The salinity and heat budgets of the subtropical North Atlantic: initial analysis.

Will Hobbs

(UCLA/JIFRESSE)

Josh Willis

(California Institute of Technology, Jet Propulsion Laboratory)

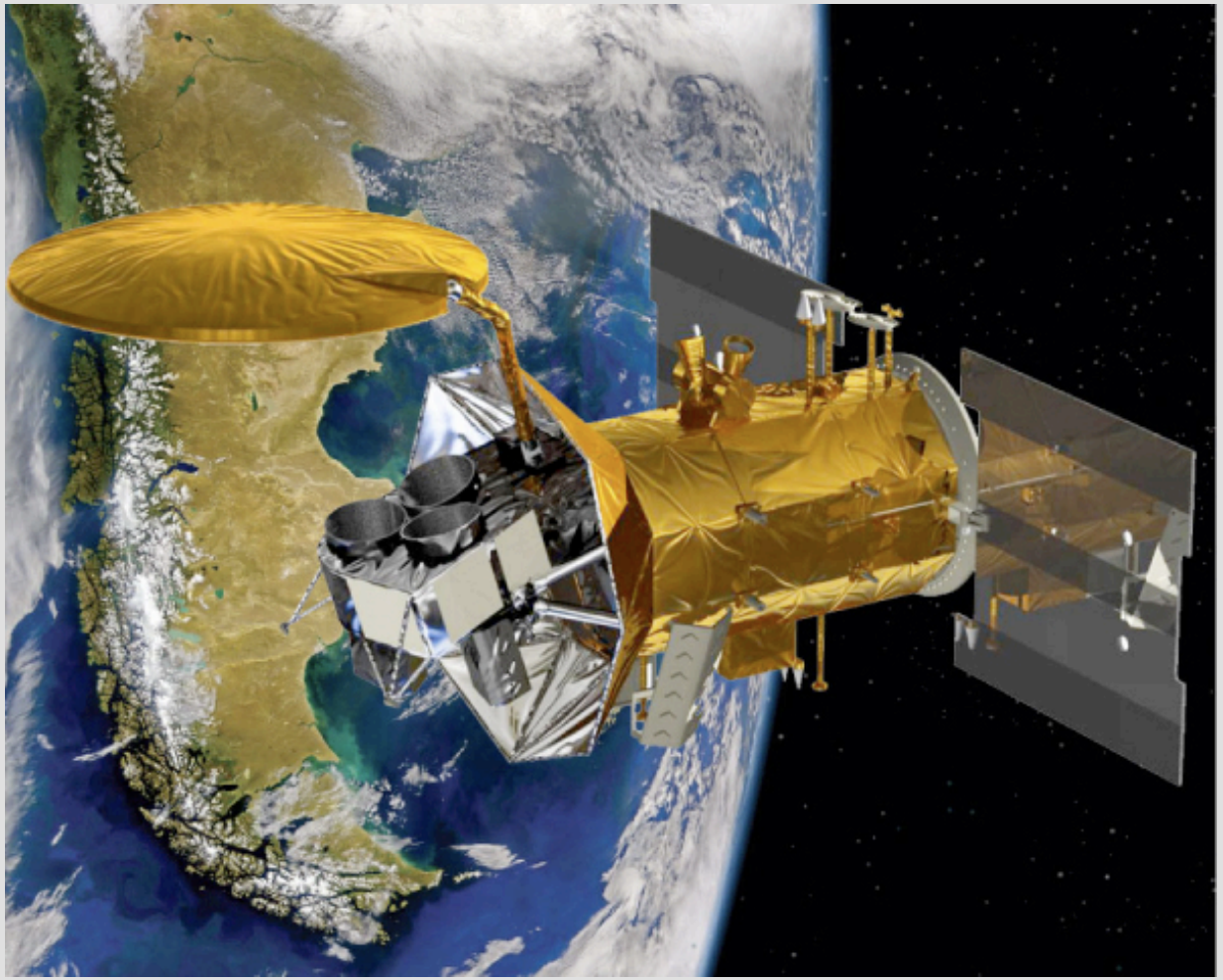
william.r.hobbs@jpl.nasa.gov

Aquarius/SAC-D sea surface salinity mission

- Launched 10th June 2011

- Measures SSS to 0.2 PSU (dependent on SST) with 150 km resolution.

