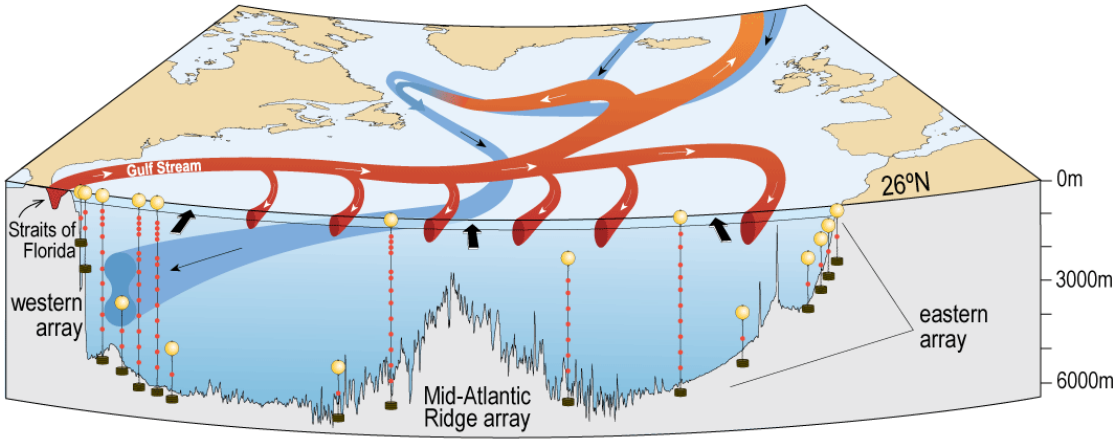
Oceanic fluxes and storage of freshwater and heat in the North Atlantic using Argo data

Elaine McDonagh

National Oceanography Centre

Southampton

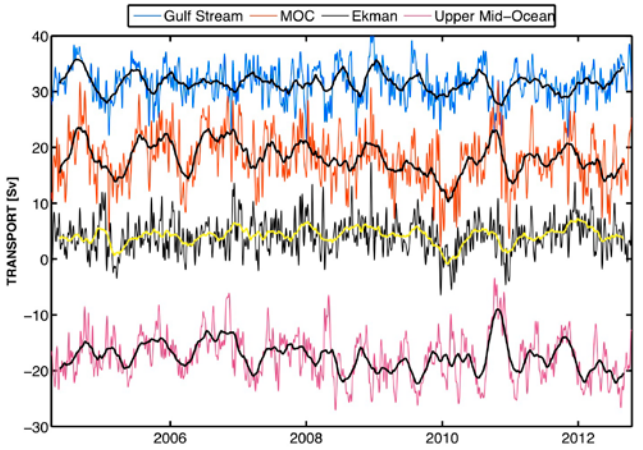
NERC's RAPID-WATCH program (MONACO)



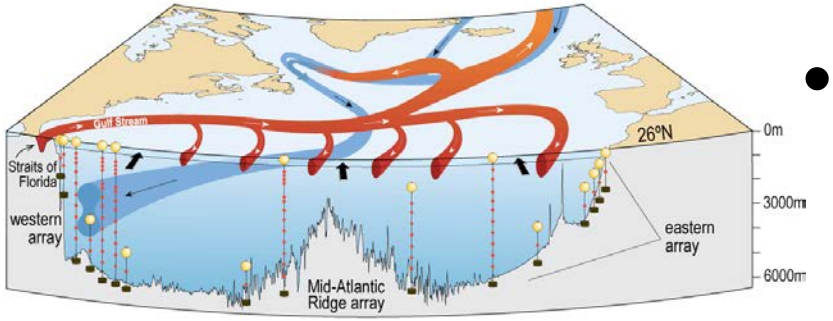
Brian King, Harry Bryden, Peggy Courtois, Stuart Cunningham, Zoltan Szuts (MPI), Chris Atkinson

