Differences between ENSO 2014-2017 and another strong ENSO events

IV International Conference on El Niño Southern Oscillation: ENSO in a warmer Climate
16-18 October 2018, Guayaquil, Ecuador.

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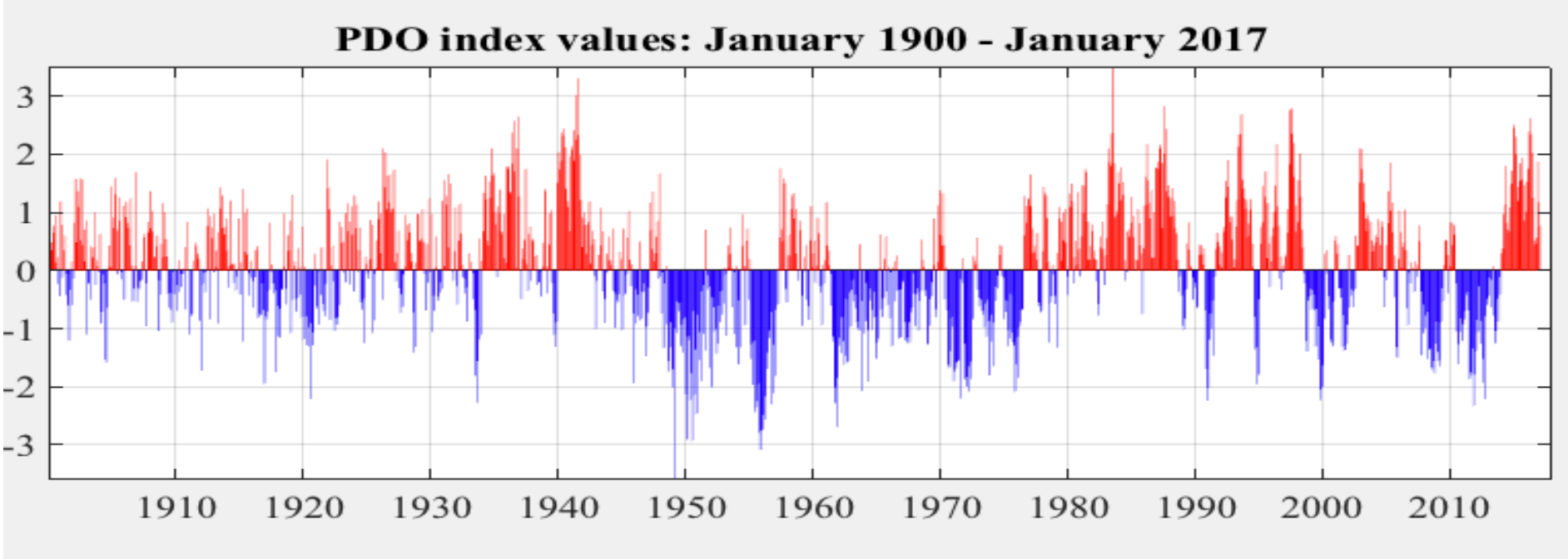
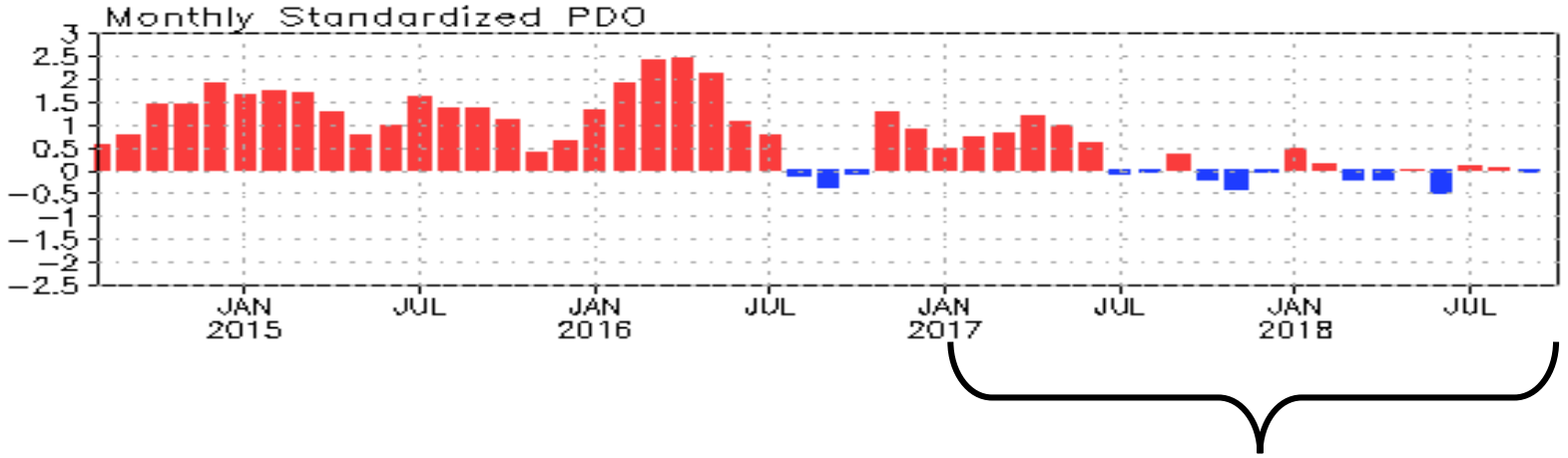
Principal Professor

La Molina National Agrarian University

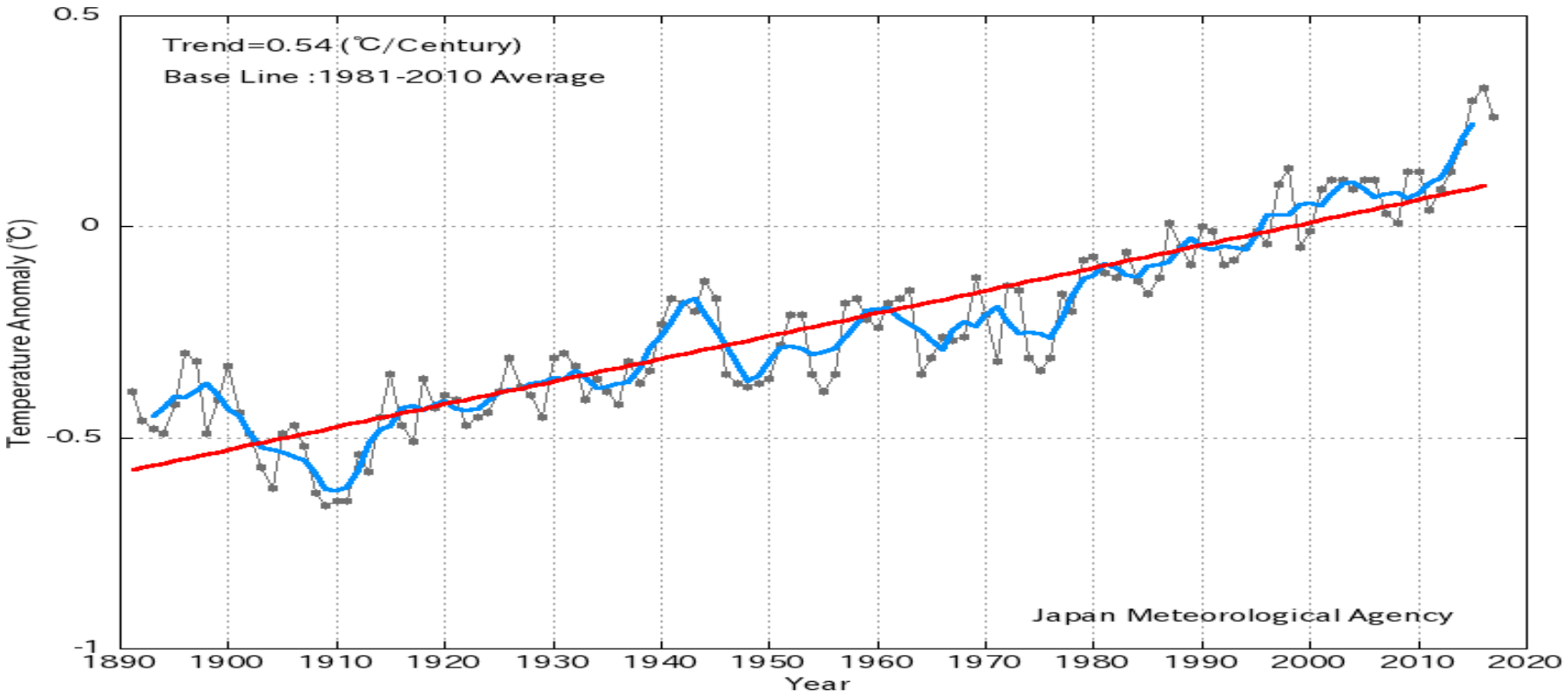
Lima-Peru


PDO index values: January 1900 - January 2017
3
2
1
0
-1
-2
-3
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010


Monthly Standardized PDO
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
JAN 2015
JUL
JAN 2016
JUL
JAN 2017
JUL
JAN 2018
JUL

Source: NOAA

The annual mean global average sea surface temperature in 2017 was +0.26°C above the 1981-2010 average, making it the third highest since 1891. The linear trend from 1891 to 2017 shows an increase of 0.54°C per century.



Time-series representation of annual global sea surface temperature anomalies
The 1981 - 2010 average is used as the normal. The black, blue and red lines represent annual global sea surface temperature anomalies, their five-year running mean and the long-term linear trend, respectively.

DATA USED FOR MONITORING ENSO

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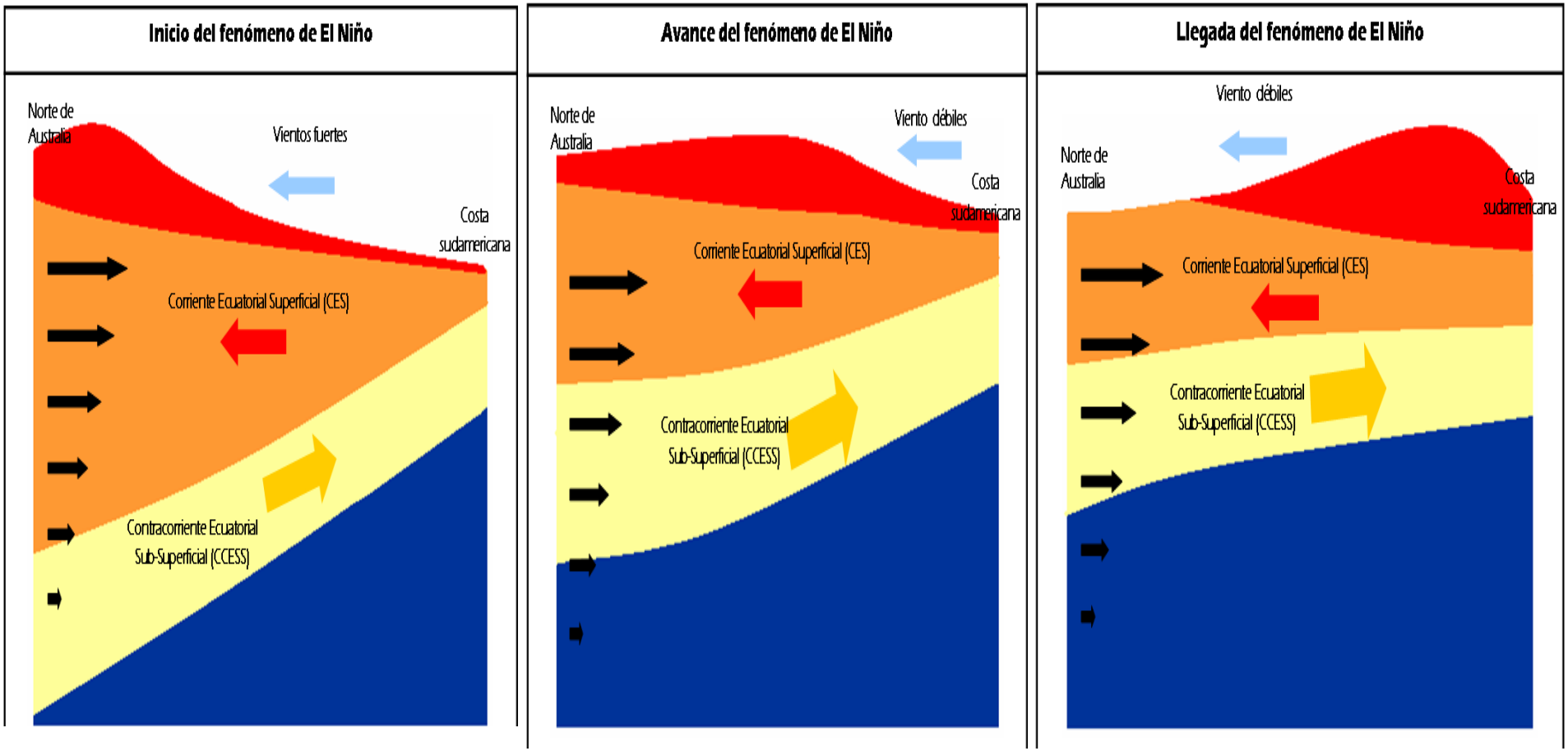
Bioindicators

Is ENSO concept the same for everybody?



