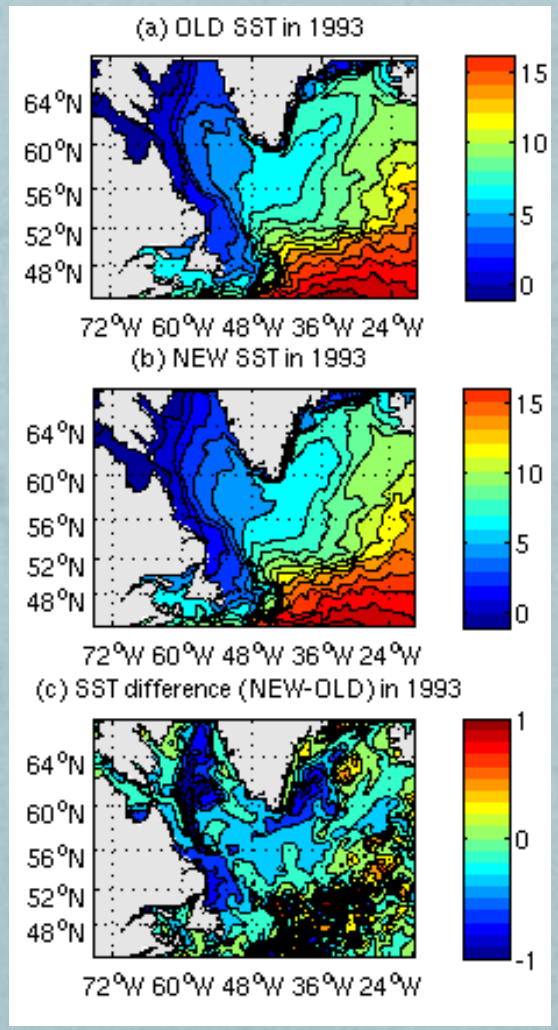


COMPARISON OF THE OCEAN SIMULATION (CONT')

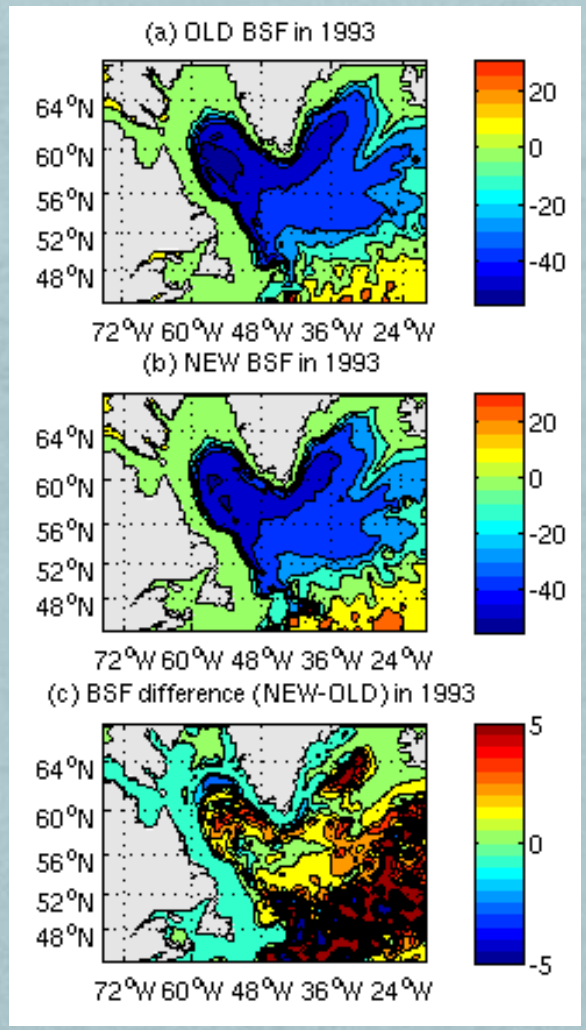
- Mixed layer depth at the end of Mar, 1993



