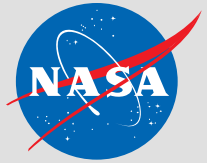

The Large Scale Salinity Budget in the North Atlantic and a First Look at ENSO from Aquarius

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Outline

- The Argo network and the RAPID array

  Estimating the ocean state and velocity from satellite and Argo data

- Heat budget calculation

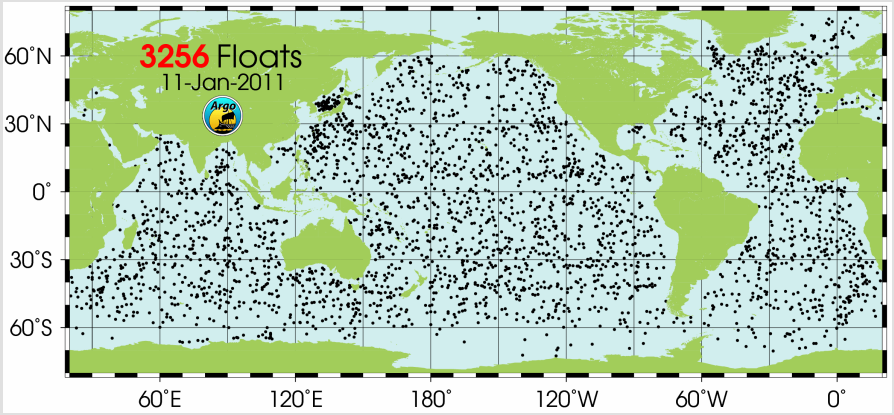
  Estimating surface freshwater loss from N. Atlantic heat budget

