

# Salinity Fronts in the Tropical Pacific Ocean

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Understanding  
the Interaction  
Between Ocean  
Circulation, the  
Water Cycle,  
and Climate by  
Measuring  
Ocean Salinity

Aquarius/SAC-D



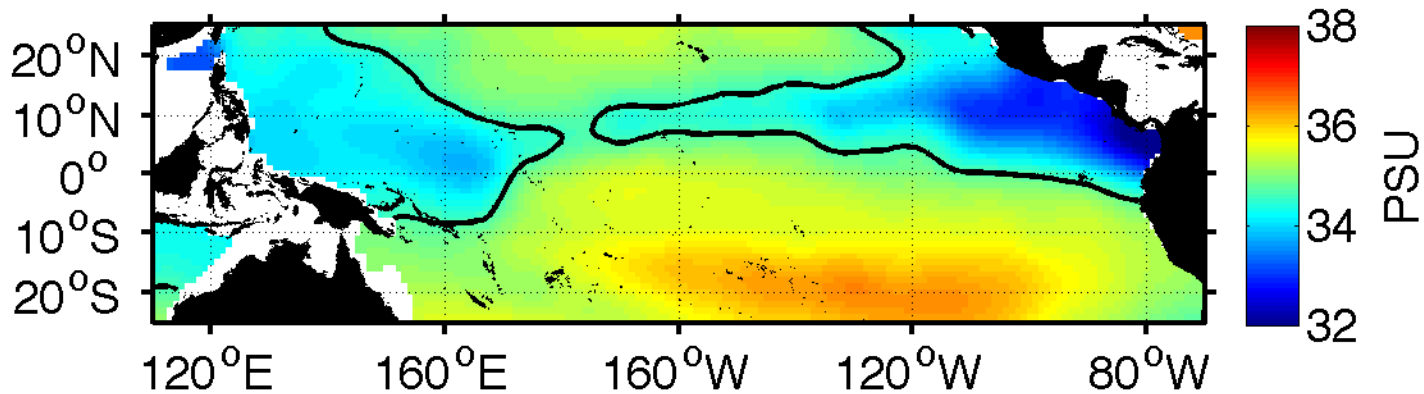
8<sup>th</sup> Aquarius/SAC-D Science Team Meeting

13<sup>th</sup> November 2013

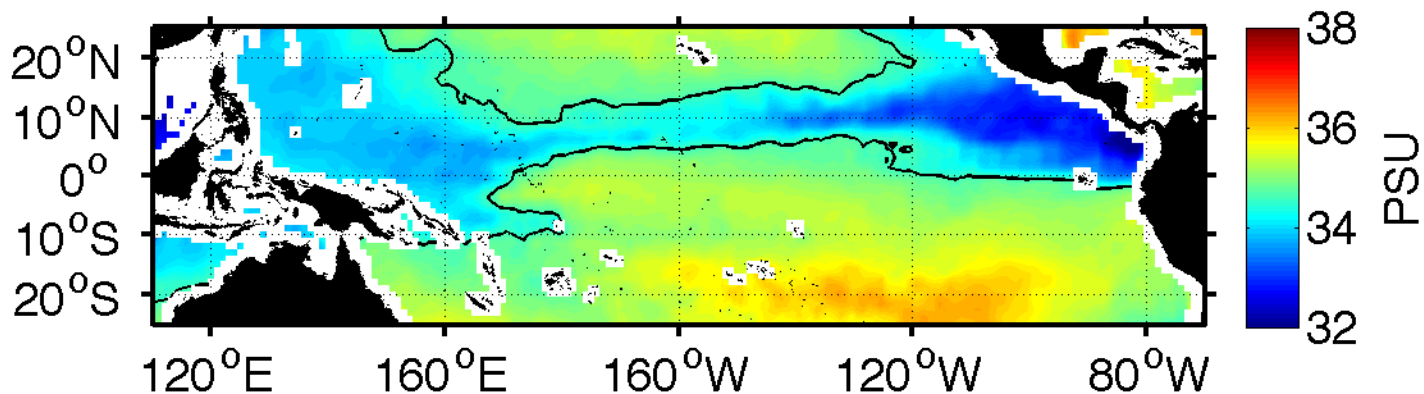
# Low SSS are observed over the ITCZ and two fresh pools in the tropical Pacific

Argo

October, 2012



Aquarius



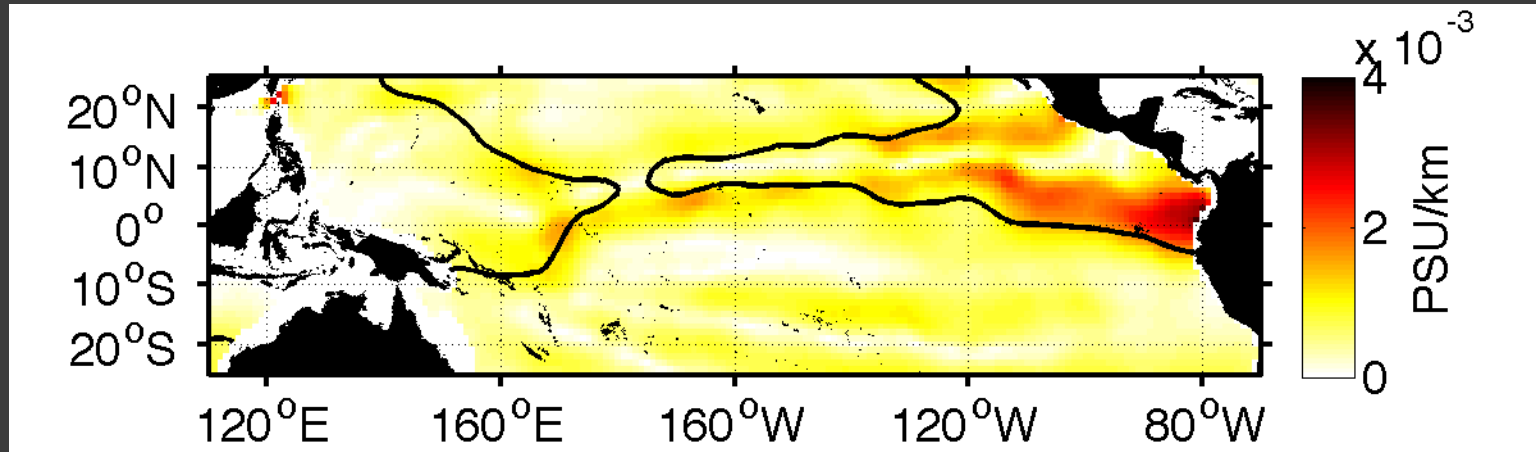
# Salinity Fronts

horizontal gradients of SSS (in psu/km)

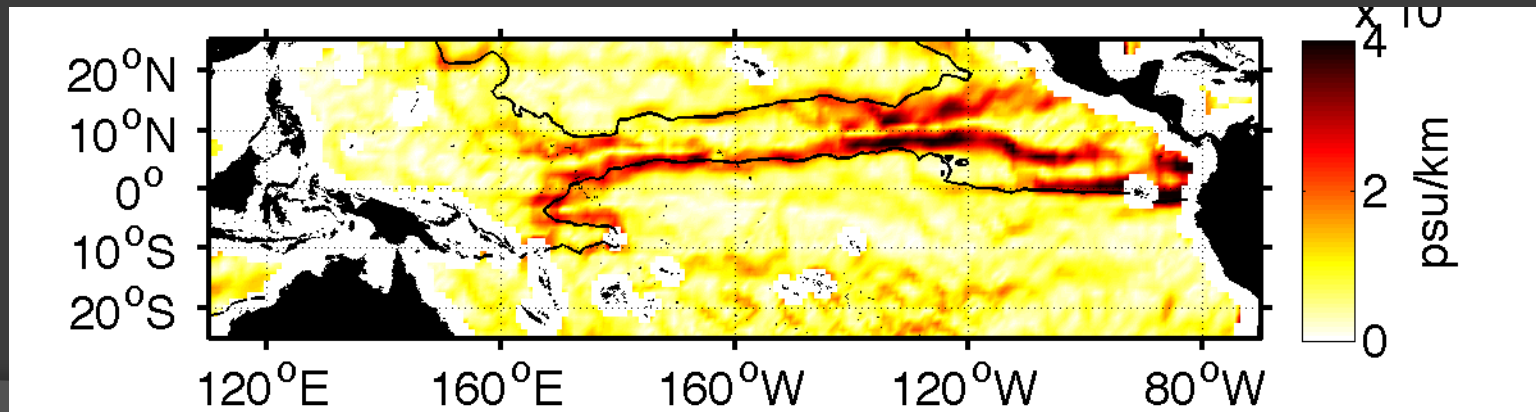
The black contours indicate the 34.6 isohalines.