Factors or parameters that can change evolution of ENSO along Equatorial Pacific

OCEAN

- Sea level variations (Dynamic height).
- **Surface and subsurface Currents (Cromwell).**
- **Sea surface and subsurface temperature (thermocline) variations.**
- **Sea surface and subsurface salinity changes, pycnocline, etc.**
- **Water mass fronts**

ATMOSPHERE

- **Zonal and Meridional Trade Winds (850 mb)**
- **Pacific Anticyclone position and pressure and West winds (from Australia)**
- **Madden Julian waves**
- **Solar radiation, OLR, clouds, etc.**

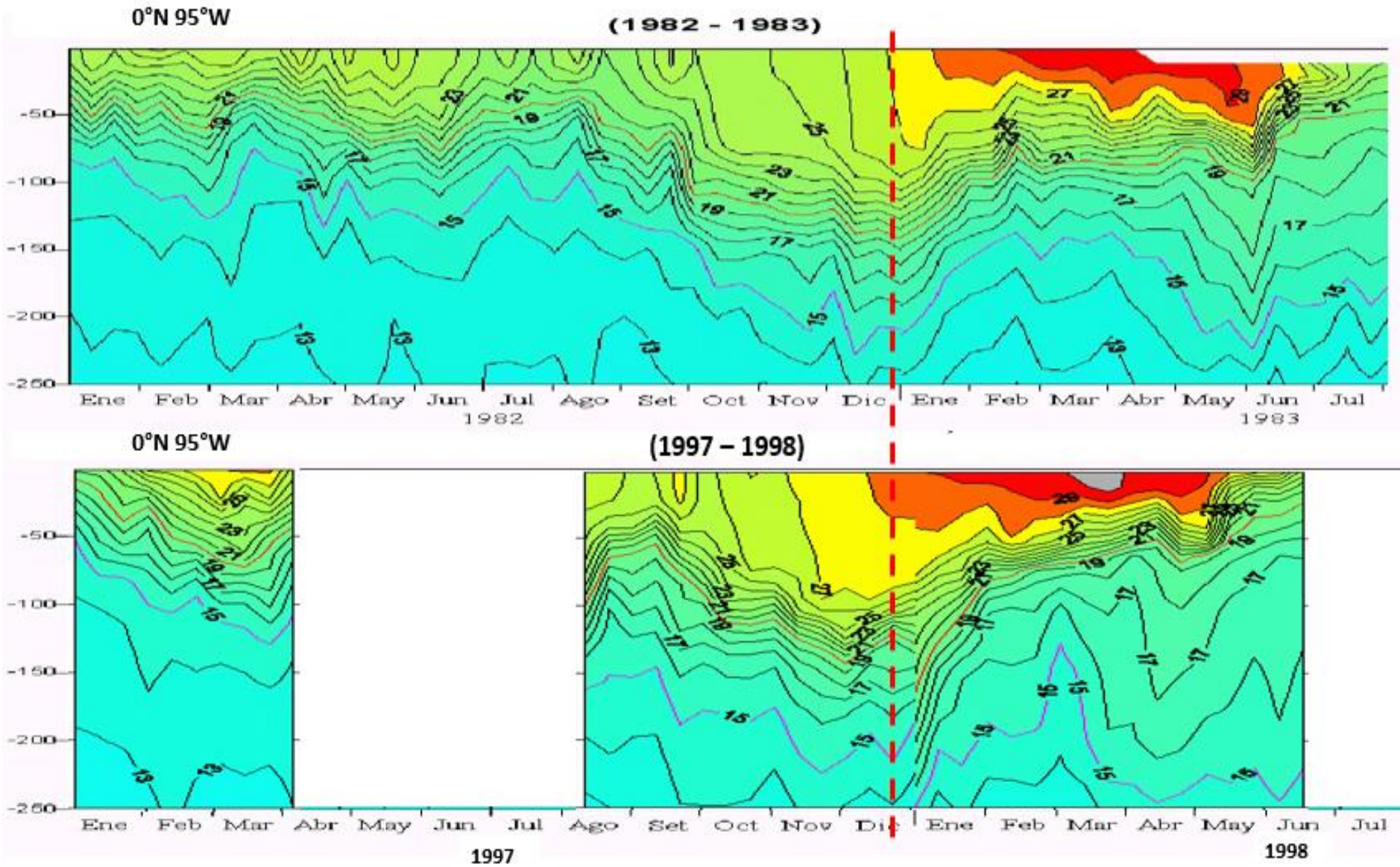
OCEAN-ATMOSPHERE INTERACTION

- **Kelvin waves and Rossby waves**
- **Heat transfer**
- **Air temperature near surface**
- **Precipitation or Evaporation.**
- **Atmospheric pressure, etc**

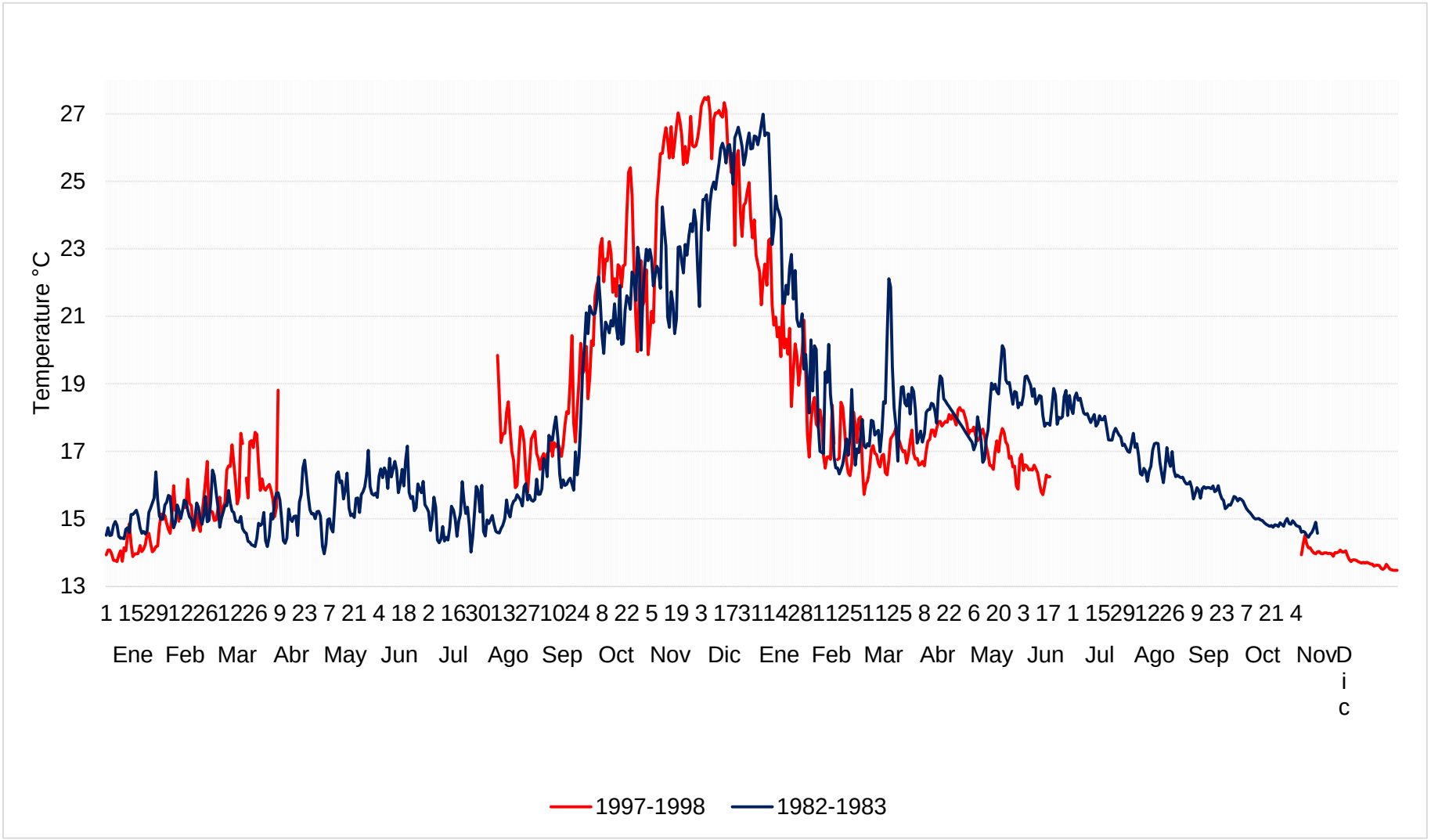
…ENSO related variables in the central pacific:

- ✓ **Subsurface temperature changes**
- ✓ **Equatorial Undercurrent (EUC)**
- ✓ **Dynamic Height**
- ✓ **Winds**

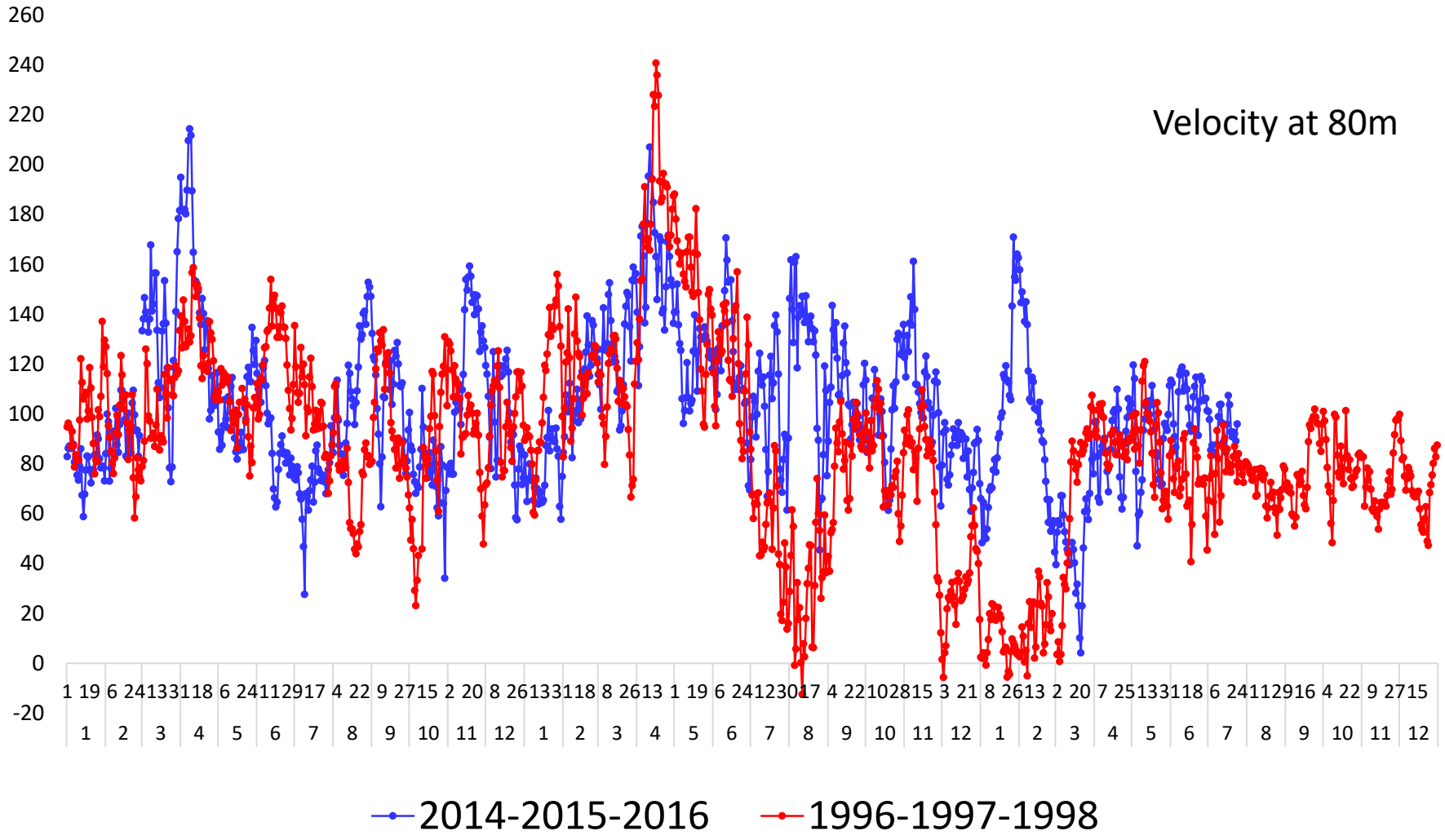
Monthly Subsurface Temperature



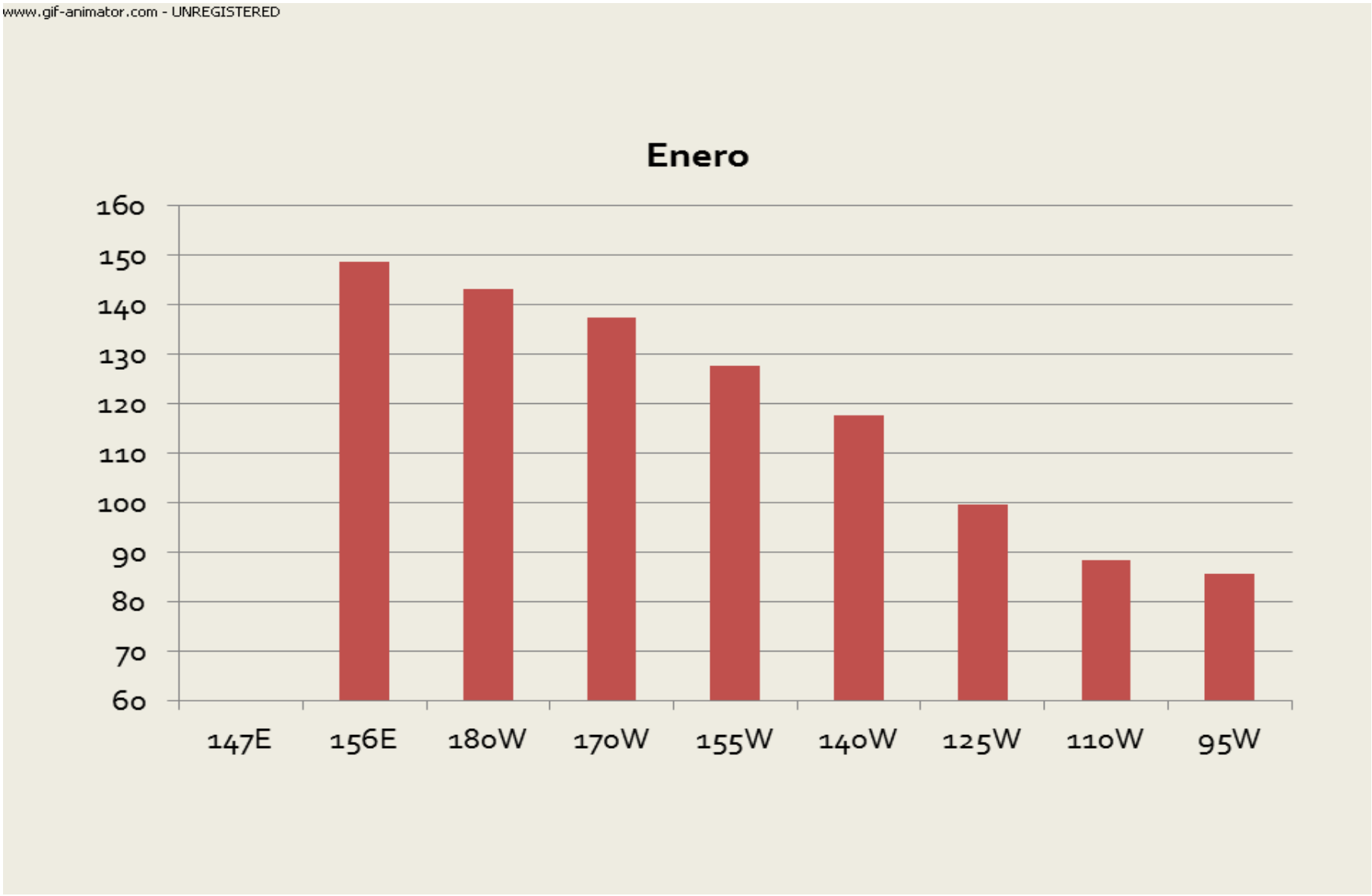
Daily 100 m SeaTemperature at 0°N 95° W
1982 -83 and 1997-98

