The second VOCALS Meeting
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Regional oceanographic scenary and Water mass distribution in the coastal VOCALS REx region in October 2008

Pisco, 13°S - San Juan, 15°S/Peru, R/V José Olaya

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III. **The VOCALS REx-Peru cruise**

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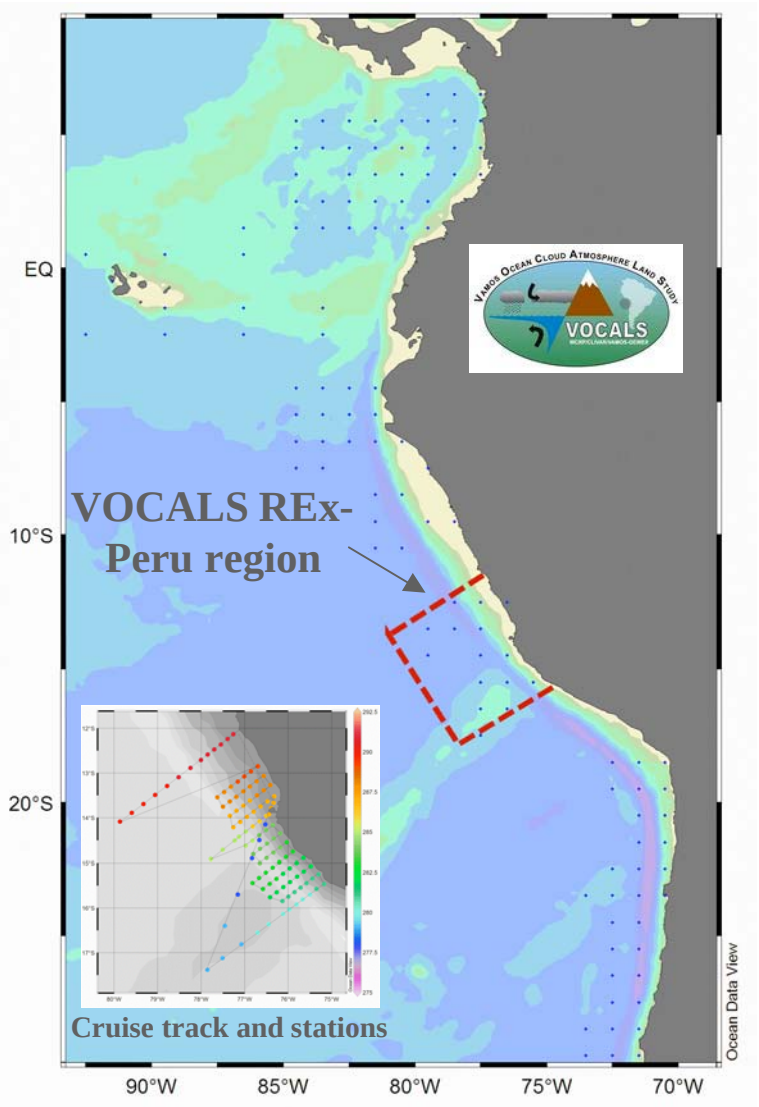
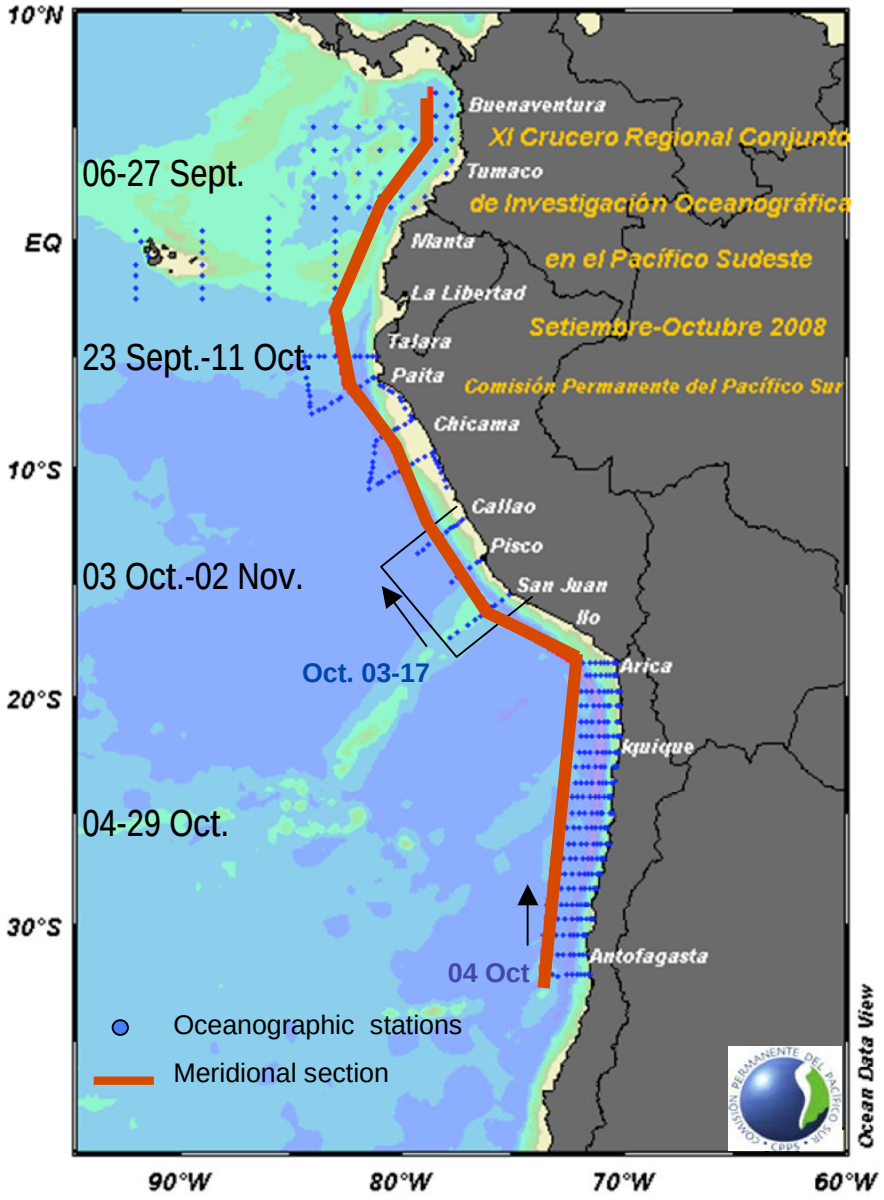


II. The Regional oceanographic scenary in October 2008

XI Joint Oceanographic Research Cruise [CPPS, 2009]

Stations: 469 Stations (29 cross-shelf transects)
Depths: 0-1000 m
Parameters: Meteo, CTD, Biogeochem, Plankton
Period: September-October, 2008
Studied area: 6º30' N - 32º10' S and from the coast to 1440km

ARC/Malpelo EAS/Orion R/V J. Olaya R/V A. Molina

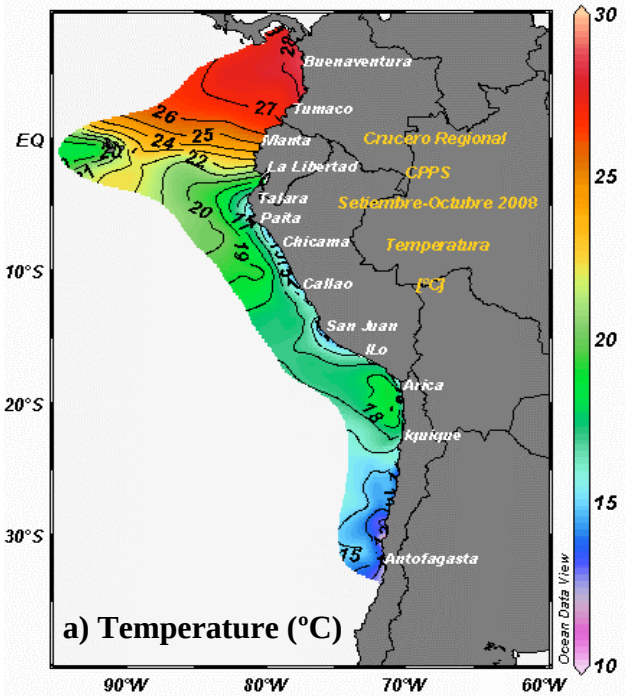


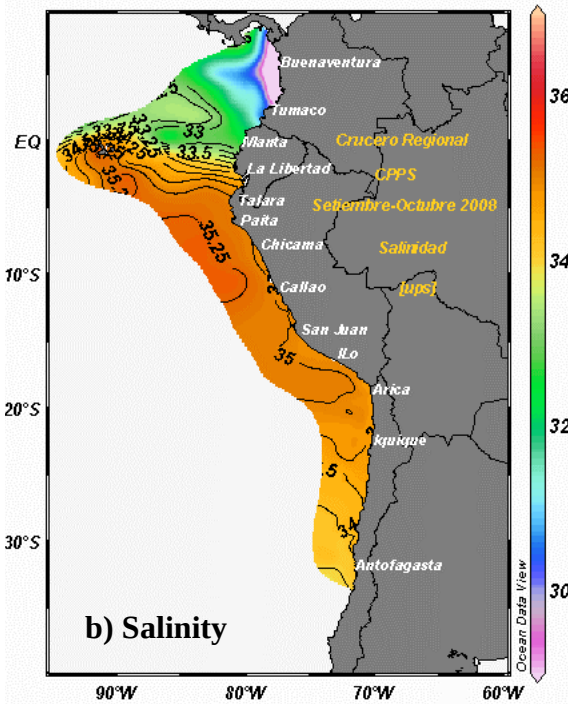
Distribution of Sea Surface Temperature (ºC), Salinity and Chlorophyll-a (µg L^{-1}), and the Depth of the 15ºC (m)

