# Interannual Caribbean salinity in satellite data and model simulations

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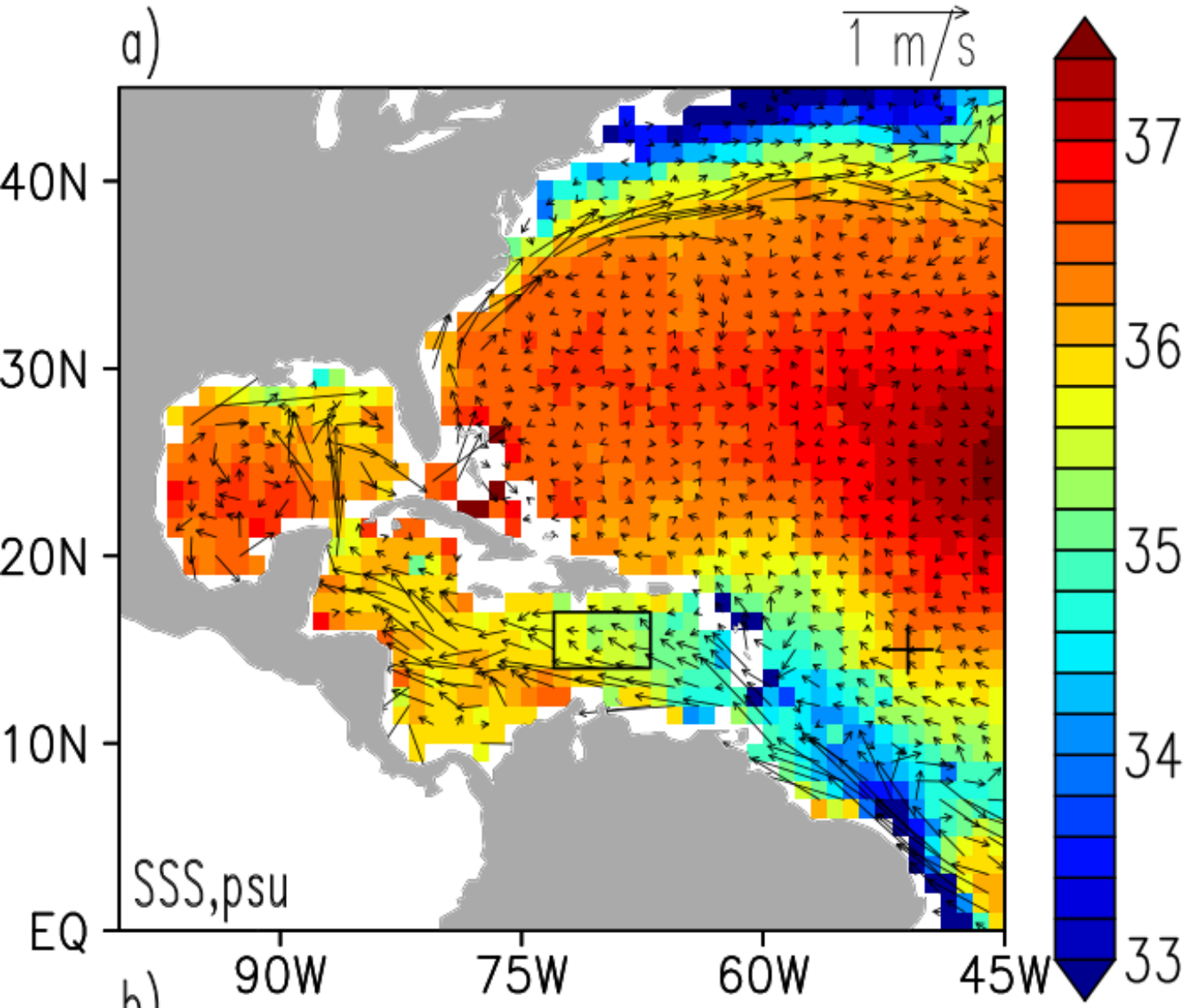
# Outline