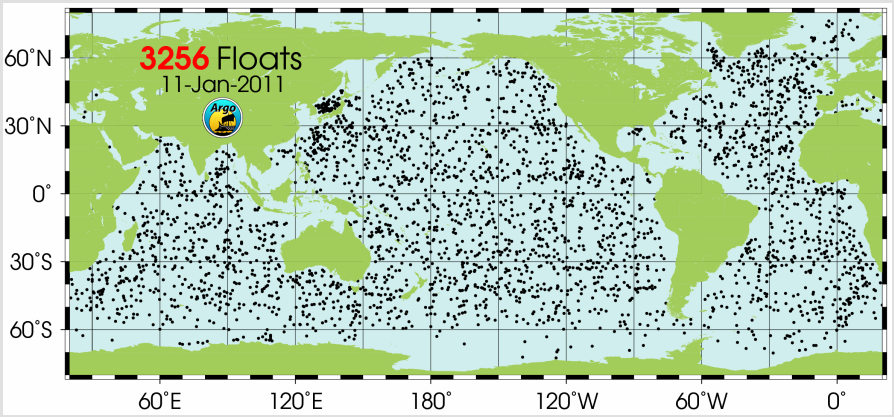
- By inferring E-P from surface salinity changes, could it Aquarius estimates of latent heat flux?



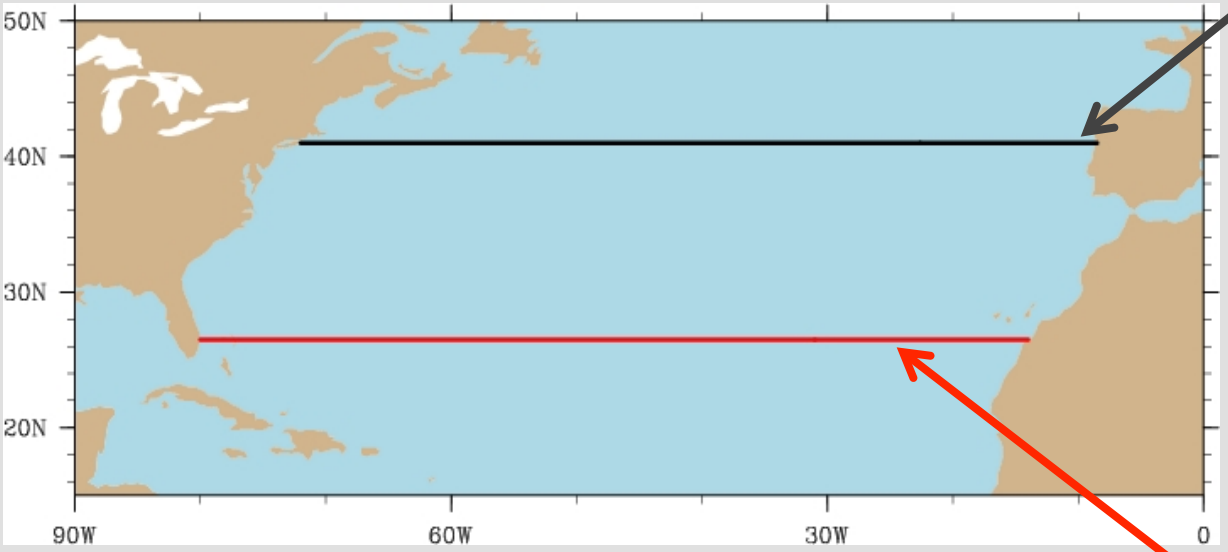
Perhaps we could explore this through the energy & mass balance of a well-observed ocean volume.

But where is there such a volume….?