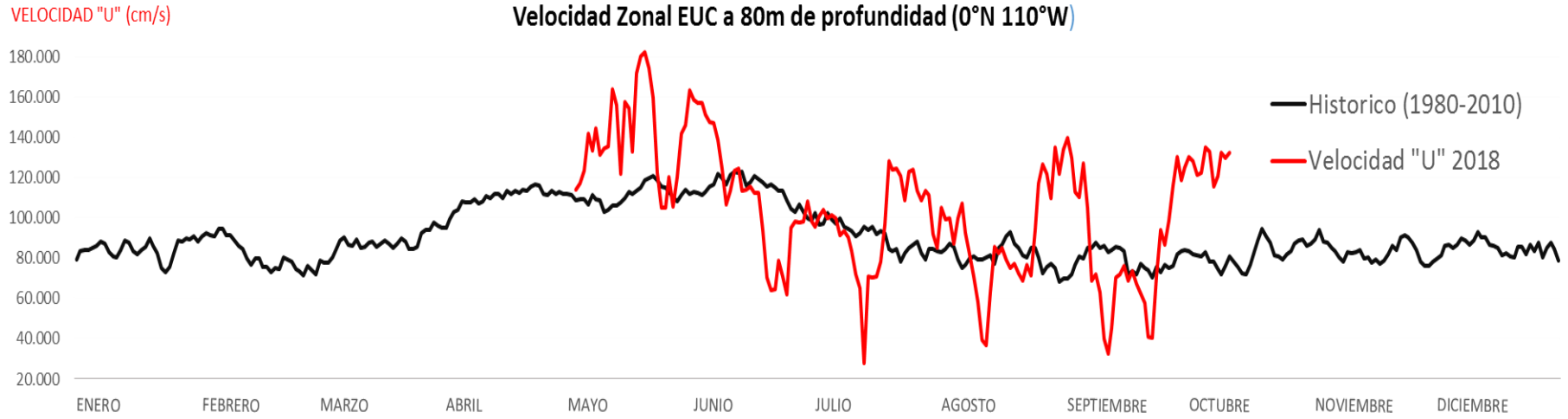


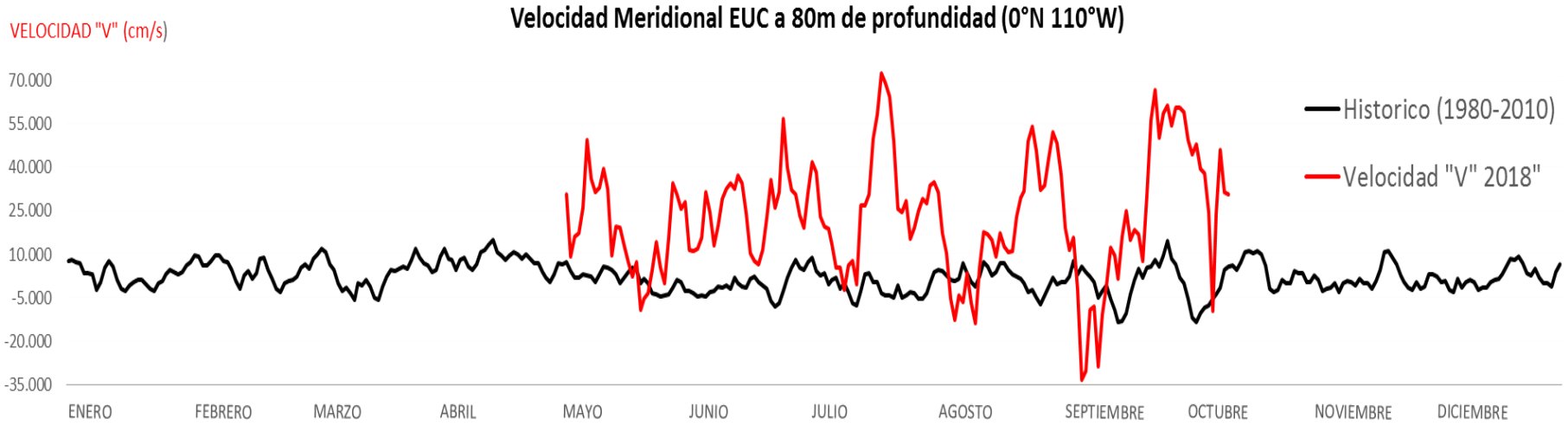
Daily EUC variations at 0 N 110 W (cm/s)

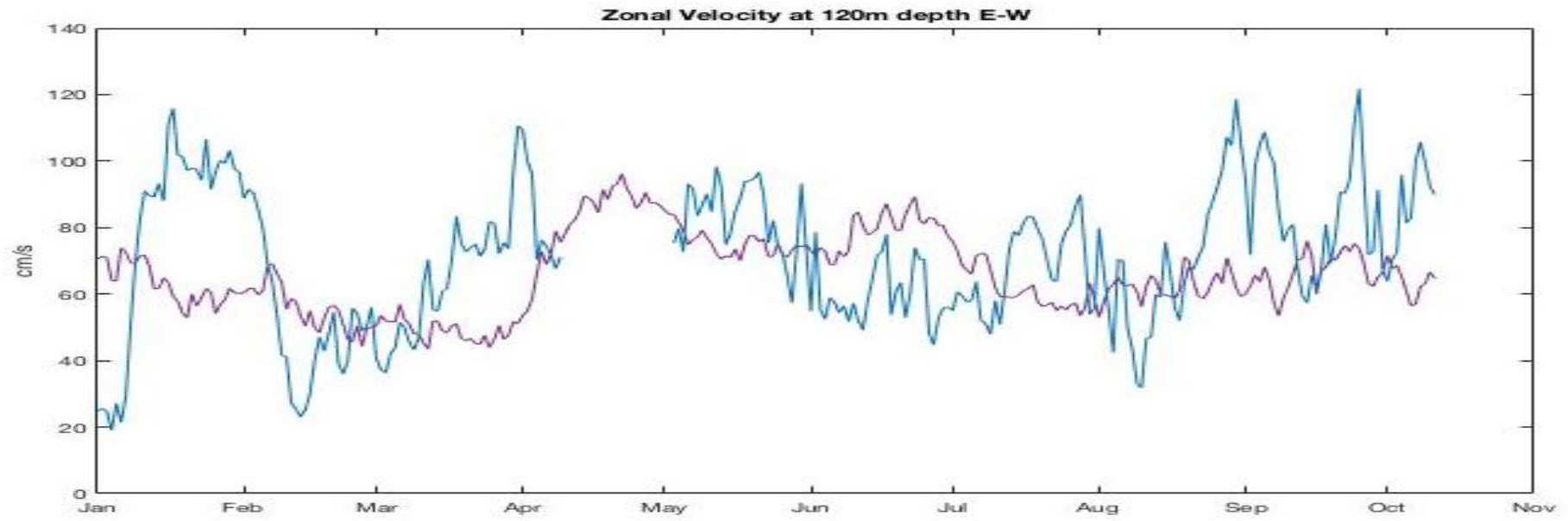


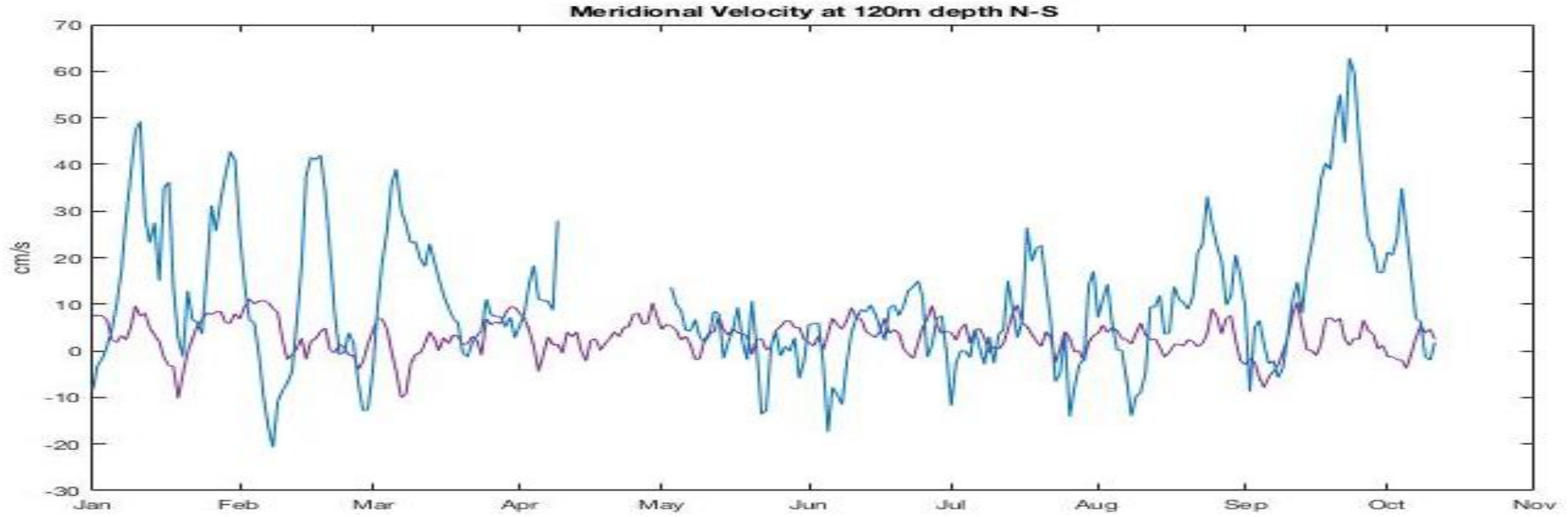
Monthly Dynamic Height
1997




Velocidad Zonal EUC a 80m de profundidad (0°N 110°W)
VELOCIDAD "U" (cm/s)
180.000
160.000
140.000
120.000
100.000
80.000
60.000
40.000
20.000
ENERO
FEBRERO
MARZO
ABRIL
MAYO
JUNIO
JULIO
AGOSTO
SEPTIEMBRE
OCTUBRE
NOVIEMBRE
DICIEMBRE
Historico (1980-2010)
Velocidad "U" 2018


Velocidad Meridional EUC a 80m de profundidad (0°N 110°W)
VELOCIDAD "V" (cm/s)
70.000
55.000
40.000
25.000
10.000
-5.000
-20.000
-35.000
ENERO
FEBRERO
MARZO
ABRIL
MAYO
JUNIO
JULIO
AGOSTO
SEPTIEMBRE
OCTUBRE
NOVIEMBRE
DICIEMBRE
Historico (1980-2010)
Velocidad "V" 2018"

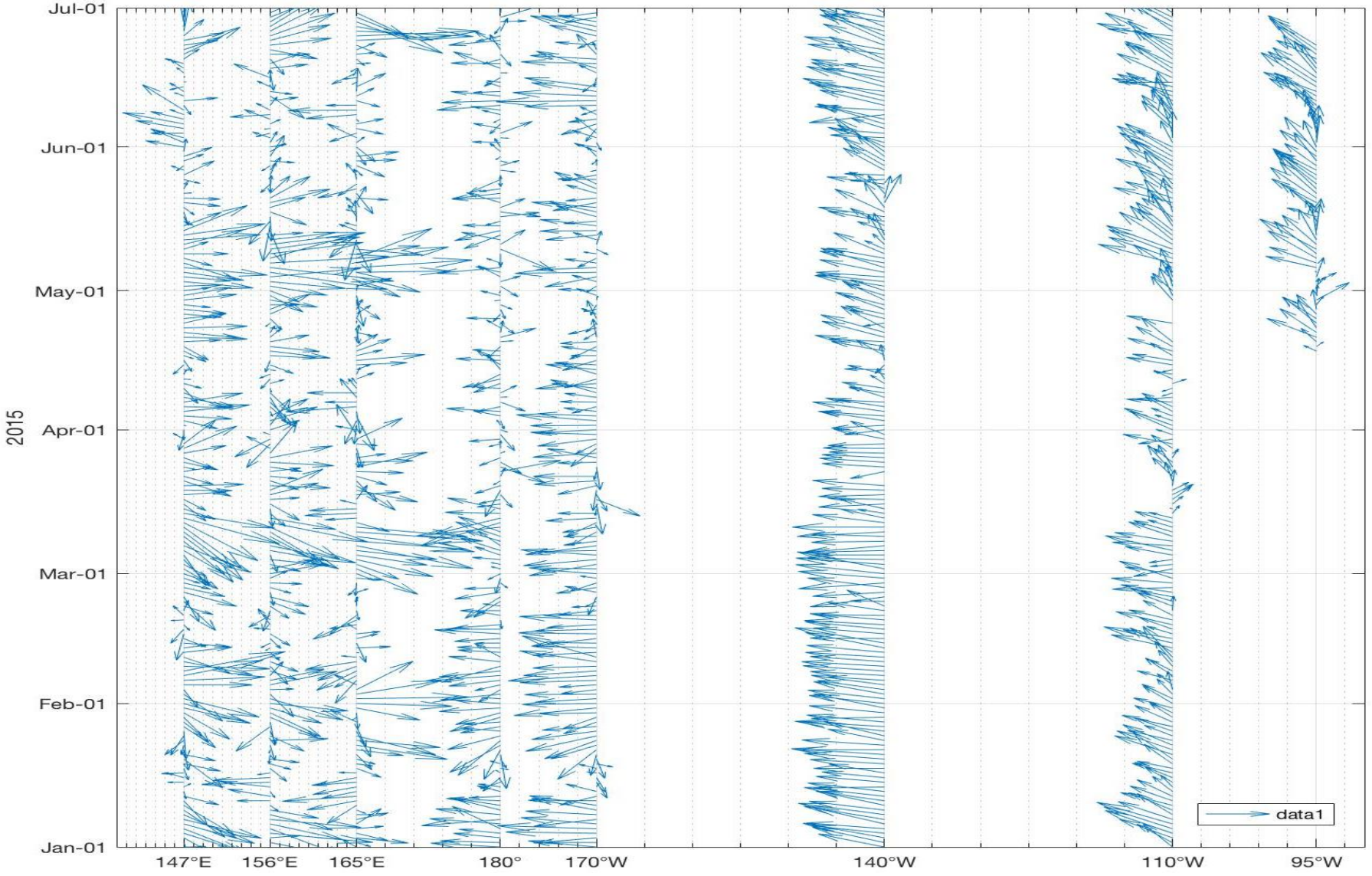




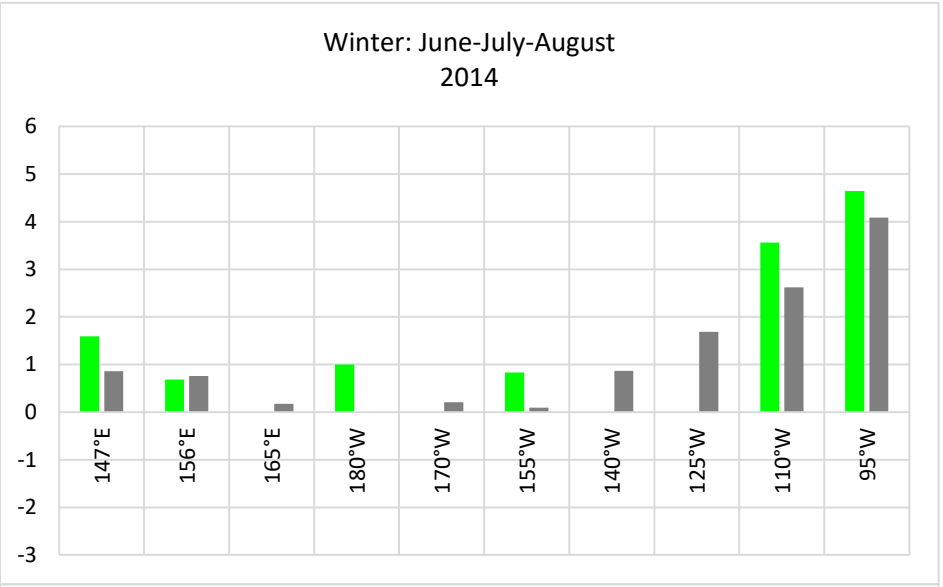
Fuente de datos: NOAA
Elaboración y análisis: CIO-CHALLENGER.

