

VOCALS All-Hands Science Meeting

Arica, Chile, November 6/7, 2008



The VOCALS-Peru Cruise Progress Report

RV Jose Olaya Cr. 2008-10

Carmen Grados (IMARPE) and the VOCALS-Peru Team



OUTLINE

- I. Hypotheses and VOCALS-Peru Work Packages**
- II. Study Region :**
 - 2.1. Mean Conditions in October**
 - 2.2. The regional climate setting in 2008**
- III. VOCALS-Peru Cruise observations**
- IV. Conclusions**



I.

Hypotheses and VOCALS-Peru Work Packages

I. HYPOTHESES

VOCALS-Peru is devoted to better understand air-sea-land-cloud interactions at a regional scale in southern Peru and their impacts on the local ecosystem.

H1: There is a strong feedback/interaction between the variability of the atmospheric coastal wind, the upwelling cell and the associated thermic front and cloud clearing between Pisco and San Juan.

H2: There is a strong interaction between oceanic physical structures and biogeochemical/fish community structures and distribution.

Work Packages

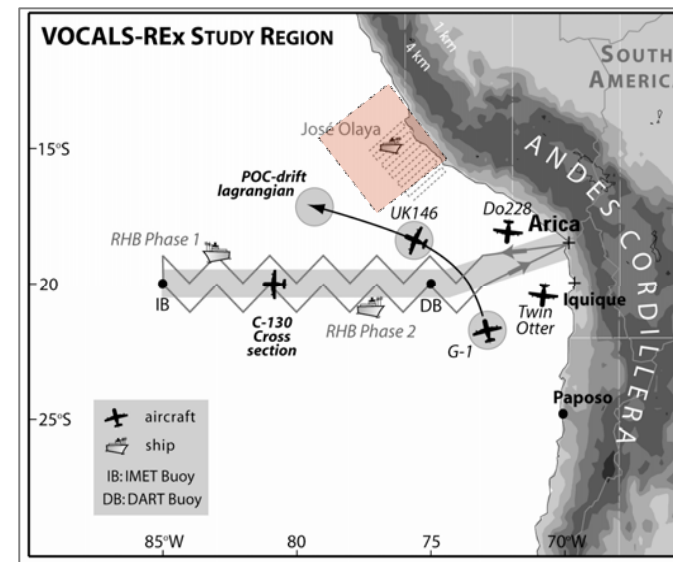
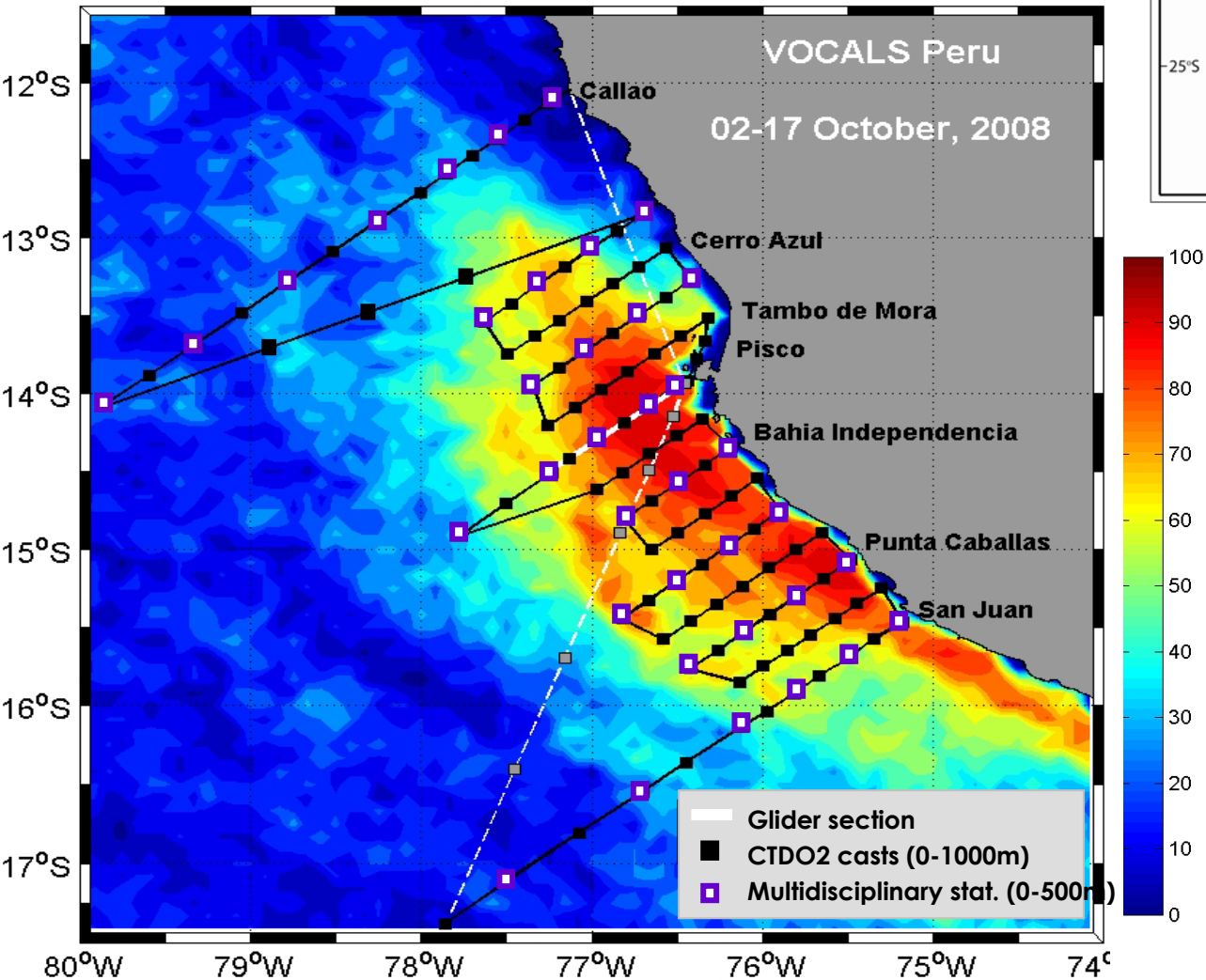
- WP 1 – Atmosphere: Coastal Wind Jet Structure and Cloud Clearing**
- WP 2 – Physical and Biogeochemical characteristics of the upwelling cell (plume and front)**
- WP 3 – Biological properties: Community structures, interface fluxes and Fish distribution**
- WP 4 – Ocean/atmosphere interactions and biological response**

II. Study Region :

2.1. Mean Conditions in October

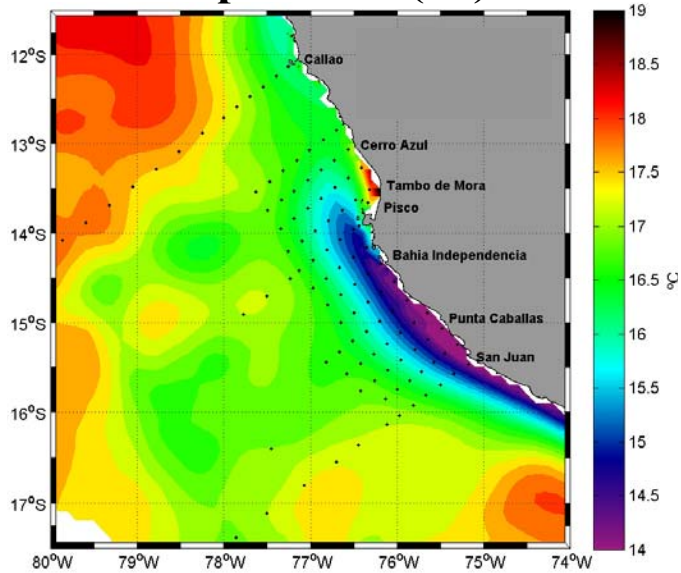
2.2. The regional climate setting in 2008

II. Study region: Survey track and stations, beneath, the mean average of total fraction of cloud clearing area (%) for October, as obtained from SeaWiFS data

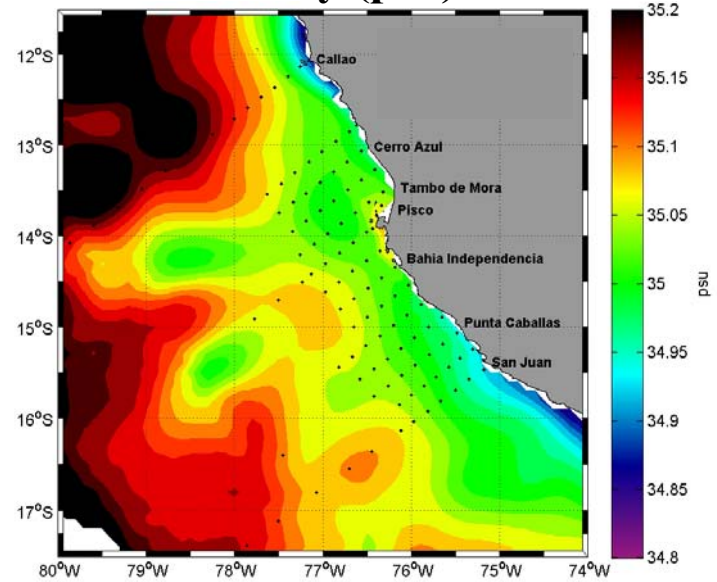


NHCS Climatology at sea surface for October

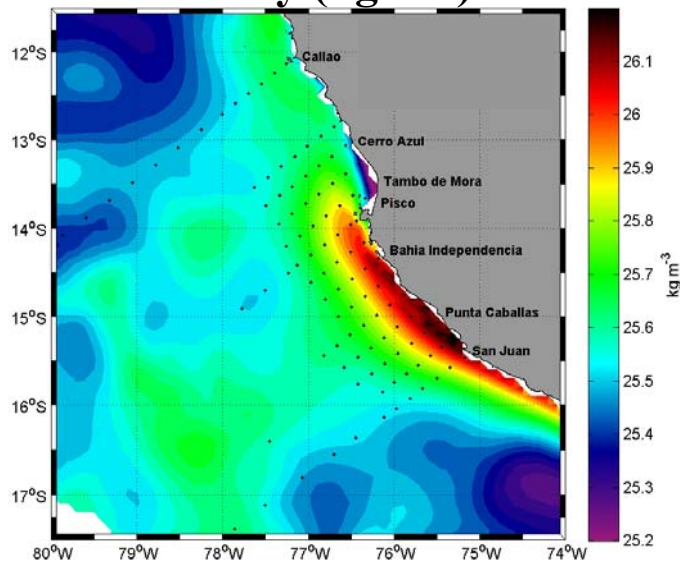
Temperature ($^{\circ}\text{C}$)