- SST in1993

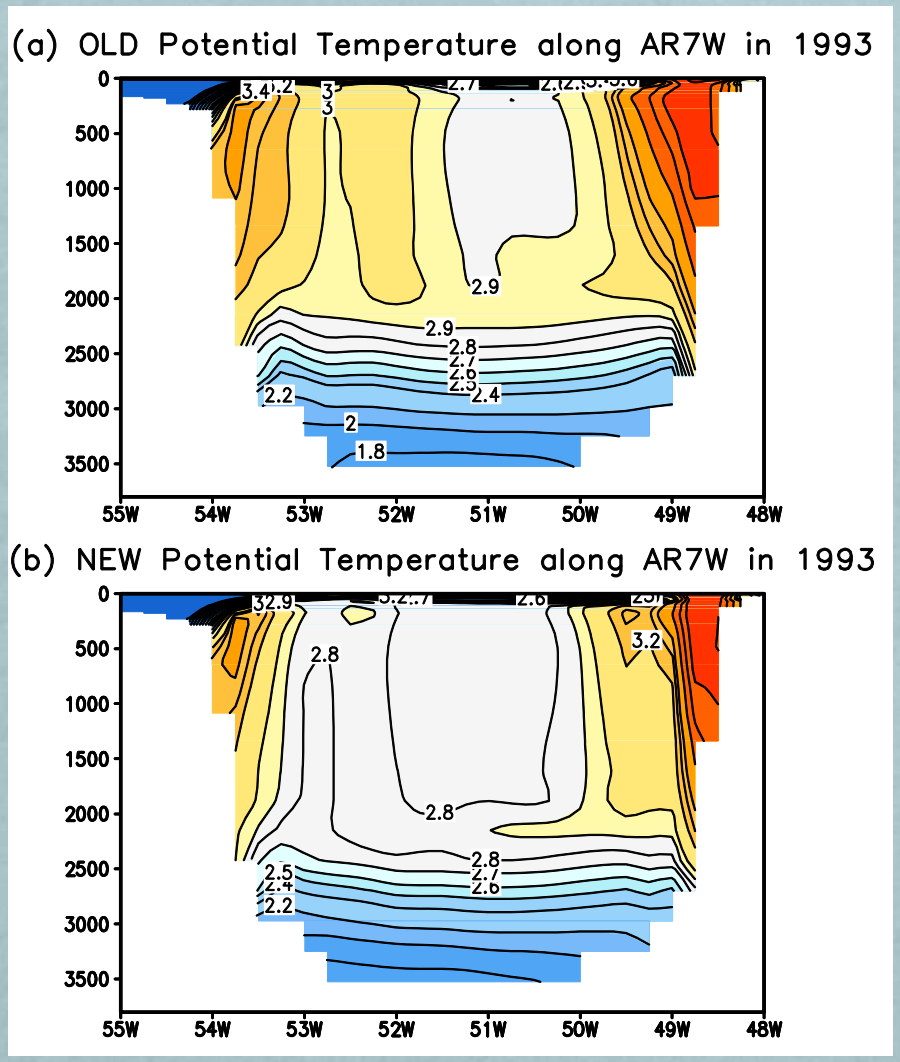


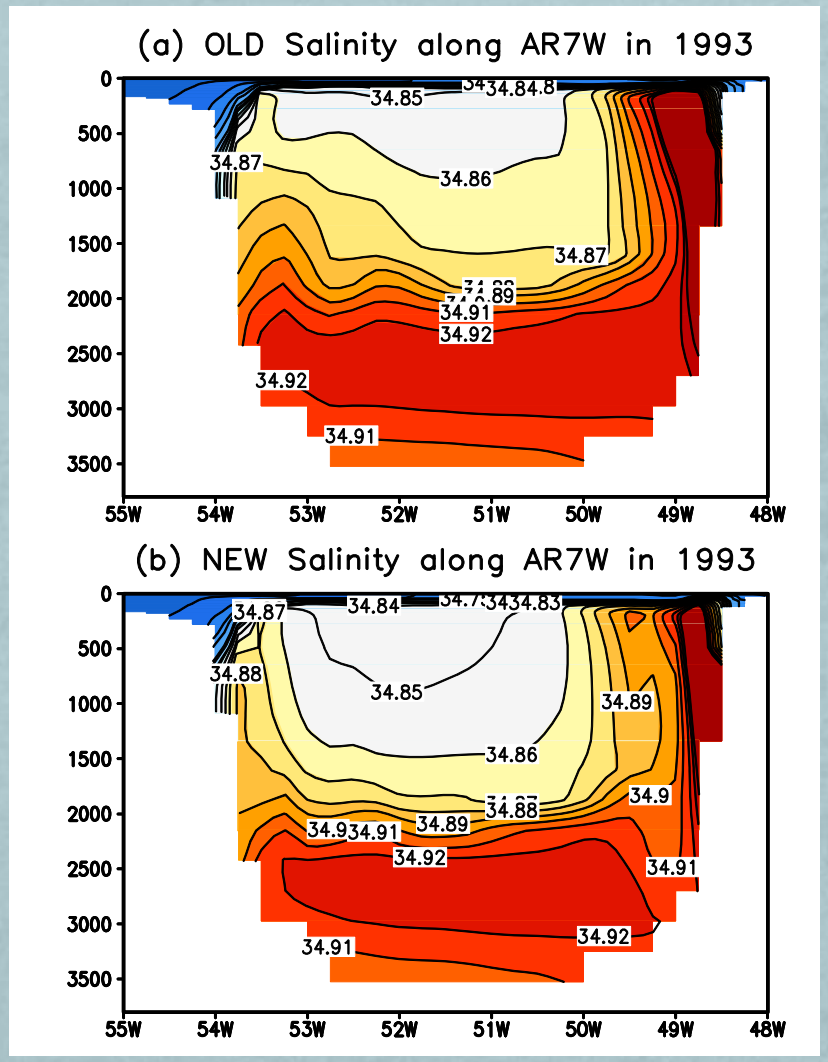
- BSF in1993



COMPARISON OF THE OCEAN SIMULATION (CONT')

- averaged in May and June, along AR7W section





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CONCLUSION

- The WRF model can capture the main features of the NCEP/NCAR reanalysis data, and properly resolve the influence of the high topography in Greenland on the atmospheric flow as well.