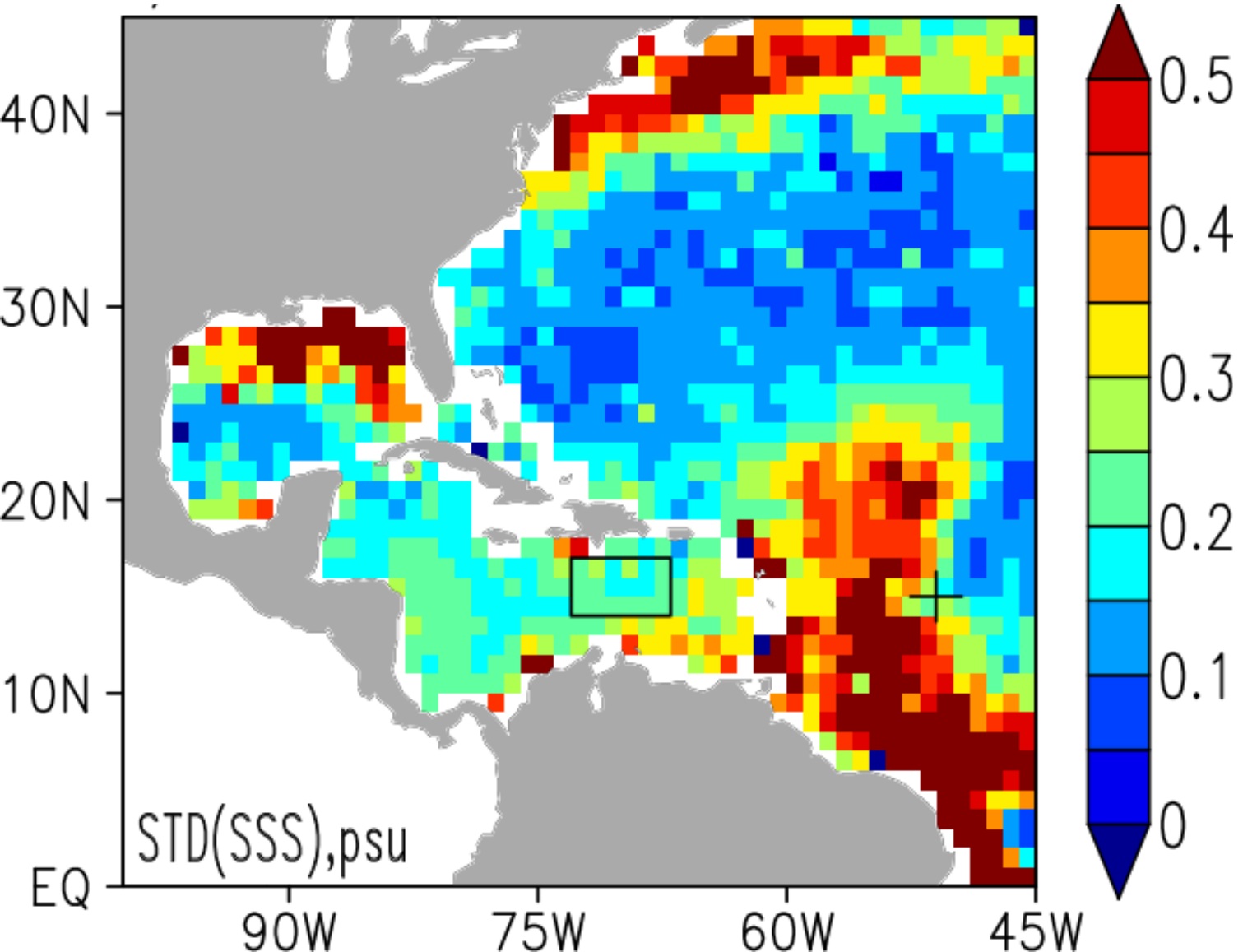
- Interannual SSS anomalies in the Caribbean sector from the Aquarius
- Comparisons with SMOS and in-situ
- Origination mechanisms of Caribbean salinity anomalies and their fate in a global $1/10^{o}$ mesoscale ocean model forced by observed surface fluxes, but *climatological runoff*.

# Time mean Aquarius SSS (v.3.0) and drifter currents



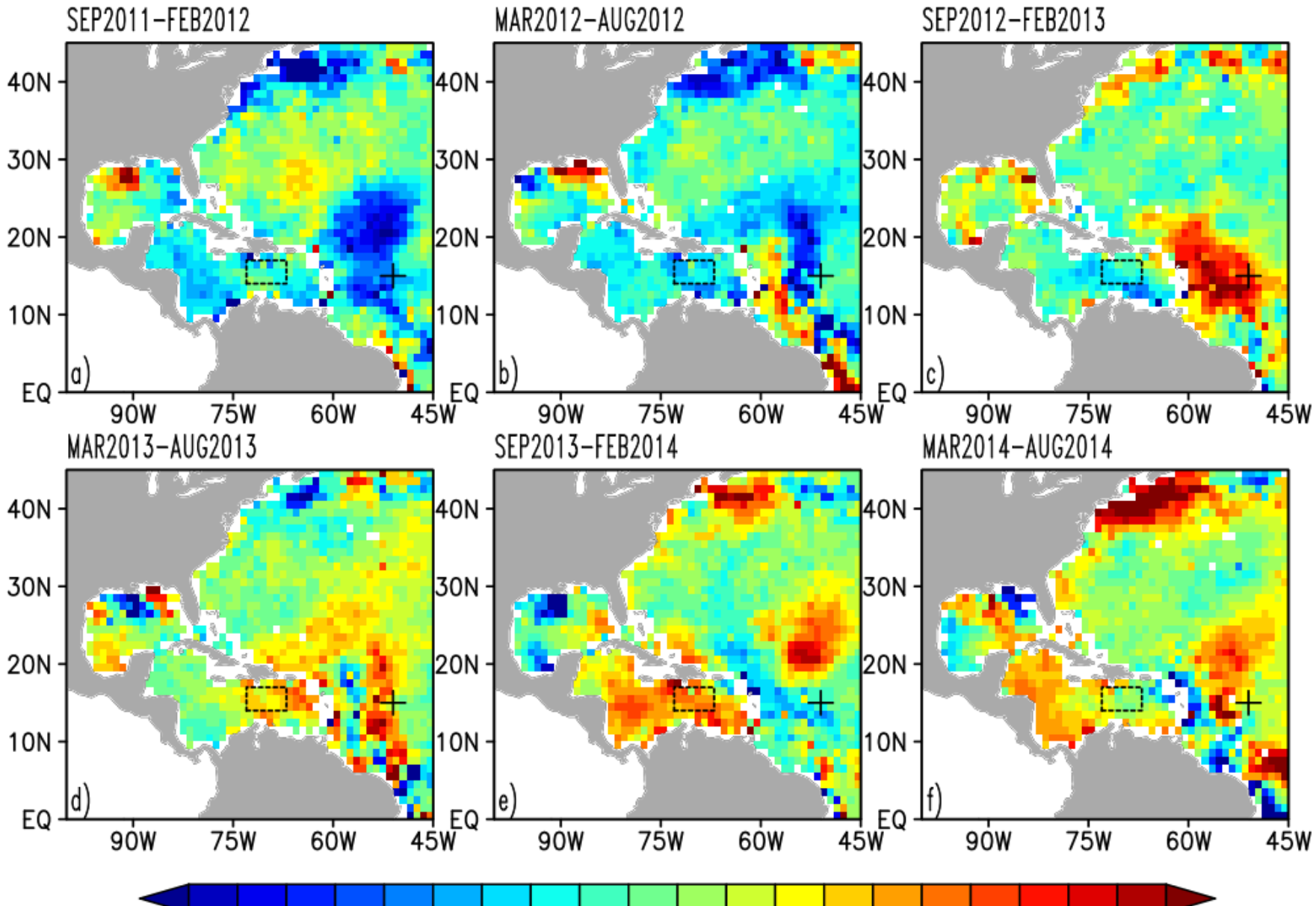

Like the rest of subtropical Atlantic, the Caribbean is evaporative basin that looses ~1m of freshwater/year. But its mixed layer salinity is fresher than in the interior subtropical Atlantic due to the Amazon water transport.

