Mesoscale Variability in the Labrador Sea – a model study

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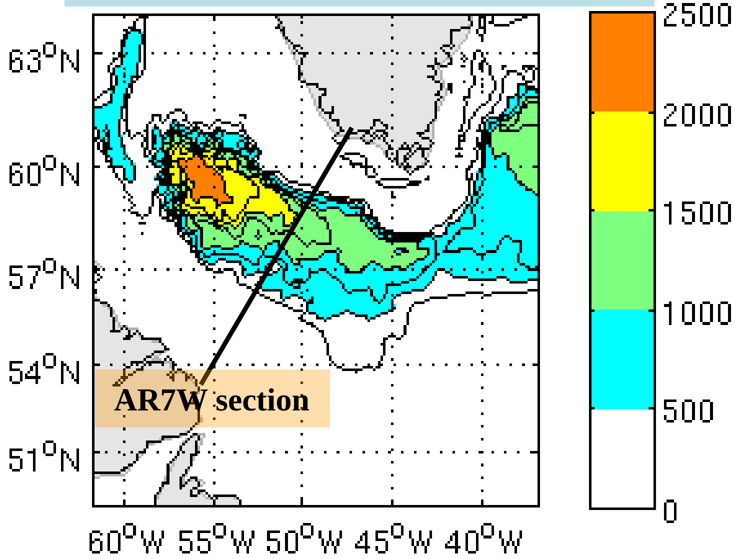
Outlines

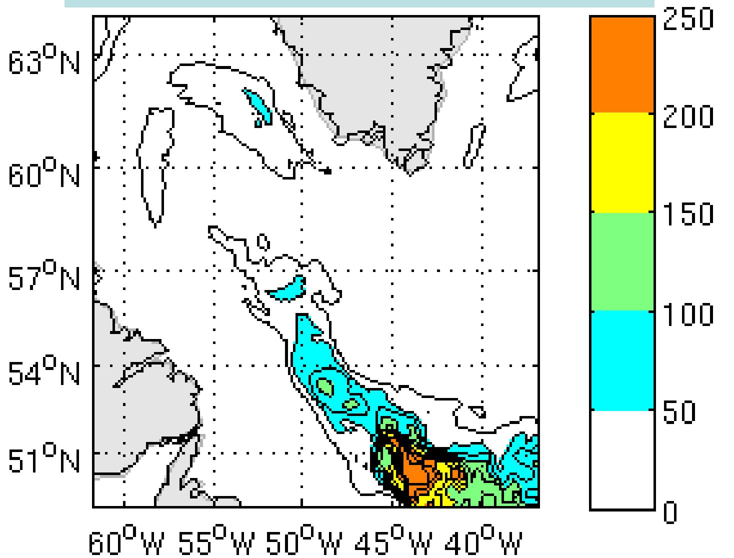
- **Deep convection in a ¼ degree model**
- **Model setup**
- **Results in an eddy-resolving model**
- **Conclusions**