Observations

- Transport time series from the Rapid array

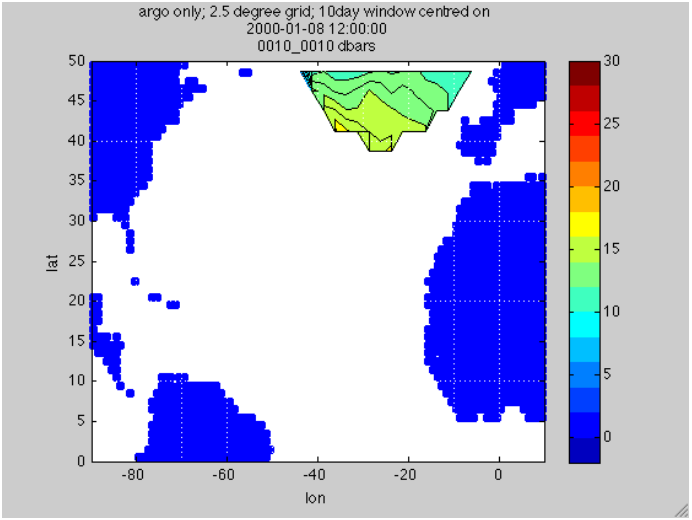


www.noc.soton.ac.uk/rpdmoc

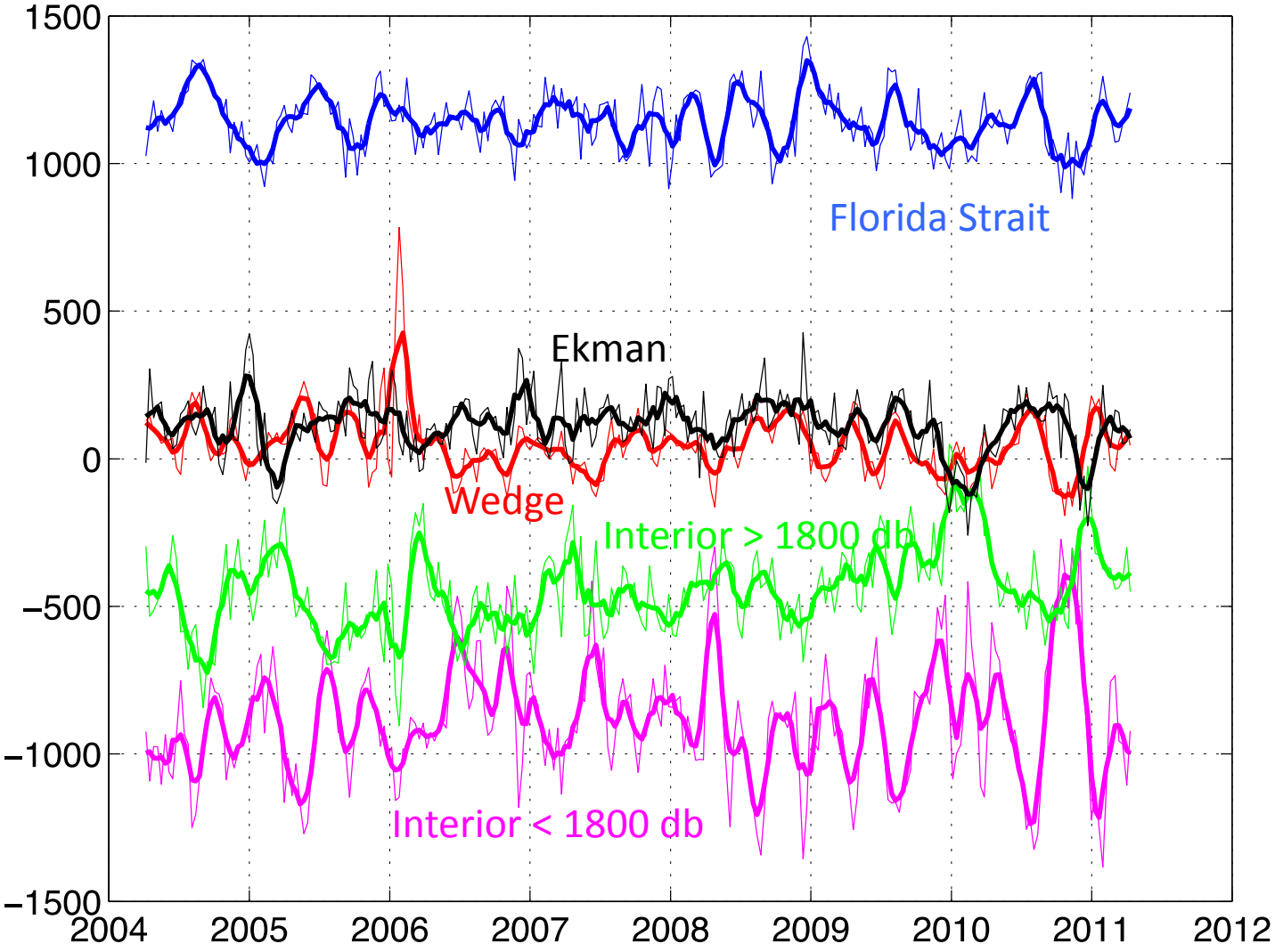