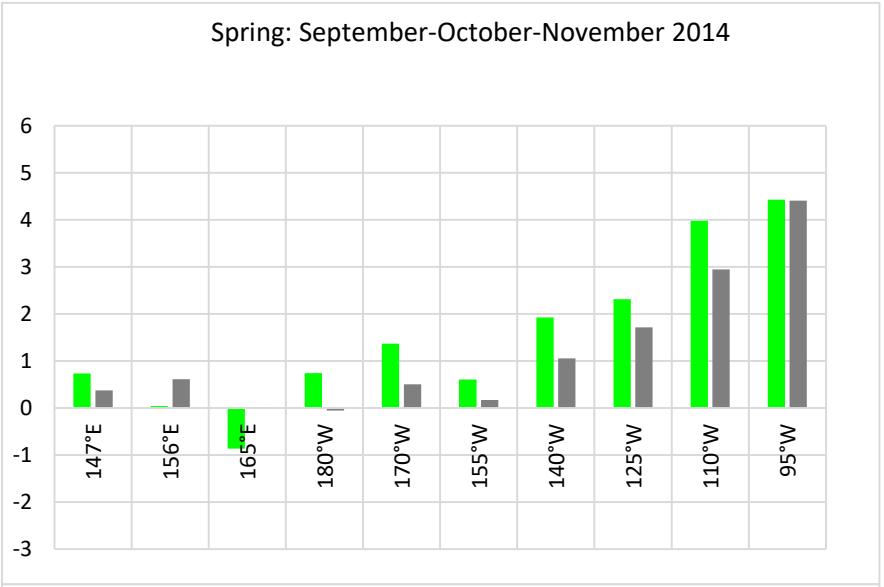
Winds during 2015

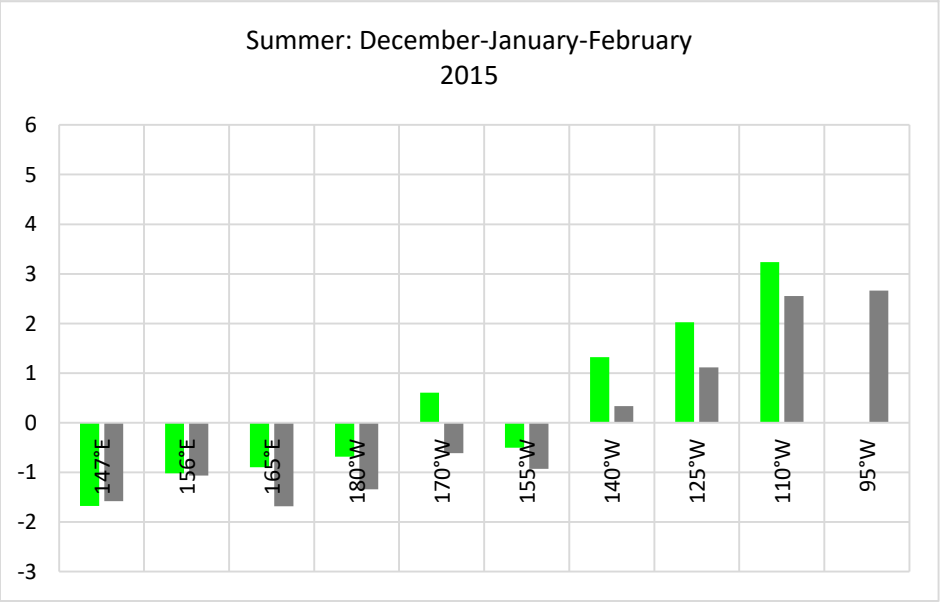
Winds along Equatorial Line

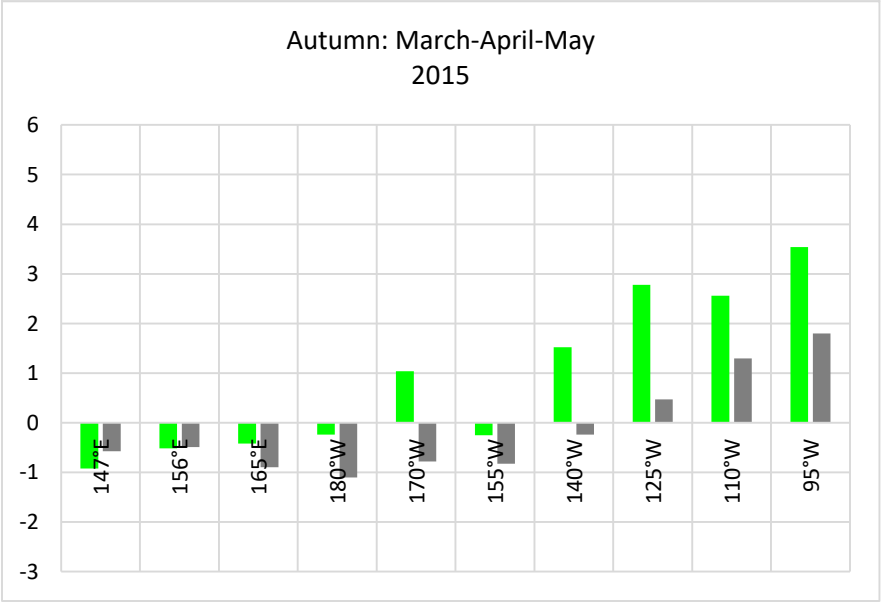


Meridional component of wind
Jun 2014 – Jul 2015

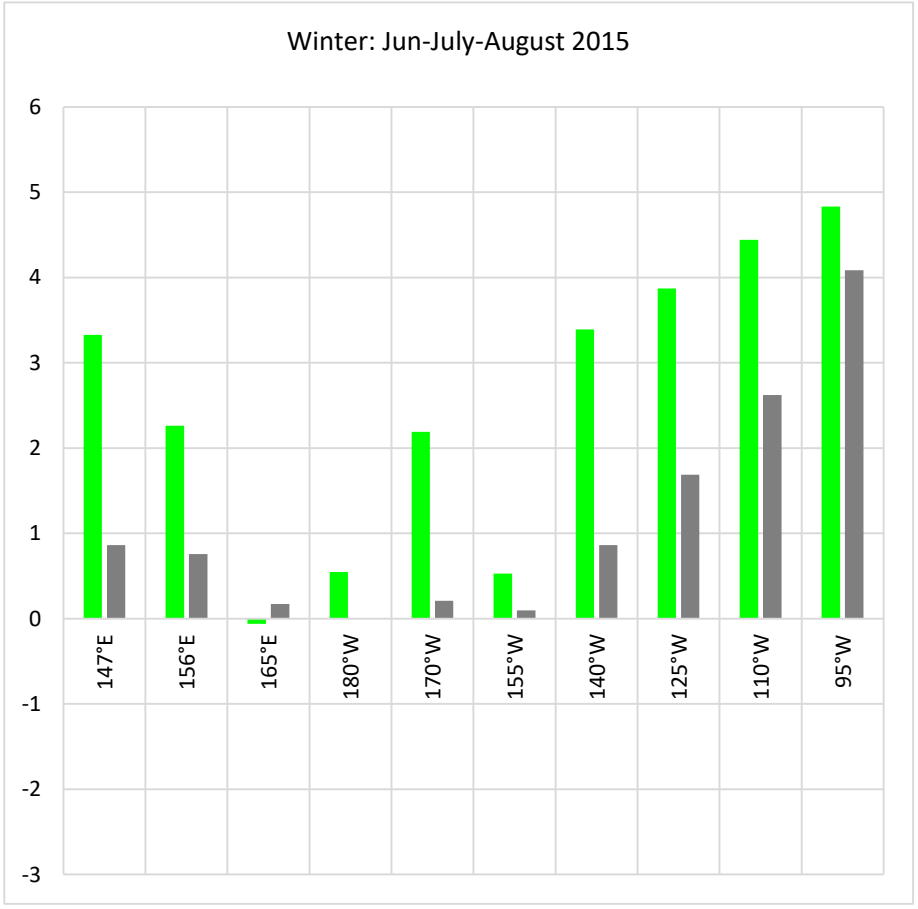


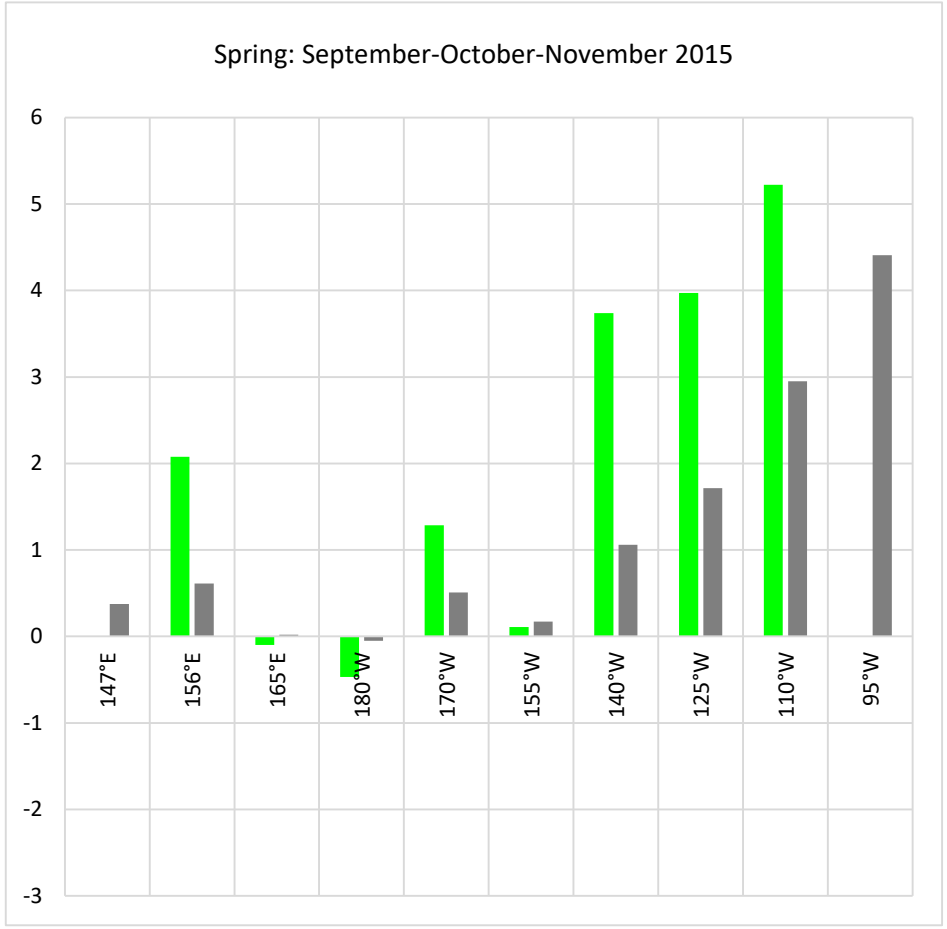




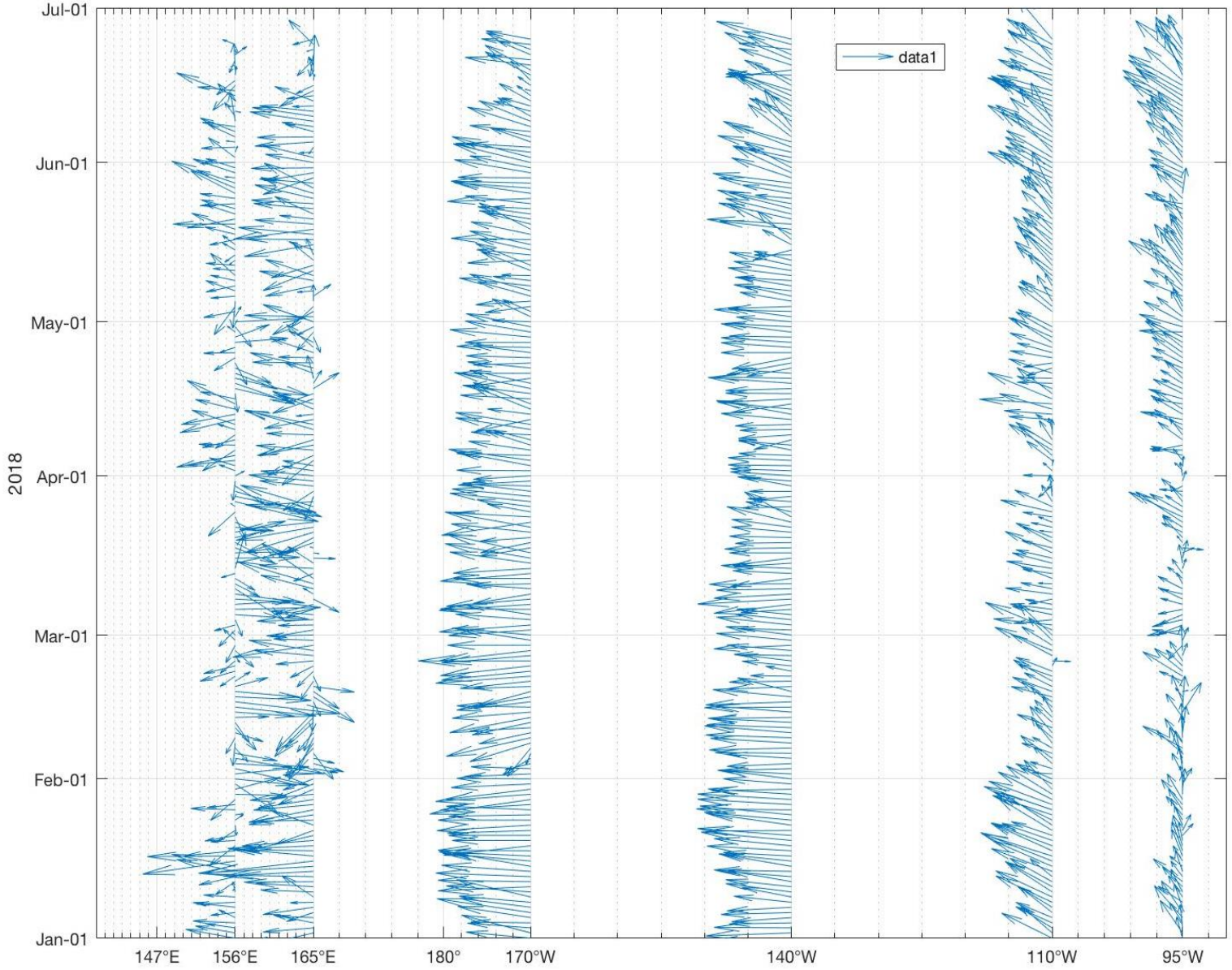


Meridional component of wind
Jun – Nov 2015





Winds during 2018 along Equatorial Line



…ENSO for The Peruvian area?