Simulations from ¼ NA model

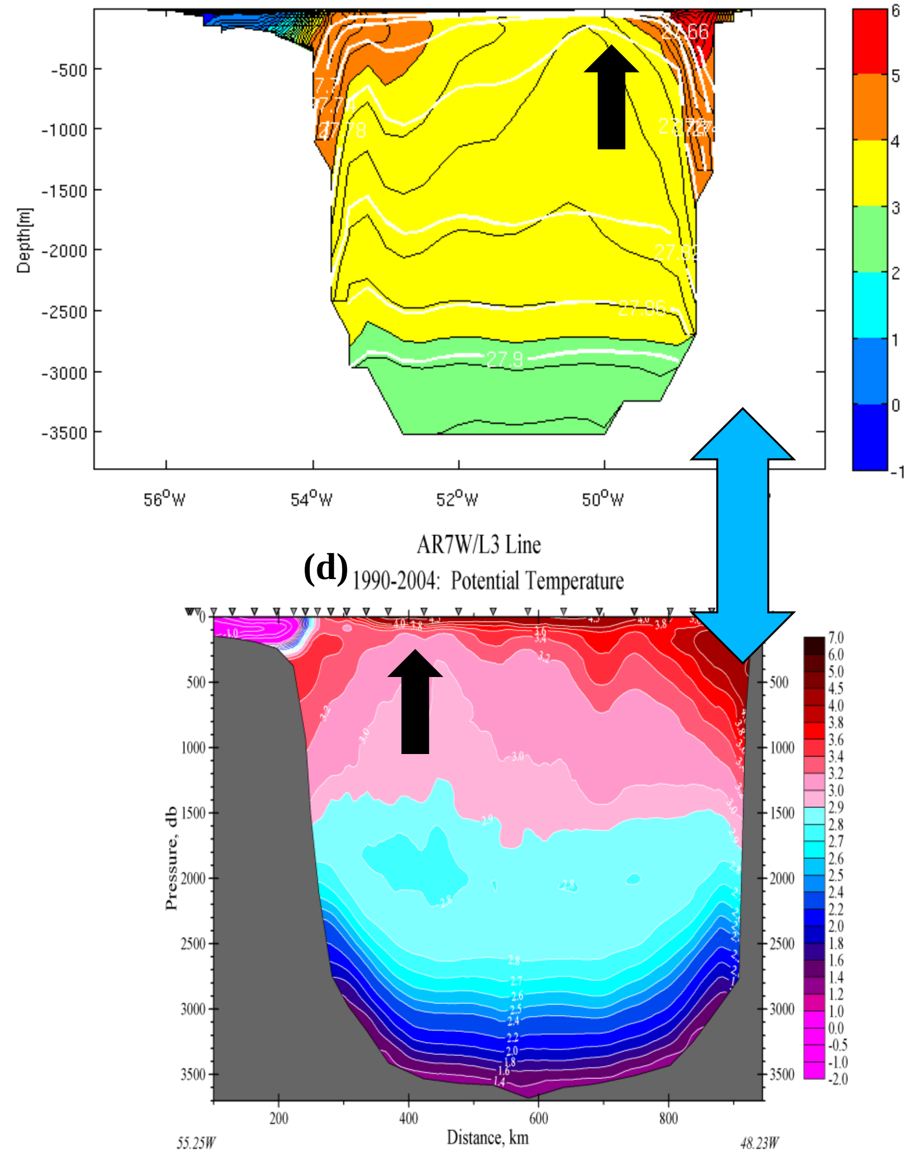
(a) mean **MLD** *at the end of March*



(b) mean **EKE**



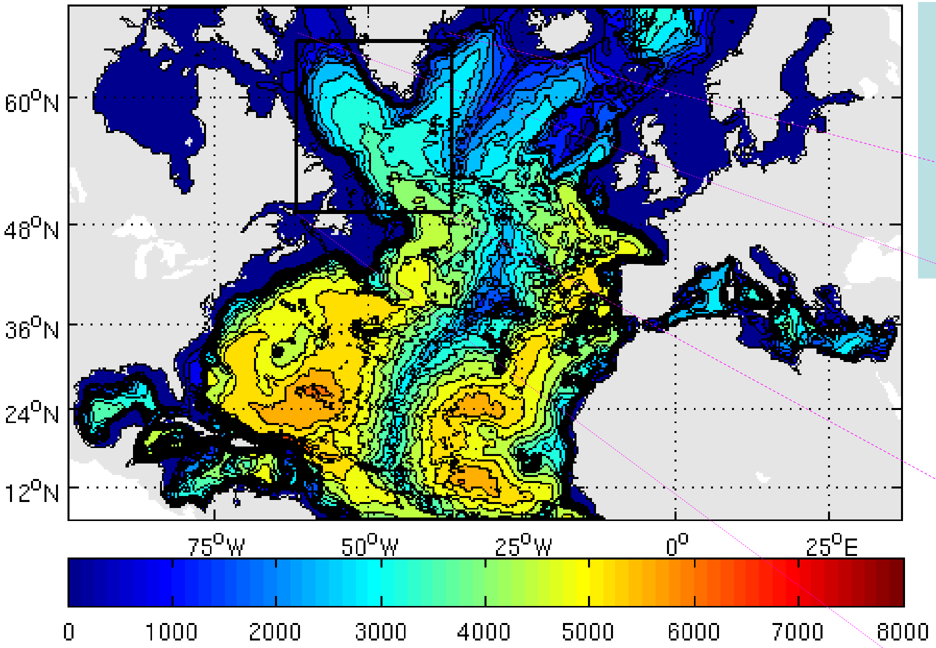
(c) mean **Potential temperature** (color) & **Potential density** (contour) along AR7W



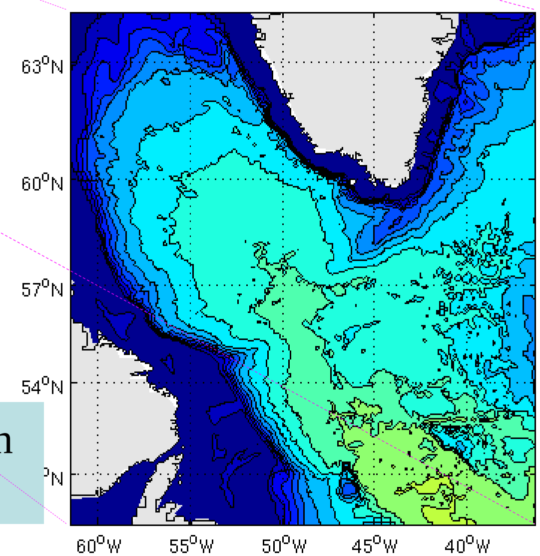
(Igor Yashayaev, personal communication)

