SSS Subfootprint variability in the SPURS-1 and SPURS-2 regions

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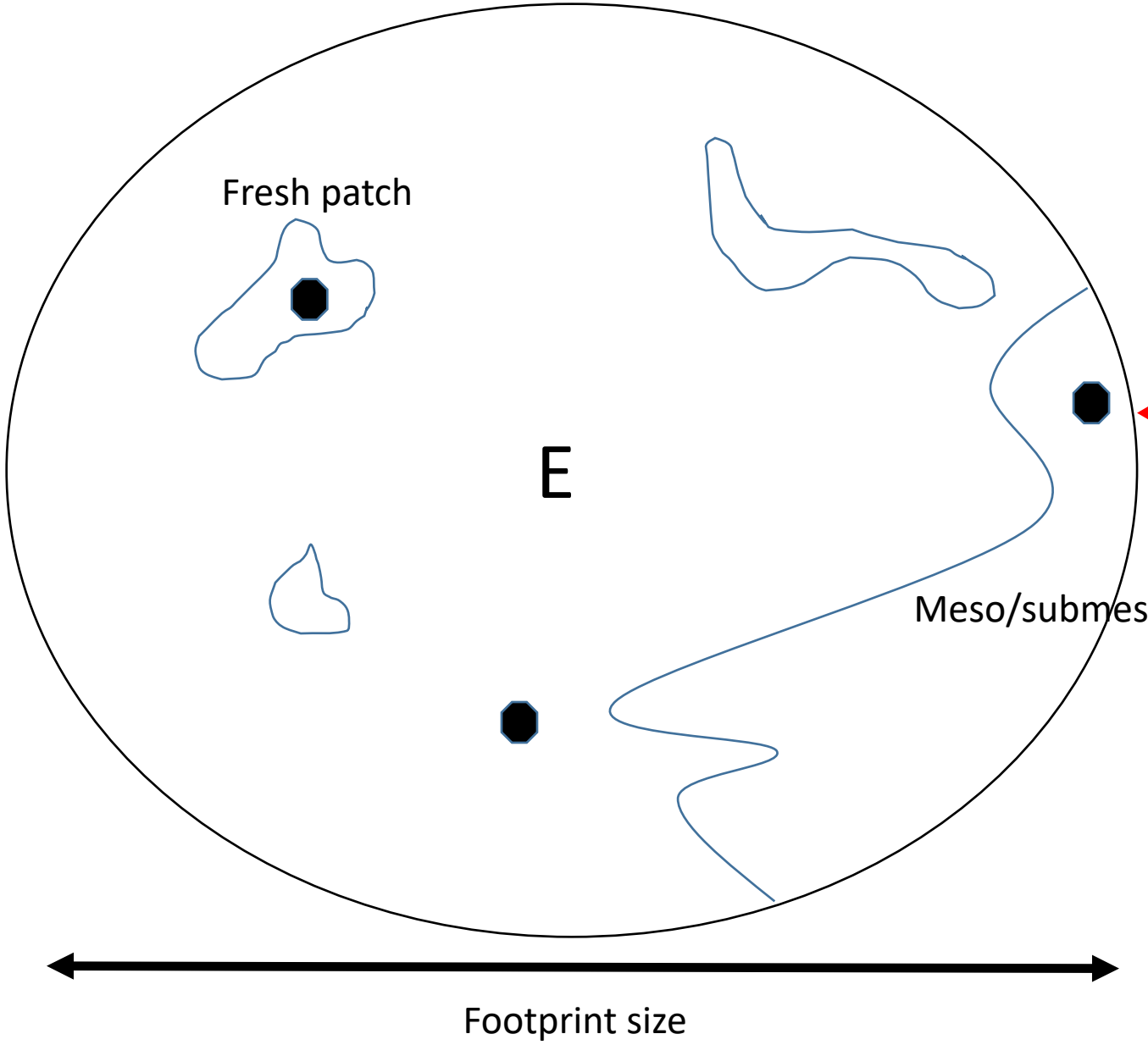
How large is the variability of SSS within the footprint of a satellite like Aquarius or SMAP?

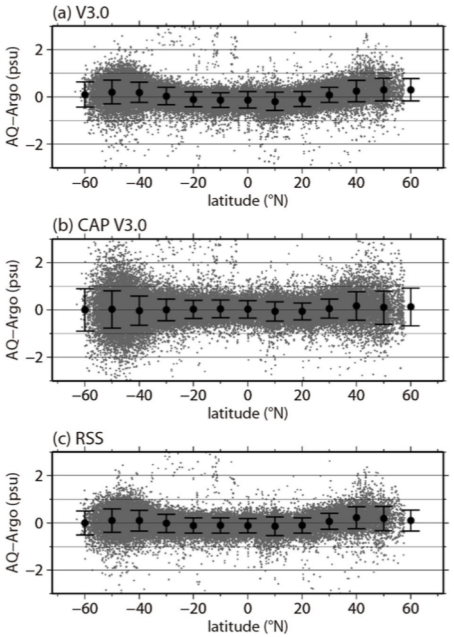
How do we quantify differences between *in situ* and remotely sensed estimates of SSS?

What are the scales of SSS variability?