# STD of anomalous monthly SSS

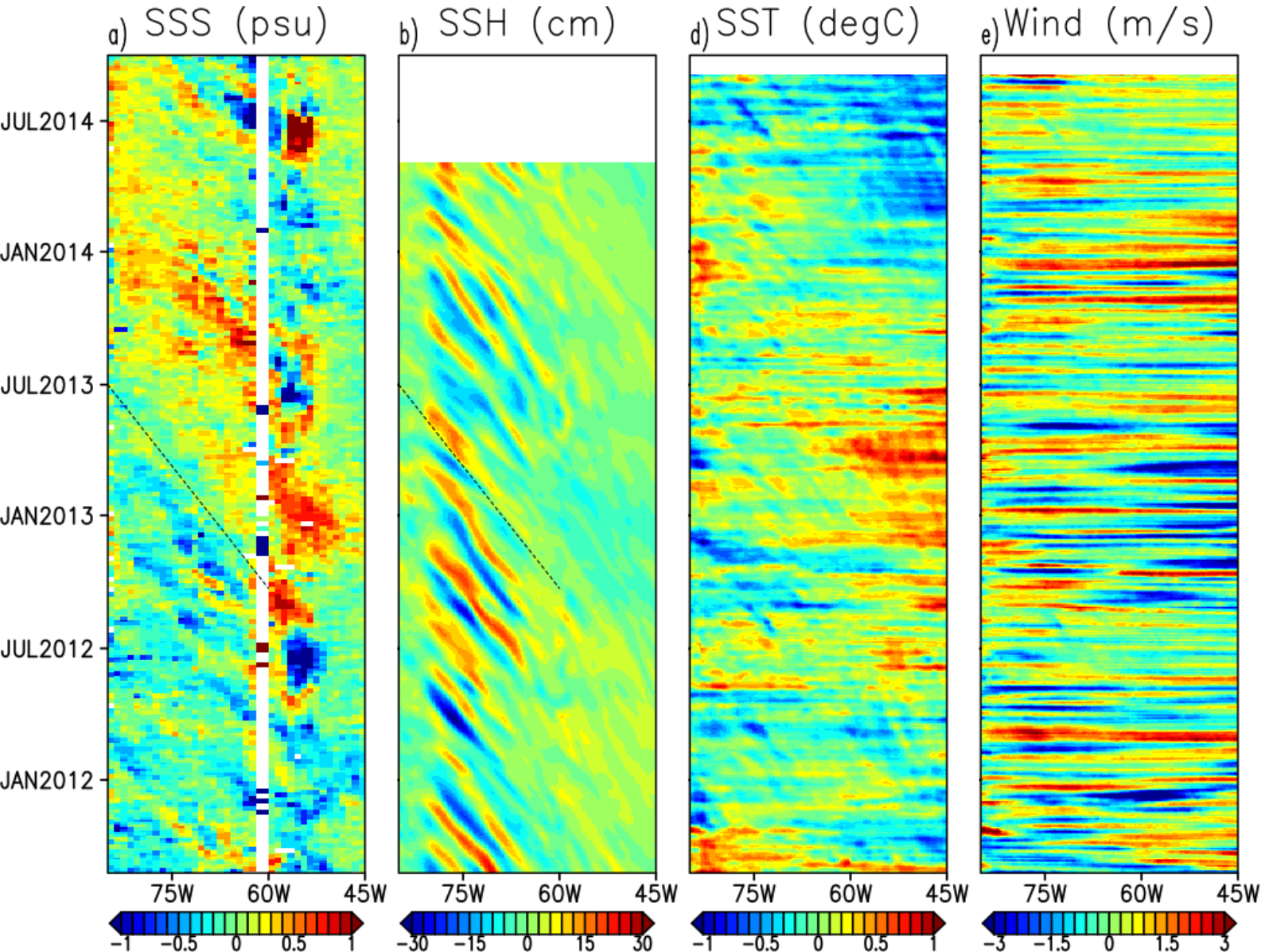



Salinity transport suggests that anomalies produced upstream in the Amazon plume may be transported across the Caribbean. Interannual SSS variations in the Caribbean are higher than in the S-max region and reach about 0.2 to 0.3 psu.