Argo

October, 2012



Aquarius



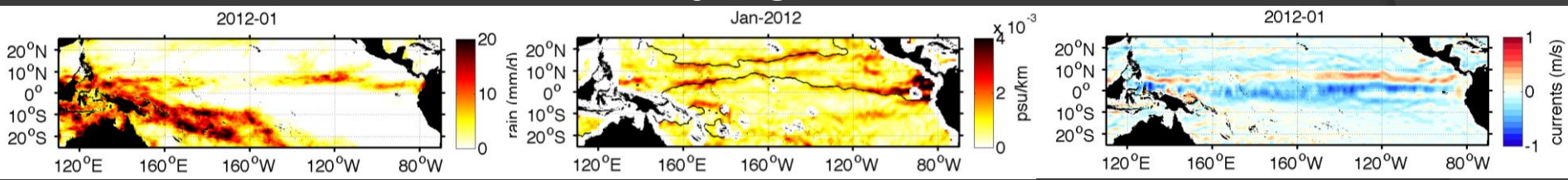
# Seasonal Salinity Fronts in 2012

## Precipitation

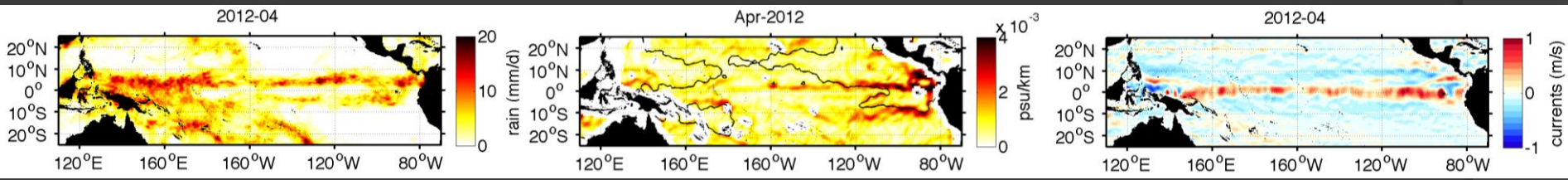
## Salinity Fronts

## Zonal currents

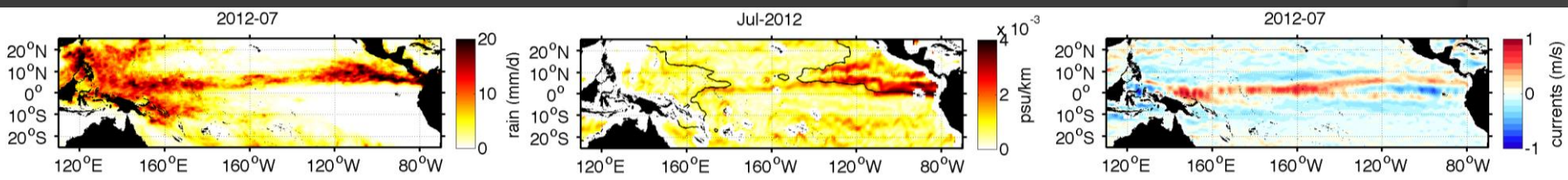
JANUARY



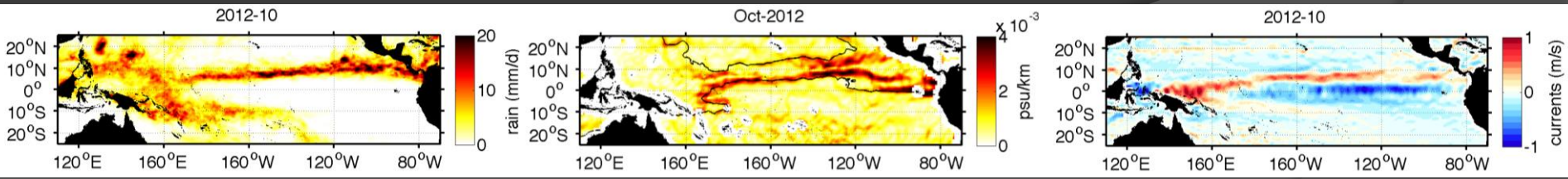
APRIL



JULY

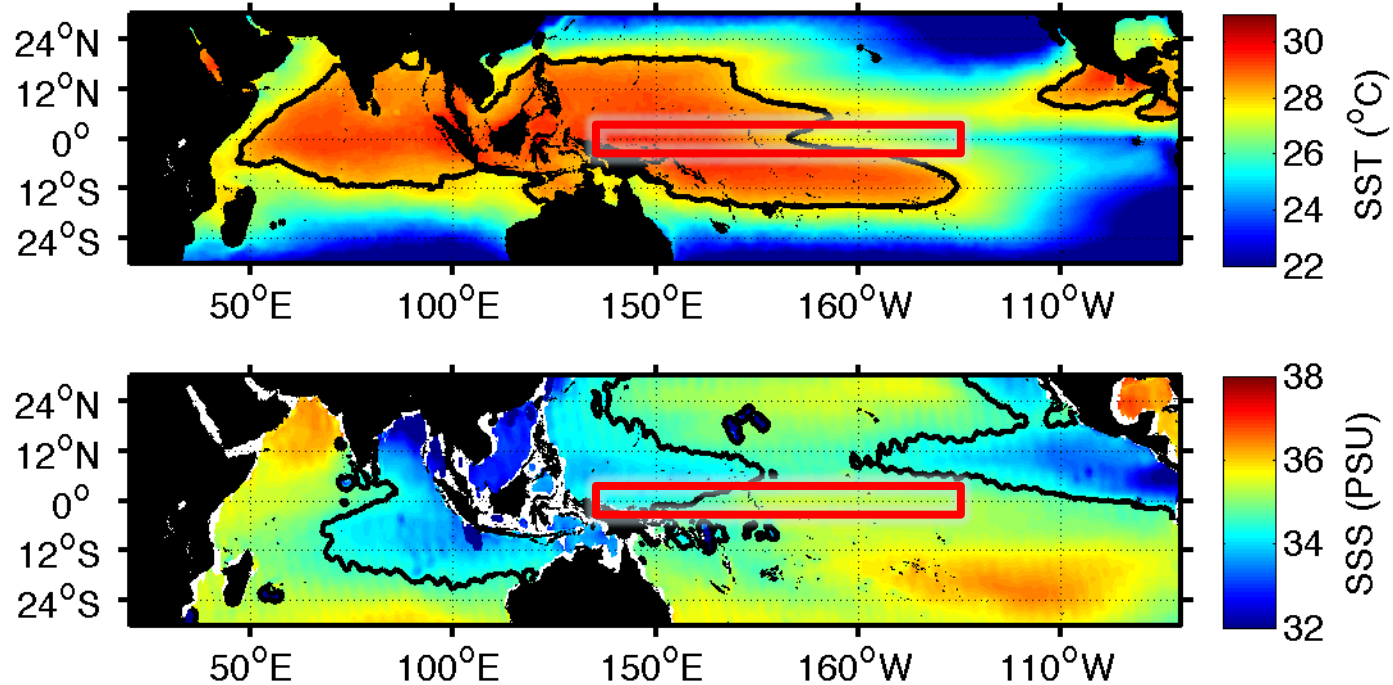


OCTOBER



# 1. Western Pacific Warm/Fresh Pool

Importance of the eastern edge of western Pacific warm pool (Picaul et al. 2001)

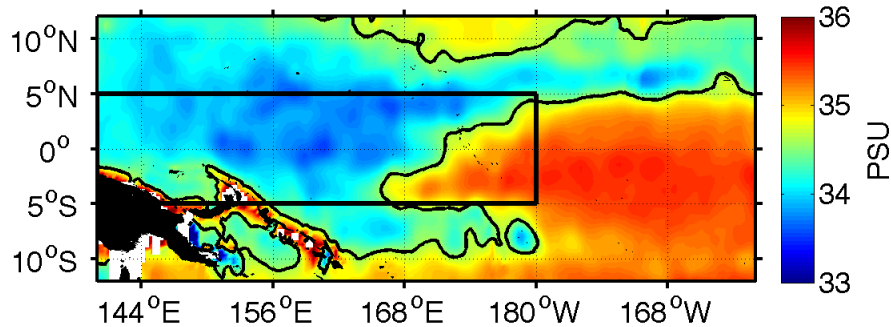


- **ENSO** coupling in the central-western equatorial Pacific
- Exchange of CO<sub>2</sub> with the atmosphere and biological production
- Displacement of tuna fishery

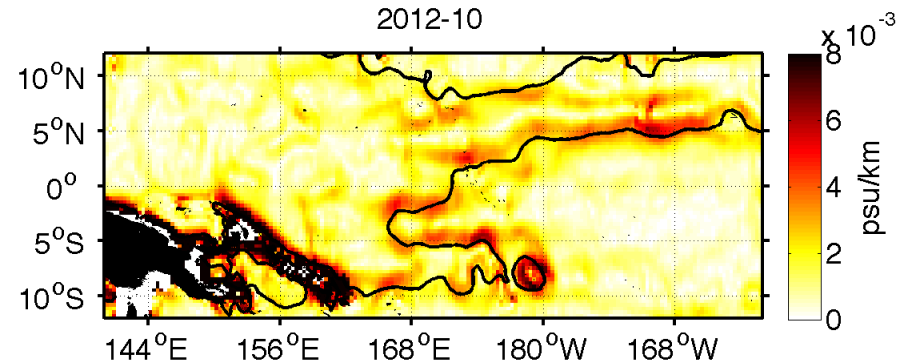
# Western Pacific fresh/warm pool on October 2012

The values of the isoligns are labeled in the titles.

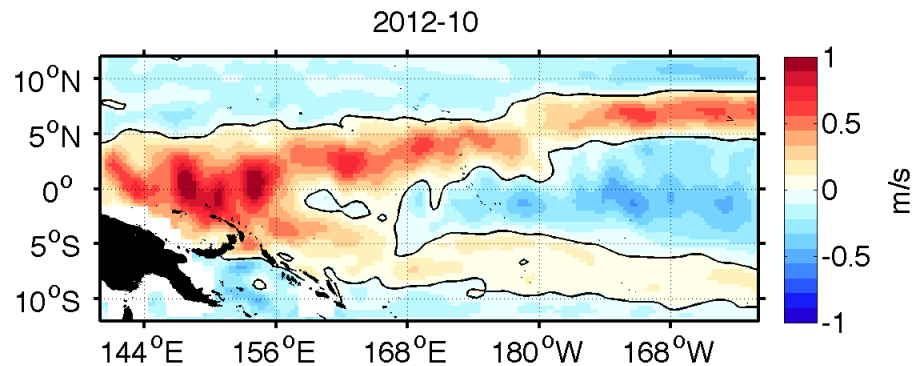
(a) SSS (34.6 psu)



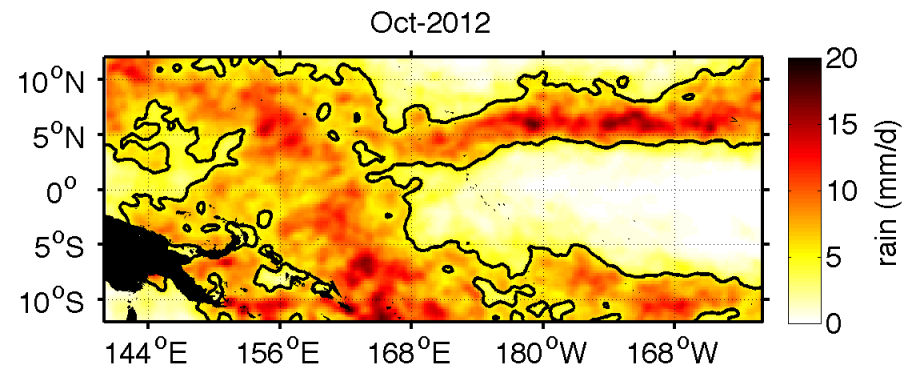
SSS fronts (34.6 psu)



