Understanding oceans
Sustaining our future

AMOC heat transport variability induced by mesoscale processes in the subpolar North Atlantic

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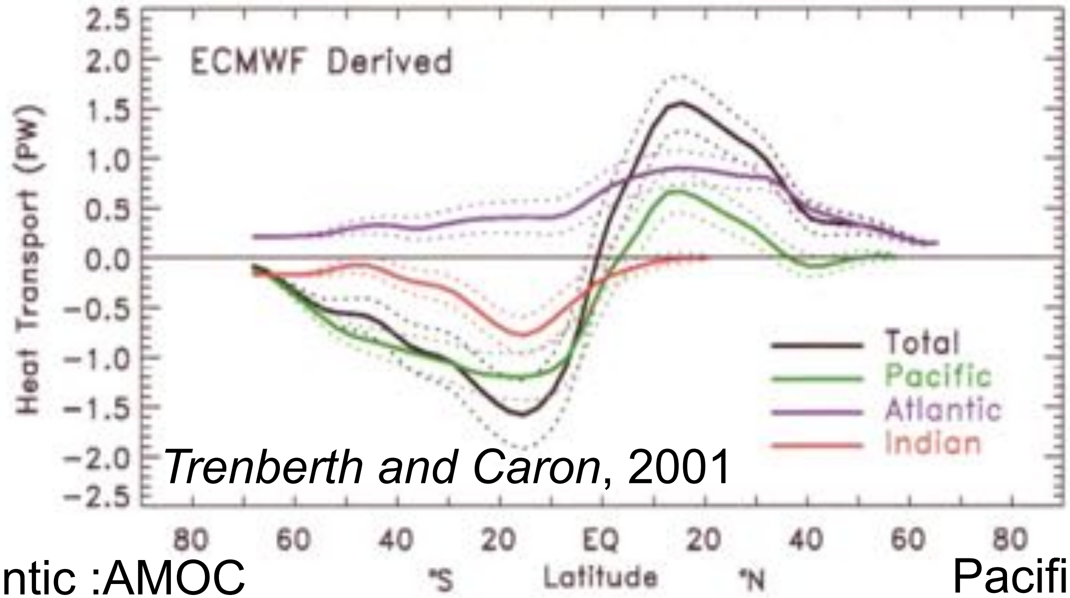
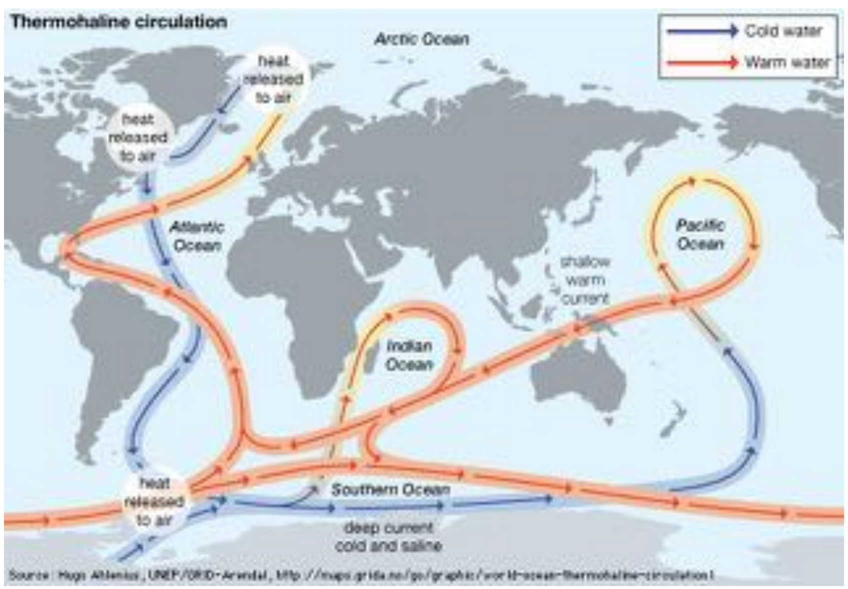
Ocean Meridional Heat Transport



Trenberth and Caron, 2001

Atlantic :AMOC
Thermohaline Circulation



Pacific : PMOC
Wind Driven Circulation

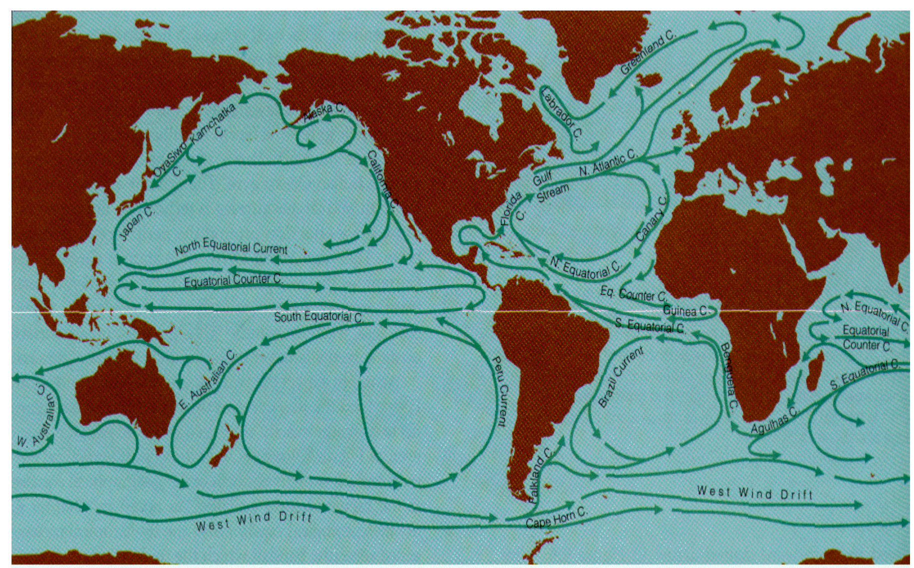
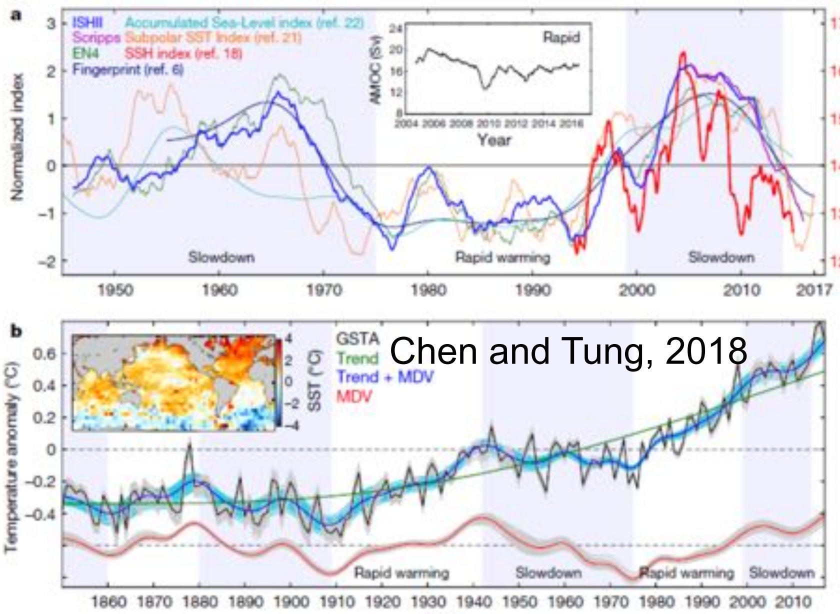
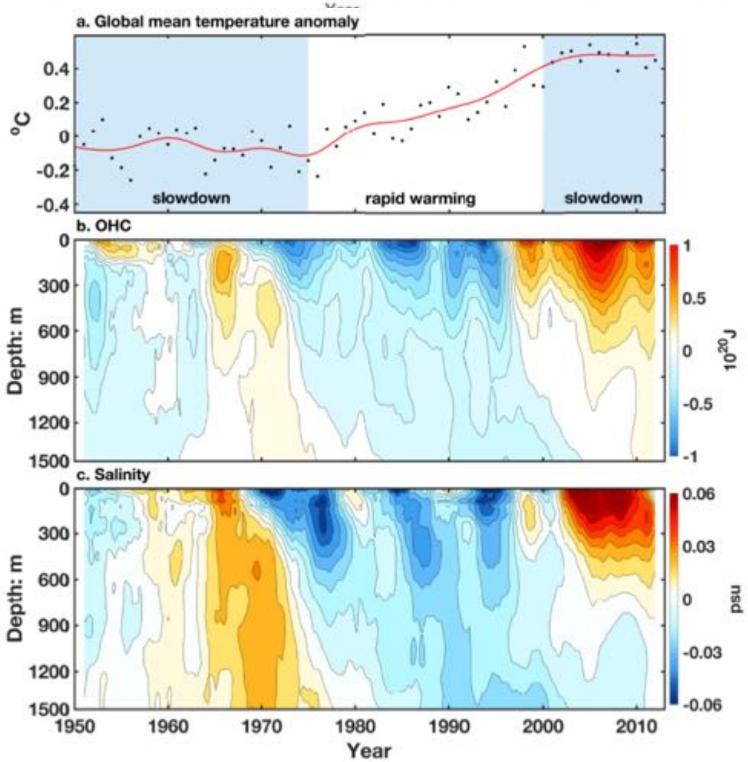


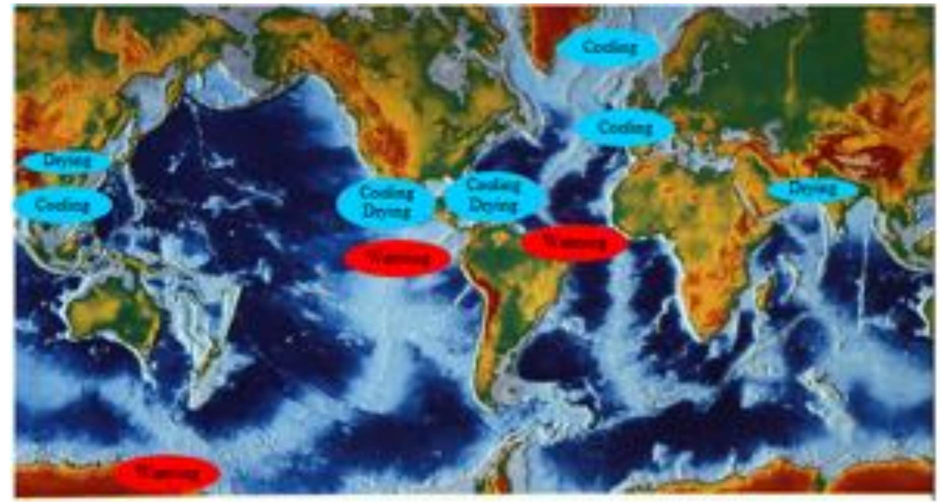
Figure 9.8 Major surface currents of the world ocean.