# Aquarius 6-month averaged anomalous SSS (psu)

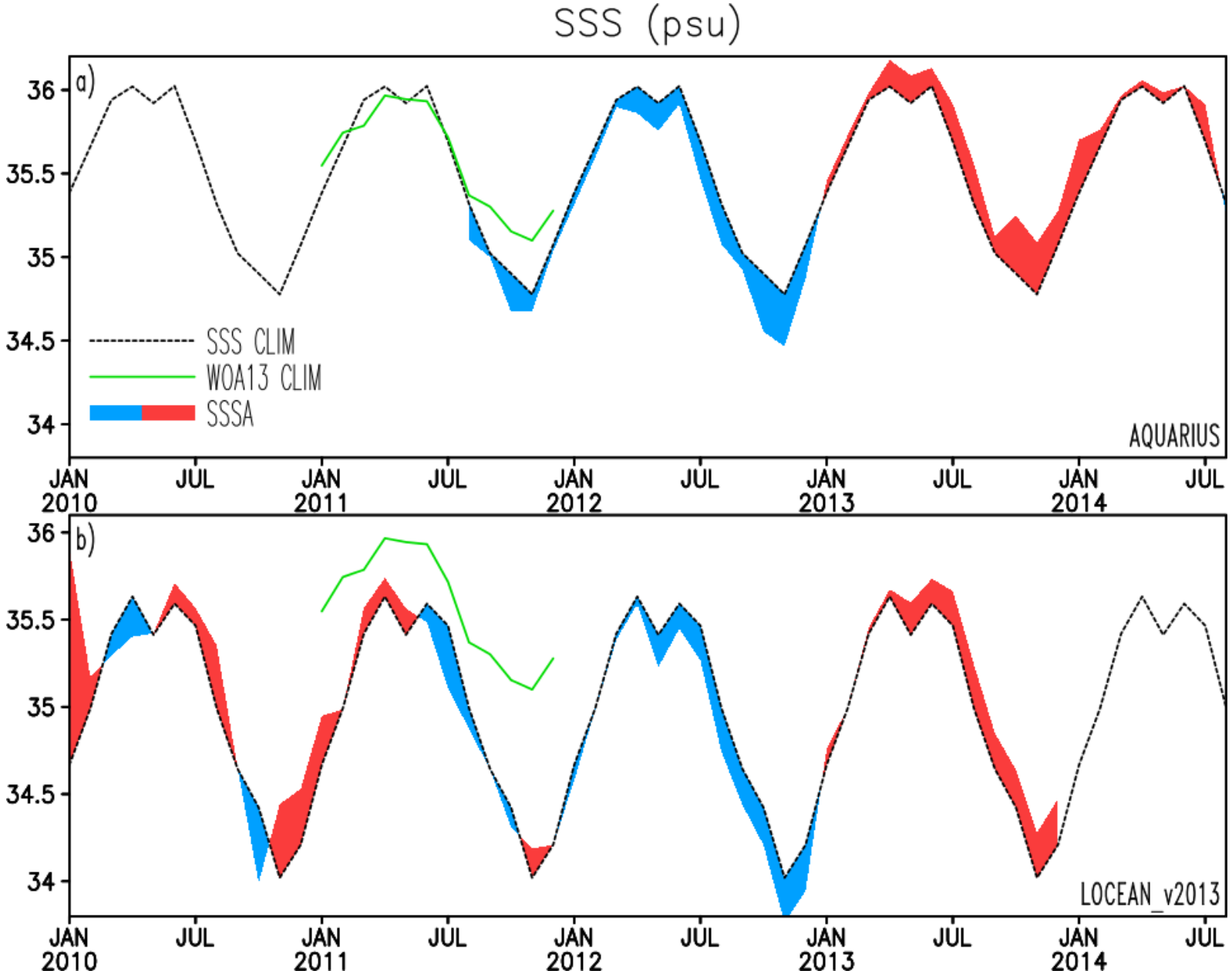


# Anomalous (a) SSS, (b) SSH, (c) SST, and (d) ASCAT wind speed averaged 14N-17N along the Caribbean.

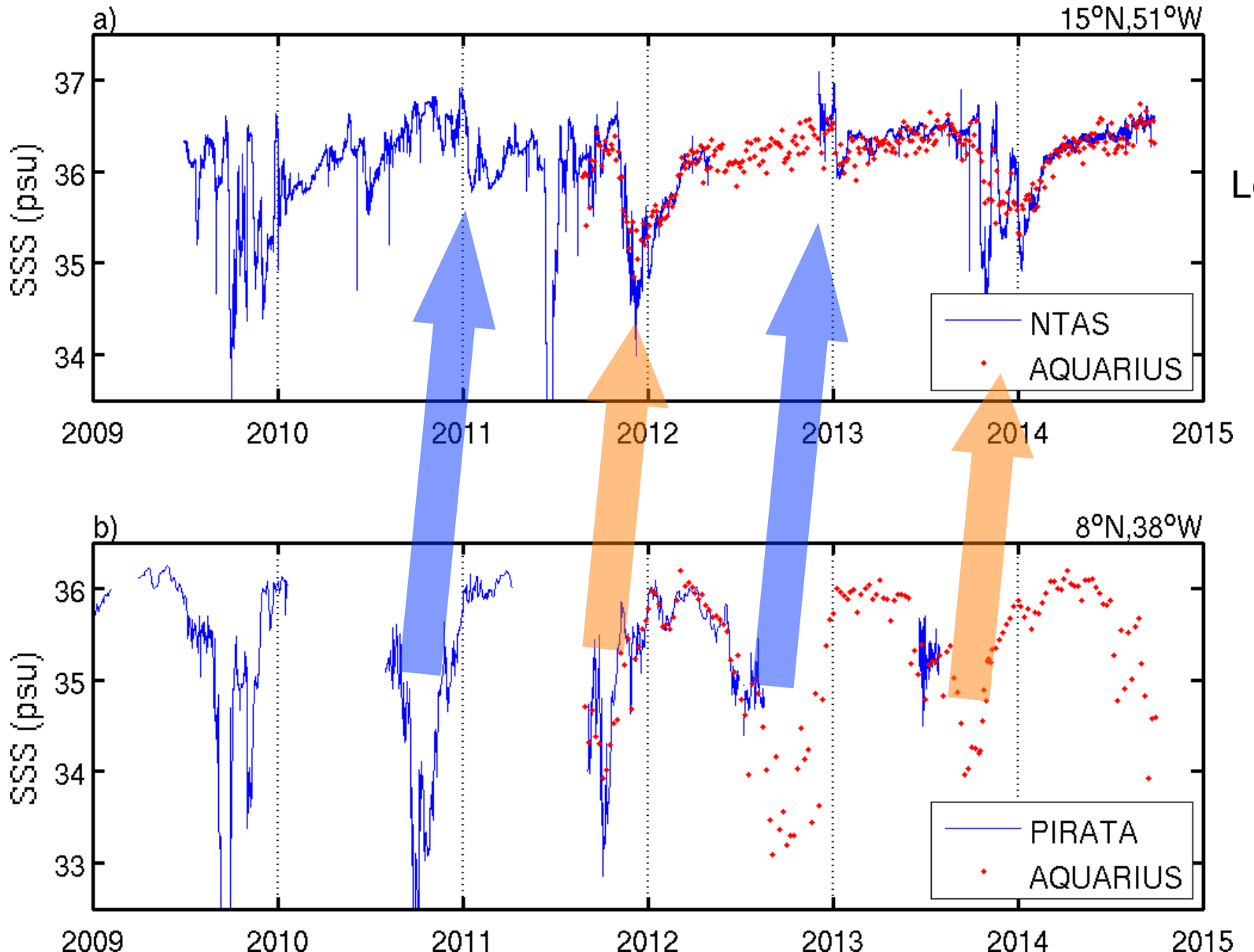



SSS and SSH propagate westward at 11cm/s. SST and wind vary quasi-instantaneously across the basin.

