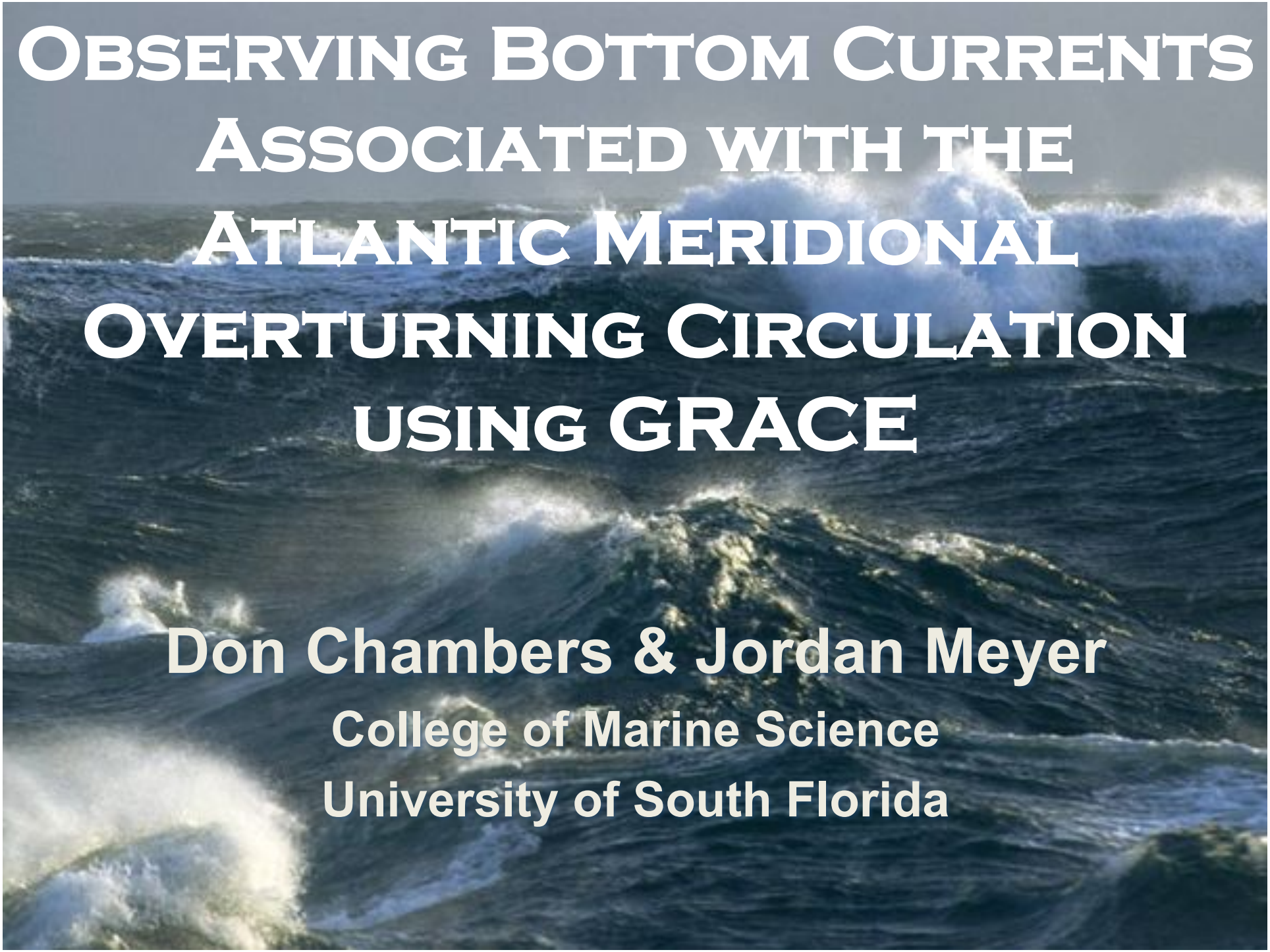

Observing Bottom Currents Associated with the Atlantic Meridional Overturning Circulation using GRACE

