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Spatio-temporal variability of the Equatorial Front in the Eastern Pacific

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La Paz, 2018

INSTITUTO DEL MAR DEL PERU
CIENCIA Y TECNOLOGIA

Institut de Recherche pour le Développement
FRANCE

Dinámicas del sistema de la Corriente de Humboldt
DISCOH

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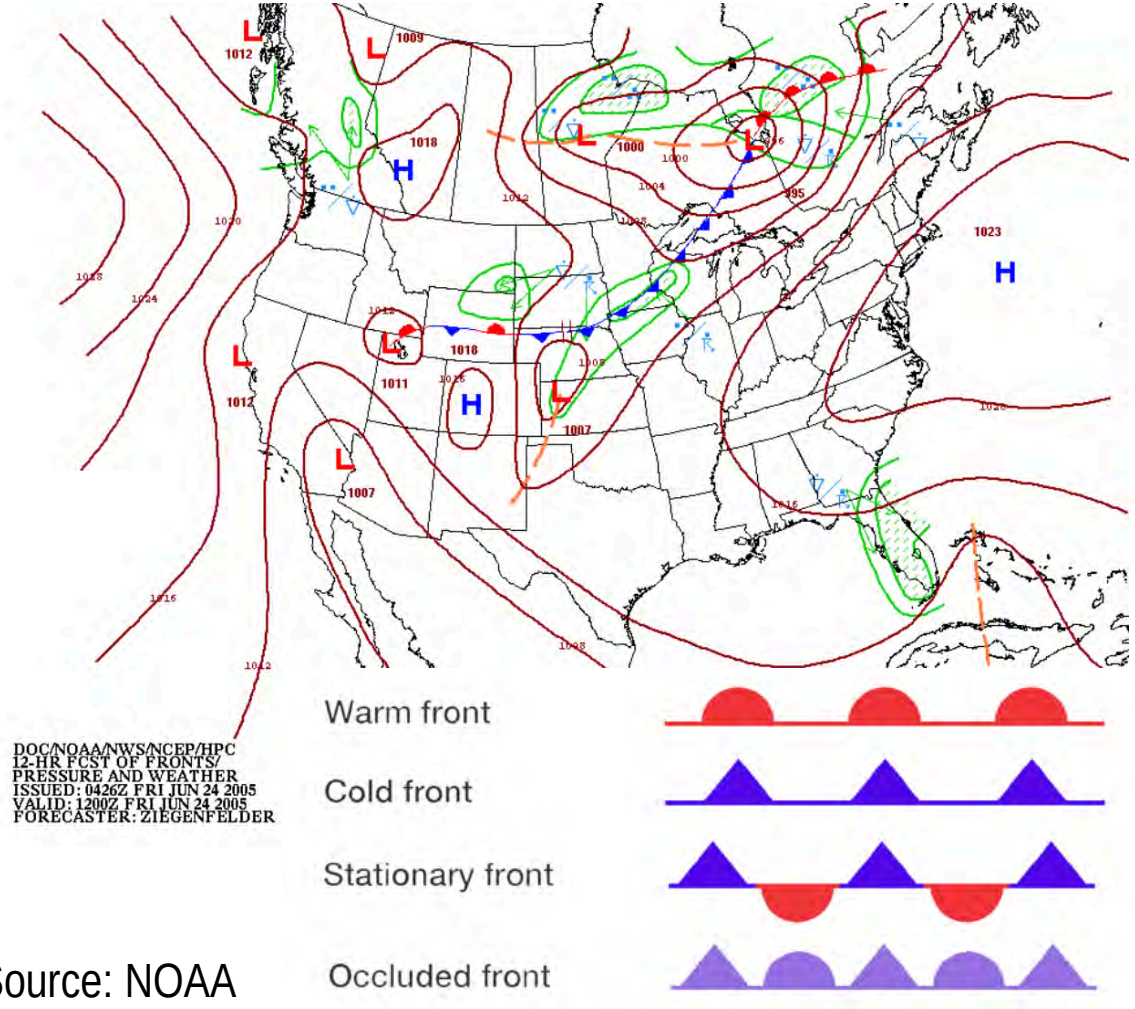
INTRODUCTION

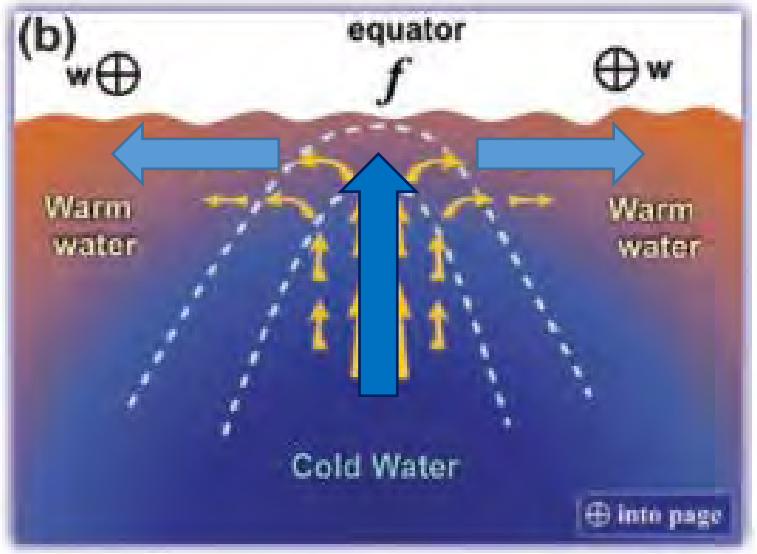
ATMOSPHERIC FRONT



Source: NOAA

OCEANIC FRONT

Acha et al., 2015

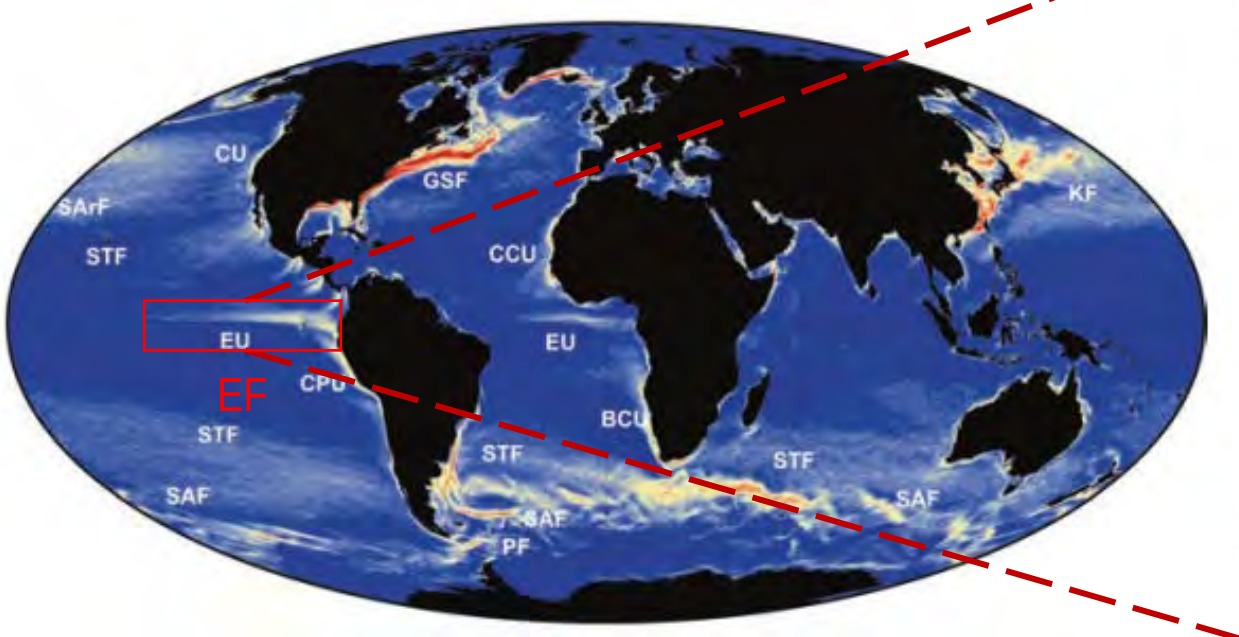


- Early described by Cromwell & Reid (1956).
- Upwelled cold water converges towards warmer water.

INTRODUCTION

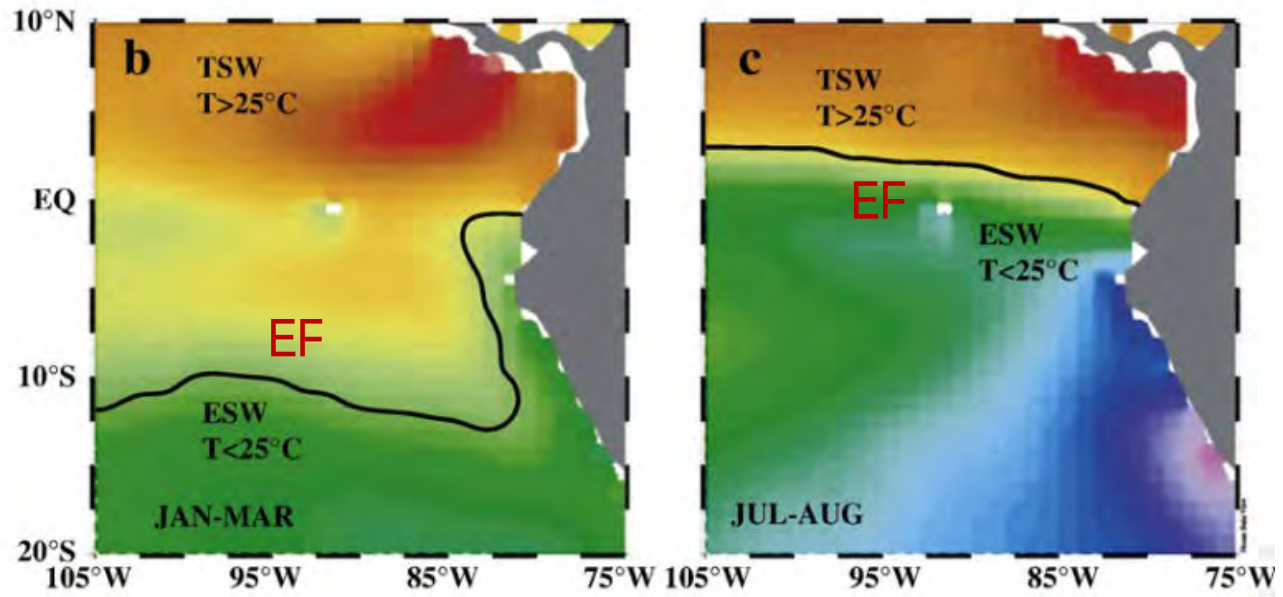
EQUATORIAL FRONT

Oceanic fronts



Acha et al., 2015

EF Variability in the Eastern Pacific



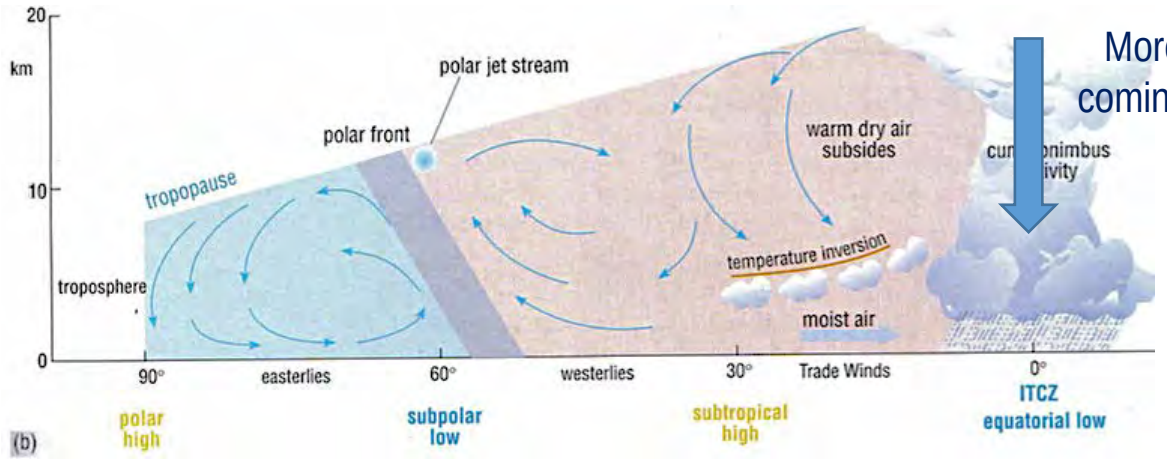
Rincón-Martinez et al., 2011

EF: Equatorial Front

- TSW converges with ESW.
- 25°C represents the separation between both water masses.