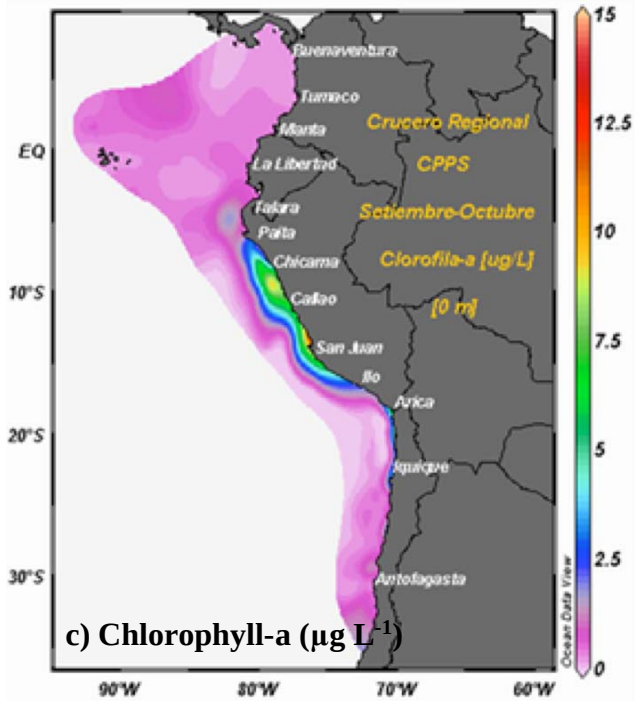
Off Peru, relatively cold conditions extended alongshore, with highly productive areas in the northern-central region (14.98 µg L^{-1}).
The Chilean sector presented cold and low-salinity waters, specially between Iquique (20S) and Antofagasta (30S).

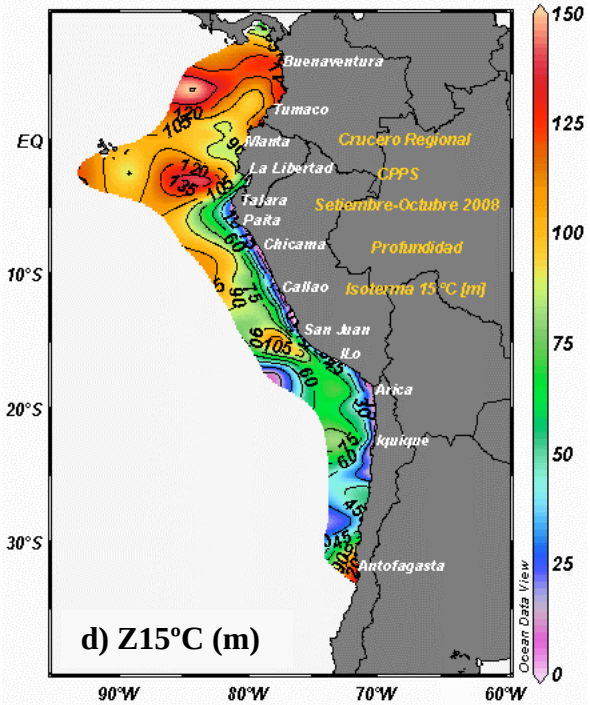
Low productive areas in the oceanic region off Buenaventura (Colombia) and the oceanic areas off Arica and Iquique (Chloro-a concentrations 0,14 µg L^{-1}),

[CPPS, 2009]

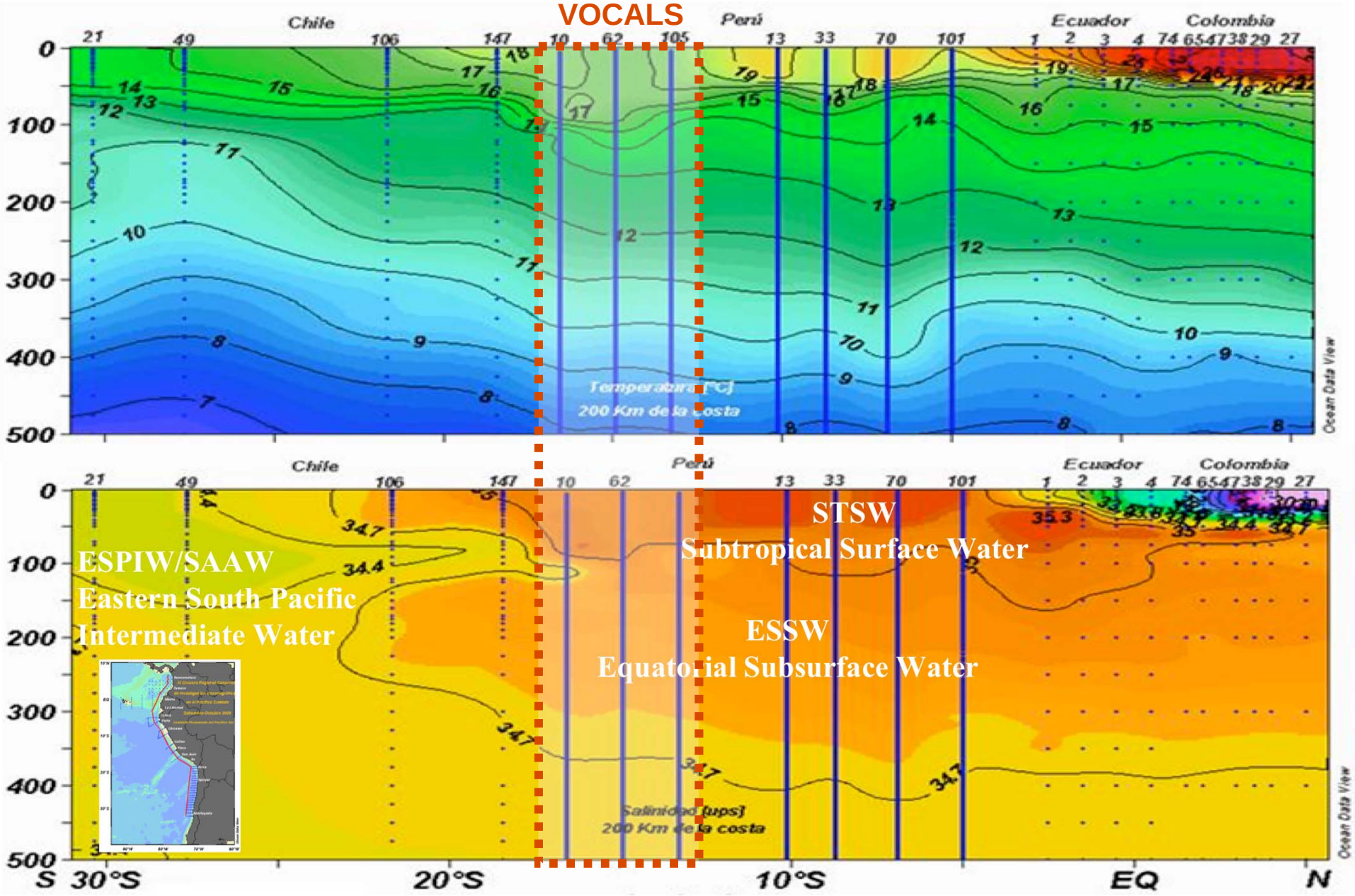








Temperature [ºC] and salinity distributions for a meridional section 100 nm off the Southamerican coast during September-October 2008 [CPPS, 2009]