- Using the fine resolution WRF-derived output to force the NEMO model, the mixed layer depth is deeper, sea water over the Labrador Sea is colder and fresher , especially during the deep convection event in 1993-1994.
- Reasons of the changes will be diagnosed.

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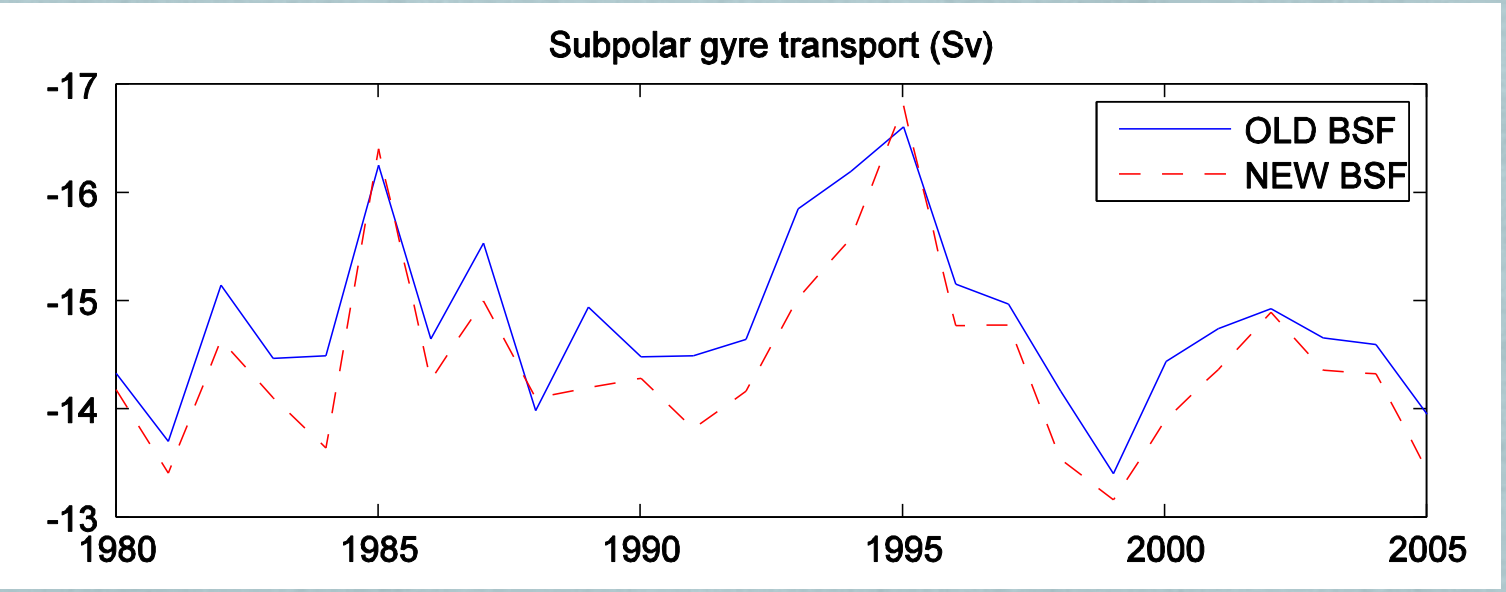
Thank You!

QUESTIONS?

COMPARISON OF THE OCEAN SIMULATION (CONT')

- yearly Barotropic Stream function averaged over (72.75W – 22.25W, 46.05N – 65.70N)



COMPARISON OF THE OCEAN SIMULATION (CONT')

- EOFs of downward heat flux averaged in winter months (JFM)