The Regional Model of the Labrador Sea

bathymetry *based on ETOPO2 dataset*

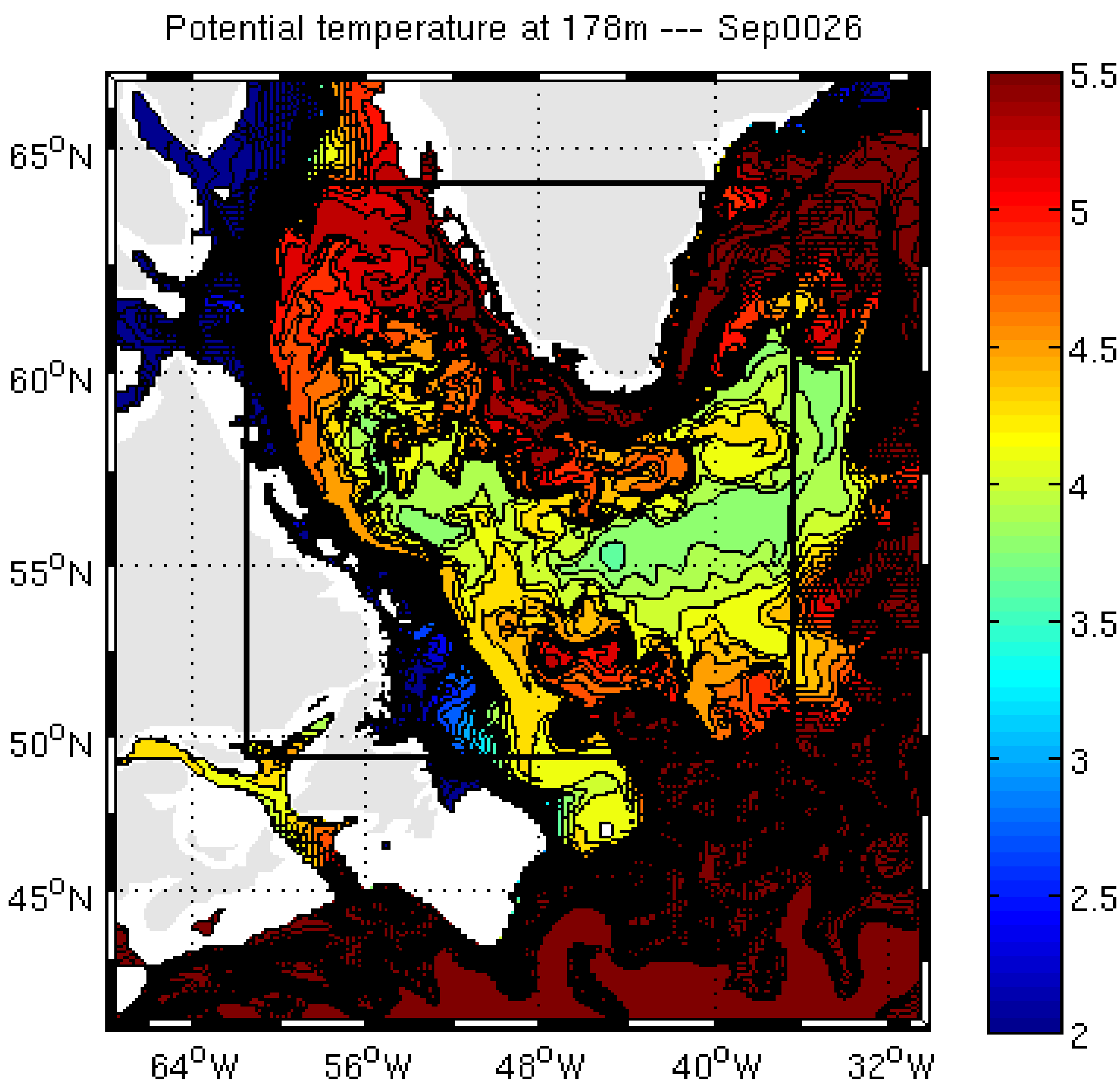


- NEMO ocean model coupled with a sea-ice model
- 1/4° horizontal resolution



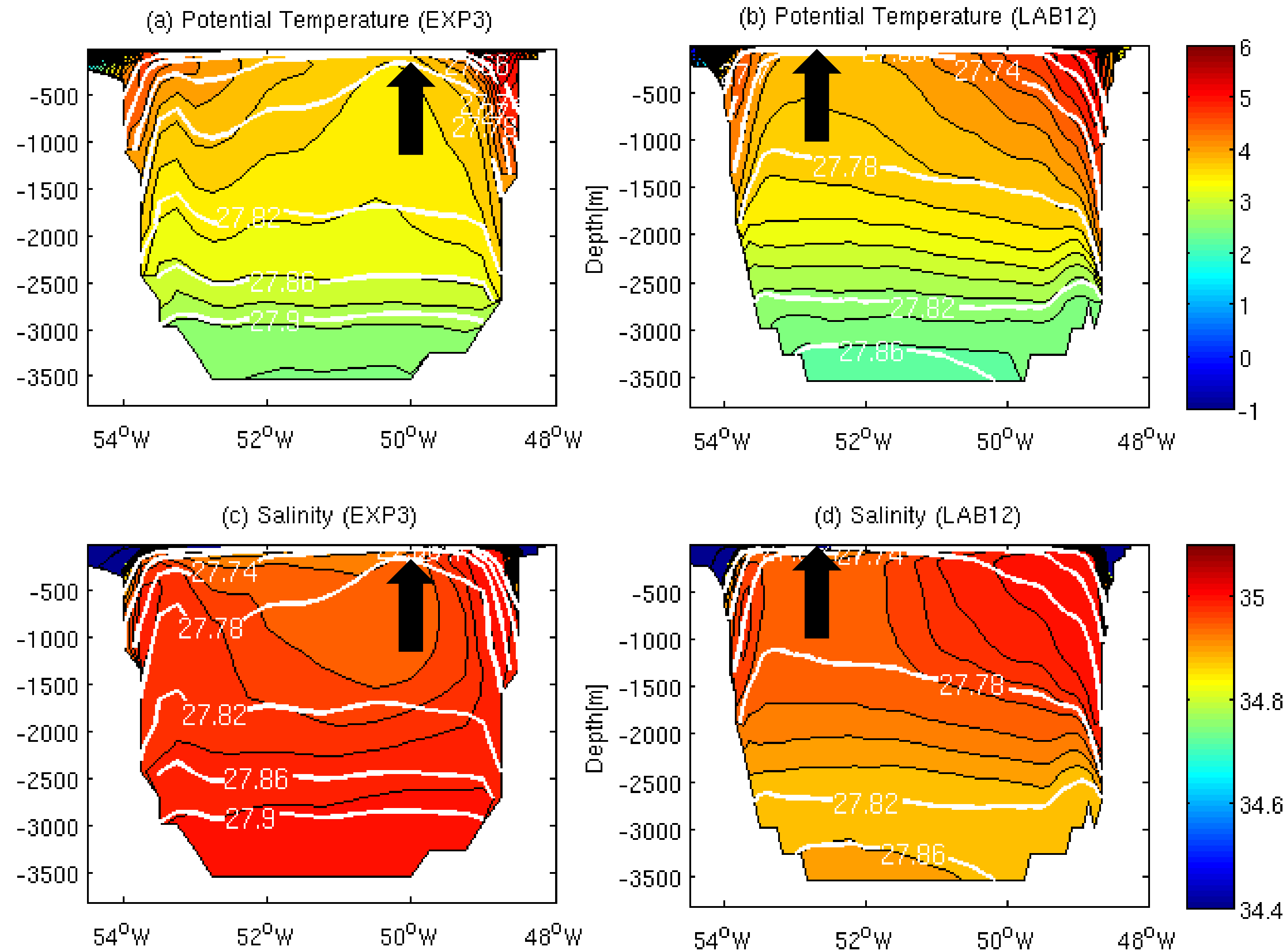
- Nested Labrador Sea Model with 1/12° horizontal resolution

Name of Model	Horizontal resolution	Horizontal dimensions	Time step (seconds)	Max. Horizontal resolution (km)	Min Horizontal Resolution (km)	Max. Biharmonic viscosity (m^4/s)	Max. Laplacian Diffusivity (m^2/s)
NA025	¼° x ¼° cosØ	544x336	2400	27.6	11.0	-1.5E+11	300
LAB12	1/12° x 1/12° cosØ	304x334	600	6.0	4.0	-2.0E+9	70