"Change of support" problem

In situ validation measurement, e.g. float

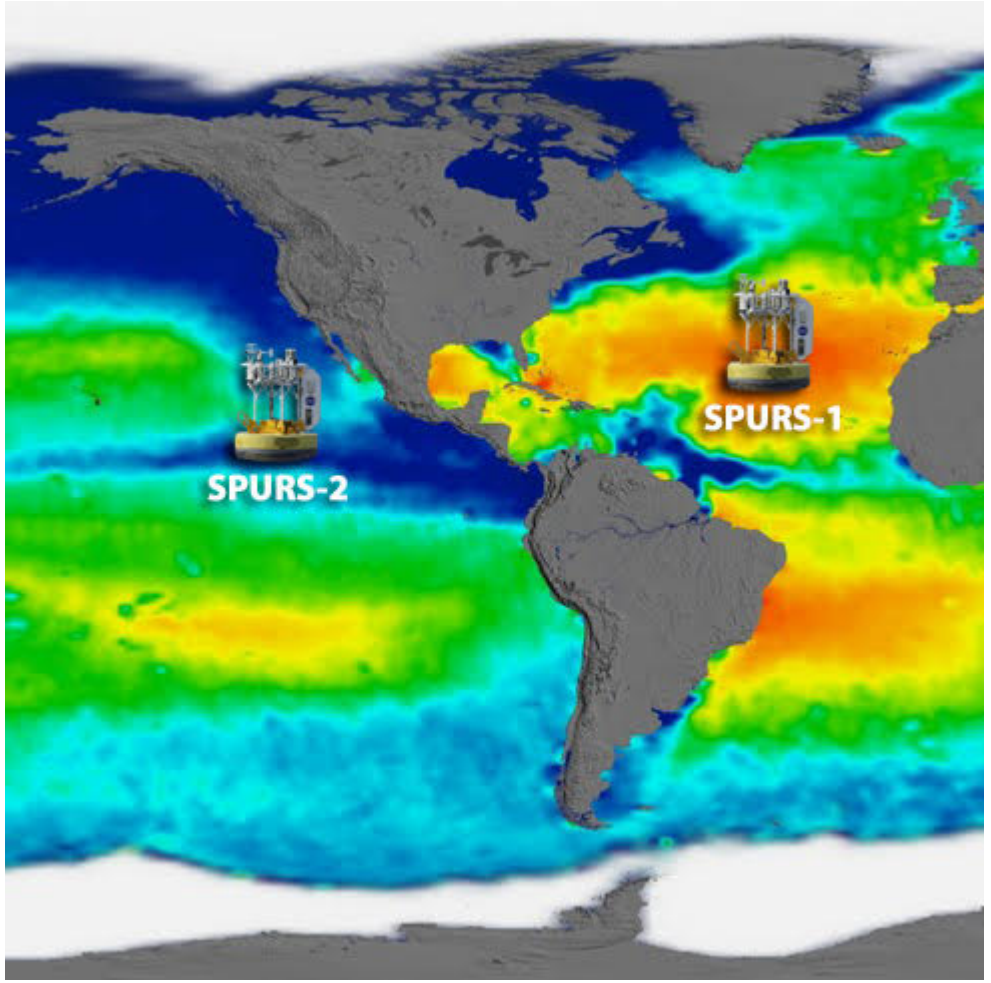


Abe & Ebuchi, 2014

SPURS-1 and SPURS-2 regions are contrasting locations to examine synoptically sampled subfootprint variability.

SPURS-1 is a relatively quiescent high SSS area of the subtropical North Atlantic.

SPURS-2 is a dynamic part of the eastern Pacific fresh pool extension.



DeCharon 2018
https://salinity.oceanobservatories.org/science-spurs.htm

Definition of subfootprint variability

Find the weighted variance at a particular place in space and time

$$\sigma^2 = \frac{\sum_C w_i (S - \bar{S})^2}{\sum_C w_i}$$

Where

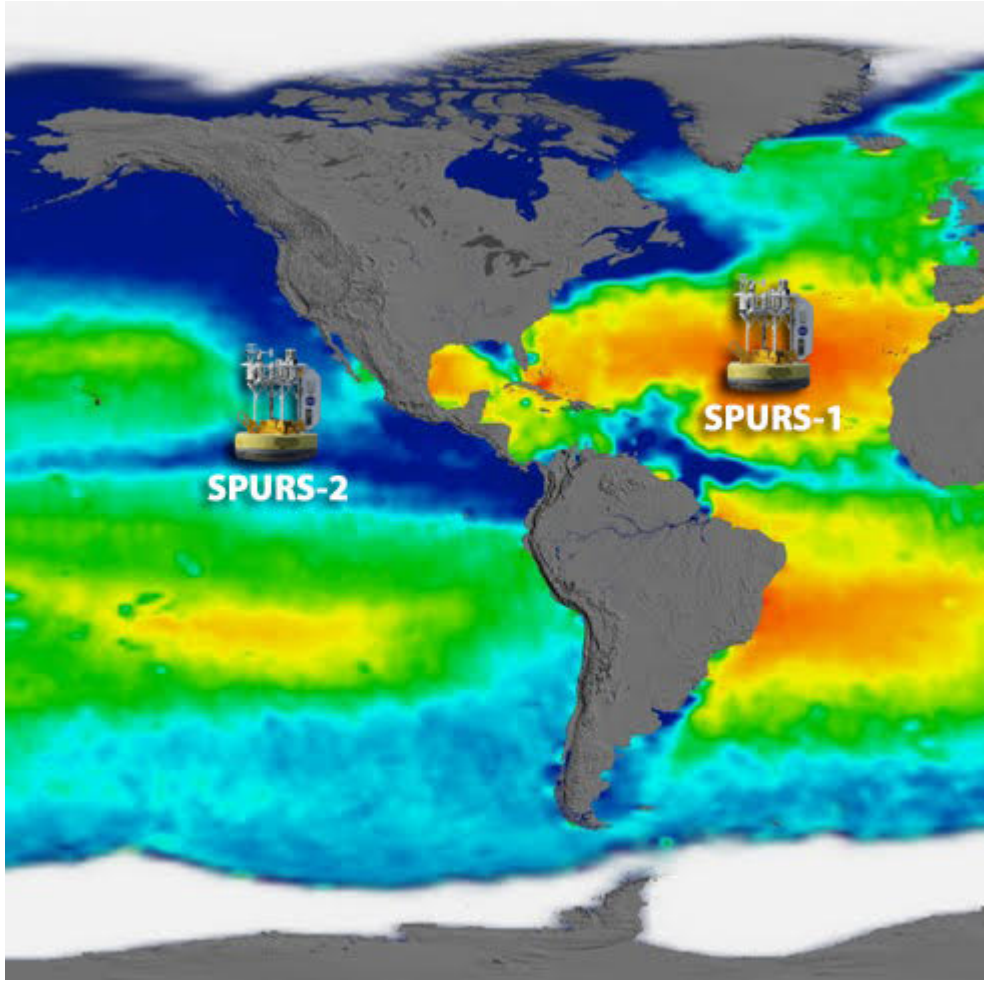
$$w_i = e^{-(d_i/d_0)^2}$$

d_0 = 50 km

d_i = distance to grid point

σ_{95} is the σ larger than 95% of others at that point

Boutin et al., 2016



DeCharon 2018

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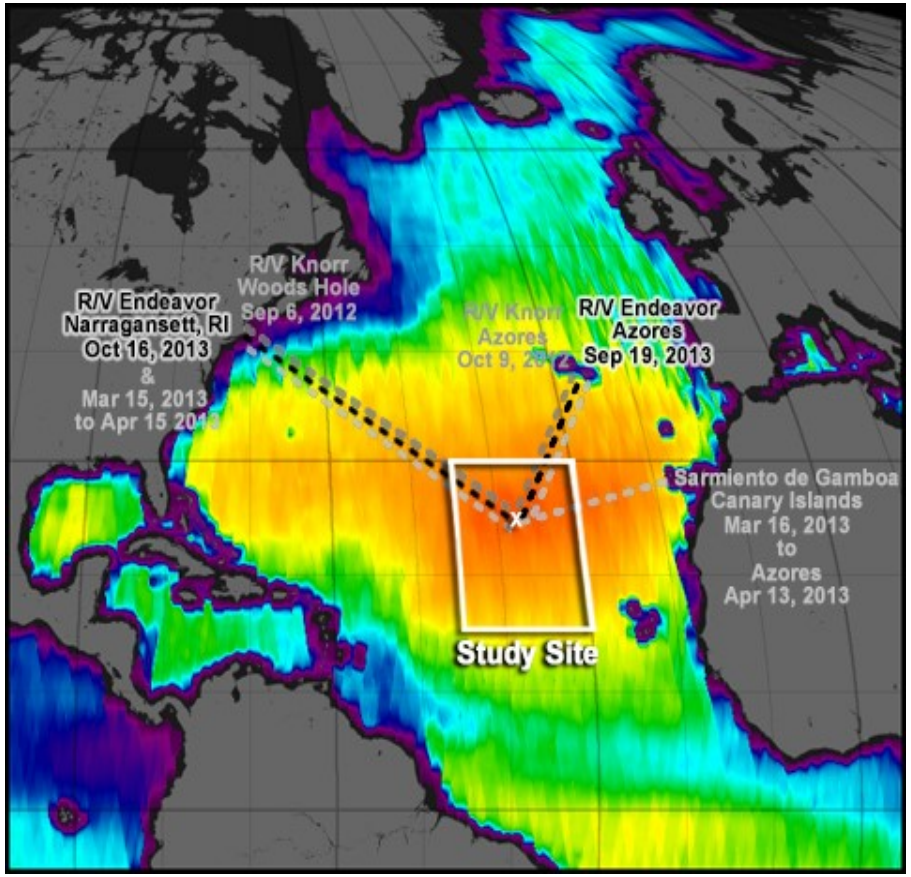
SPURS-1