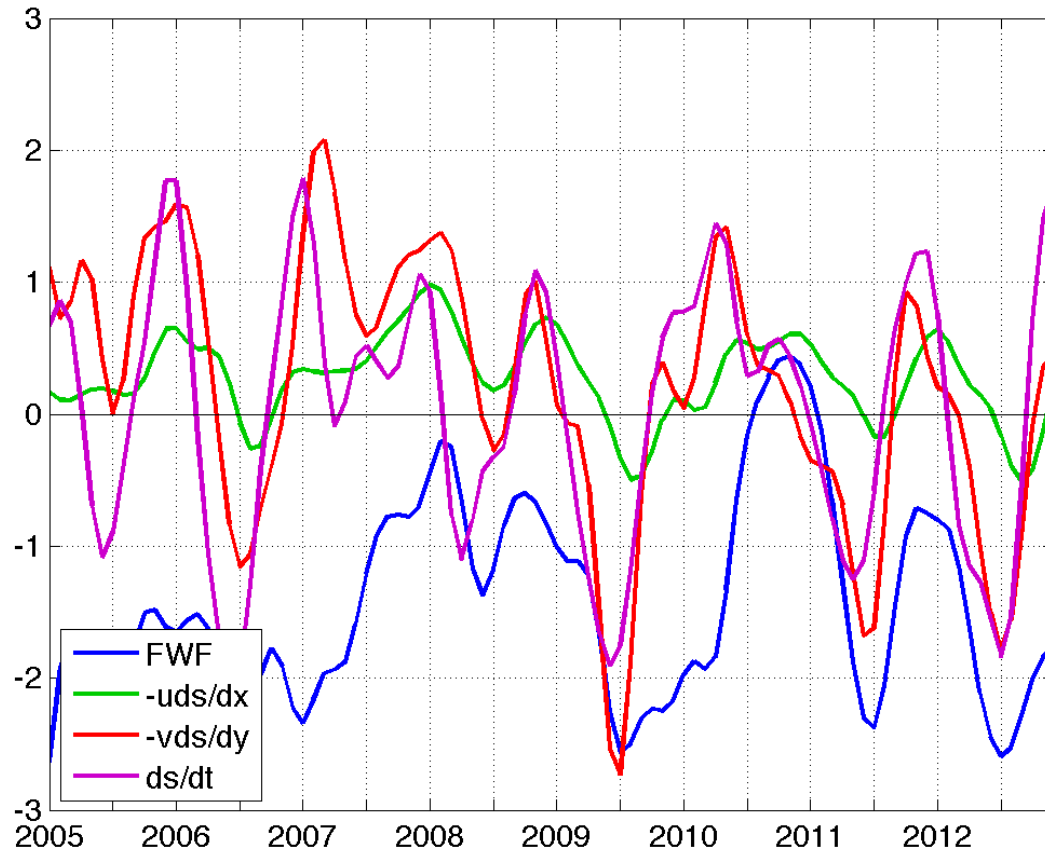
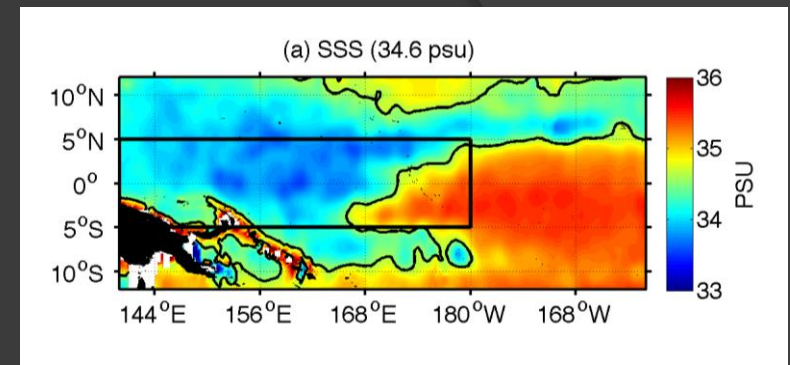
Zonal currents (0 m/s)



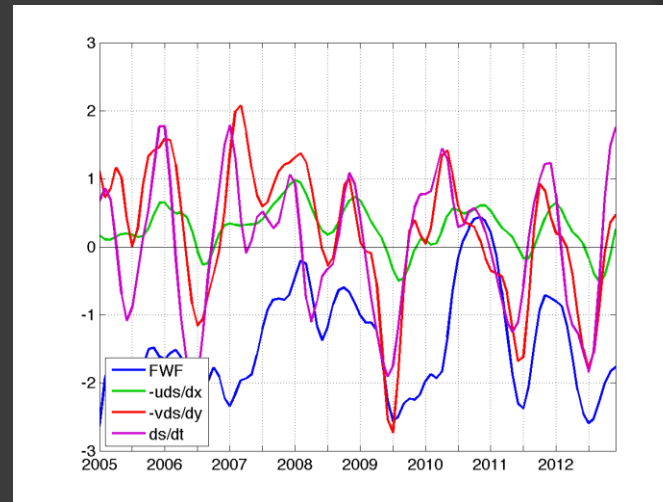
Precipitation (5mm/day)



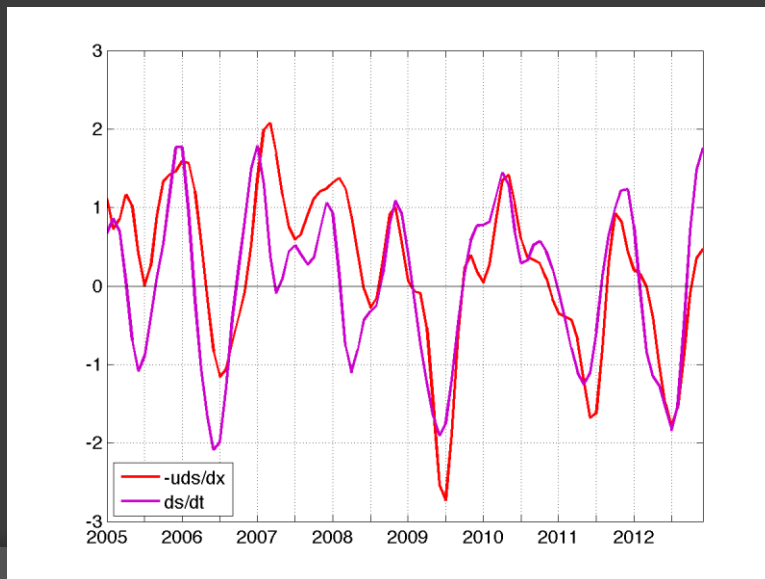
Near surface salinity budget averaged in the western Pacific from 2005-2013 in psu/year.



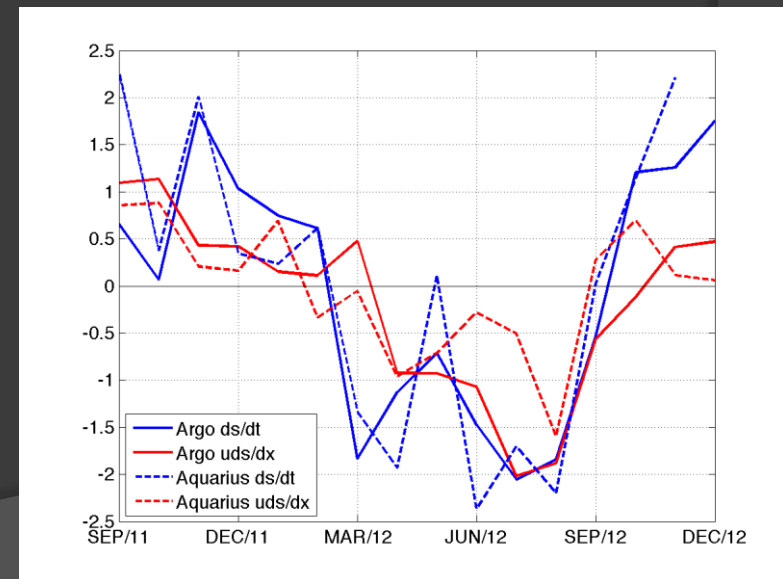
# Near surface salinity budget in the western Pacific



## Salinity tendency and Zonal advection terms

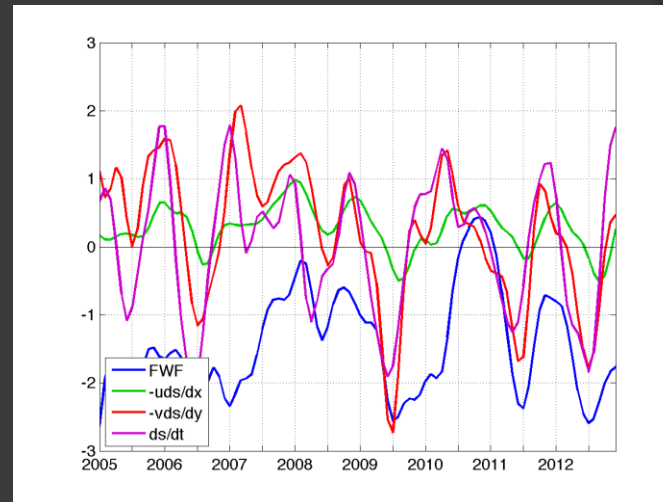


## Using Aquarius data

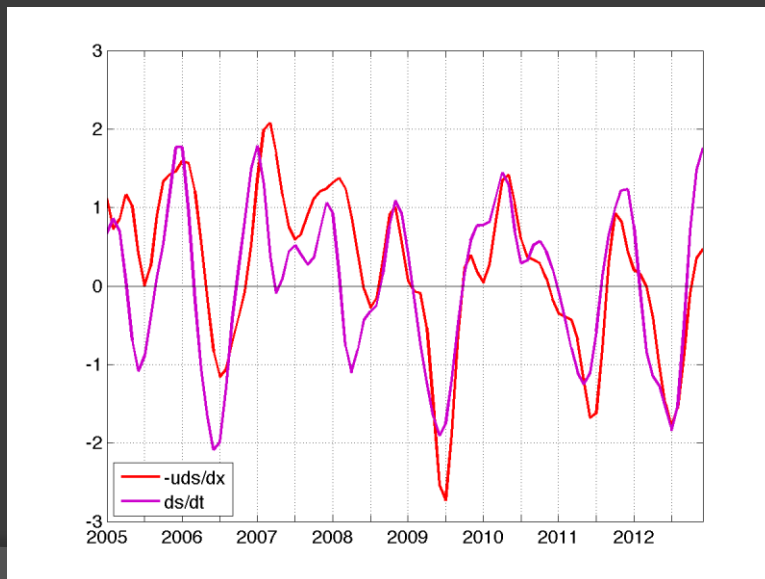




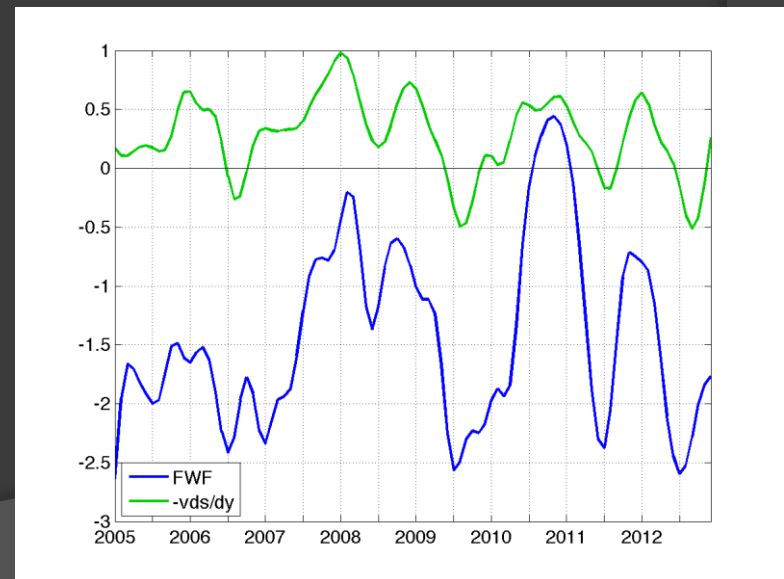
# Near surface salinity budget in the western Pacific