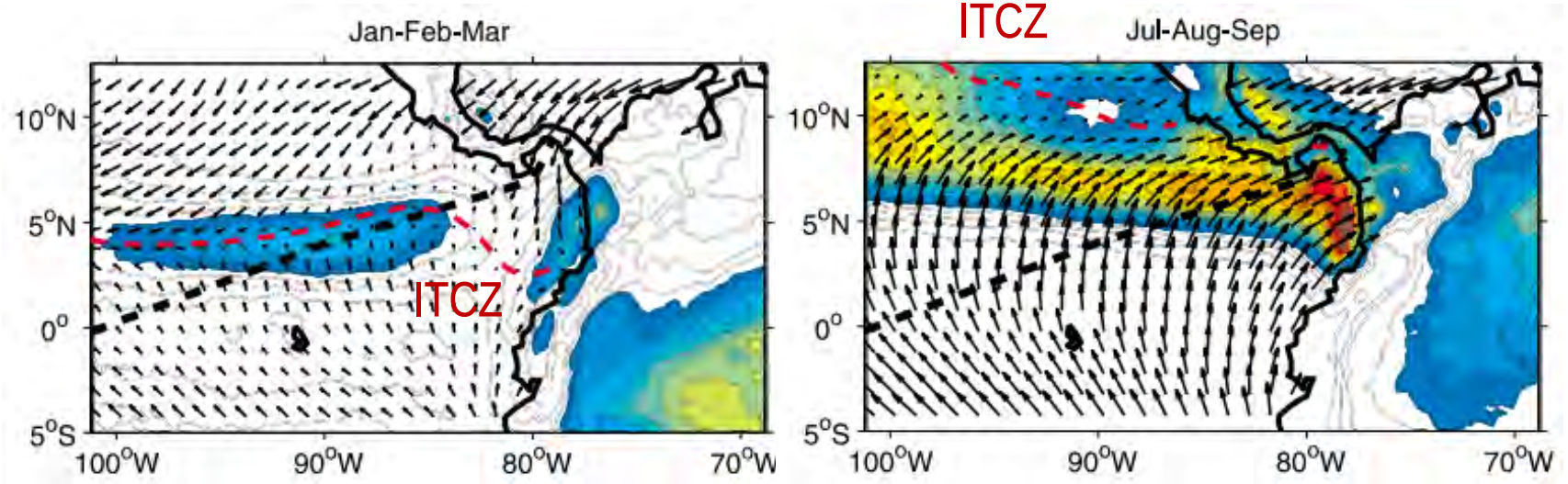
INTRODUCTION

WINDS IN THE EASTERN PACIFIC



More energy coming from the Sun

Austral Summer



Austral Winter

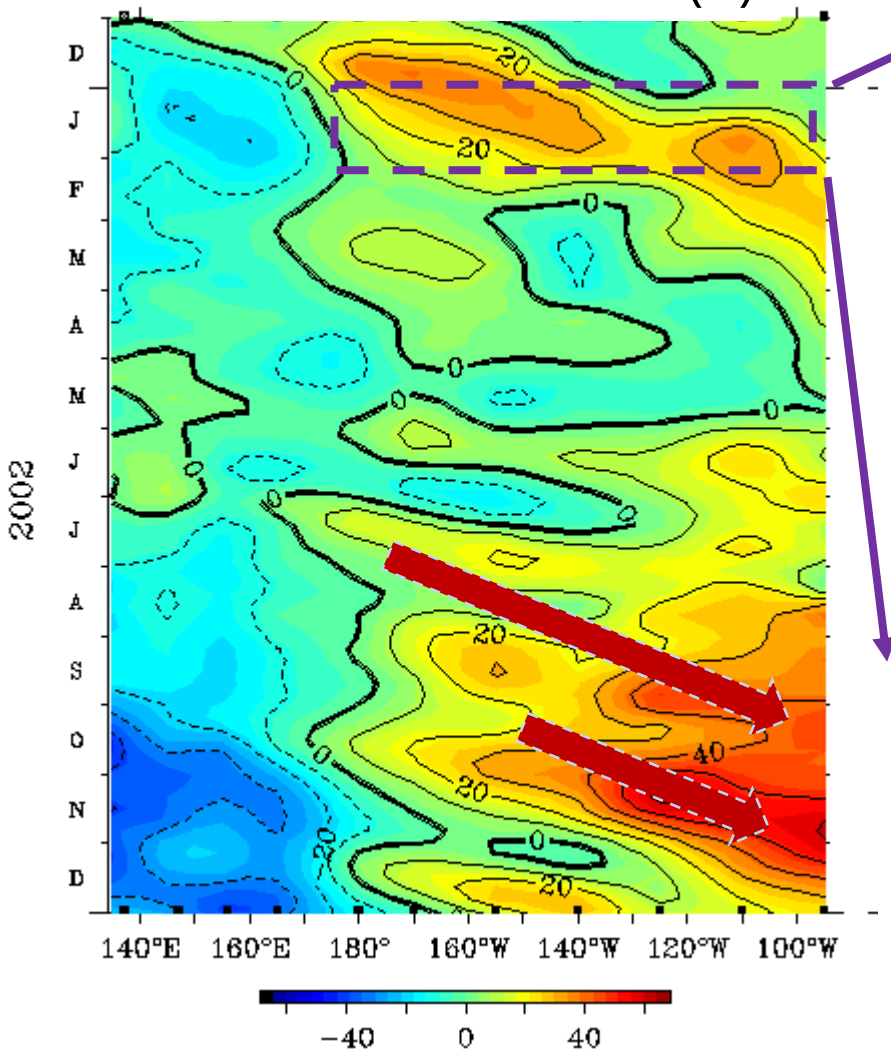
ITCZ

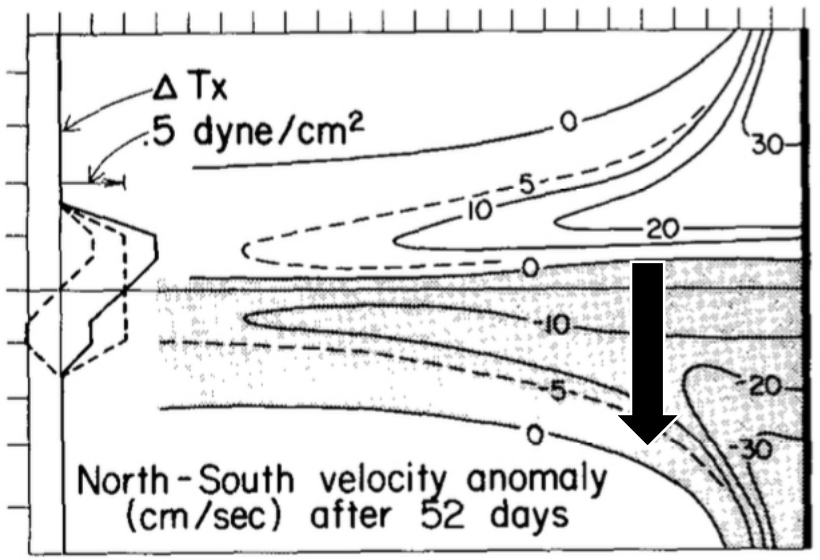
Alory et al., 2012

INTRODUCTION

KELVIN WAVES AND MERIDIONAL ADVECTION

20°C ISOTHERM DEPTH (m)





McCreary et al., 1976

- Starts in the Central Pacific due to wind perturbance.
- Downwelling Kelvin Waves. Rise of the mean sea level. Deeper thermocline.
- Currents entered slightly north of equator migrates southward. Possible changes in the EF position.

Source: TAO-TRITON Project

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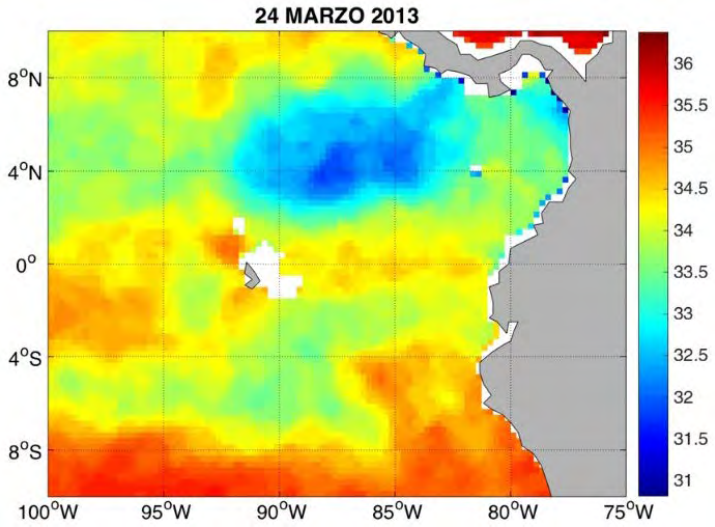
DATA AND METHODOLOGY

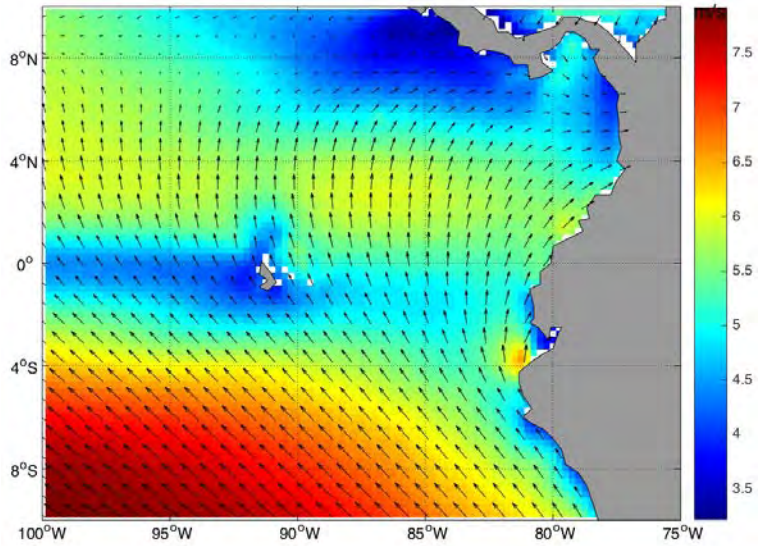
- Region of interest: 10°N-10°S; 75°W-100°W
- Data