# Anomalous SSS (shaded) in the Caribbean index area from (a) Aquarius and (b) SMOS



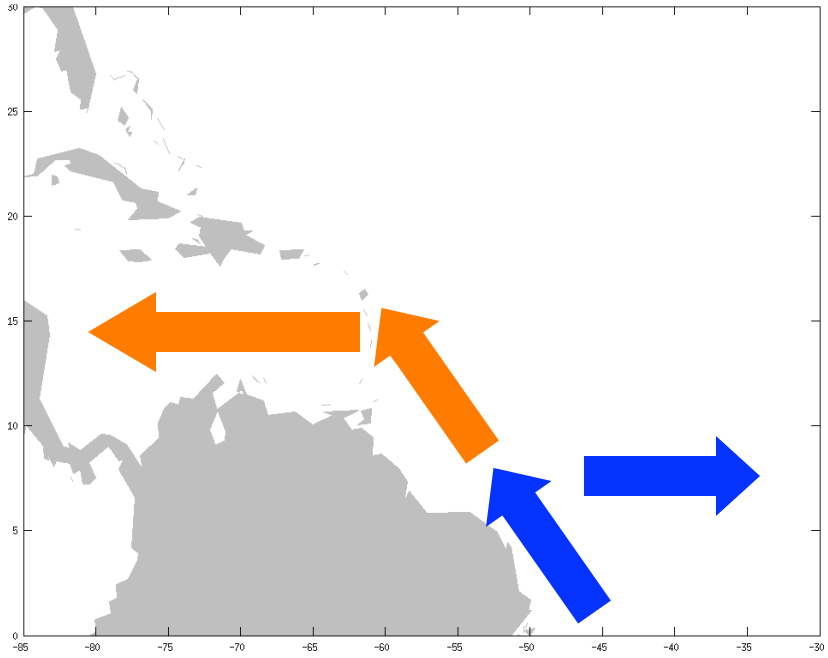
# Daily Aquarius SSS and in-situ 1m-depth salinity at NTAS and PIRATA moorings.