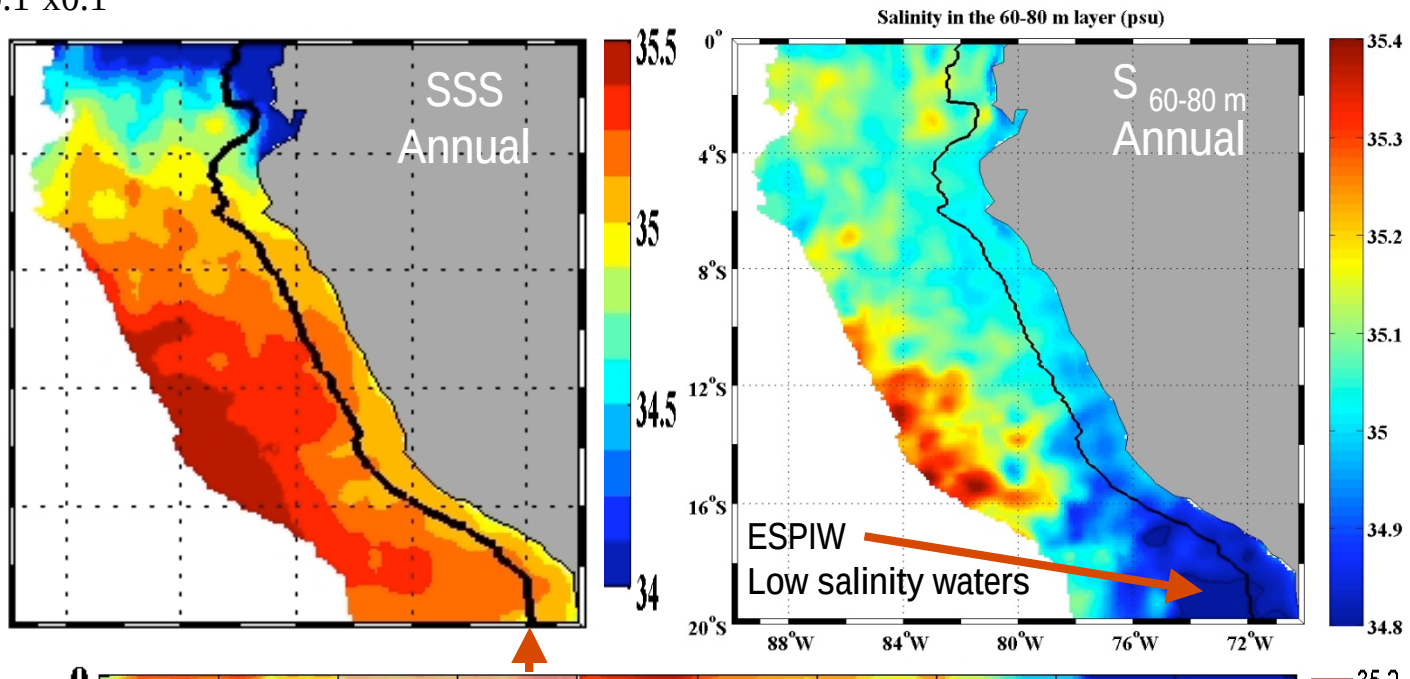


III. The VOCALS REx-Peru cruise

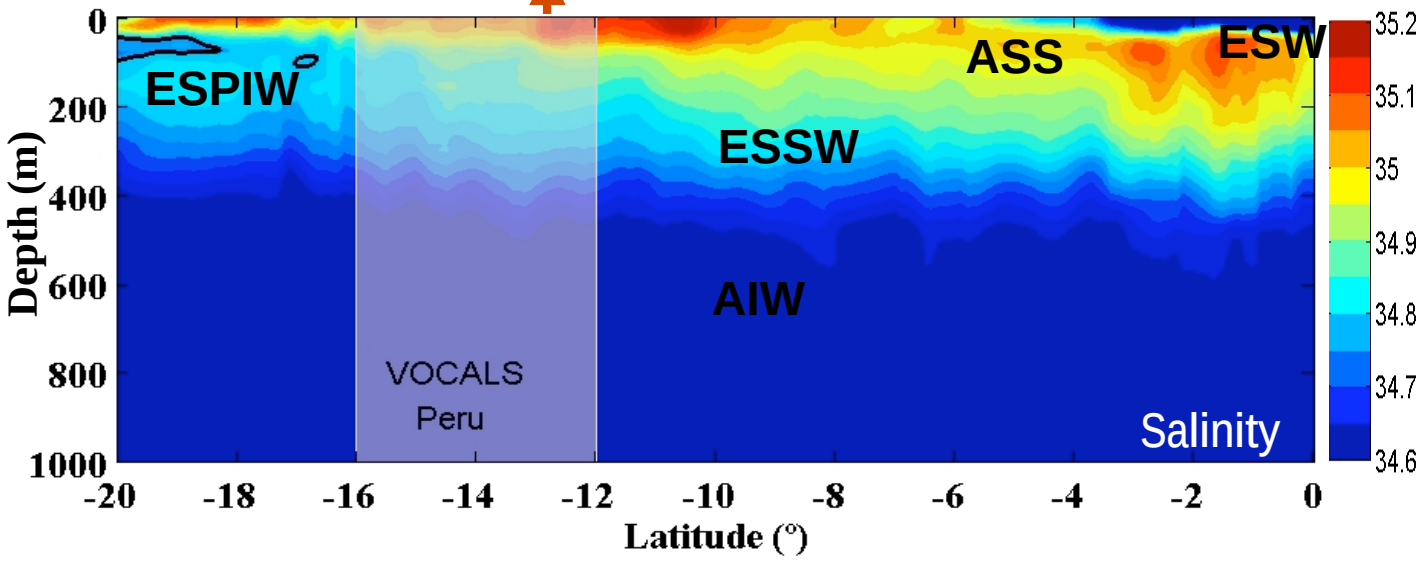
3.1) Retrospective data analysis : Construction of a high-resolution climatology

- Data sources: WOA05, ARGO and in-situ Peru/Chile data bases over 1960-2008
- From the coast to 8º offshore, from the surface to 1000 m depth (55 standard levels)
- Spatial resolución of 0.1ºx0.1º

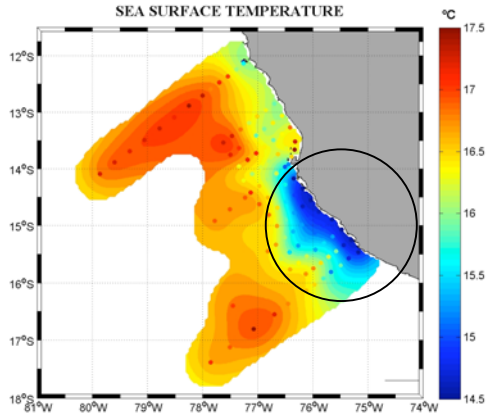
Annual mean state of a) SSS (left) and b) Salinity in the 60-80m layer depth (right)

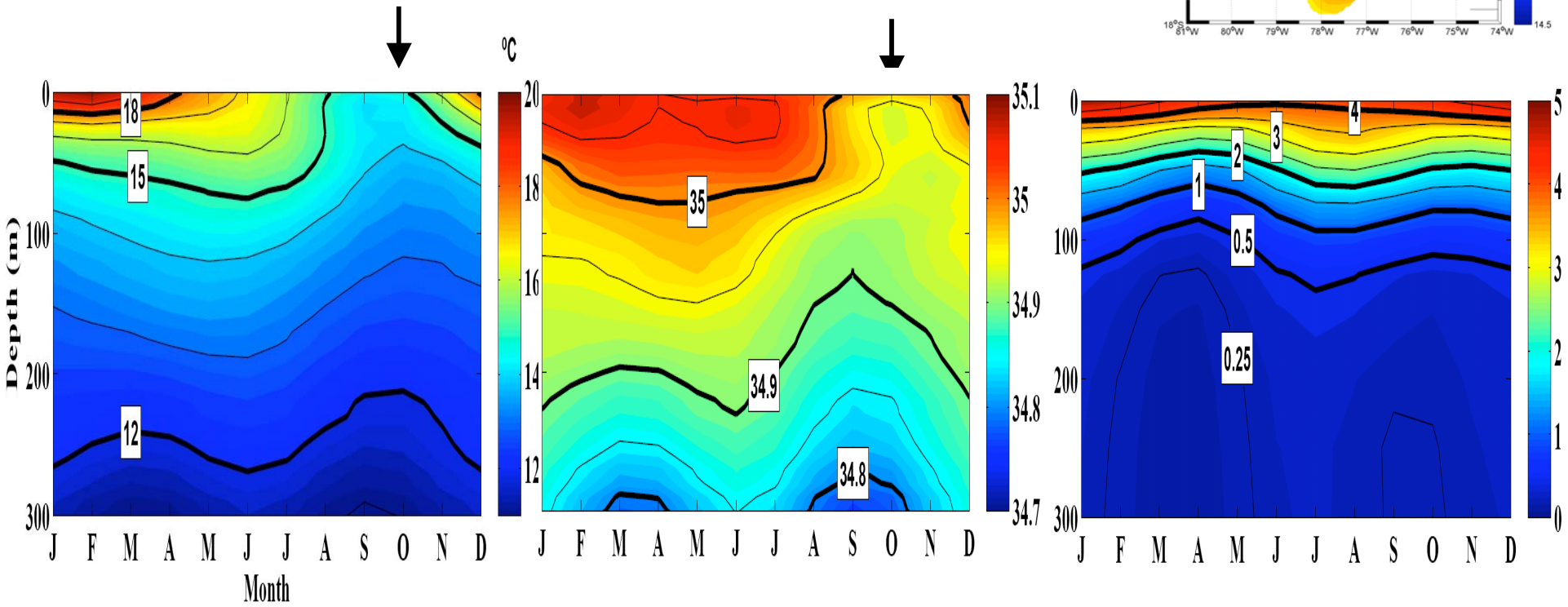


Mean annual vertical Salinity distribution (NHCS climatology) along a meridional section 100 nm parallel to the coast



Seasonal cycle of a)Temperature (ºC), b) Salinity, c) Oxygen (ml L^{-1}) distribution integrated from the coast and the upwelling front between Pisco-San Juan

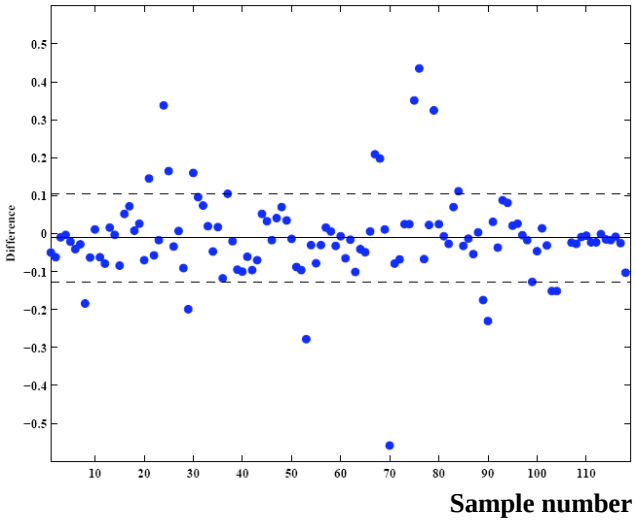




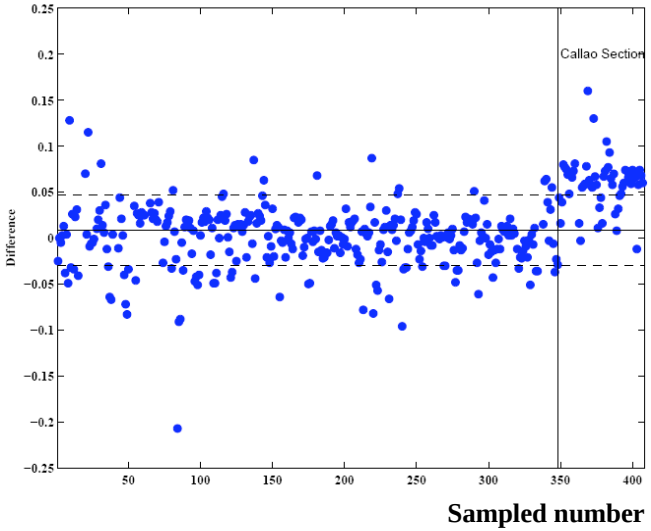
3.2. **Water mass analysis**: Data validation, definition of water mass properties