SALINITY



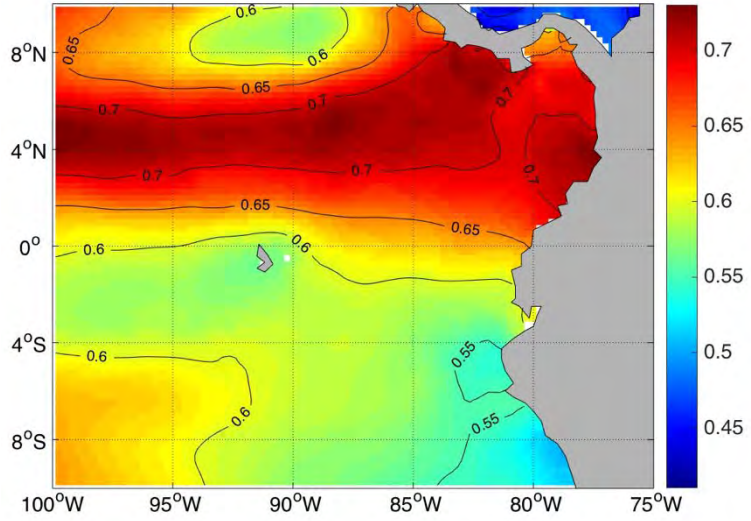
SMOS
0.25° x 0.25°
2010 – 2015 (every 4 days)

WINDS



QuikScat - ASCAT
0.25° x 0.25°
1999 – 2015 (daily)

DYNAMIC HEIGHT

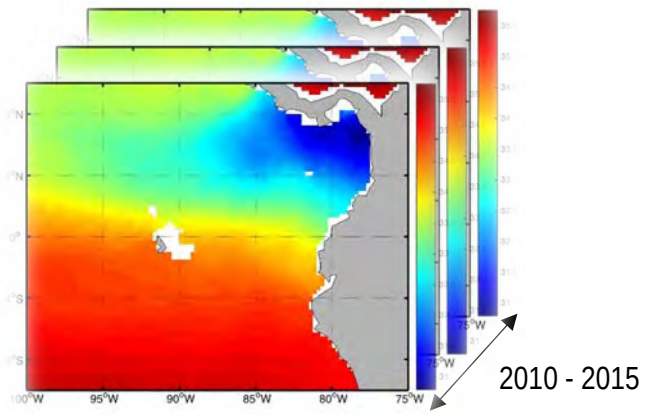


MADT
0.25° x 0.25°
1993 – 2014 (every 4 days)

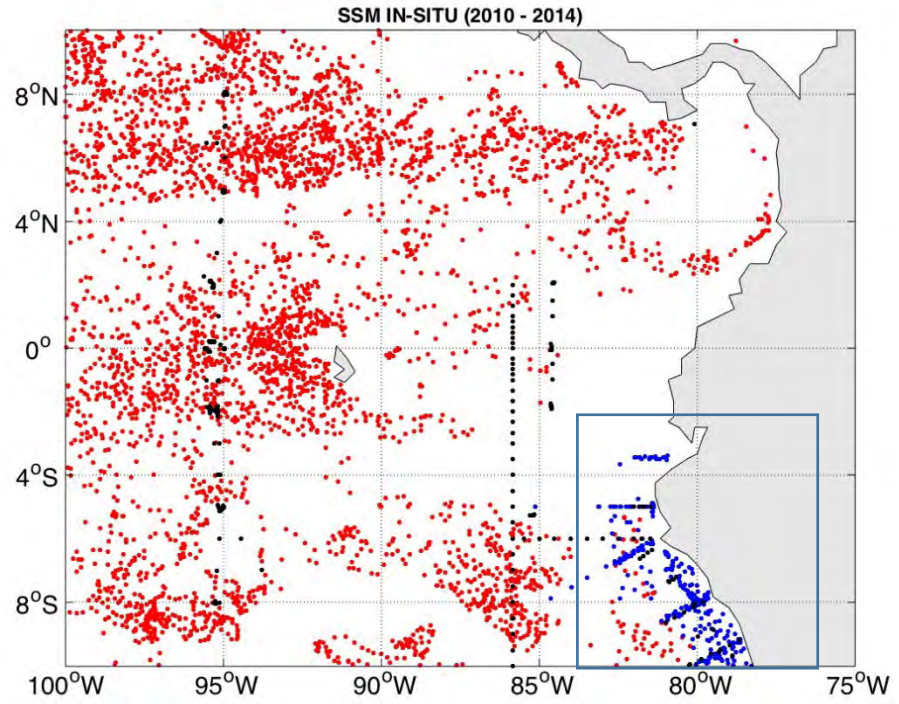
DATA AND METHODOLOGY

VALIDATION OF SMOS USING IN-SITU DATA

SMOS



INSITU ARGO, WOD (9400 profiles)

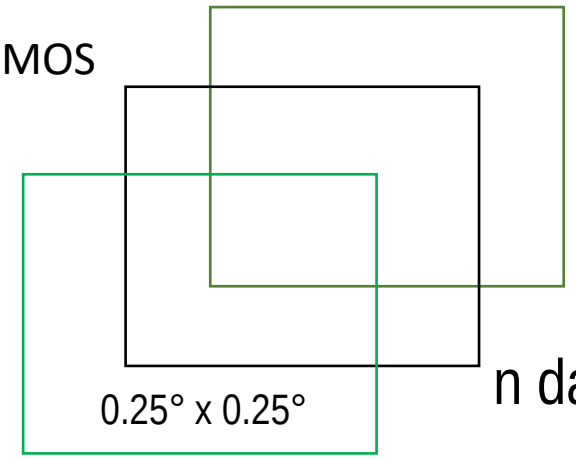


IMARPE (300 profiles)