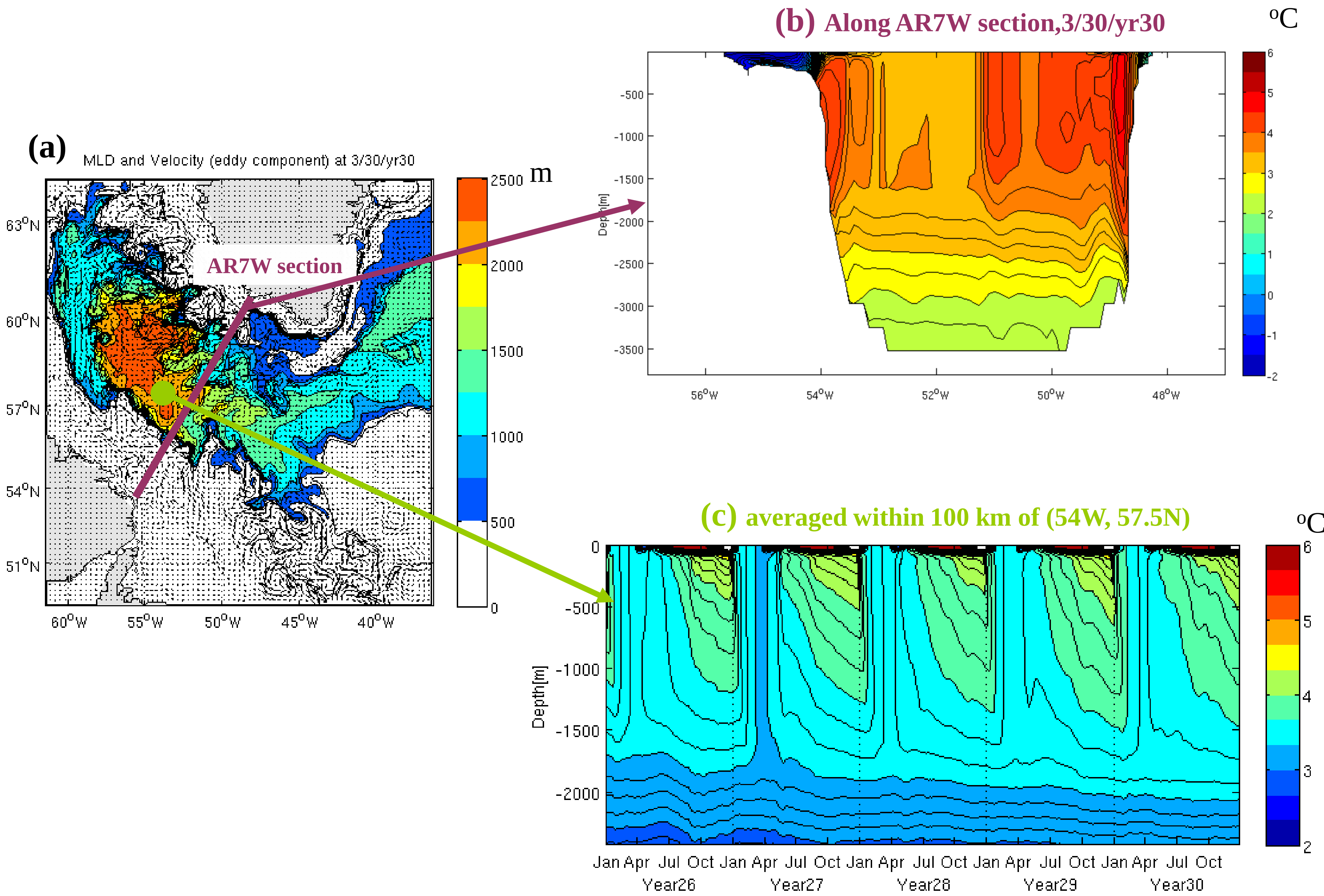

Potential temperature at 178m --- Sep0026
65°N
60°N
55°N
50°N
45°N
64°W
56°W
48°W
40°W
32°W
5.5
5
4.5
4
3.5
3
2.5
2