- Temperature and salinity data from the Rapid array

- Optimally interpolated Argo data



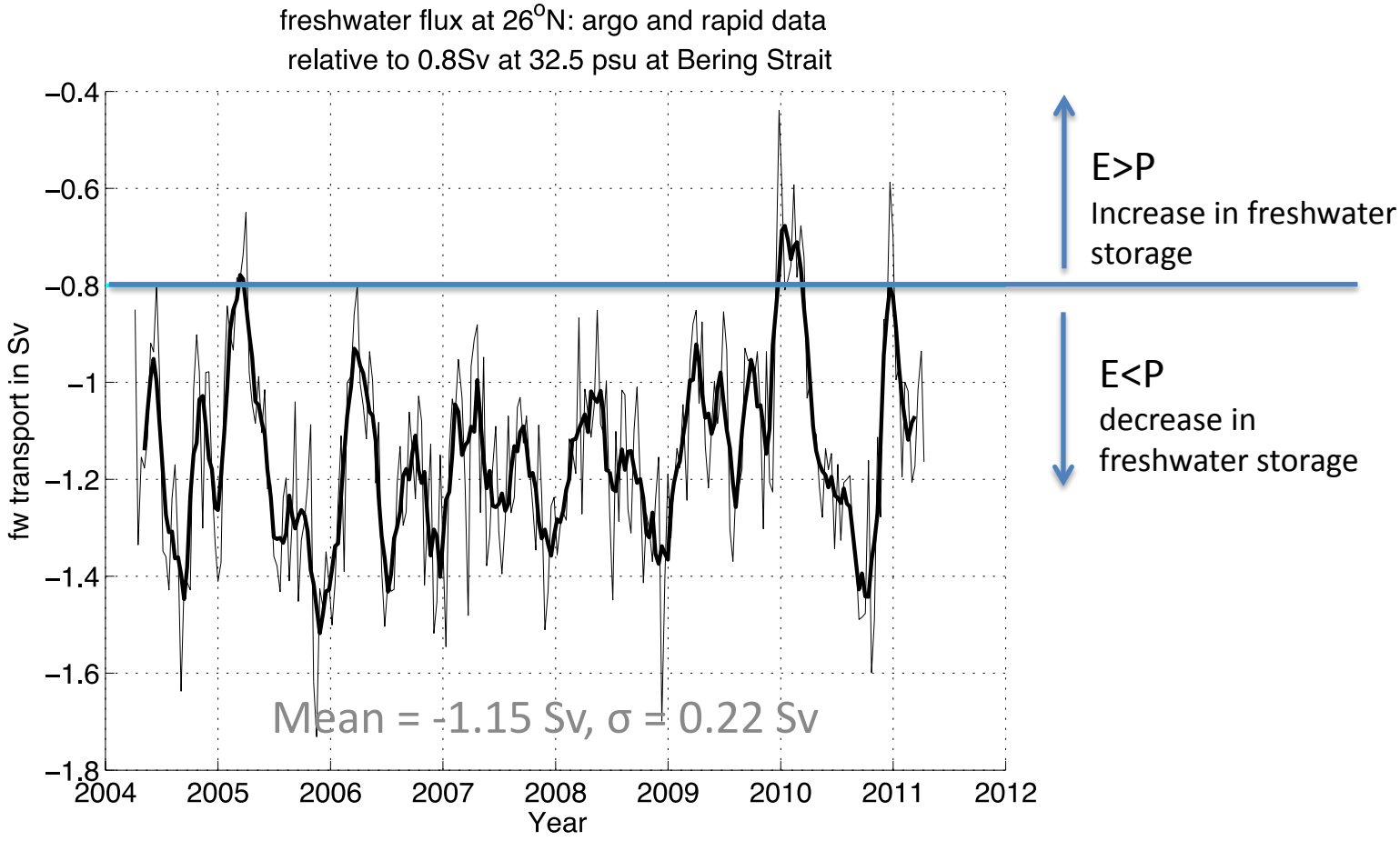
How do we calculate freshwater flux?