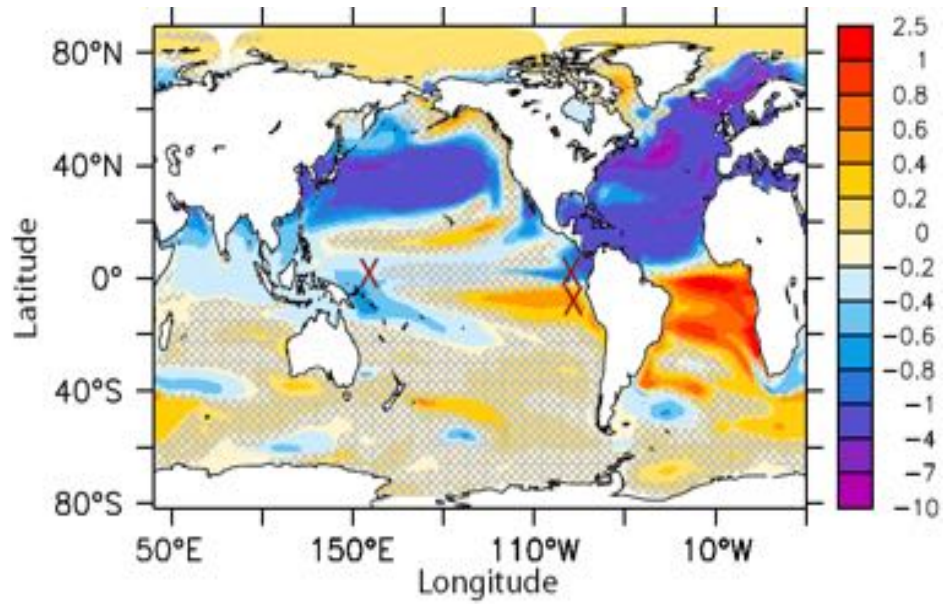
From fttp://global.britannica.com/science/thermohalinecirculation http://www4.ncsu.edu/eos/users/c/ceknowle/public/chapter07/part1.html



Chen and Tung, 2018







Zhang and Delworth, 2005

Teleconnection Via Atmospheric and Oceanic Bridges

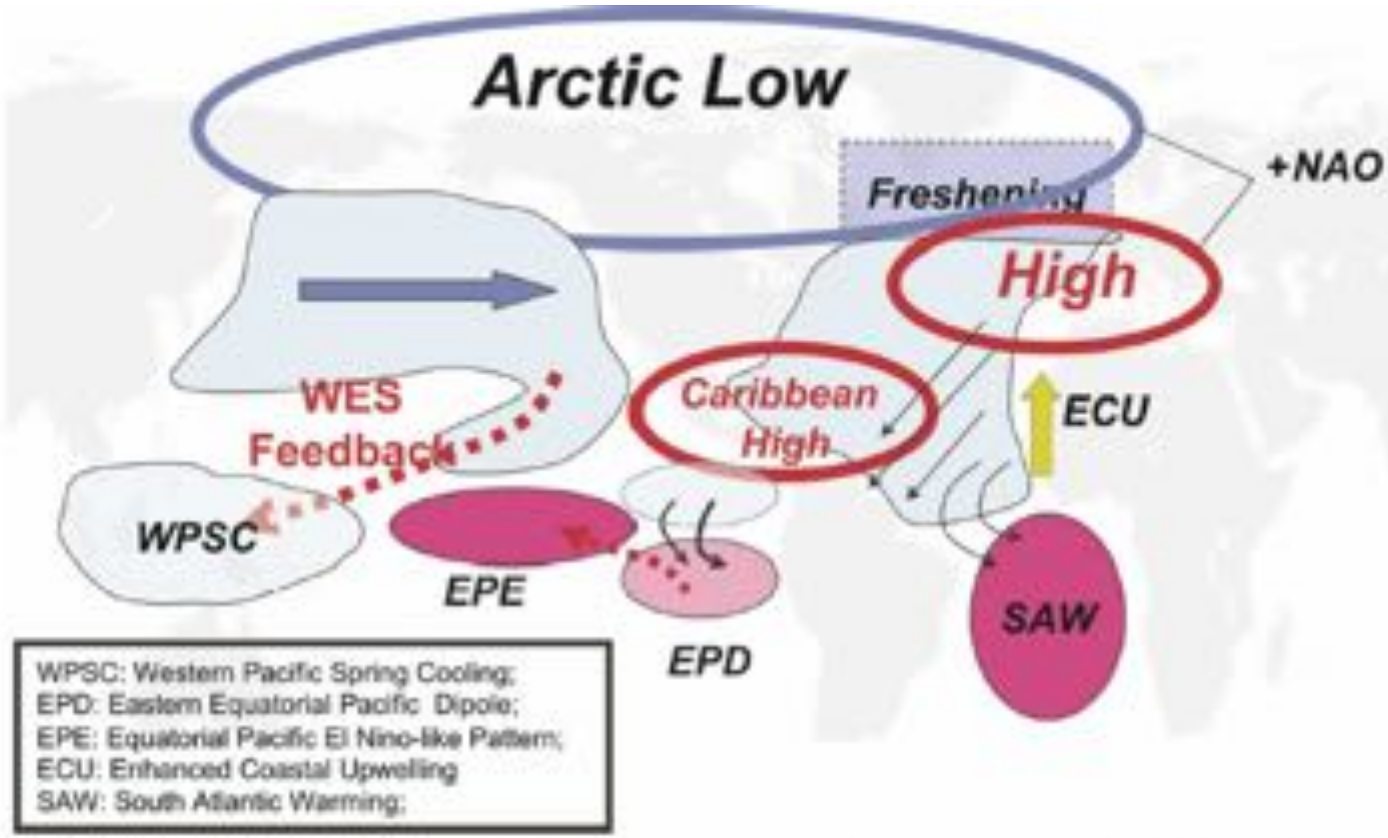
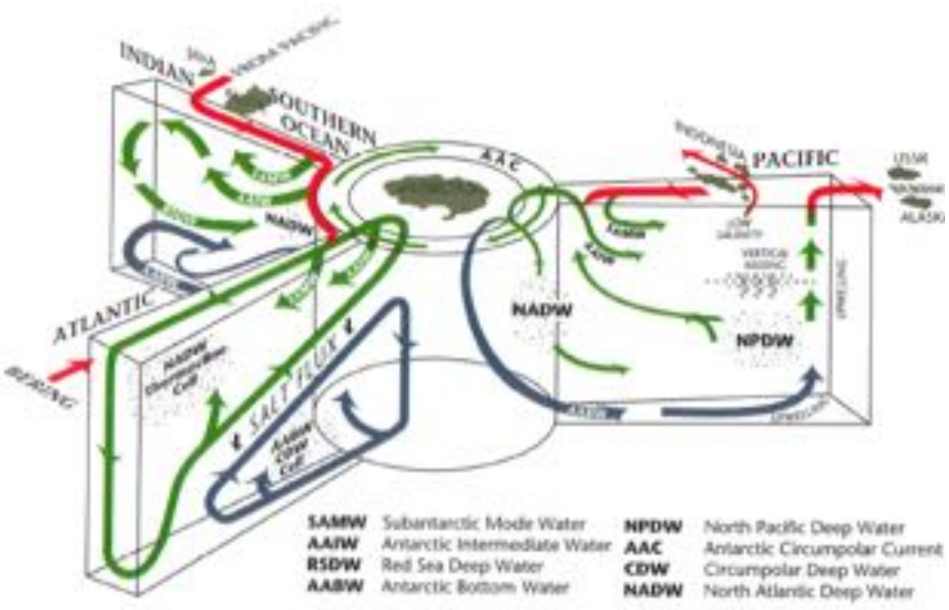
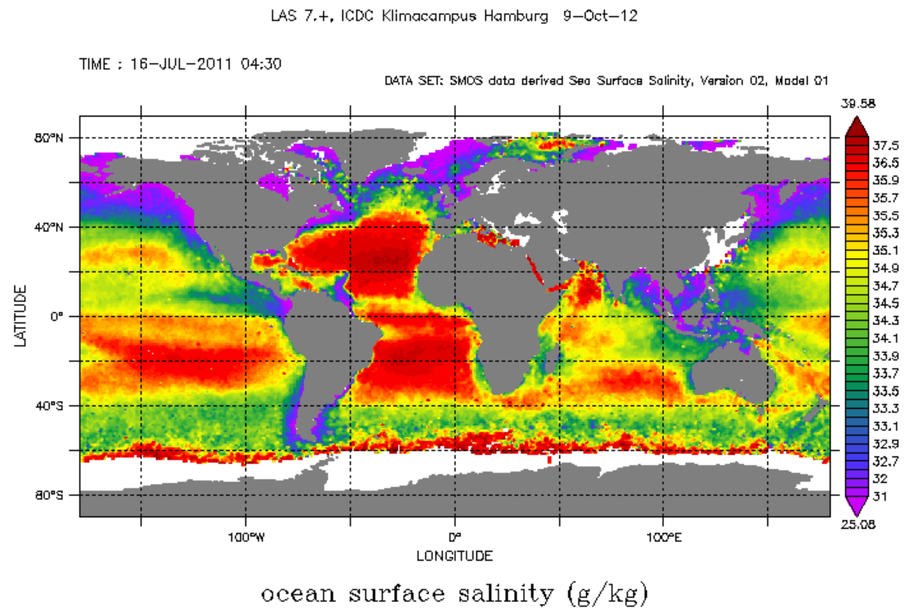
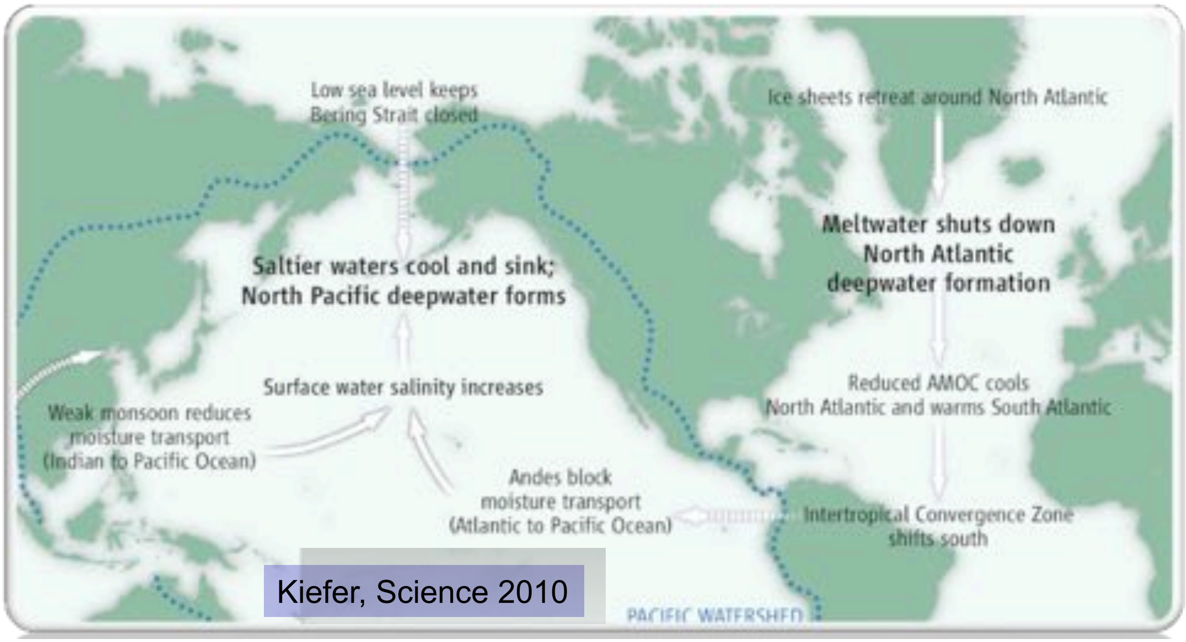