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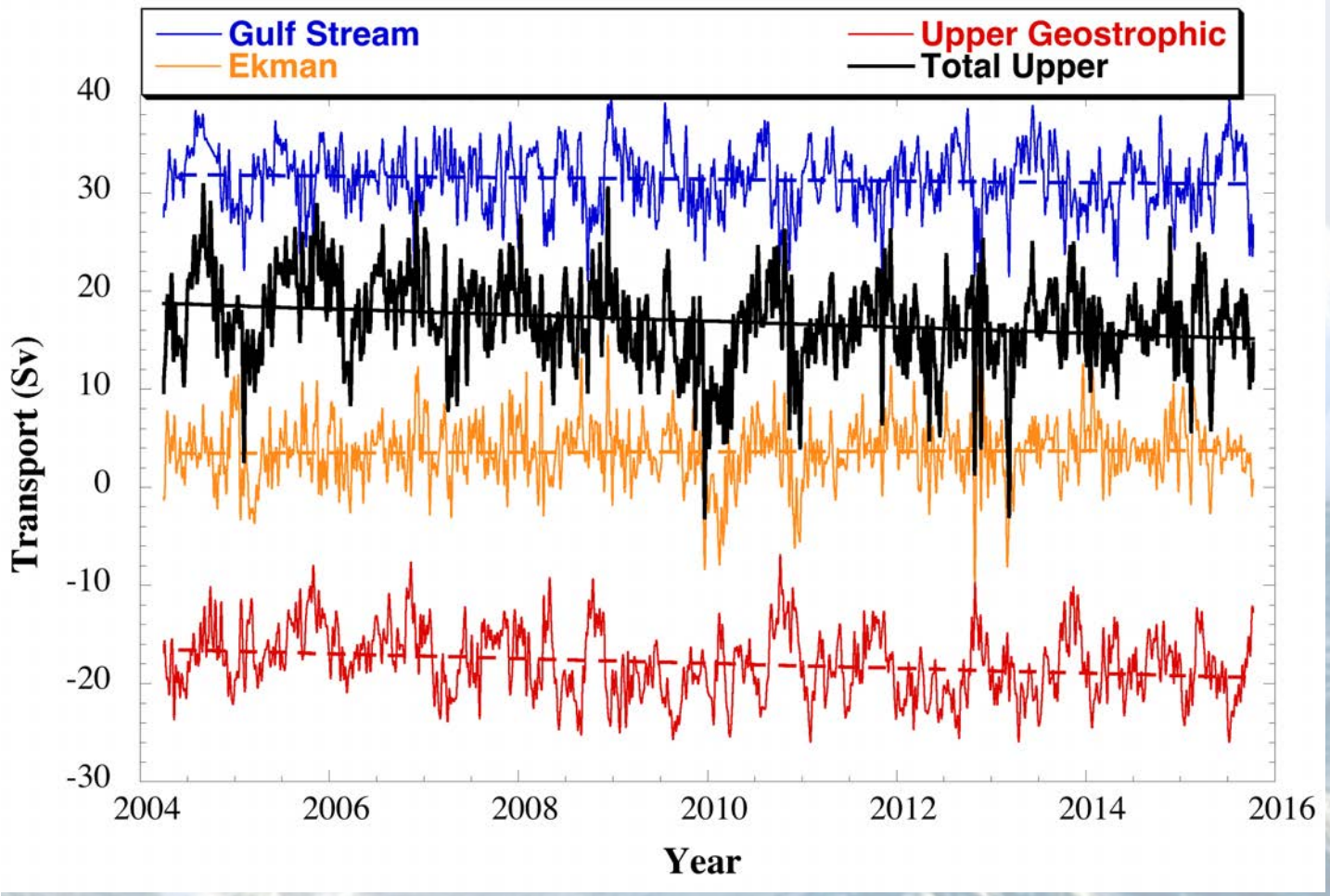


