The North Atlantic Subtropical Surface Salinity Maximum as Observed by Aquarius

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Also thanks to J. D’Addezio!
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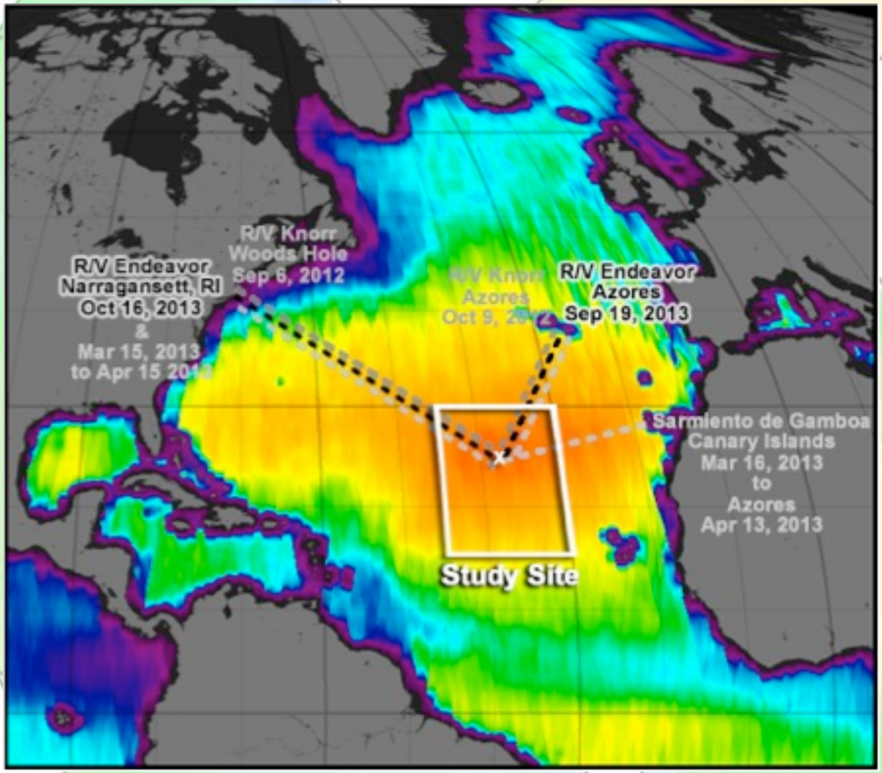
The SPURS Experiment

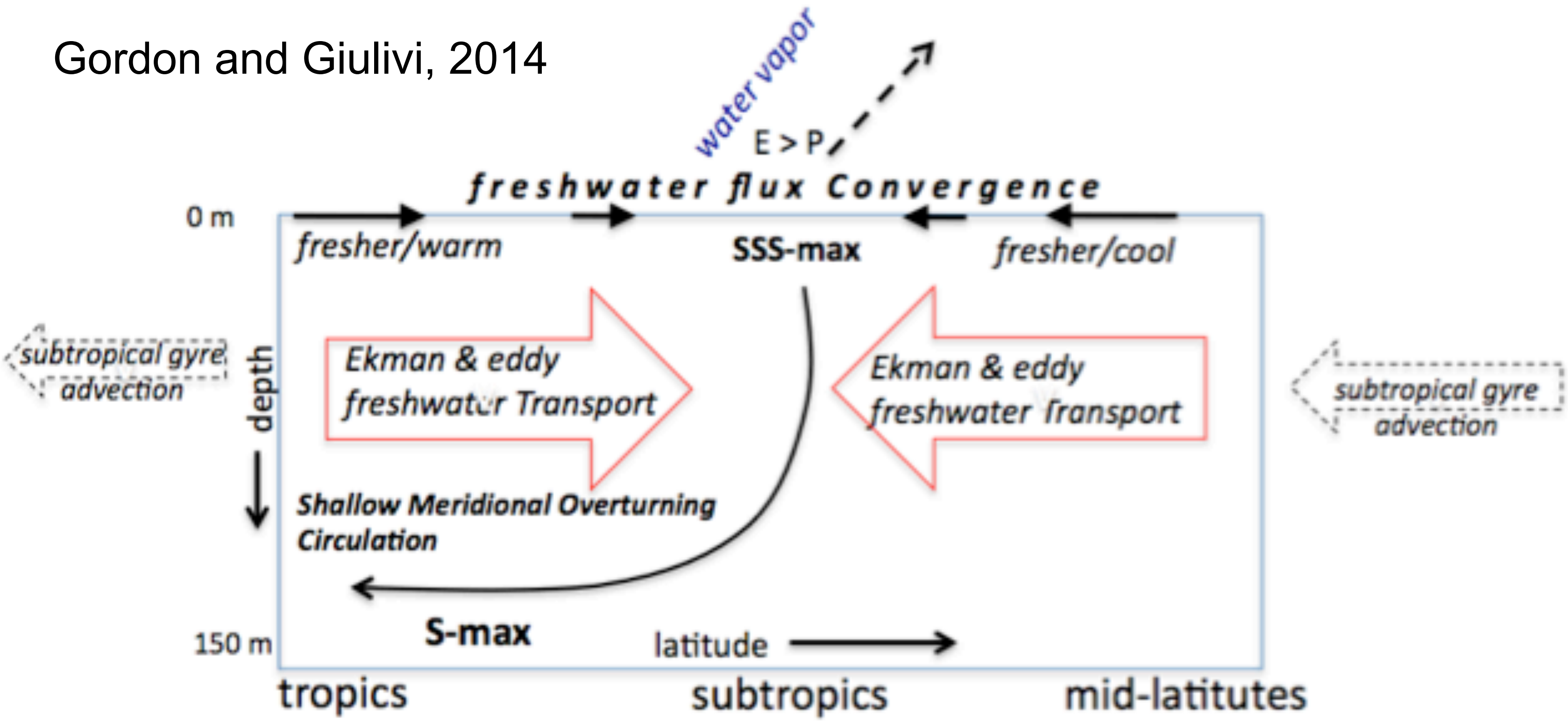


- Surface salinity maximum and formation site of subtropical underwater (STUW)