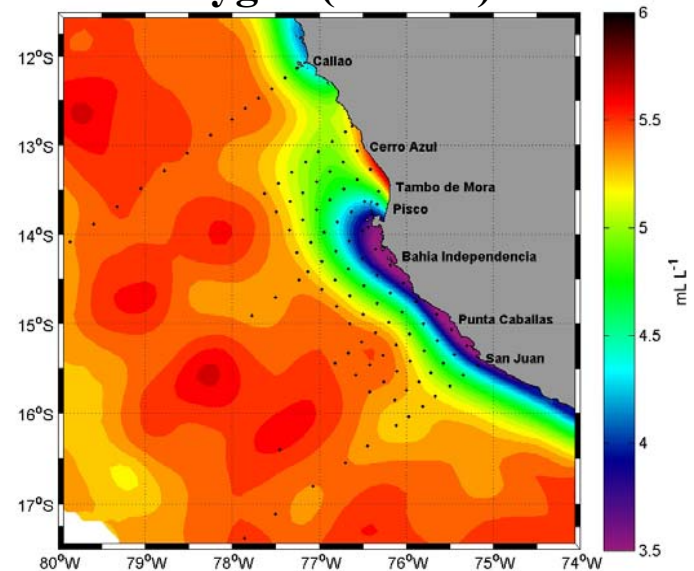
Salinity (psu)



Density (kg m^{-3})

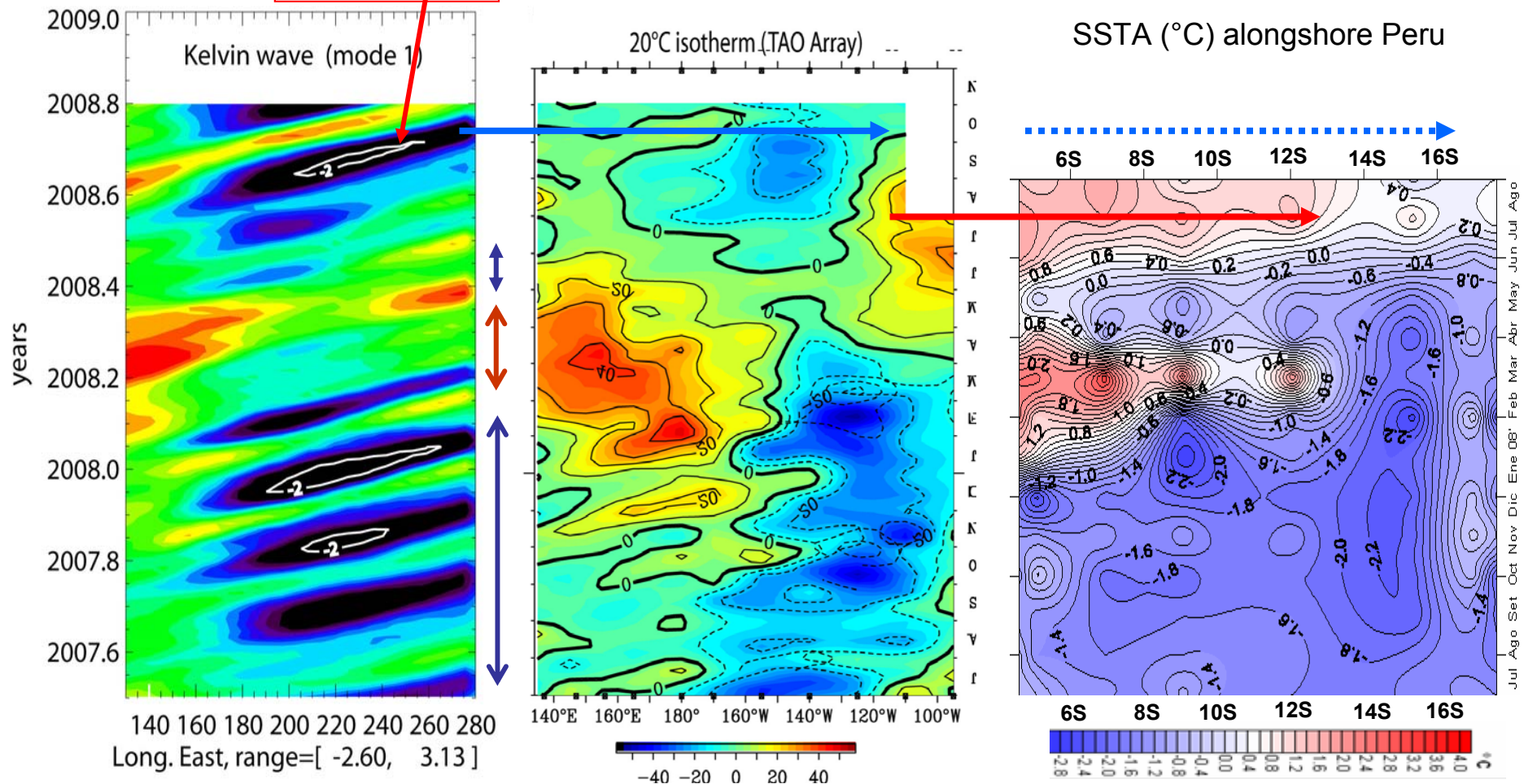


Oxygen (mL L^{-1})



Synoptic oceanic conditions: Presence of an upwelling equatorial Kelvin wave during the cruise