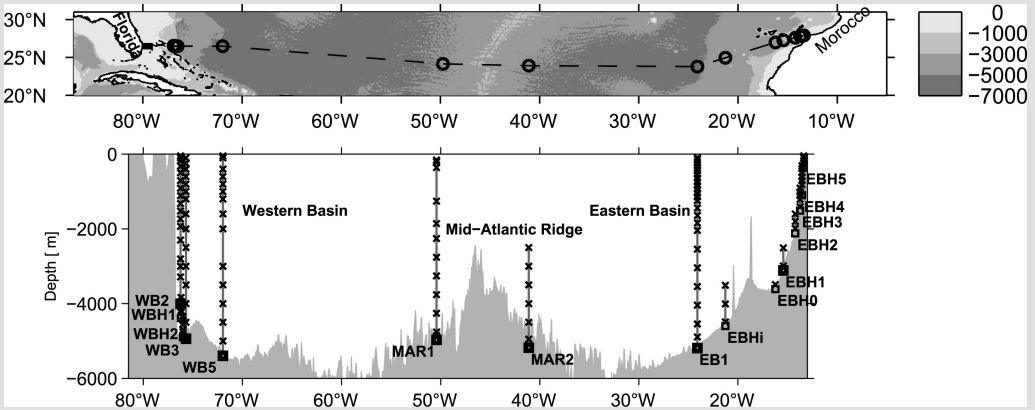
North Atlantic overturning observations



Argo/SSH network



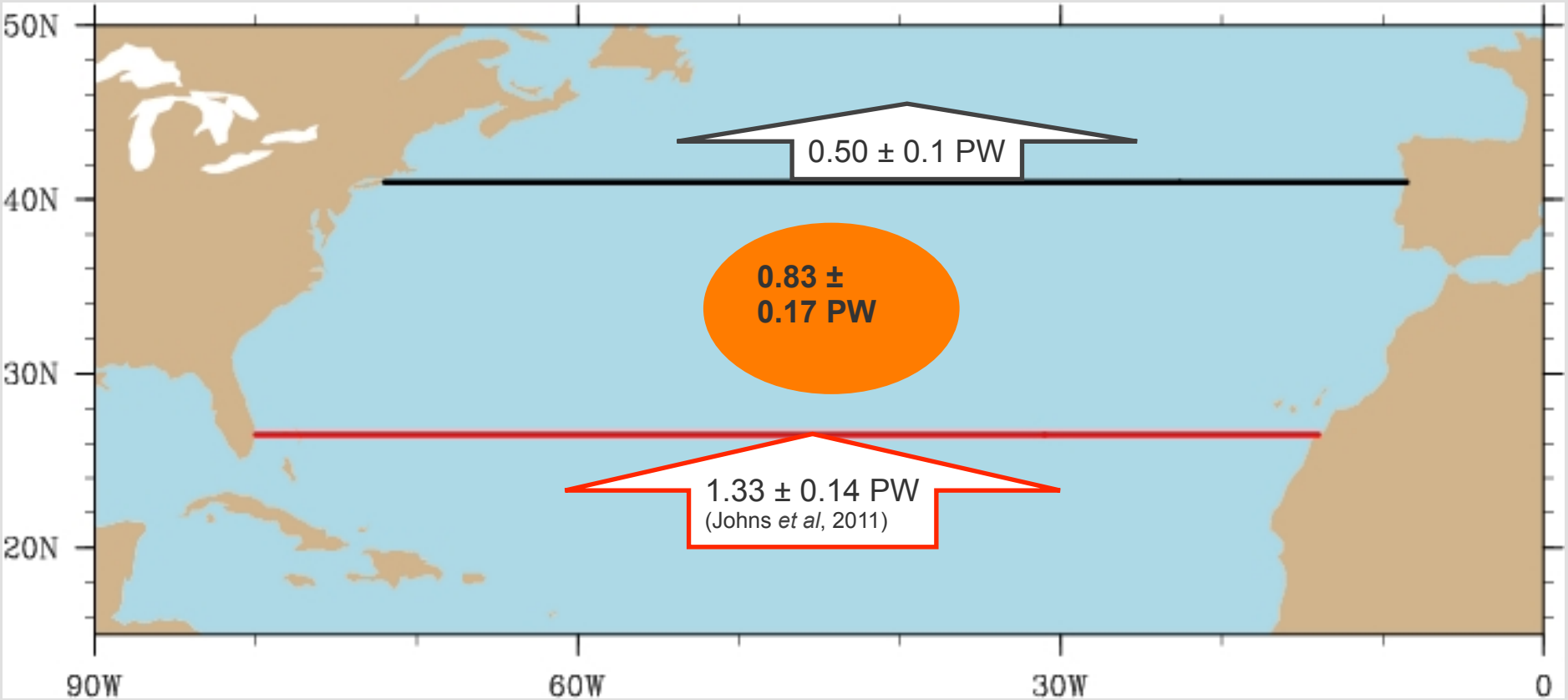
RAPID array



1. RAPID-ARGO domain heat balance

dH/dt = 0.01 PW (from Roemmich & Gilson Argo data)

➔ Net surface flux = **0.82 PW**



Estimating Latent Heat (LH) as a fraction of Net surface flux

Net flux = Rn + SH + LH

$$LH = \beta \cdot \left(Netflux - Rn \right)$$

$$\beta = \frac{(\overline{LH})}{(\overline{Htflux})}$$

From NOC flux (v2) data, for RAPID-Argo domain:

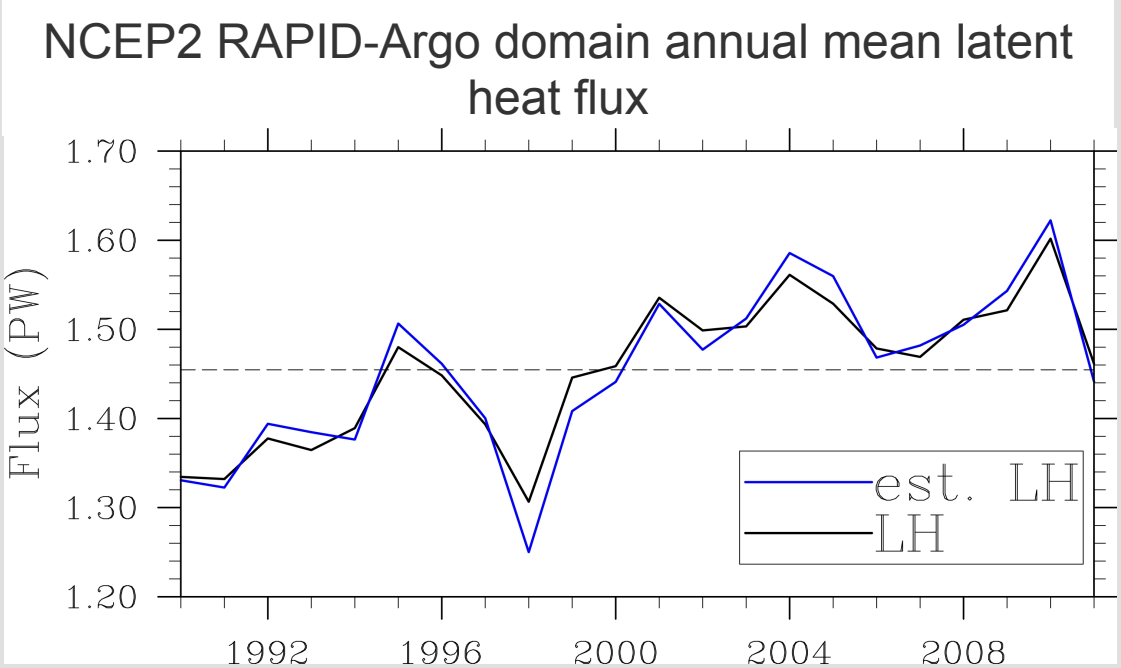
Net flux = 0.82 ± 0.17 PW

Rn = -1.4 ± 0.12 PW
β = 0.90 ± 0.09

➔LH = 2.0 ± 0.27 PW

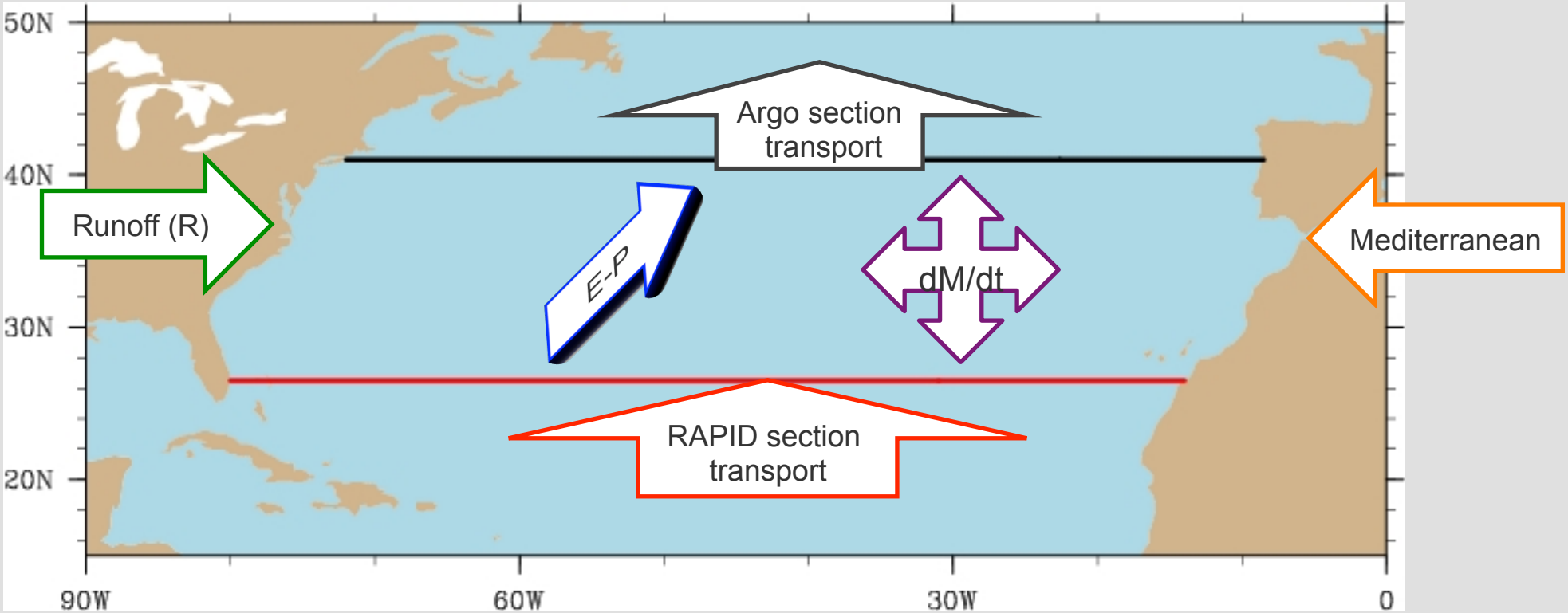
Equivalent to an evap. of:

E = 0.8 ± 0.1 x 10^9 kgs^{-1}



2. RAPID-ARGO freshwater balance

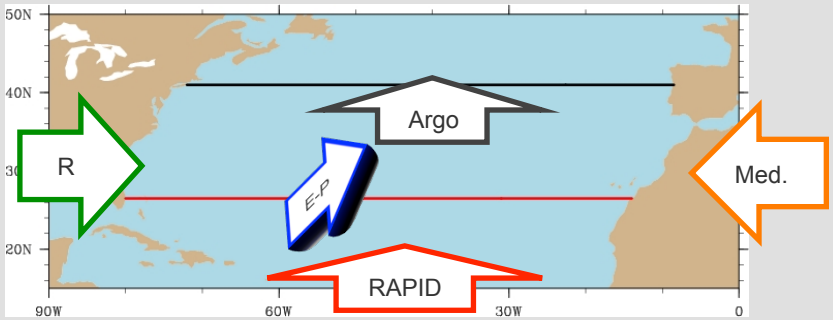
$$E - P = R + FWtrans_{26.5} + FWtrans_{41} + FWtrans_{Med} + dM_{FW}/dt$$

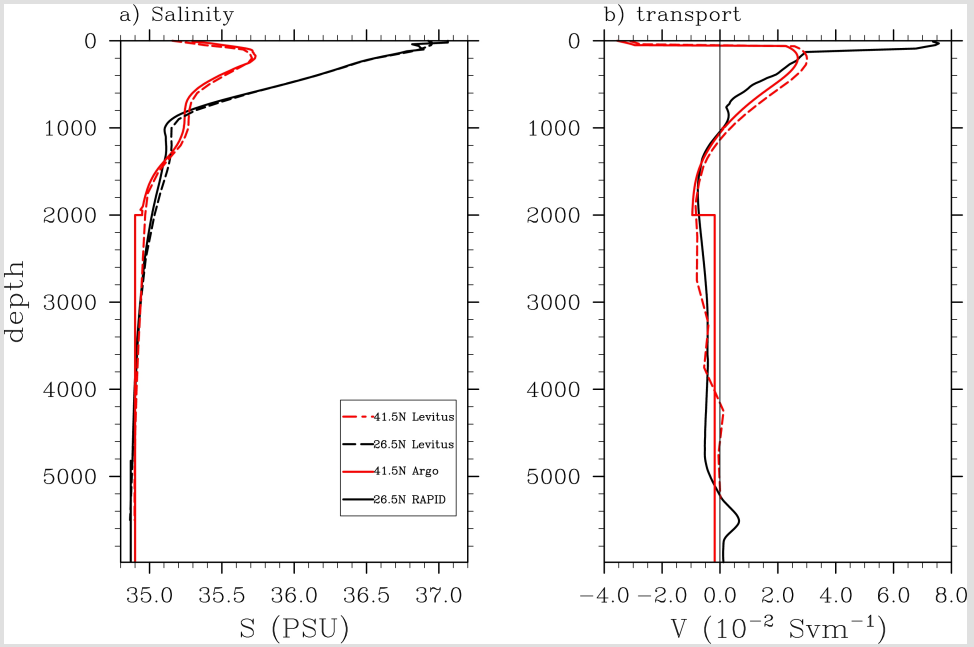


Annual-mean freshwater budget: (assuming dM/dt ~ 0)