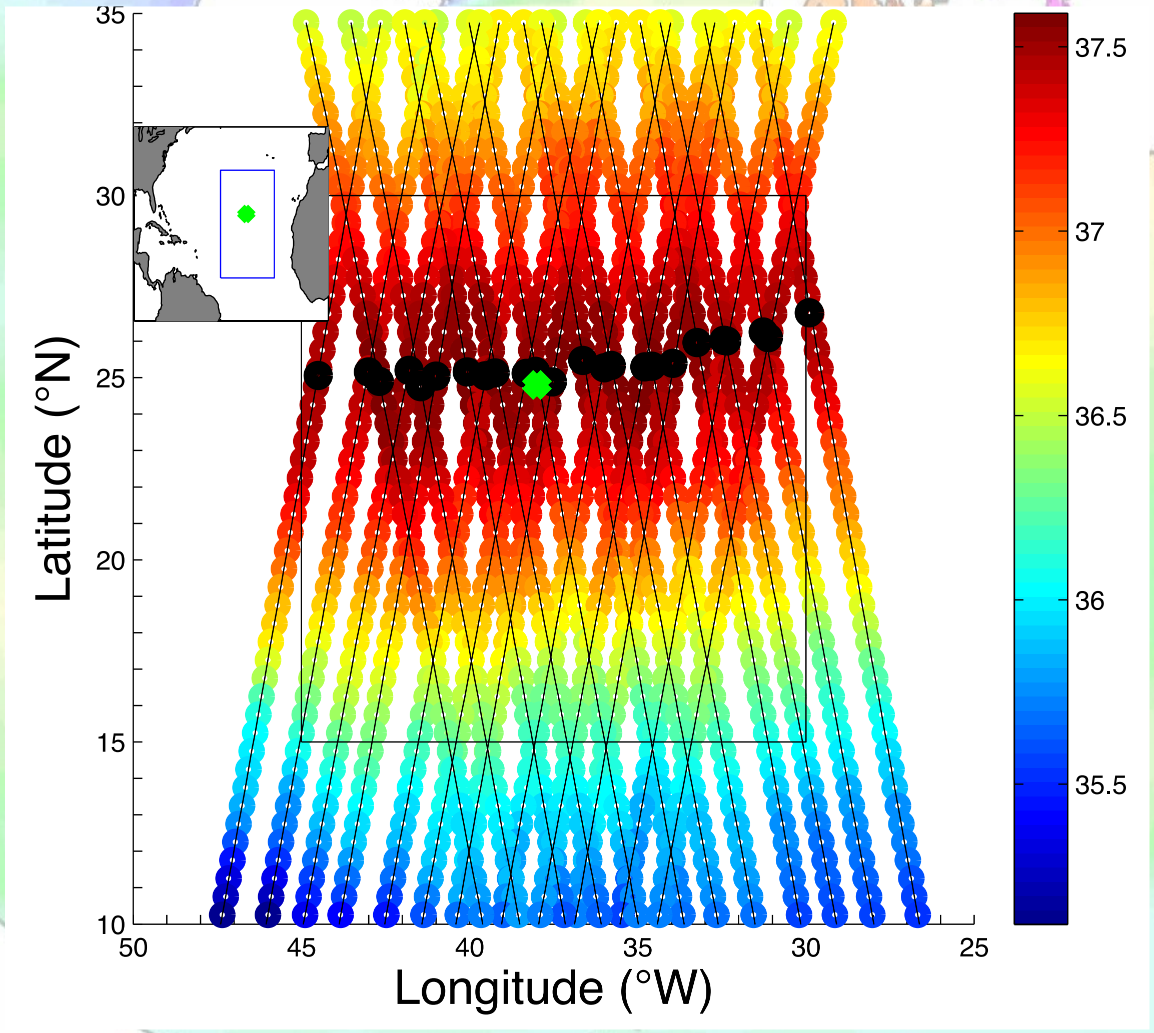
- O'Connor et al., (2005)