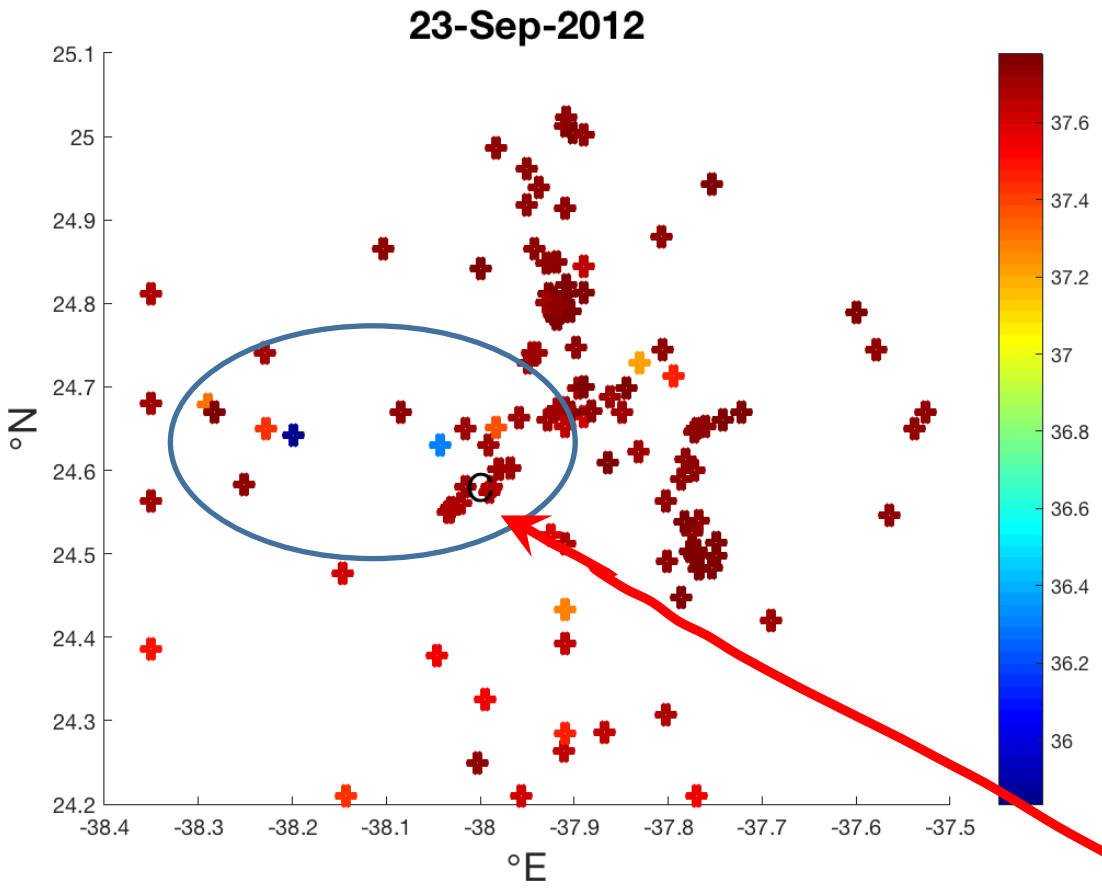
Used all in situ SSS data from the 2012-2013 field campaign, drifters, wavegliders, shipboard TSG, etc.

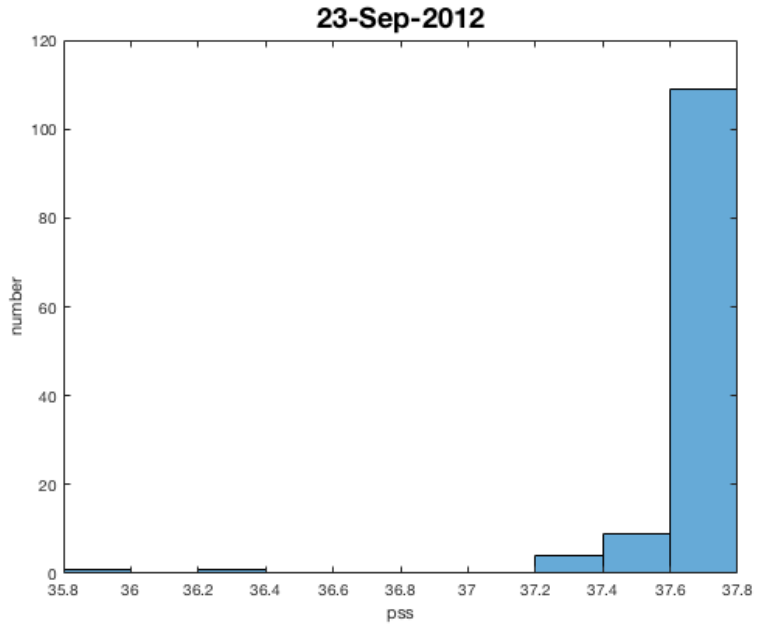
SFV was calculated in weekly intervals and in the vicinity of the central mooring: (25°N,38°W)