- <u>Data validation</u>: CTD & Sampling samples intercomparison

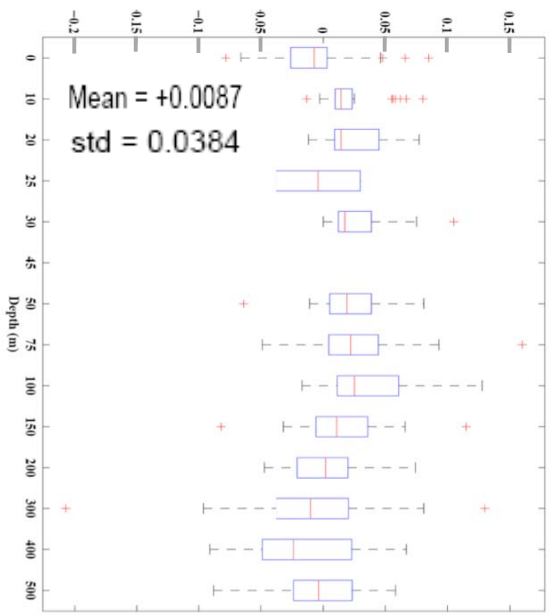
CTD – TG Surface Temperature



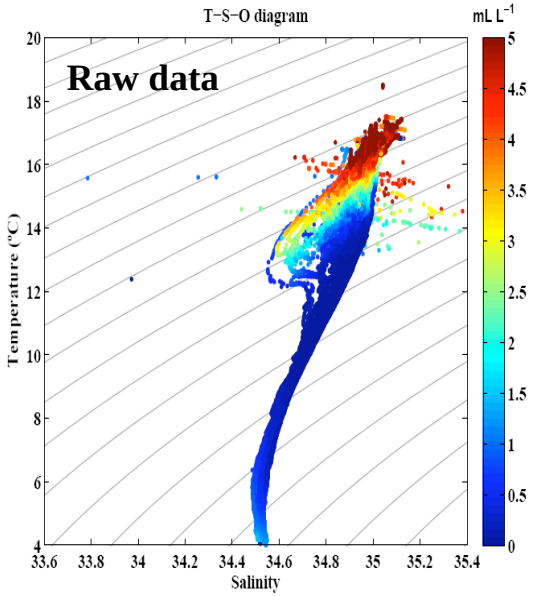
Measured vs. Sampled salinity

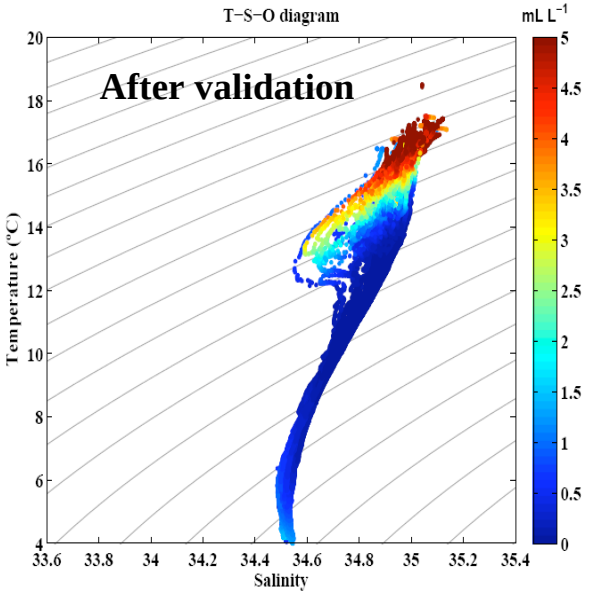


Measured vs. Sampled salinity

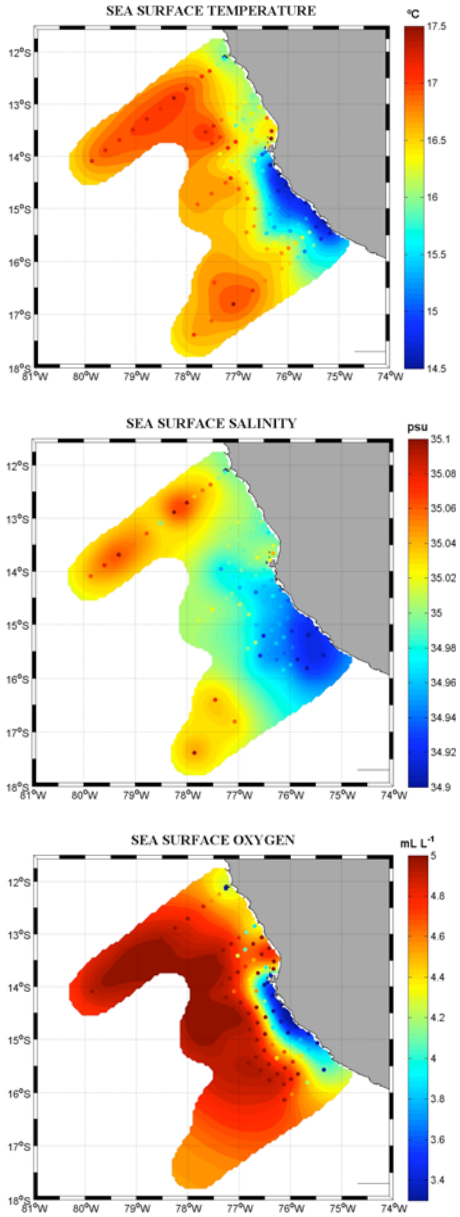


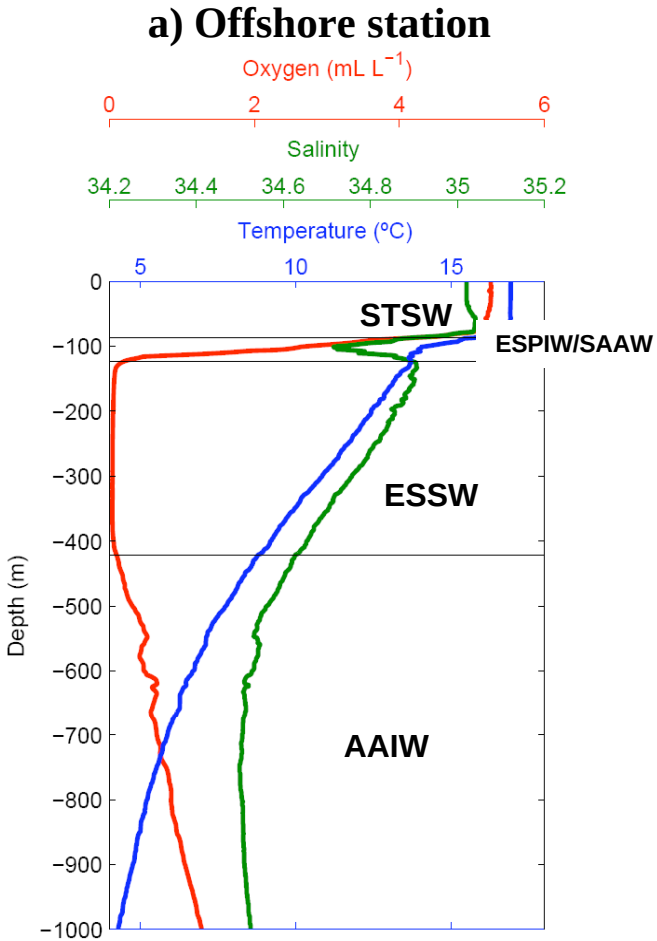
TSO_2 diagrams

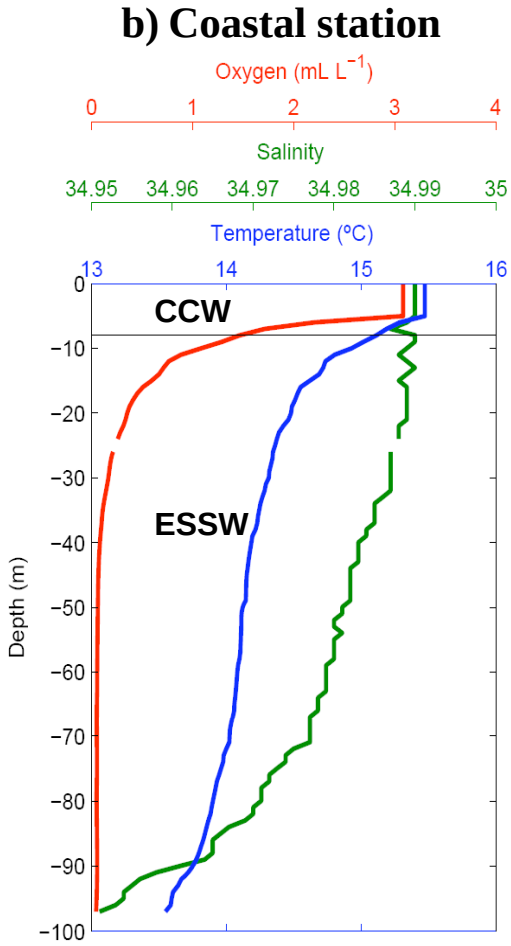




- TSO_2 “typical” vertical distribution for an a) offshore and b) coastal stations during the VOCALS Peru cruise







STSW: SubTropical Surface Water,
CCW: Cold Coastal Water,
ESPIW: Eastern South Pacific Intermediate Water (also SAAW, Subantarctic Water),
ESSW: Equatorial Sub-Surface Water,
AAIW: Antarctic Intermediate Water