Formation of STUW

Gordon and Giulivi, 2014

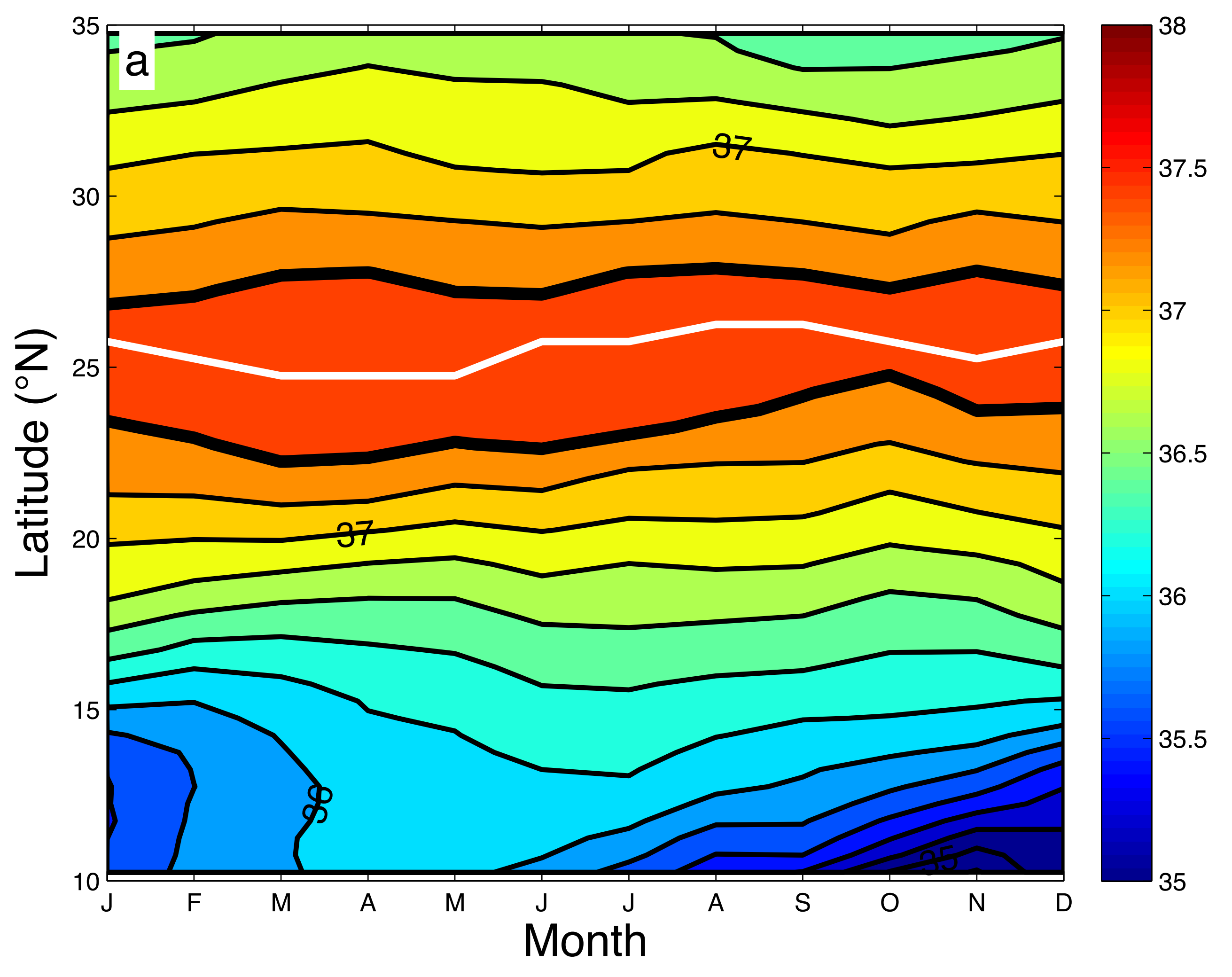


Mean SSS in SPURS region from Aquarius

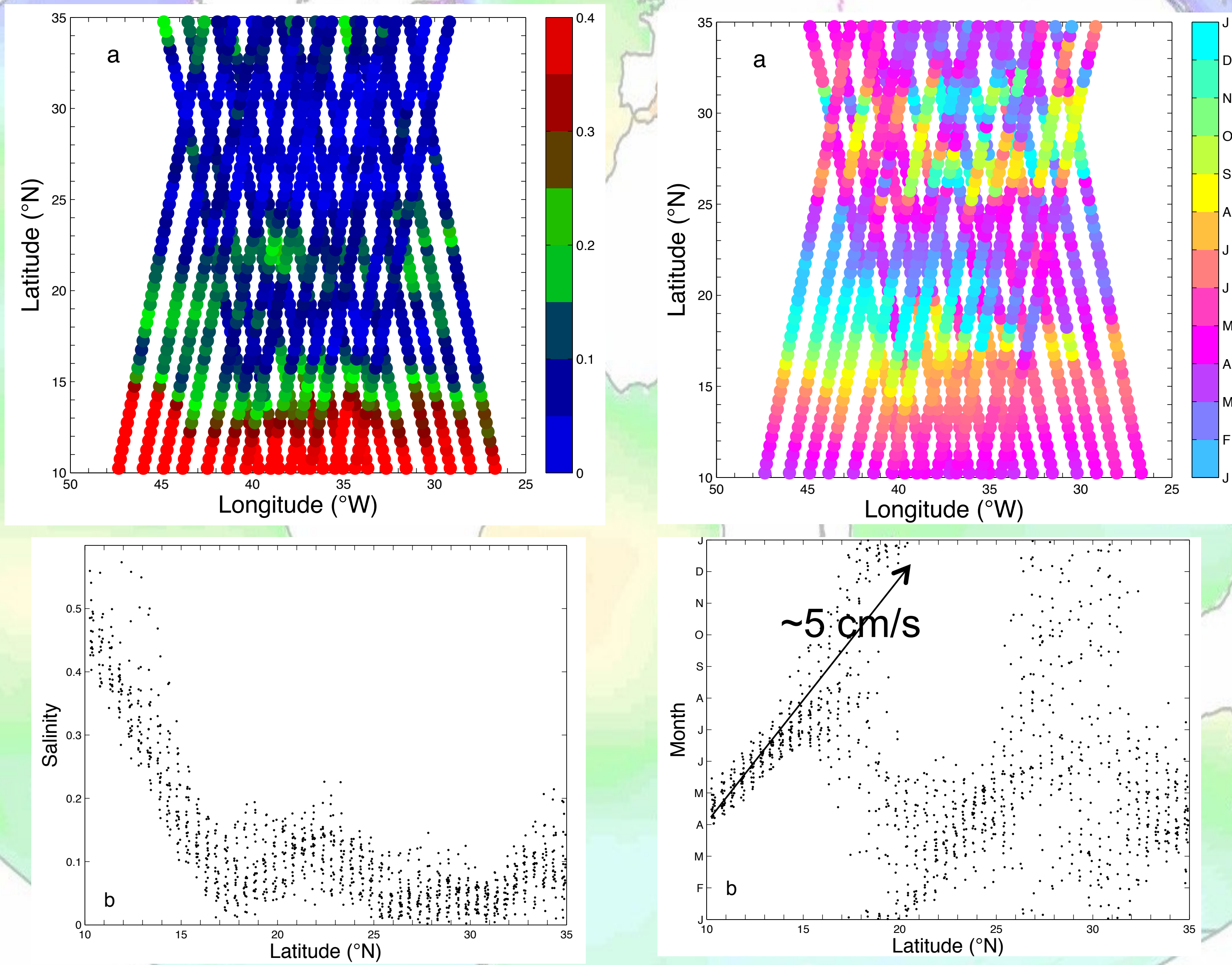


Aquarius L2 V3.0 data averaged into 0.5° along-track bins. Aug. 2011 – Sept. 2013