- Freshwater budget calculation

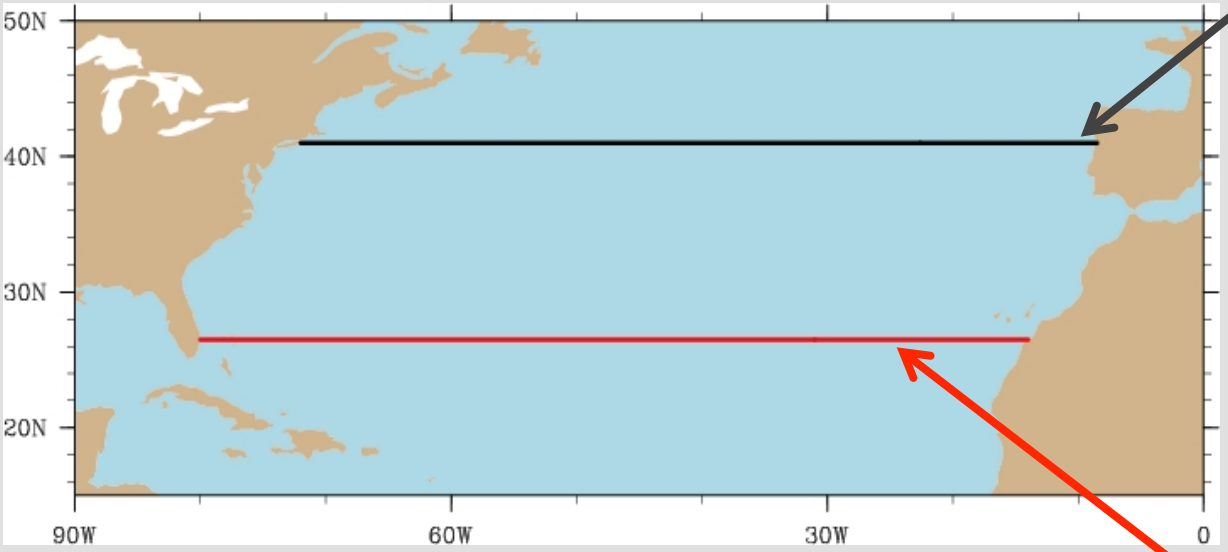
- Implications for SSS observation

North Atlantic Heat/Freshwater budget

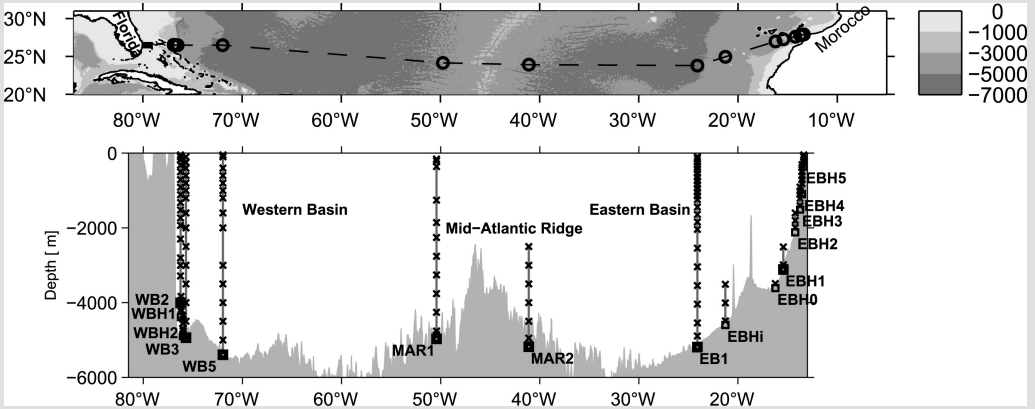
North Atlantic overturning observations



Argo/SSH network

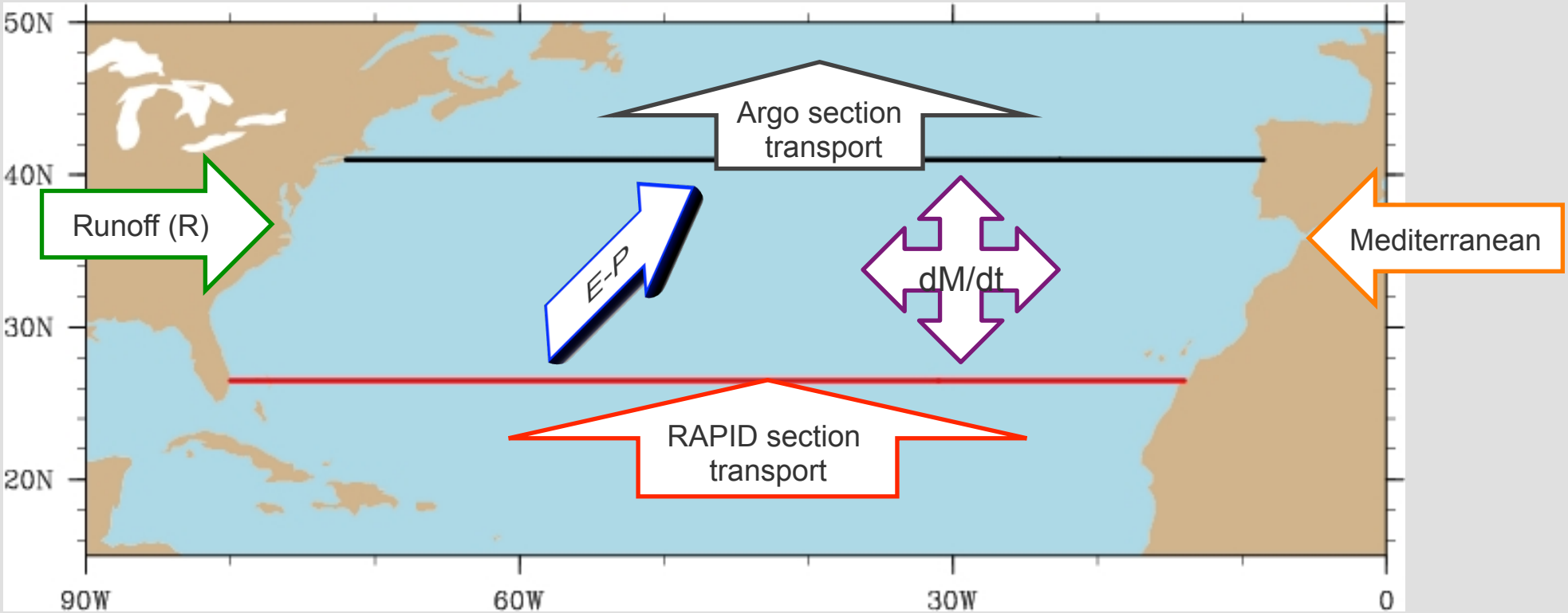


RAPID array



RAPID-ARGO freshwater & heat balance

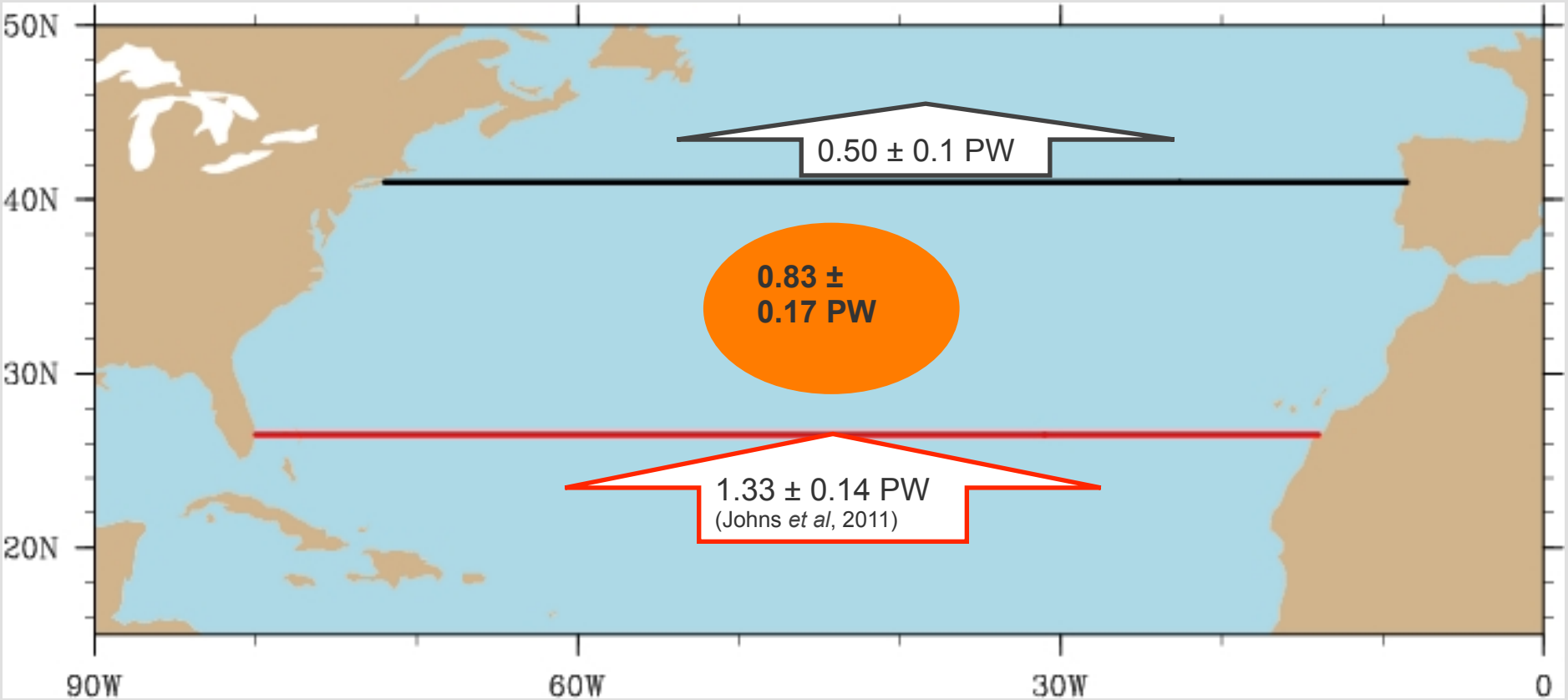
$$E - P = R + FWtrans_{26.5} + FWtrans_{41} + FWtrans_{Med} + dM_{FW}/dt$$