in-situ

SMOS

in-situ



n – 2 day

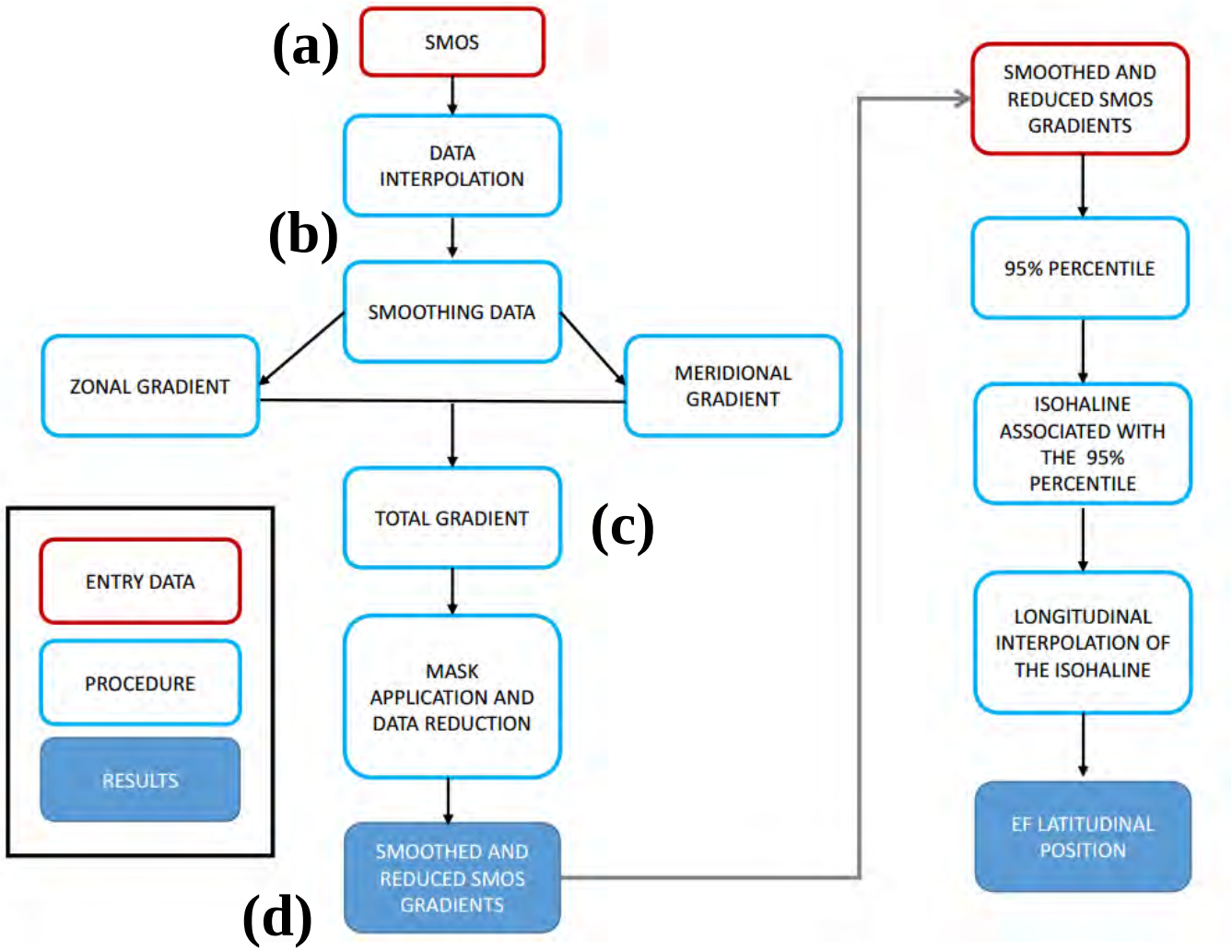
n day

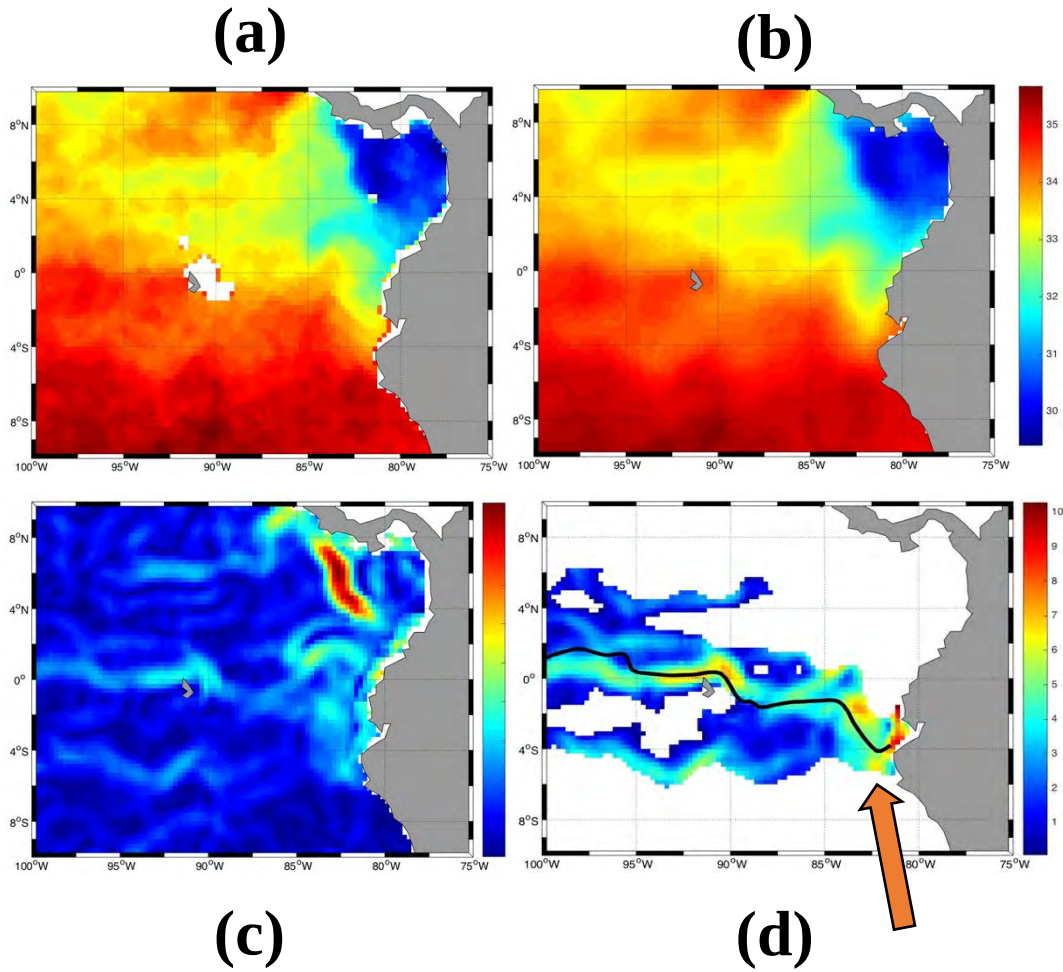
n + 2 day

CORRELATION

DATA AND METHODOLOGY

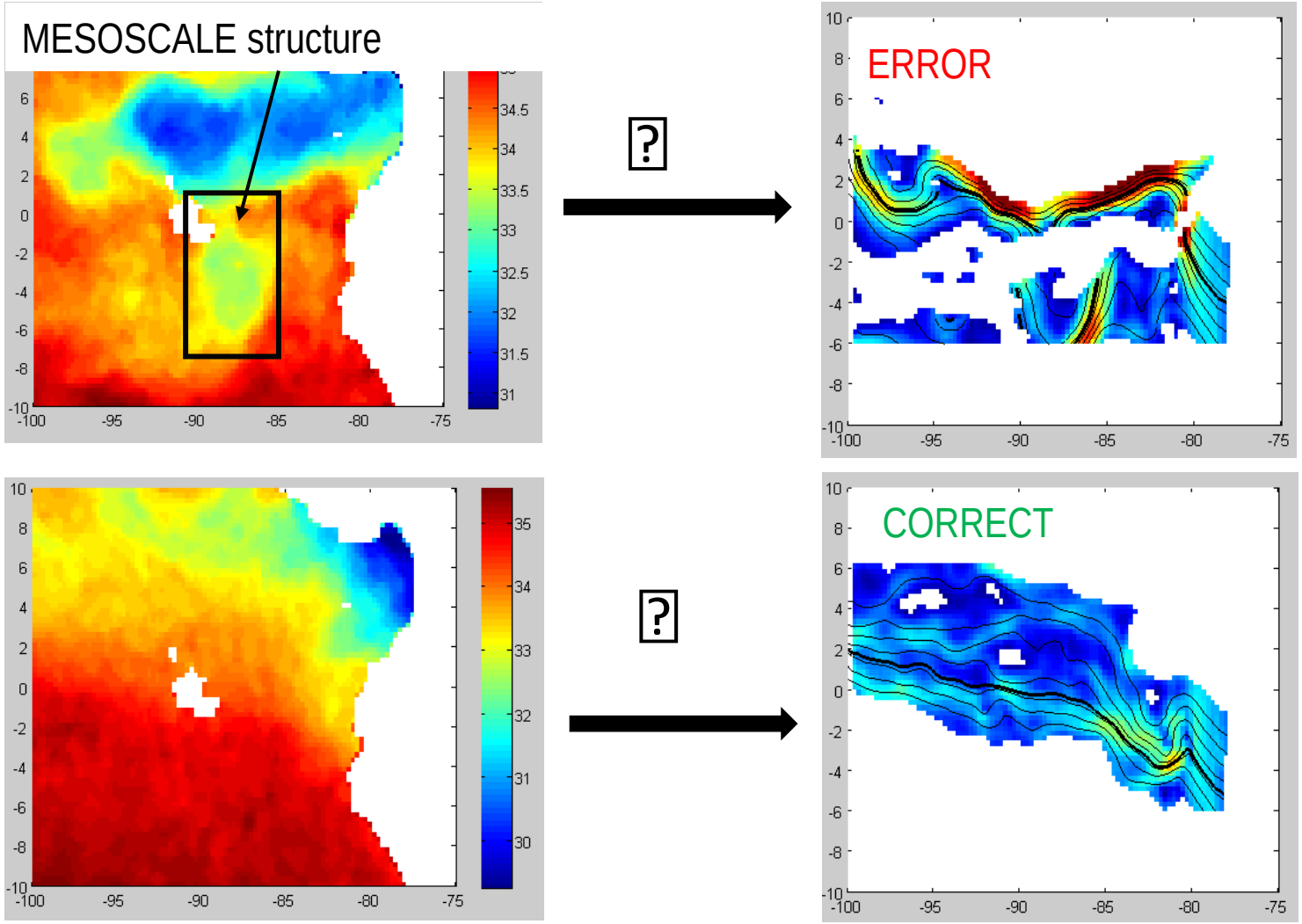
EF DETECTION ALGORITHM





DATA AND METHODOLOGY

EF FRONT DETECTION - SMOS



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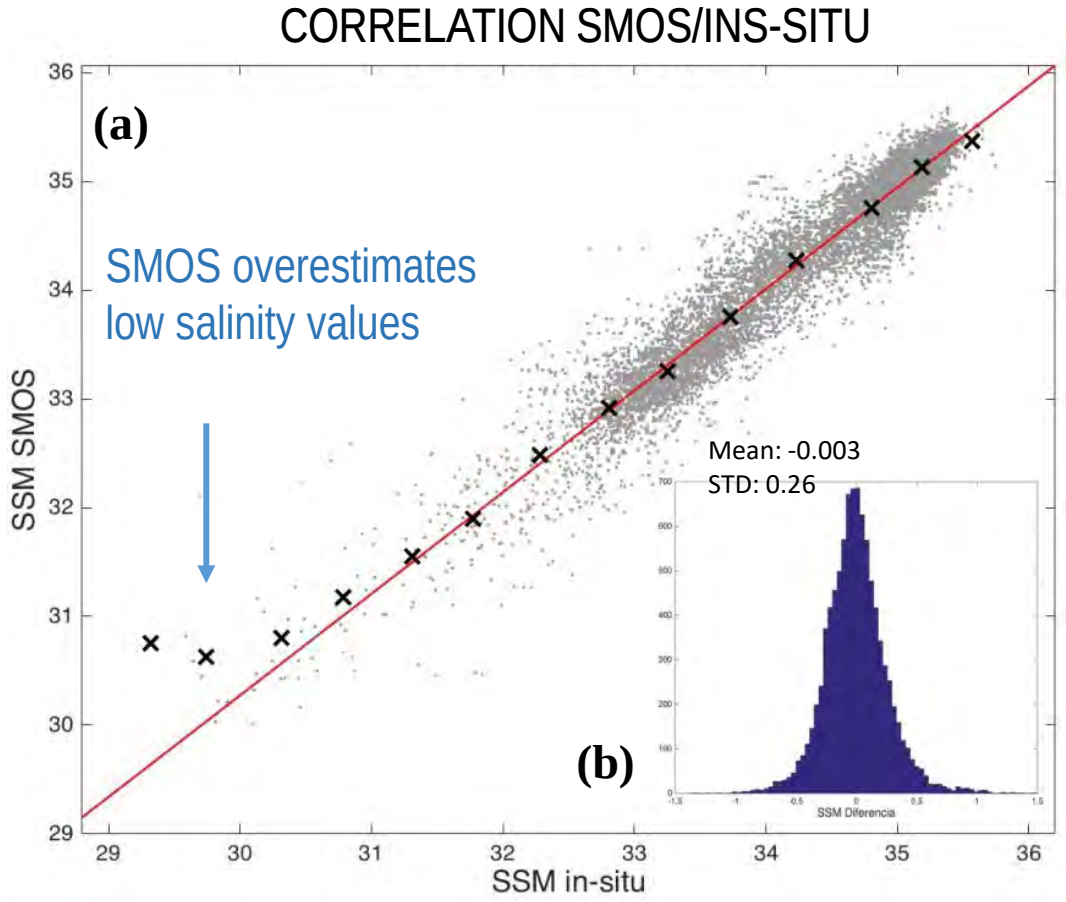
RESULTS AND DISCUSSION

