Salt balance in a global 0.1° x 0.1° simulation 1979-2009

Eulerian analysis

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Model: 0.1°x0.1°x10m global POP2 /CICE GCM forced by Large-Yeager daily surface flux. Initial conditions based on model forced by years of Normal Year Forcing. All budget terms retained. We examine a 15yr sample 1994-2008.

Vertically integrated Eulerian salt budget equation

$$\underbrace{<\frac{\partial S}{\partial t}>}_{TEND} = \underbrace{-<u\frac{\partial S}{\partial x}>}_{ZADV} \underbrace{-<v\frac{\partial S}{\partial y}>}_{MADV} \underbrace{-<w\frac{\partial S}{\partial z}>}_{VADV} + \underbrace{\frac{(E-P)S}{H}}_{SSF} + \underbrace{\frac{Q_{DIF}(z=H)}{H}}_{VDIF} + <HDIF>$$

HADV

Vertical ave: 0-MLD or 0-100m

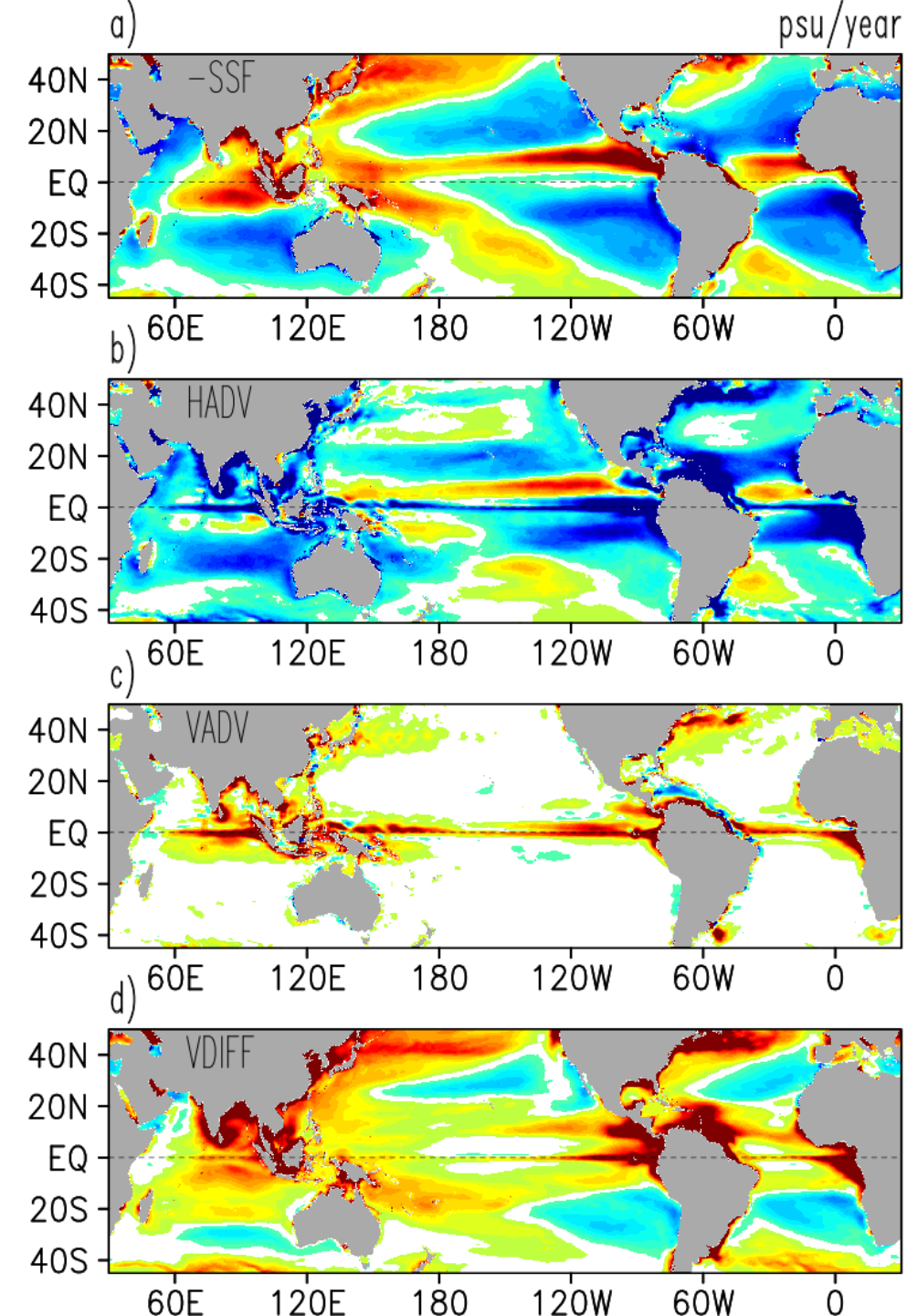
Time decomposition

55-dy avg

$$<\overline{\vec{u}\cdot\nabla_h S}> = <\vec{u}\cdot\nabla_h \overline{S}> + <\overline{\vec{u}'\cdot\nabla_h S'}>$$

Not a perfect scale separation..