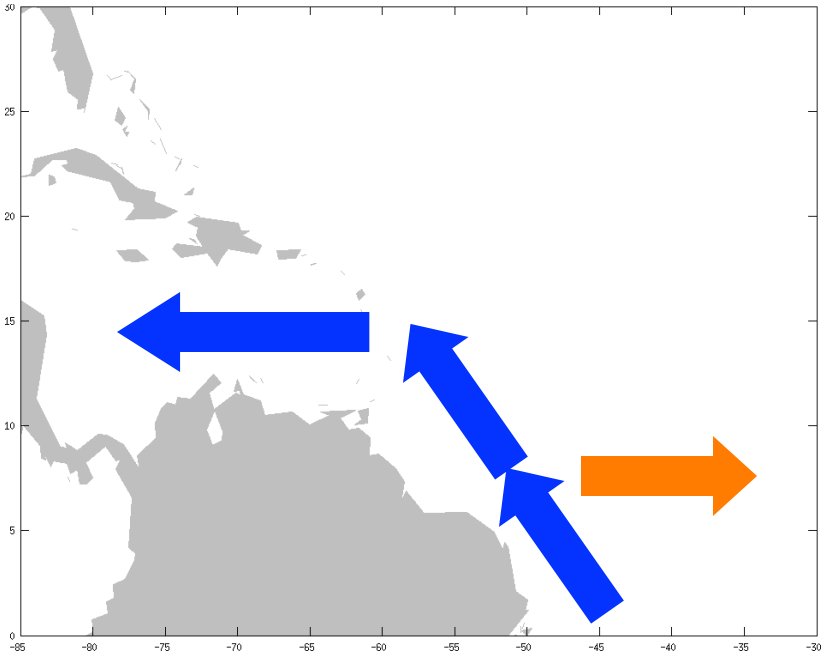

East of the Lesser Antilles

East of the NBC retroflection

# Possible scheme of salt transport regulation by the NBC retroflection

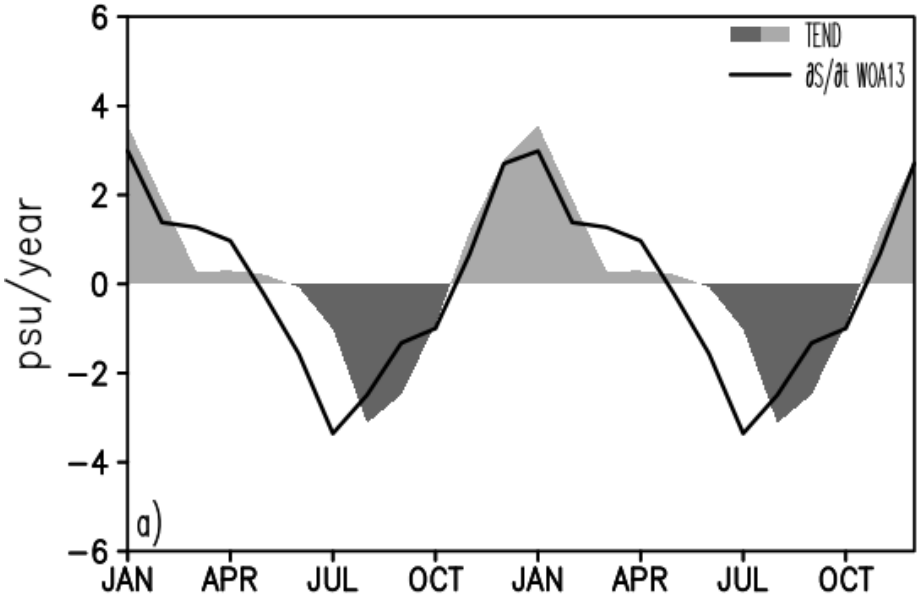



Strong retroflection, fresh NECC, salty Caribbean

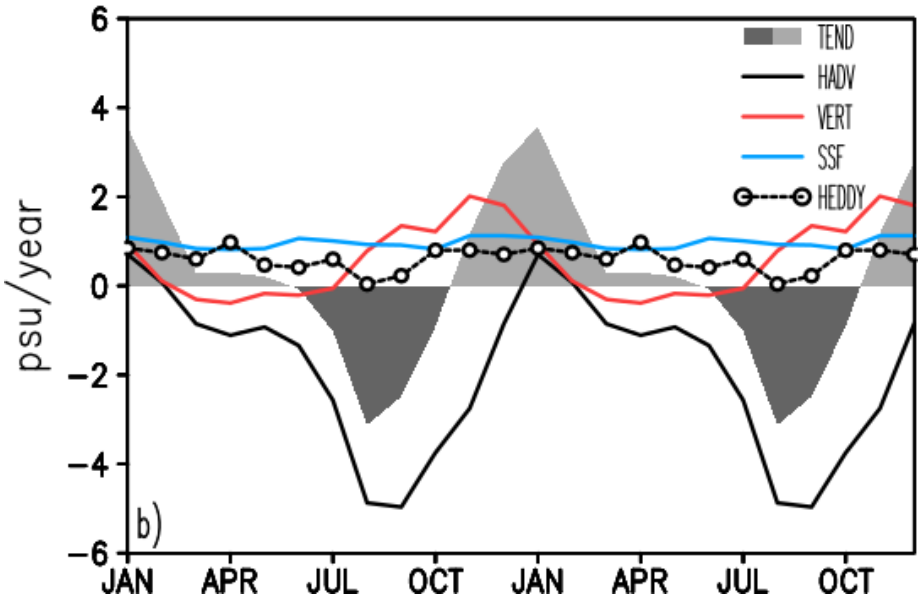



Weak retroflection, salty NECC, fresh Caribbean

# Seasonal cycle of the mixed layer salinity budget in the Caribbean Index Box

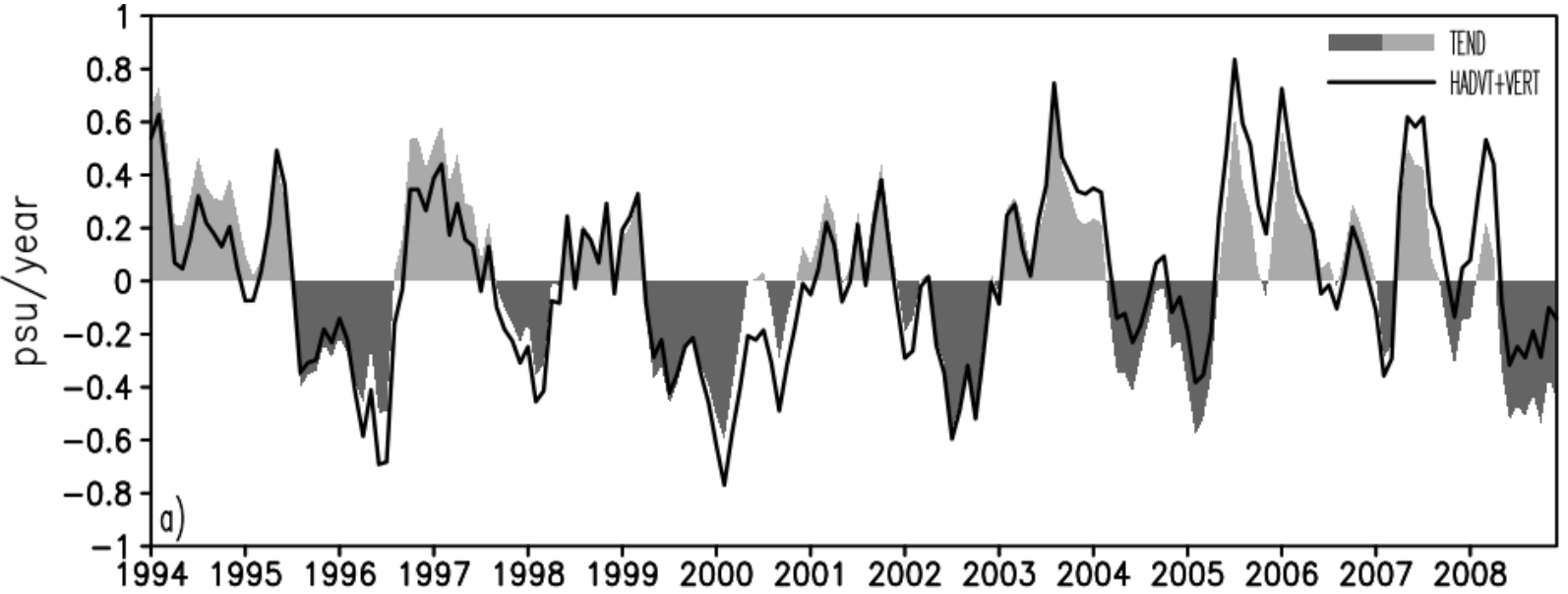