-0.8 ± 0.2 Sv/decade

-3.1 ± 0.2 Sv/decade

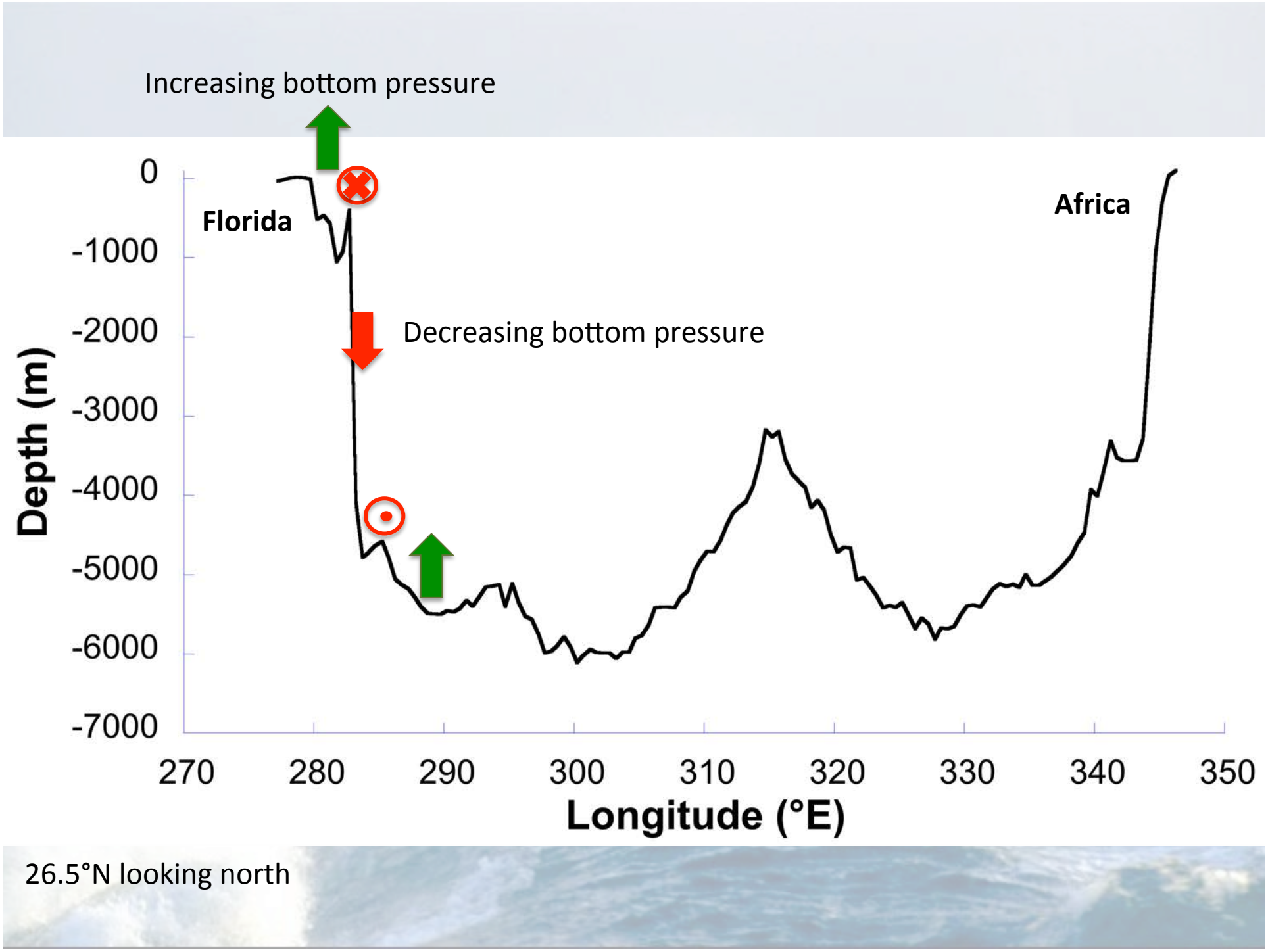
0.3± 0.2 Sv/decade

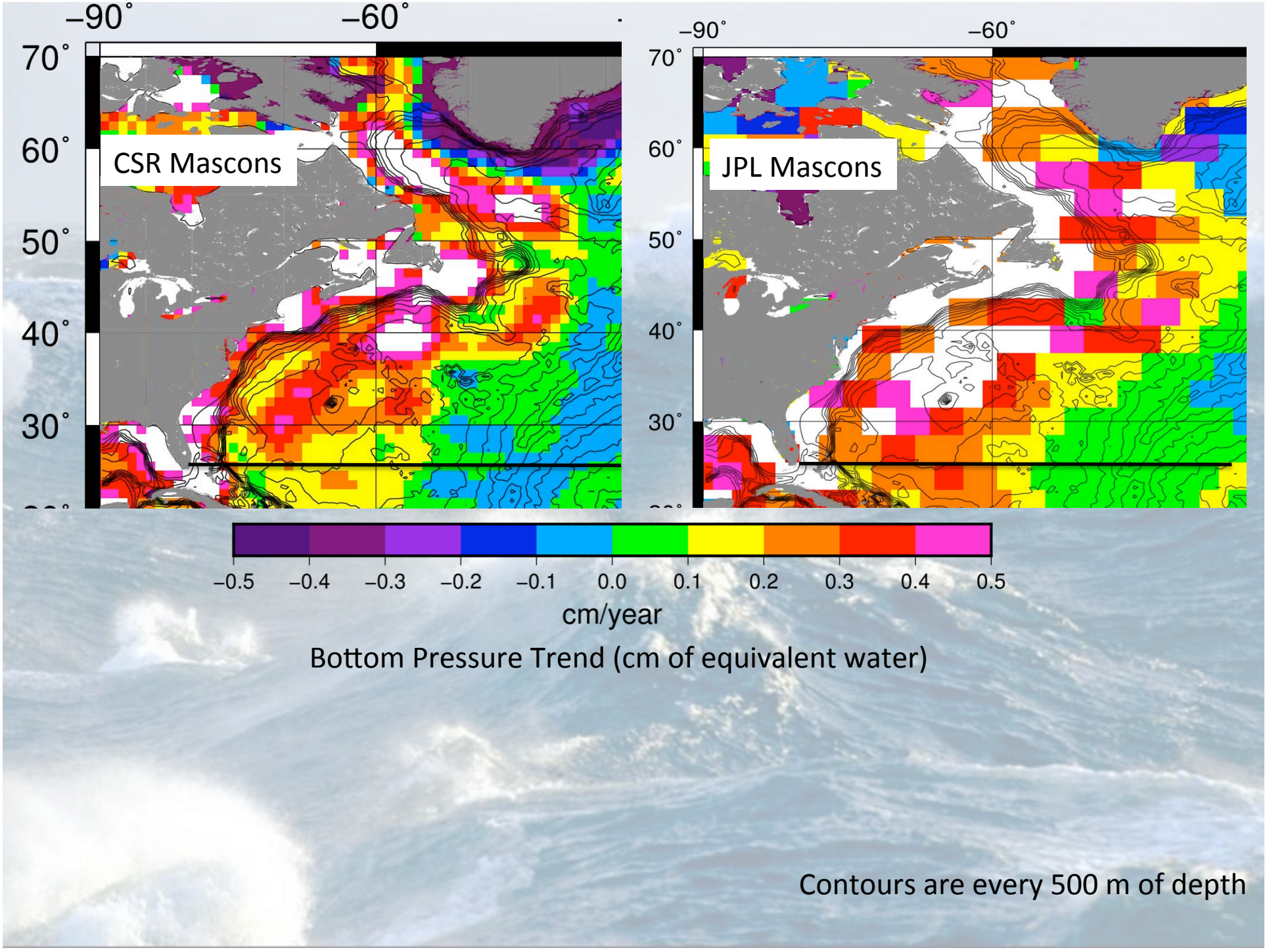
-2.5 ± 0.2 Sv/decade

(90% confidence)