Time mean mixed layer

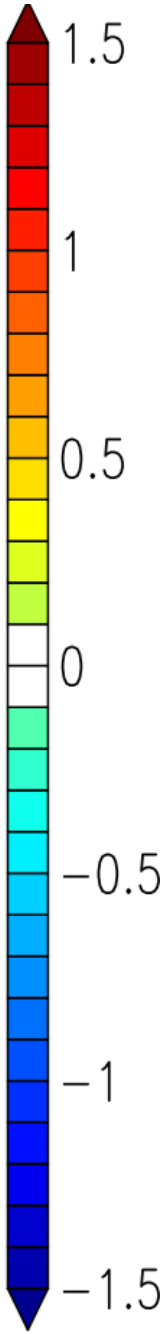


Surface freshwater flux

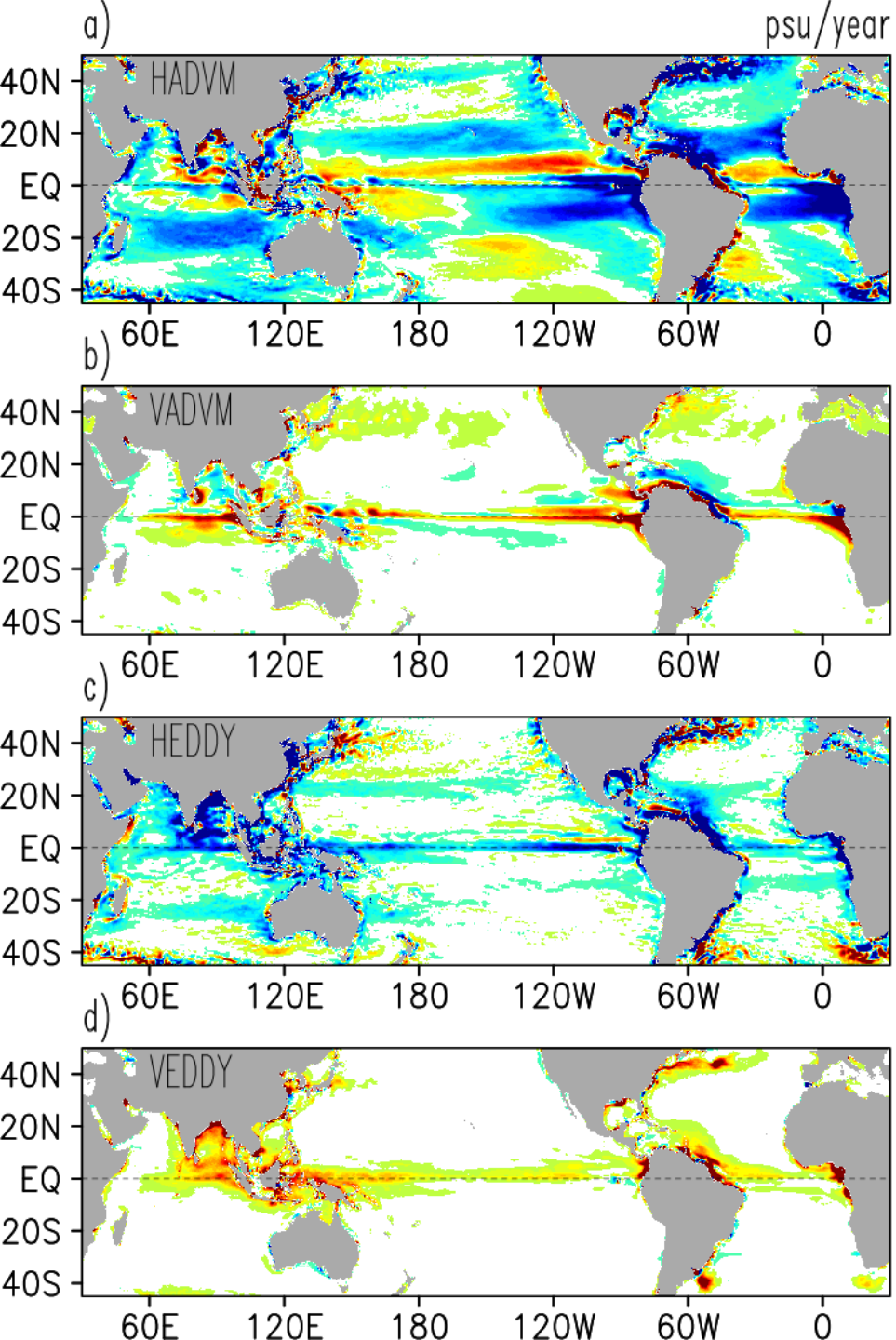
Horizontal advection
(mean and eddy)