- Water mass determination

Clustering method: A distance function is defined,

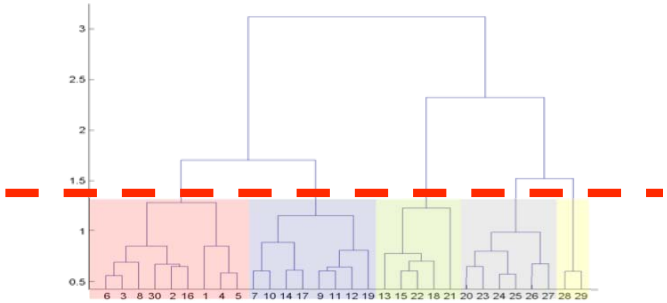
$$F_D = T_n^2 + S_n^2 + d_n^2$$

where

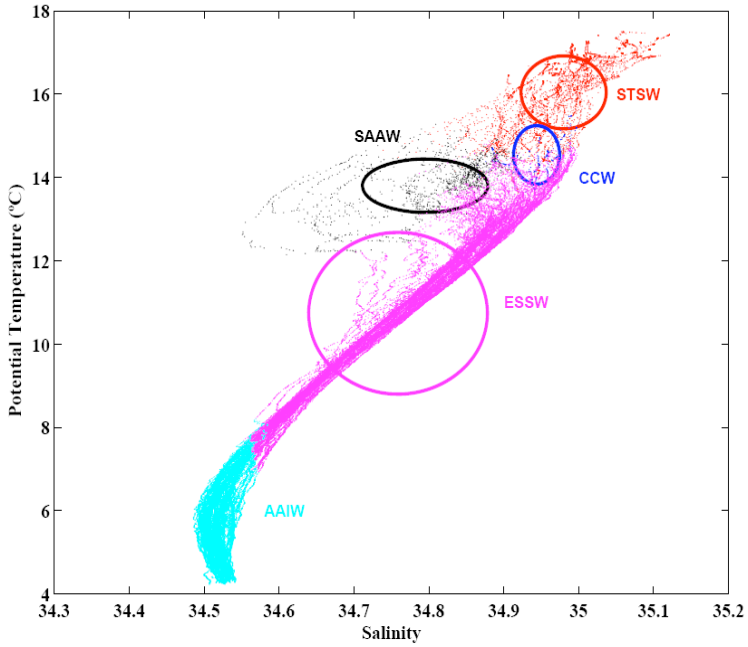
$$T_n = \Delta T_c / \sigma_T$$

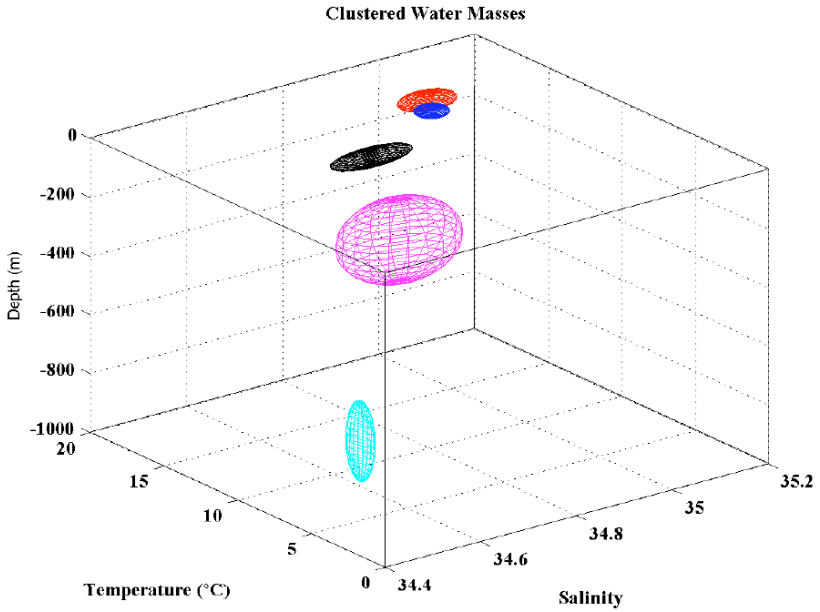
$$S_n = \Delta S_c / \sigma_S$$

$$d_n = \Delta d_c / \sigma_d$$

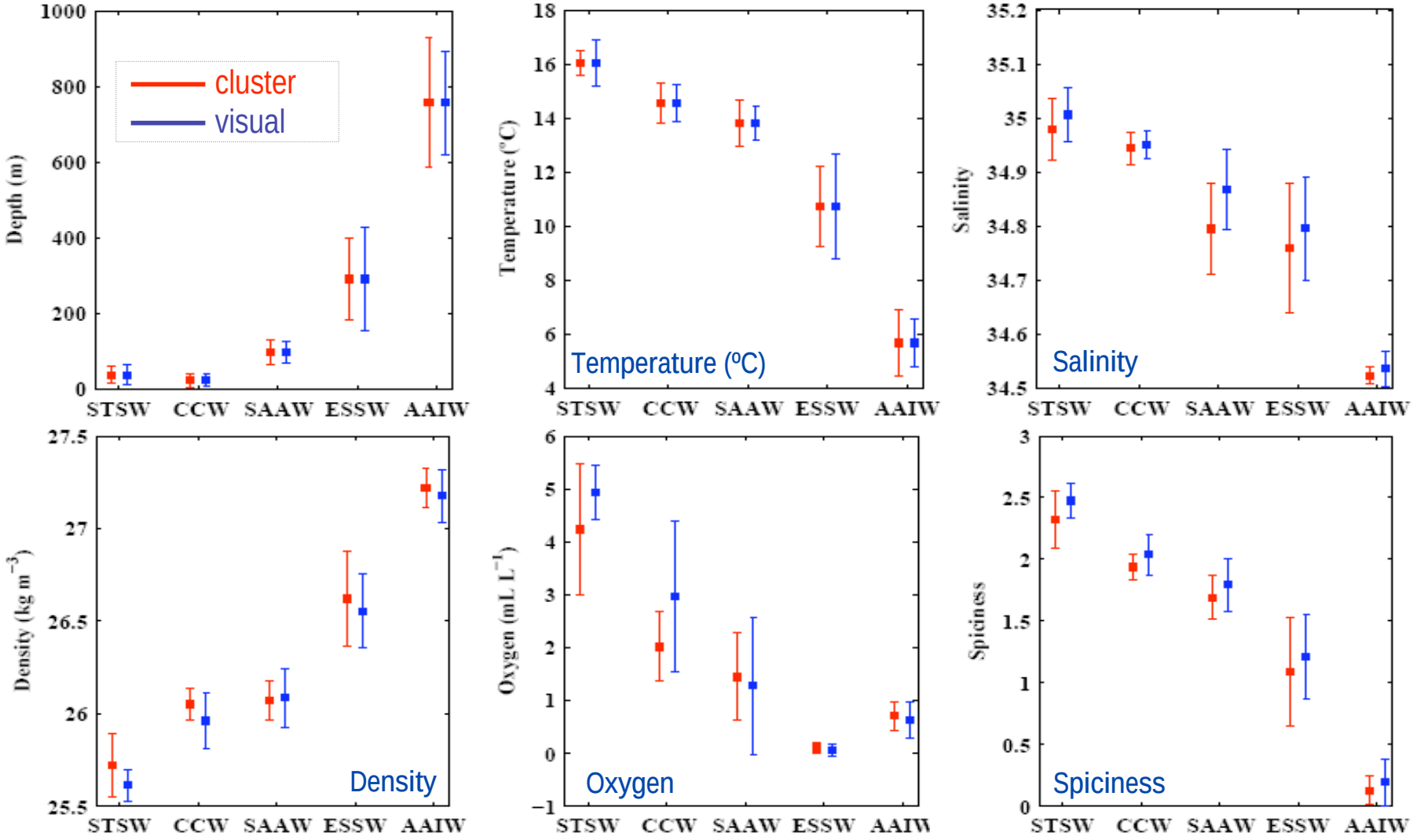