Seasonal SSS in SPURS Region



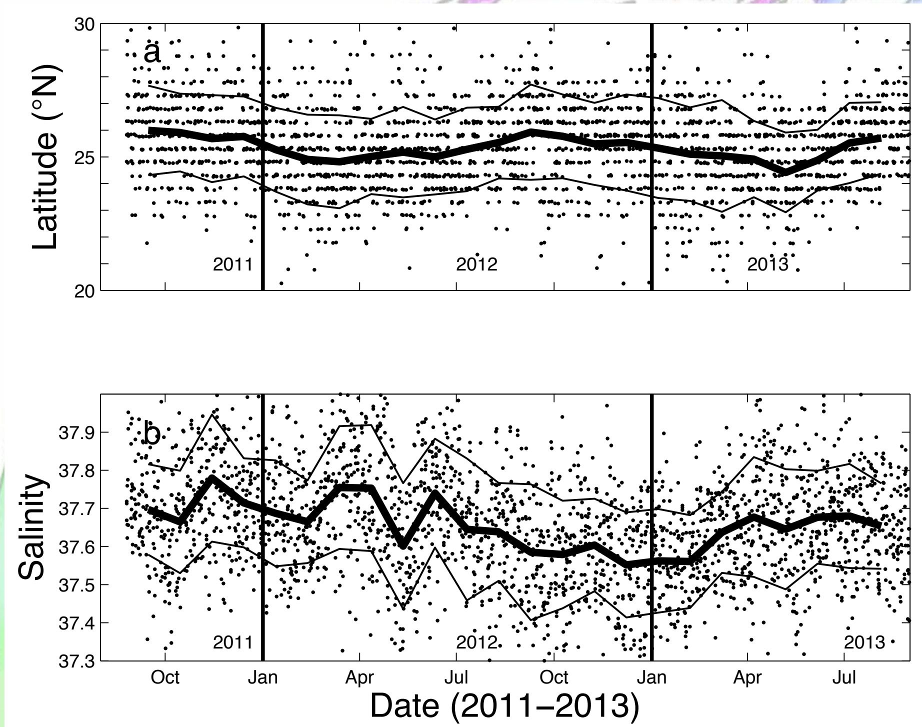
Harmonic Analysis of SSS



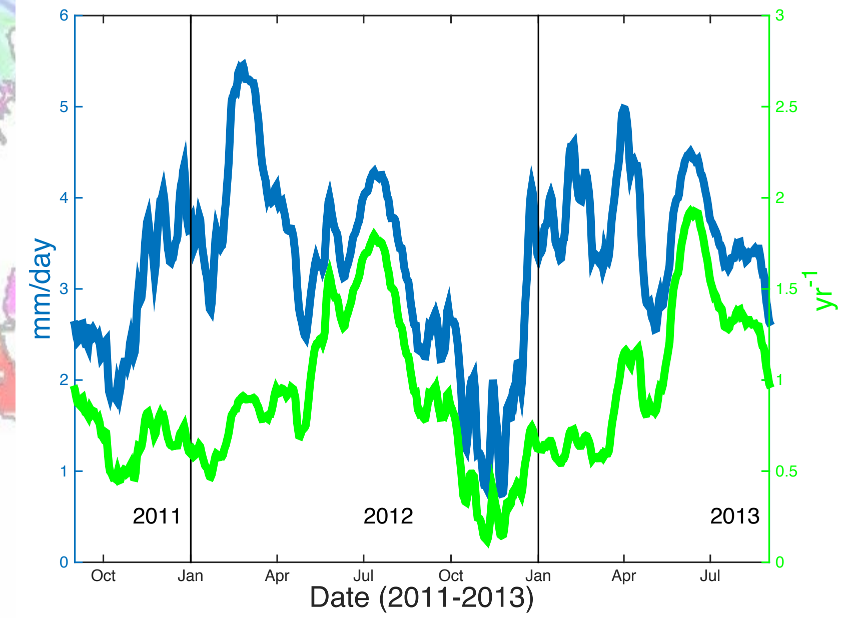
Amplitude

Phase

Seasonal migration of maximum SSS



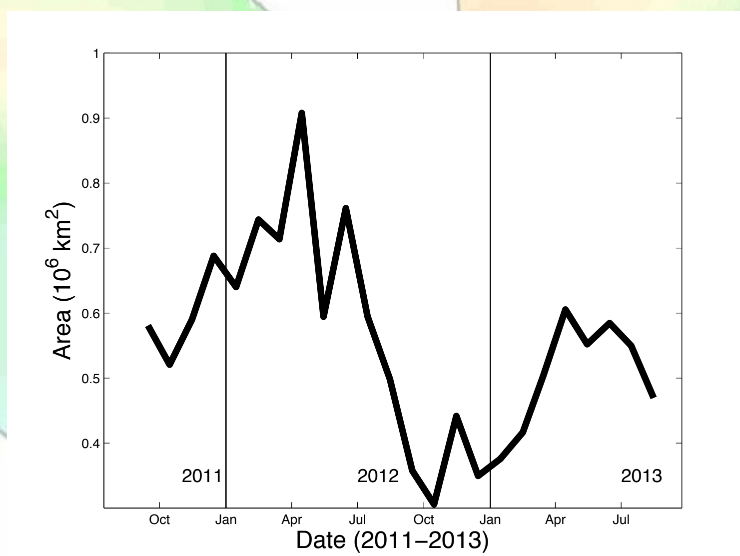
Change in maximum SSS



E-P for SPURS Region from ERAI (blue)

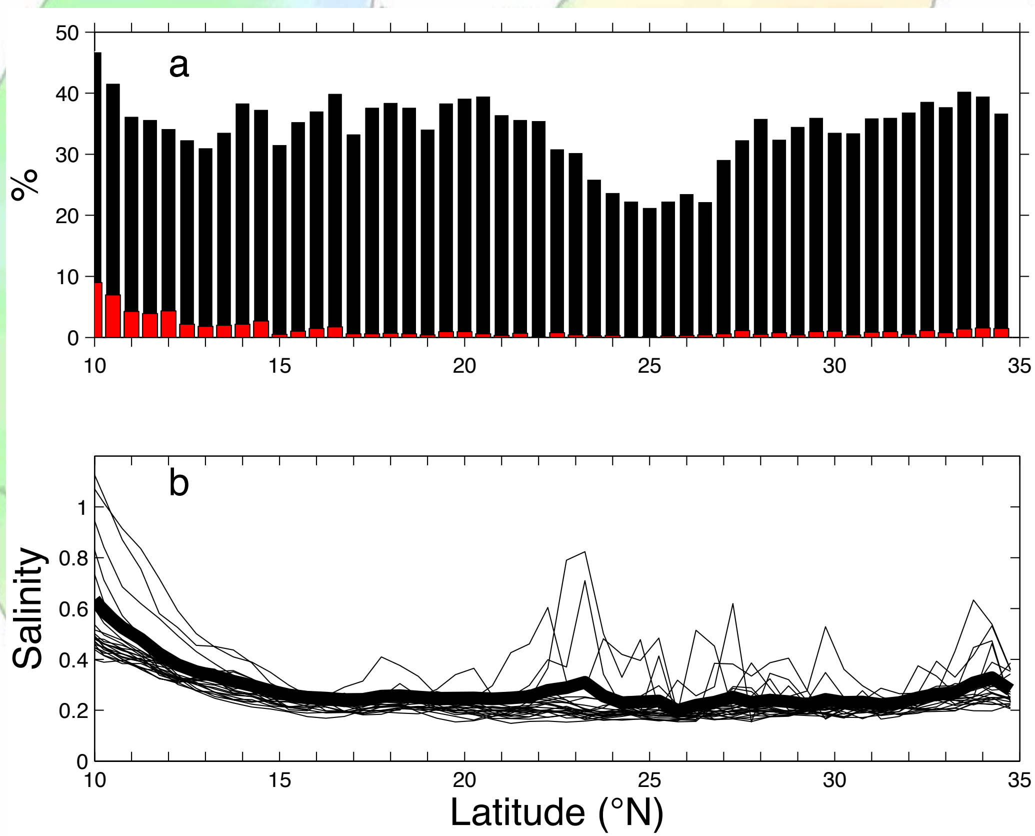
S_0(E-P)/h for the SPURS region (green)