How do we calculate freshwater flux?

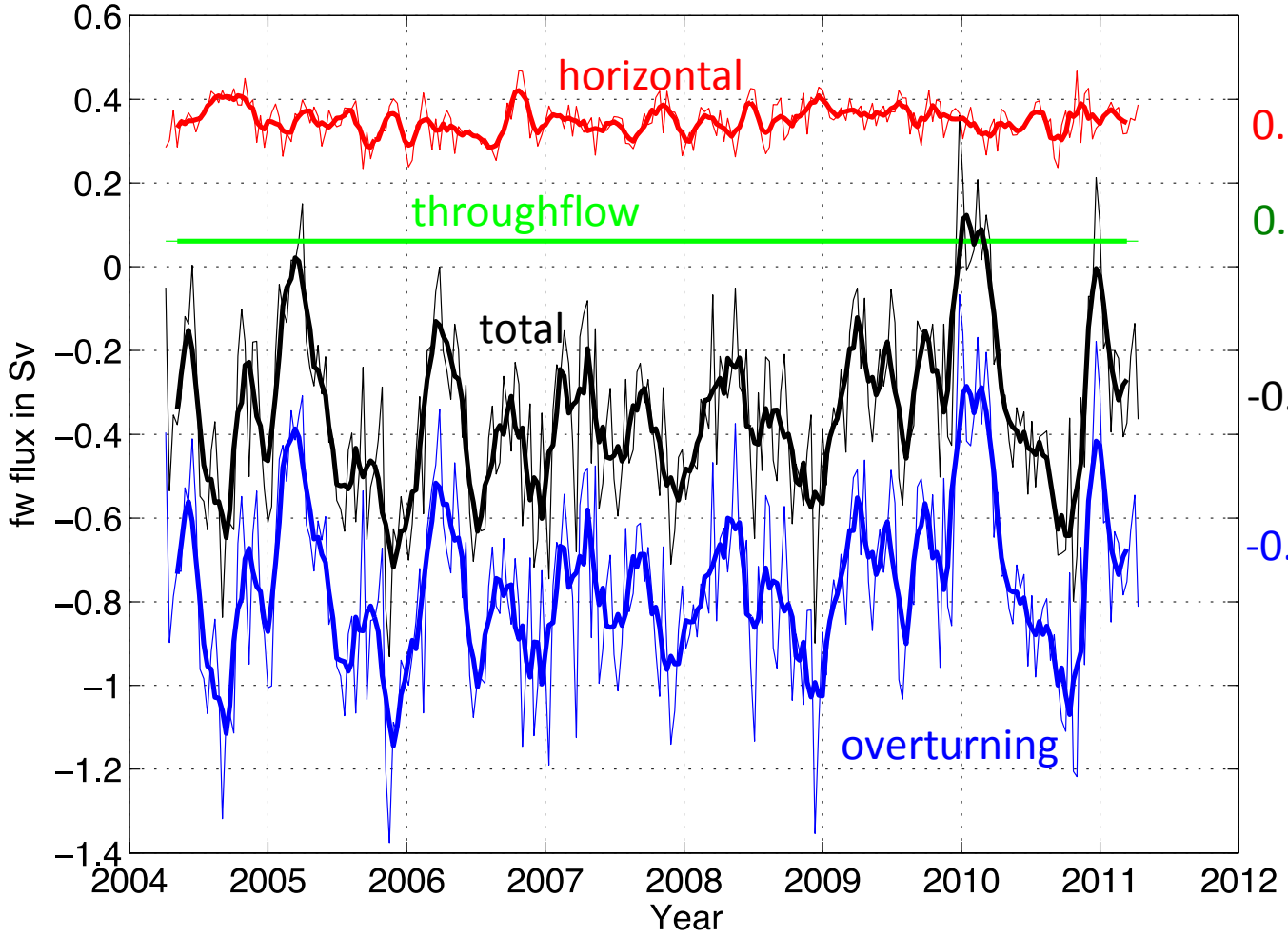
- Constrain the salinity flux at each timestep to be -26 Svpsu (salinity flux at Bering Strait) by adding a volume flux at the section average salinity.
- The net volume flux across the section is the freshwater flux.