Clustered water masses



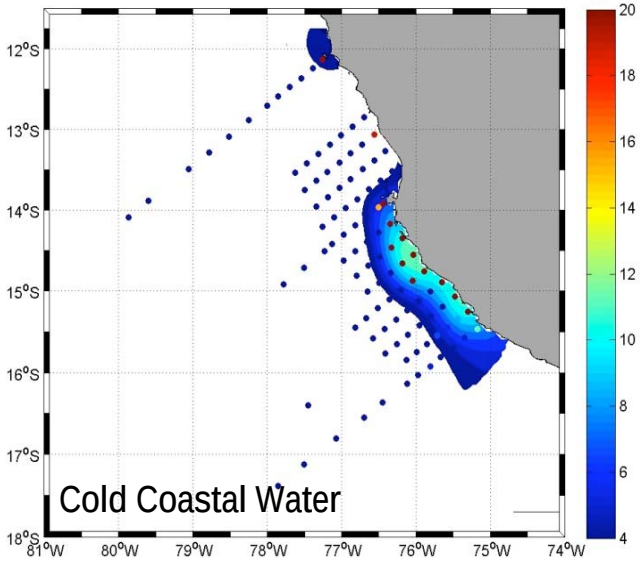


- Water Mass properties

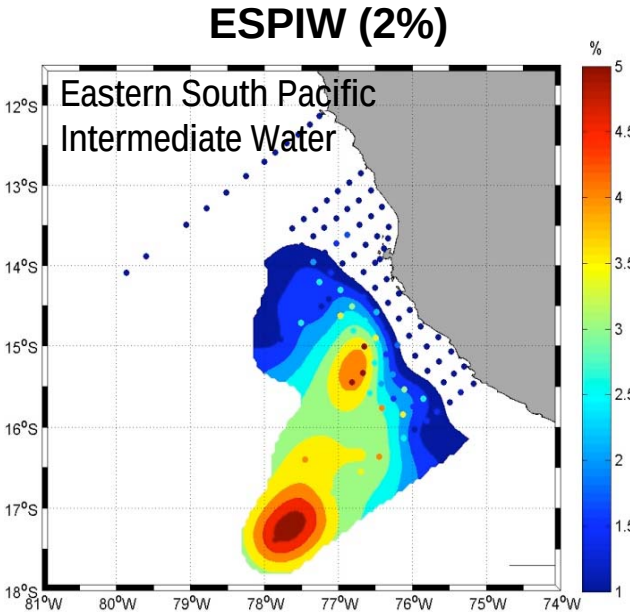


- Volumes occupied by the water masses

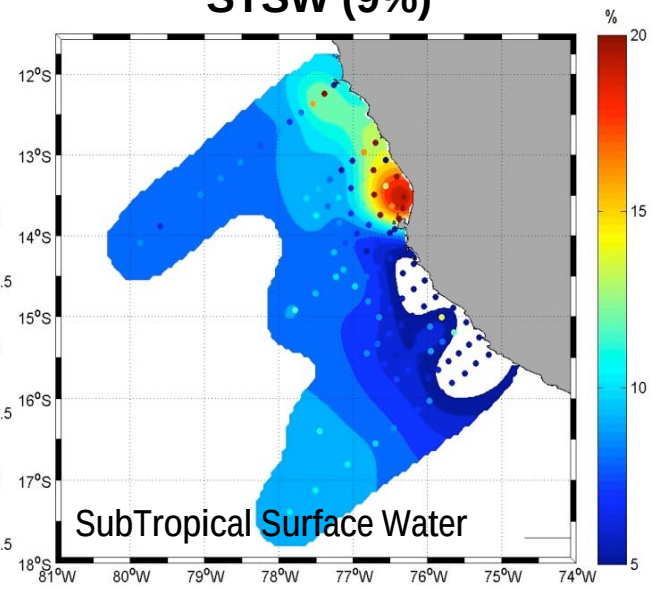
CCW (3%)



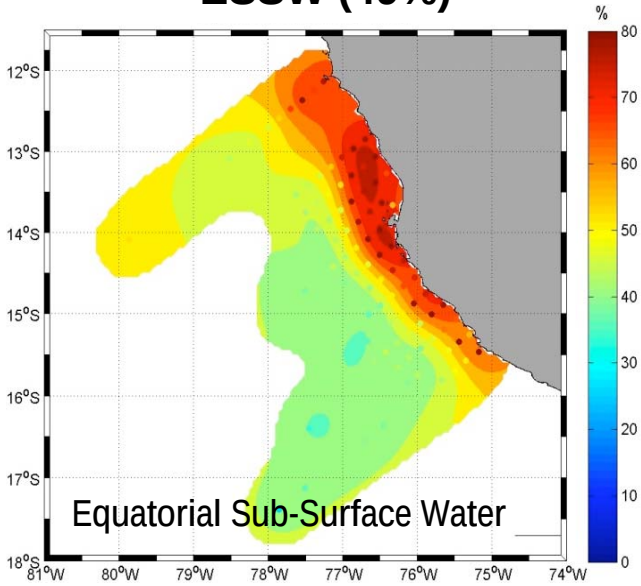
ESPIW (2%)



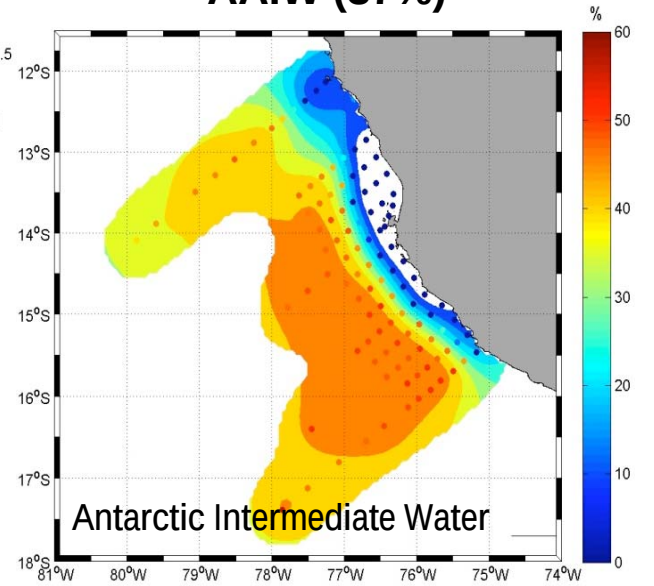
STSW (9%)



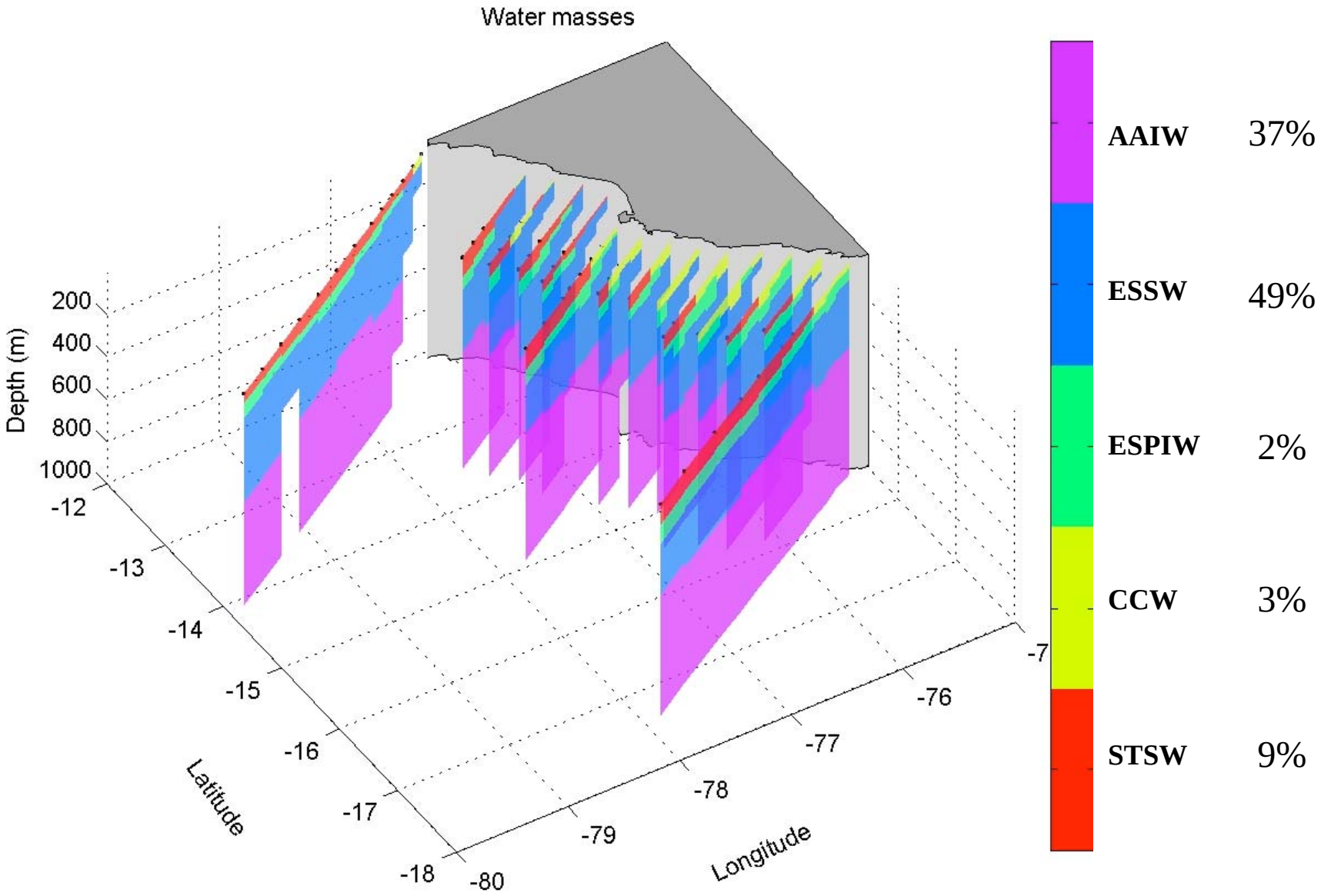
ESSW (49%)



AAIW (37%)