FIG. 13. Schematic diagram of global teleconnections in response to AMOC shutdown.

Zhang et al., 2005; Wu et al., 2008; Sun et al., 2017







Kiefer, Science 2010

Climate Models Show:

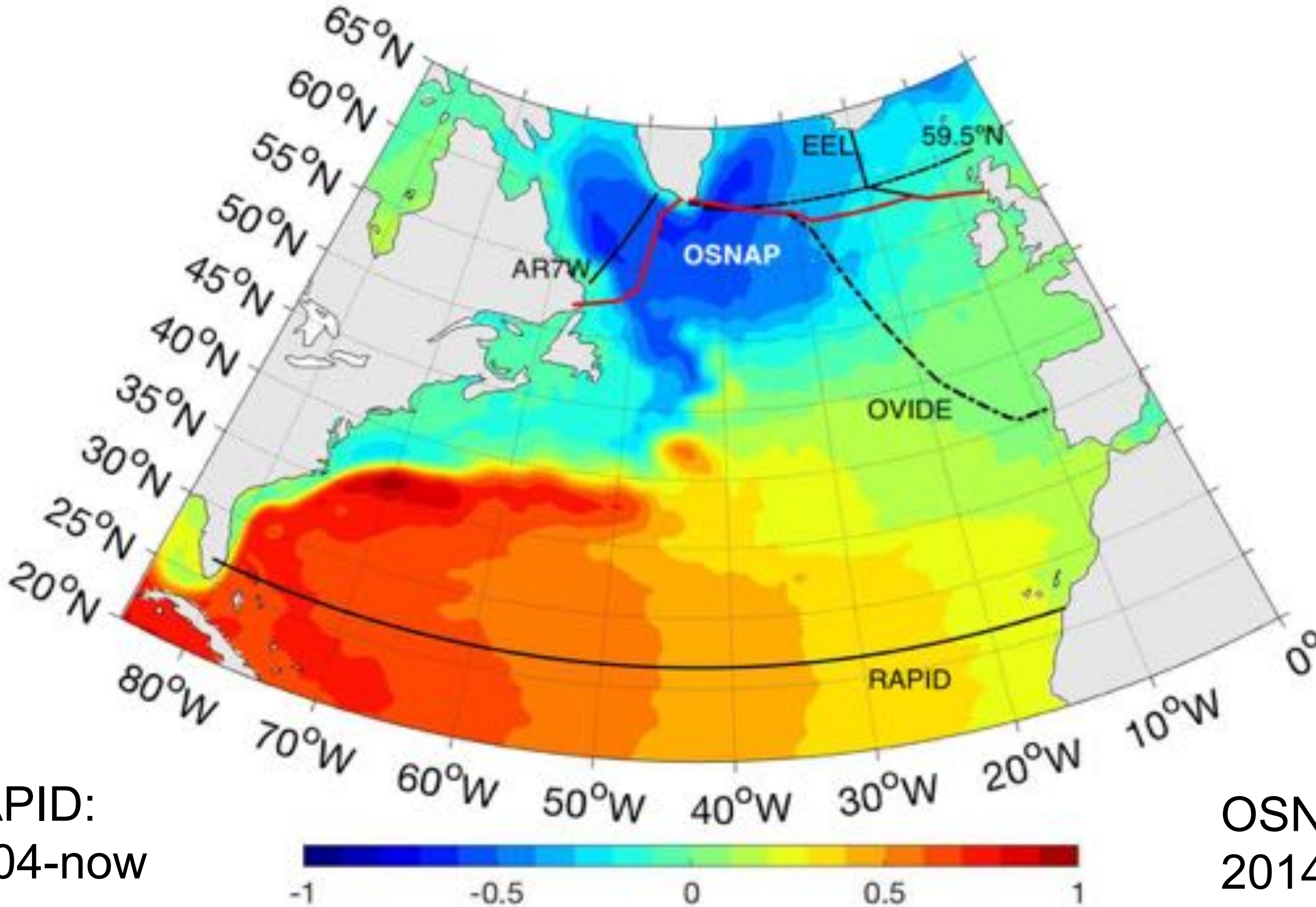
AMOC due to deep convection in Labrador Sea

Ice melting will reduce AMOC

AMOC Variability

RAPID Climate Change - Atlantic Meridional Overturning Circulation (RAPID 26.5N)

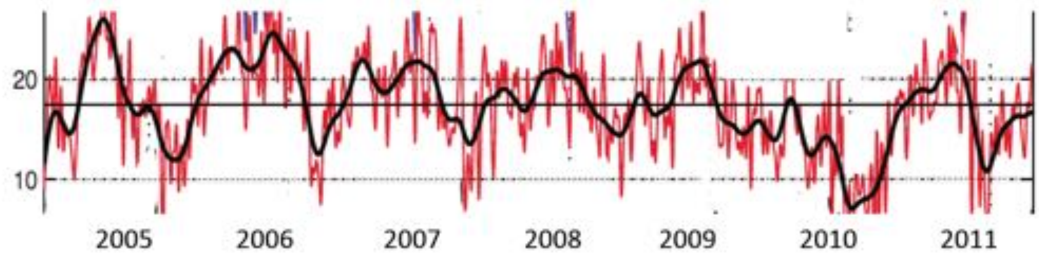
Overturning Circulation in the North Subpolar North Atlantic (OSNAP 55N）