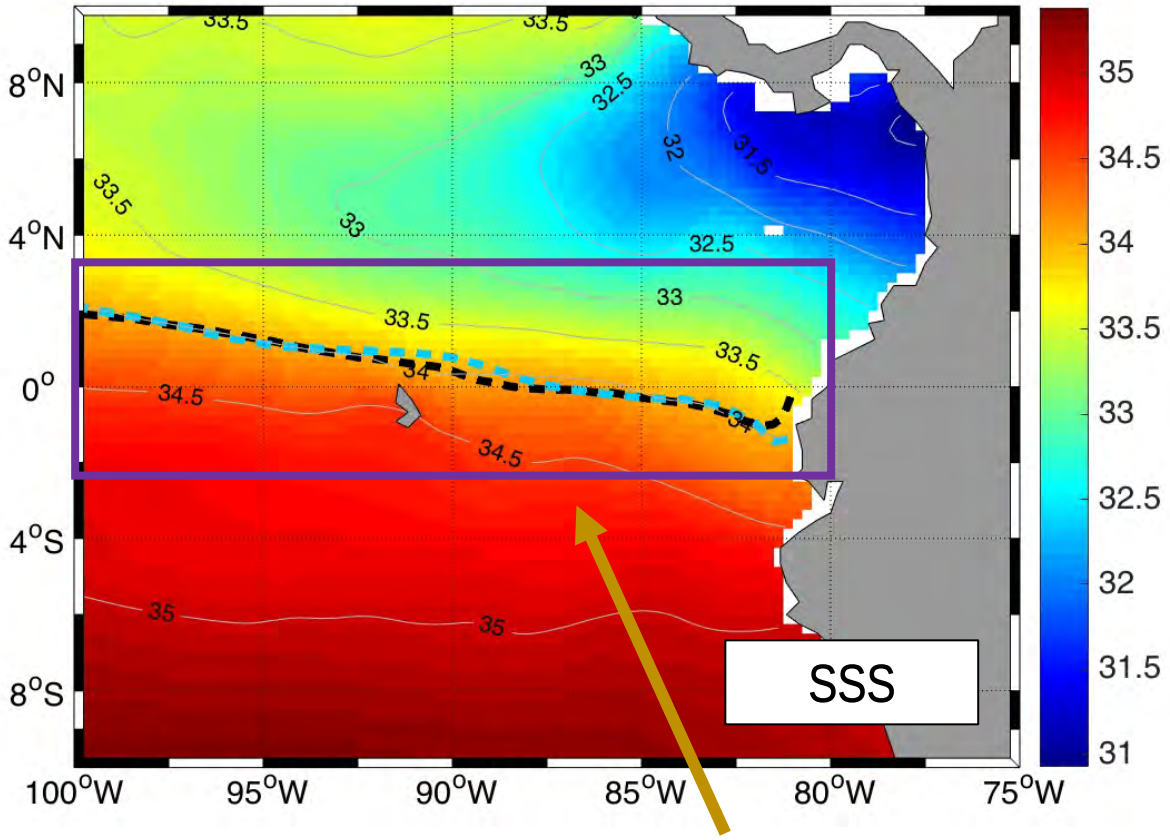
VALIDATION OF SMOS USING IN-SITU DATA



Correlation coef: 0.96

RESULTS AND DISCUSSION

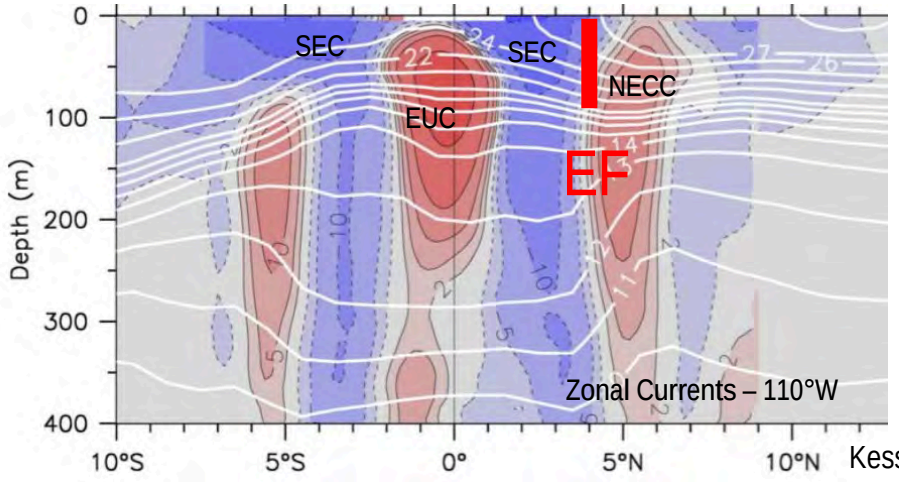
MEAN POSITION OF THE EF



The EF is correctly defined by SSS

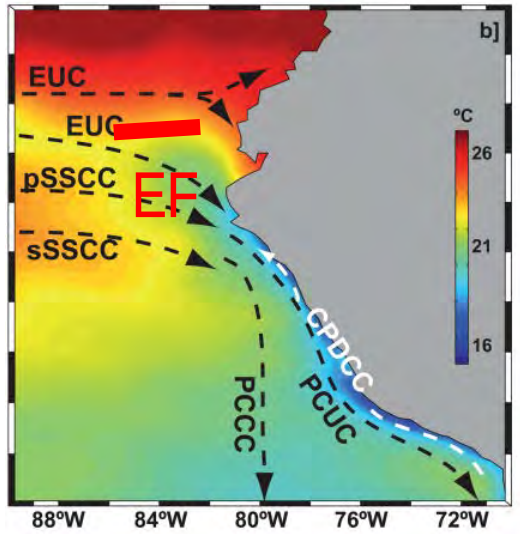
--------- EF SMOS

WEST OF GALAPAGOS



Kessler, 2006

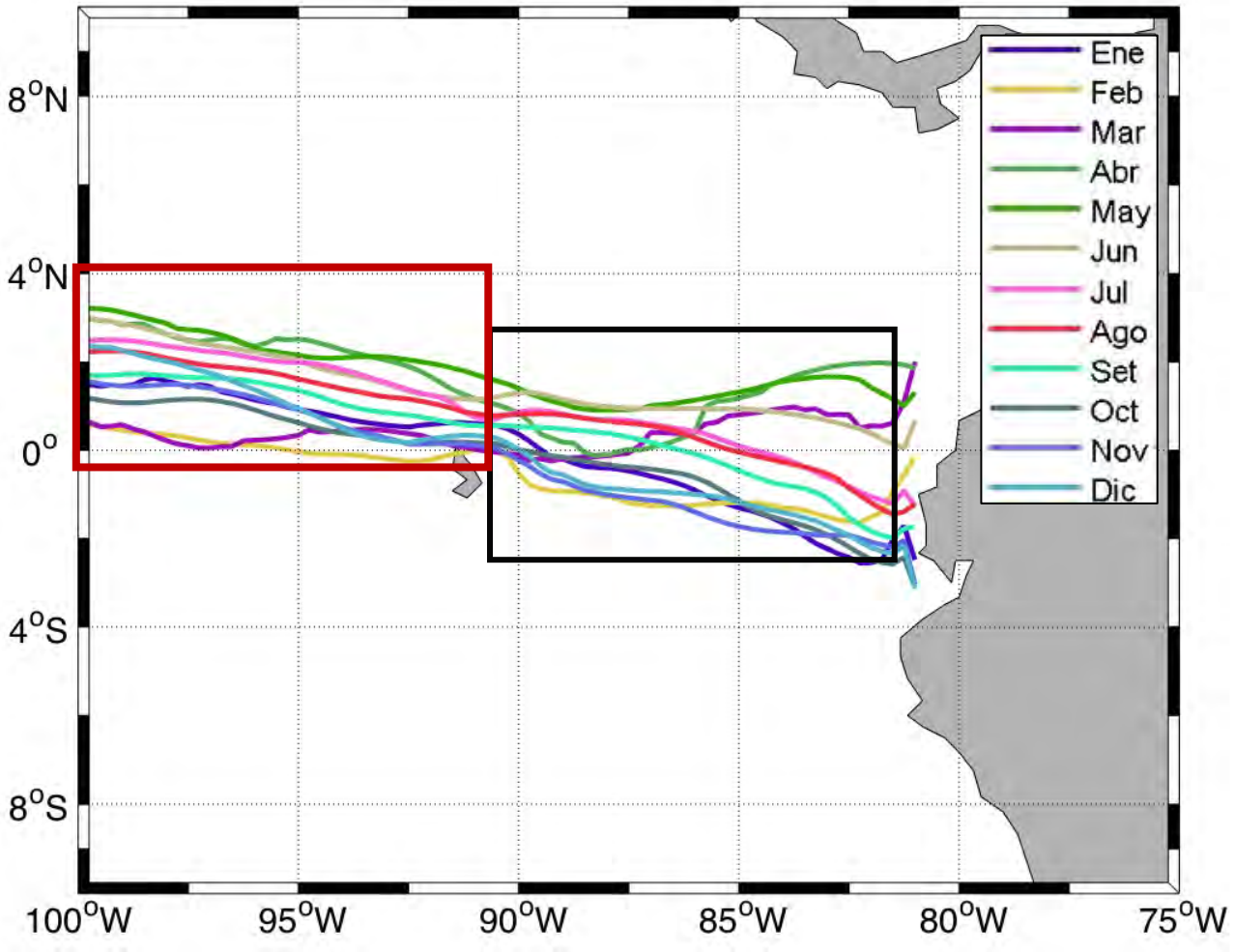
EAST OF GALAPAGOS



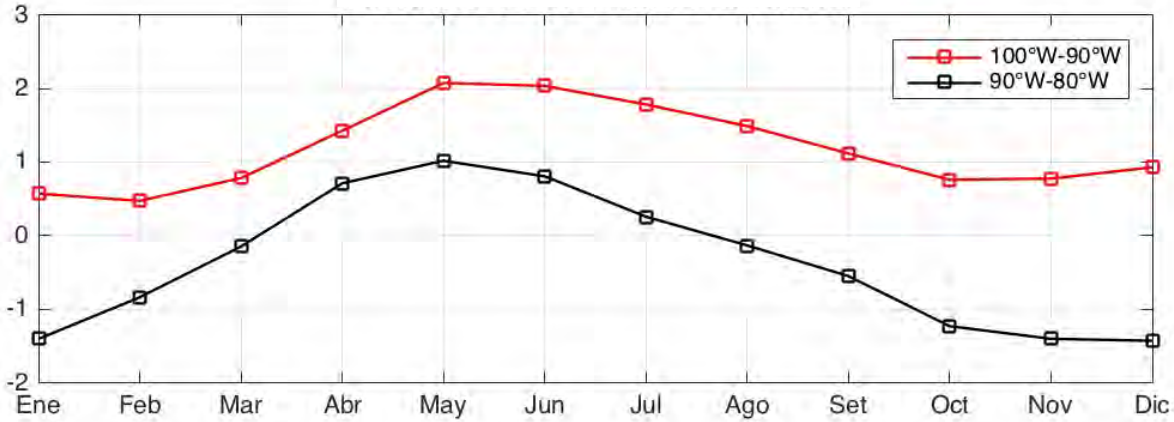
Chaigneau et al., 2013