- Volumes occupied by the 5 water masses



IV. Conclusions

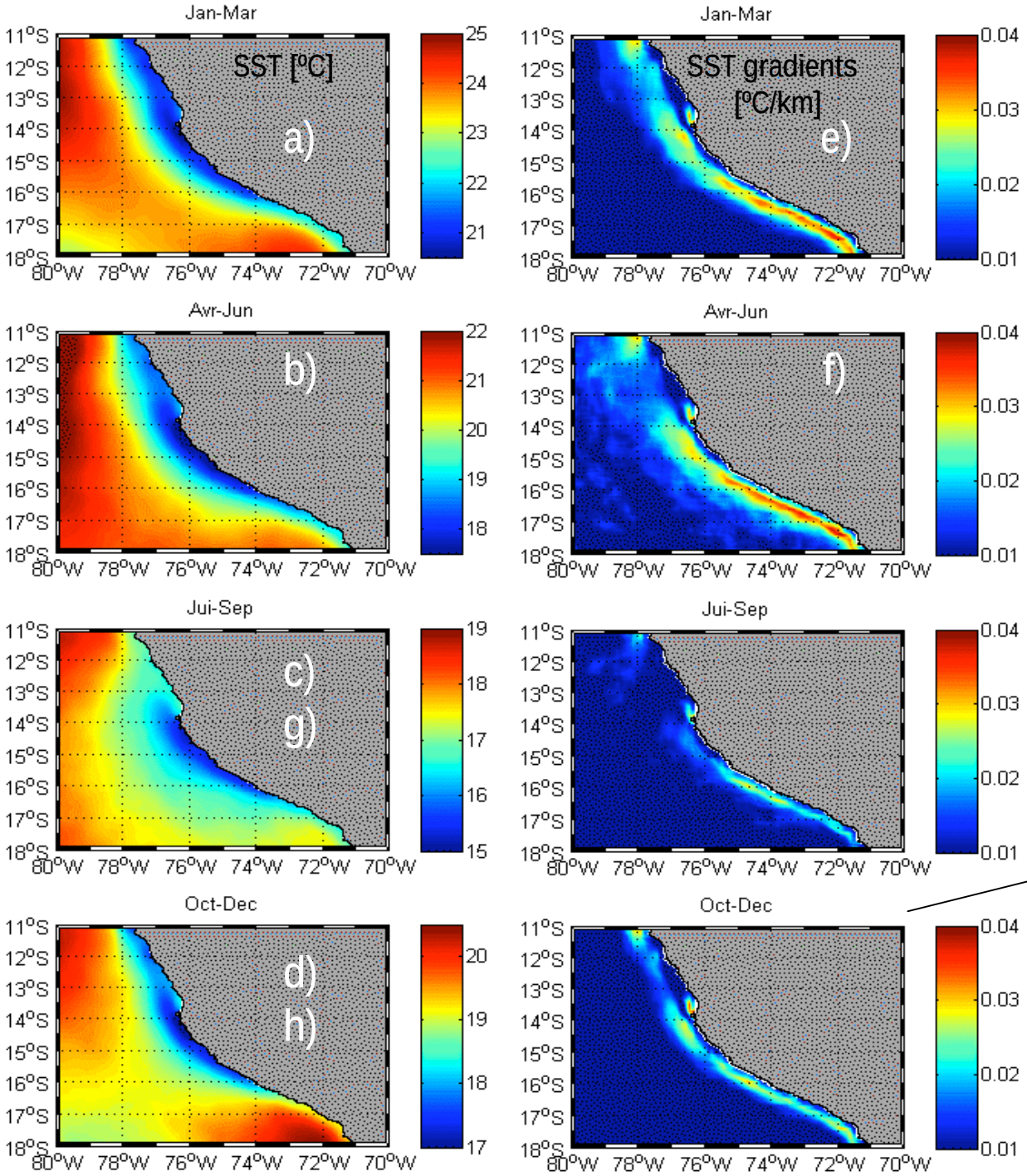
- Neutral to “La Niña-like” conditions characterized the coastal ocean off the western coasts of Southamerica in October 2008. Particularly, the VOCALS-Peru cruise was realized in an “upwelling-favourable regime” (upwelling Kelvin wave + intense winds).
- The upwelling cell of Pisco-San Juan presents a strong seasonality in temperature (Δ=6ºC), much lesser in salinity.
- Five water masses were identified (STSW, CCW, ESPIW, ESSW, AAIW) and present very distinctive properties, volumes, and distribution.

V. Perspectives

- Document the relationship between the water masses and biogeochemical/fishery data during the VOCALS Peru cruise.
- Study the low- and high-frequency variability of water masses properties (in situ and glider data, respectively).
- Document on the dynamics and transformation of the ESPIW and CCW.

Structure and Variability of the upwelling front off Pisco

Seasonal distribution of (a-d) SST [ºC] and (e-h) SST gradients [ºC/km]

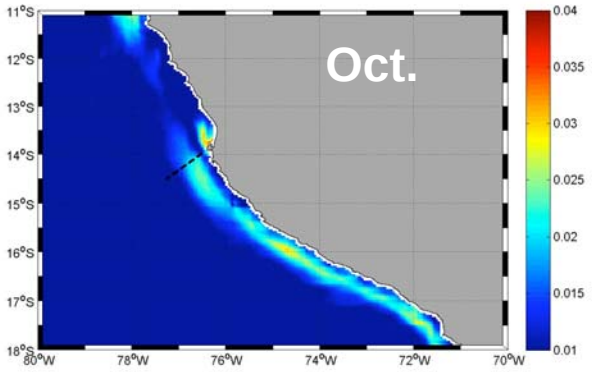


Data:

- *282* monthly images of AVHRR Pathfinder SST v5 for Jan.1985 – Jun.2008 from PODAAC,
- glider data (VOCALS REx- R/V Jose Olaya).

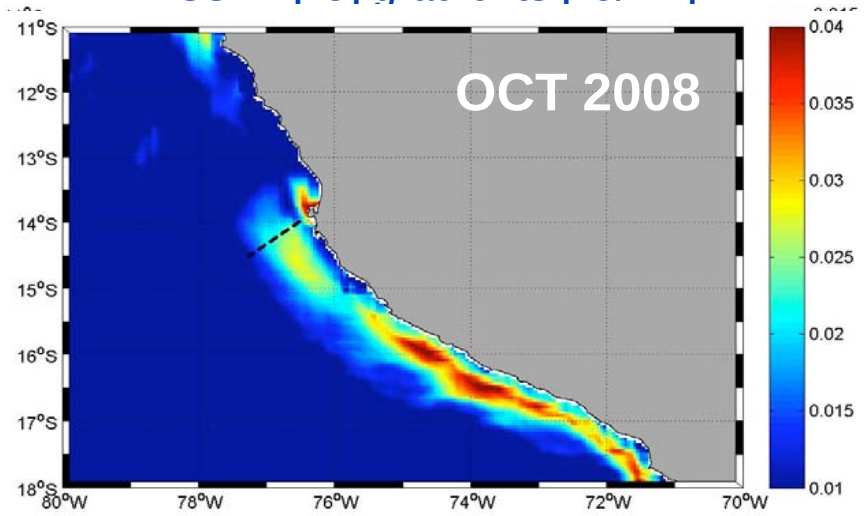
Study area: 70°-80°W, 11°-18°S de latitude, résolution de 16 km2.

Methods: DINEOF method [Alvera-Azcárate et al, 2004] for data reconstruction and interpolation and [Shimada et al, 2006; Atae-Allah et al, 2001] for frontal zones determination.

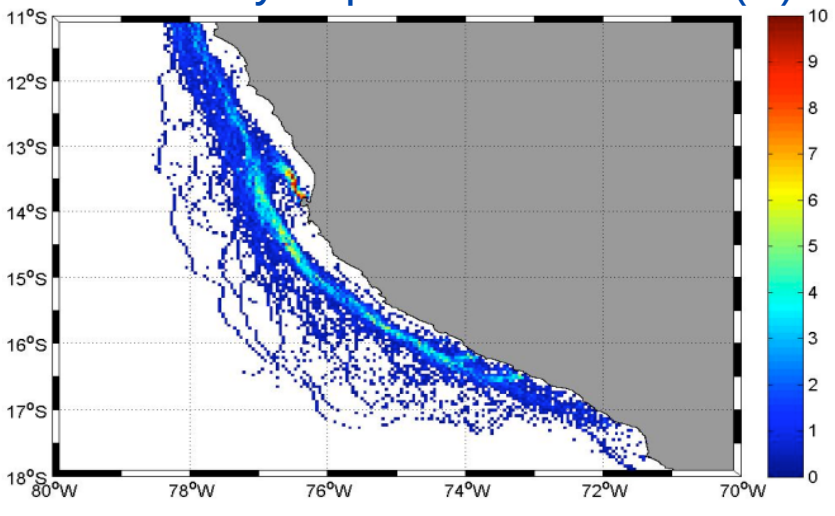


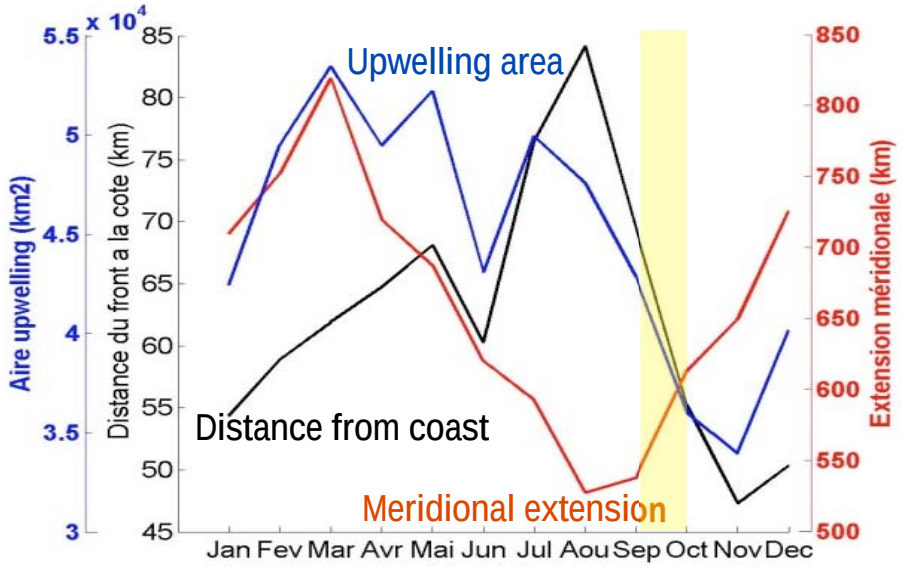
Seasonal cycle of the upwelling front – Some characteristics