From RAPID-MOCHA project

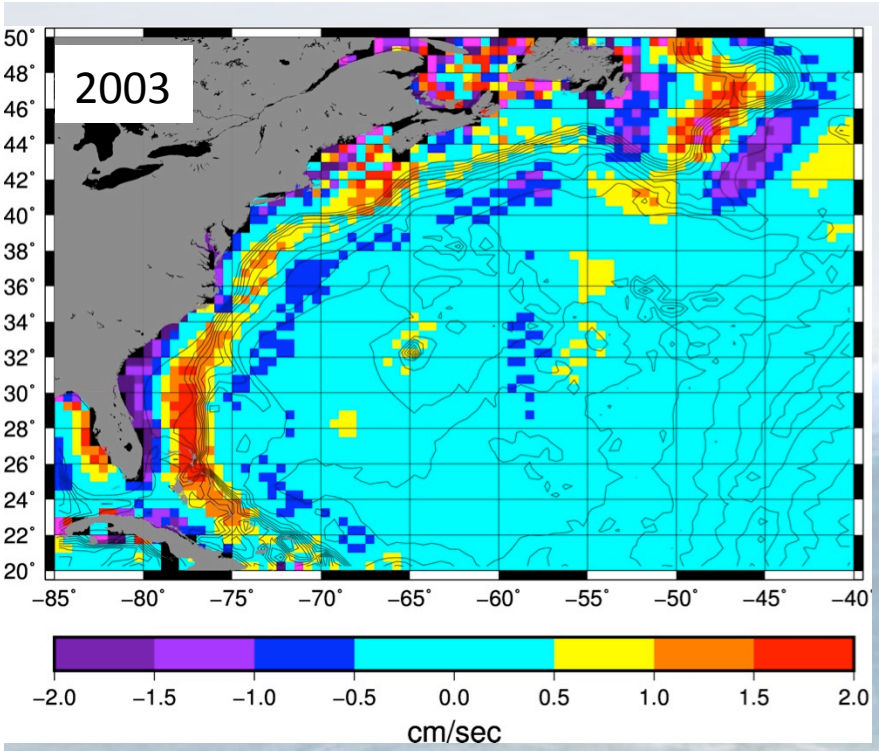
1 Sv = 10^6 m^3 s^{-1}

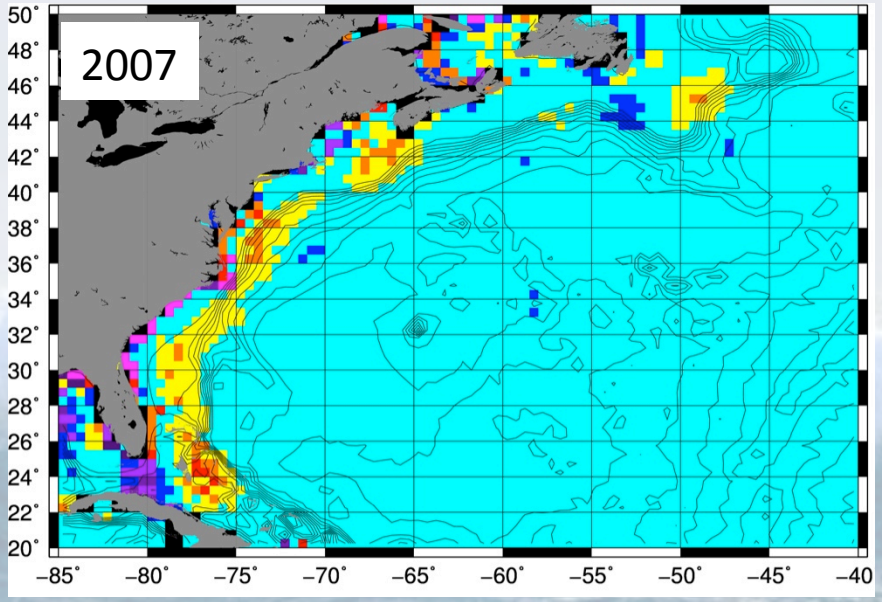

Increasing bottom pressure
Florida
Africa
Decreasing bottom pressure
Depth (m)
0
-1000
-2000
-3000
-4000
-5000
-6000
-7000
270
280
290
300
310
320
330
340
350
Longitude (°E)
26.5°N looking north



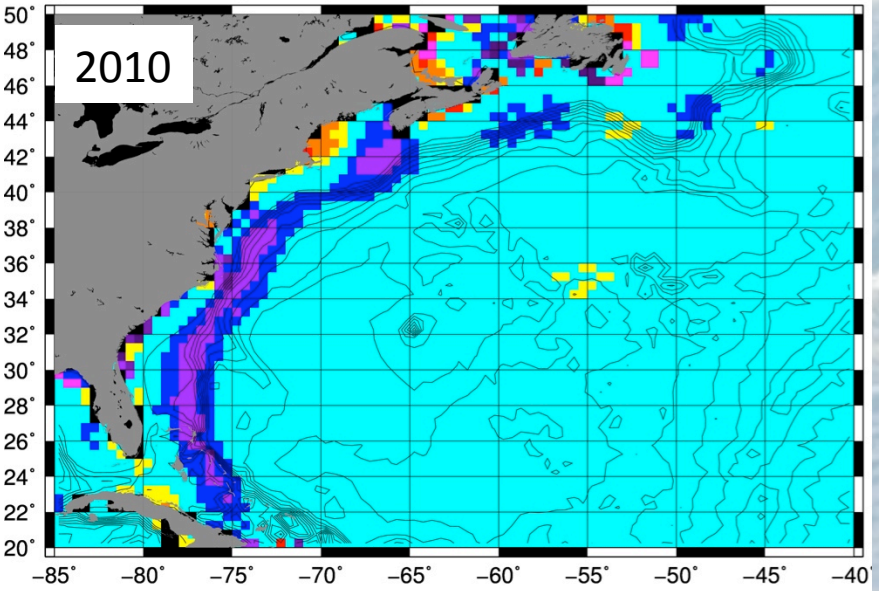
Bottom Pressure Trend (cm of equivalent water)