Freshwater Flux at 26°N



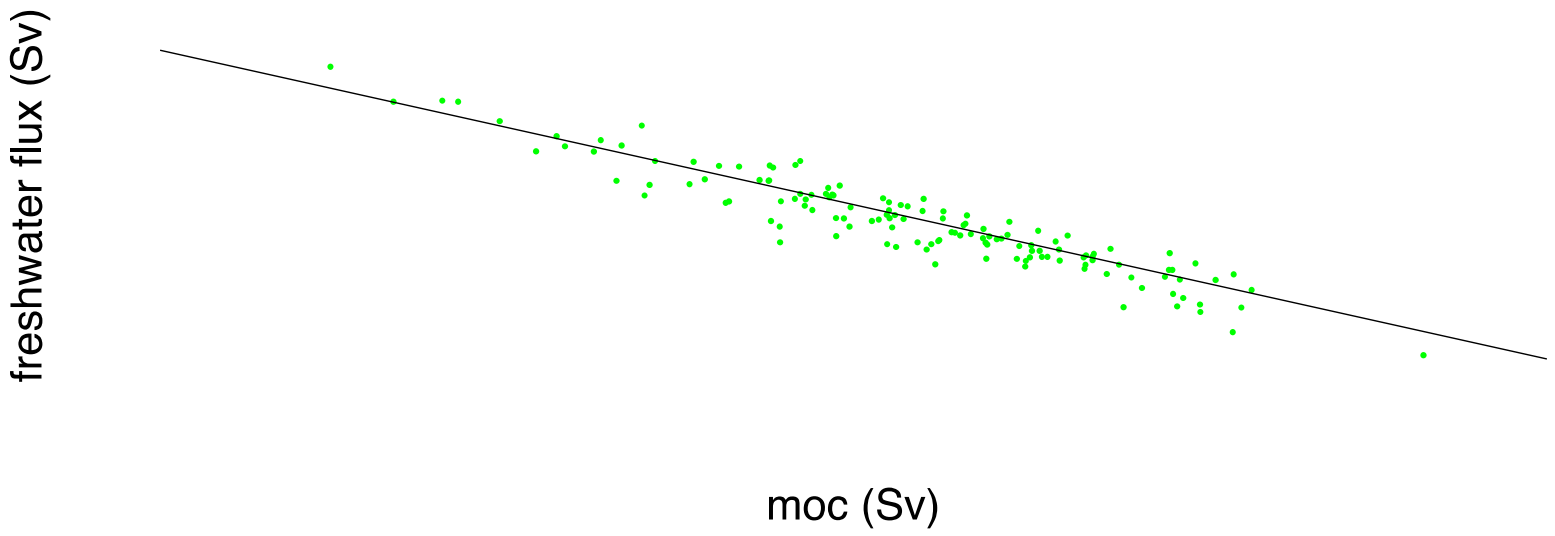
- Mass flux across the section
- Based on oceanic salinity conservation
- Difference in volume flux across Bering Strait and 26°N (freshwater divergence) includes air-sea fluxes (Evaporation, precipitation), runoff, ice melt/formation, oceanic salinity storage/freshening