Simulated salinity rate of change (TEND) is close to WOA13 observations

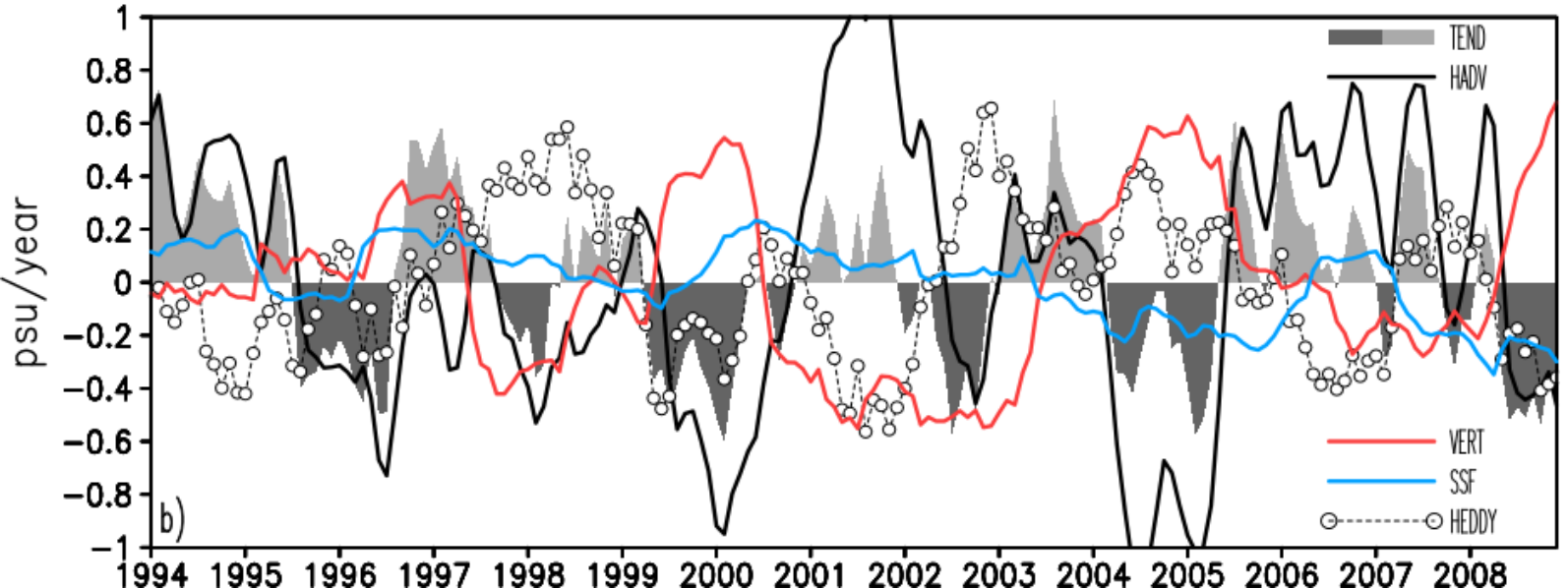



Seasonal cycle of SSS is primarily forced by horizontal advection, which varies in phase with TEND

# Running year-smoothed anomalous mixed layer salt budget in the Caribbean index box

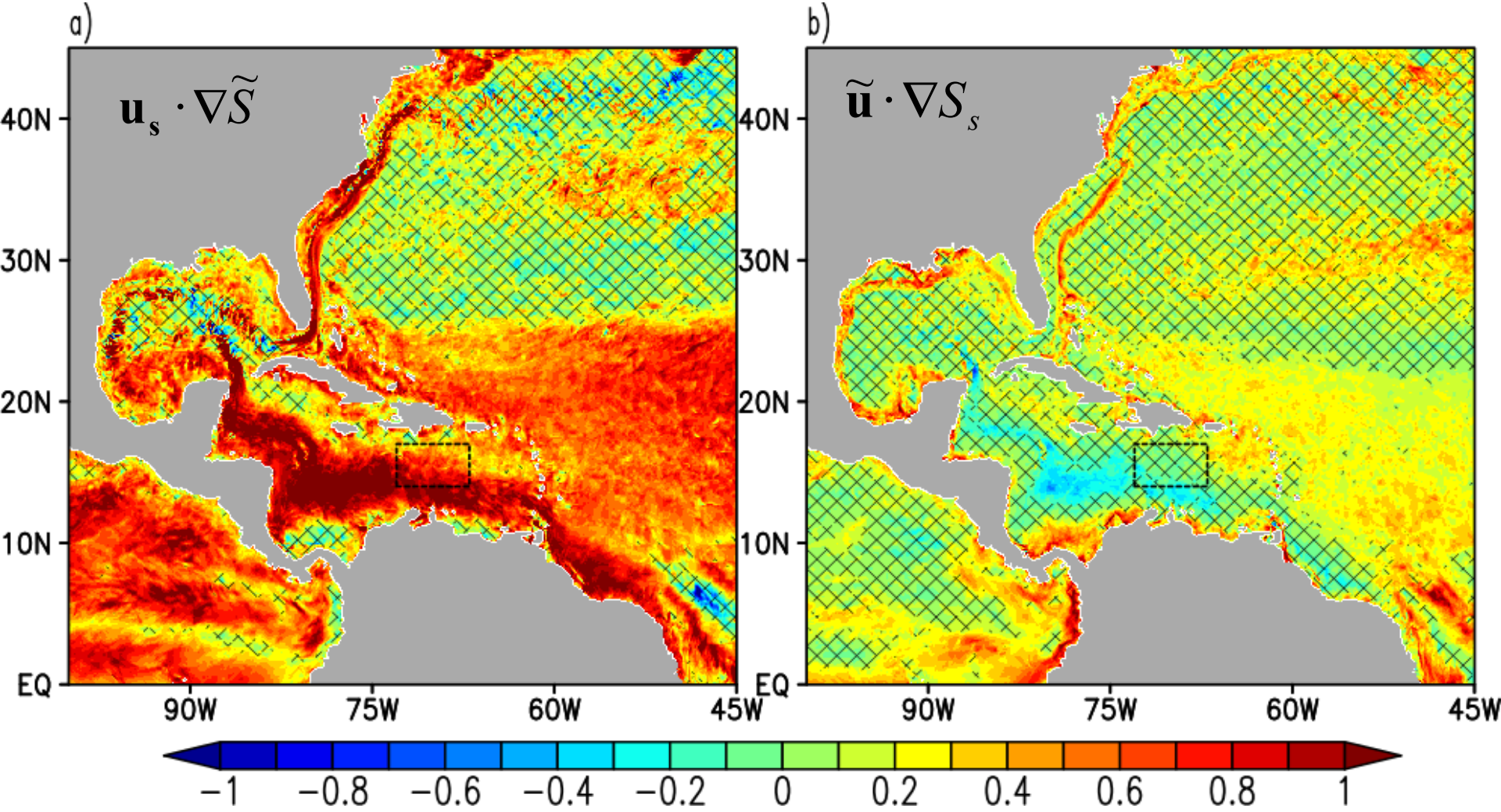



Interannual variations are explained by 3D advection and VDIFF, surface flux plays lesser role