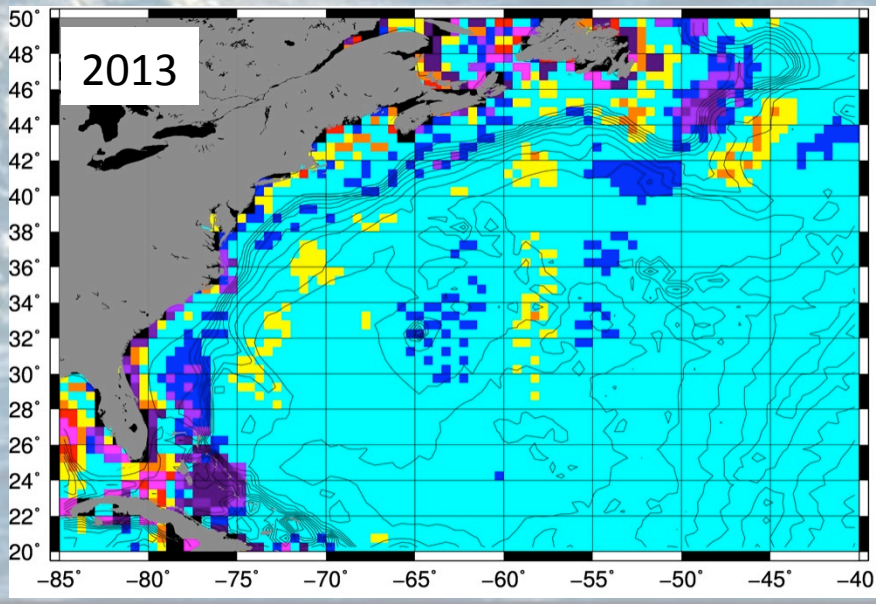
Contours are every 500 m of depth

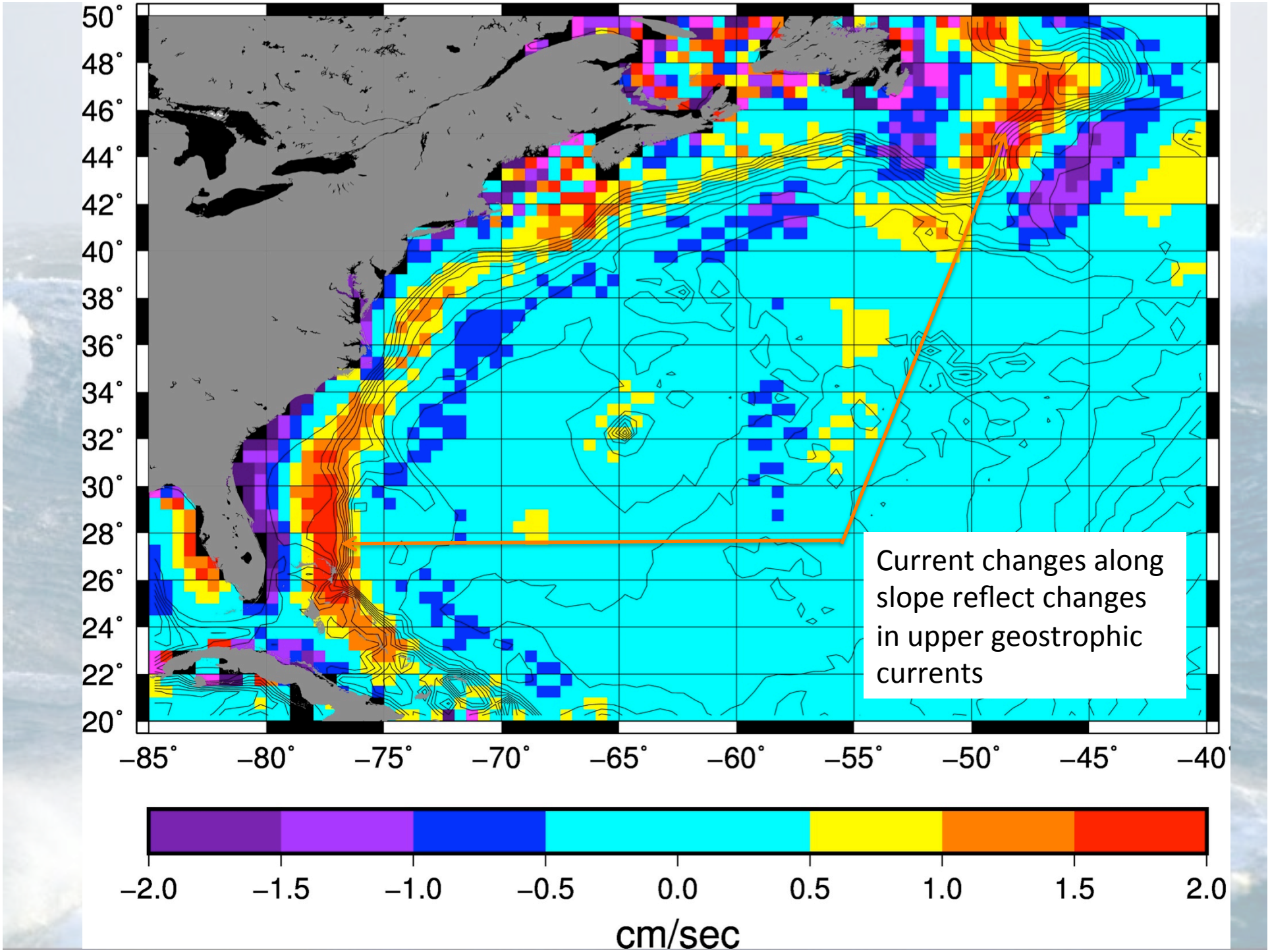


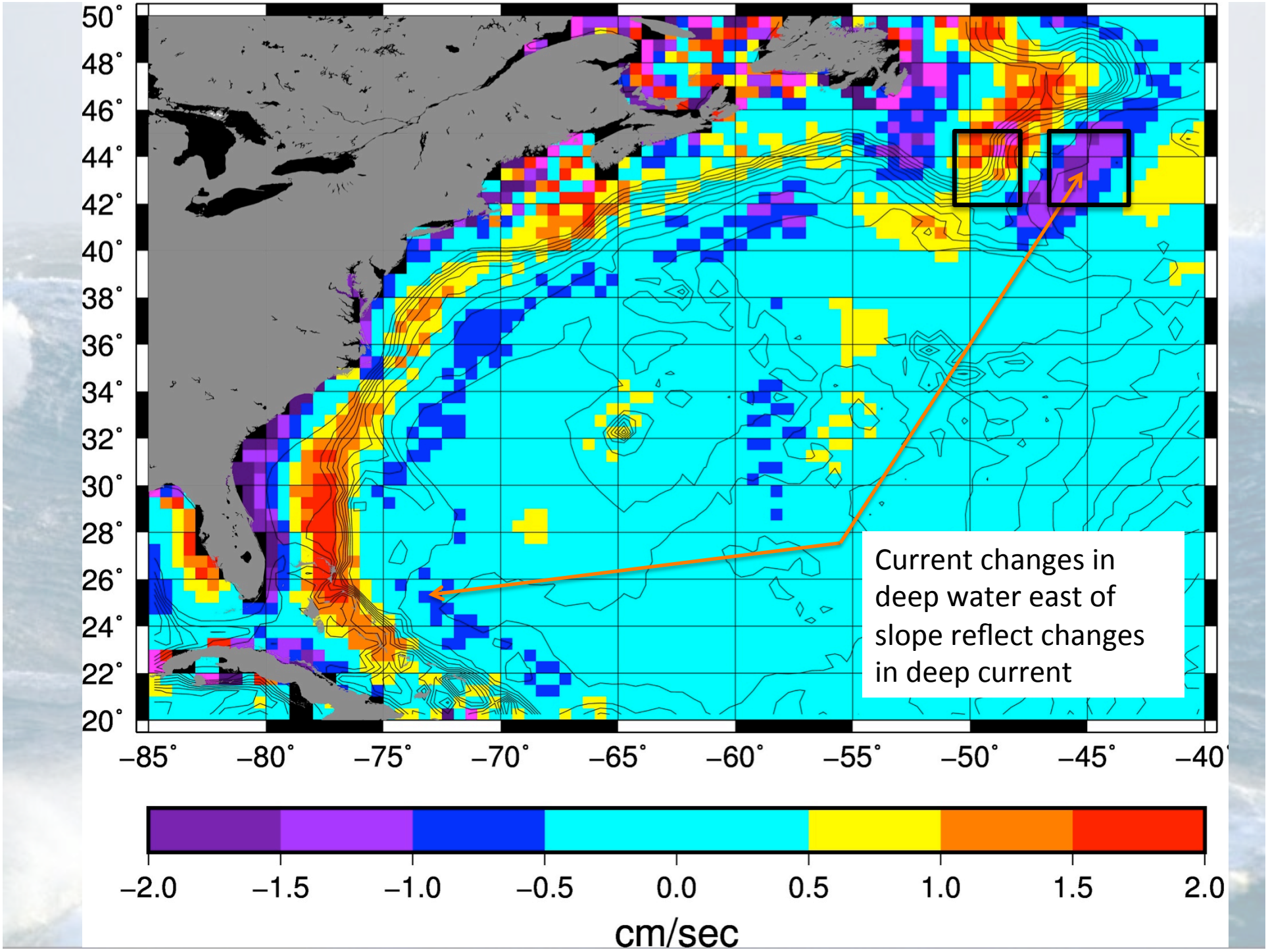