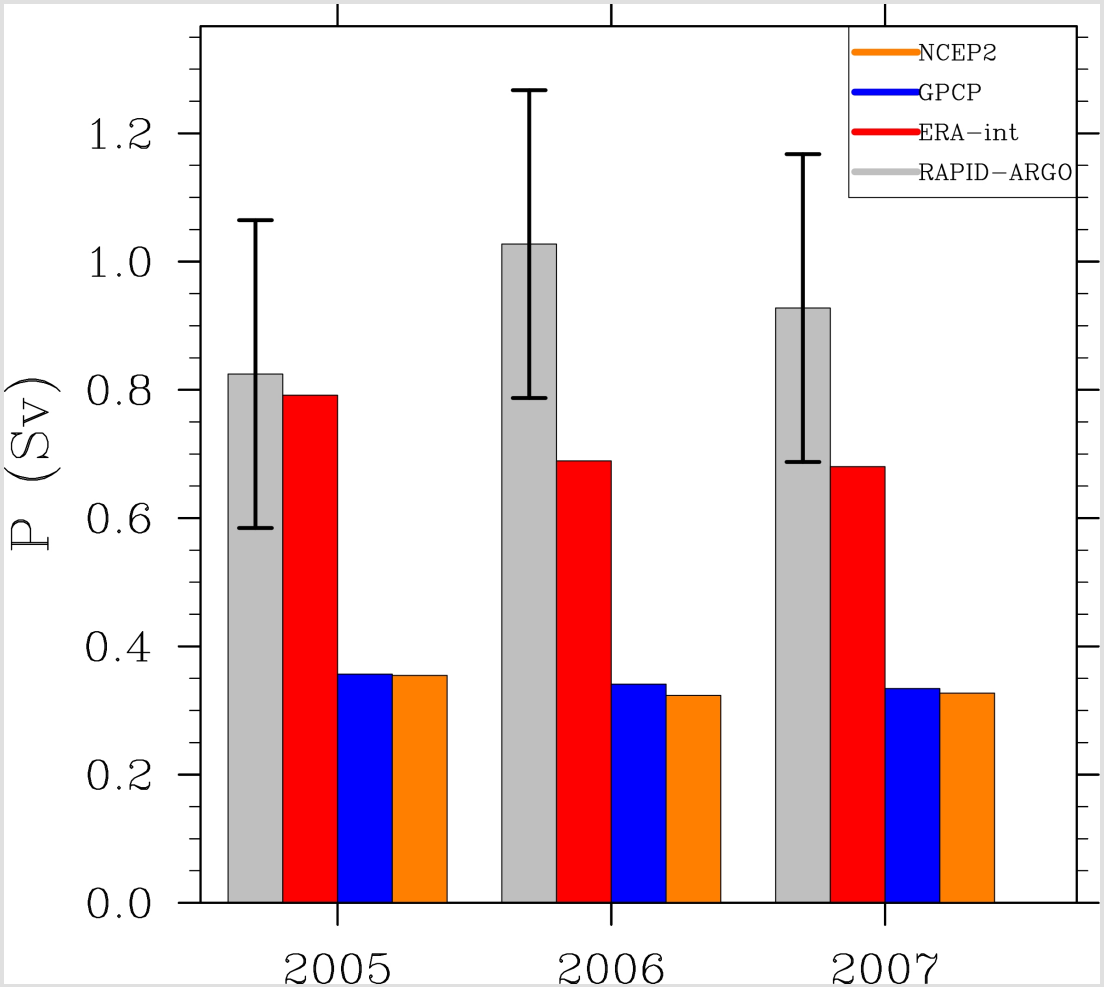
$$P = E - R - FWtrans_{26.5} + FWtrans_{41} + FWtrans_{Med}$$

	FW flux (10^9 kgs^{-1})
26.5°N transport	-0.27 ± 0.07
41.5°N transport	+0.16 ± 0.03
Straits of Gibraltar throughflow	-0.041 ± 0.01 (Criado-Aldeanueva *et al*, 2012)
Net ocean FW transports	**-0.15 ± 0.08**
Runoff	0.041 (± 0.02 ?) (Dai *et al*, 2009)
E-P	**-0.11 ± 0.084**
E	0.8 ± 0.1
P (inferred)	**0.91 ± 0.13**