RESULTS AND DISCUSSION

EF SEASONAL VARIABILITY - SMOS



MONTHLY POSITION EF

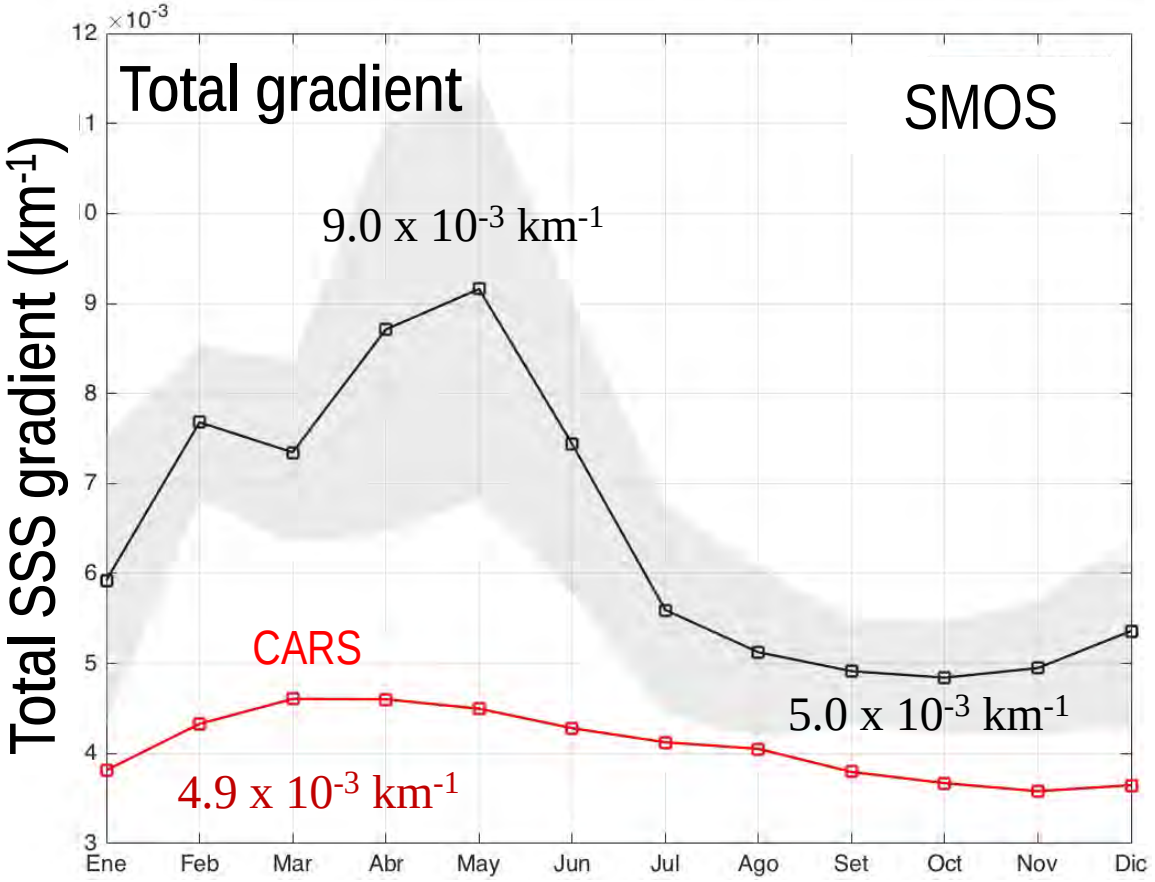


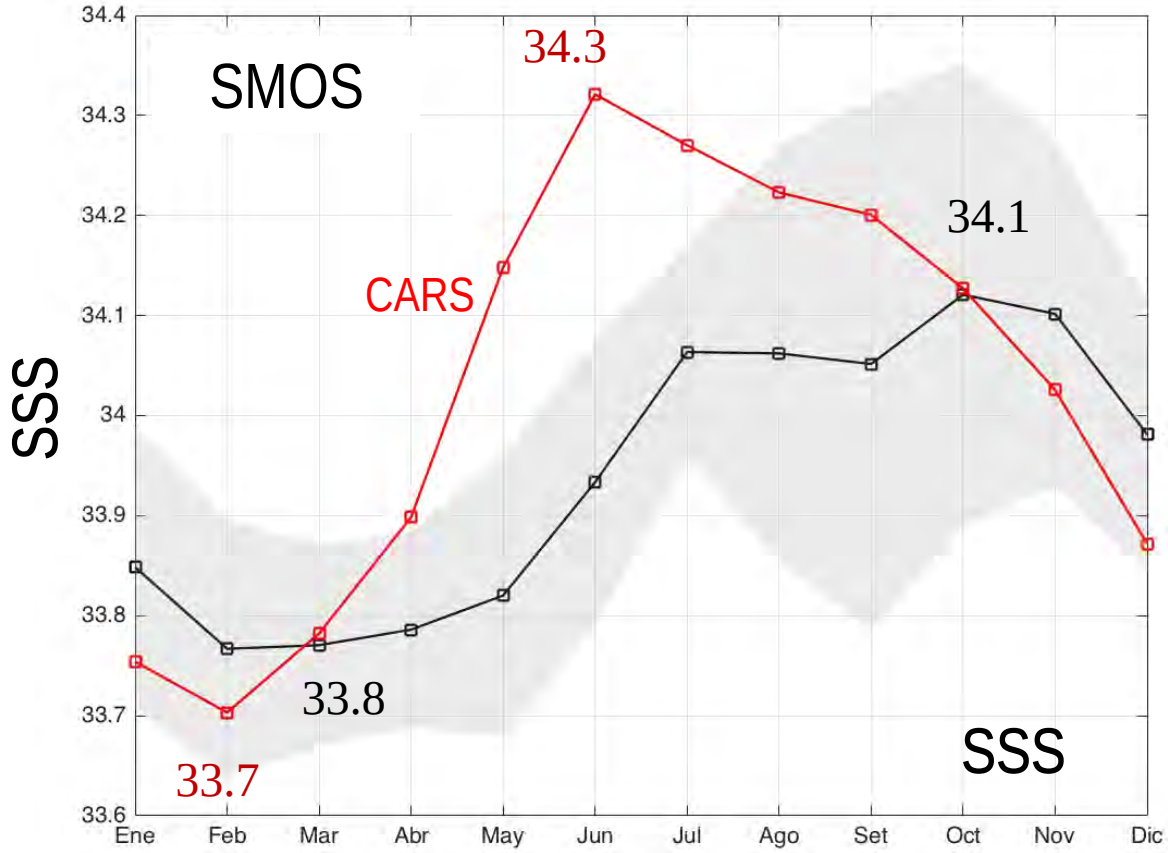
April-Jun: Northward displacement

Oct-Dic: Southward displacement

RESULTS AND DISCUSSION

SEASONAL INTENSITY AND SSS ASSOCIATED WITH THE EF

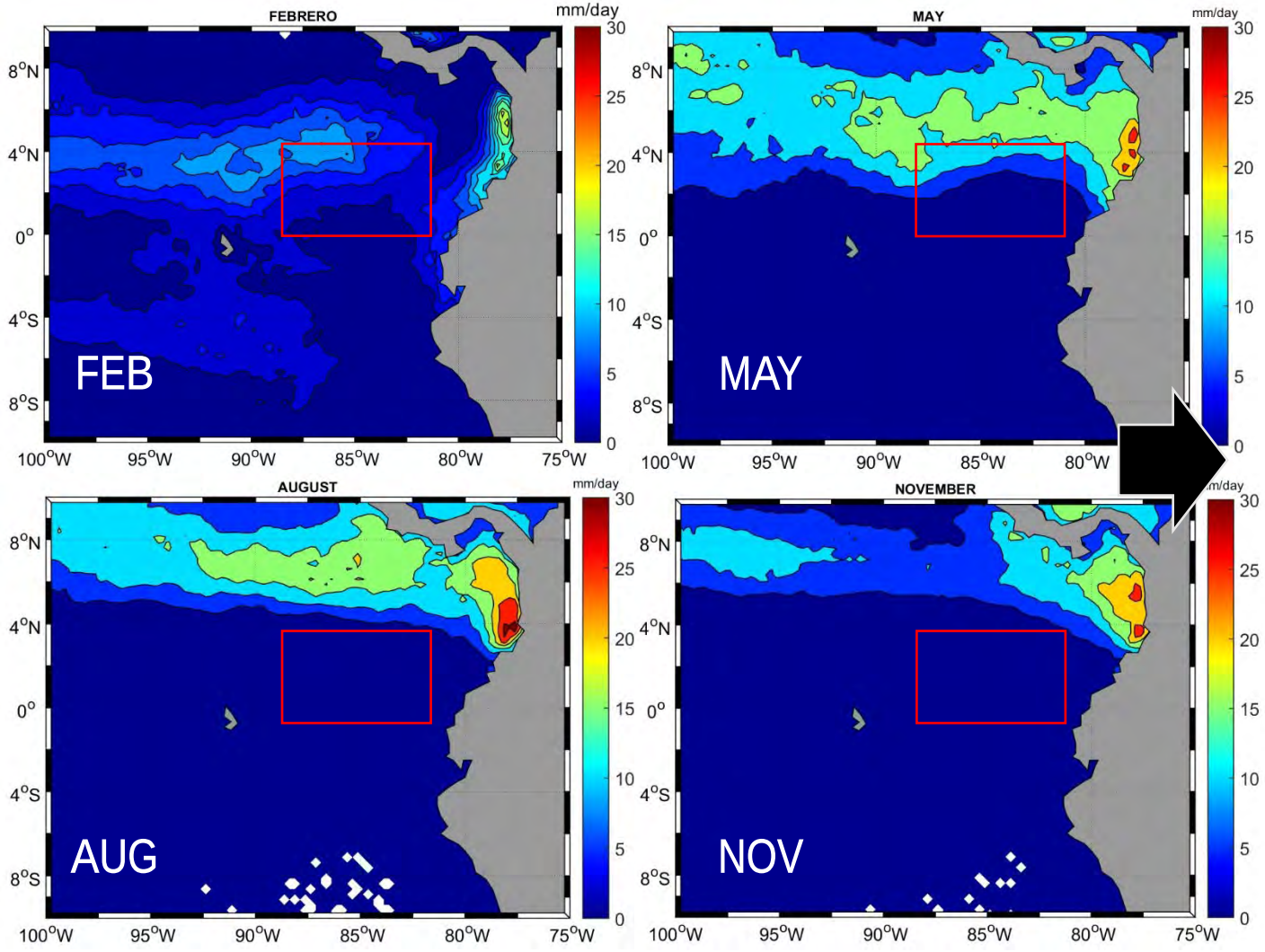


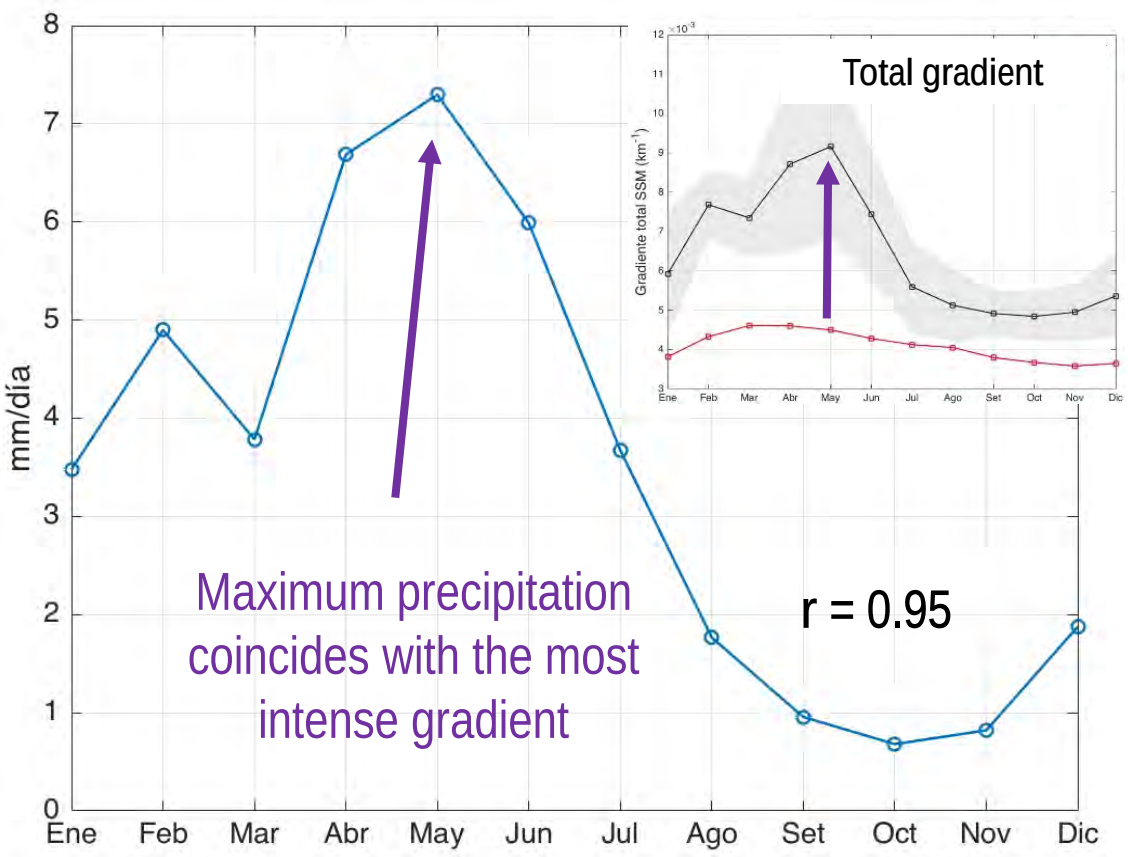


- Seasonal changes probably influenced by the ITCZ.