It was 2015 – 2016 … or 2014 -2017?

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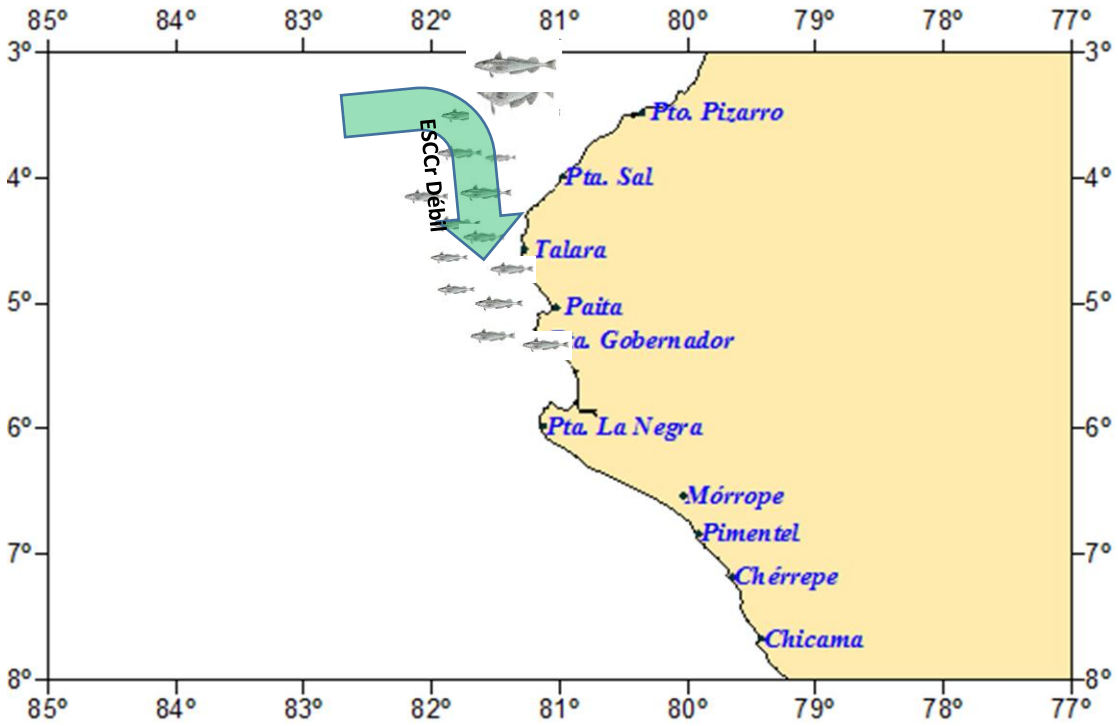
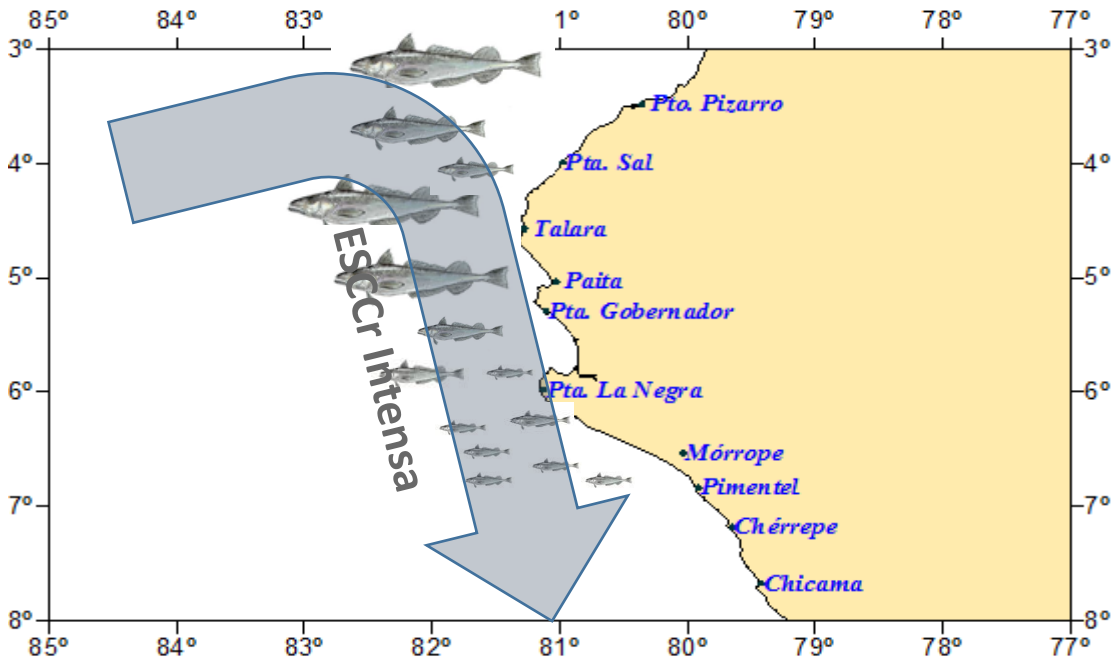
Bioindicadores

Weak EUC and hake distribution area (during La Niña or ENSO cold phase)



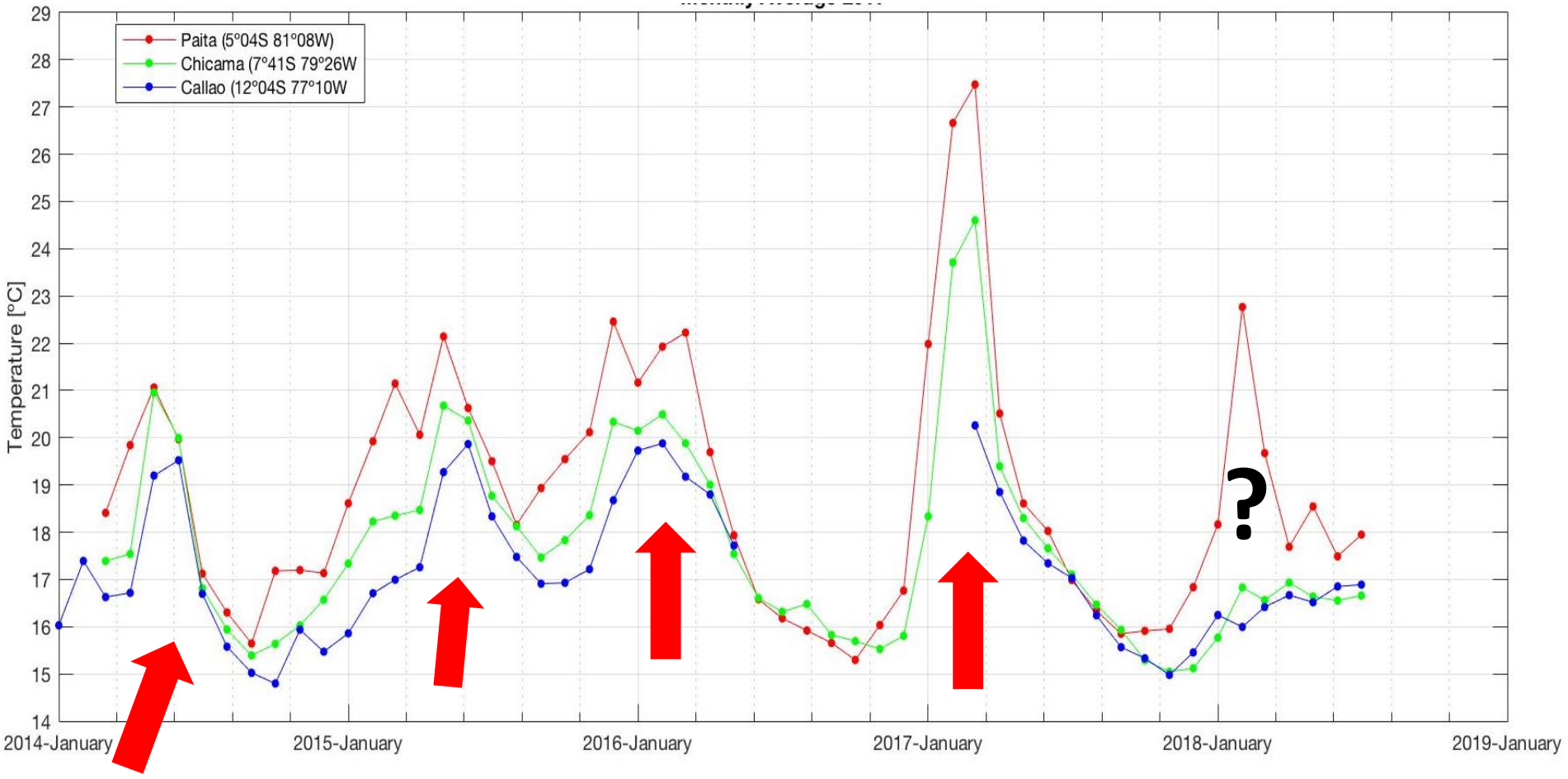
Por ejemplo en: Octubre-Noviembre de 2012

Strong EUC and hake distribution area during ENSO (Year -1 and 0)

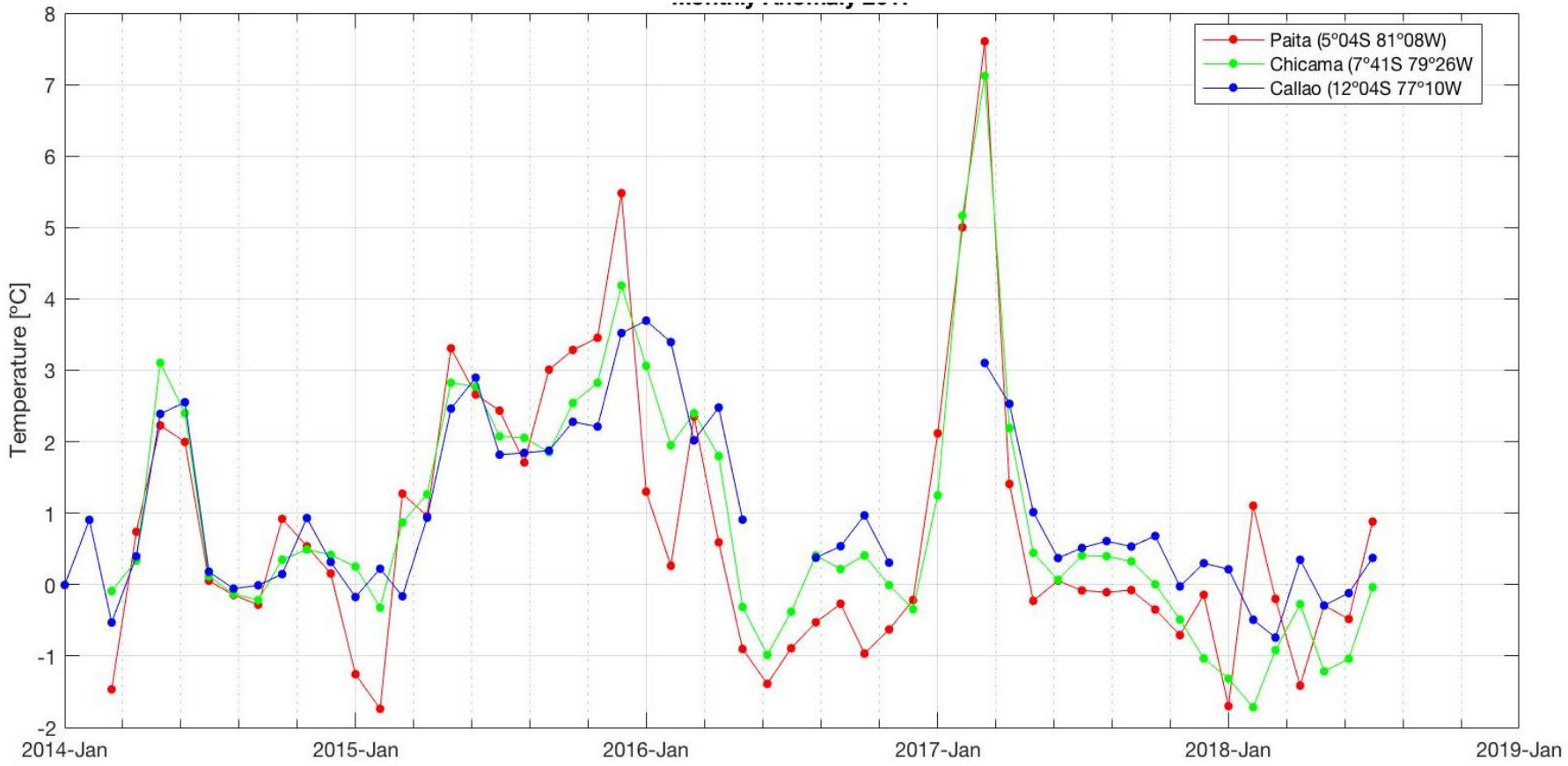


According to hake evaluation cruise on May 1997, the species was found more than 300 miles of their normal bottom distribution area.
SOURCE: Bulletin IMARPE 1997