Vertical advection
(mean and eddy)

Vertical diffusion



Mixed layer salt transport partitioning



Horizontal advection by mean currents

Vertical advection by mean currents

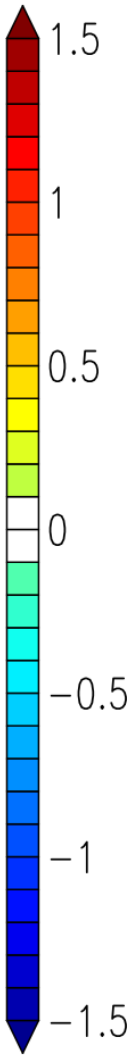
Mostly freshens

Horizontal **eddy** advection

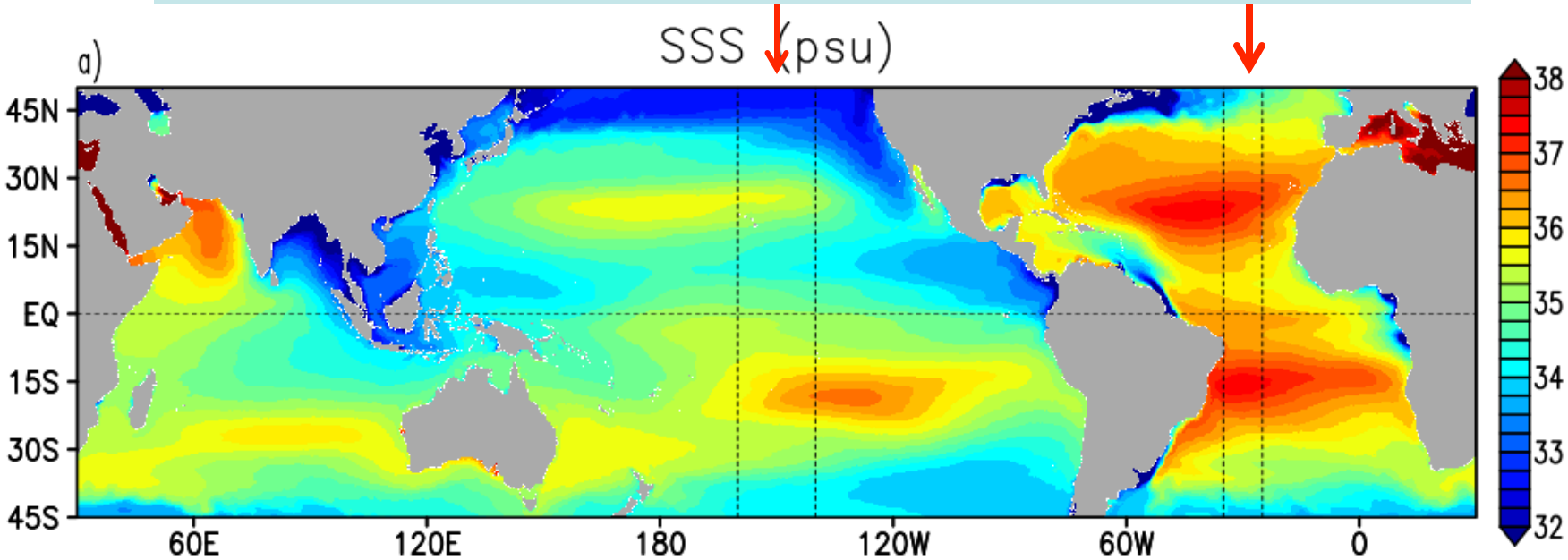
Agulhas eddies?