RESULTS AND DISCUSSION

➢ There is a relation between precipitation variability and seasonal changes in the total gradient.



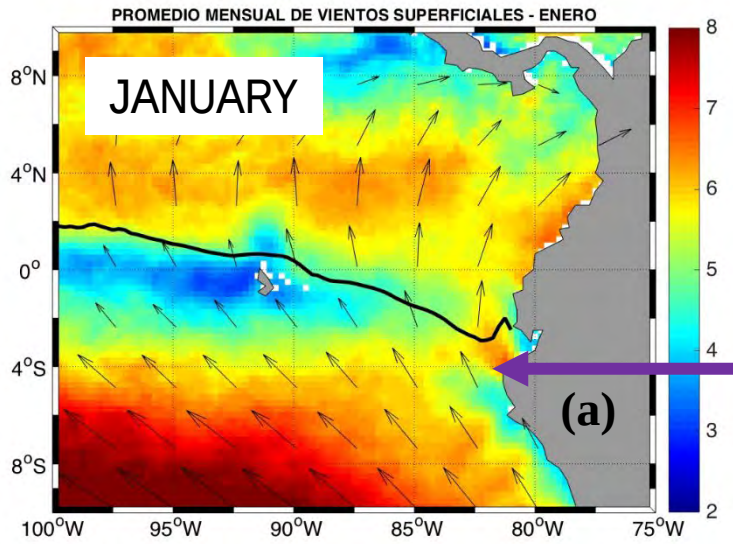


RESULTS AND DISCUSSION

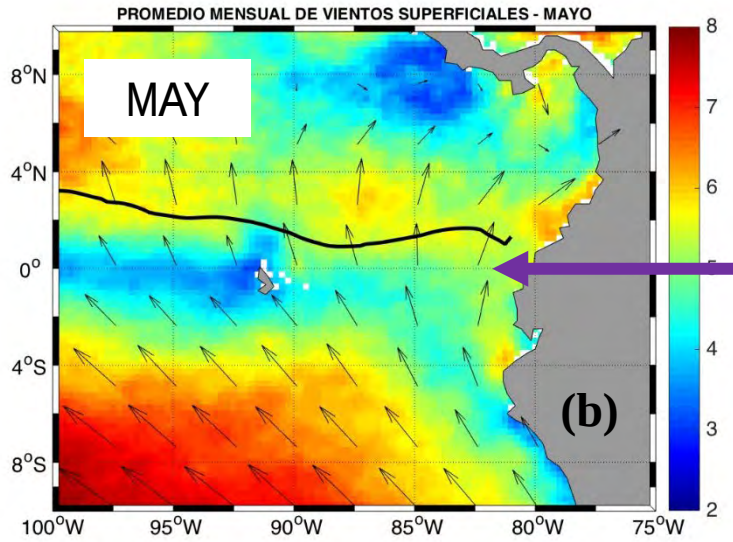
IS THERE A DIRECT INFLUENCE OF THE SURFACE WINDS FIELD AND INTENSITY IN THE SEASONAL VARIABLITY OF THE EF?

- Under the assumption that winds advect the EF.

There is no clear influence!



Strong winds ~6 ms^{-1}

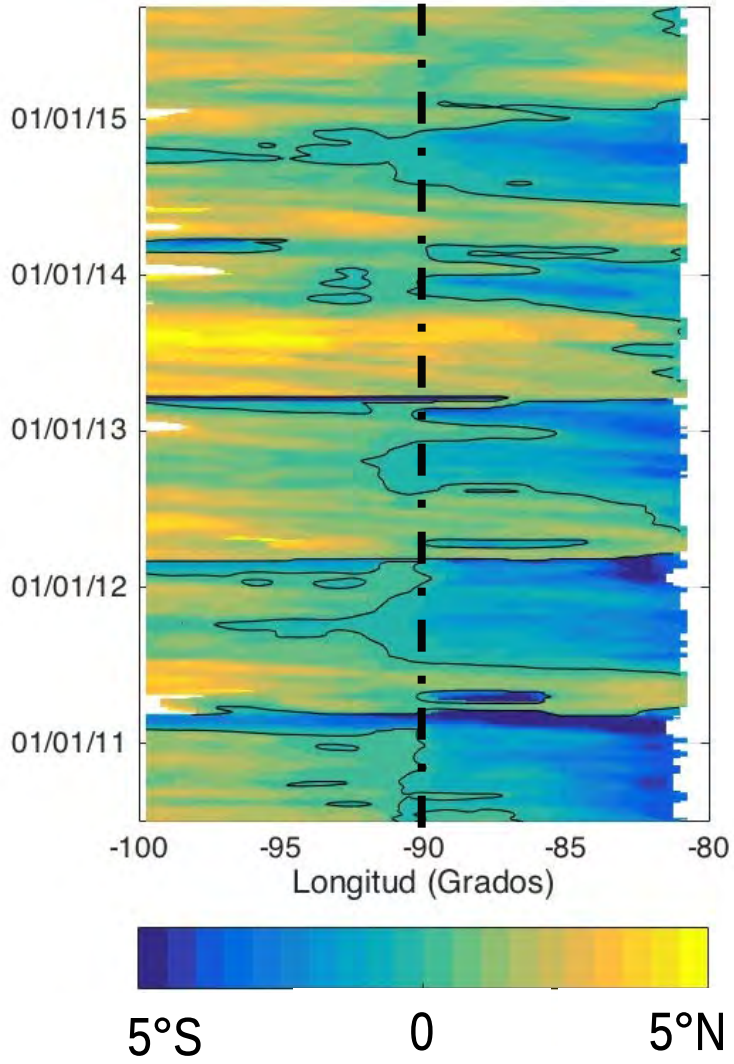


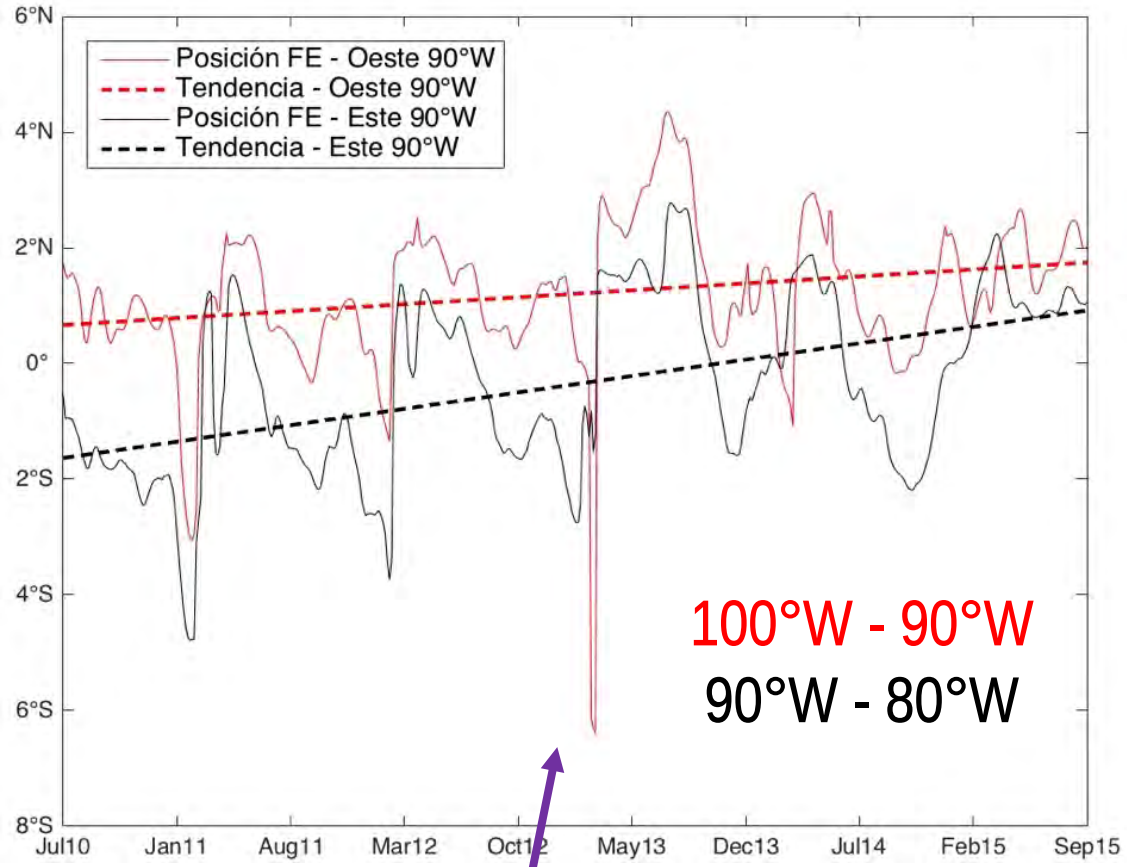
Relatively weak winds ~4.5 ms^{-1}

RESULTS AND DISCUSSION

LATITUDINAL POSITION EF - INTERANNUAL VARIABILITY

- Possibly mesoscale structures.
- West of Galapagos, the EF is always to the north of the equator.
- East, more variability in comparison to the west.