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

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

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

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

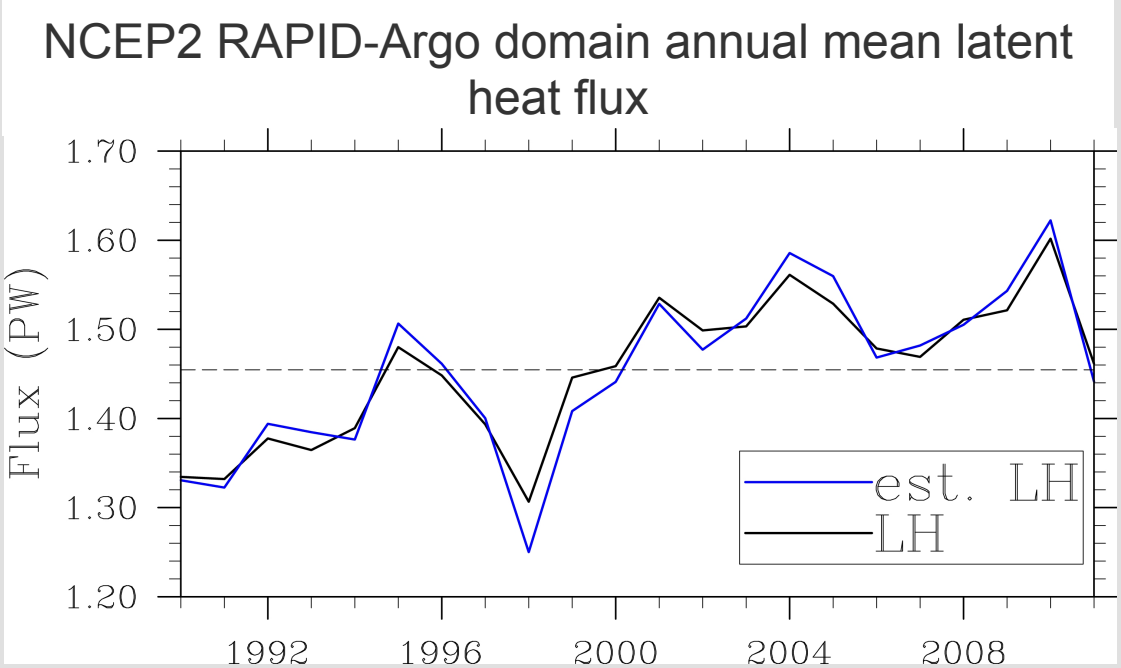
Net flux = 0.82 ± 0.17 PW

Rn = -1.4 ± 0.12 PW
β = 0.90 ± 0.09

➔LH = 2.0 ± 0.27 PW

Equivalent to an evap. of:

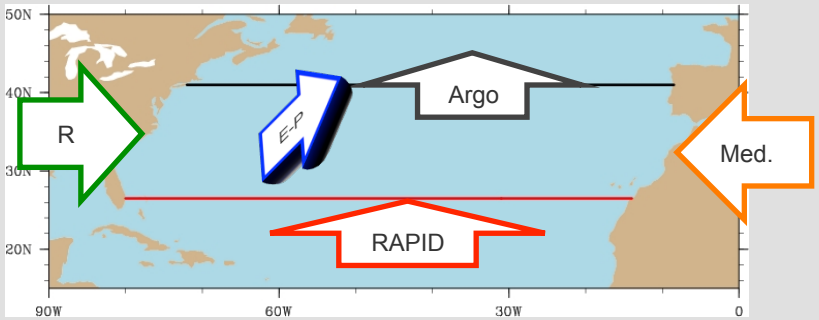
E = 0.8 ± 0.1 x 10^9 Sv

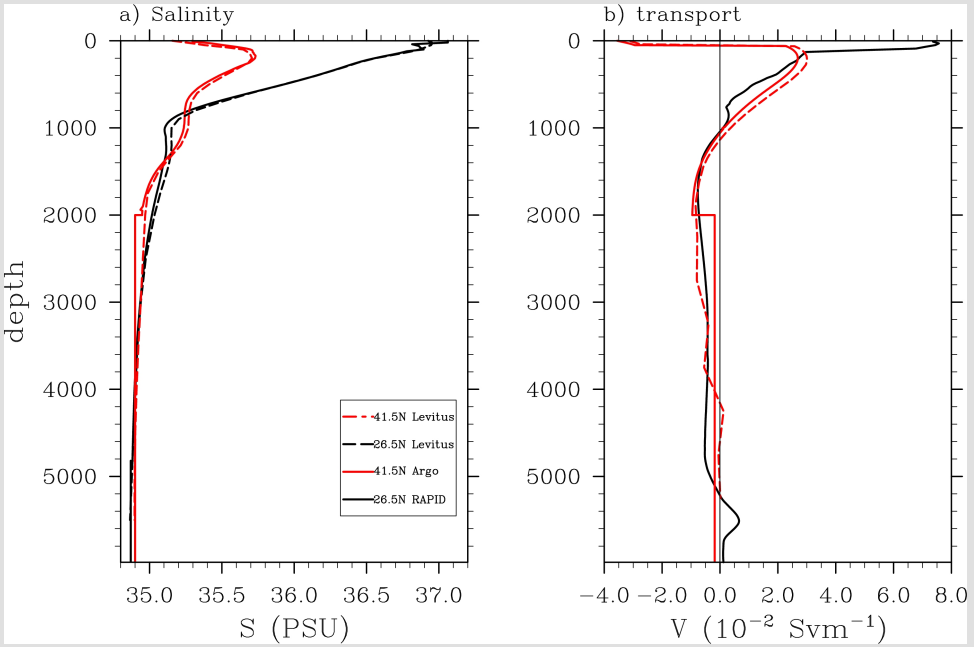


Annual-mean freshwater budget: (assuming dM/dt ~ 0)

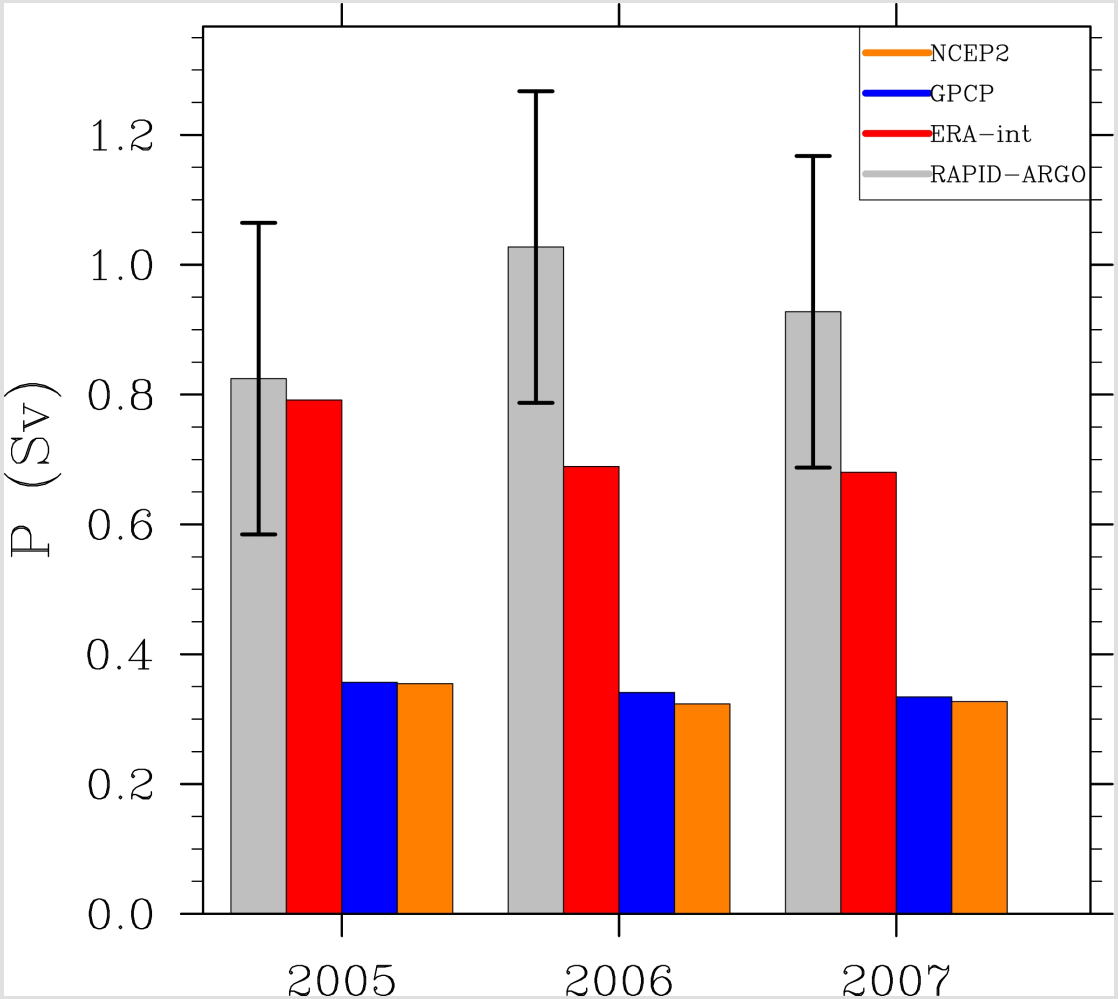
$$P = E - R - FWtrans_{26.5} + FWtrans_{41} + FWtrans_{Med}$$