salinifies

Vertical **eddy** advection

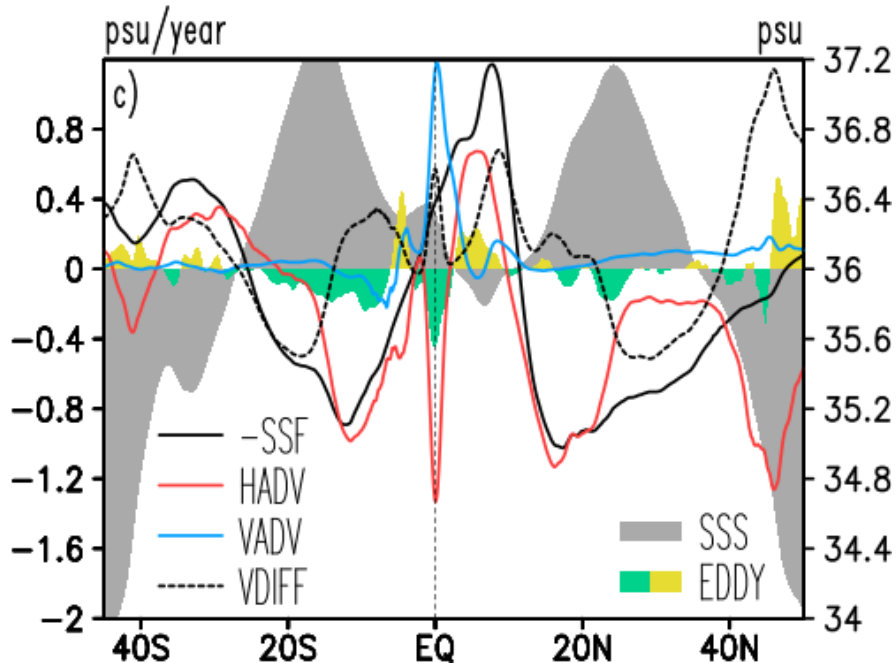


Mean mixed layer salt budget with latitude



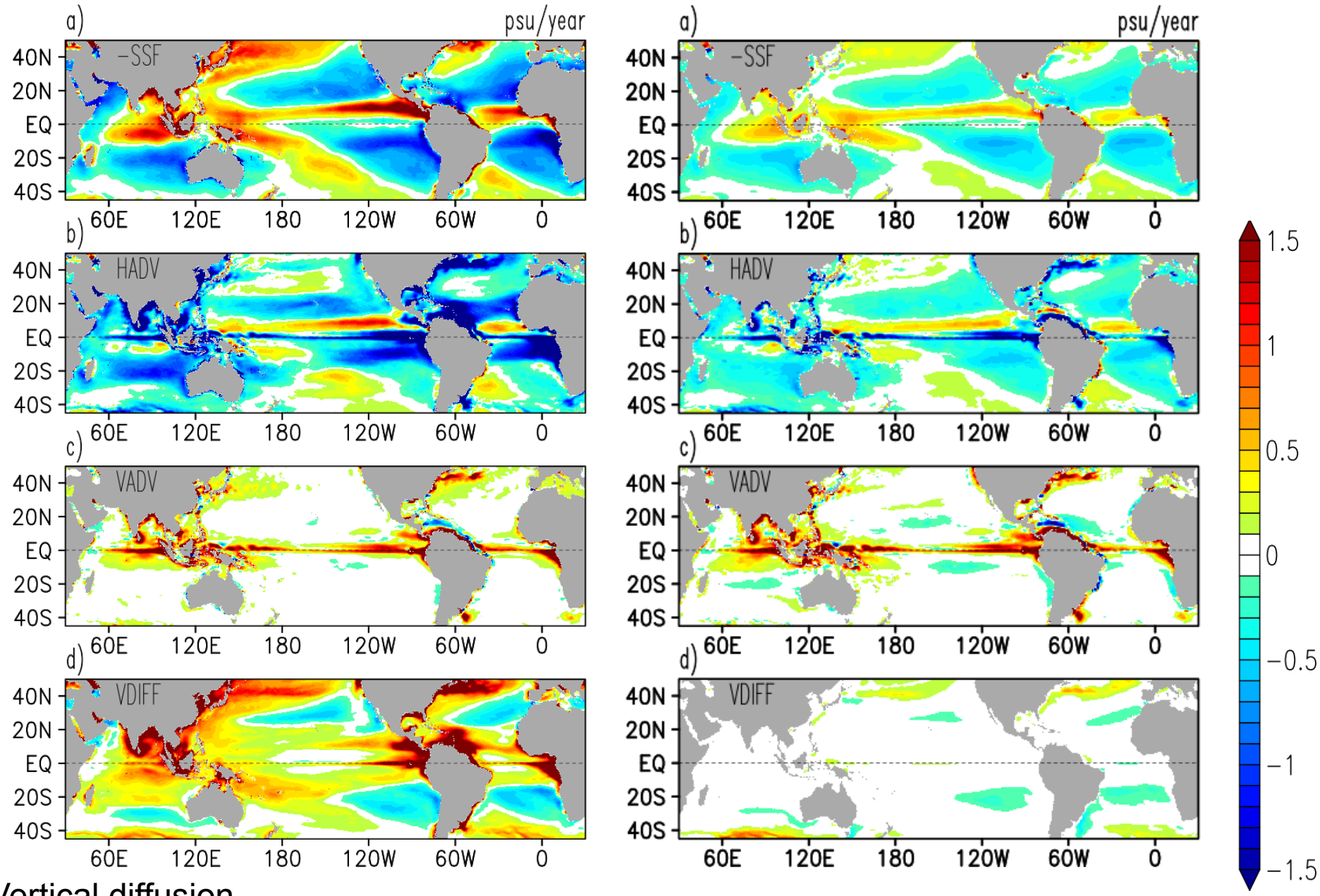
salinifying ↑

freshening ↓