Annual-mean precipitation inferred from RAPID-Argo

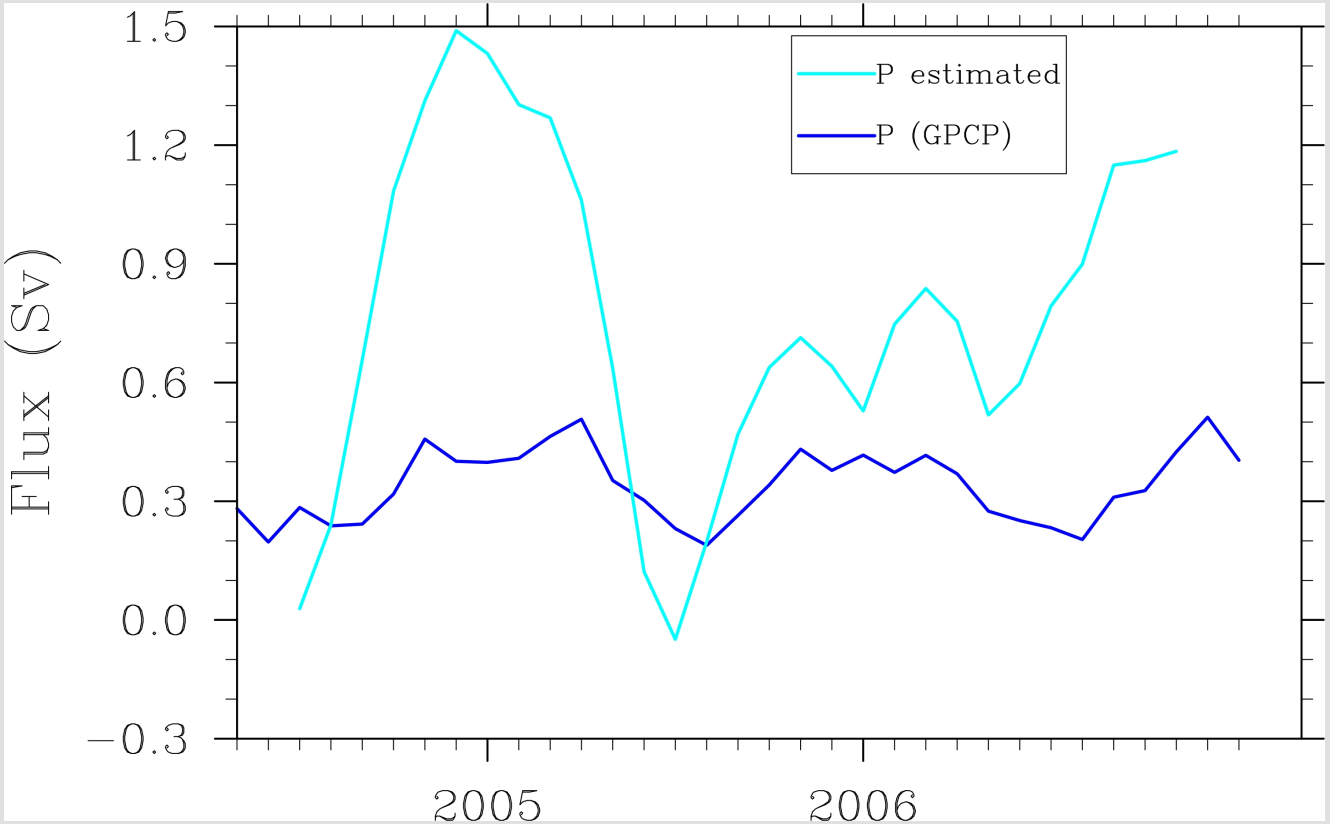


	FW flux (10^9 kgs^{-1})
26.5°N transport	-0.27 ± 0.07
41.5°N transport	+0.16 ± 0.03
Straits of Gibraltar throughflow	-0.041 ± 0.01 (Criado-Aldeanueva *et al*, 2012)
Net ocean transports	**-0.15 ± 0.08**
Runoff	0.041 (± 0.02 ?) (Dai *et al,* 2009)
E-P	**-0.11 ± 0.084**
E	0.8 ± 0.1
P (inferred)	**0.91 ± 0.13**

Relationship to near-surface salinity

On shorter timescales, dM_{FW}/dt is non zero…

$$E - P = R + FWtrans_{26,5} - FWtrans_{41} + Med + \bar{\rho}\int \frac{\partial SSH}{\partial t} dA + \int \frac{\partial}{\partial t}\left[\rho\left(1 - S/1000\right)\right] dV$$