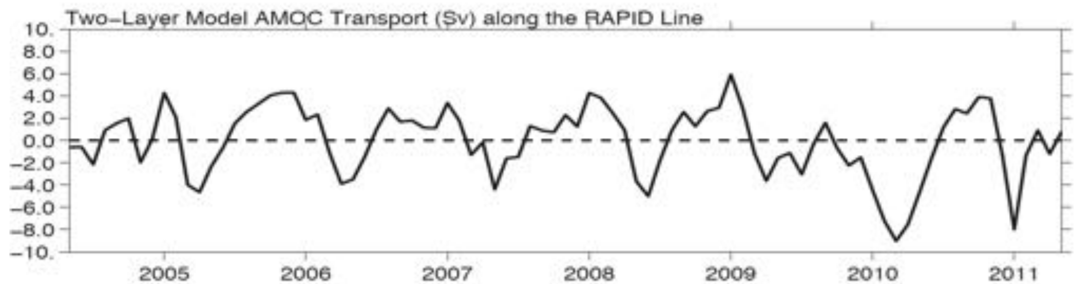
RAPID:
2004-now

OSNAP:
2014-now

AMOC in RAPID Observation

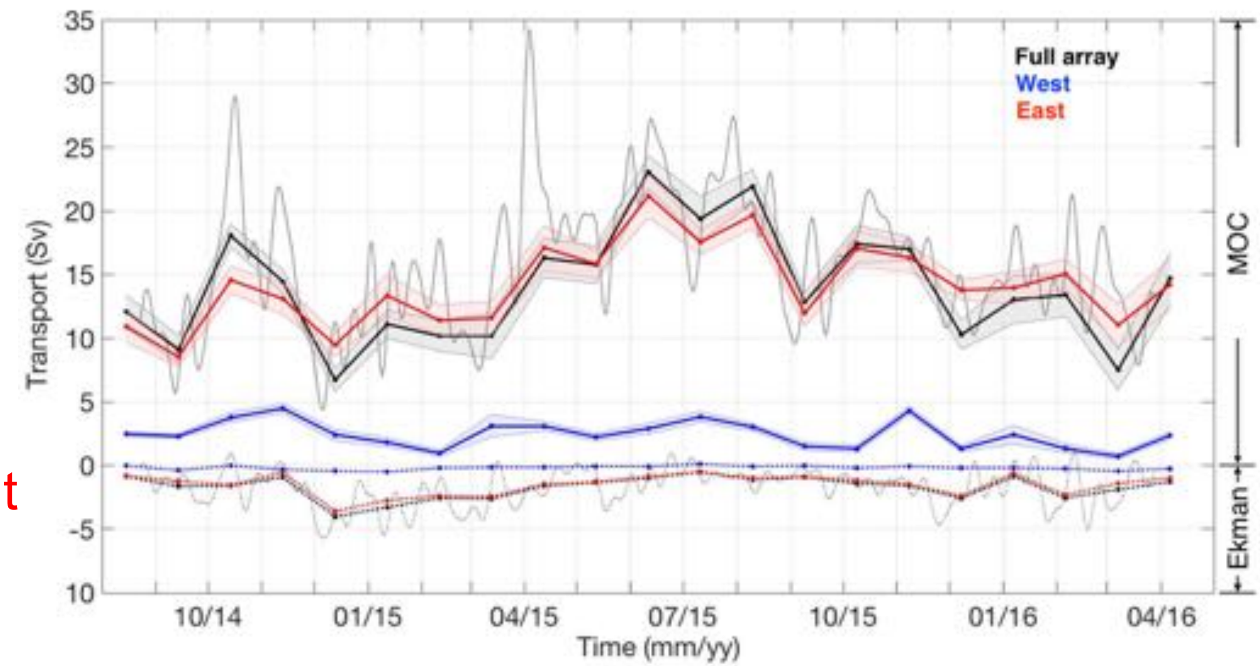


Wind Driven Ocean Two-Layer Model



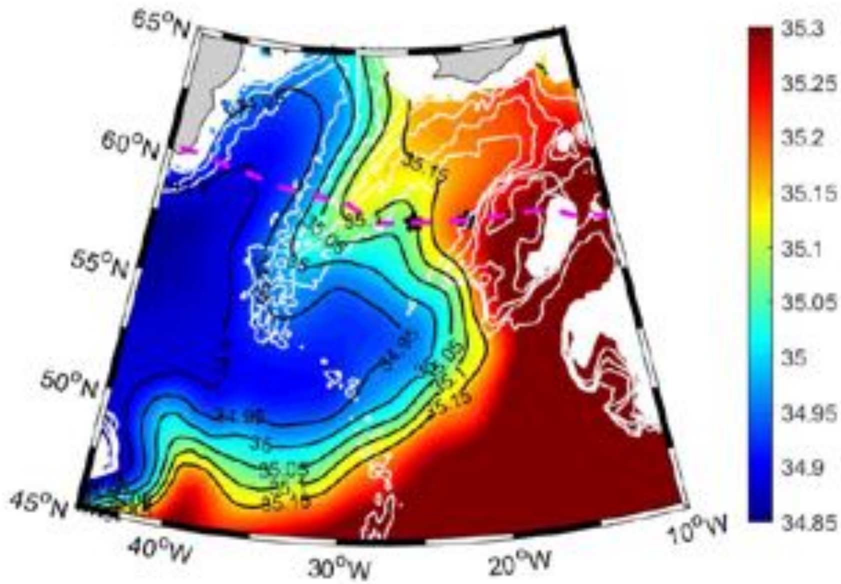
AMOC change in RAPID is due to wind

AMOC in OSNAP

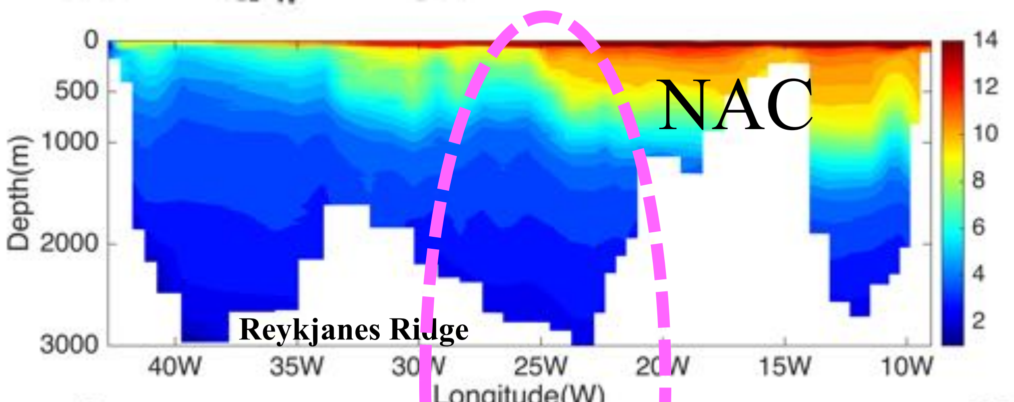


Deep convection in Labrador Sea is not important

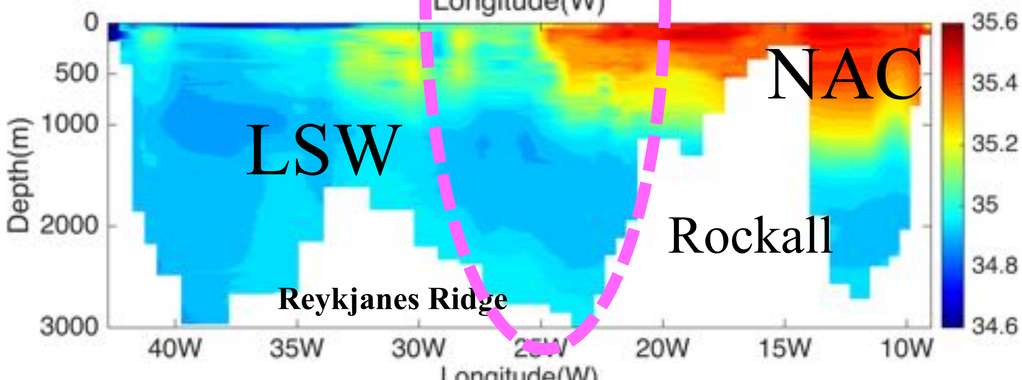
Overflow is dominant



Salinity at 500m
WOD 2013

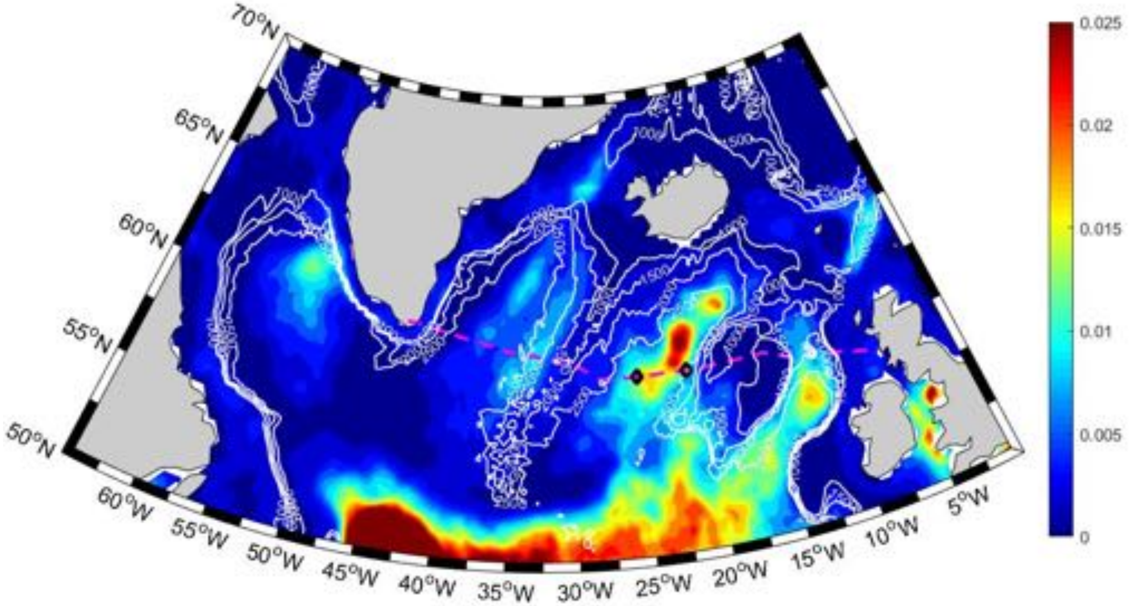


Temperature

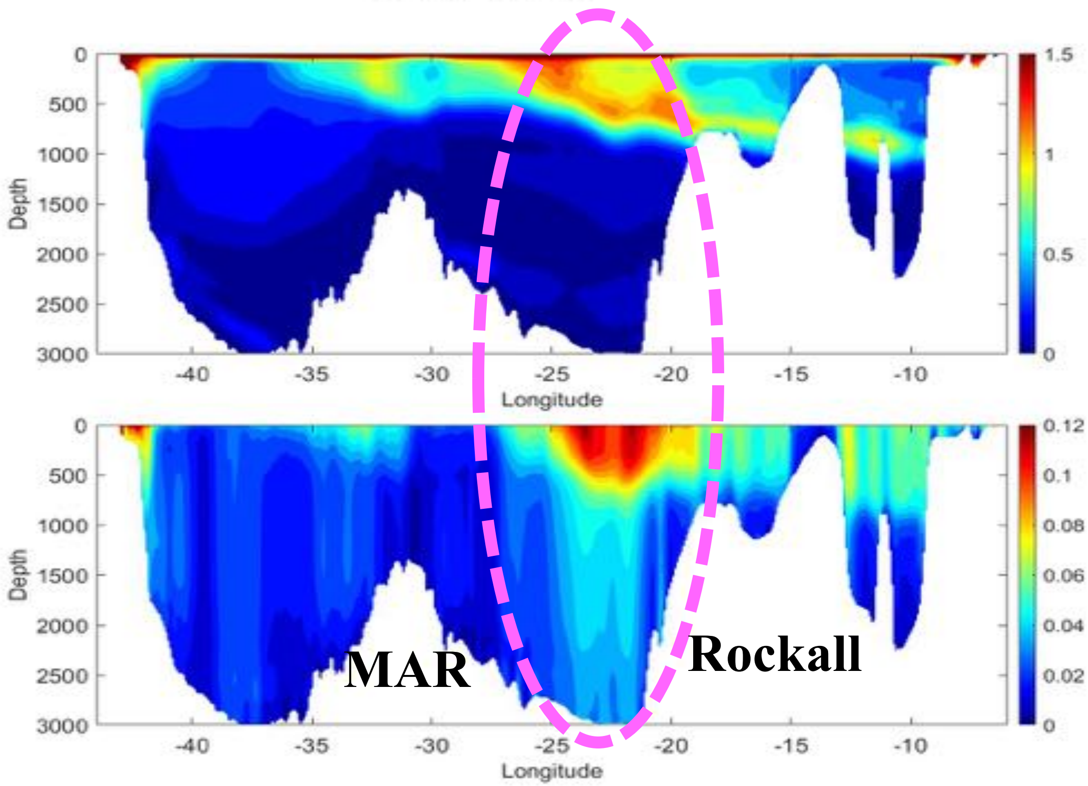


Salinity

OSNAP 2014 cruise
Penny Holliday
(NOC, UK)