Courtesy: J. D’Addezio



Surface area of SSS>37.4

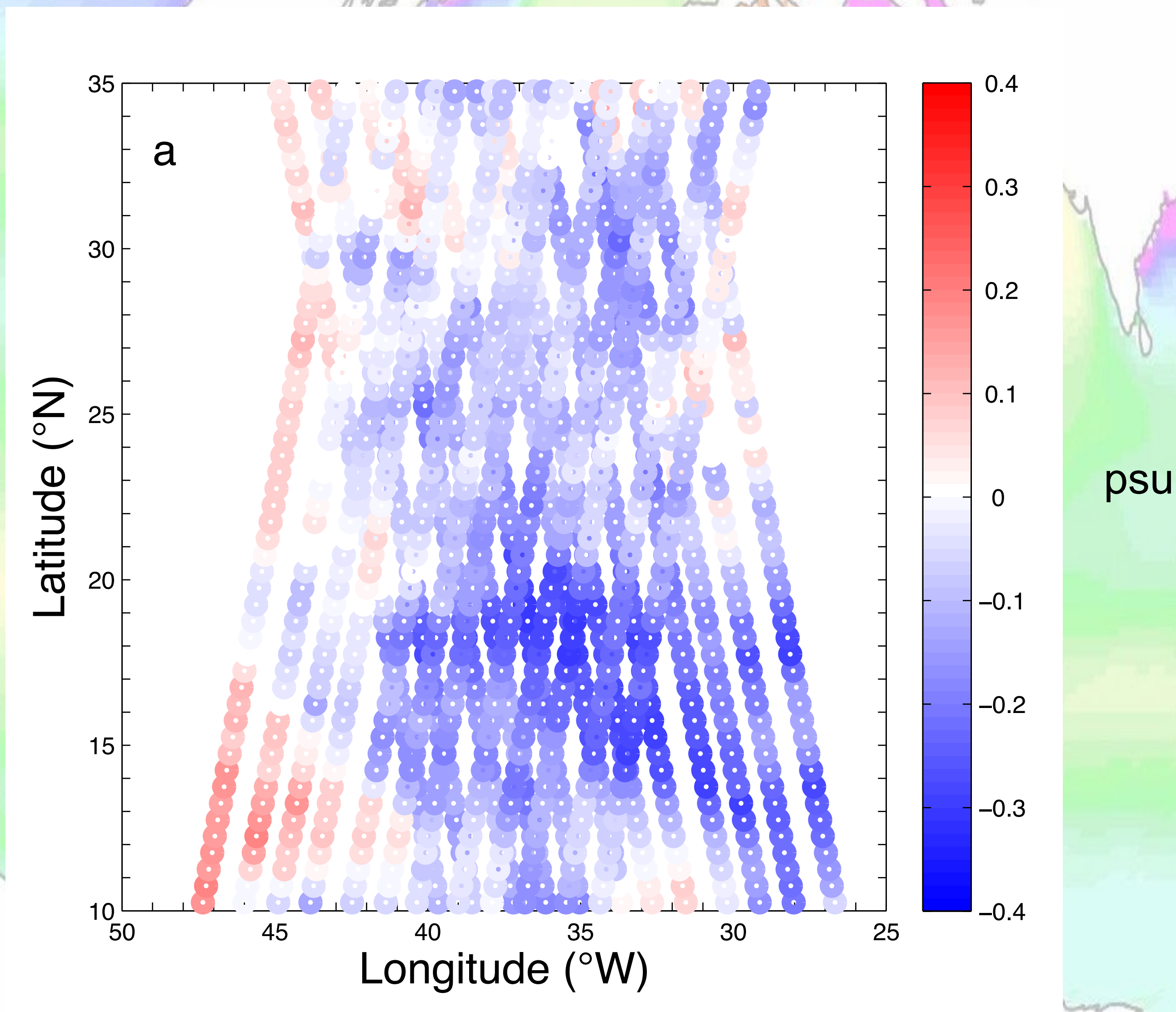
Along-track variability



Probability of finding fronts

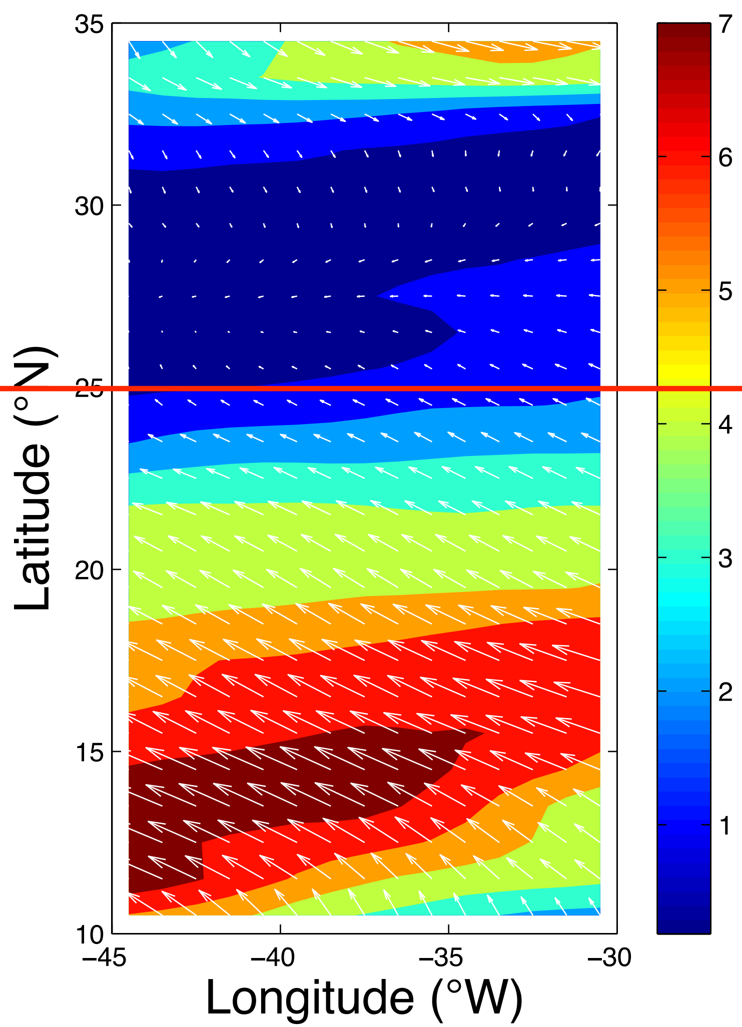
Along-track standard deviation

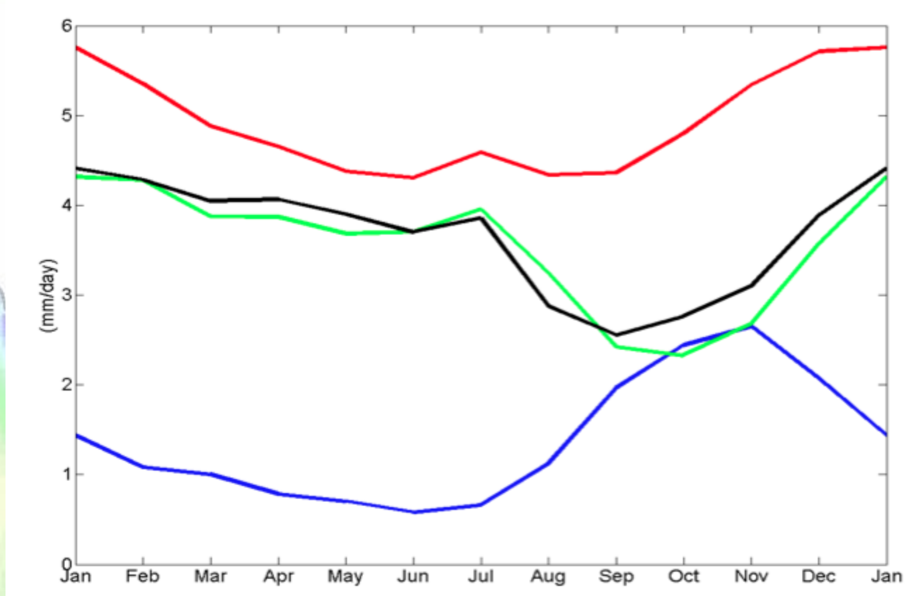
SSS change (2013-2012)-(2012-2011)