Components of the equivalent freshwater flux



The overturning circulation transports freshwater southwards

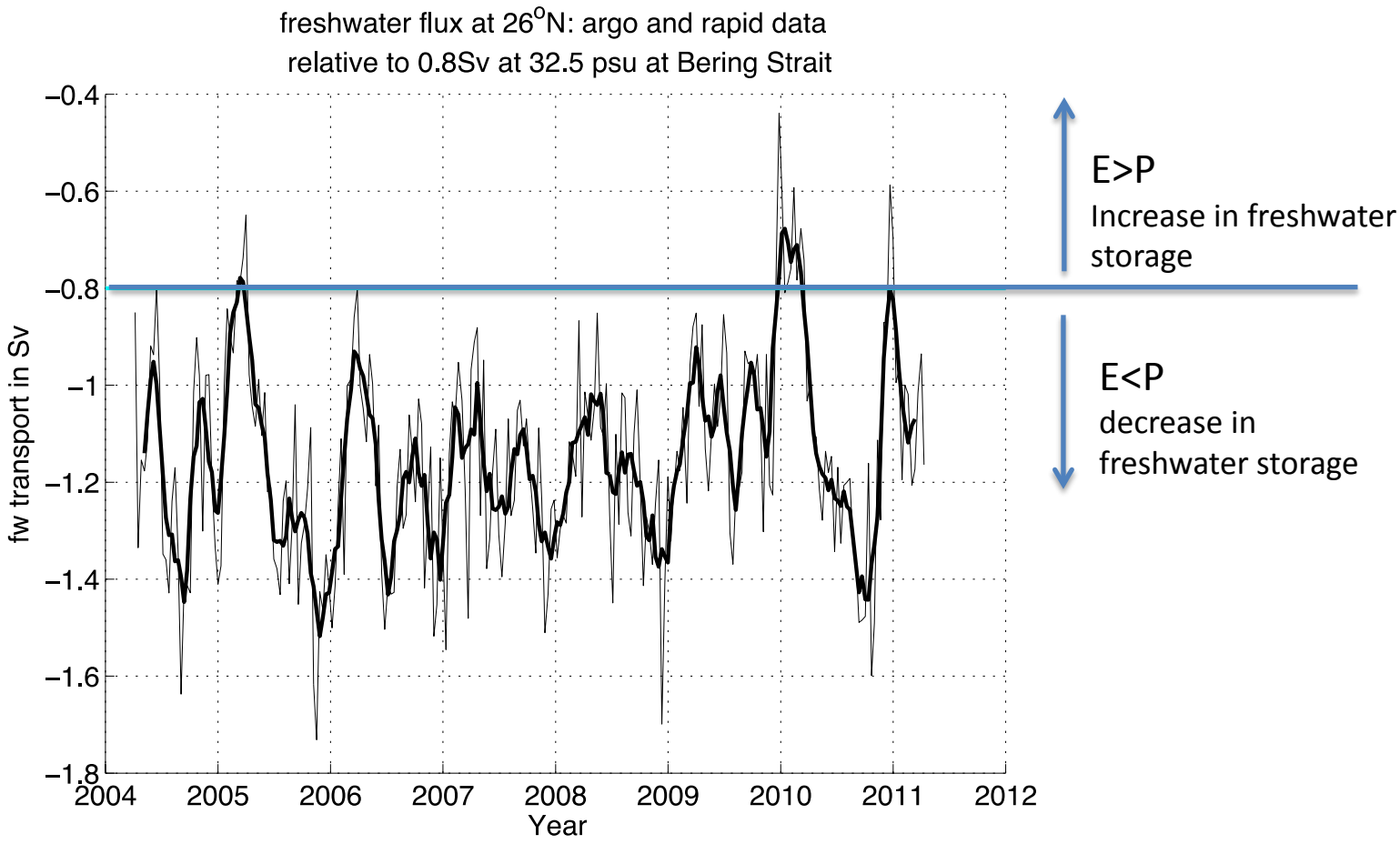
Relationship between moc and freshwater flux