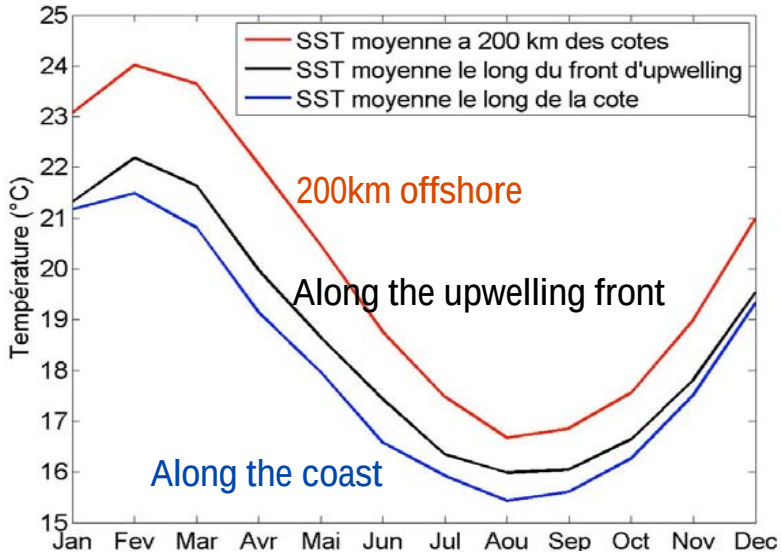
SSTA [ºC] gradients [ºC/km]



Probability map of front ocurrence (%)





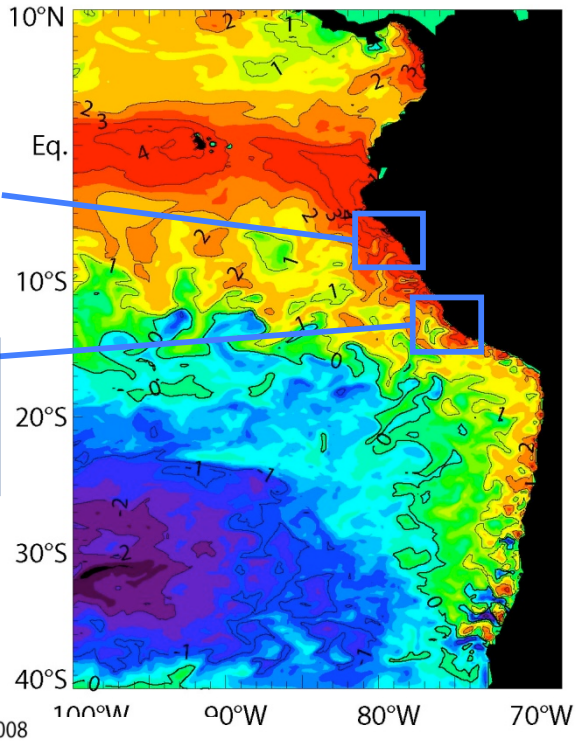


Model configuration (ROMS 1/6°)

Open Boundary conditions:

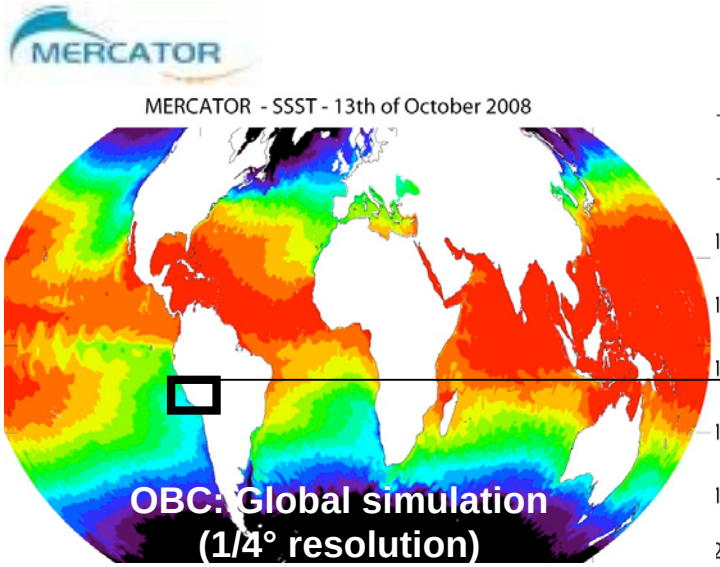
- Mercator (2007- 2008)
- Wind stress forcing/QuickSCAT
- Heat-flux: Bulk + ERA40

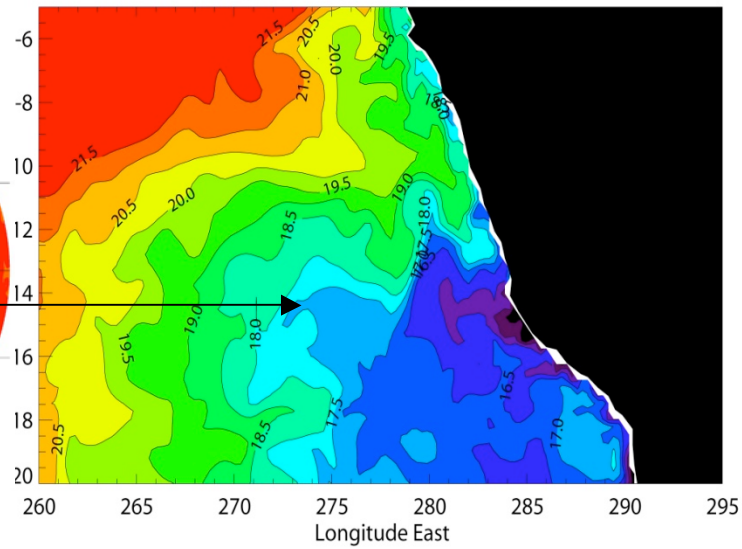
Model domain



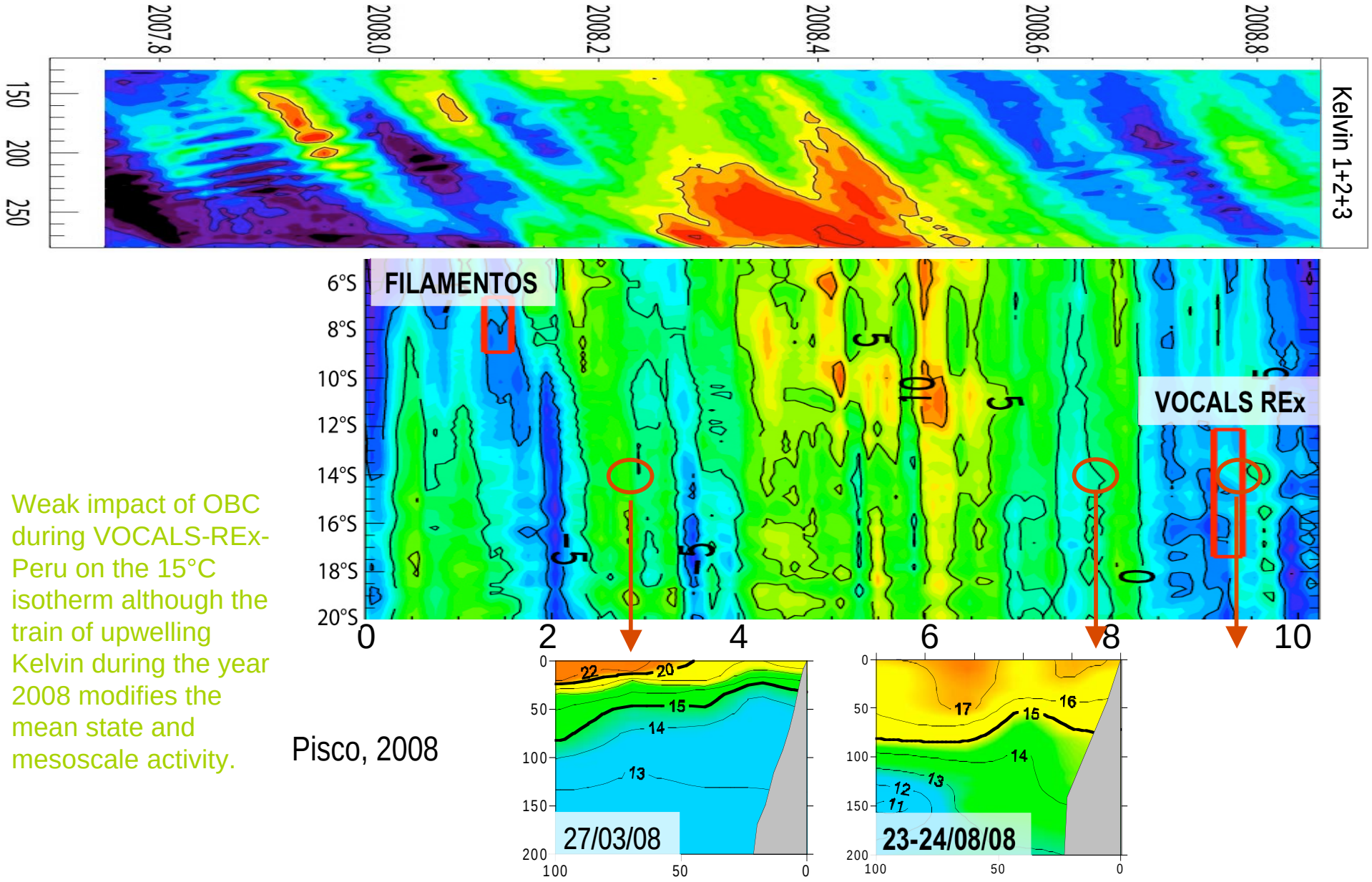
"FILAMENTOS"
Chicama, 7S
Feb, 05-20, 2008

"VOCALS REx-Peru"
Pisco 13S-San Juan 15S
Oct, 03-17, 2008





a) Kelvin wave contribution (Oct. 1, 2007-Nov.06,2008) in Mercator, b) Simulated SLA (cm) along the coast (0-50km) (from Jan. 01-Nov.06, 2008) - (ROMS 1/6°), c) temperature (ºC) cross-shelf sections off Pisco during 2008.



Weak impact of OBC during VOCALS-REx-Peru on the 15°C isotherm although the train of upwelling Kelvin during the year 2008 modifies the mean state and mesoscale activity.

Pisco, 2008