Mean (1993-2013) current speed (cm/s) from OSCAR

SSS-max



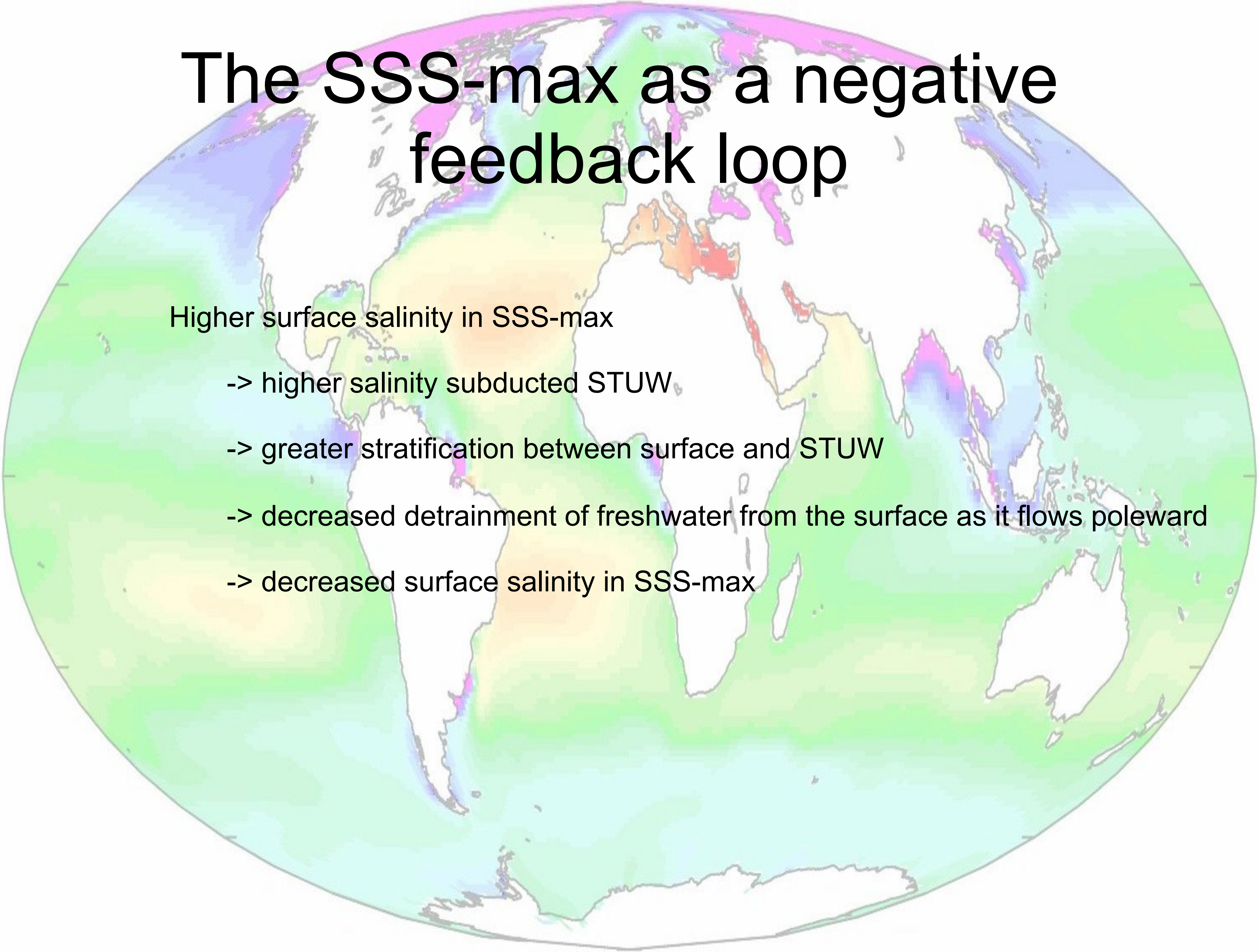


Mean E (red), P (blue), E-P (green) and moisture flux divergence (black)

Observed E-P plus observed surface current gives SSS change of ~0.6 between 15 and 25°N vs. observed of about 1.5*