	FW flux (10^9 kgs^{-1})
26.5°N transport	-0.022 ± 0.08
41.5°N transport	+0.002 ± 0.001
Straits of Gibraltar throughflow	-0.041 ± 0.01 (Criado-Aldeanueva *et al*, 2012)
Net ocean transports	**-0.06 ± 0.06**
Runoff	0.041 (± 0.02 ?) (Dai *et al*, 2009)
E-P	**-0.02 ± 0.084**
E	-0.8 ± 0.1
P (inferred)	**0.82 ± 0.13**





Annual-mean precipitation inferred from RAPID-Argo



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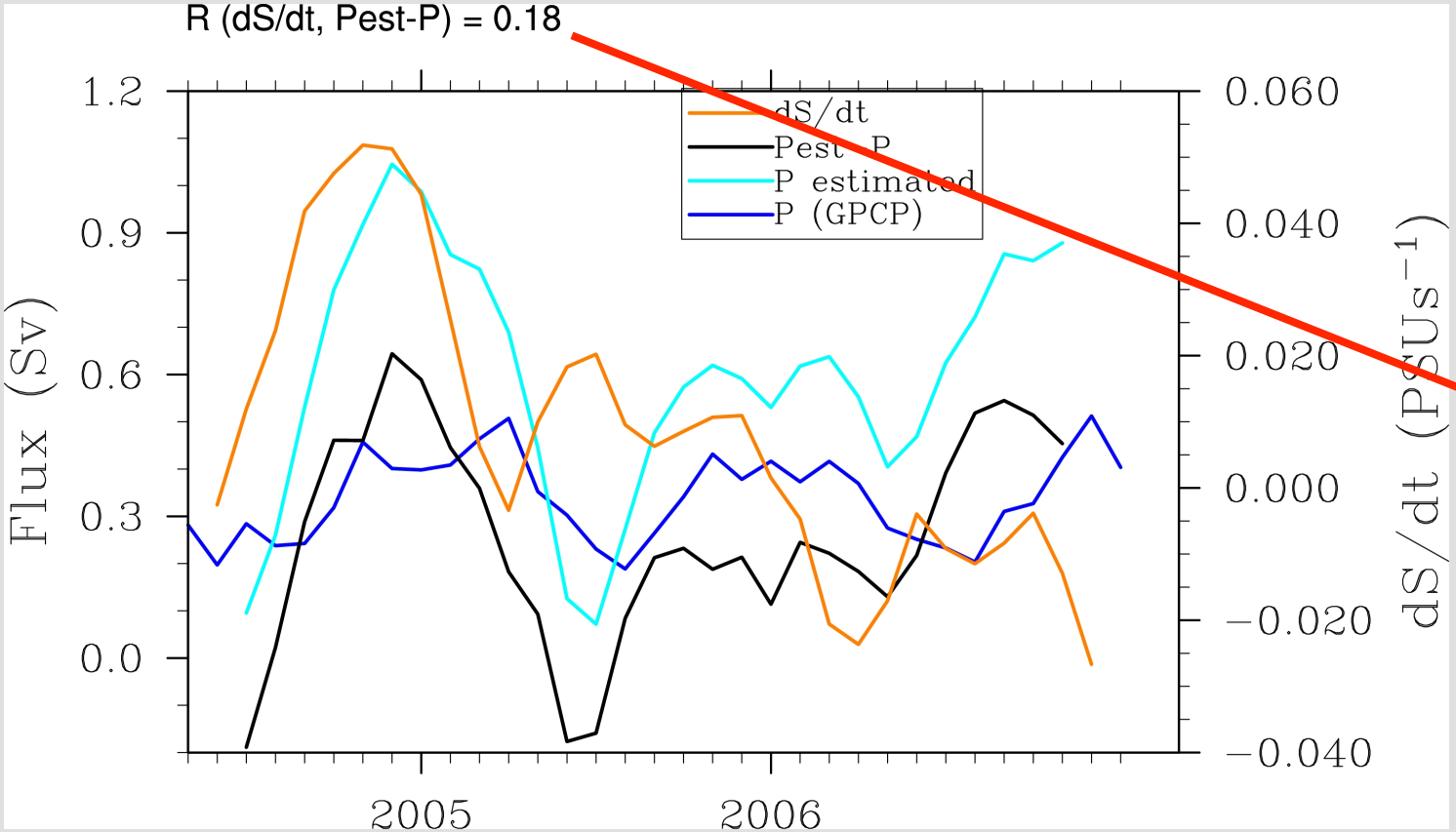
P (inferred)	**0.82 ± 0.13**