¼ model simulations

1/12 model simulations

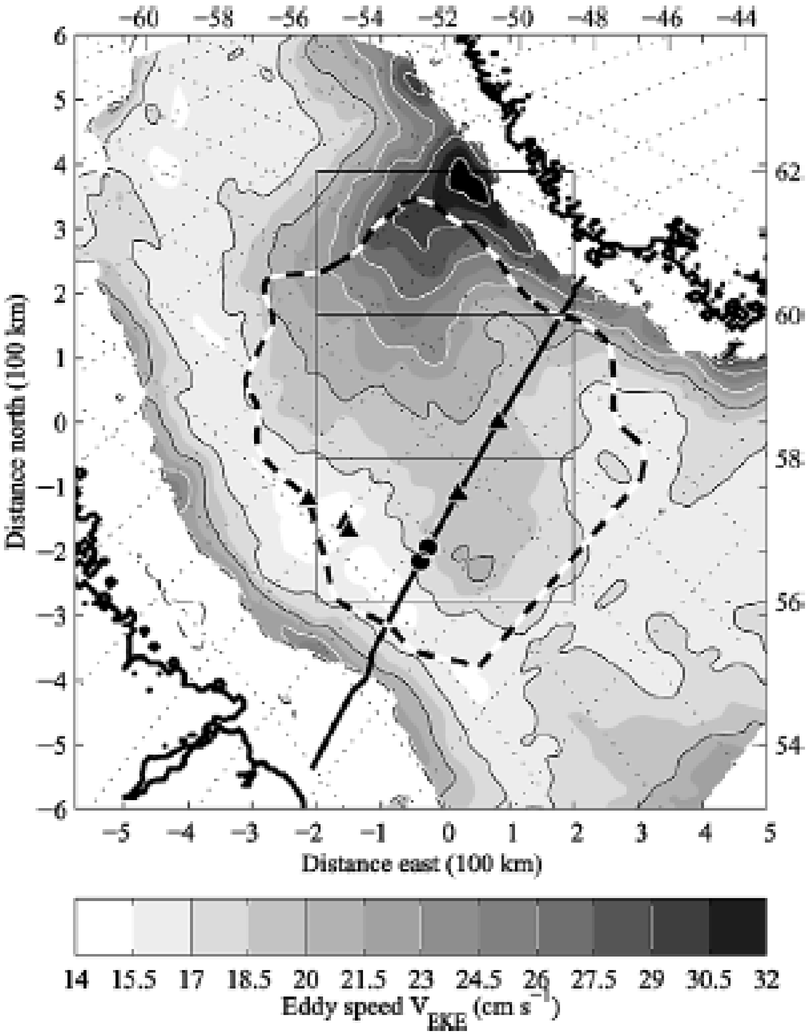


Potential temperature



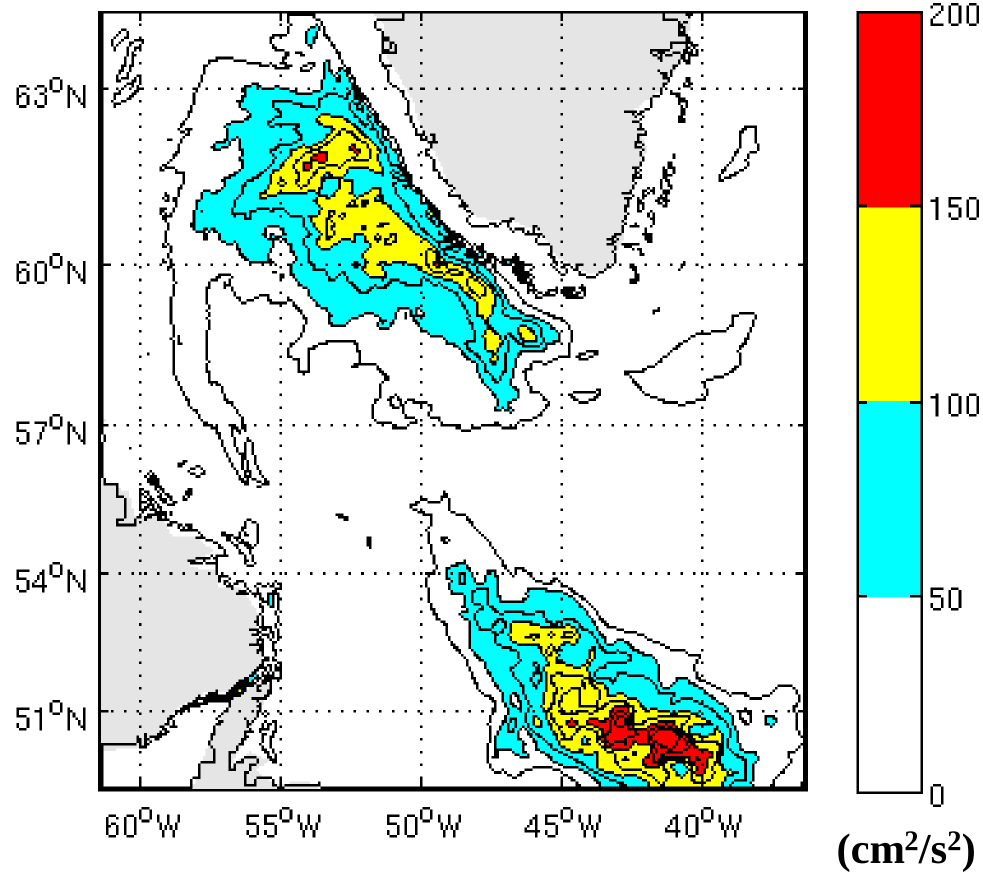
Distribution of Surface Mesoscale Variability