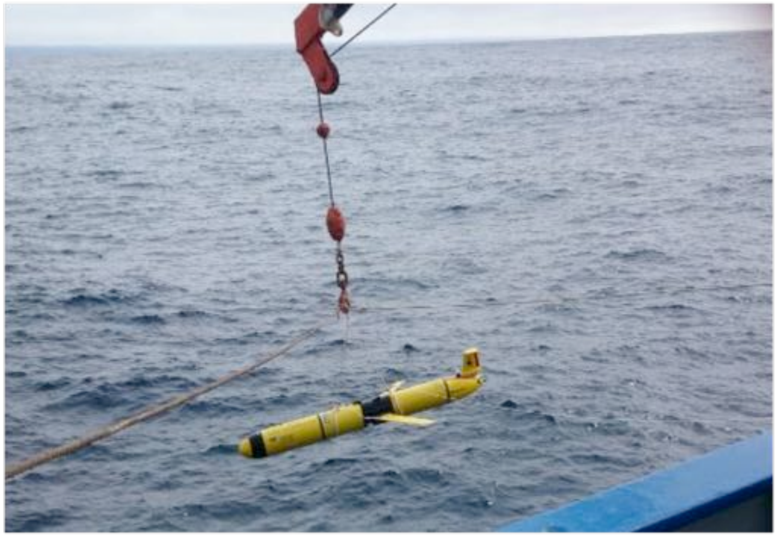


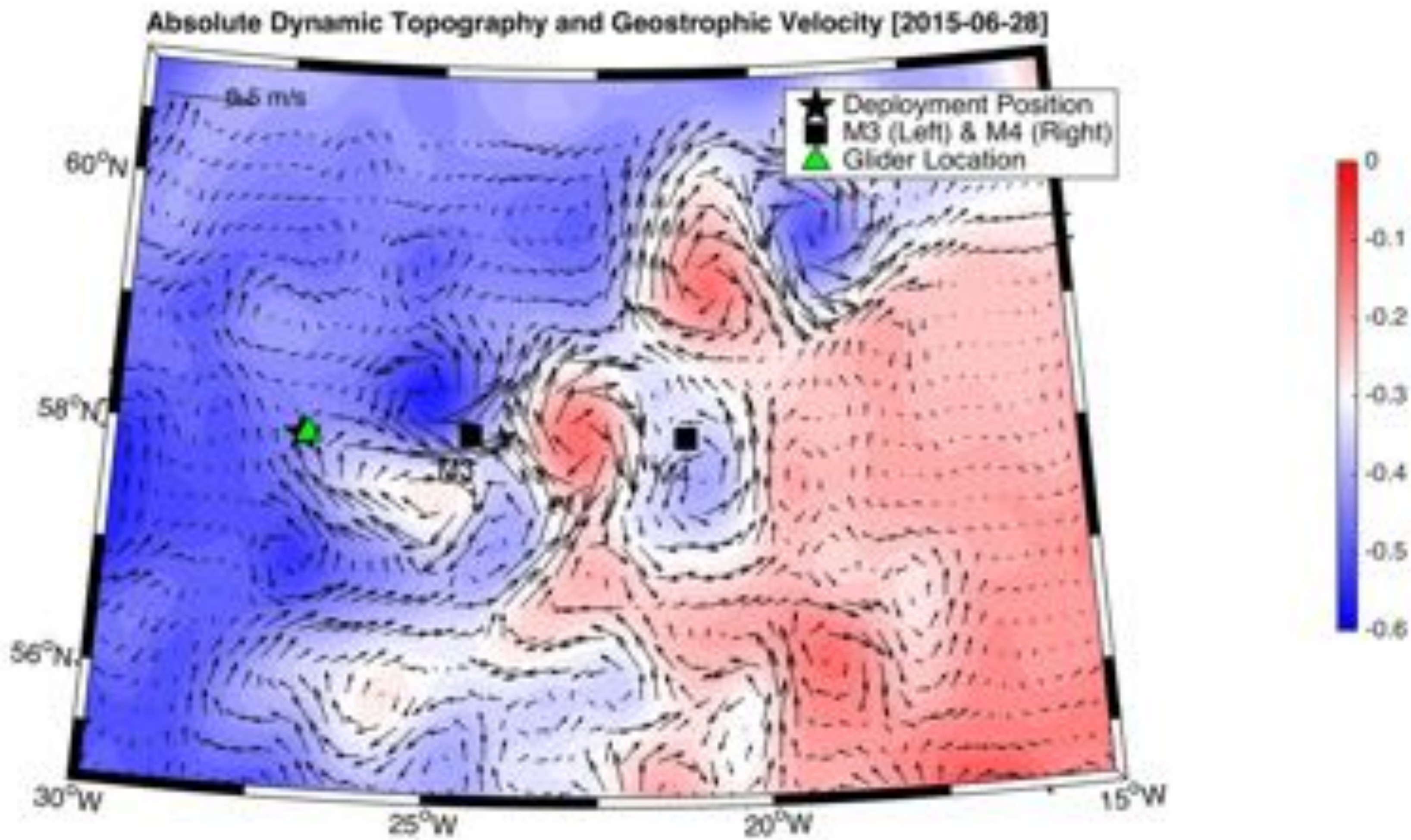
Surface geostrophic EKE

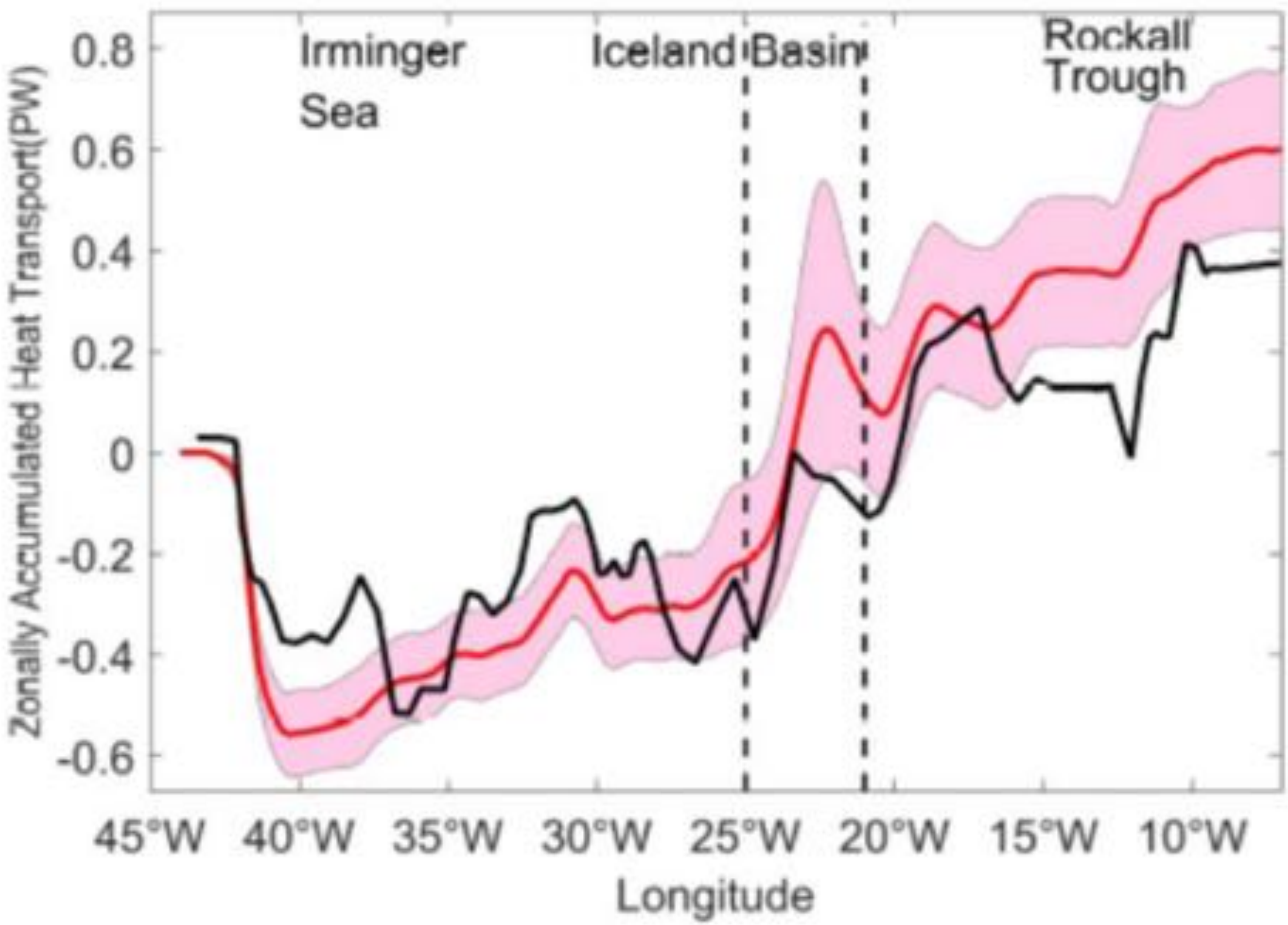


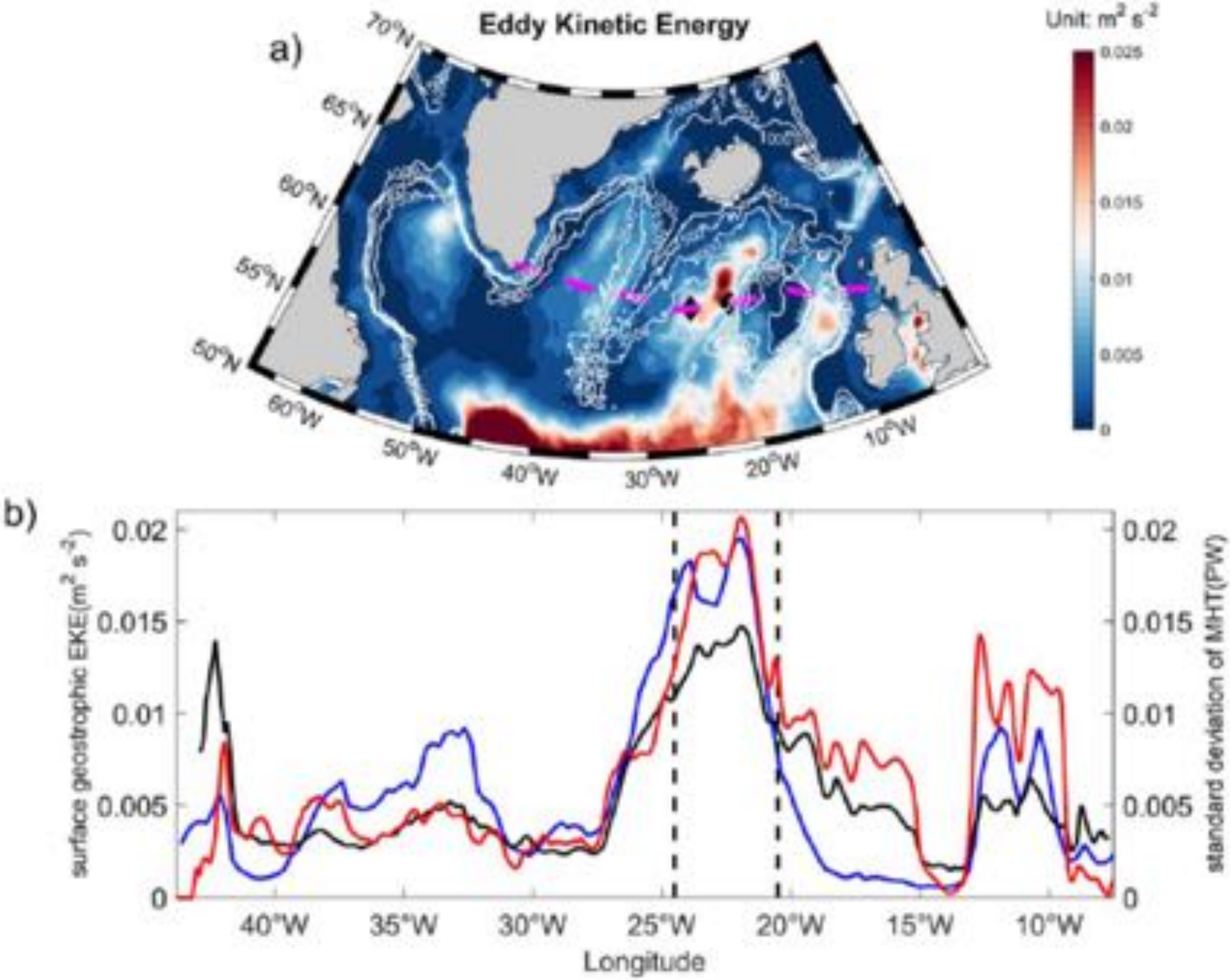
Temperature
standard deviation

Velocity
standard deviation

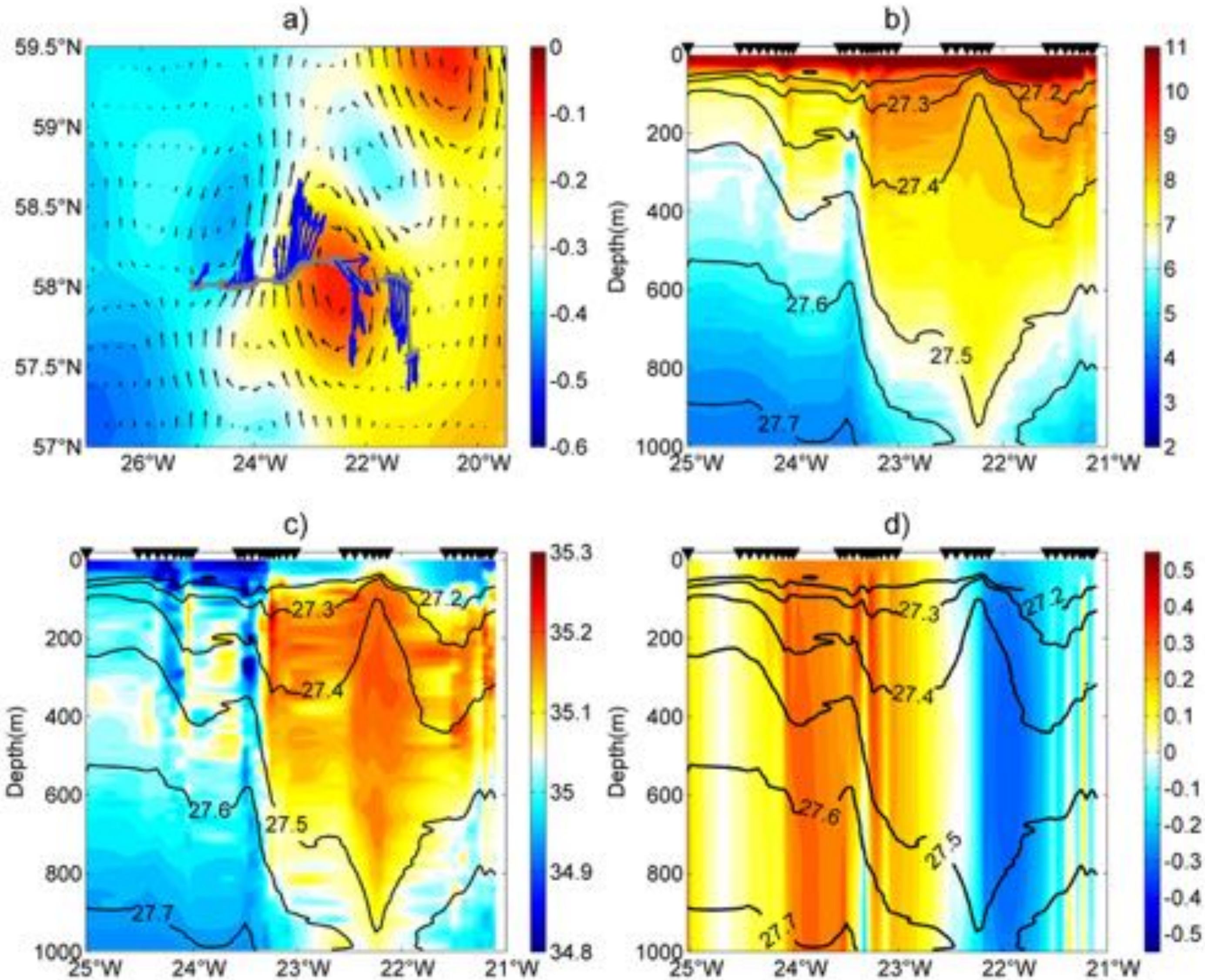



Absolute Dynamic Topography and Geostrophic Velocity [2015-06-28]
0.5 m/s
Deployment Position
M3 (Left) & M4 (Right)
Glider Location
60°N
58°N
56°N
30°W
25°W
20°W
15°W
M3
M4
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6


Irminger
Sea
Iceland Basin
Rockall
Trough
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
Zonally Accumulated Heat Transport(PW)
45°W
40°W
35°W
30°W
25°W
20°W
15°W
10°W
Longitude