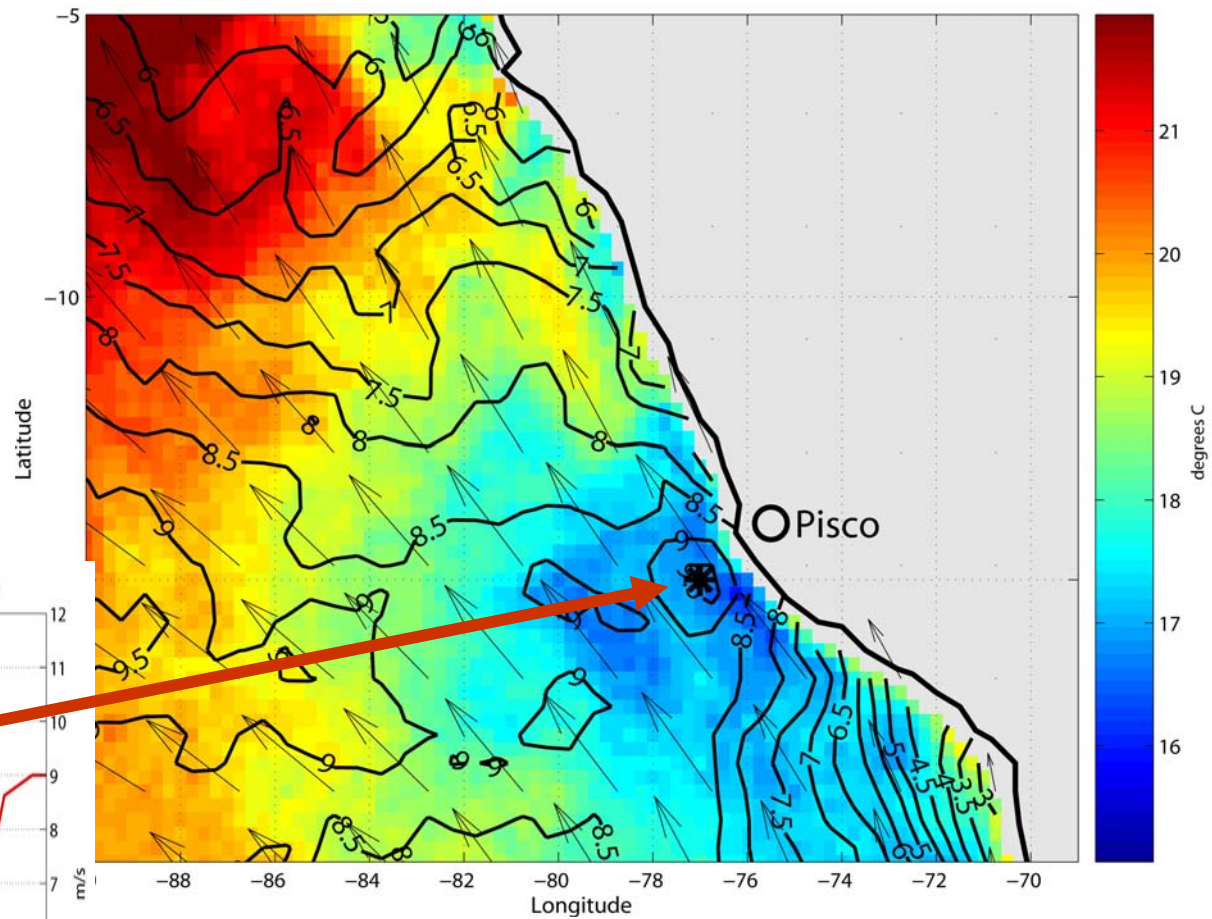
VOCALS-REx



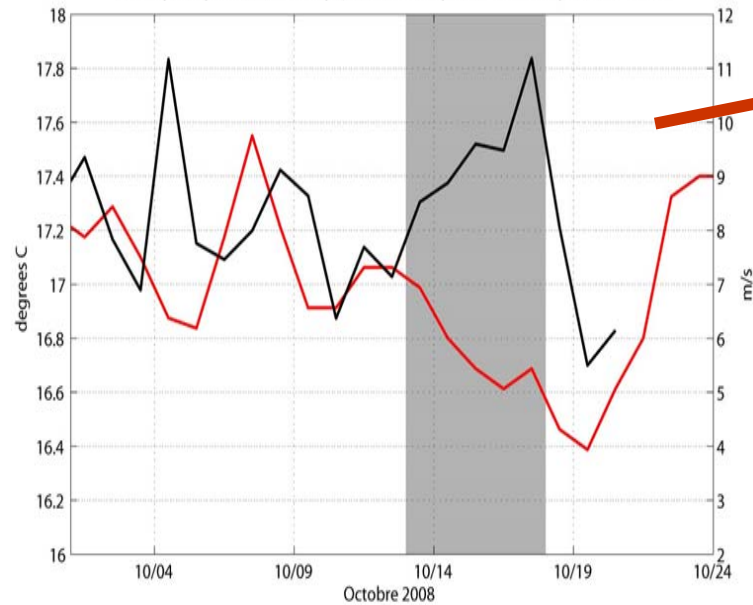
Equatorial Kelvin wave (in cm) as estimated by a linear model forced by QuickSCAT winds (baroclinic mode 1)

20°C isotherm variation during the same period (from the TAO array)

Mean SST (TMI) and Wind (QuickSCAT) between 13th–18th October 2008



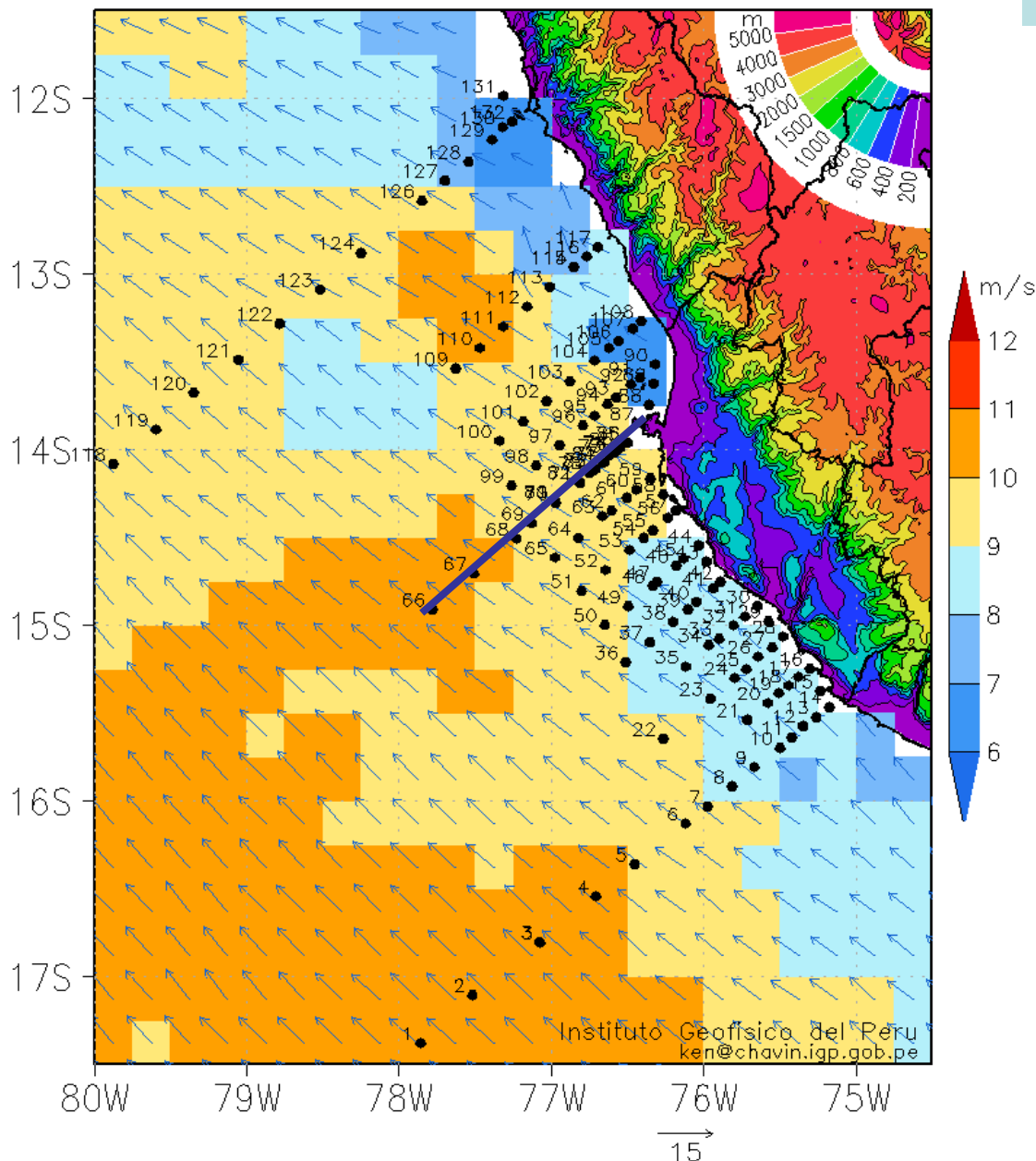
SST (TMI) and Wind (QuickSCAT) timeseries, 77W–15S



III.

VOCALS Peru Cruise Observations

VOCALS-Rex Peru (Oct 5-17, 2008)
 Radiosounding locations with topography (m) and mean
 QuikScat winds (m/s) for Oct 5-18, 2008

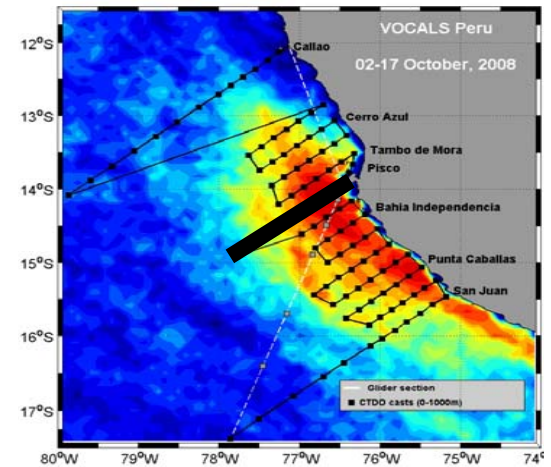
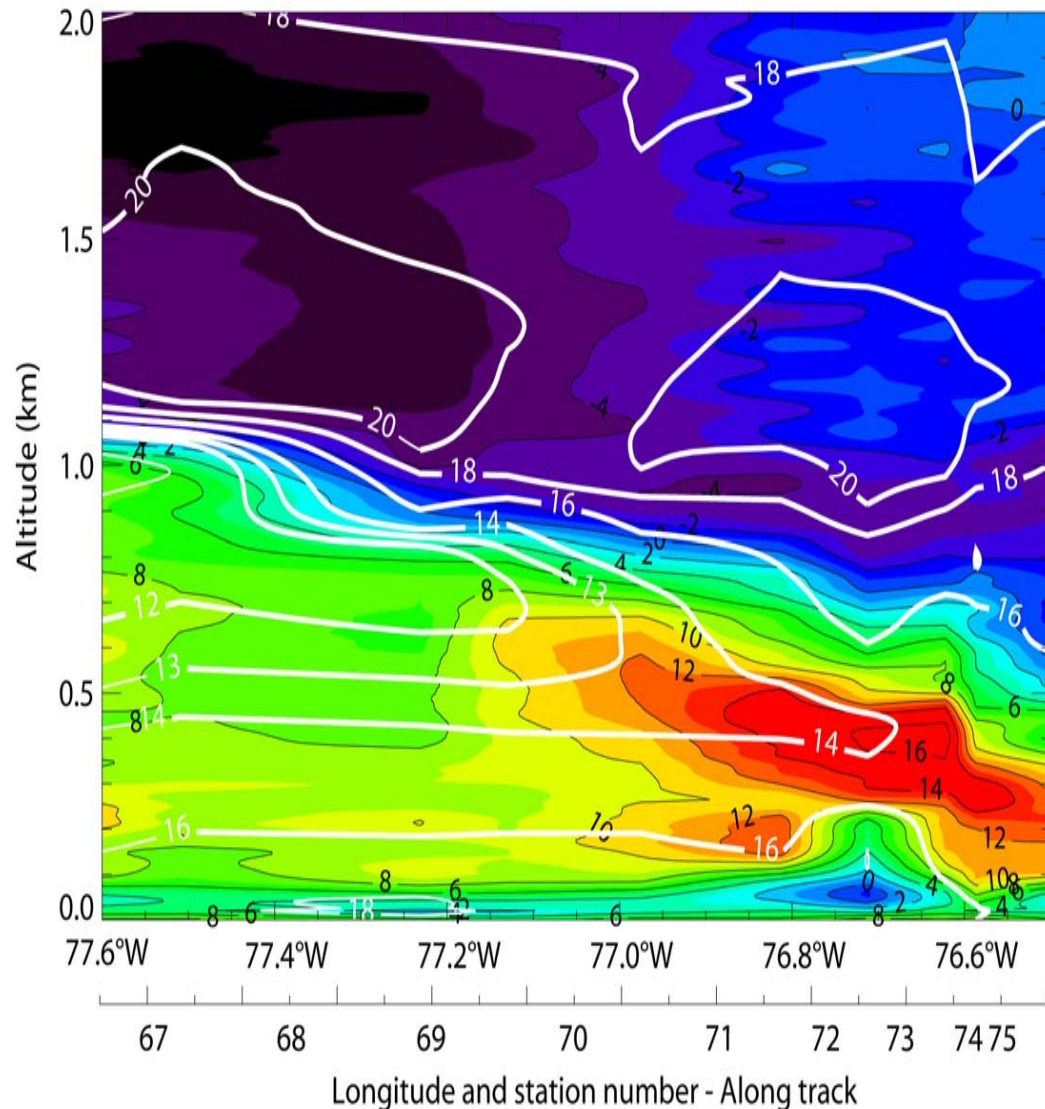