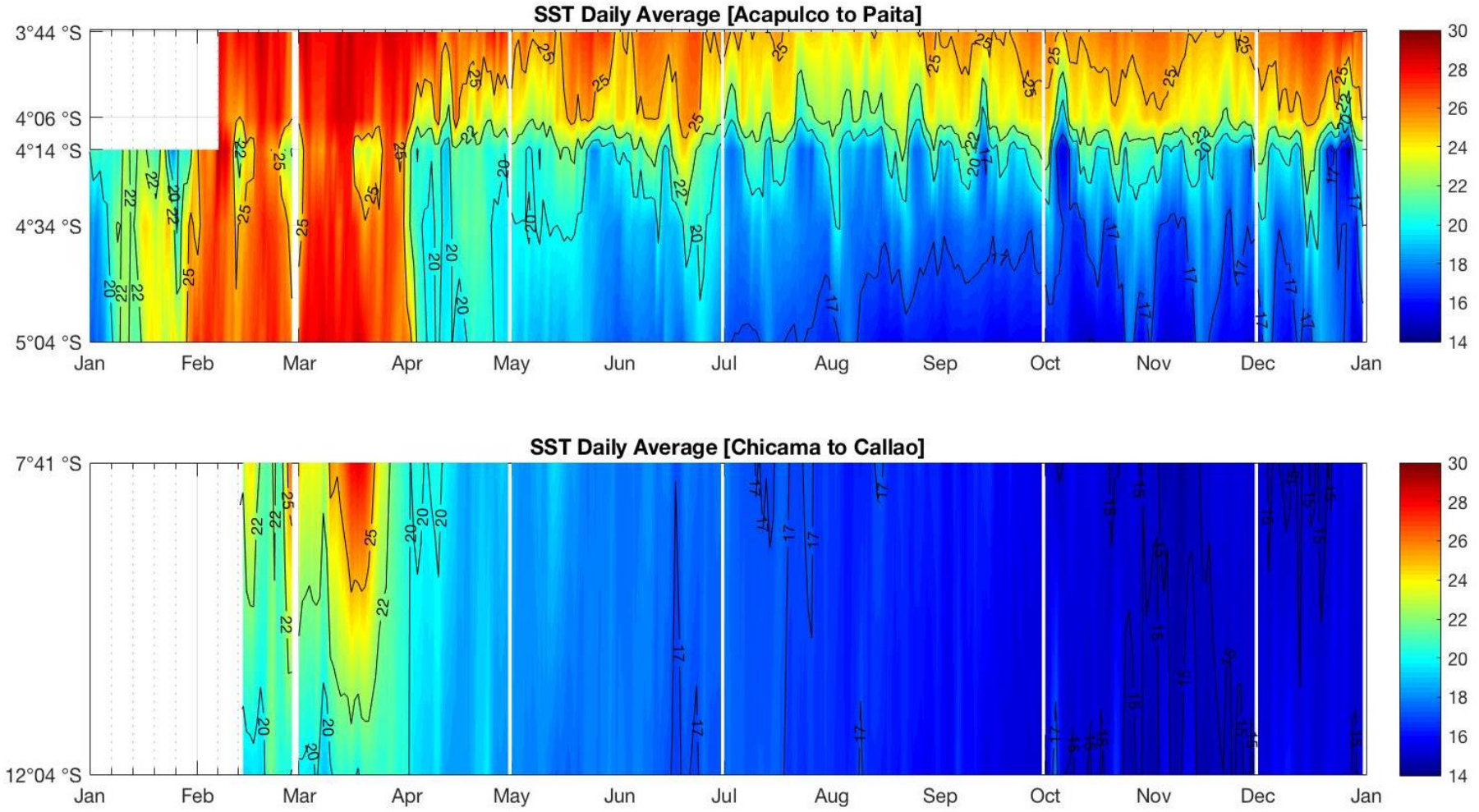
Monthly Sea Surface Temperature 2014-2018 at Paita (5ºS) Chicama(8ºS) and Callao (12ºS) (Data each 15 min)



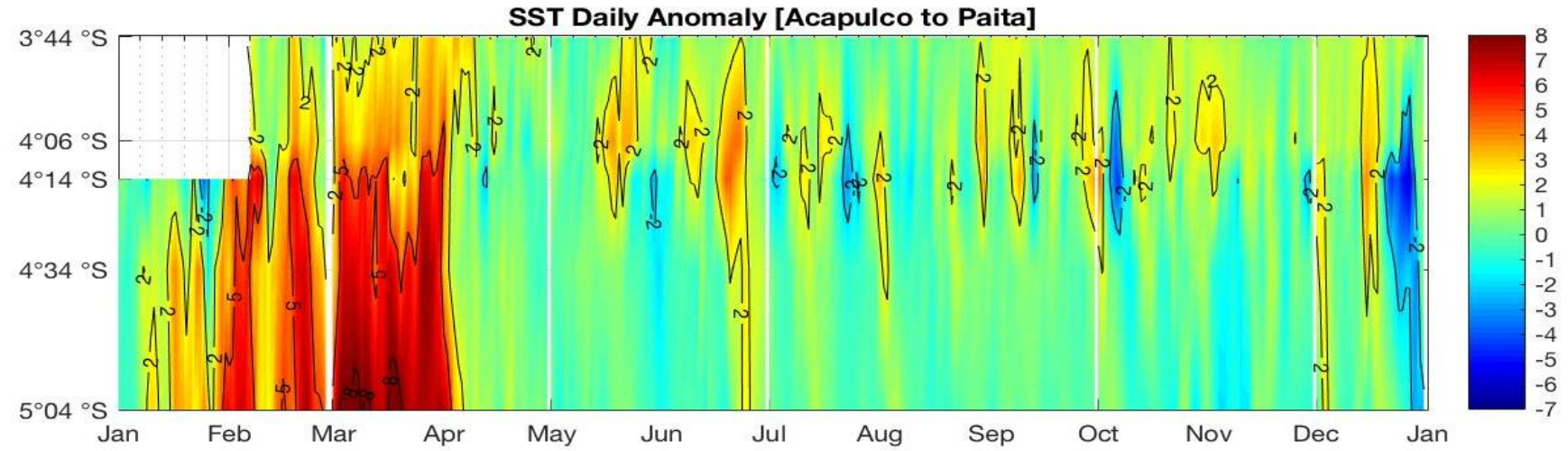
Monthly Anomaly 2014-2018
5 S, 8 S and 12 S

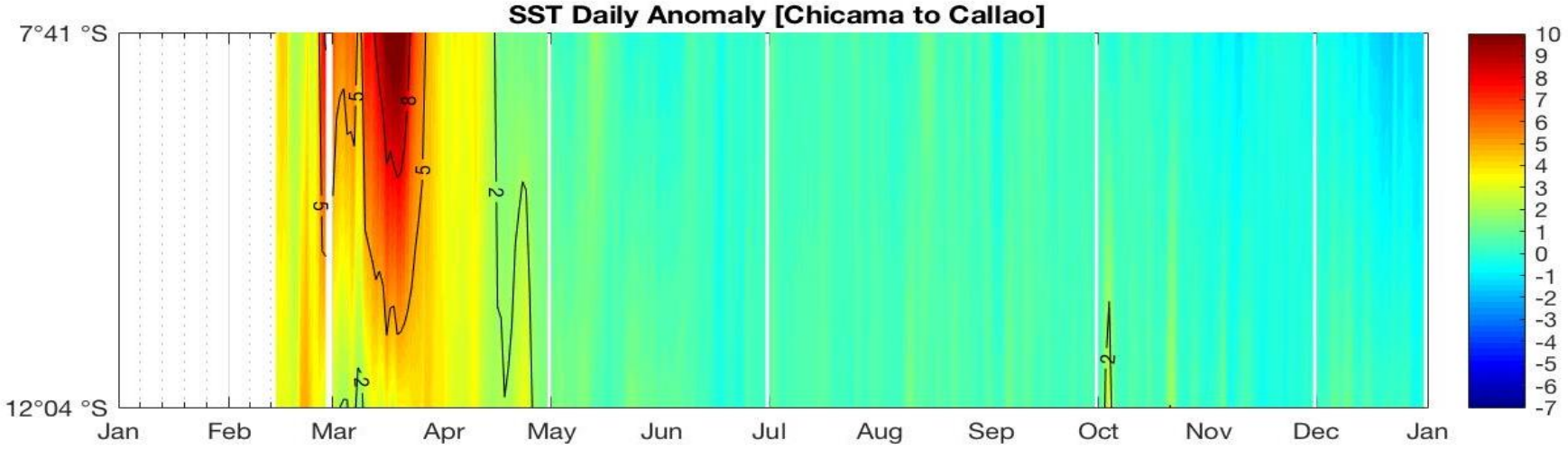


Daily SST anomaly along Peruvian Coast during 2017

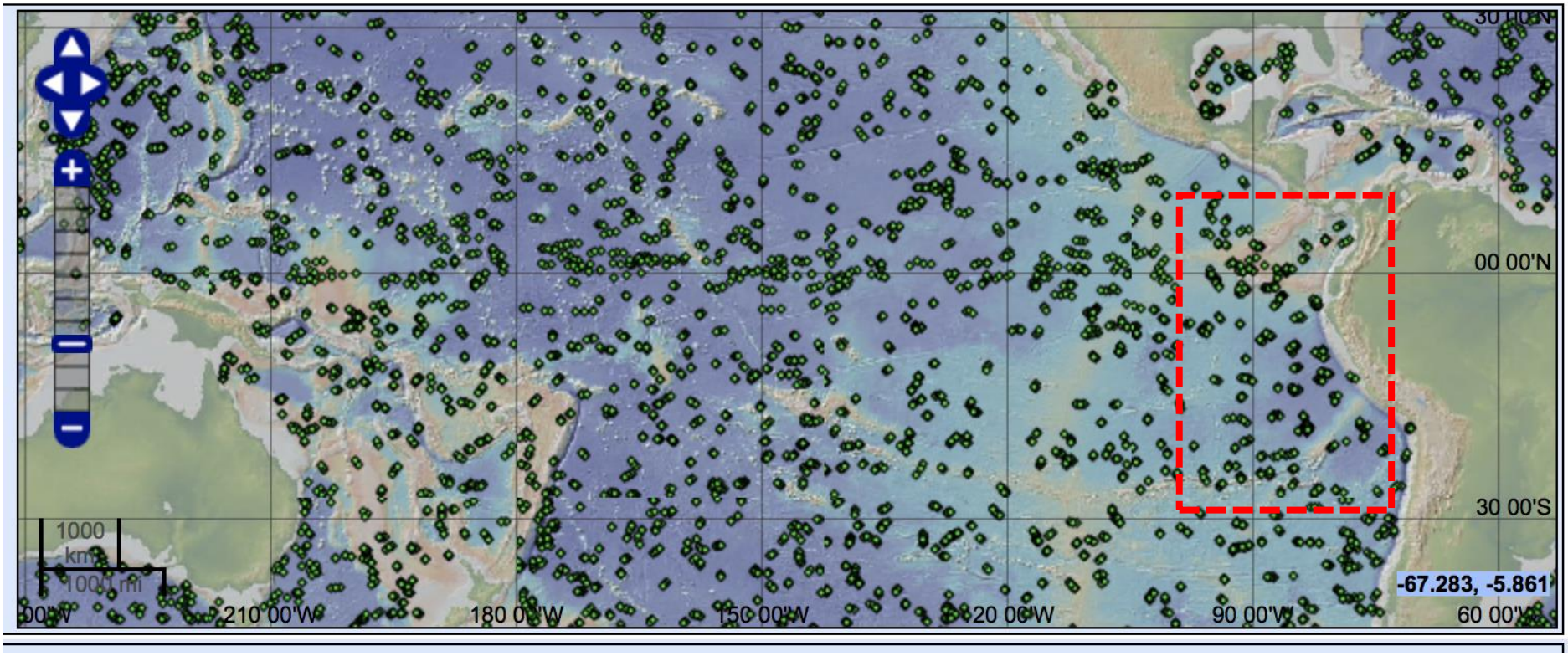


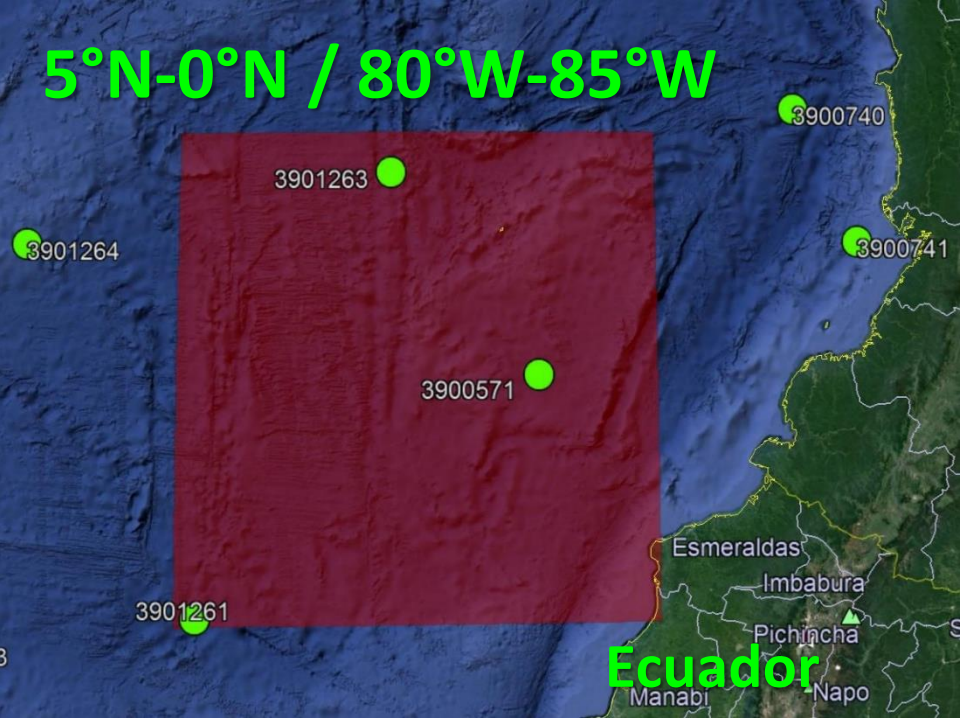
Daily SST anomaly along Peruvian Coast during 2017