Relationship to near-surface salinity

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

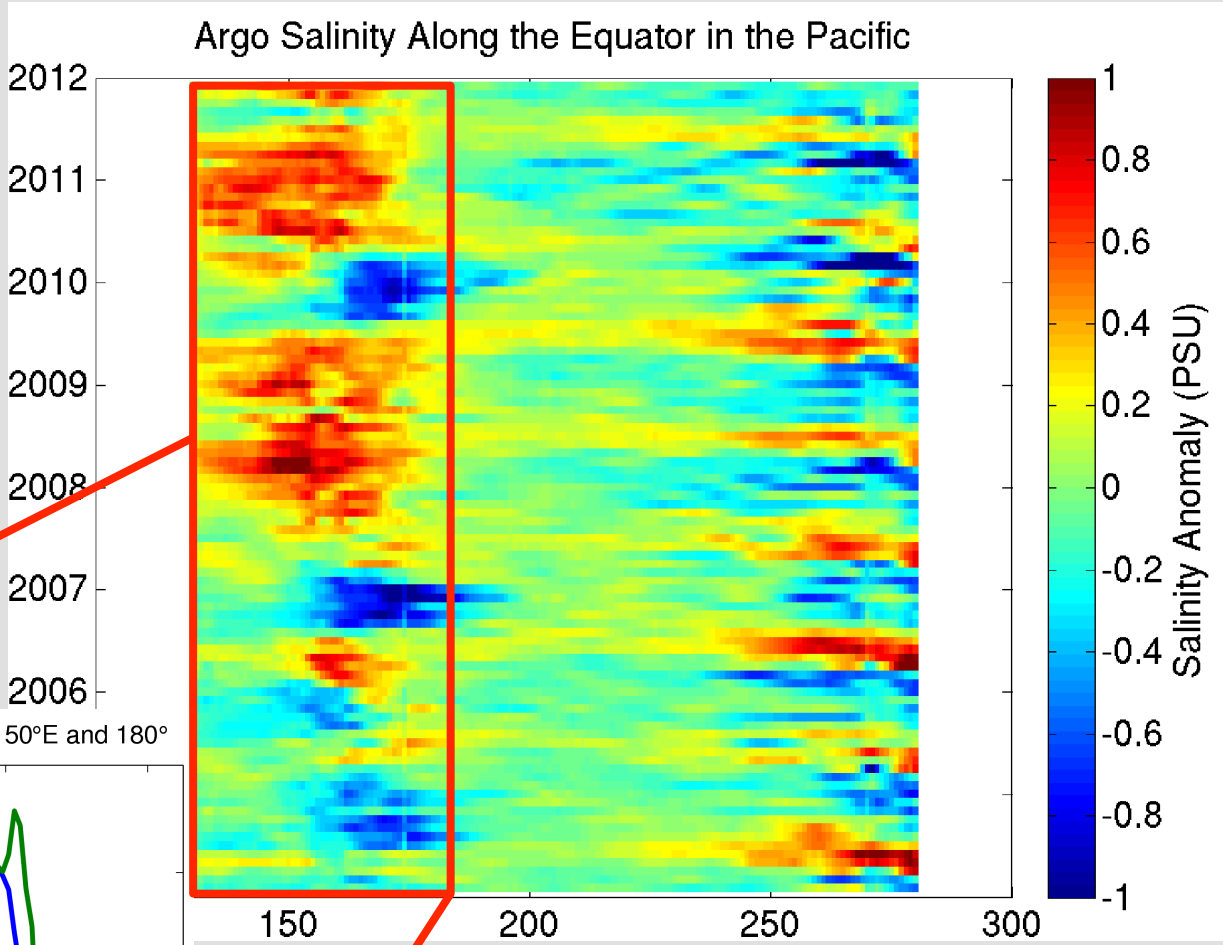
$$E - P = R + FWtrans_{26,5} - FWtrans_{41} + M + \rho \int \frac{\partial SSH}{\partial t} dA + f\left(\frac{\partial S}{\partial t}\right)$$

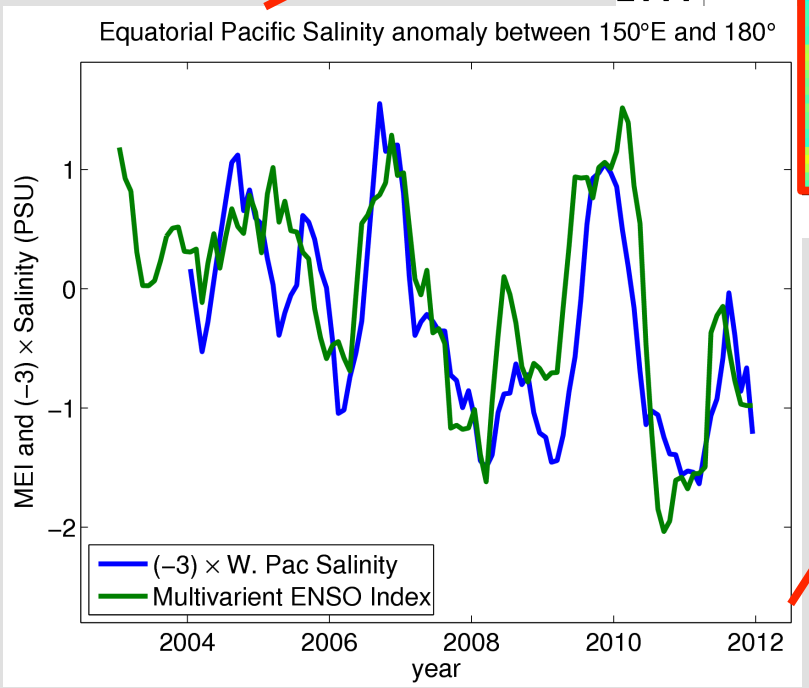


Estimating this relationship is the challenge!