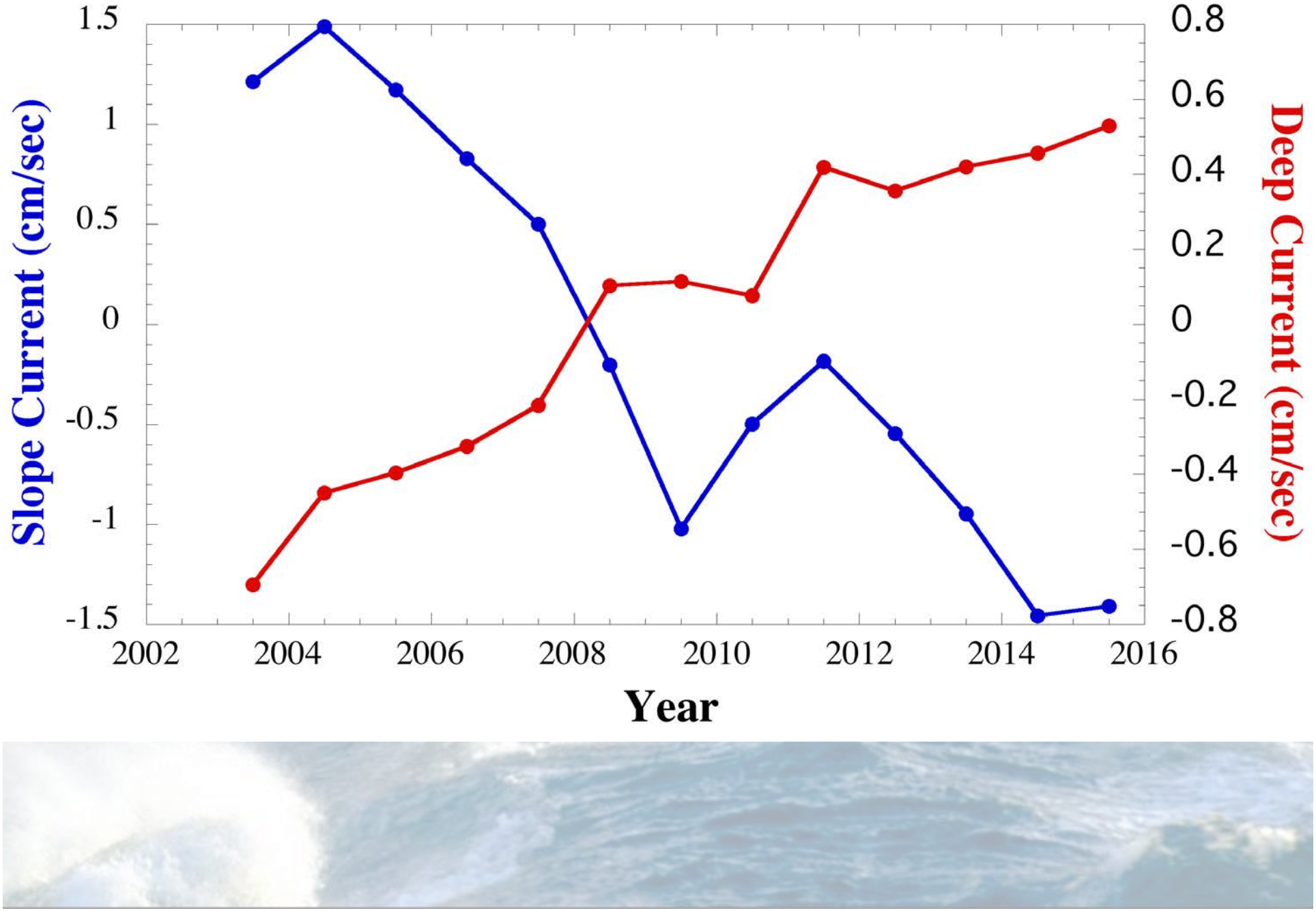
Anomalous meridional bottom current; positive to the north (CSR GRACE mascons)