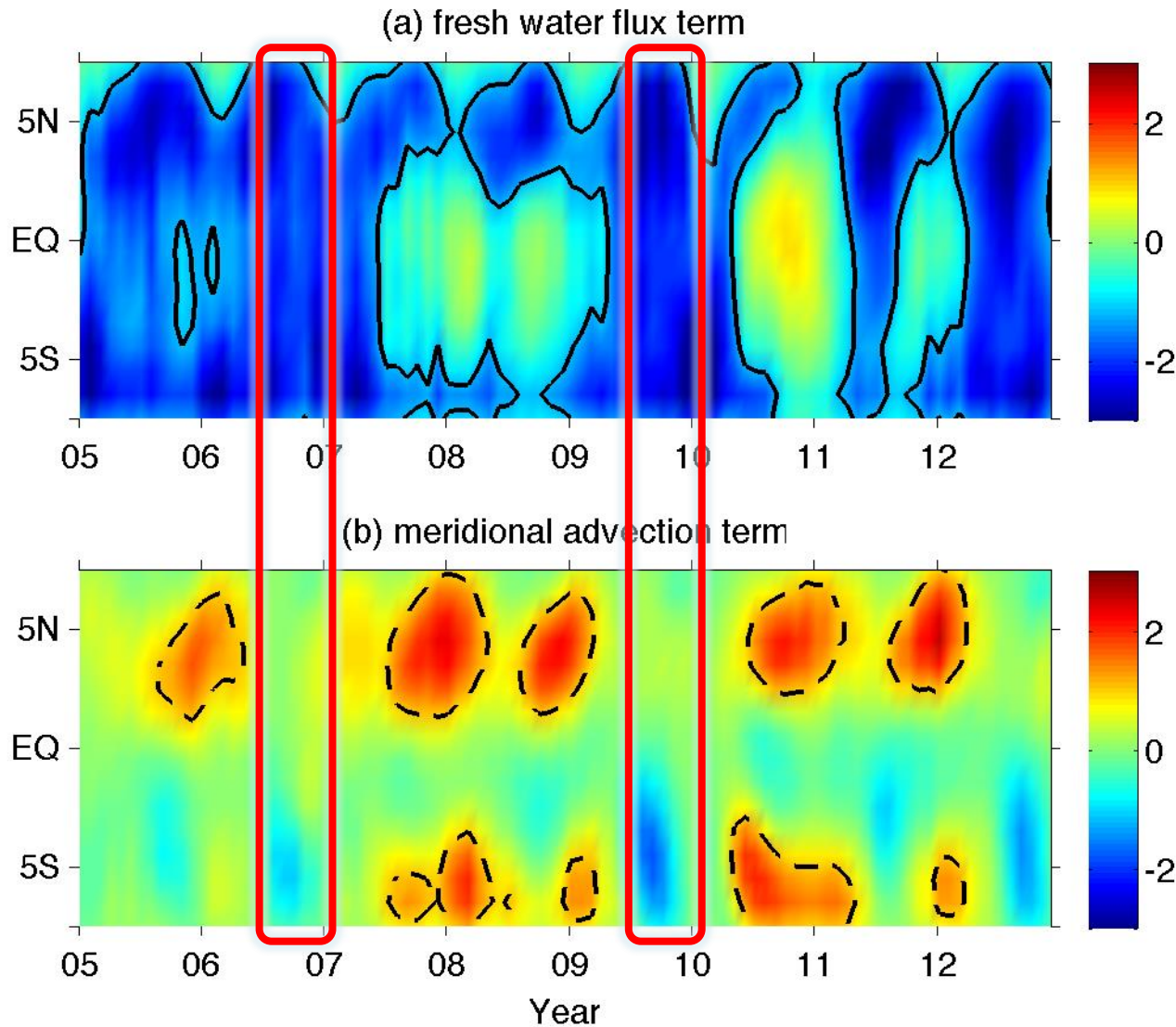
## Salinity tendency and Zonal advection terms



## Fresh water flux (blue) and meridional advection terms



# Hovmöller diagrams of fresh water flux term and meridional advection term



El Niño years:

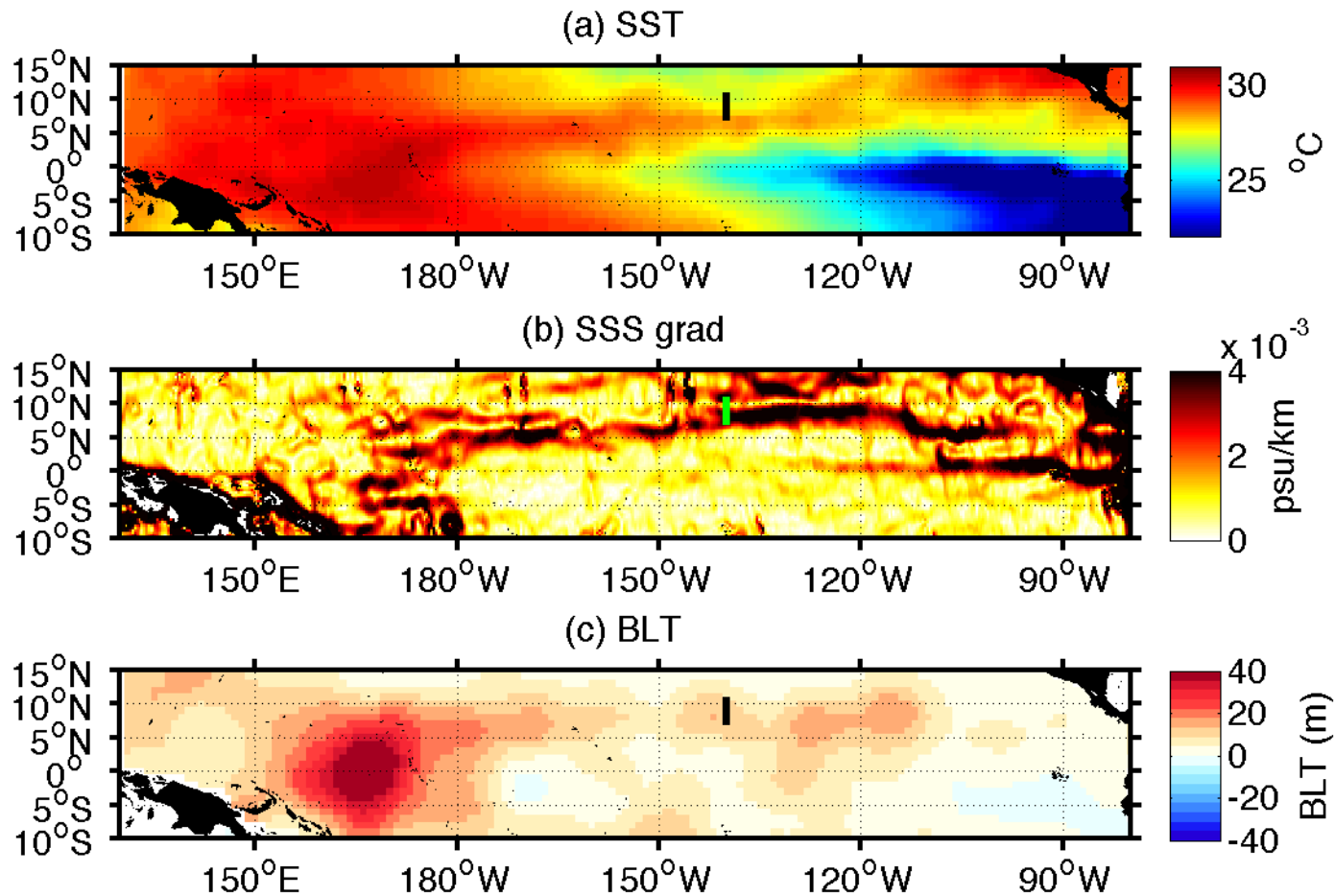
Strong precipitation

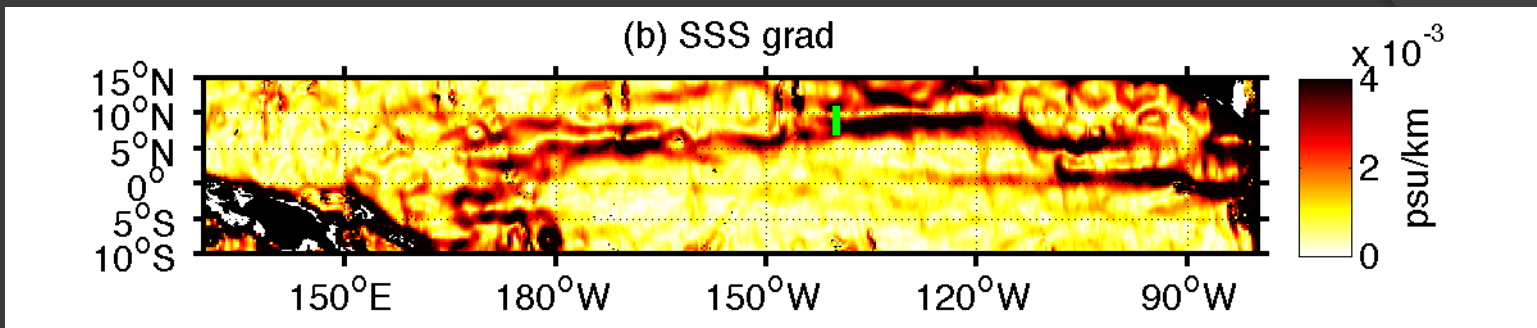
-> negative FWF

-> no meridional  
SSS gradient

-> missing or  
negative meridional  
advection term

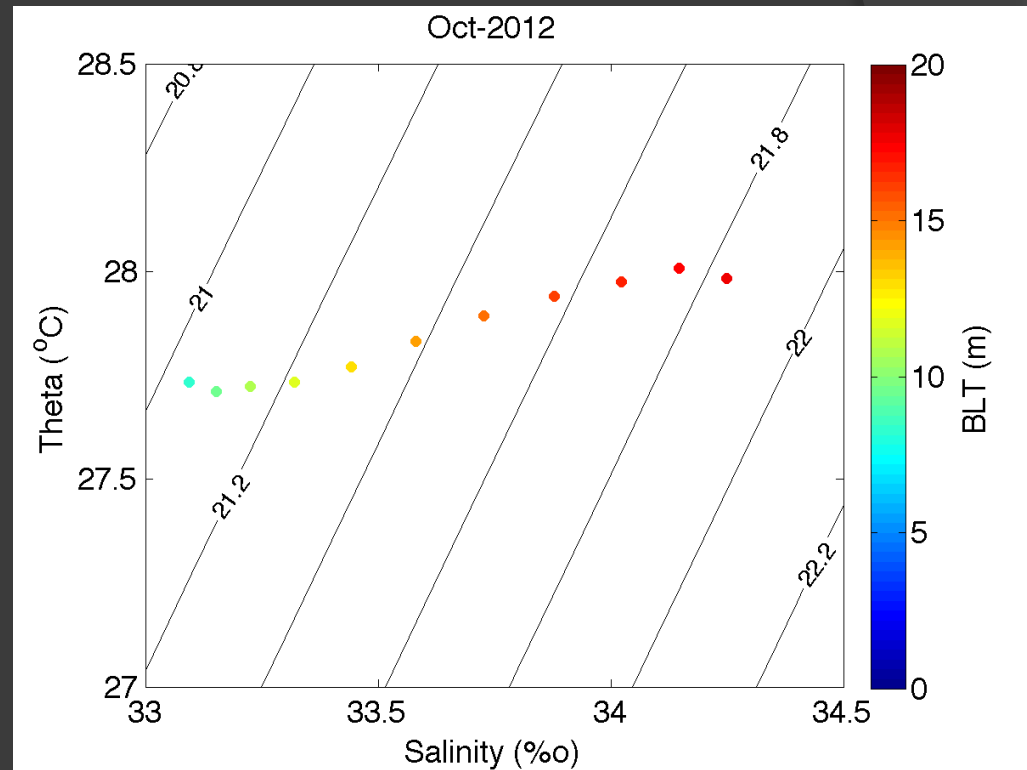
# 2. Intertropical Convergence Zone





The T-S diagram of the values on each grid point along the cross line. The black contours indicate the density in  $\text{kg/m}^3$  and the color indicate the BL thickness