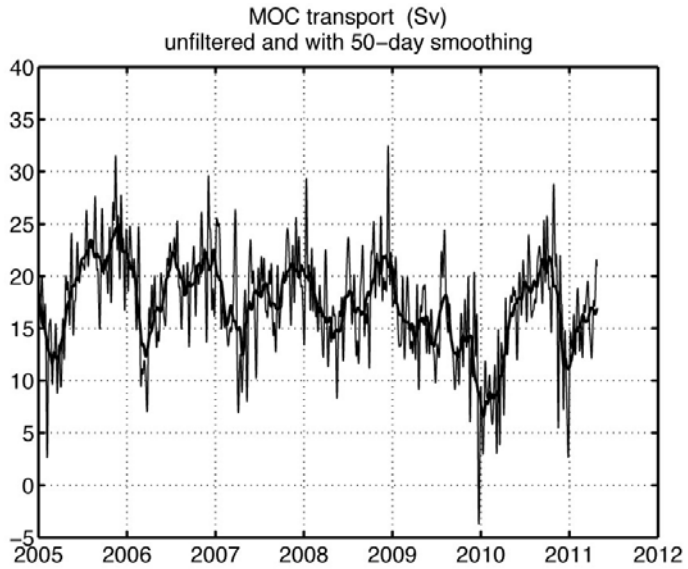
Freshwater flux = -0.37 – 0.045*moc

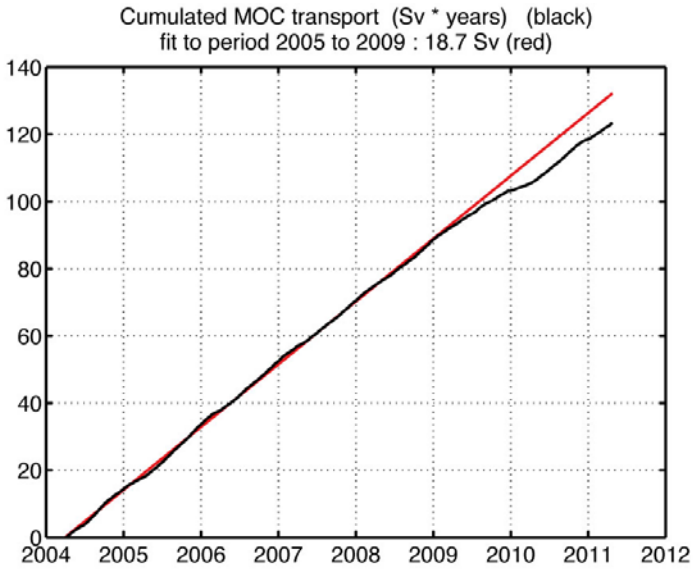
84% of variance in the freshwater flux can be explained by variability in moc