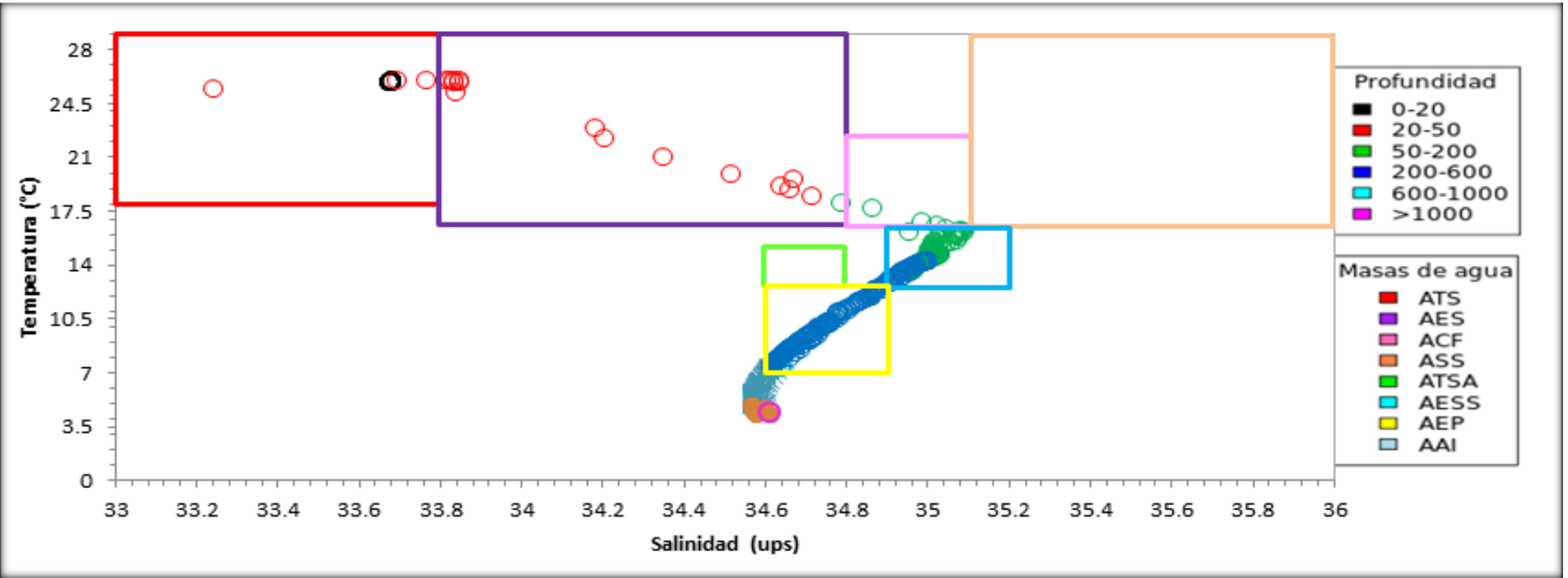


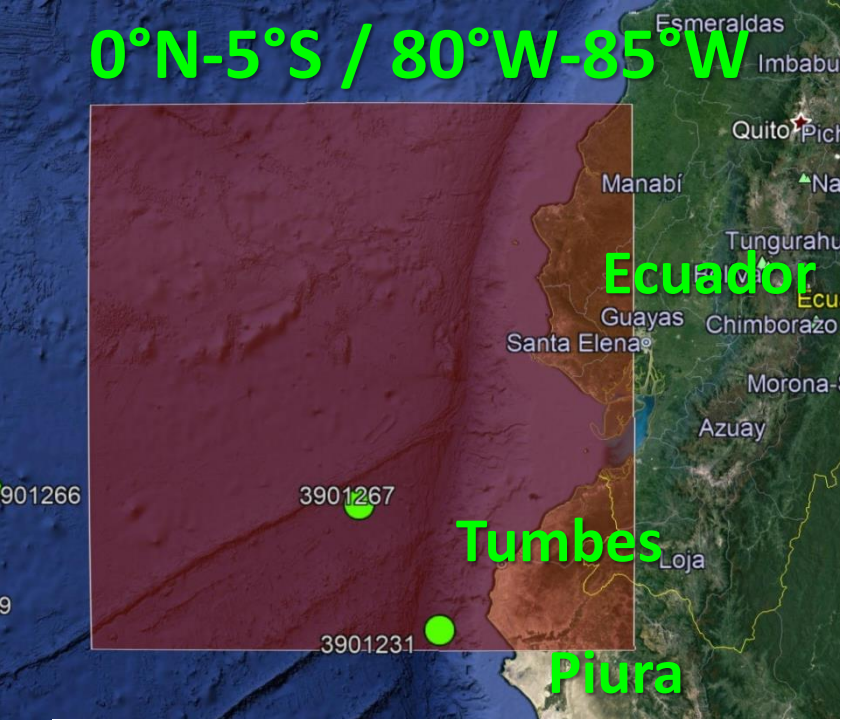
ARGO FLOATS: About 50 in front of Peruvian and Equatorial Coast used for identification of water mass





- **AES** and **ATS** are present from 20m to 50m depth with temperatures from 16°C to 26°C.
- **AESS** are present from 50m to 300m with temperatures between 13°C and 15°C.
- The **AEP** from 200m to 600m depth, where is the oxygen minimum.
- There is no presence of **ACF** or **ASS**.





In the Northern zone of Peru, **AES** is present (up to 20 m depth) with a temperature range between 18 °C and 21 °C.

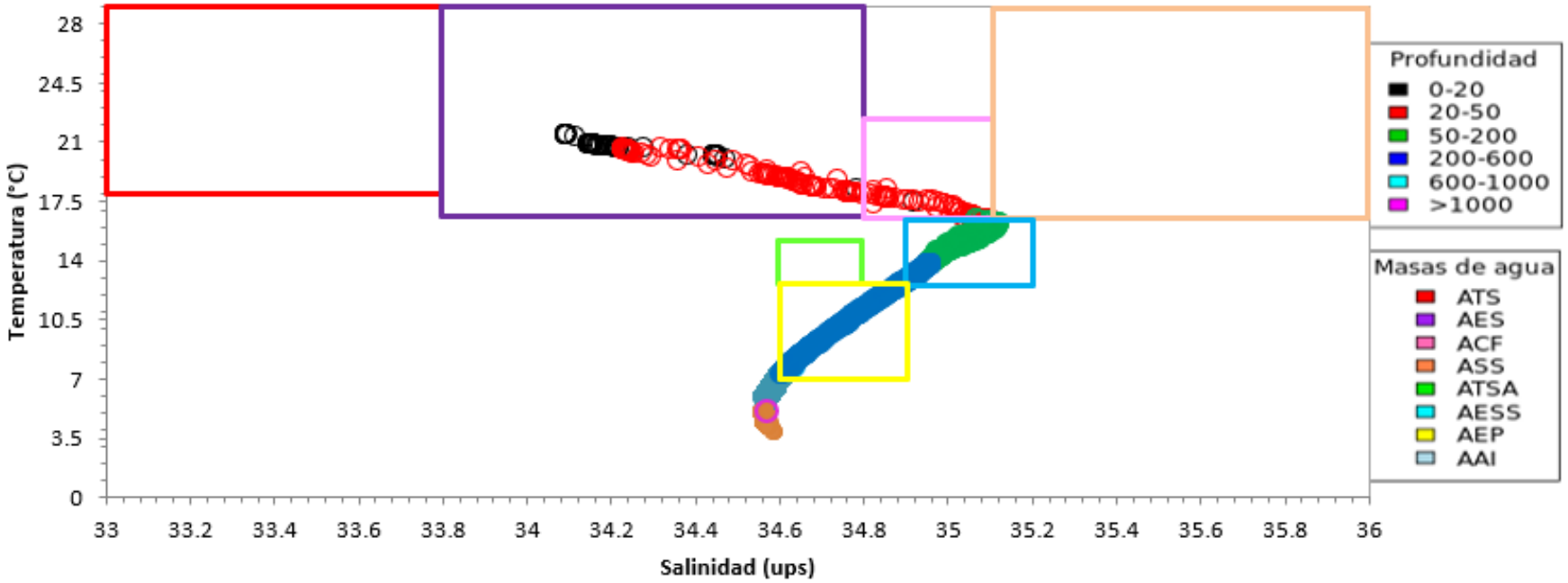
There is no presence of **ATS**.

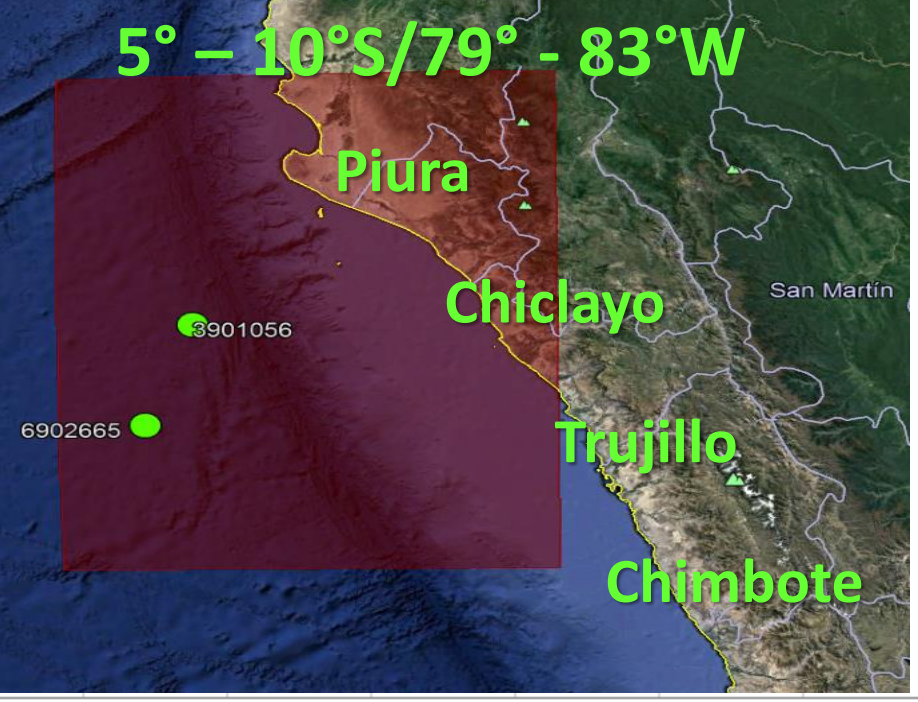
Between 20 m and 50 m depth, there is a mixed-layer that has **ACF** origin with salinities above 34.8 UPS.

The **AESS** are present between 50 m and 250 m.

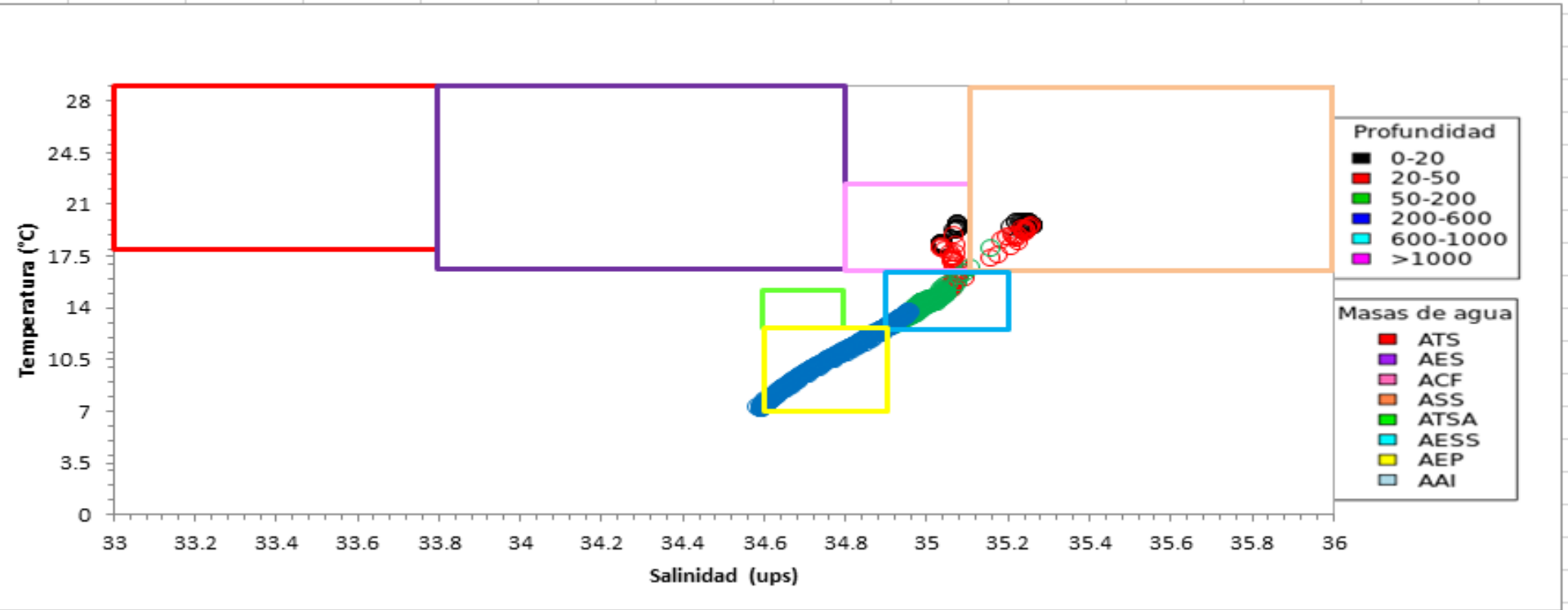
The **AEP** are found between 250 m and 600 m depth

There is no presence of **ASS**.