Radiosonde data

- 131 out of 132 successful launches
- Of these, 60% reached above 15 km, all reached above 5 km.
- 60% were launched within 3 hour intervals to achieve high horizontal resolution (~10 km) near the coast and sample the diurnal cycle

Vertical structure of air temperature and along-shore winds (Pisco)

Section Pisco - Wind (m/s) and Temperature ($^{\circ}\text{C}$)



Temperature Inversion
Zone

« Coastal Jet »

Characteristics of the marine PBL

Some preliminary observations:

- Strong thermal inversions were typical ($\Delta\theta \sim 10$ K) but in other cases they were very eroded.

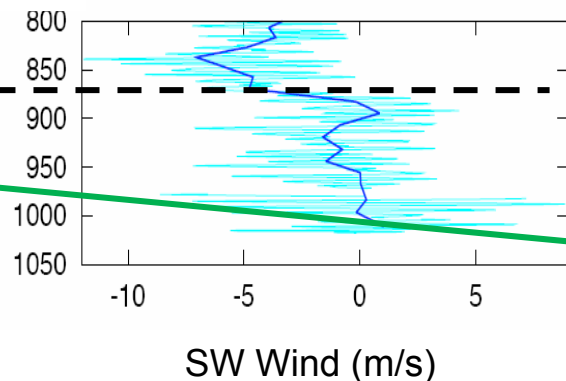
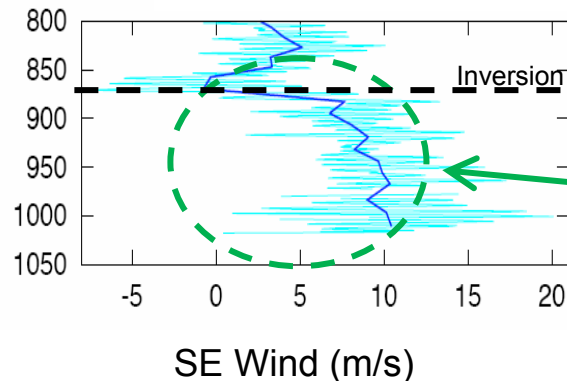
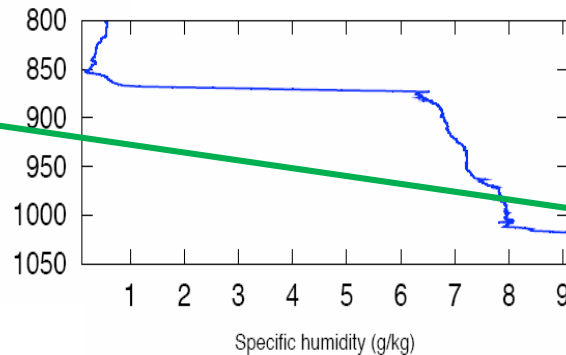
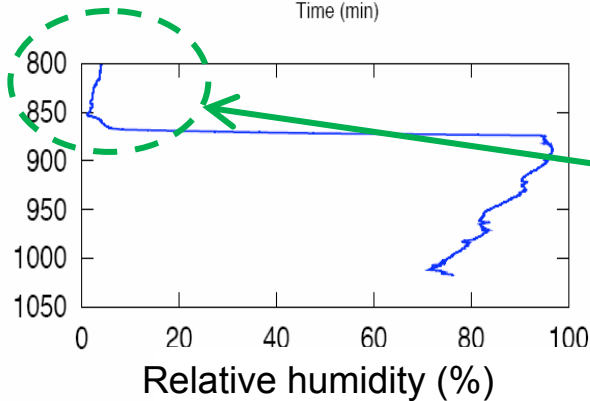
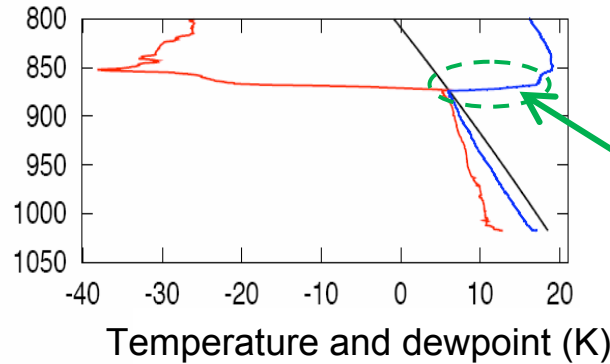
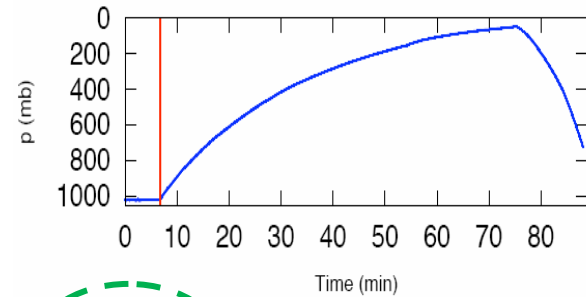
- Inversion levels varied between 870 and 980 hPa.

- Very dry air above the PBL (RH apparently as low as 1%) in many cases, with moist intrusions in others.

- Vigorous turbulent motions apparent in the wind

- Trade-wind jet generally located under the thermal inversion

Station 001: 5/10 12:34, Lat=-17.377, lon=-77.859



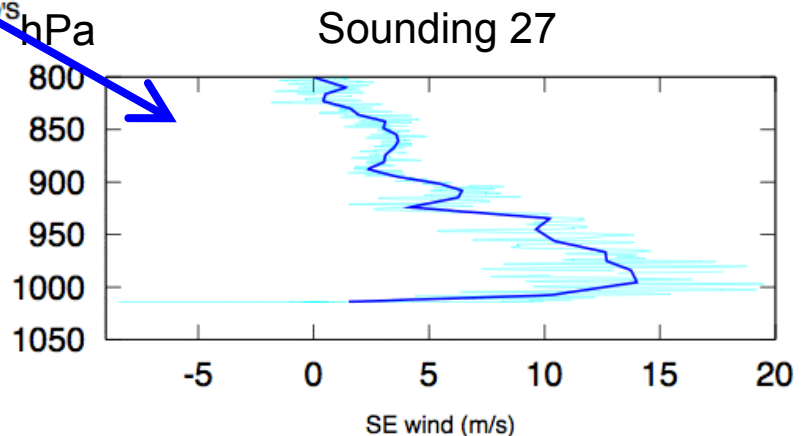
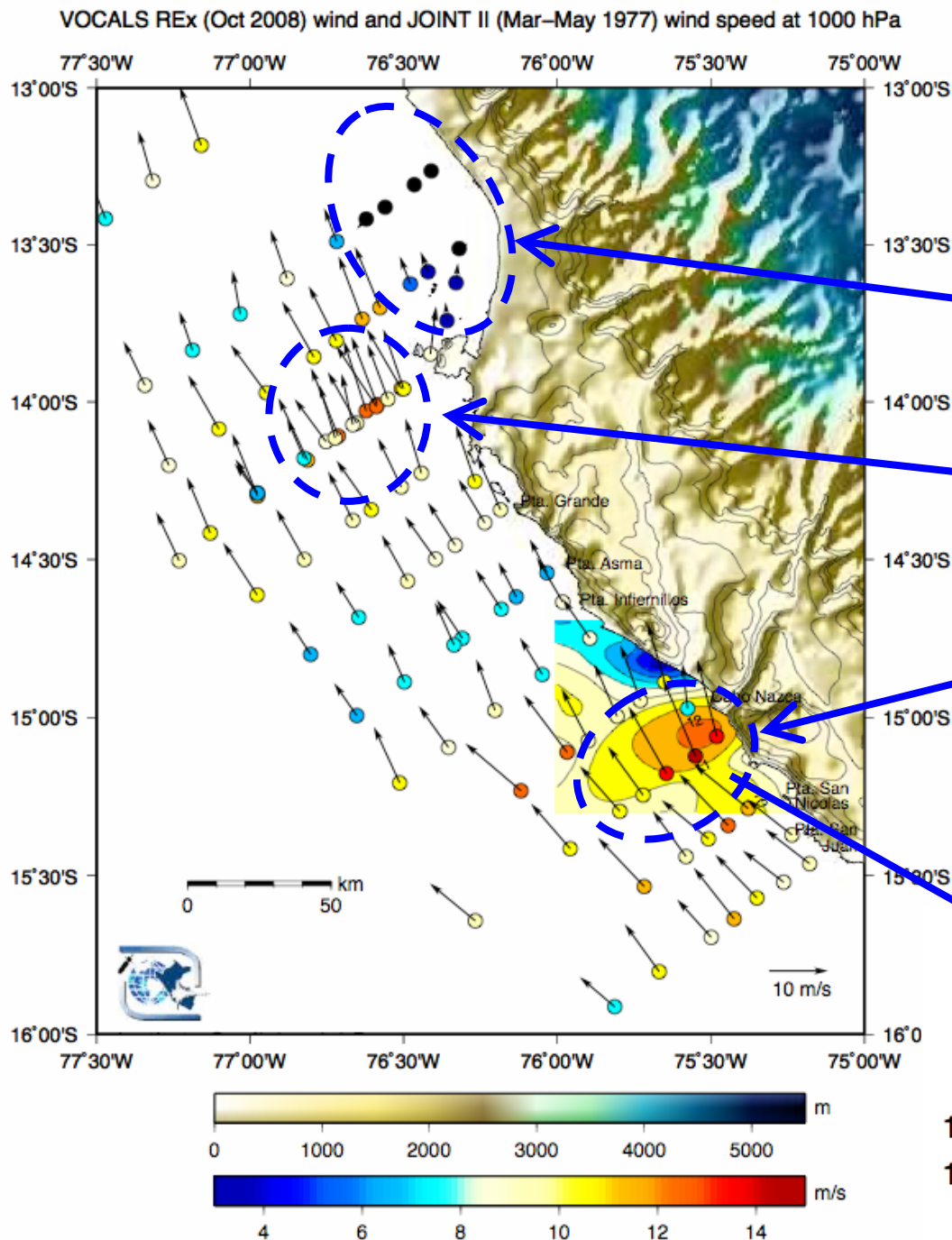
Low-level coastal winds