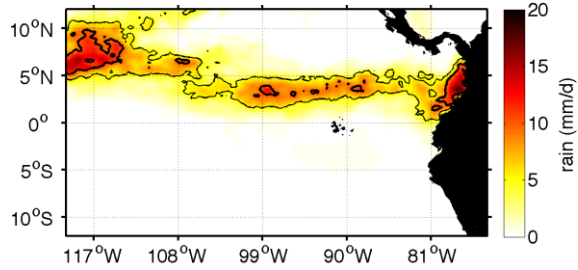
The  $0.8 \text{ kg/m}^3$  density difference within the 4 degree latitude is mainly contributed by the salinity with 1.3 psu variance.



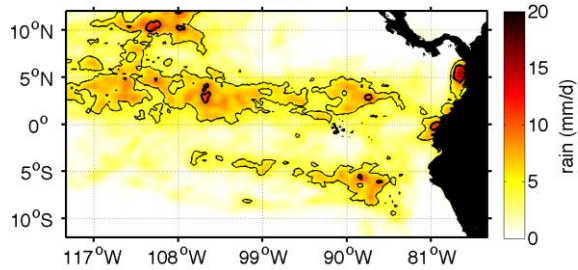
# 3. Double ITCZ in the Eastern

## Precipitation

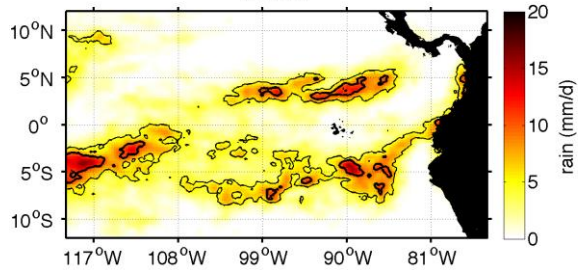
2012-01



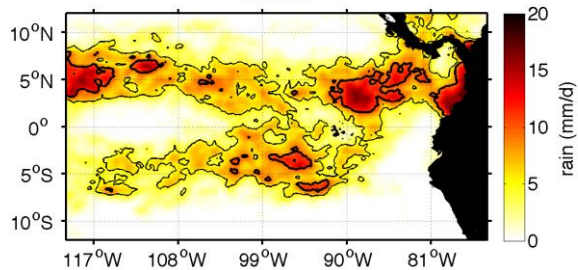
2012-02



2012-03

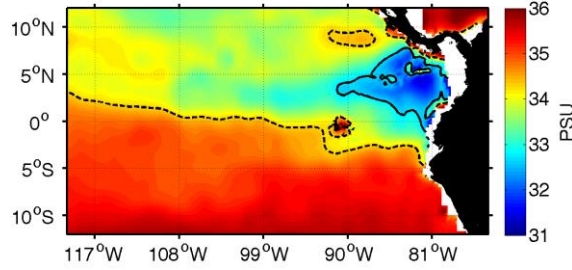


2012-04

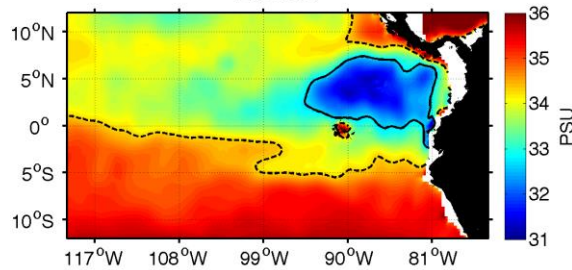


## SSS

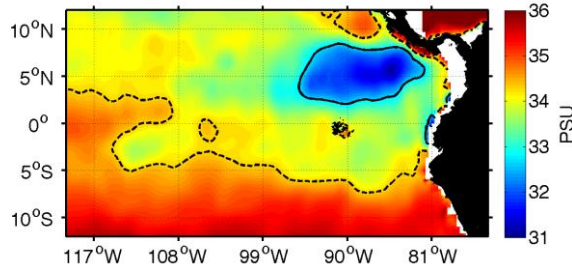
Jan-2012



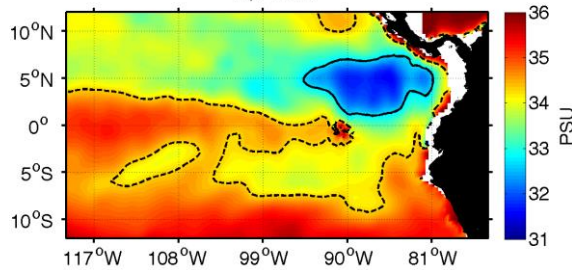
Feb-2012



Mar-2012

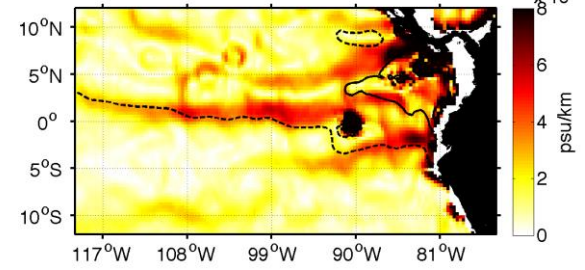


Apr-2012

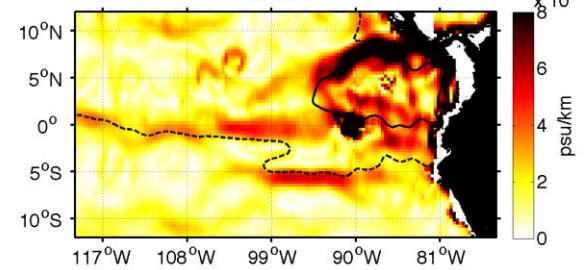


## SSS Fronts

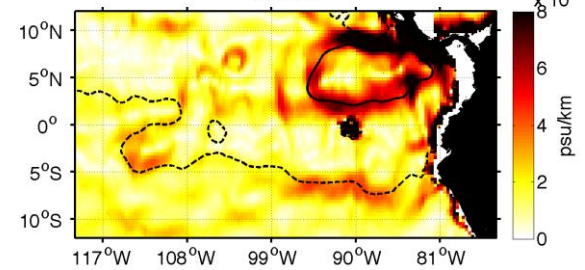
2012-01



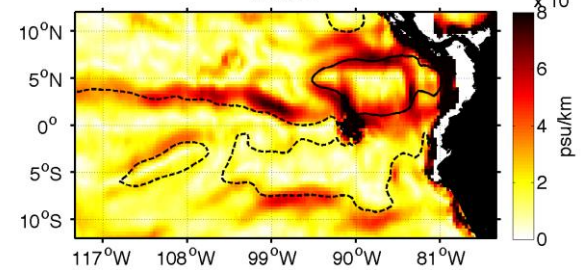
2012-02



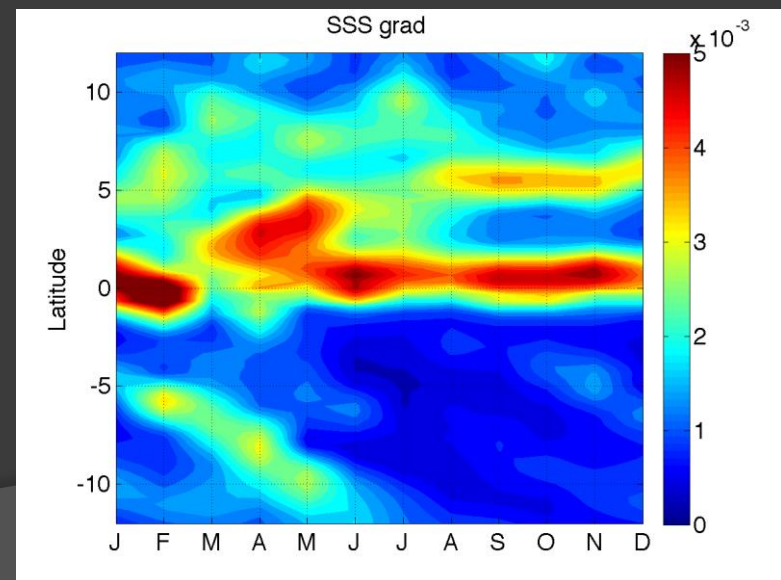
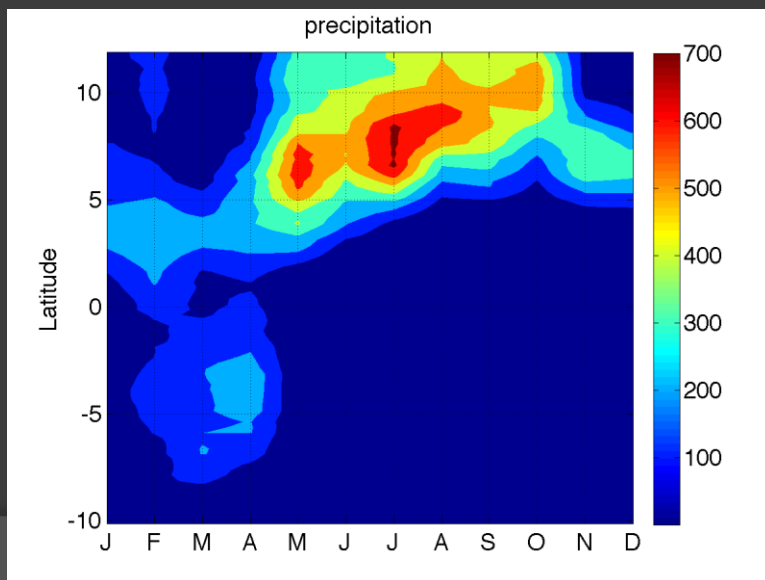
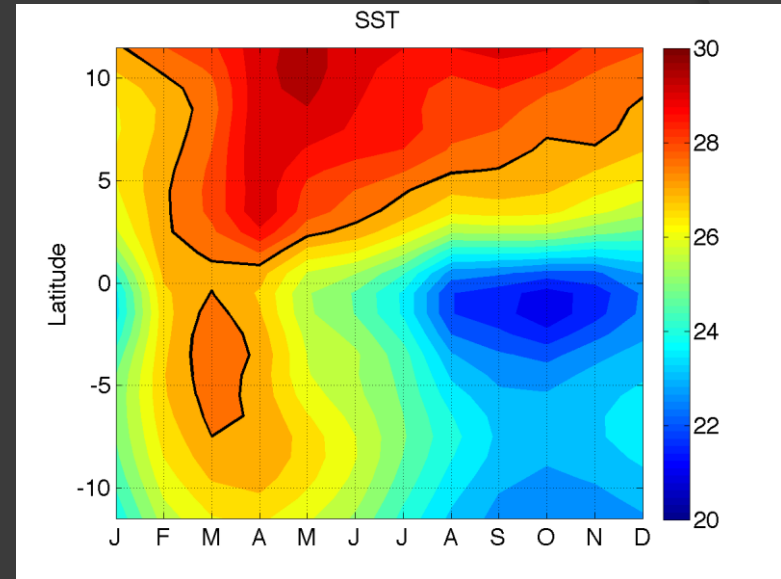
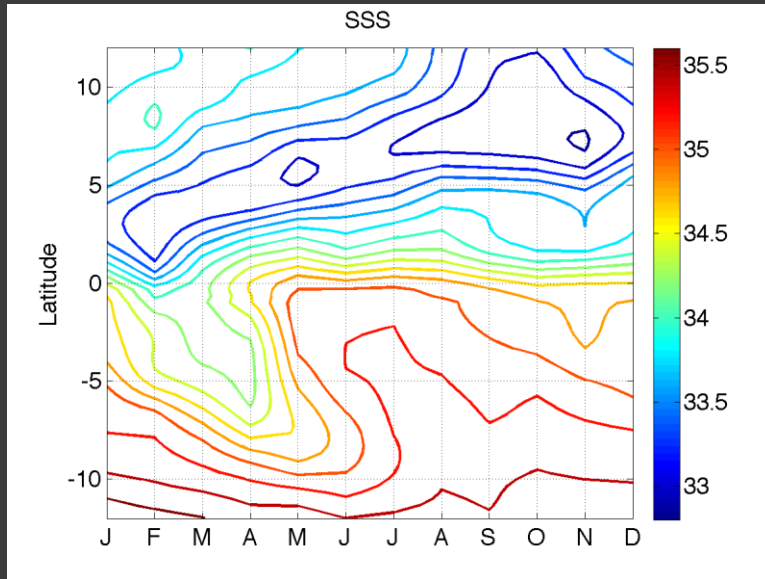
2012-03