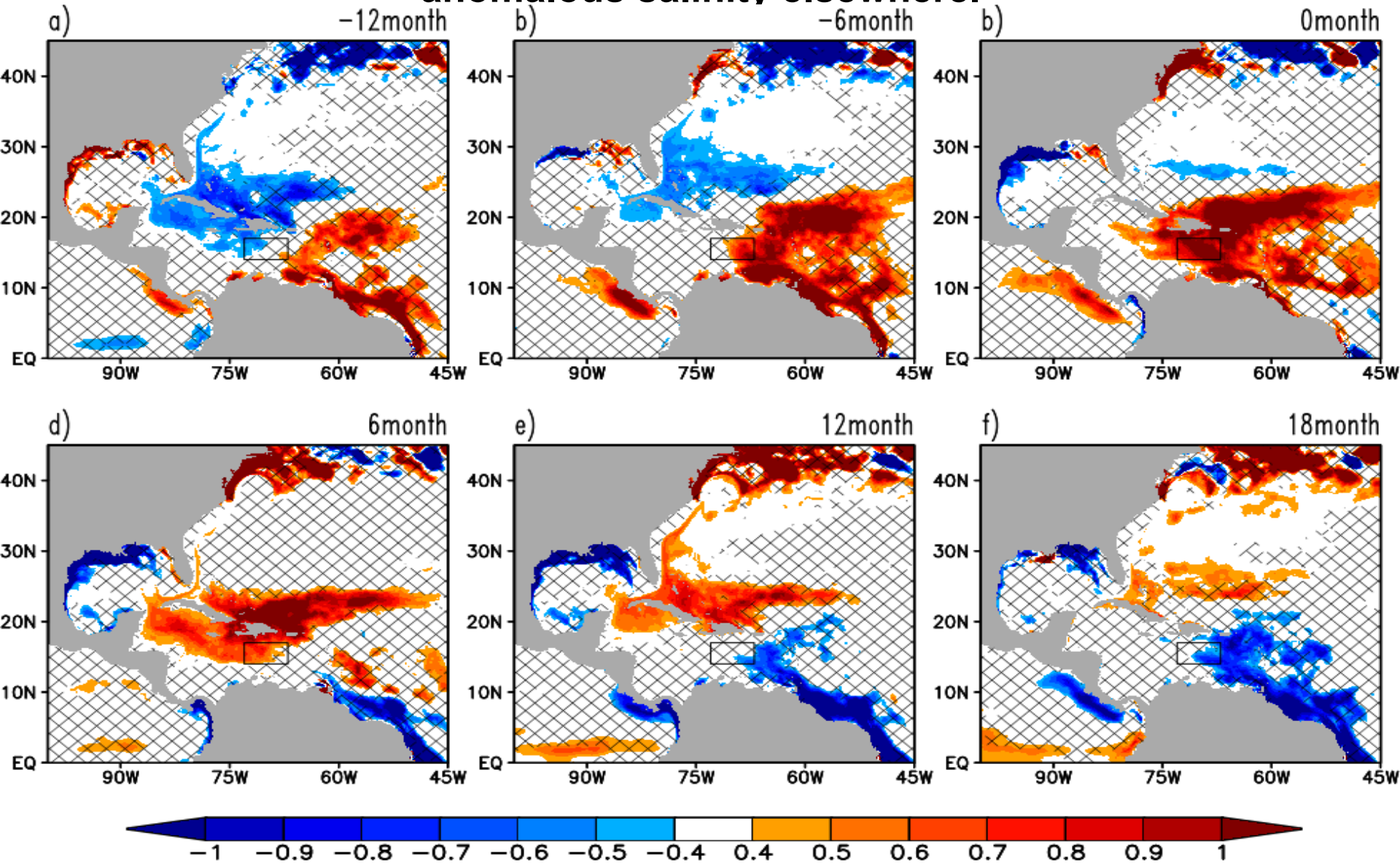

Interannual variations are also forced by HADV. Other terms play negative feedbacks. HEDDY is comparable to other terms

**Anomalous horizontal salt advection partitioning. Shading is temporal regression with (a) anomalous salt advection by mean currents ($\mathbf{u}_s \cdot \nabla \widetilde{S}$), (b) mean salt advection by anomalous currents ($\widetilde{\mathbf{u}} \cdot \nabla S_s$).**




**Correlation below the 95% confidence level of zero correlation is cross-hatched. For these calculations anomalies are estimated from monthly means by subtracting the seasonal cycle. The Caribbean index region is also shown.**

# Lagged regression of anomalous salinity in the Caribbean index box with anomalous salinity elsewhere.




Regions below the 95% confidence level of zero correlation are cross-hatched. Negative lags correspond to time before the peak of an event in the box.

# Conclusions

- Caribbean SSS vary by 0.5 psu between interannual salty and fresh events, which propagate west at ~11cm/s.
- Caribbean SSS anomalies are preceded by corresponding events east of the Lesser Antilles, which originate in the Amazon/Orinoco plume and are possibly regulated by NBC retroflection.
- In contrast to SSS (which propagates), SST changes in-phase across the Caribbean, thus is primarily forced by the surface flux.
- Simulations confirm that interannual SSS is forced by mean horizontal currents acting on anomalous salinity.
- SSS anomalies propagate into the Florida Current and reach the Gulf Stream in about 6 to 12 months after crossing the central Caribbean.
- Although model river discharge doesn't vary interannually, the magnitude of simulated SSS corresponds to observations, thus suggesting that interannually forced ocean dynamics plays a key role in river plume variability and spatial dispersion.