Some preliminary results

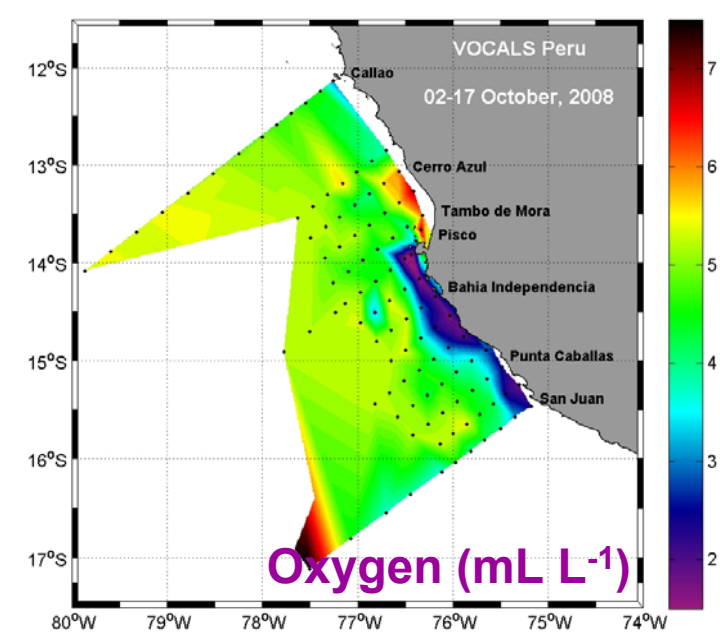
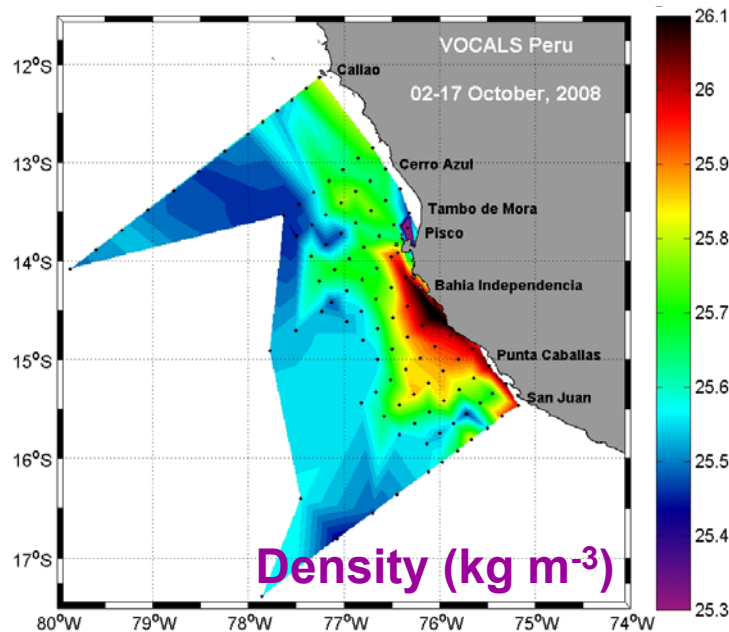
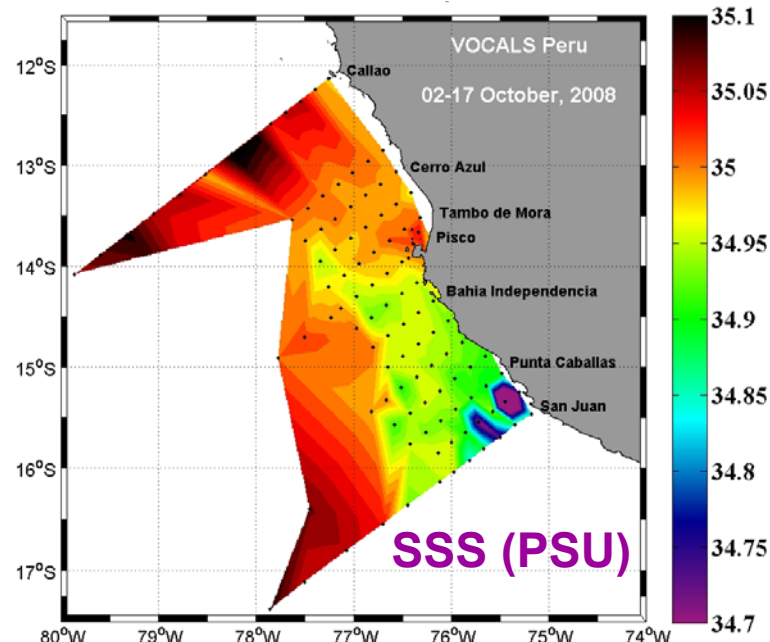
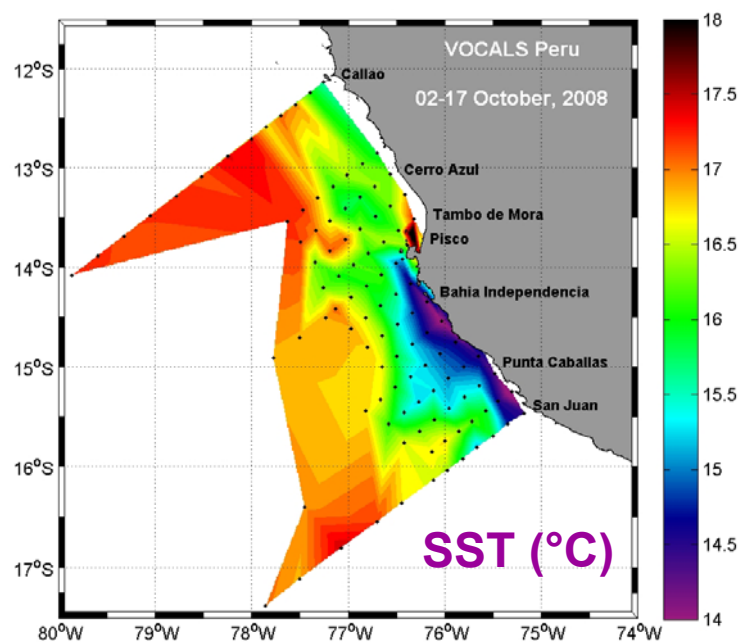
Stagnant flow downstream of Paracas peninsula

Strong wind west of Paracas peninsula, but with strong temporal variability

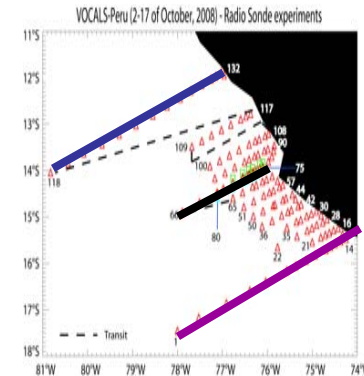
Results consistent with the mesoscale (< 50 km) jet observed in 1976-77 (JOINT II).



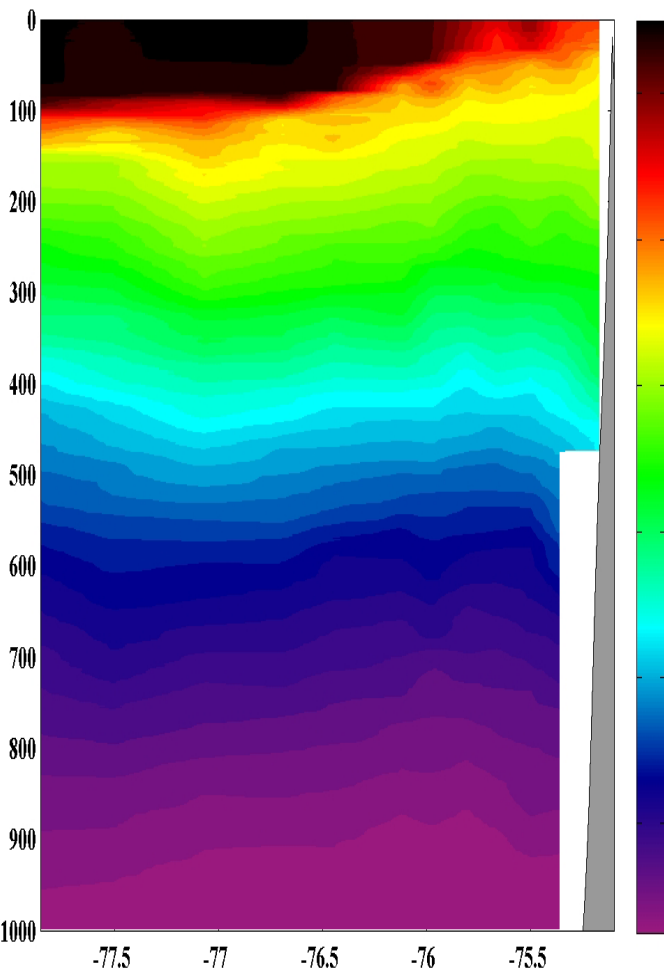
Surface hydrology (CTD data)