SPURS-1

$\sigma \approx 0.25$

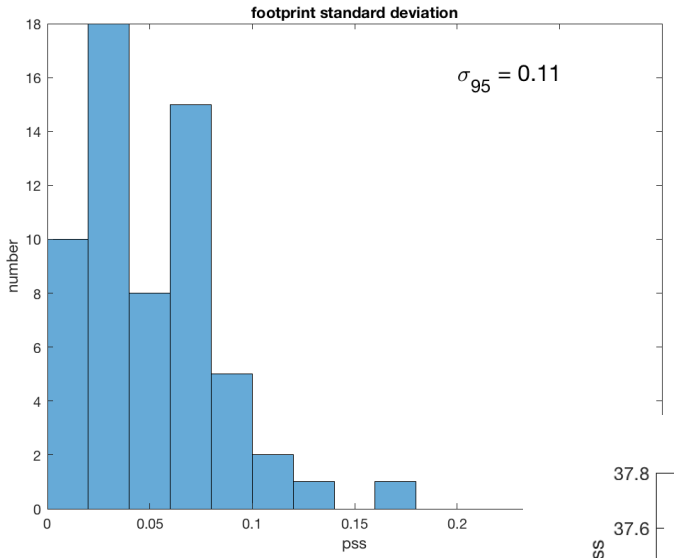




Central mooring

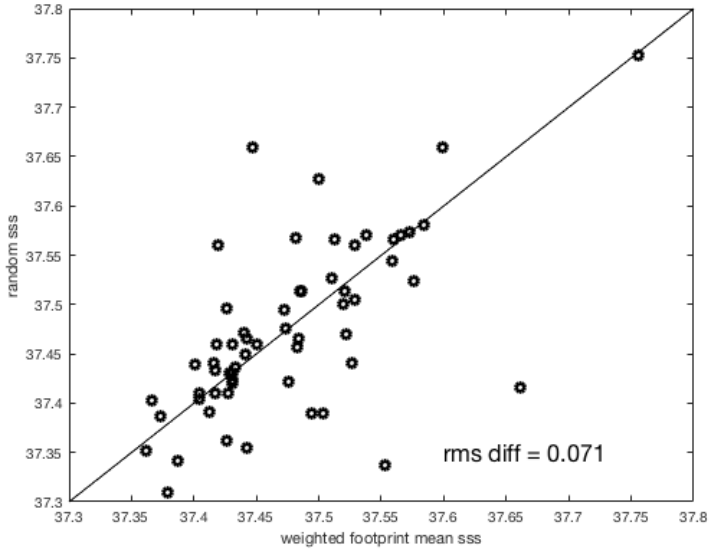
$\sigma_{95} \approx 0.11$

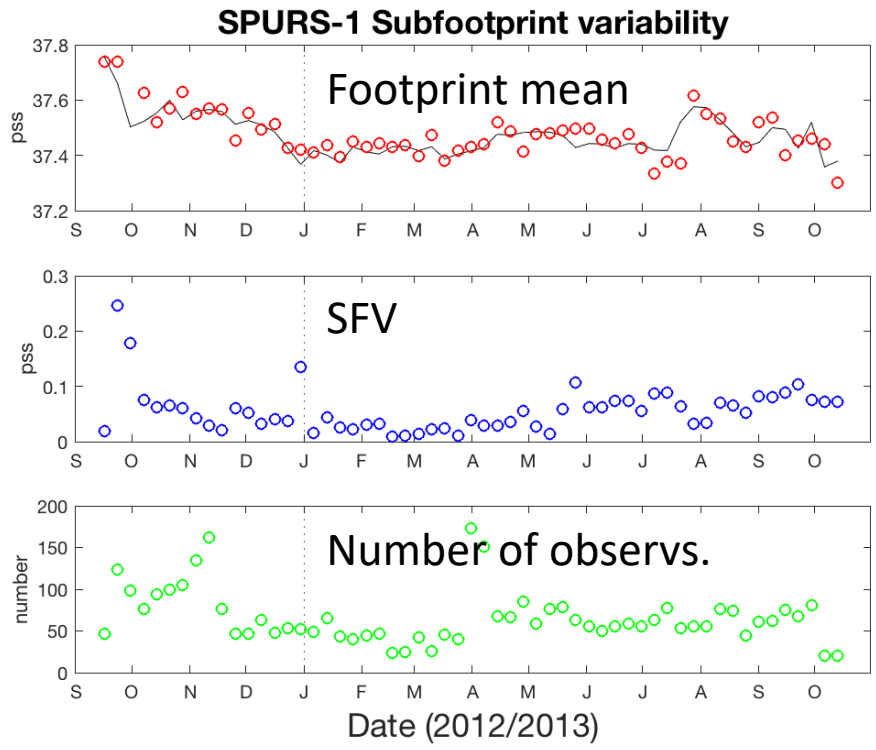
SPURS-1



SFV histogram

A random value within the footprint vs. footprint mean



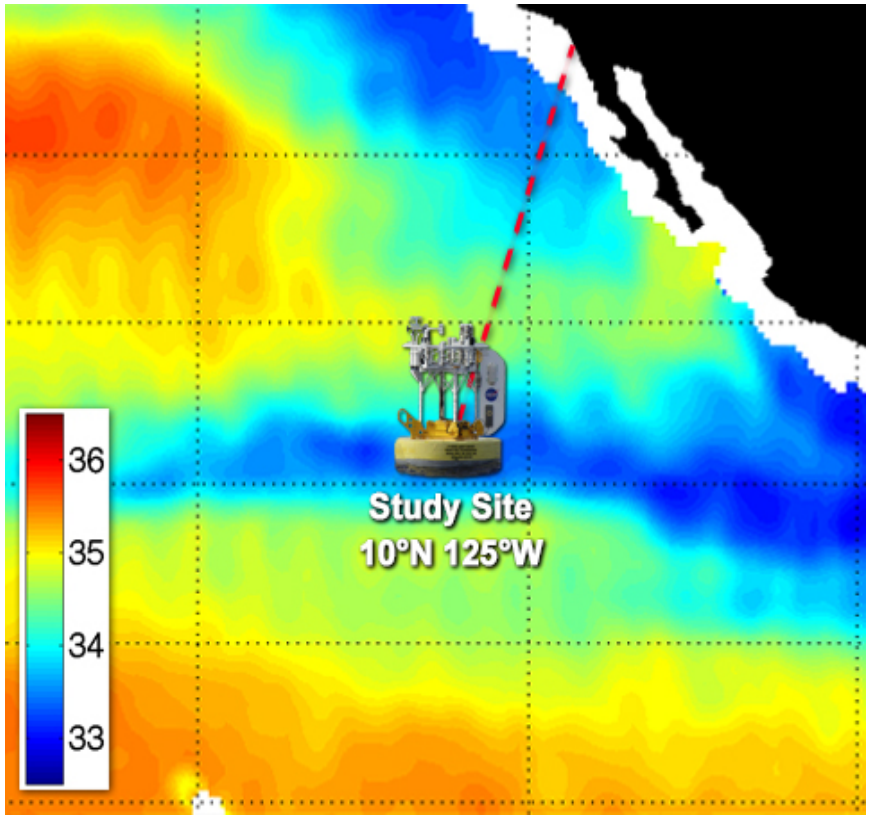


SPURS-2

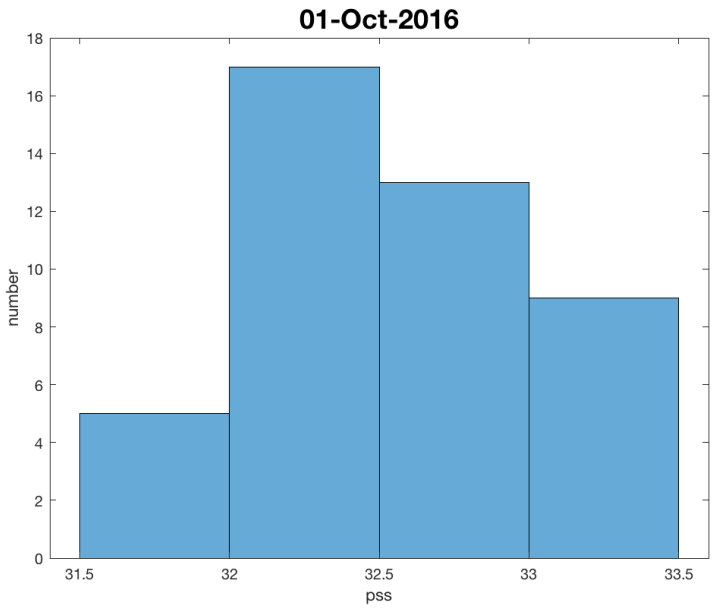
Used only waveglider data from the field campaign.