2012-04



# Hovmöller diagrams of SSS, SST, precipitation and SSS gradient in the eastern Pacific averaged between 90-110W.



# Summary

- Aquarius shows high temporal and spatial resolution of salinity variability, and it's useful to identify the variations of Pacific fresh pools, ITCZ and salinity fronts
- The shear currents are essential for the formations of salinity front other than the precipitation
- Salinity fronts are useful for understanding the upper ocean dynamics in the western Pacific, the density variance at the south boundaries of ITCZ and the split ITCZ in the eastern Pacific.



# Thank You!

NASA

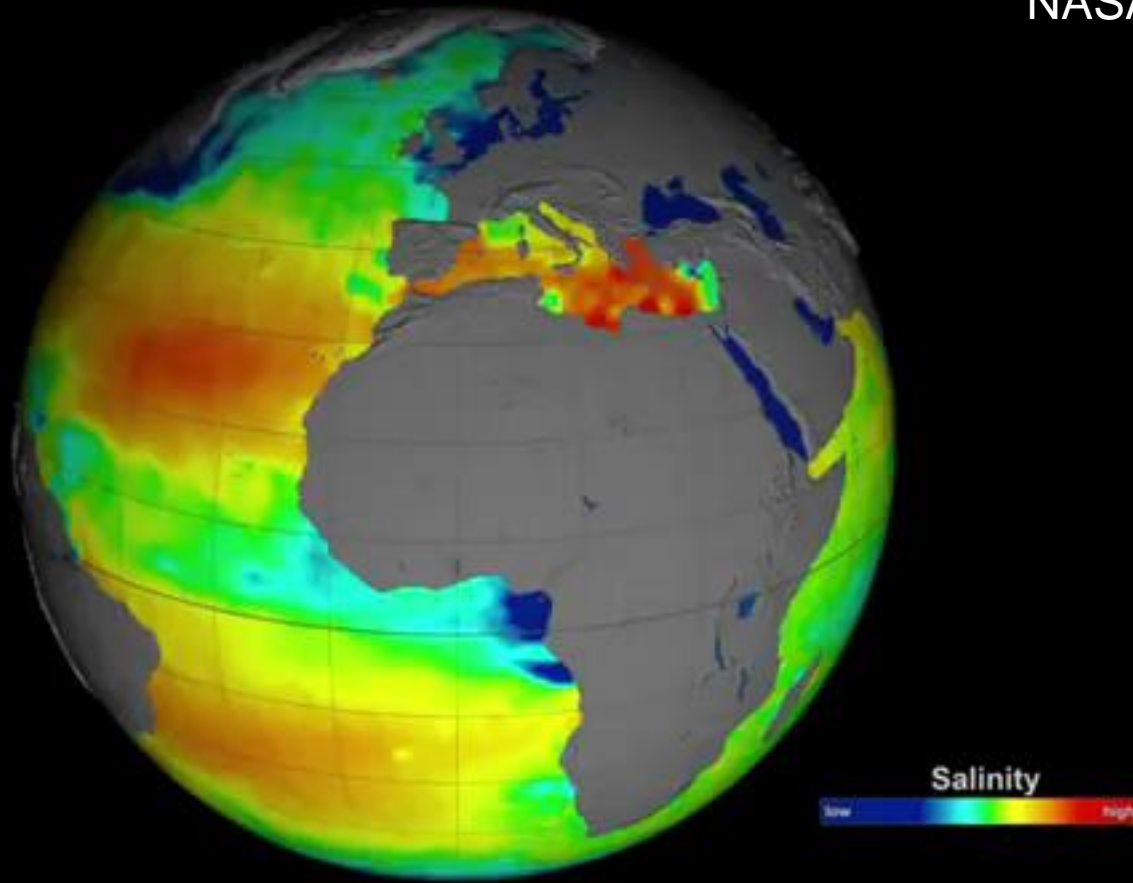
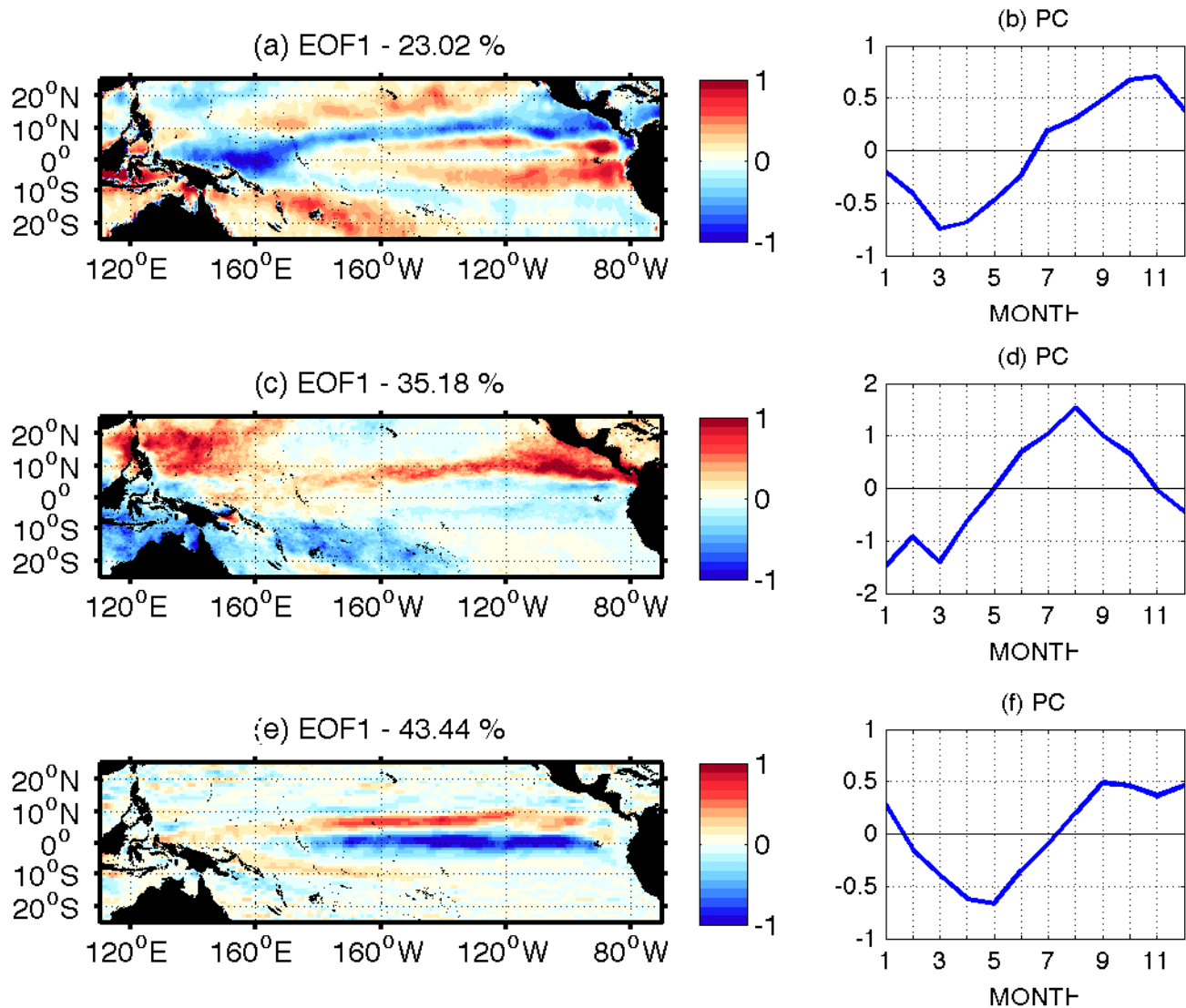
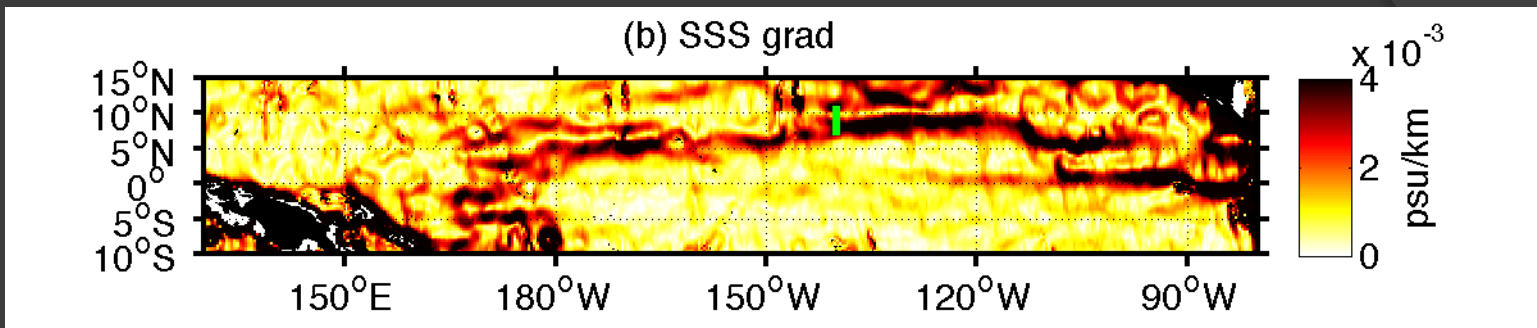