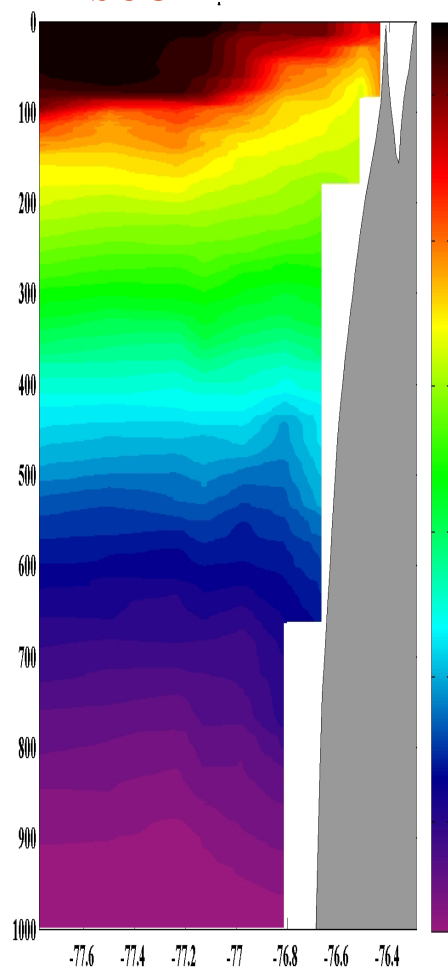
Vertical distribution of temperature (°C) along 3 sections



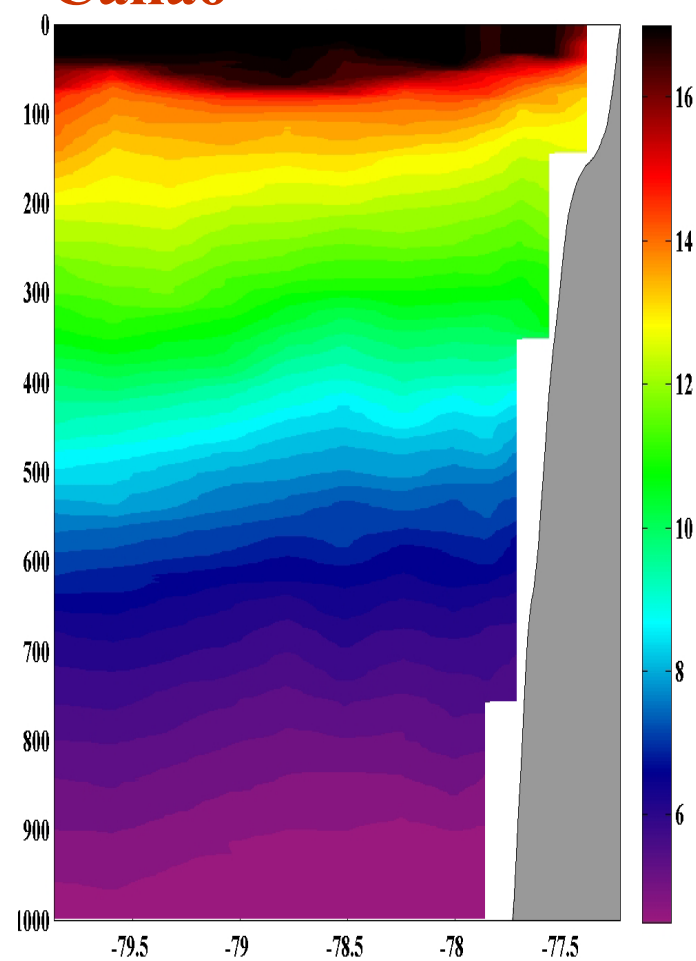
San Juan



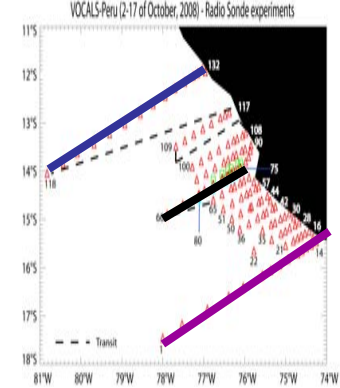
Pisco



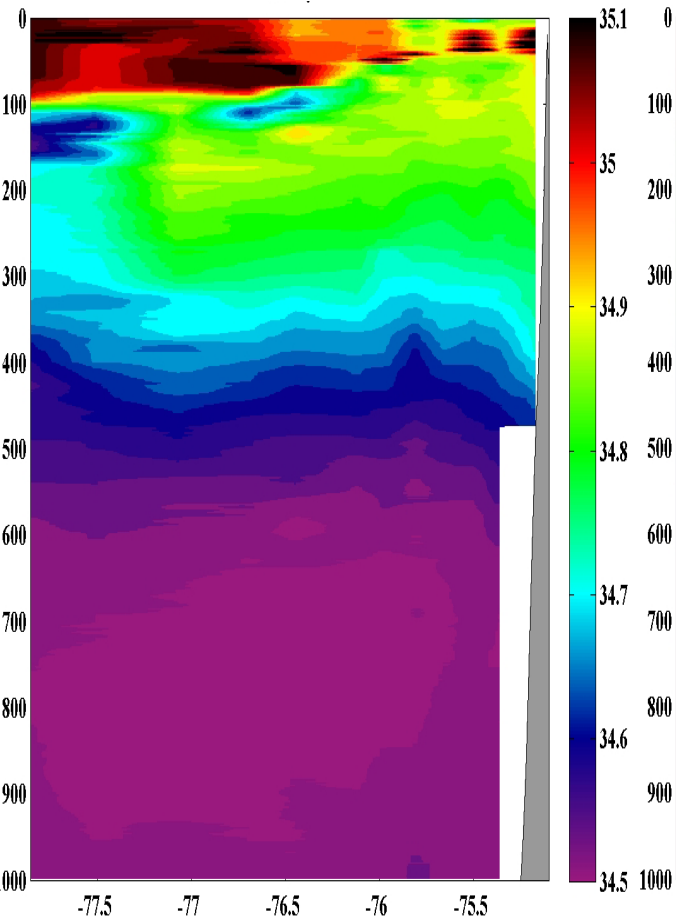
Callao



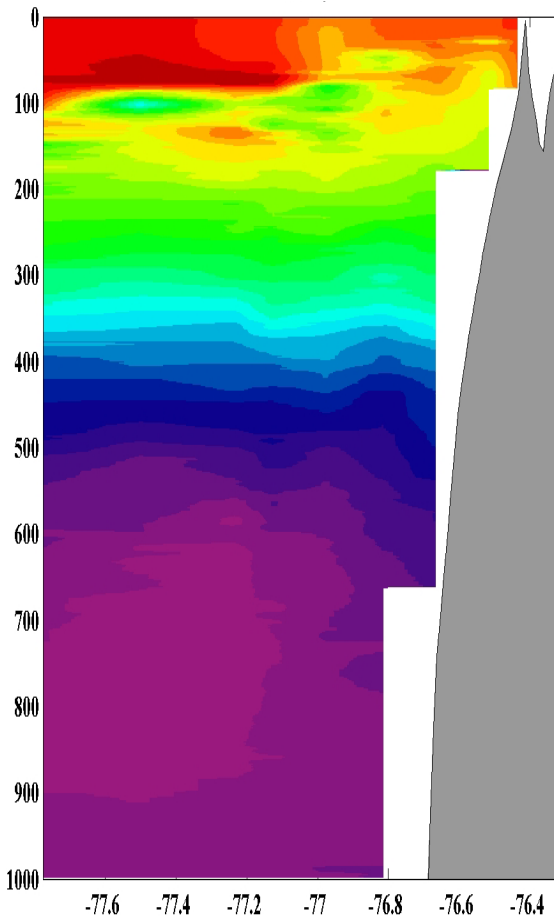
Vertical distribution of salinity (psu) along 3 sections