Weekly values of SFV in the vicinity of the central mooring:

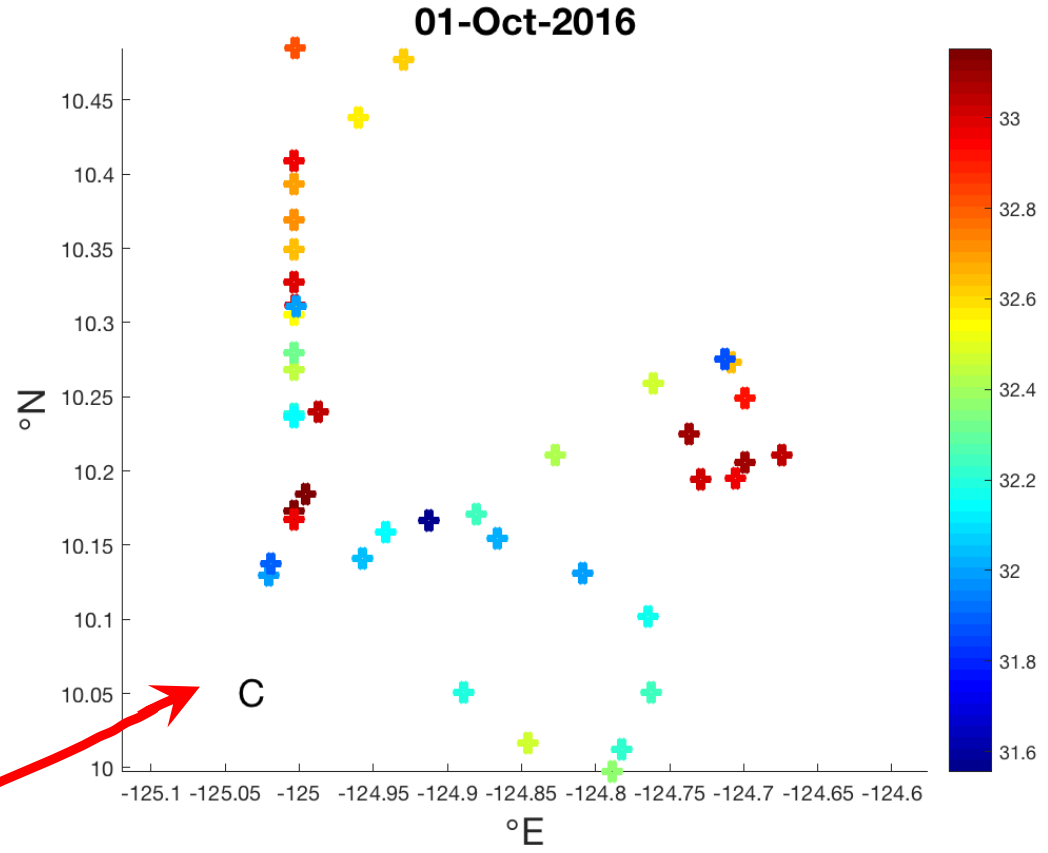
(10°N,125°W)



SPURS-2



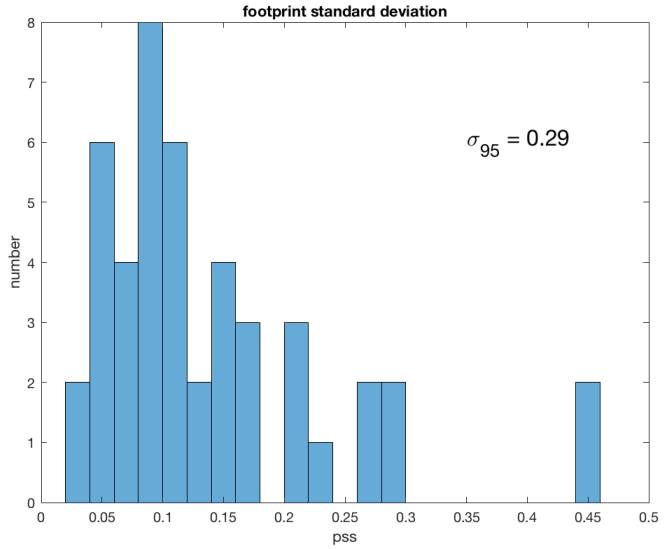
$\sigma \approx 0.45$



Central mooring

$\sigma_{95} \approx 0.29$

SPURS-2



SFV histogram

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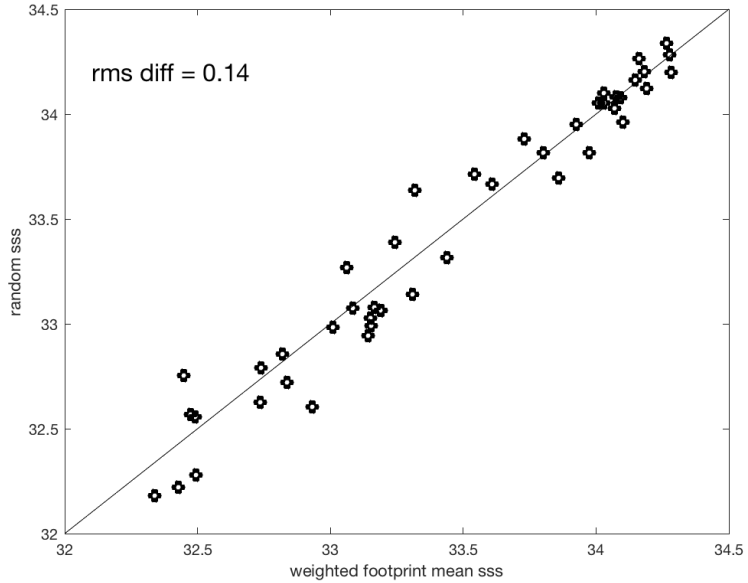
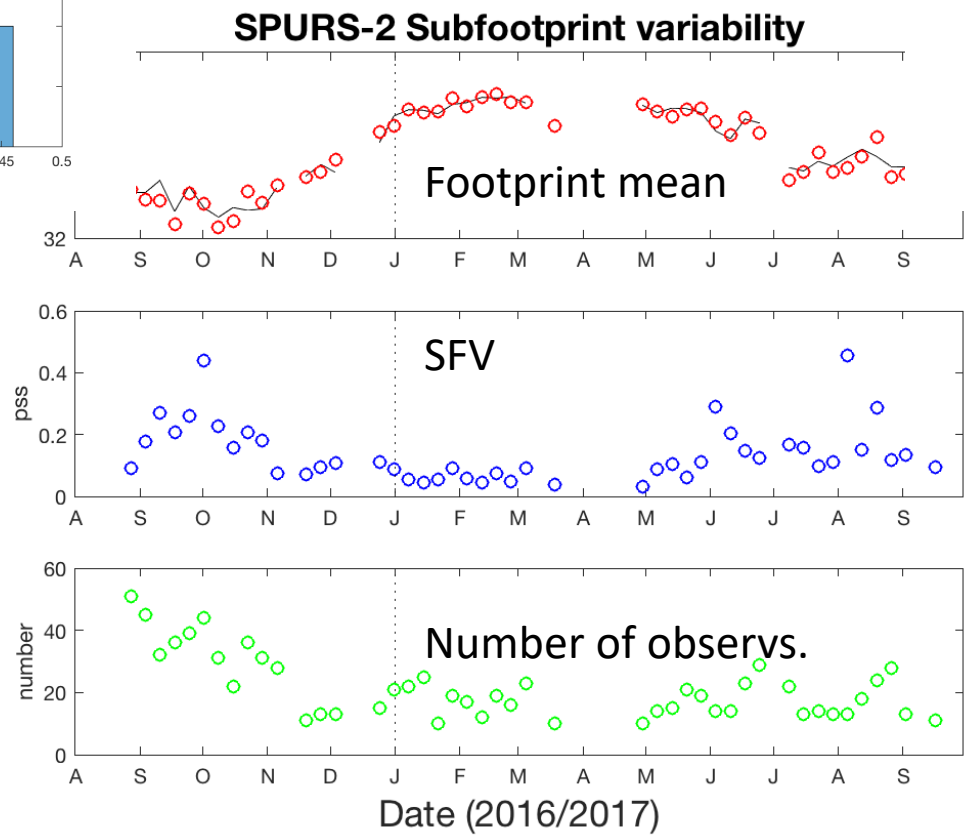
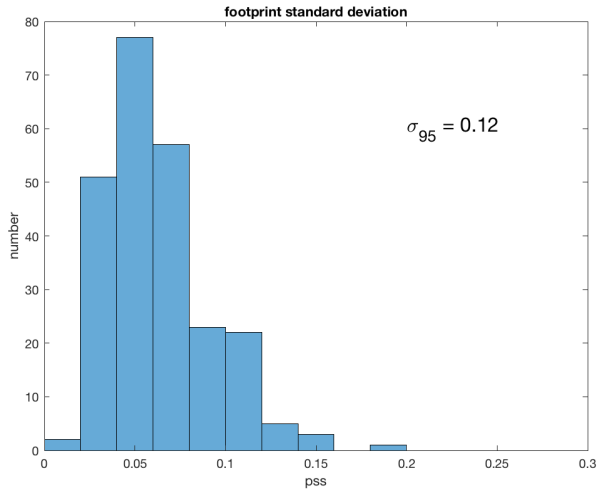