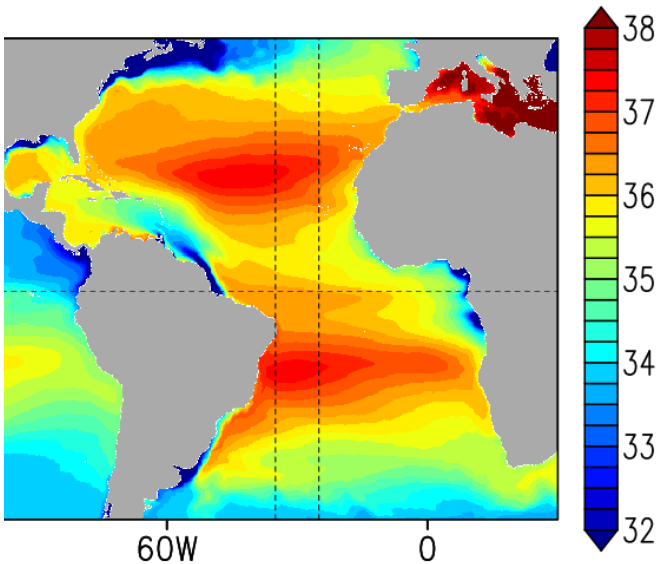
Time mean mixed layer

Time mean 0-100m layer

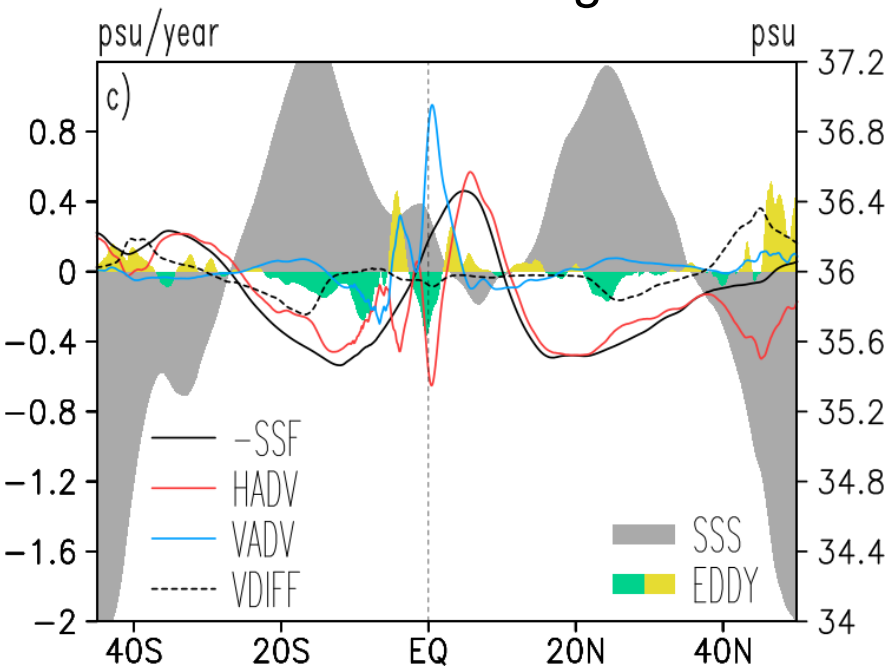


Vertical diffusion

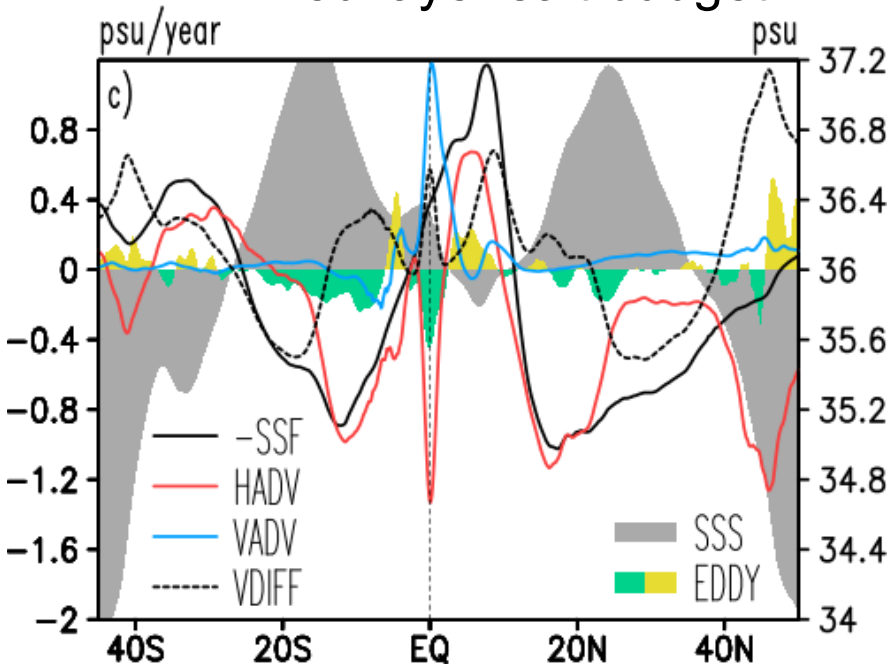
Time mean salt budget: mixed layer vs 0-100m