*D'Addezio and Bingham, 2014. Data are from ERAI, averaged over 1979-2013

The SSS-max as a negative feedback loop



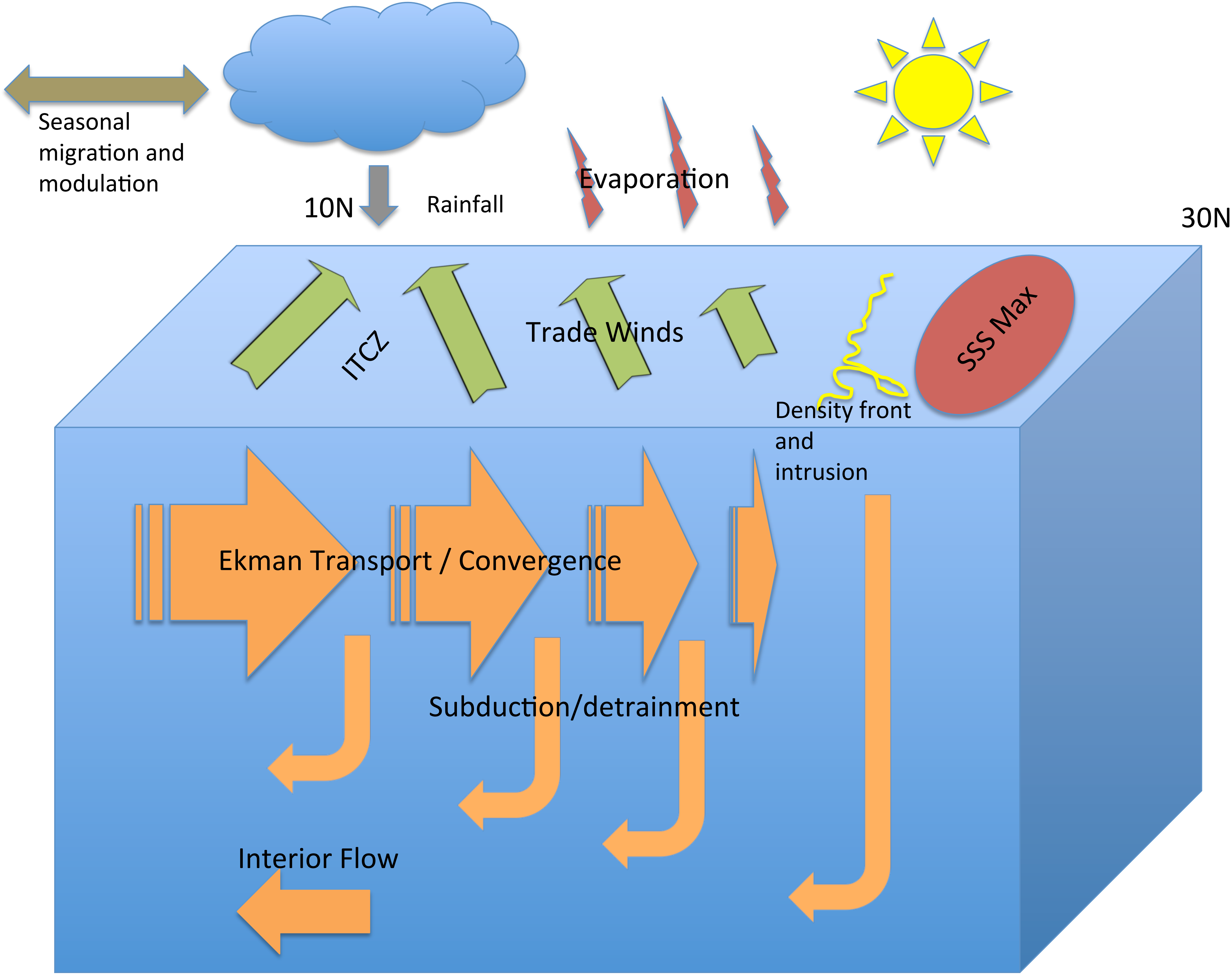
Higher surface salinity in SSS-max

-> higher salinity subducted STUW

-> greater stratification between surface and STUW

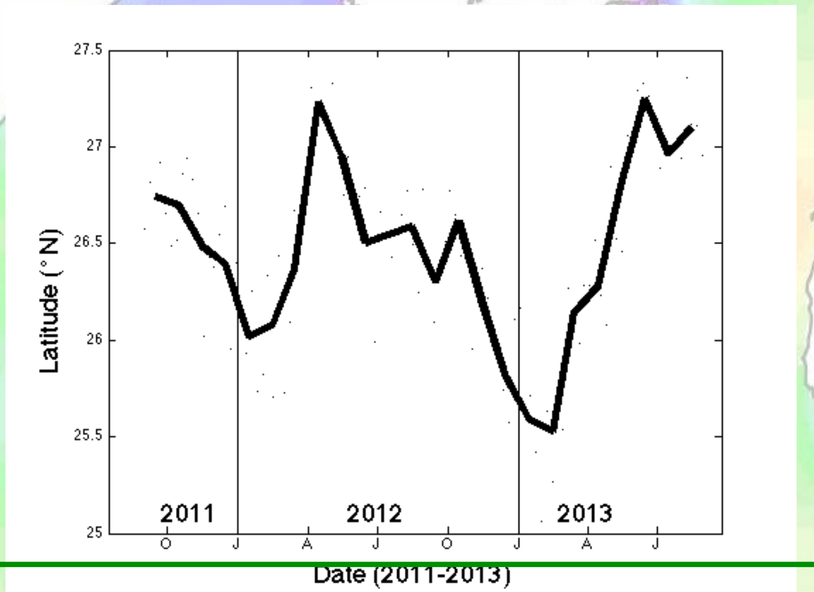
-> decreased detrainment of freshwater from the surface as it flows poleward

-> decreased surface salinity in SSS-max

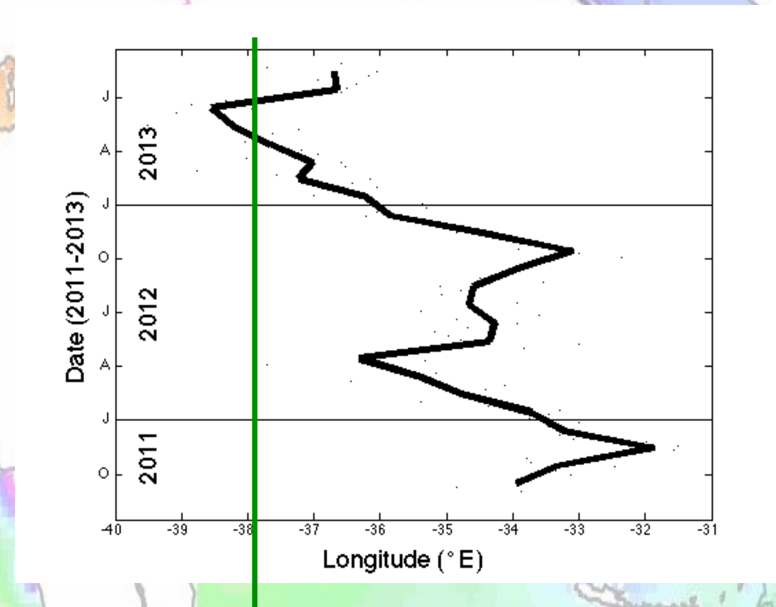


Seasonal migration and modulation
10N
Rainfall
Evaporation
30N
ITCZ
Trade Winds
SSS Max
Density front and intrusion
Ekman Transport / Convergence
Subduction/detrainment
Interior Flow