(a) The **Topex-derived** Surface EKE speed

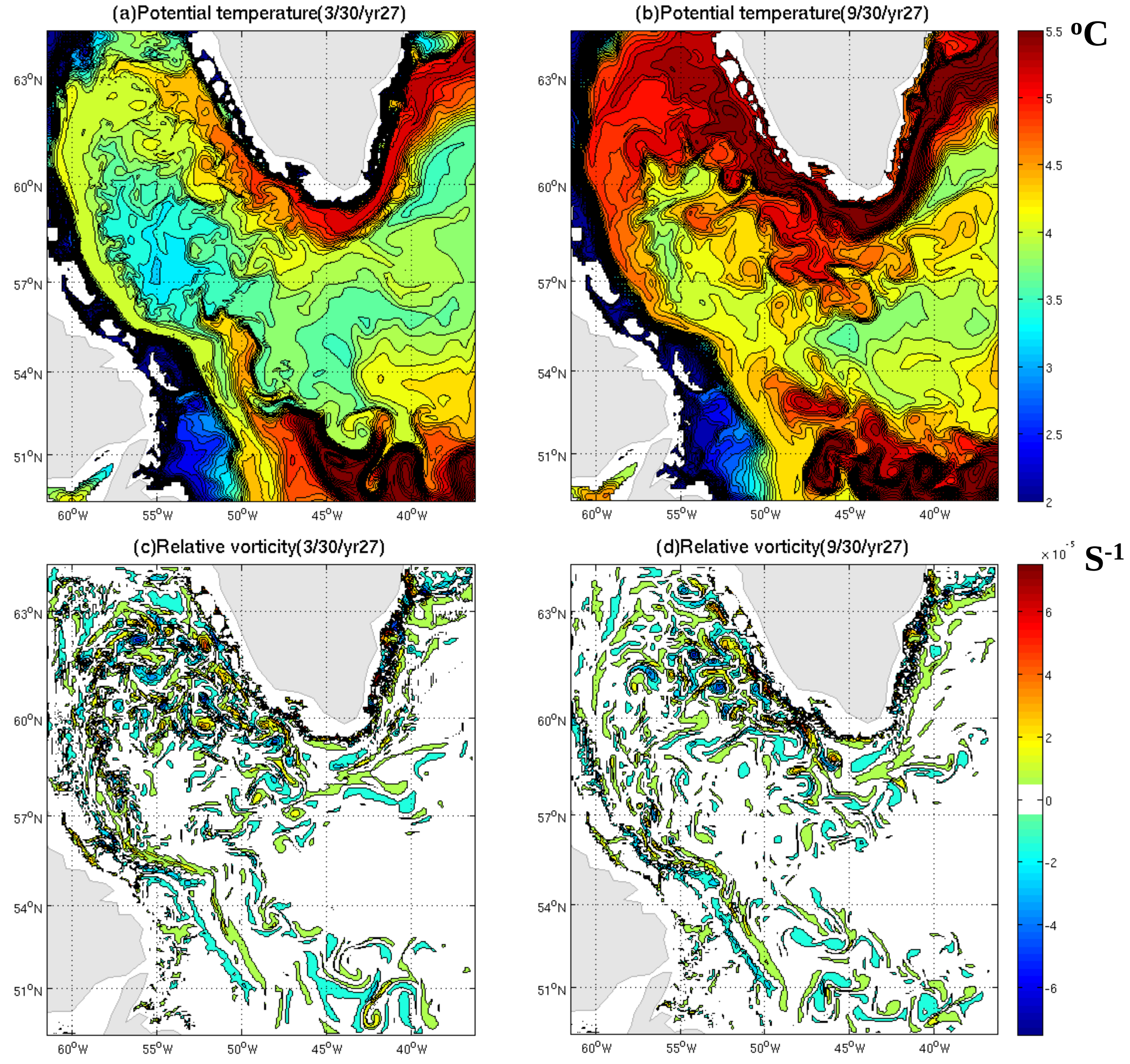


(Lilly et al., 2003)

(b) The **simulated** Surface Eddy Kinetic Energy



Snapshots: Winter vs. Summer



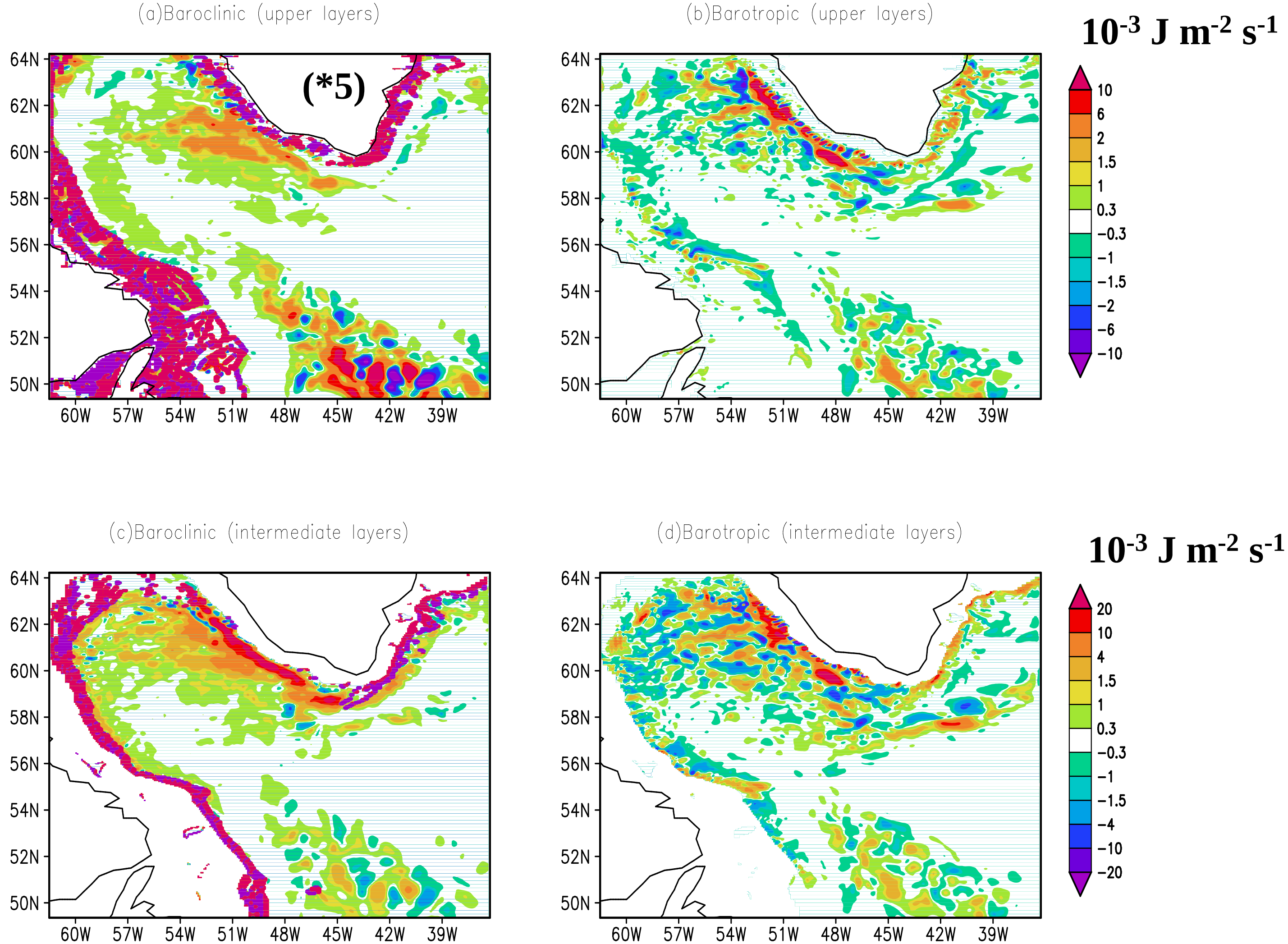
Baroclinic and Barotropic
Energy Transfer Rates