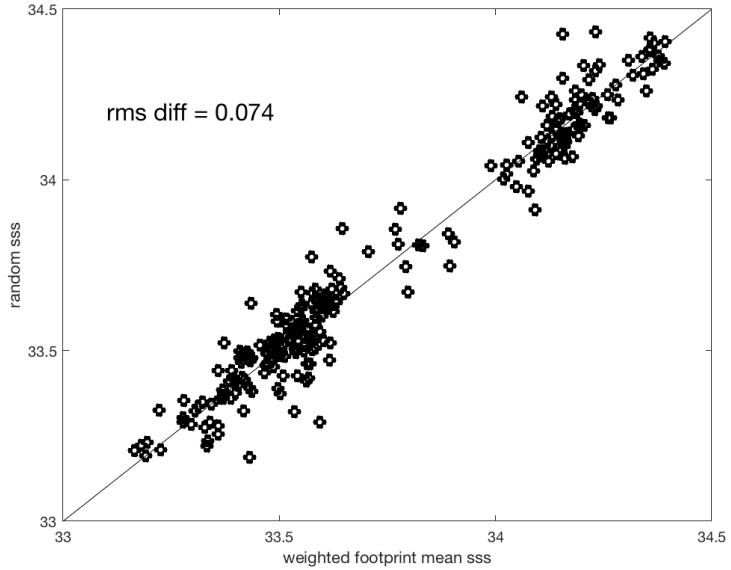
SPURS-2 ROMS simulation

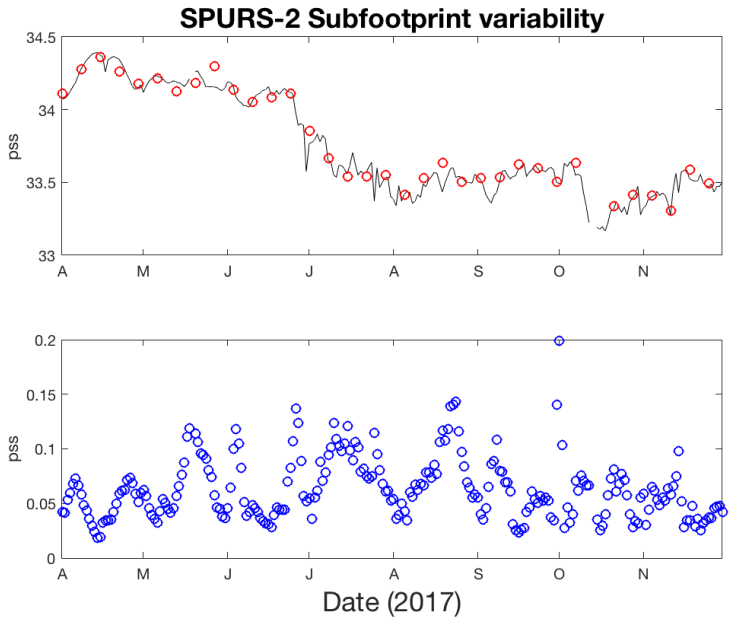
$\sigma_{95} \approx 0.12$



SFV histogram

A random value within the footprint vs. footprint mean