100m salt budget

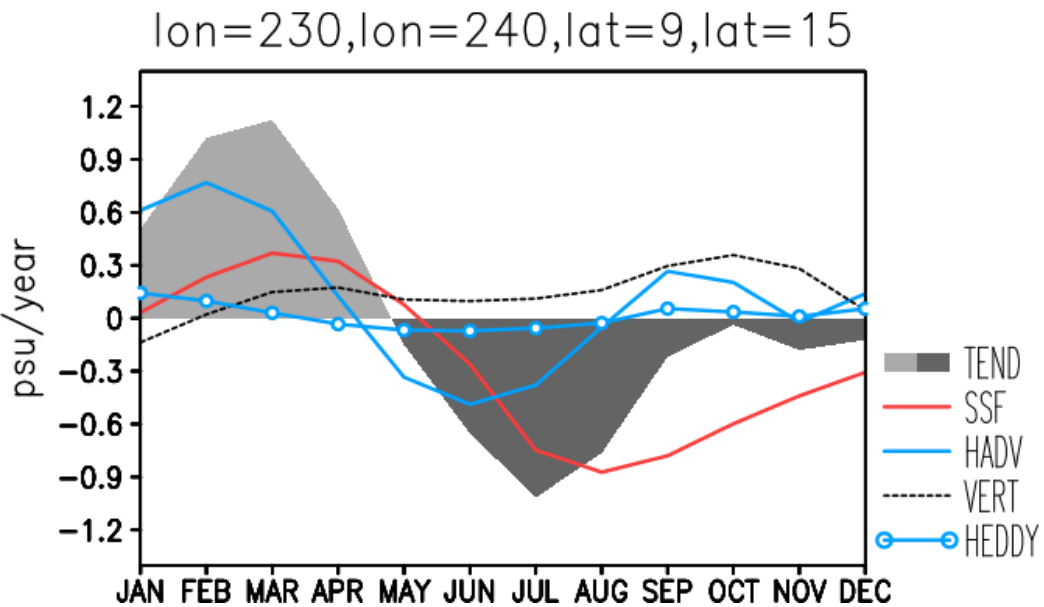


Mixed layer salt budget

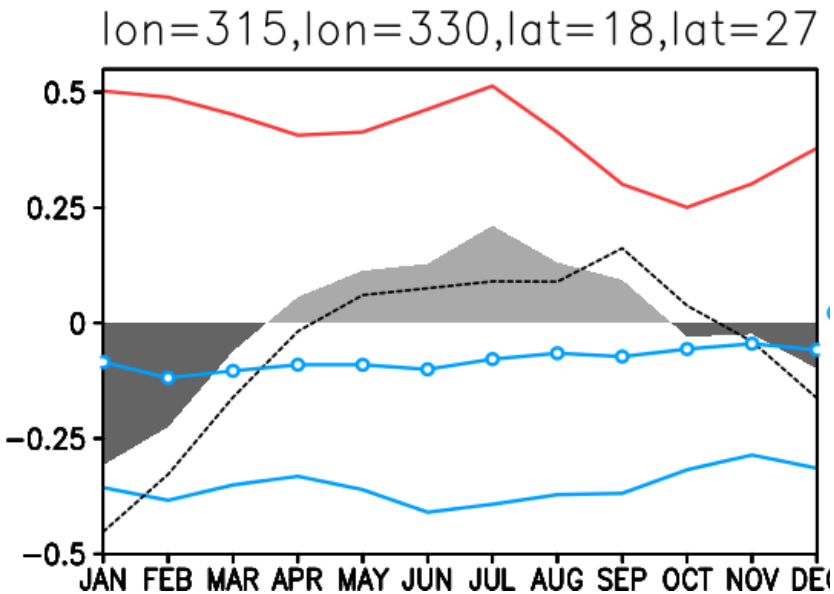


100m seasonal SPURS salt budgets

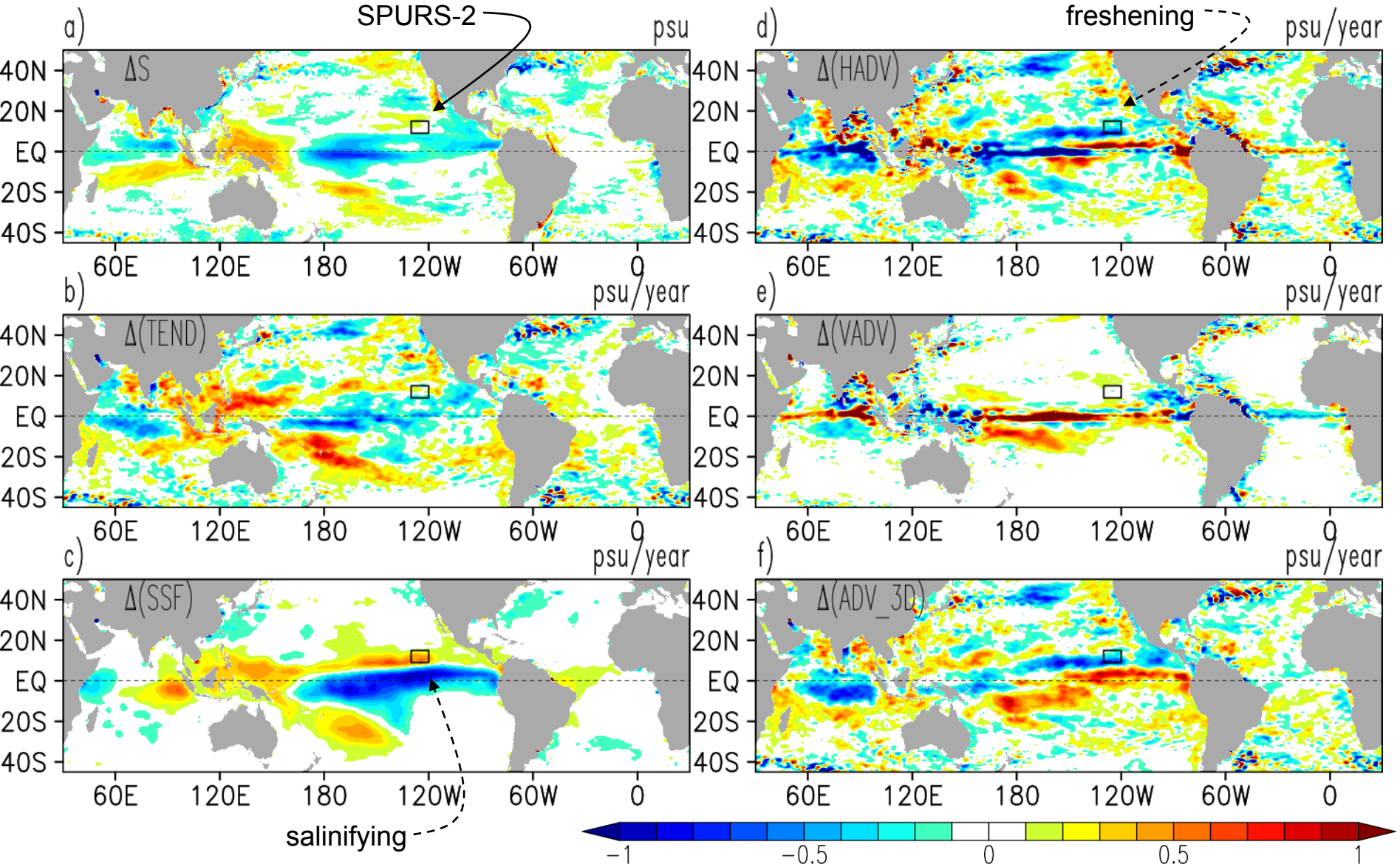
SPURS-2



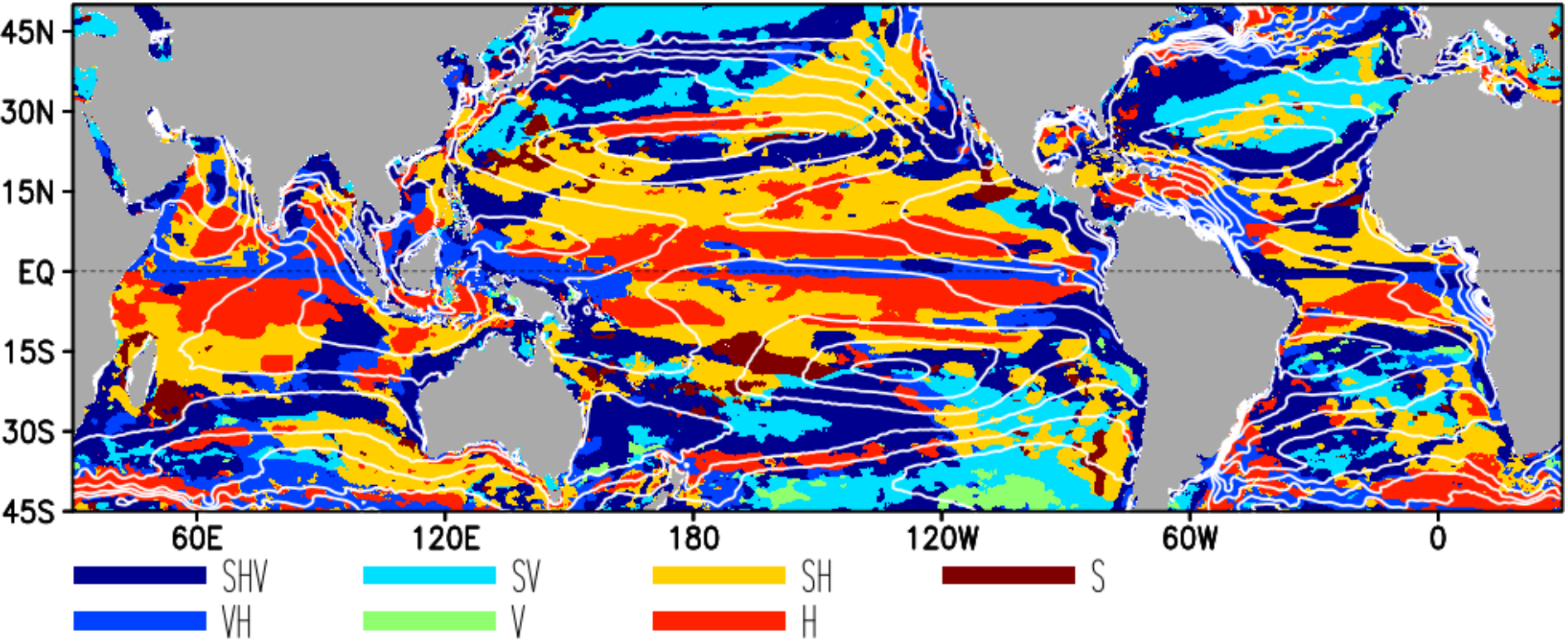
SPURS-1



Changes due to ENSO:
El Nino (May1997-April1998) - La Nina (May1998-April1999)



Terms balancing tendency in the seasonal mixed layer salt budget



S-surface flux,
H-horizontal transport,
V-vertical processes (VDIFF+VADV)

Remarks

- **Time mean mixed layer**
  - Salty pools: polar side: VDIFF balances E-P*, equatorial side: HDIFF balances E-P
  - Tropics: HADV and eddy fluxes balance ITCZ rain
- **SPURS-1 vs SPURS-2**
  - Eddies more important in SPURS-1
  - Vertical processes more important in SPURS-1
  - Seasonal P-E and HADV crucial in SPURS-2
  - ENSO phase alters relative importance of P-E and HADV, but not S in SPURS-2
- **Eddies (55-dy time separation)**
  - Contribution is 10-20%
  - Horizontal and vertical contributions compensate somewhat in tropics

*different for 0-100m budget