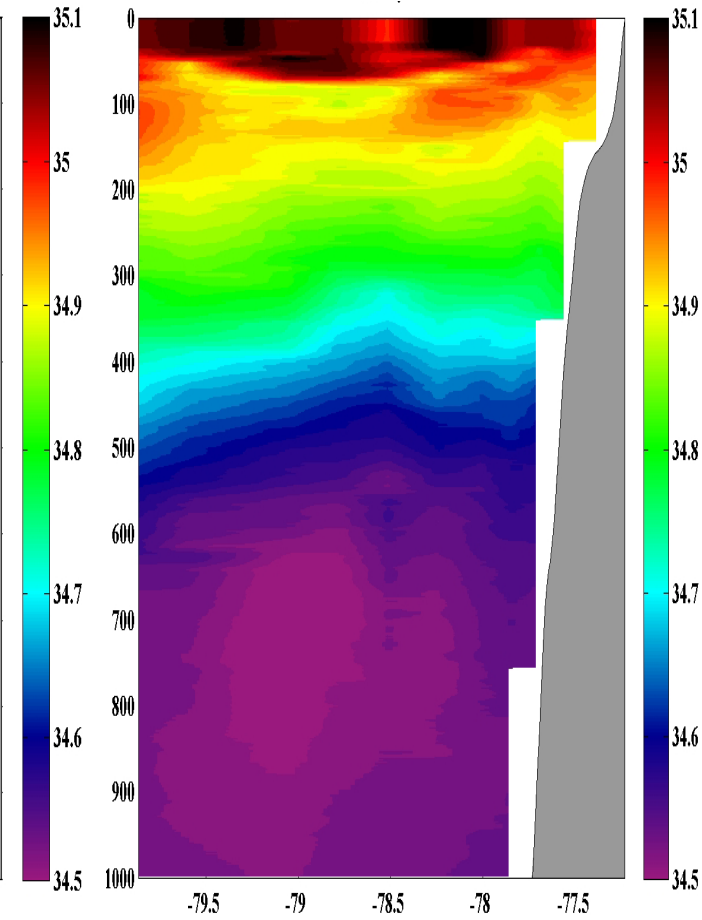
San Juan



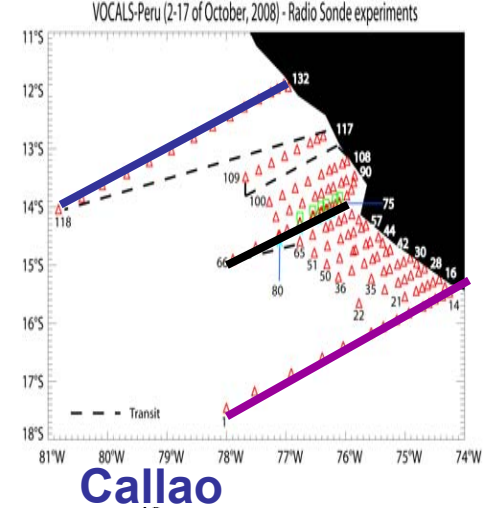
Pisco



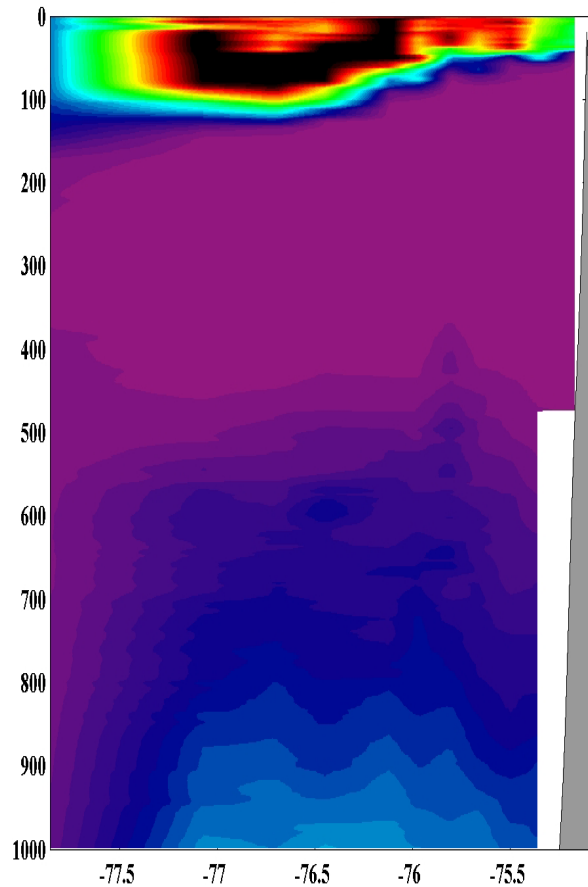
Callao



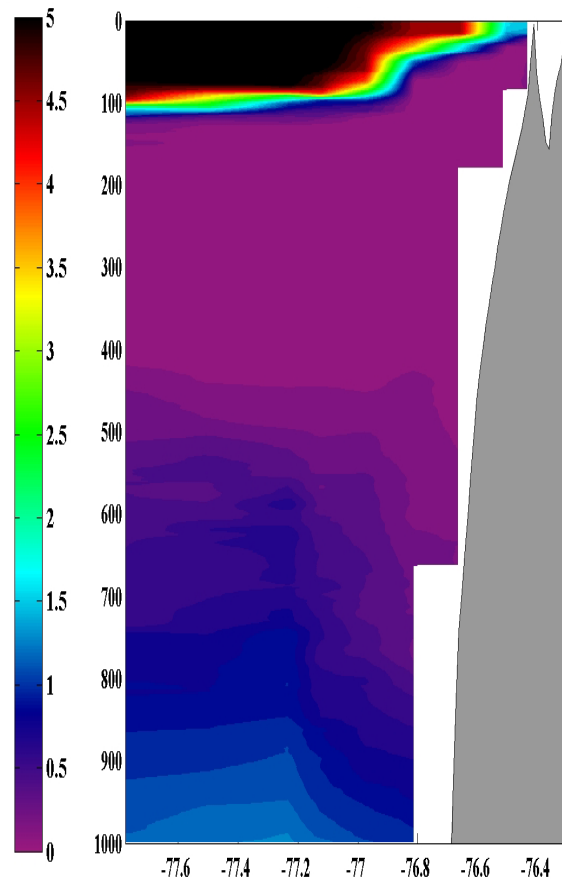
Vertical distribution of oxygen (mL L⁻¹) along 3 sections