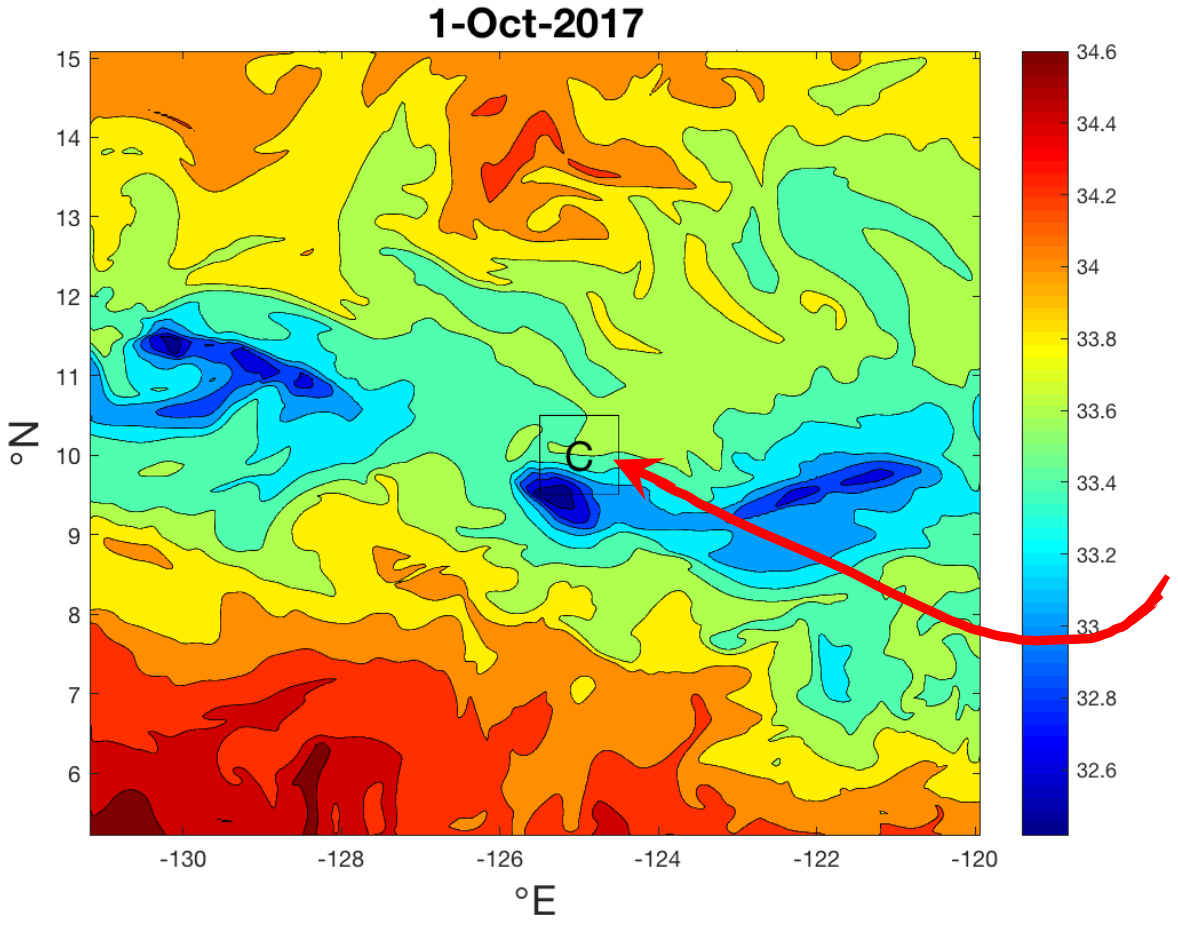


Footprint mean

SFV

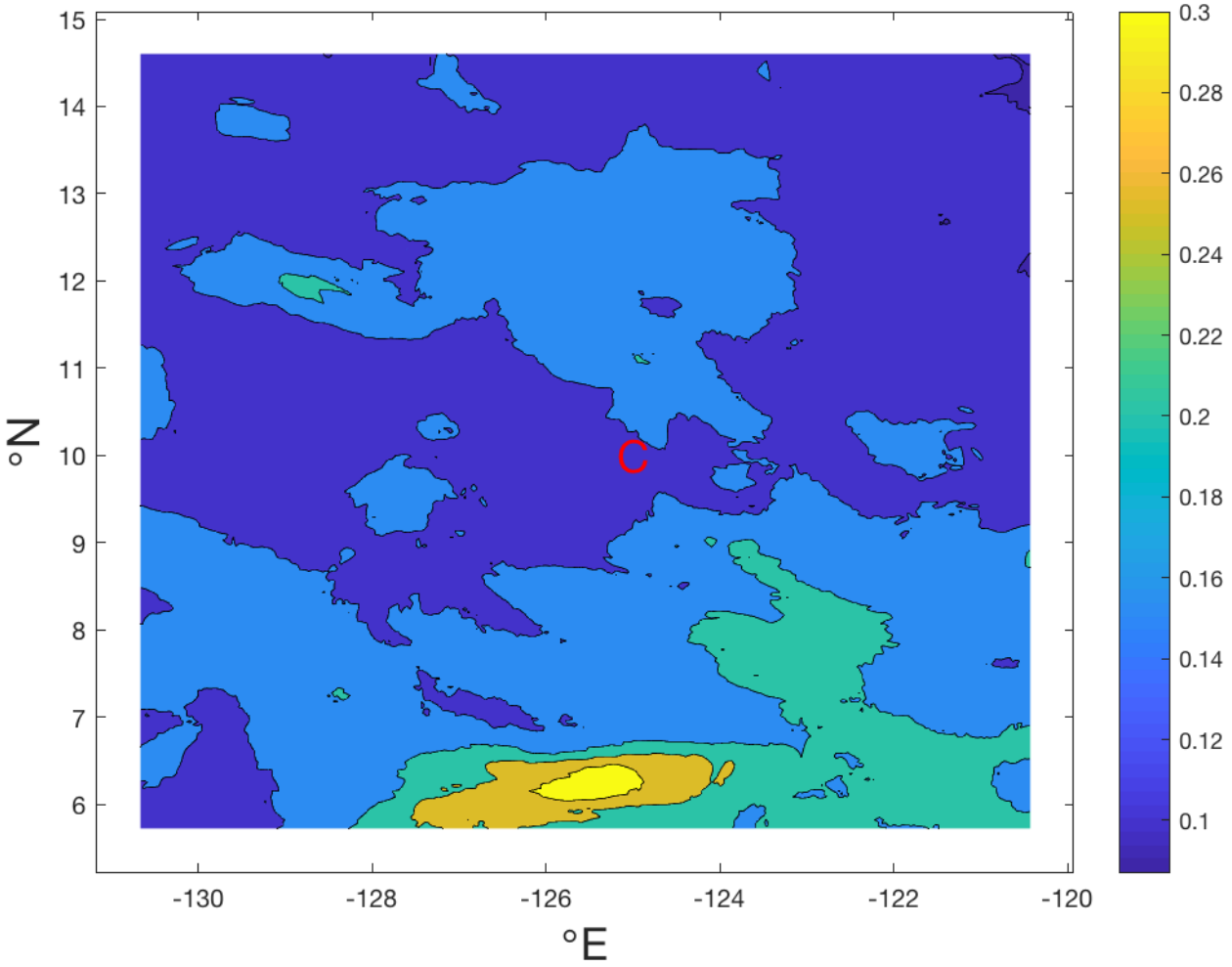
Note: I only had access to the simulation from April to November 2017