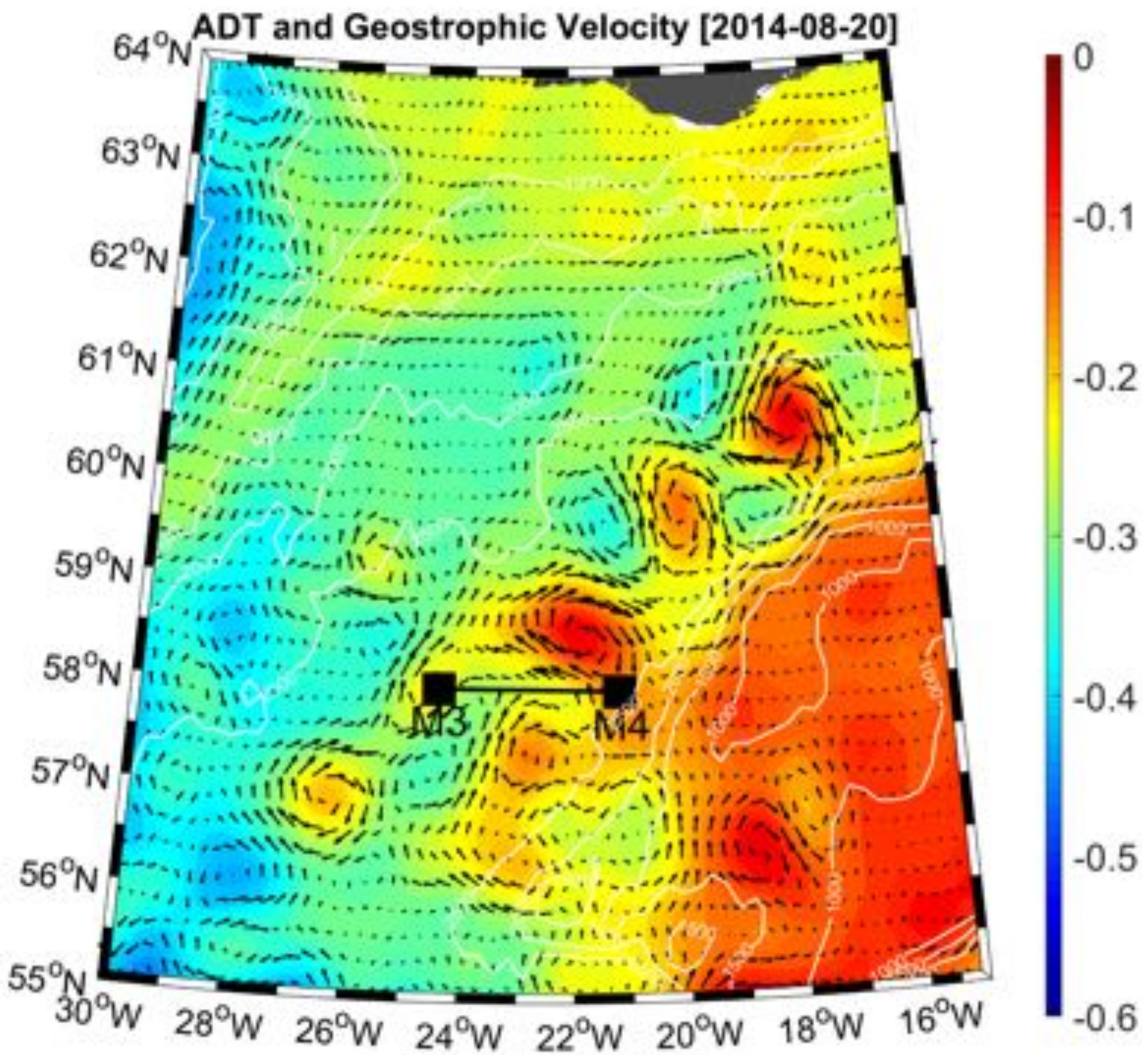


a)
Eddy Kinetic Energy
Unit: m² s⁻²
0.025
0.02
0.015
0.01
0.005
0
70°N
65°N
60°N
55°N
50°N
60°W
50°W
40°W
30°W
20°W
10°W
b)
surface geostrophic EKE(m² s⁻²)
standard deviation of MHT(PW)
0.02
0.015
0.01
0.005
0
40°W
35°W
30°W
25°W
20°W
15°W
10°W
Longitude

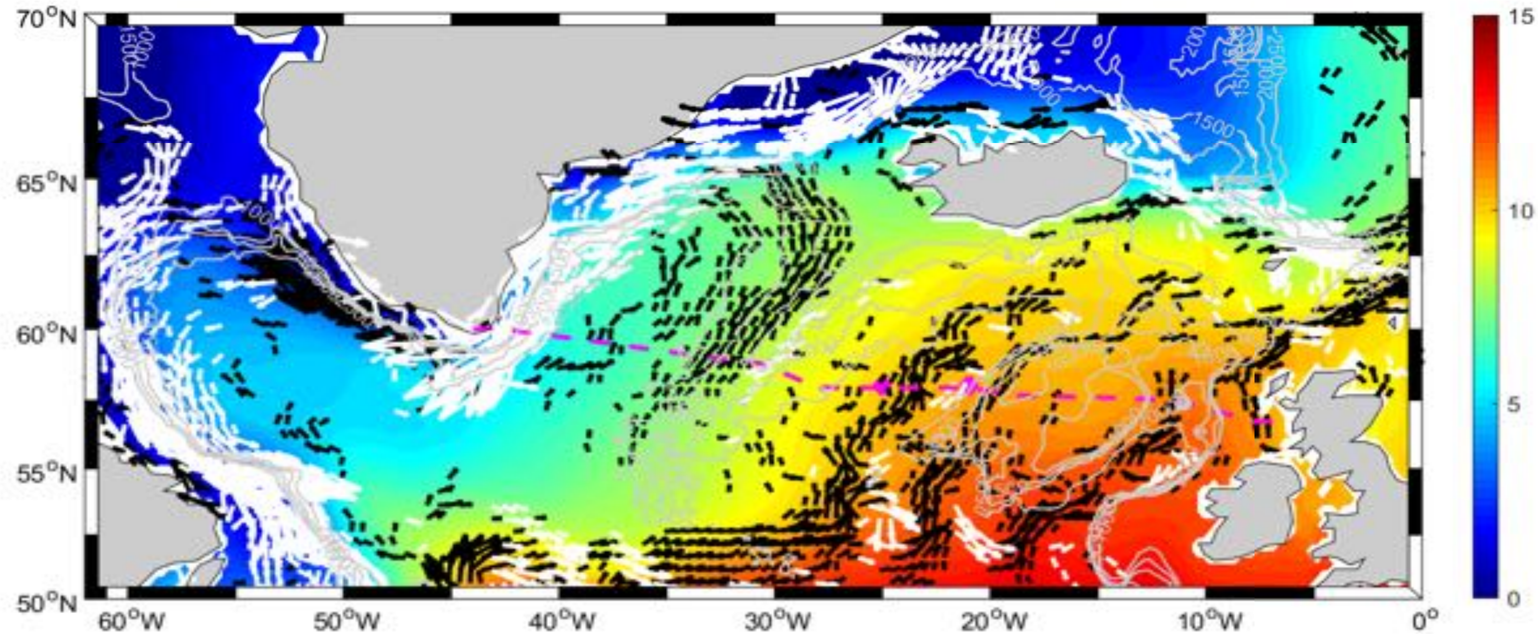


a)
b)
c)
d)
59.5°N
59°N
58.5°N
58°N
57.5°N
57°N
26°W
24°W
22°W
20°W
Depth(m)
25°W
23°W
21°W
27.2
27.3
27.4
27.5
27.6
27.7

Eddy affects the circulation in the Iceland Basin



Summary



Standard deviation

0.13PW

West of IB (0.09PW)

IB(0.11PW)

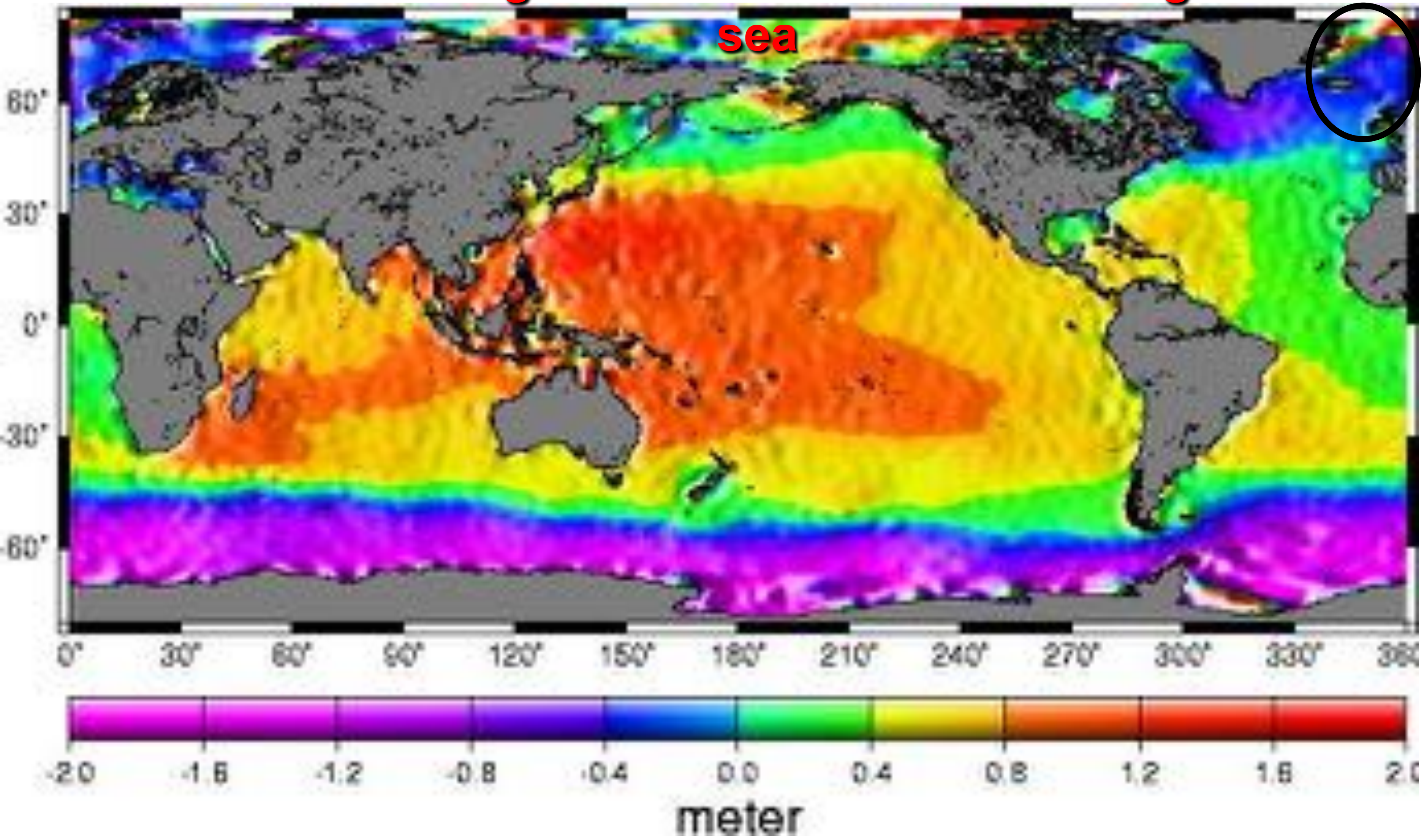
East of IB (0.10PW)