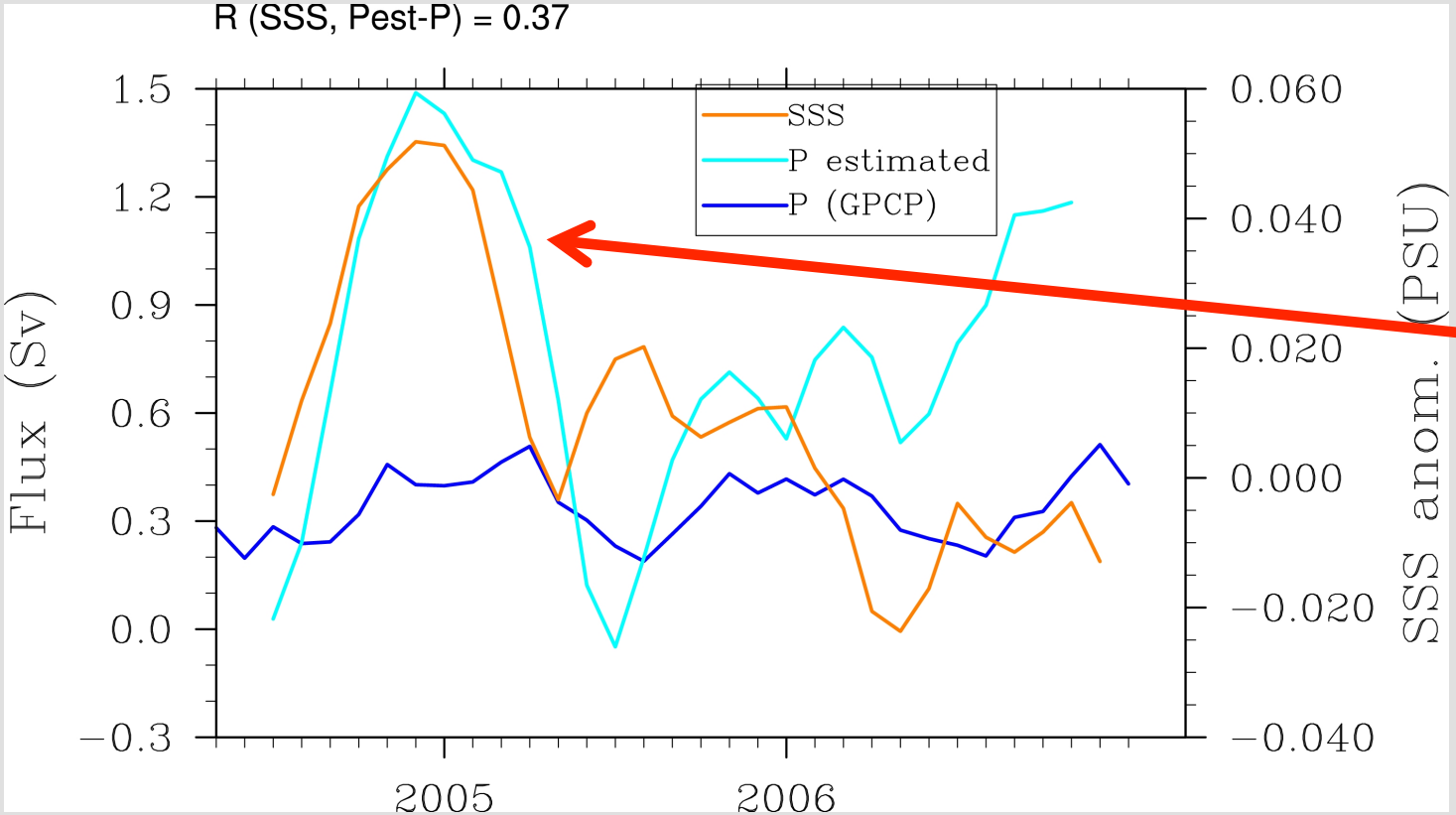


No salinity info here

Relationship to near-surface salinity

On shorter timescales, dM_{FW}/dt is non zero…

$$E - P = R + FWtrans_{26,5} - FWtrans_{41} + Med + \overline{\rho}\int \frac{\partial SSH}{\partial t} dA + \int \frac{\partial}{\partial t}\left[\rho(1-S)\right] dV$$



0.02 PSU/month ~ 1 Sv dM/dt

Summary

- Estimates of annual-mean P from heat and freshwater budgets are reasonable, if somewhat high.

- For sub-monthly time scales, more work required to relate surface salinity data to freshwater mass variability

Moving forward….

- Start implementing Aquarius SSS data (we now have 1 full year!)

- Explore relationship between SSS and subsurface salinity variability

  how can we best use SSS information for FW budget?

- Try other latitudes for AMOC estimates (e.g. Line W)