FIRST LOOK AT ENSO FROM AQUARIUS

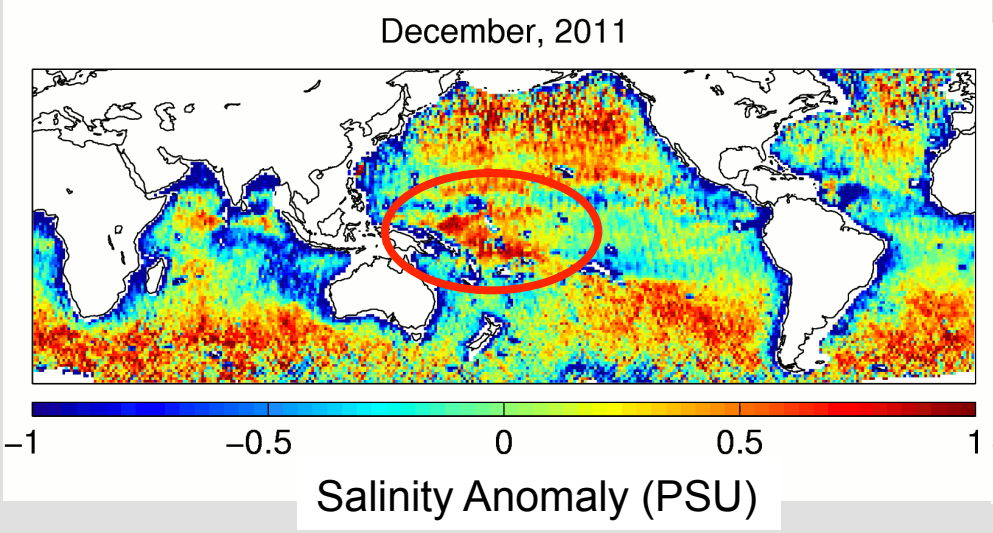
Argo near-surface salinity shows strong ENSO signal in the Western Pacific