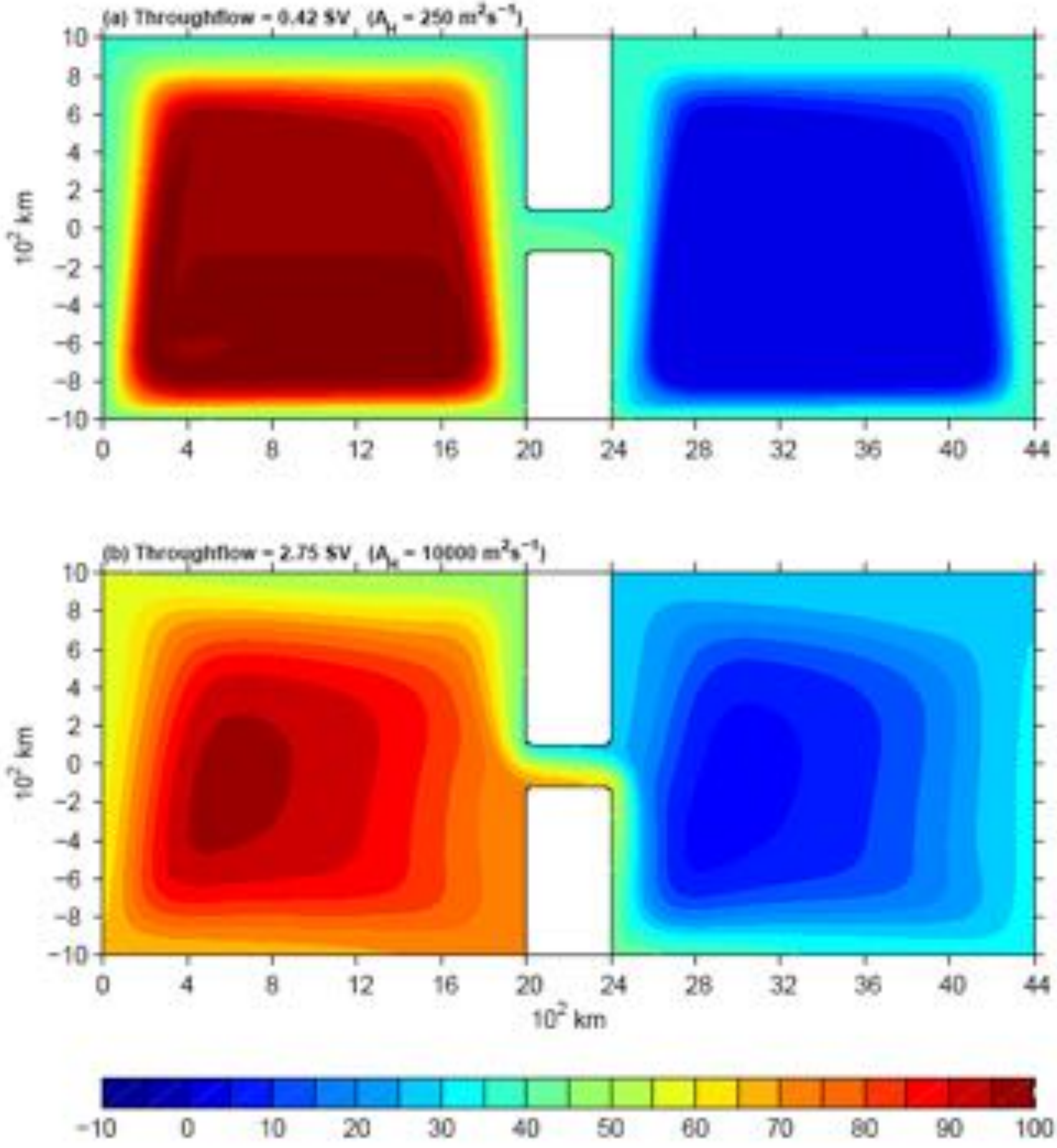
Large (0.09PW)

Mesoscale (0.06PW)

Sea Surface Height

There is enough dense water in the Norwegian sea





Yang and Price, JPO, 2008

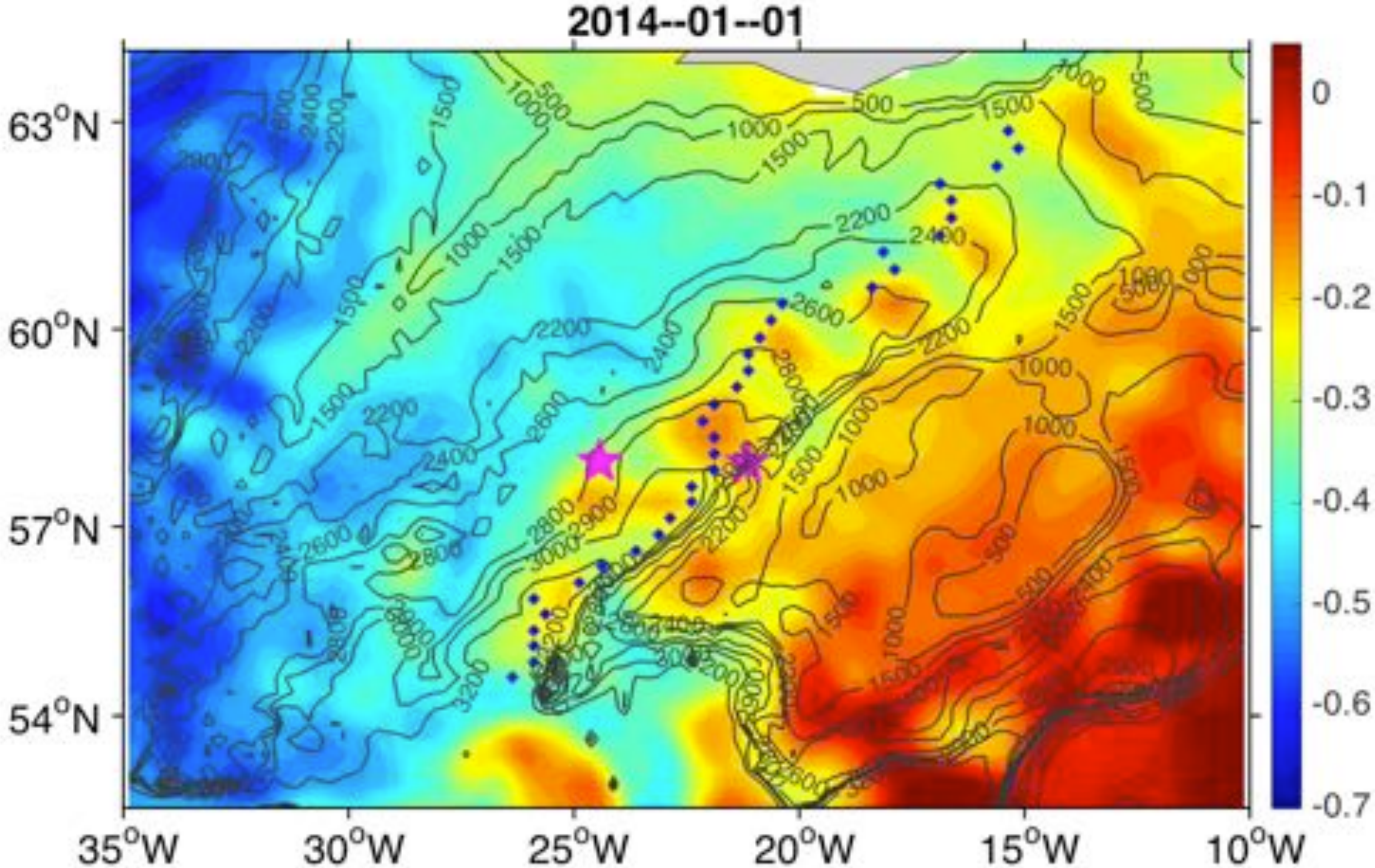
A greater A_H *results in greater throughflow.*

Friction determine the transport between the two basin.

Friction is caused by eddies in the real ocean.

Spall, 2011

absolute dynamic topography



Oceanic Eddies may be important to modulate AMOC in longer time scale

Thank You!