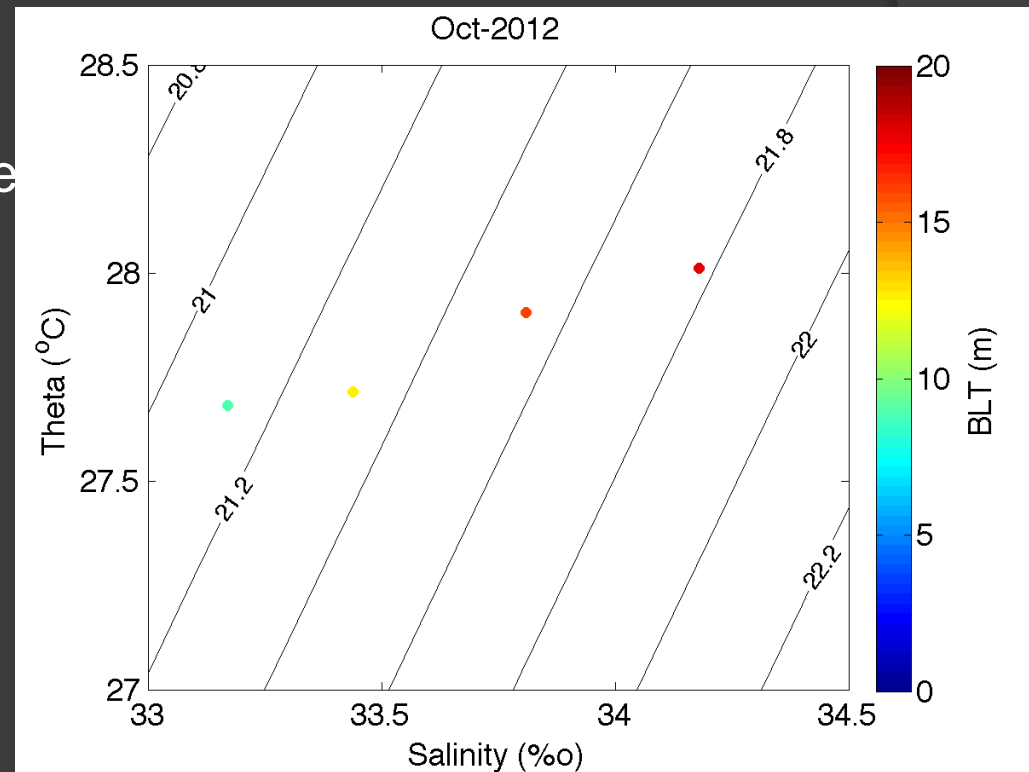
Figure 3. First EOF patterns of (a) SSS, (c) precipitation and (e) zonal currents. The percentages of variance explained by the first EOF mode are indicated on the top of the panels. (b), (d) and (f) are the respective principal components (PC).



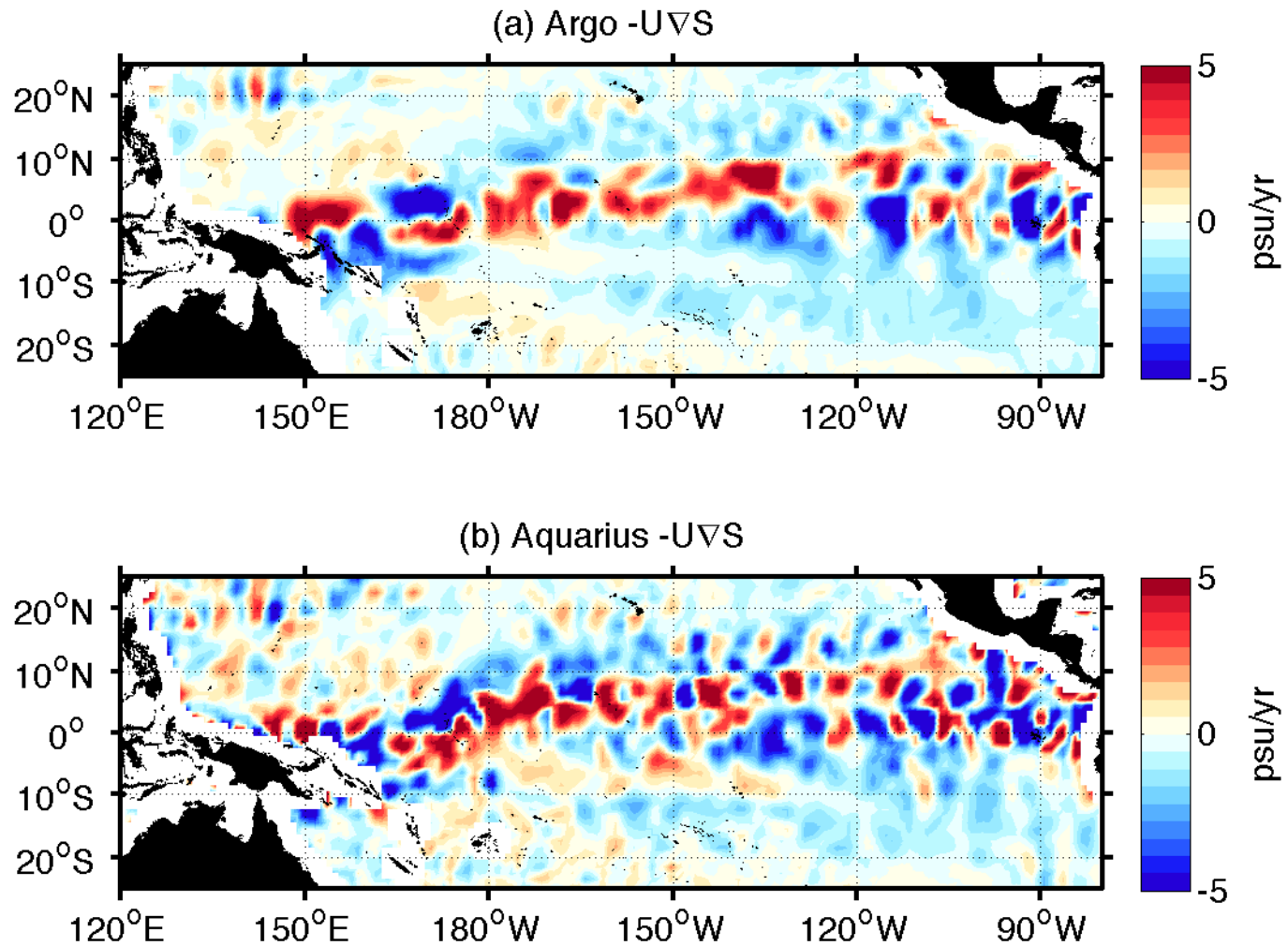


The T-S diagram of the values on each grid point along the cross line  
 The black contours indicate the density in  $\text{kg/m}^3$  and the color indicate the BL thickness

The salinity gradients can be as large as

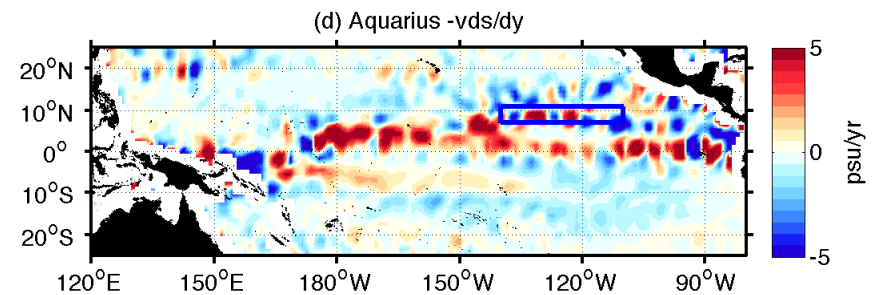
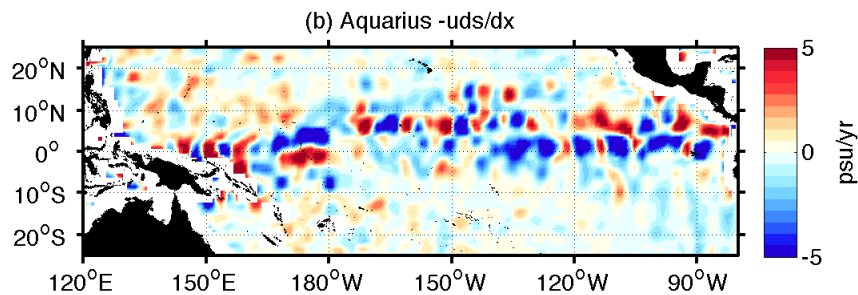
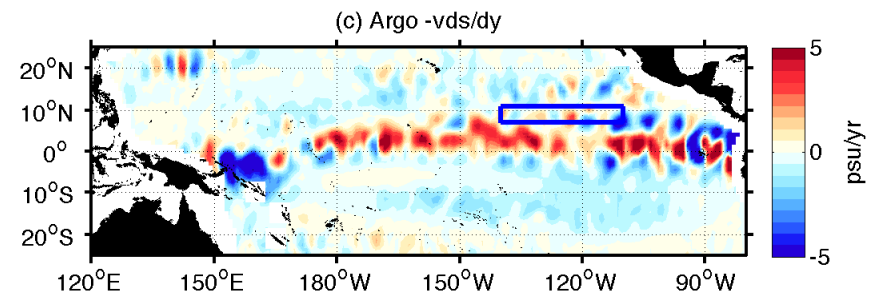
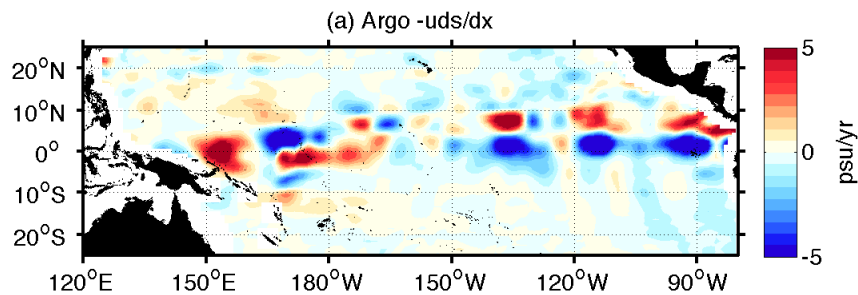


# The horizontal advection term in SSS budget on October 2012.



# The zonal and meridional advection terms in SSS budget.

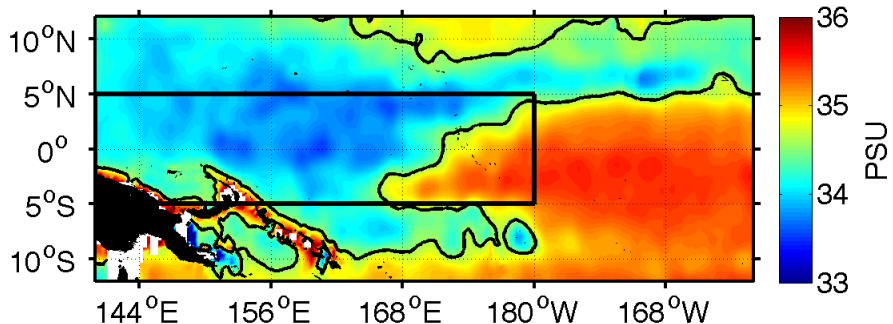
The blue boxes show the regions of strong salinity fronts.