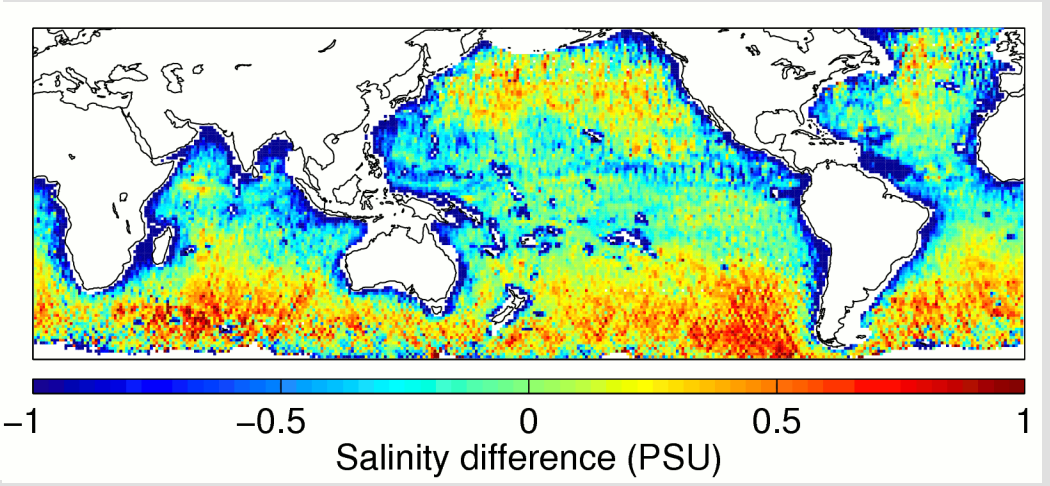


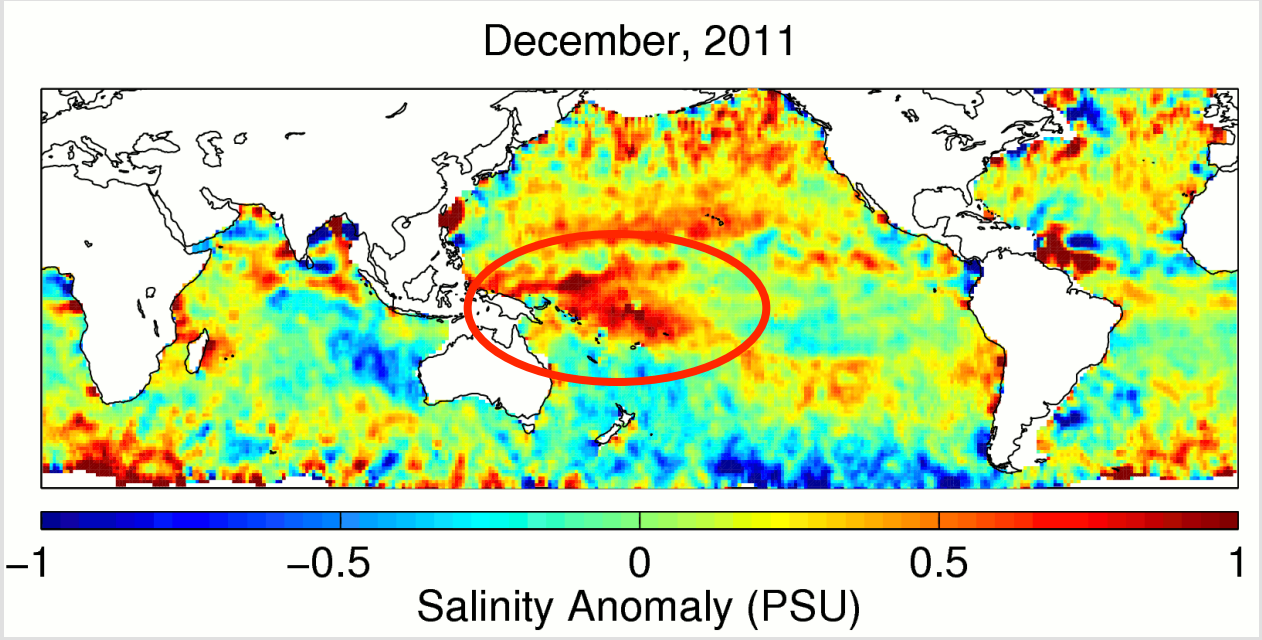
Scaled salinity and MEI comparison

Aquarius minus Argo mean (’05 – ’08)



Aquarius Sept-Oct ‘11 minus Argo Sept-Oct ‘11

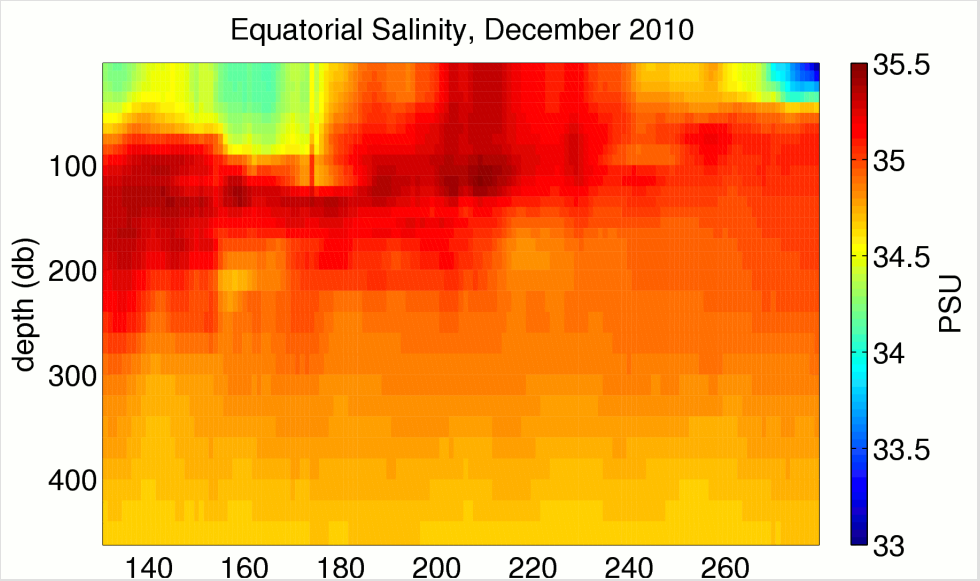




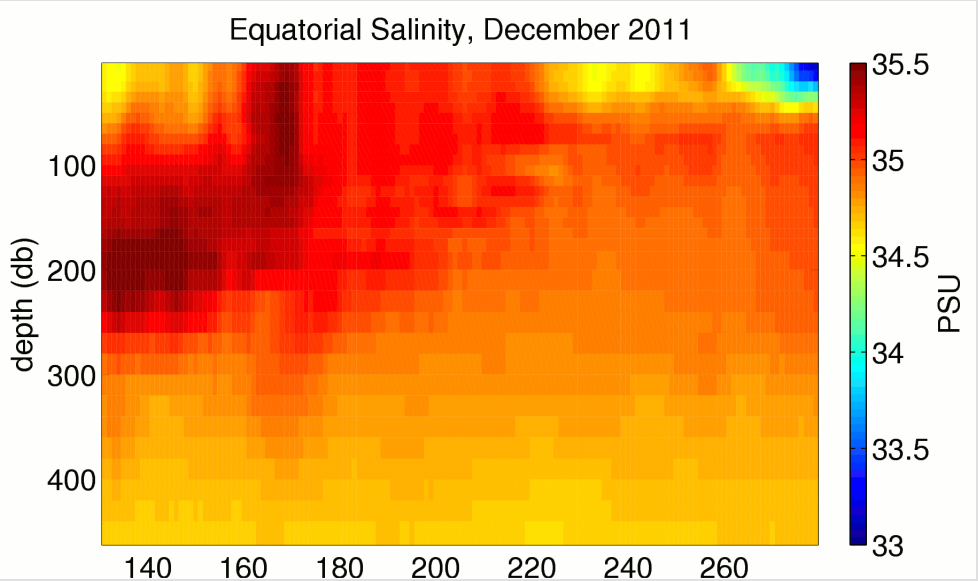
“bias corrected” Aquarius anomaly for Dec. 2011

Argo based salinity along the Equator

During the 2010 El Niño event, near surface salinity is low in the west and salinity maximum is near the center of the Pacific



During the 2010 La Niña event, near surface salinity is high in the west and salinity maximum has migrated west



Summary

- Estimates of annual-mean P from heat and freshwater budgets are reasonable, but somewhat high.
- For sub-monthly time scales, more work required to relate salinity data to E-P to get useful estimates
- ENSO variability should be one of the biggest large-scale, climate signals visible in the Aquarius data