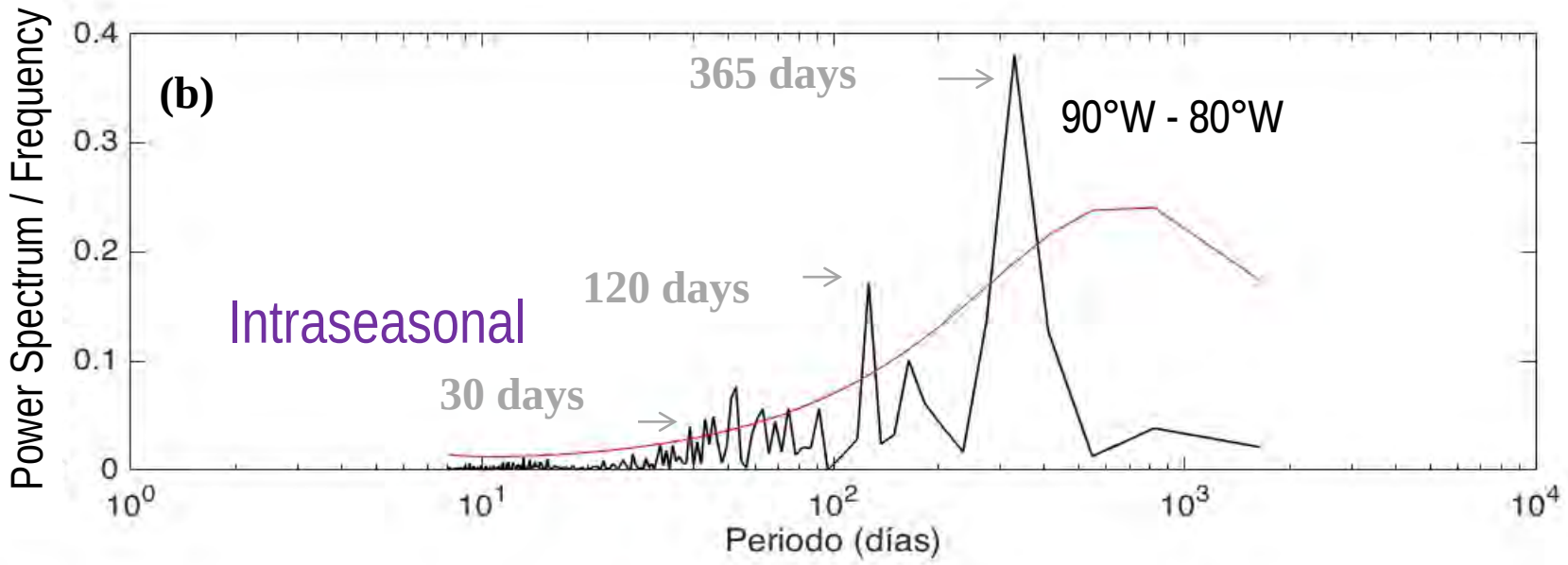




Abnormal distribution in the SSS fields

RESULTS AND DISCUSSION

SPECTRAL ANALYSIS

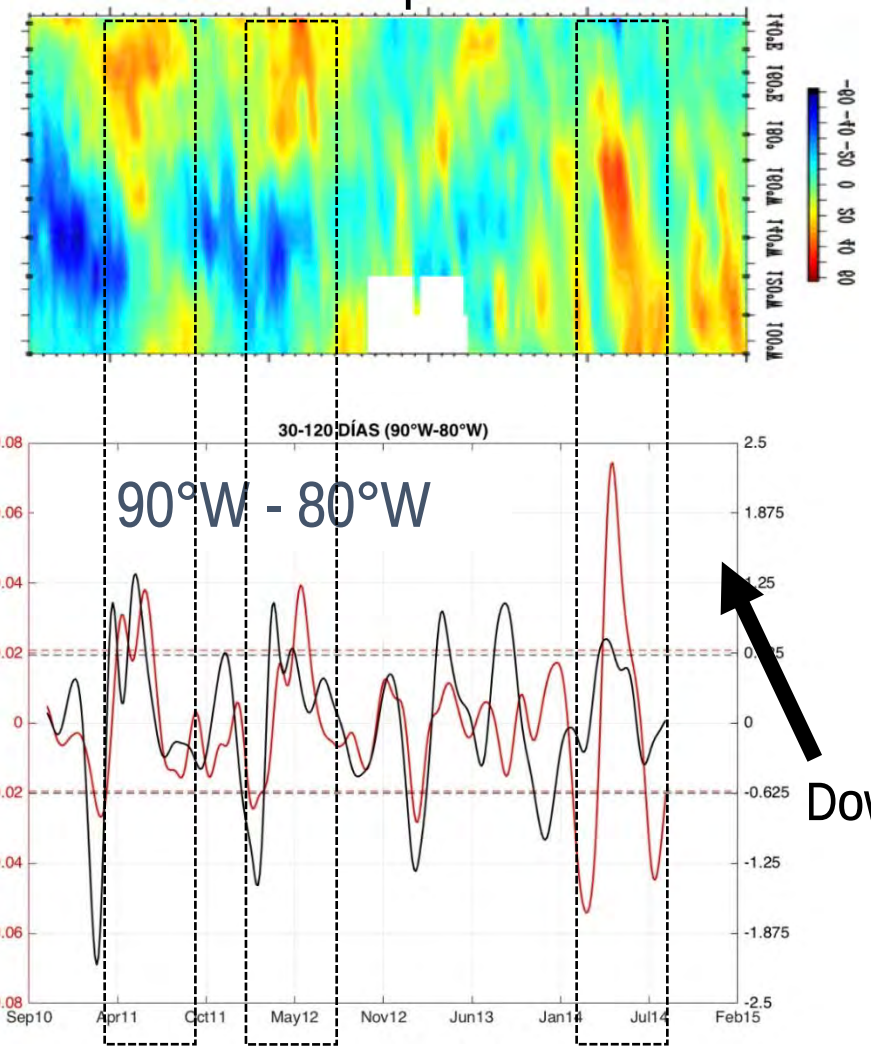


- Peaks of significant variability in the intraseasonal band.

RESULTS AND DISCUSSION

INTRASEASONAL VARIABILITY

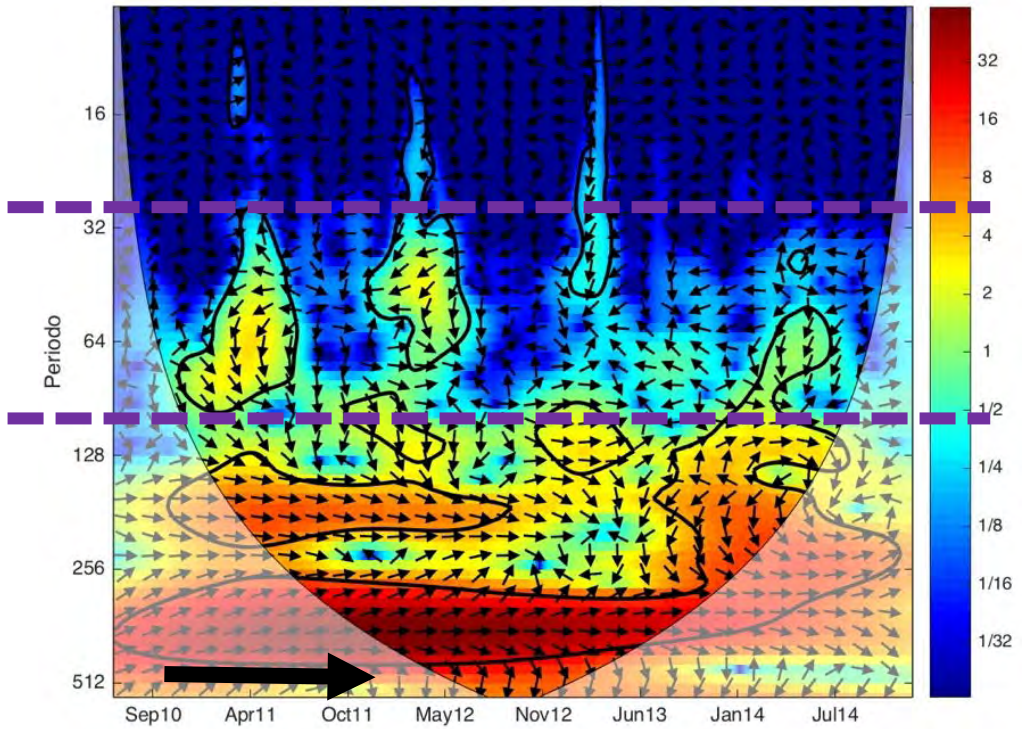
Thermocline depth



Downwelling KW

30 – 120 days

Cross-wavelet SLA-EF

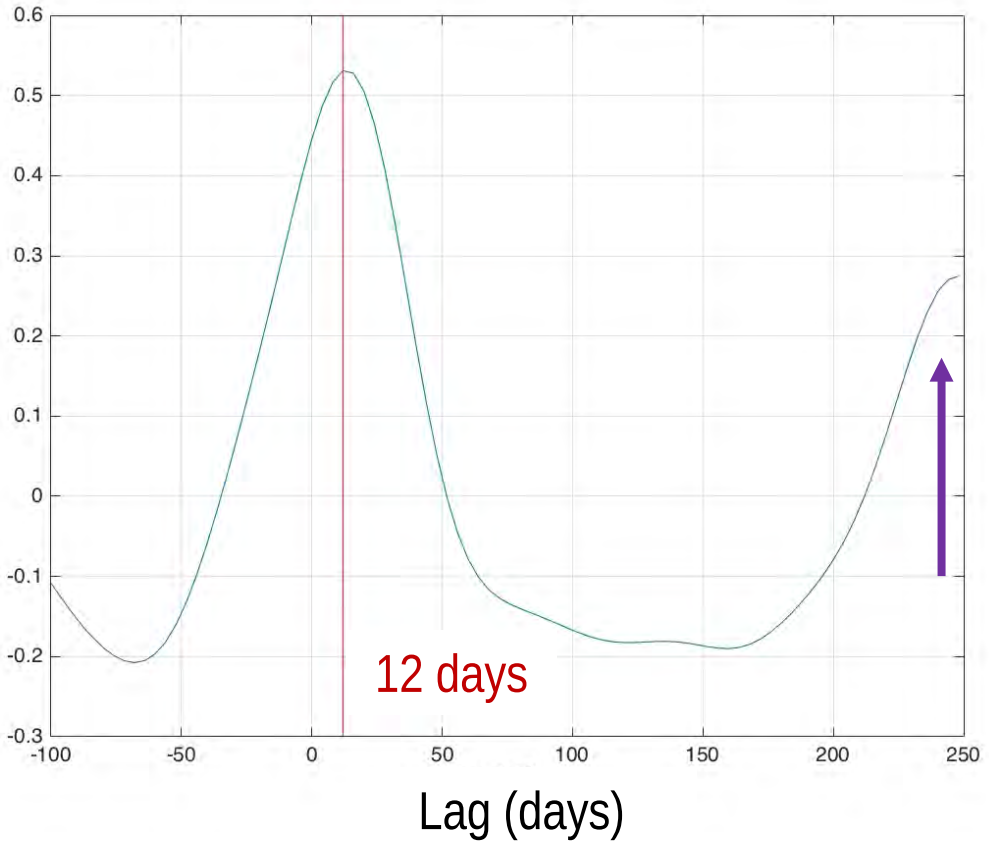


- Displacements up to 2.5° from the mean.
- Lag between EF and SLA is indicated arrows in the *cross-wavelet*.

RESULTS AND DISCUSSION

EFECTS OF THE KW IN THE INTRASEASONAL VARIABILITY OF THE EF

Normalized cross-correlation



- Region considered (2°N-2°S; 88°W-87°W).
- Maximum correlation (0.5) of variability with a *lag* of 12 days.
- Lag EF in relation to SLA.

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CONCLUSIONS

The EF was a permanent structure, with intense horizontal gradients and important scales of variability in its position.

1. High correlation (r = 0.97) between SMOS and *in-situ* data.

2. Automatic detection of the EF in the SSS fields.

3. In normal conditions, East of Galapagos, the EF was to the south of the equator; On the contrary, West of Galapagos, was to the north. More seasonal displacements of the EF East of Galapagos, where during austral Autumn-Winter reach its maximum northern position. Its maximun southern position was observed in Spring.

4. We observed an internannual variability up to 4° in its position. Also, intraseasonal up to ~2.5°. Precipitation was very related (r = 0.95) with the total SSS gradient.

5. Surface winds didn't show a direct influence in seasonal displacements of the EF. Whereas intraseasonal changes in its position was associated, among others, with downwelling Kelvin Waves.

THANK YOU

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