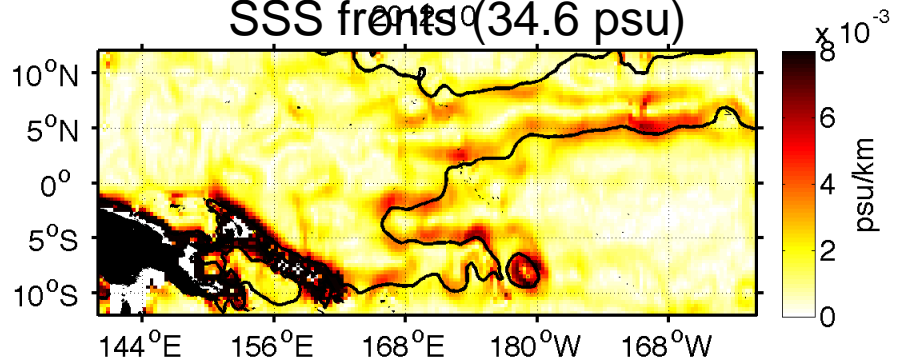
# Western Pacific fresh/warm pool on October 2012

The values of the isoligns are labeled in the titles.

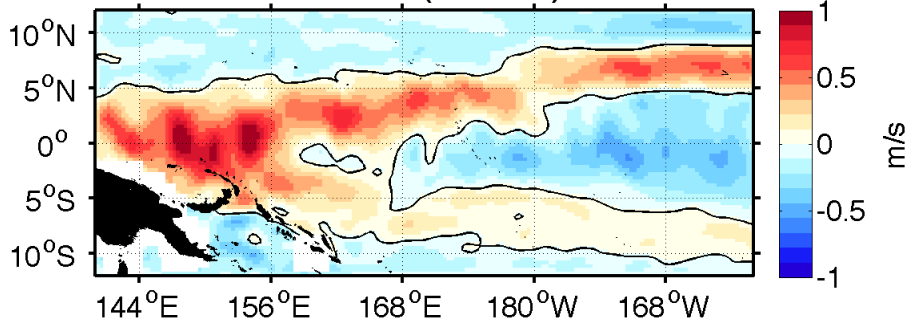
(a) SSS (34.6 psu)



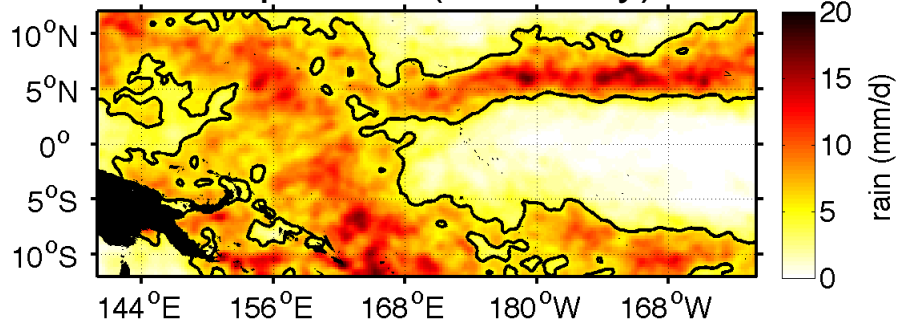
SSS fronts<sup>o</sup>(34.6 psu)



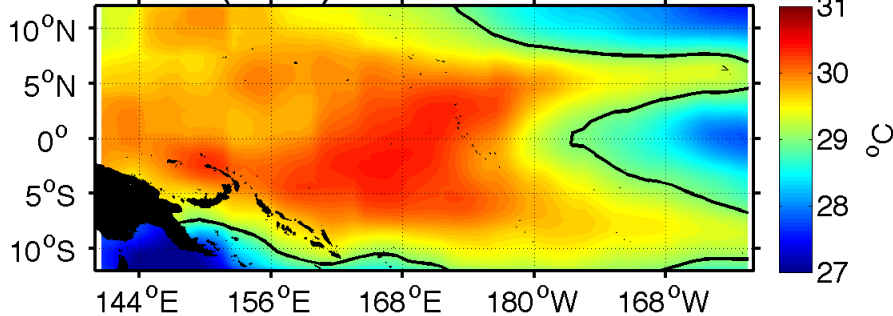
Zonal currents (0 m/s)



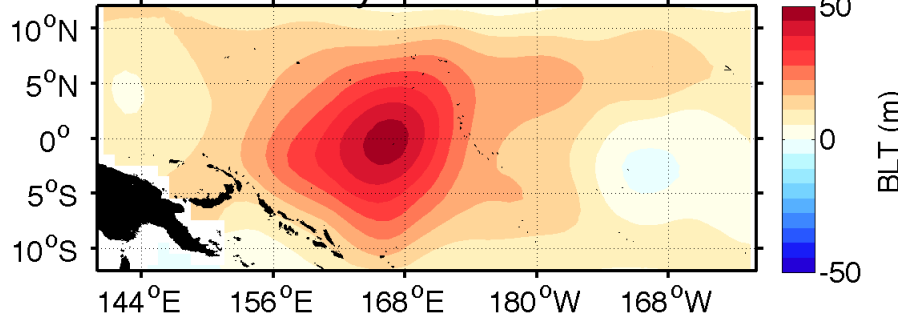
Precipitation (5mm/day)



SST (29C)



Barrier Layer Thickness

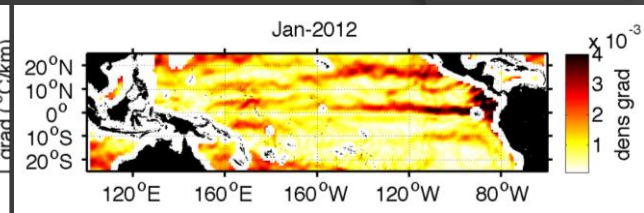
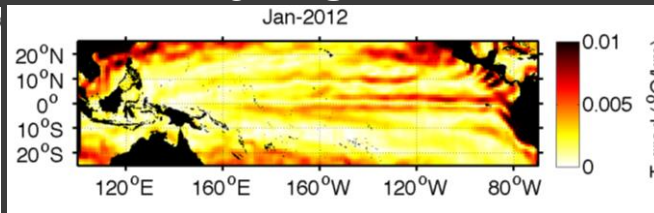
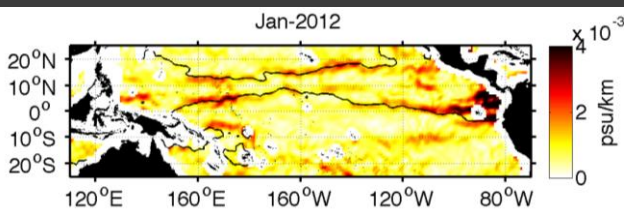


# Seasonal maps of the Fronts in 2012

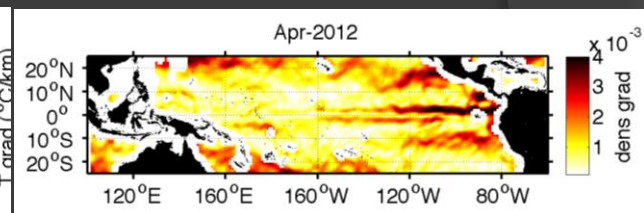
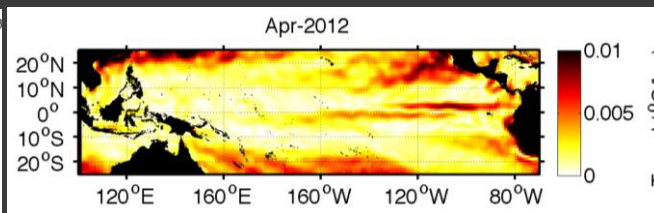
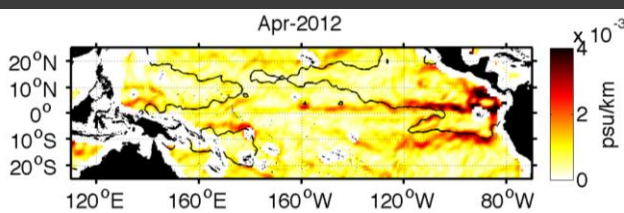
## SSS front

## SST front JANUARY

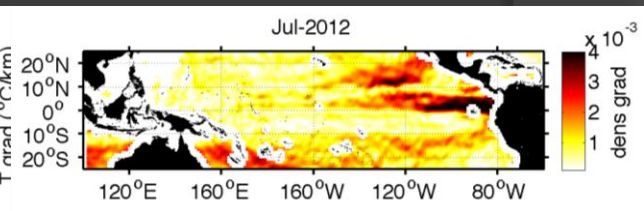
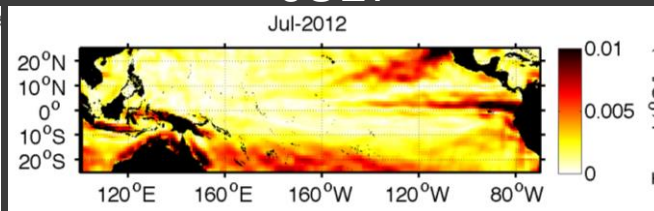
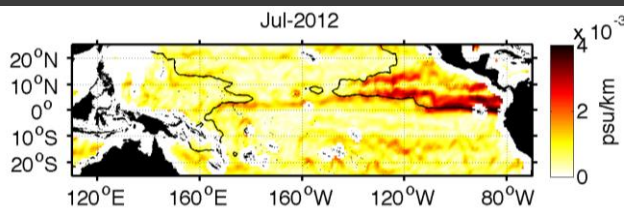
## Density front



## APRIL



## JULY



## OCTOBER