Motion of Barycenter of SSS-max

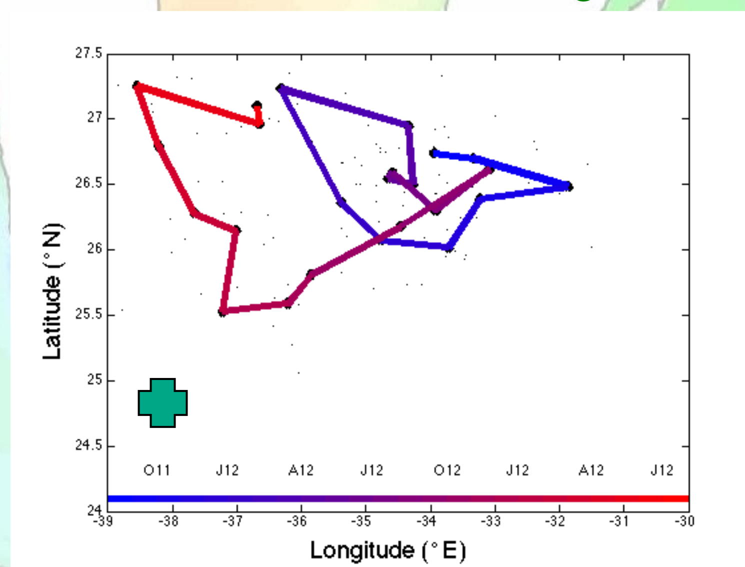


Latitude



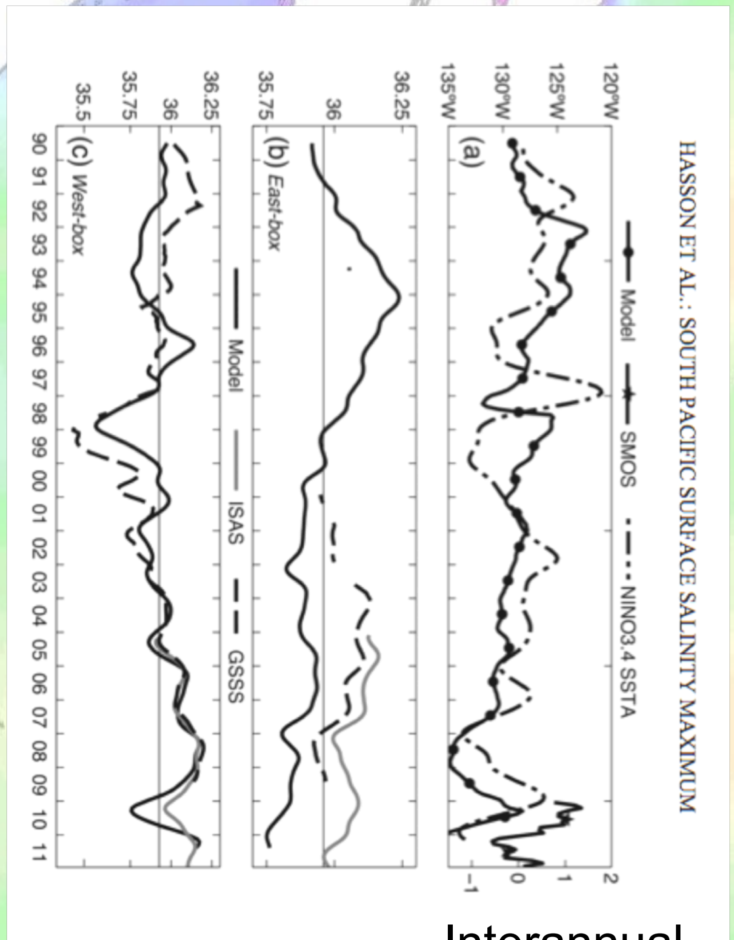
Longitude

SPURS Central Mooring

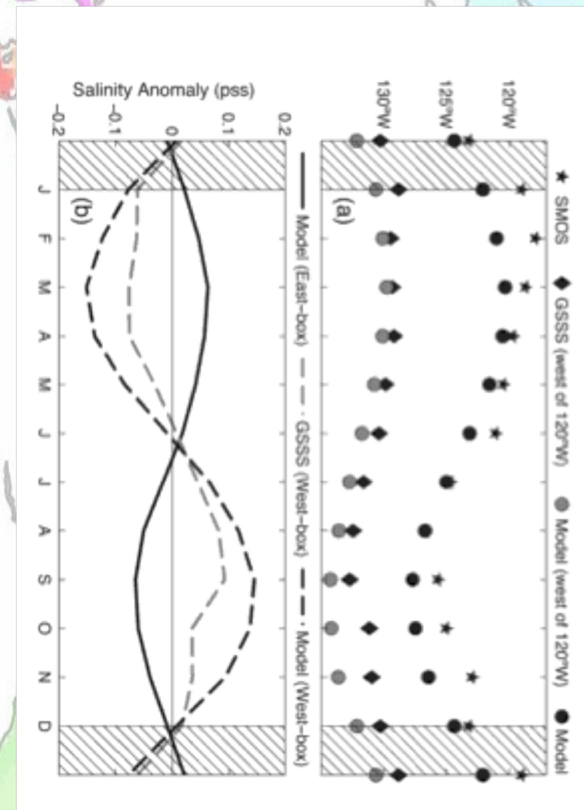


Position

South Pacific SSS-max



Interannual longitude



Seasonal longitude

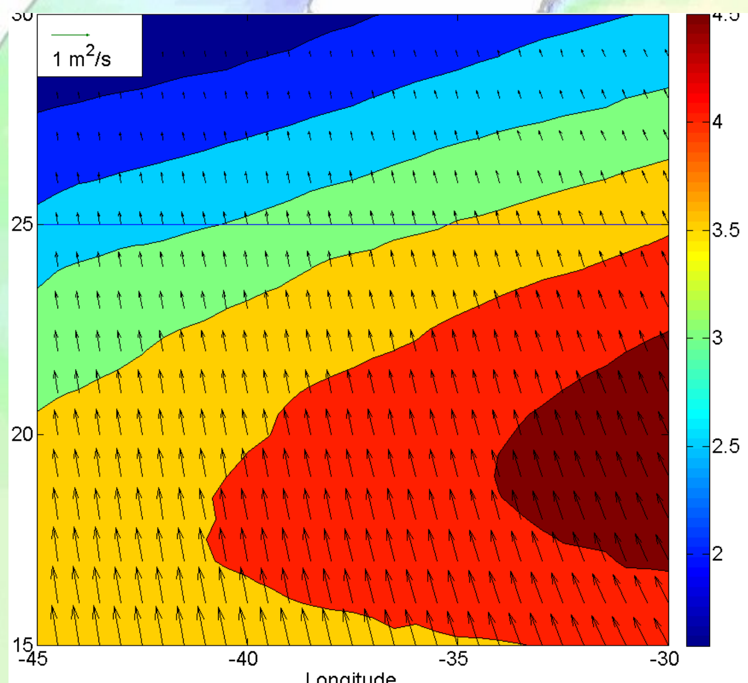
South Pacific SSS-max position is correlated with ENSO. What about the N. Atlantic?

South Pacific SSS-max has similar seasonality to N. Atlantic, but with larger amplitude

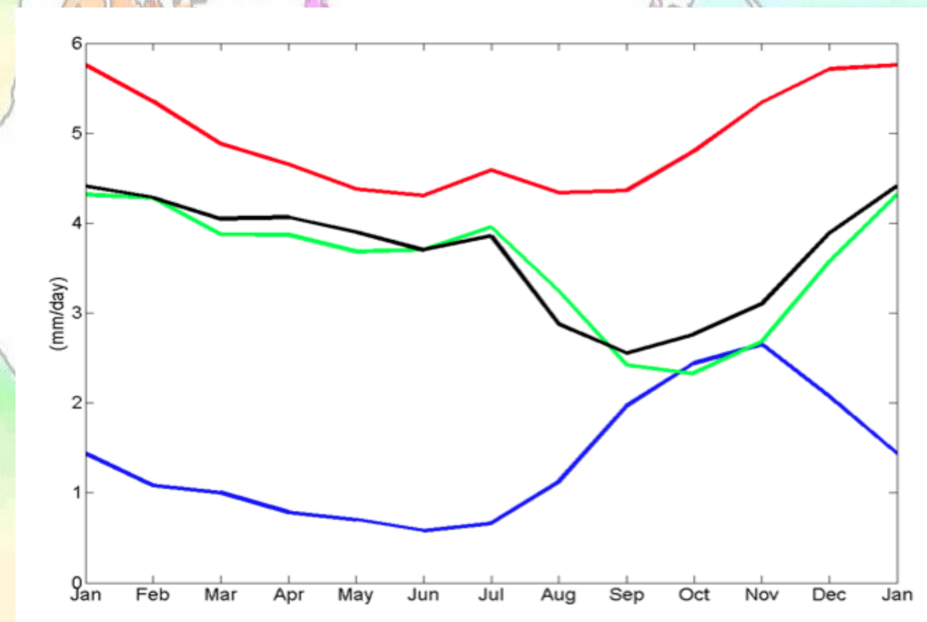
Summary

- Documented mean structure and variability of the SSS-max using Aquarius data
- The SSS-max has low variability and a small seasonal cycle
- Parts of the SPURS region have gotten fresher at a rate of ~0.2-0.3 psu/yr
- Propagation of seasonal phase is consistent with northward transport by Ekman flow and the classic view of SSS-max formation
- The SSS-max shows evidence of frontal structures and fresh intrusions, either advective or from rainfall
- There was a rapid decrease in SSS in the second half of 2012 and a decrease in surface area covered by the SSS-max, possibly related to low E-P (heavy seasonal rainfall)
- Future work will gain insight from comparison with other ocean basins and by elucidating the links between the SSS-max areas and global phenomena such as ENSO and the NAO

A Subtropical North Atlantic Regional Atmospheric Moisture Budget*



E-P (mm/day) plus Ekman Transport



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