$$-\rho_0\left(\frac{g}{N\rho_0}\right)^2\left[u'\rho'\frac{\partial\tilde{\rho}}{\partial x}+v'\rho'\frac{\partial\tilde{\rho}}{\partial y}\right]$$

$$-\rho_0\left[u'u'\frac{\partial\tilde{u}}{\partial x}+u'v'\left(\frac{\partial\tilde{u}}{\partial y}+\frac{\partial\tilde{v}}{\partial x}\right)+v'v'\frac{\partial\tilde{v}}{\partial y}\right]$$

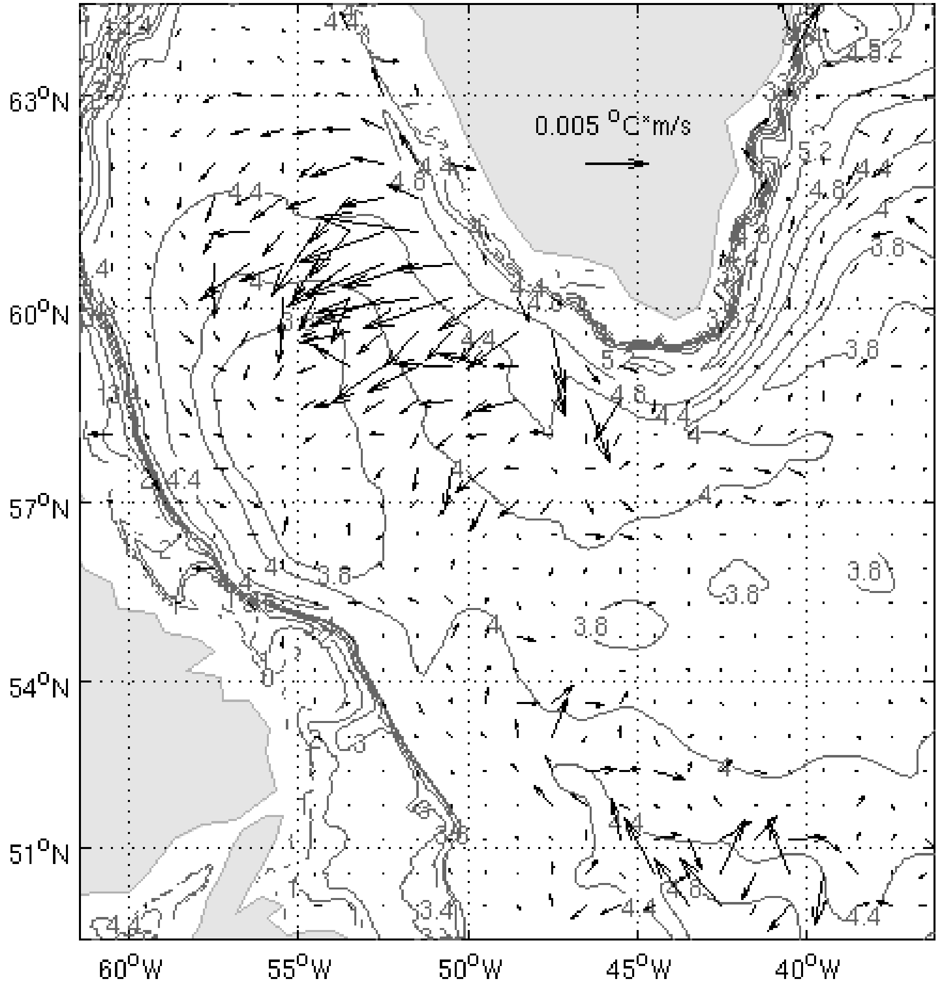
Upper Layers
(16m to 418m)

Intermediate Layers
(418m to 2008m)



Lateral Eddy Flux

(Vertically Averaged from 170 to 1210m)



Eddy Heat Flux (Vectors) & Mean Temperature (Contours)

Conclusion

- The lateral distribution of deep convection is misrepresented in the prognostic non-eddy-resolving models;
- The mechanism of IRs is mixed by barotropic and baroclinic instability;
- Lateral eddy flux is important for the lateral distribution of deep convection.