SPURS-2 ROMS simulation



Central mooring and 100 km box

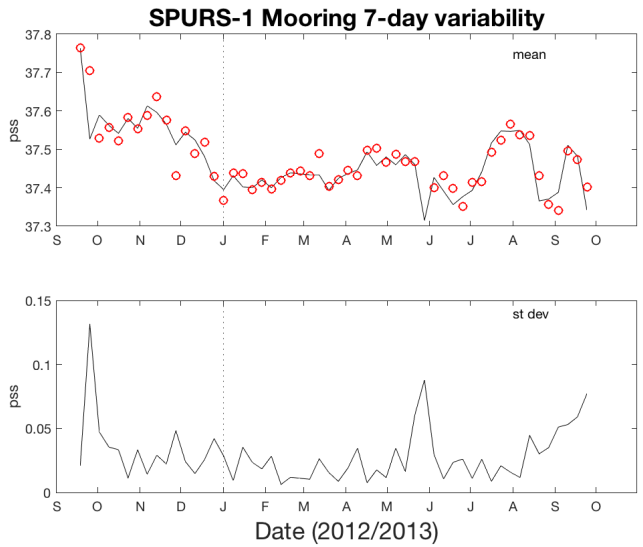
SPURS-2 ROMS simulation

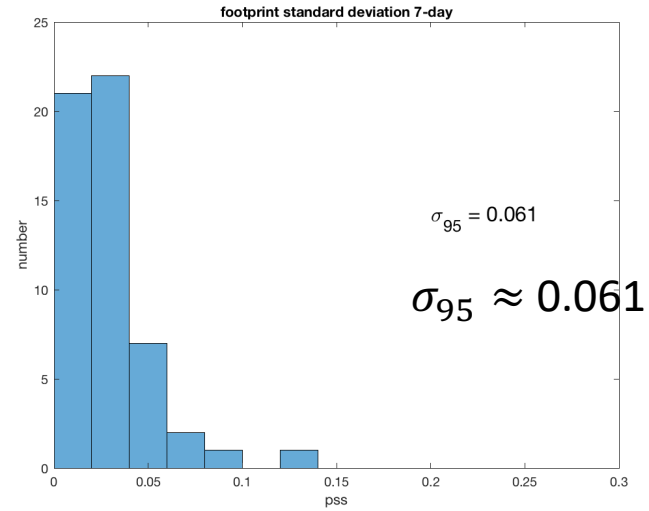


σ_{95} over the model domain

SPURS-1 and 2 Moorings

SPURS-1





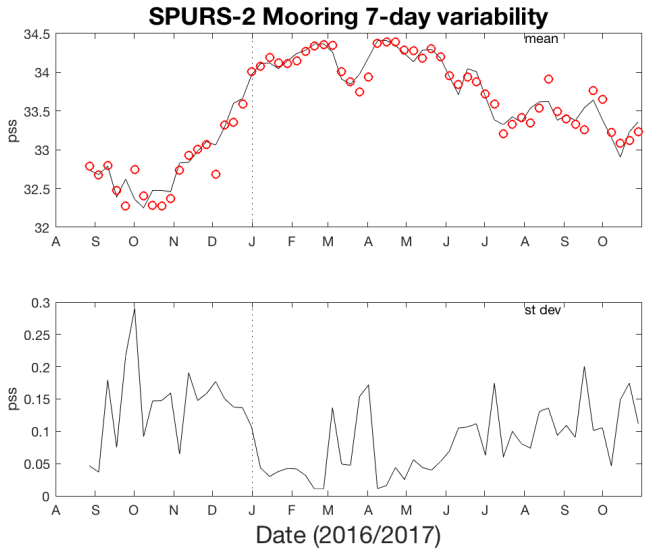
$\sigma_{95} \approx 0.061$ vs. 0.11

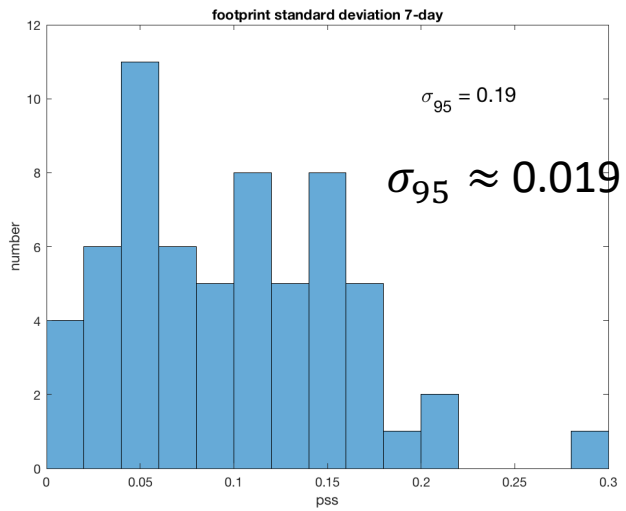
Can mooring data be used to compute SFV?

For central moorings, I took 7-day standard deviations from observations at 6-hour intervals.

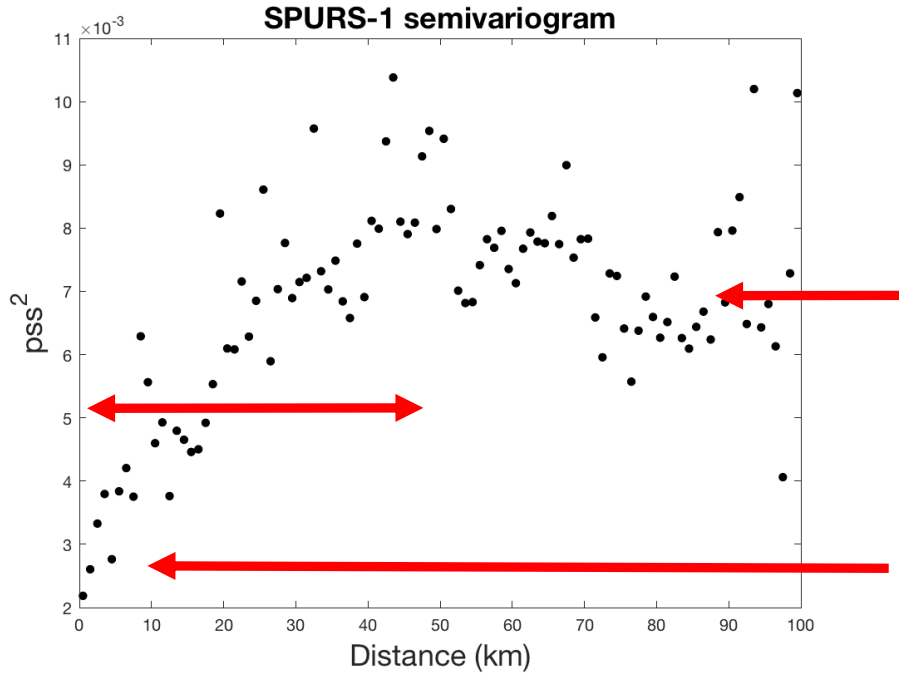
Both moorings have decorrelation time scales of 7-10 days once you remove the seasonal cycle

SPURS-2





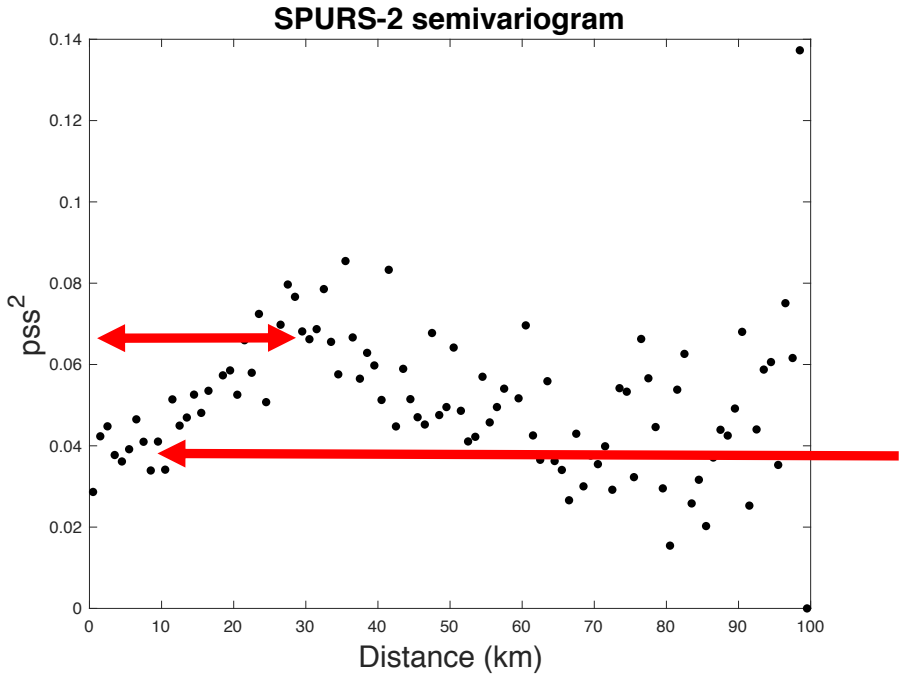
$\sigma_{95} \approx 0.019$ vs. 0.29



Sill ≅ 0.08 pss

Range ≅ 50 km

Nugget ≅ 0.05 pss



$$\gamma(h \pm \delta) = \frac{1}{2N(h)} \sum_{i,j \in N(h \pm \delta)} (S_i - S_j)^2$$

Range ≅ 30 km

Nugget ≅ 0.2 pss

Conclusions

Best estimates of SFV are σ_{95} values from SPURS-1 – 0.11. From SPURS-2 – 0.29. Both estimates from the locations of the central moorings

SFV is variable and depends on the region and time. Seasonal variability.

Values of SFV from in situ data, moorings and ROMS are different, and not directly comparable.

SFV at a particular location can be driven by small numbers of extreme outliers

In both the SPURS locations the instantaneous decorrelation scales are short, 50 km for SPURS-1 and 30 km for SPURS-2.