Freshwater Flux at 26°N



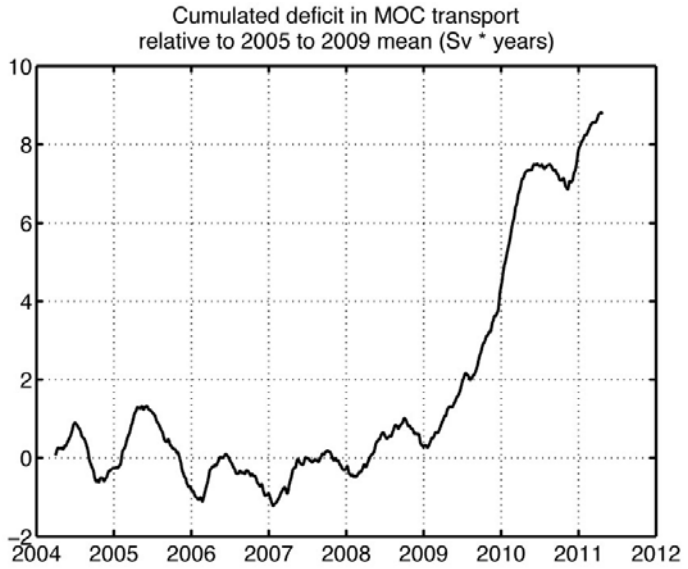
MOC slowdown 2009 onwards





The ‘deficit’ in MOC is about
8 Sv*years

Equivalent to
18.2×10^{21} J
4.0×10^{14} kg salt



Heat and salt content

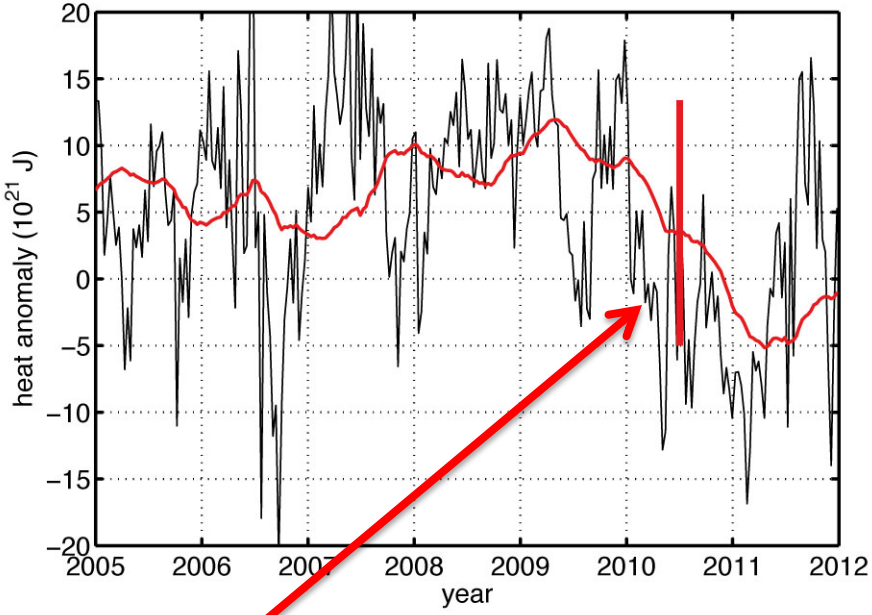
60W to 20W
25N to 45N
Upper 1800 metres

10-day independent values and
360-day running means

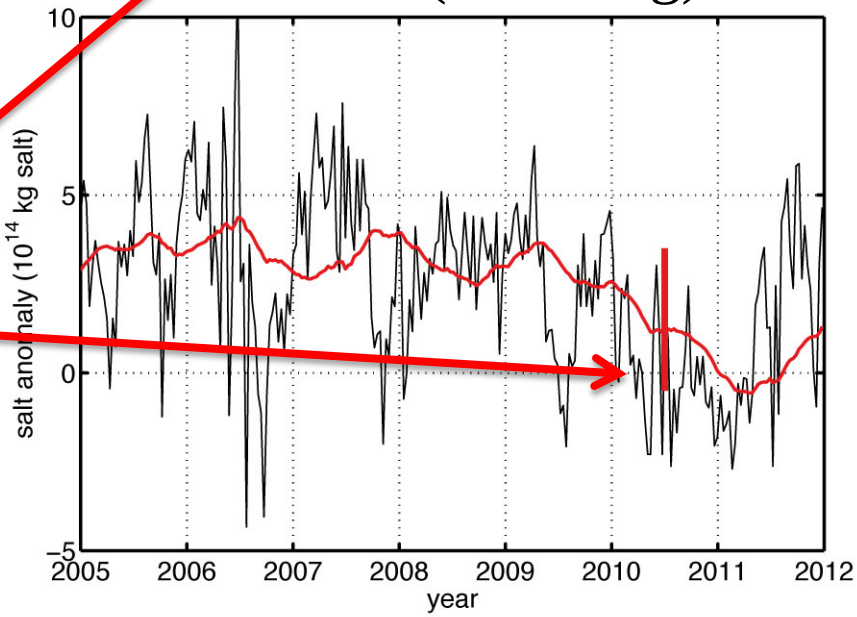
Anomalies relative to Hydrobase climatology

Vertical red bars are shortfall in heat and salt from reduction in overturning at 26N of
8 Sv for 1 year

Heat (x 10^{21} J)



Salt (x 10^{14} kg)



Summary

- Derived a seven year time series of freshwater flux at 26°N
- Calculated the sensitivity of the freshwater flux to the overturning circulation
- Related changes in the circulation (moc) to variability in the upper ocean heat and salt content.