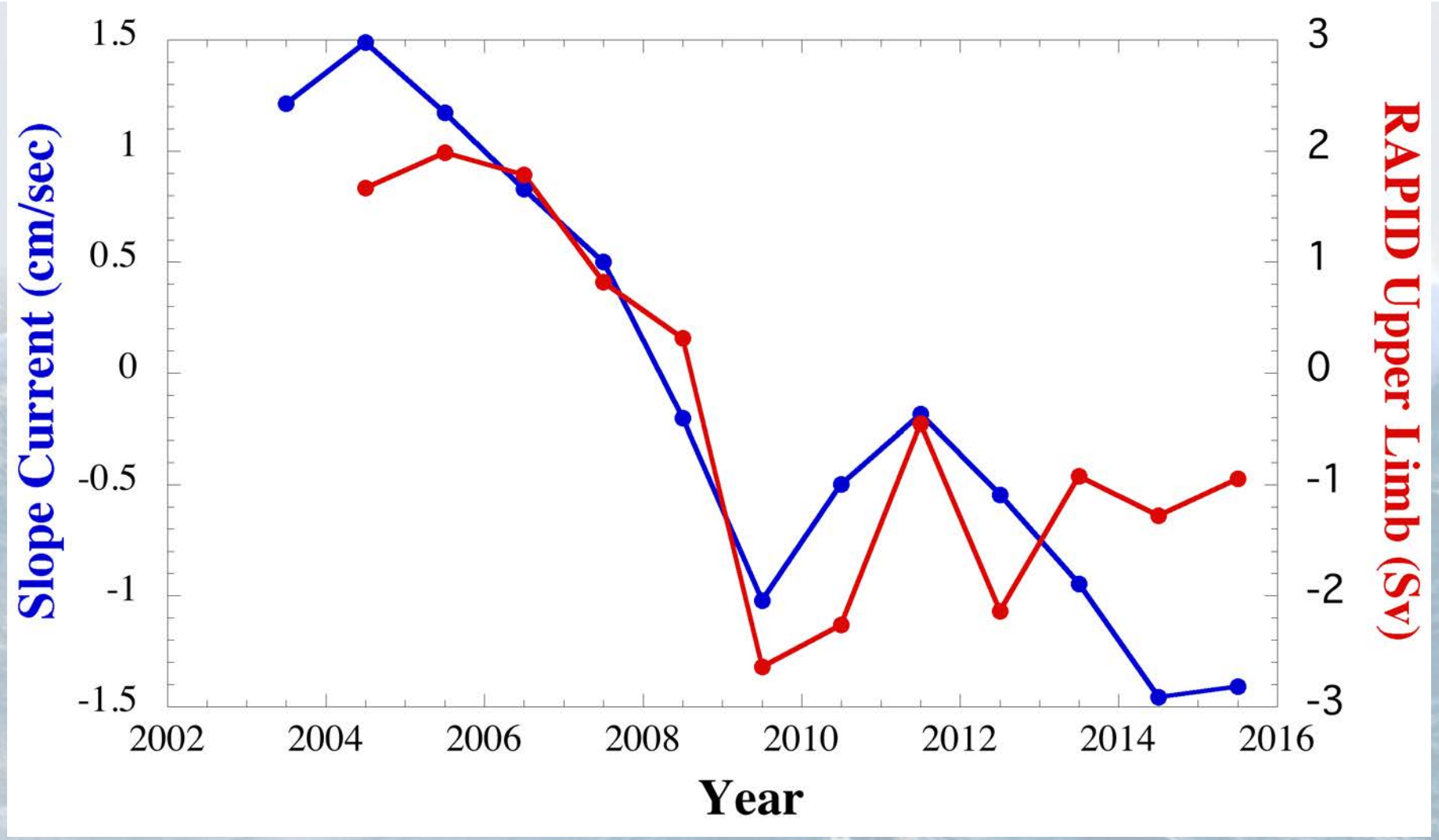




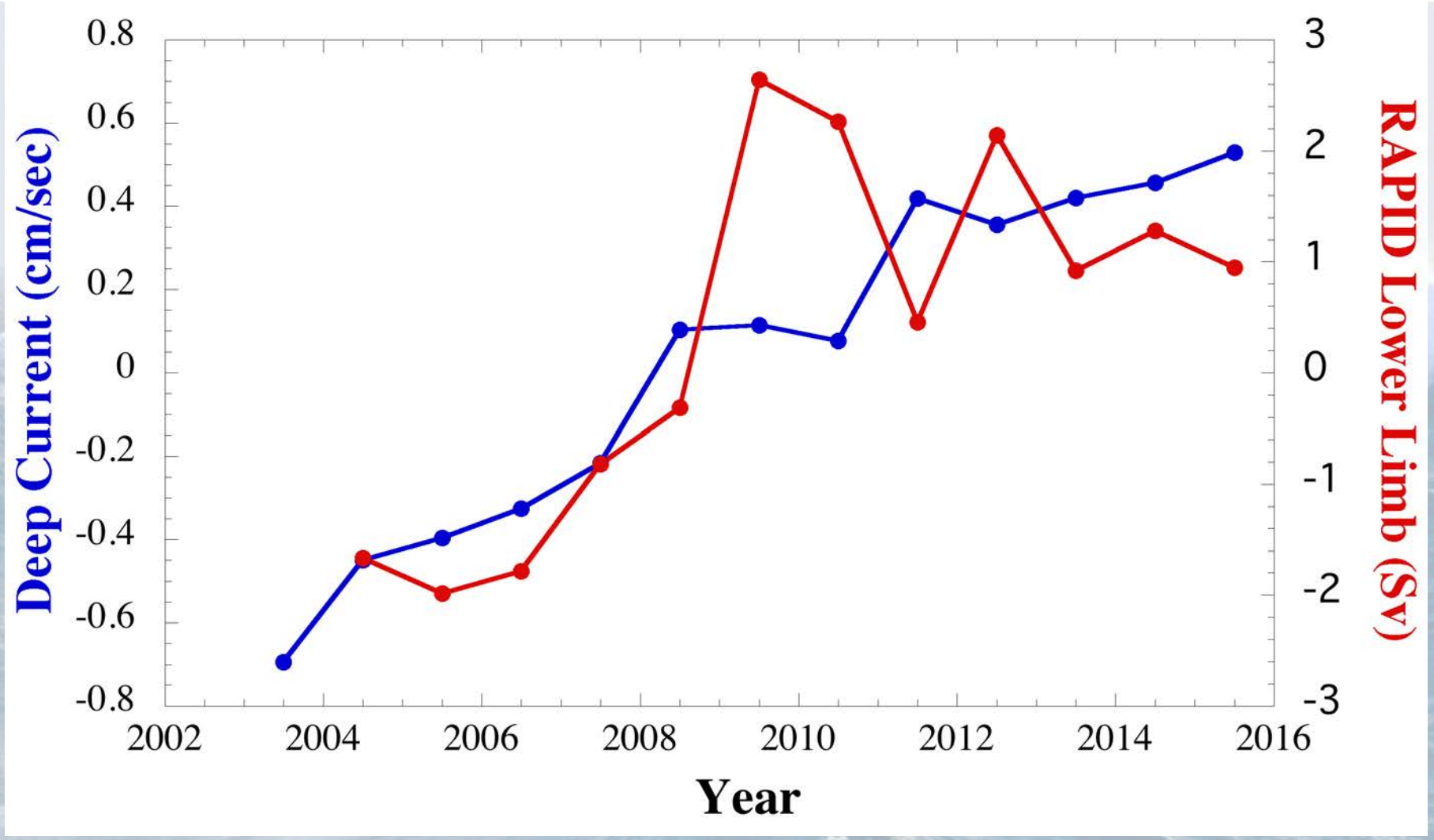

50°
48°
46°
44°
42°
40°
38°
36°
34°
32°
30°
28°
26°
24°
22°
20°
−85°
−80°
−75°
−70°
−65°
−60°
−55°
−50°
−45°
−40
Current changes along slope reflect changes in upper geostrophic currents
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0
cm/sec


50°
48°
46°
44°
42°
40°
38°
36°
34°
32°
30°
28°
26°
24°
22°
20°
−85°
−80°
−75°
−70°
−65°
−60°
−55°
−50°
−45°
−40
Current changes in deep water east of slope reflect changes in deep current
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0
cm/sec


Slope Current (cm/sec)
Deep Current (cm/sec)
Year
1.5
1
0.5
0
-0.5
-1
-1.5
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
2002
2004
2006
2008
2010
2012
2014
2016



Correlation = 0.84



Correlation = 0.74

Note that lower limb transport inferred from negative of upper limb

Conclusions

- Current GRACE solutions have leaked bottom pressure variations from shelf and deep water onto slope
- Computing gradient and looking at bottom currents reduces this large-scale error, showing upper and lower limb geostrophic currents with similar trends and variability as measured by RAPID array
- Can improve results by introducing correlations along shelf, slope, and deep water in mascon solutions. Work to be done.