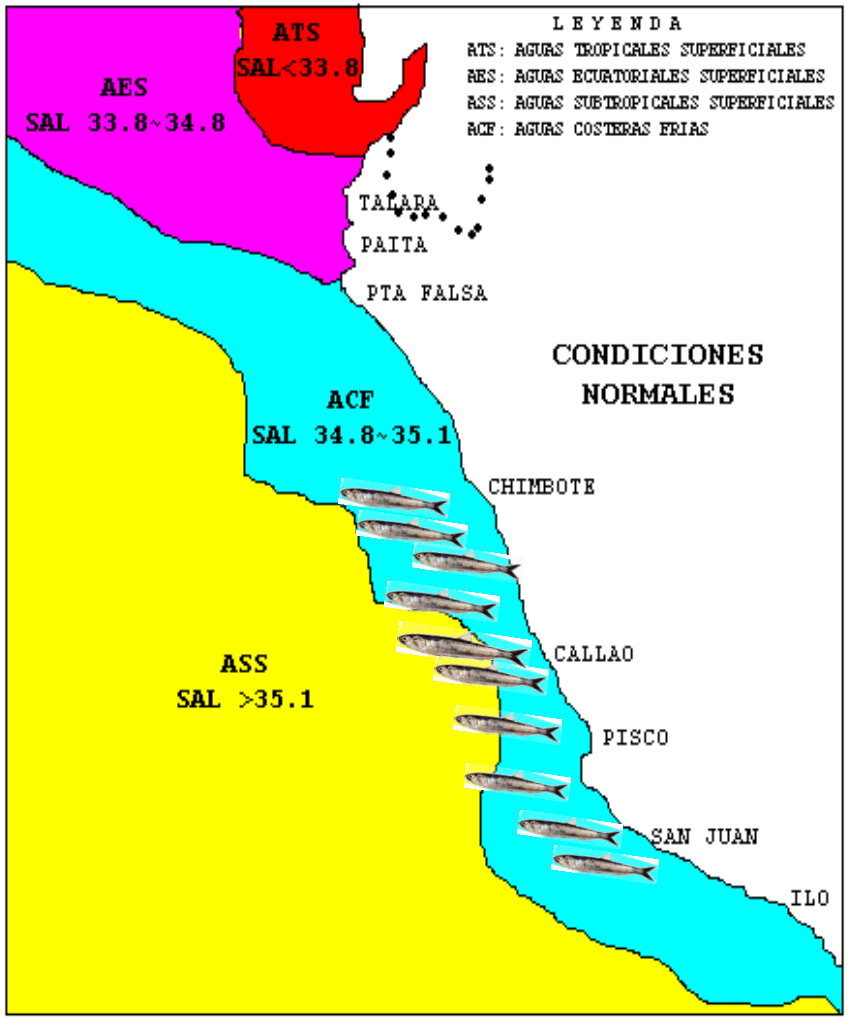


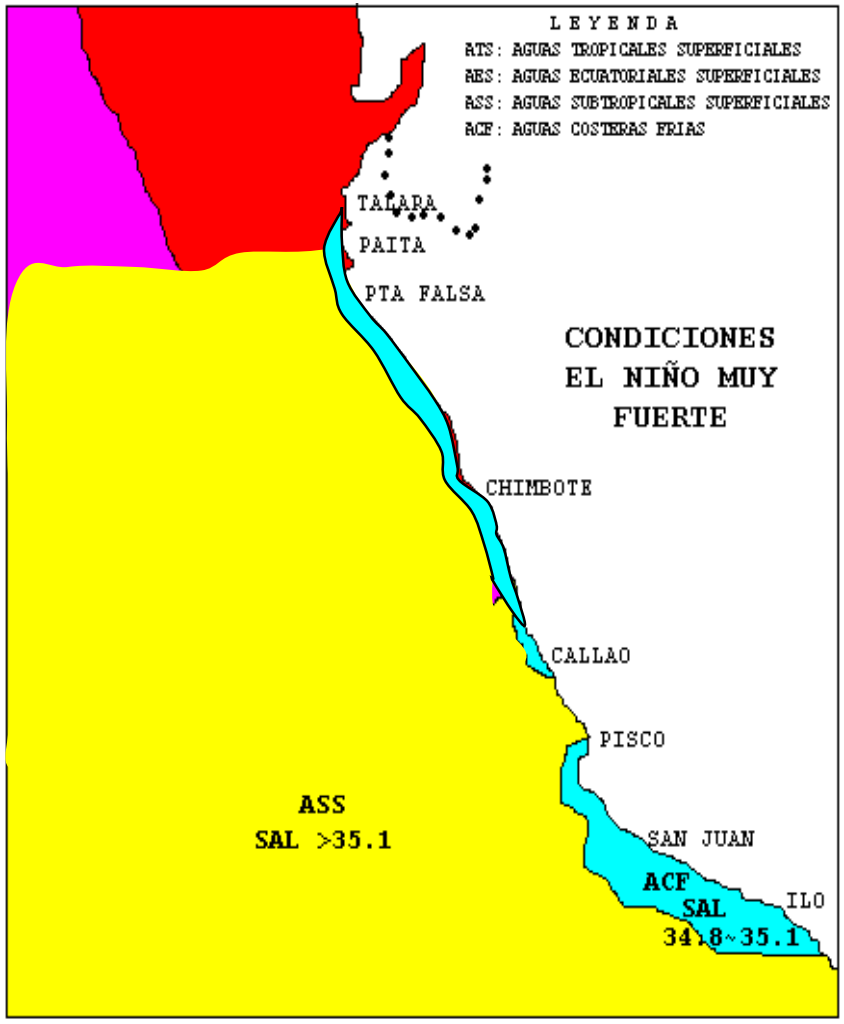
- There is presence of ASS and ACF with a temperature range between 17.5 and 21 °C . There was a slight temperature increase of 1°C compared with the last month.
- At 50m Depth ASS is present with a salinity range between 35.1 and 35.3 ups.
- Between 70 and 200 m Depth AESS are present and AEP are found at 200 m depth.



Schematic resume of ENSO events difference related to water mass distribution near the Peruvian Coast

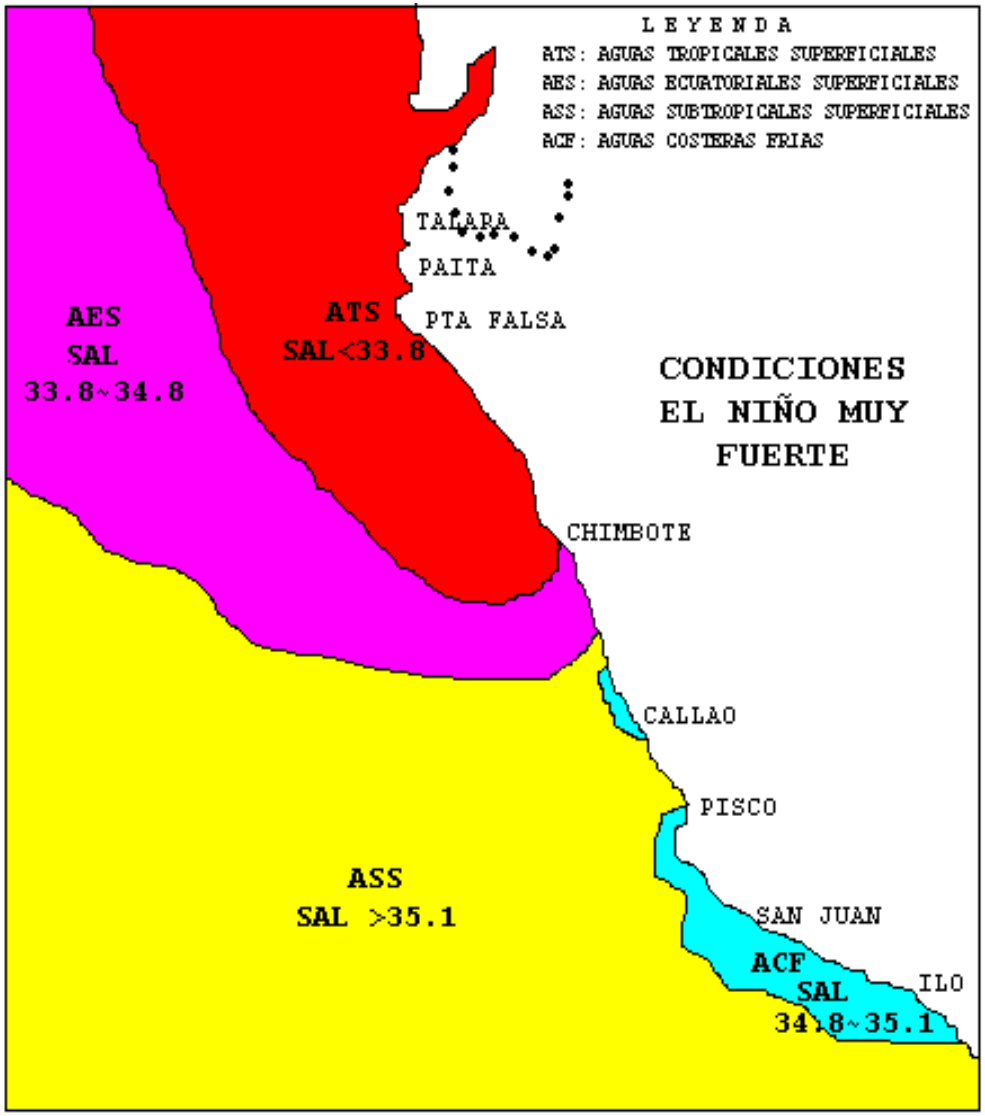
Surface water mass before and during the first stage of ENSO

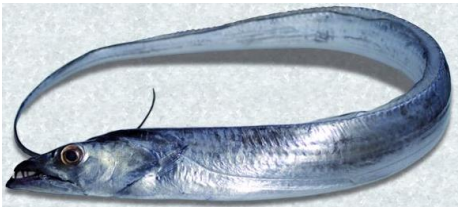




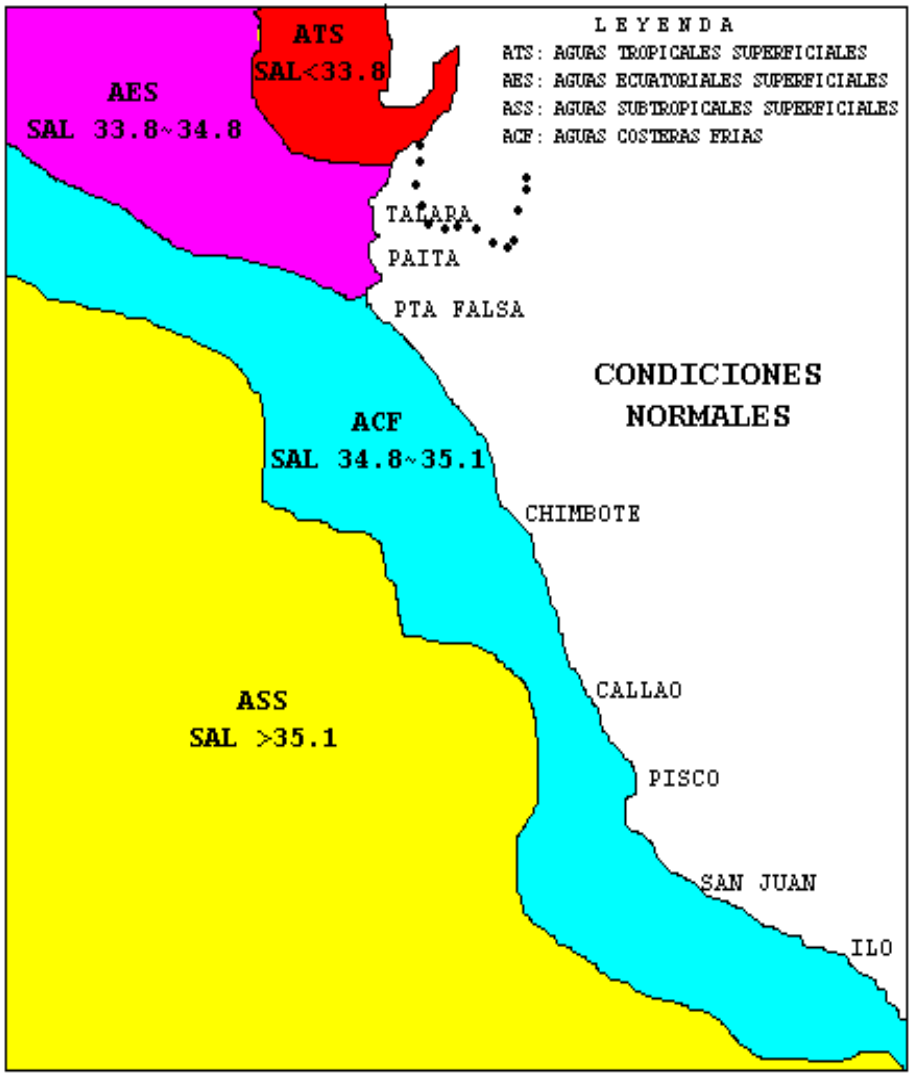
Source: http:// tarwi.lamolina.edu.pe/licochea

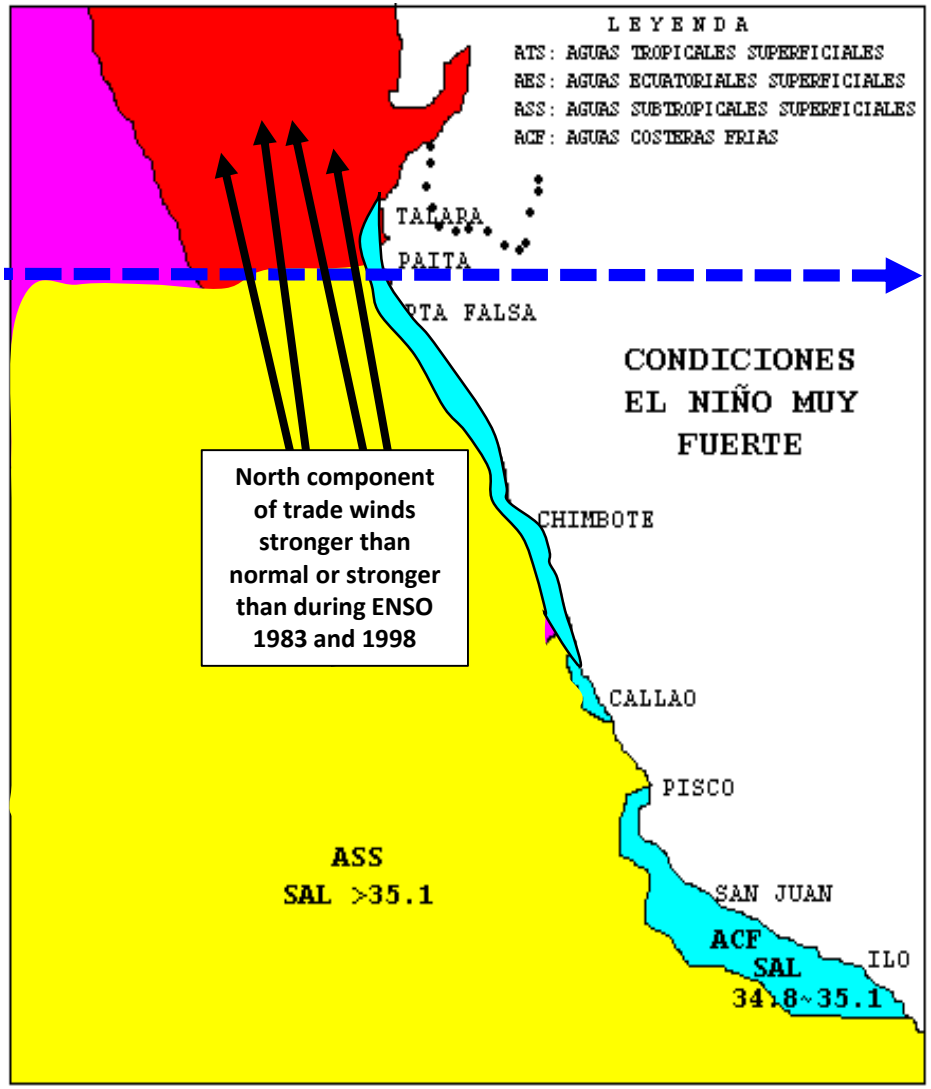
ENSO Surface Water Mass Distribution (last stage) during Peruvian Summer 1983 and 1998





ENSO Surface water mass distribution before and during summer 2016 and 2017





CONCLUSIONS

- ENSO beginning and their mechanism is very similar during different events.
- Many parameters influence during advance of the warm pool. The end of El Niño could be different along the Peruvian coast like as was observed during the period 2014 – 2017. It was different from ENSO 82 – 83 and ENSO 97 - 98
- It will be recomendable to insert in the different ENSO models variables (not so used) in order to obtain a best prediction ef ENSO events in the future.

Oceanography Research Team

CHALLENGER (CIO-CHALLENGER in fb)