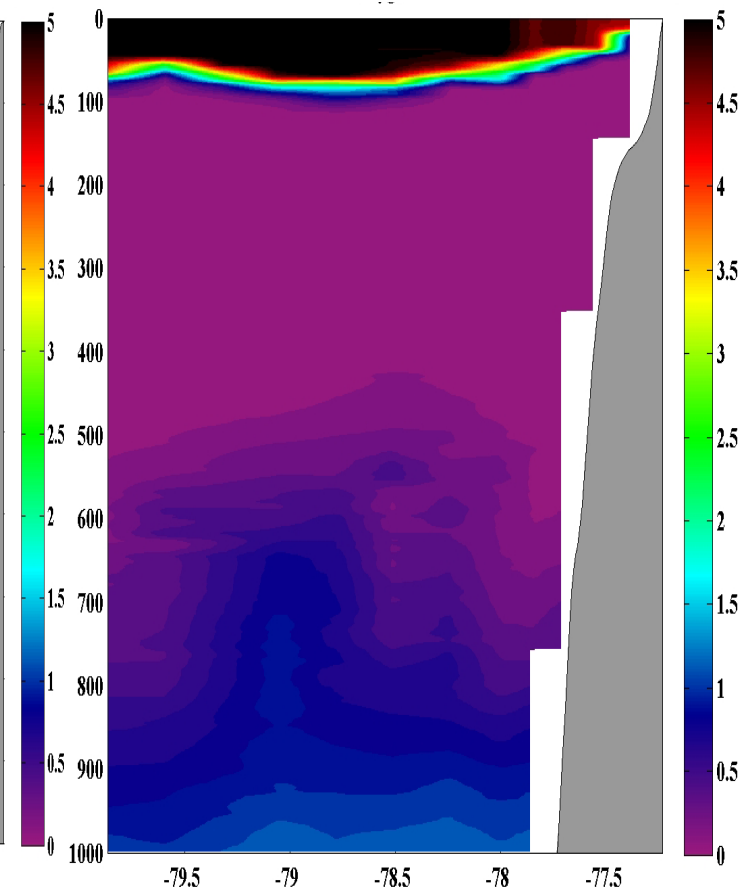
San Juan



Pisco

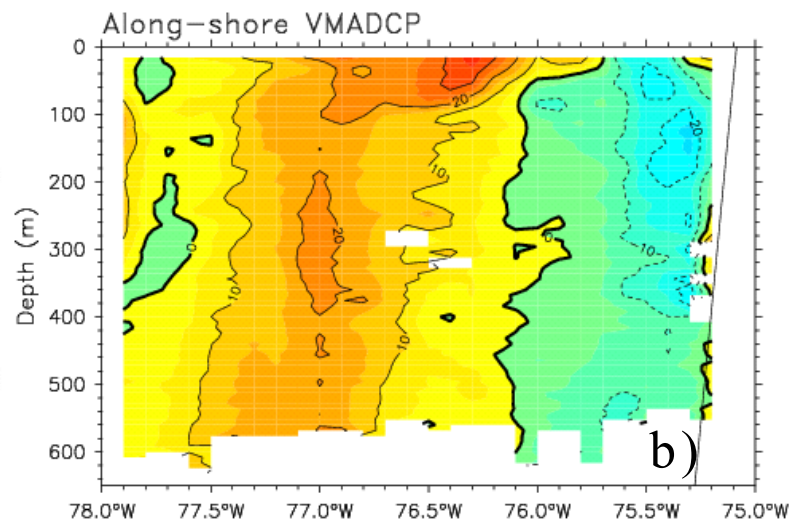
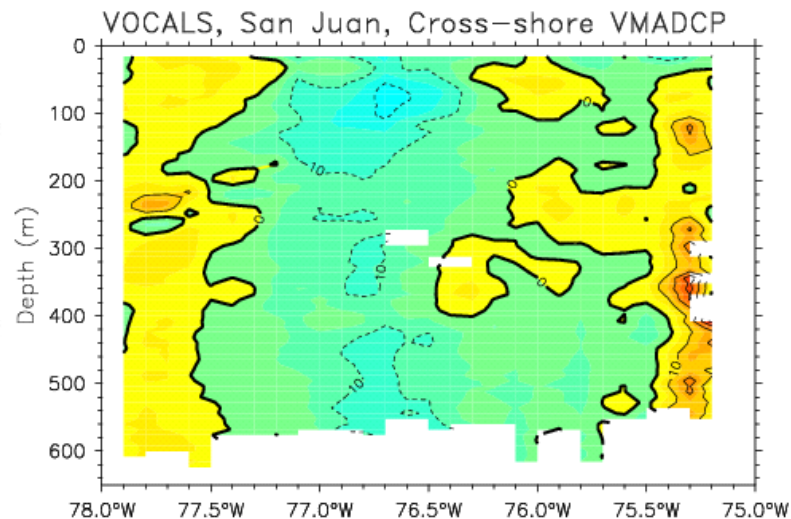
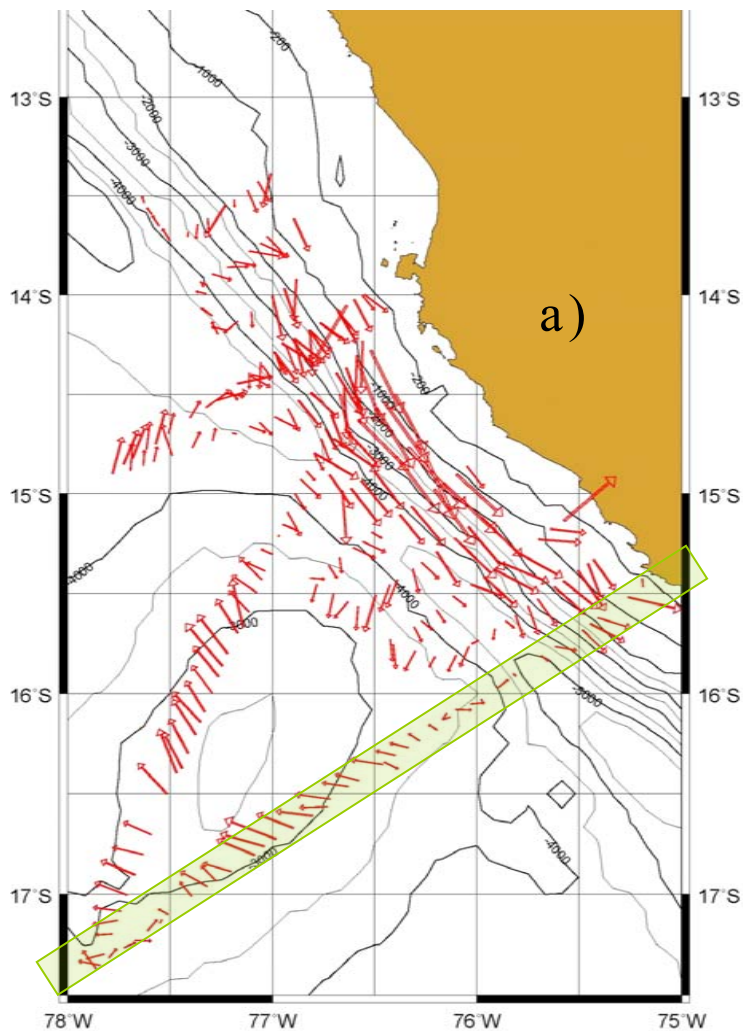


Callao



Currents obtained from ADCP measurements

Vertical Average

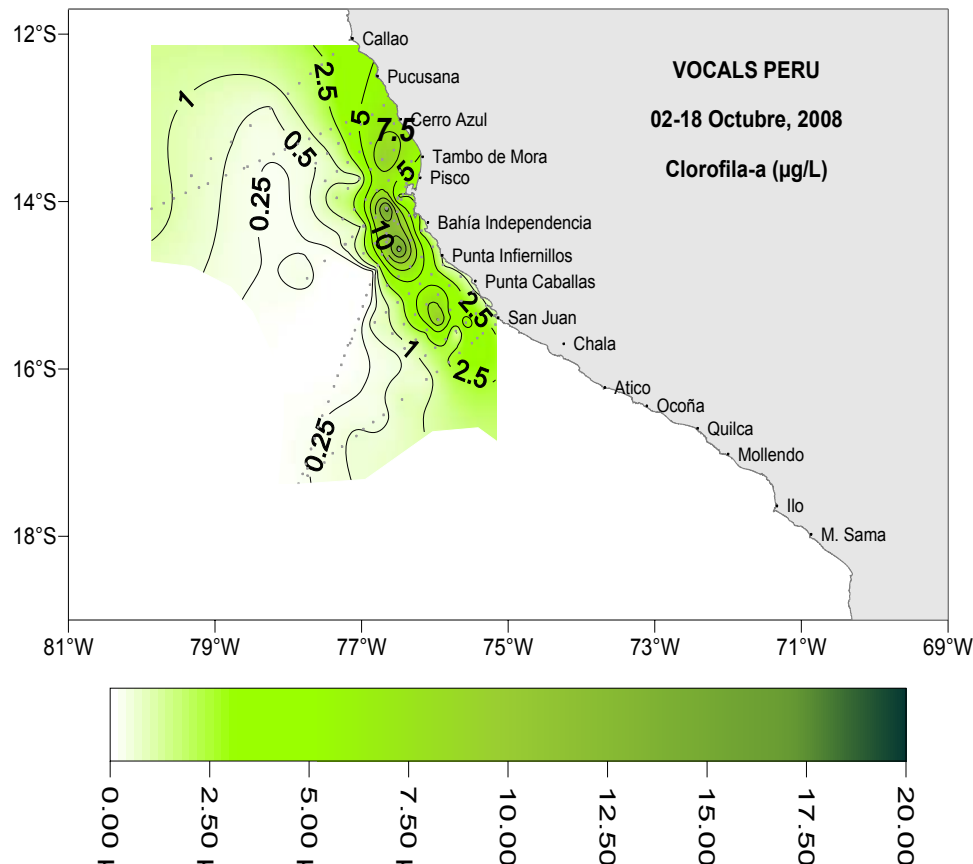


Biological measurements

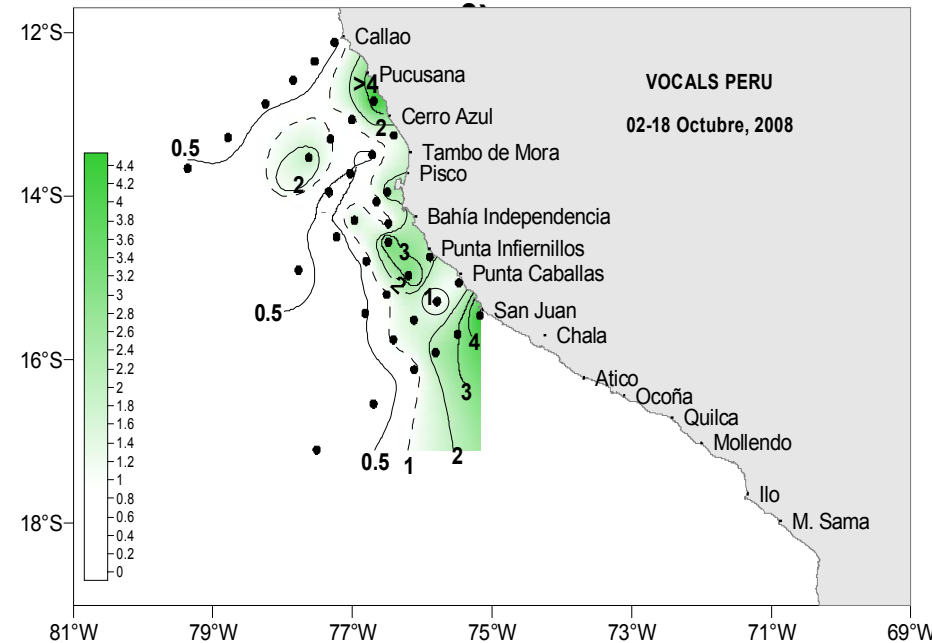
-Chlorophyll-a and Phytoplankton-



Chlorophyll-a ($\mu\text{g L}^{-1}$)



Phytoplankton volumes (mL m^{-3})

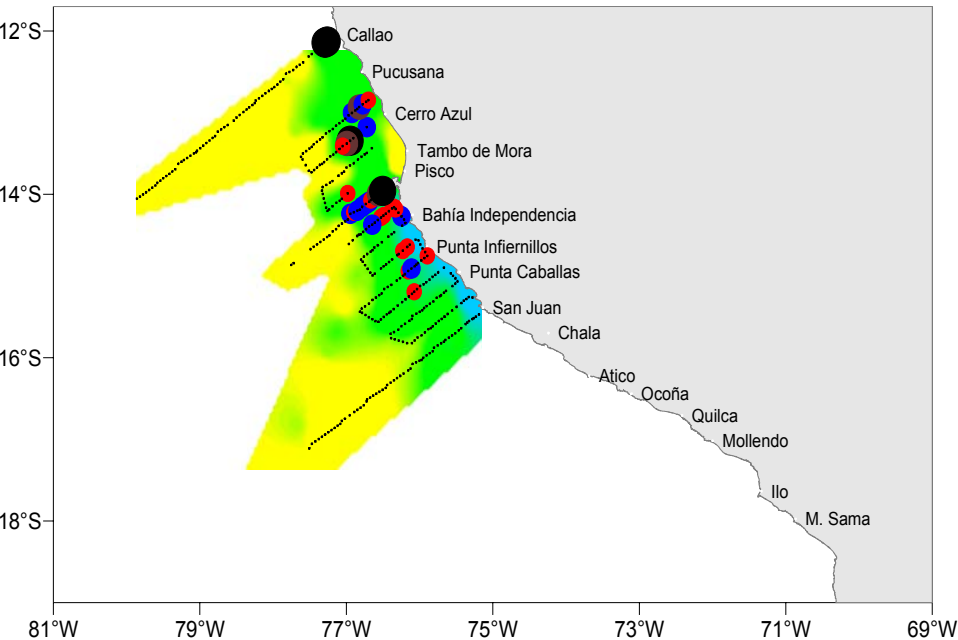


Biological measurements

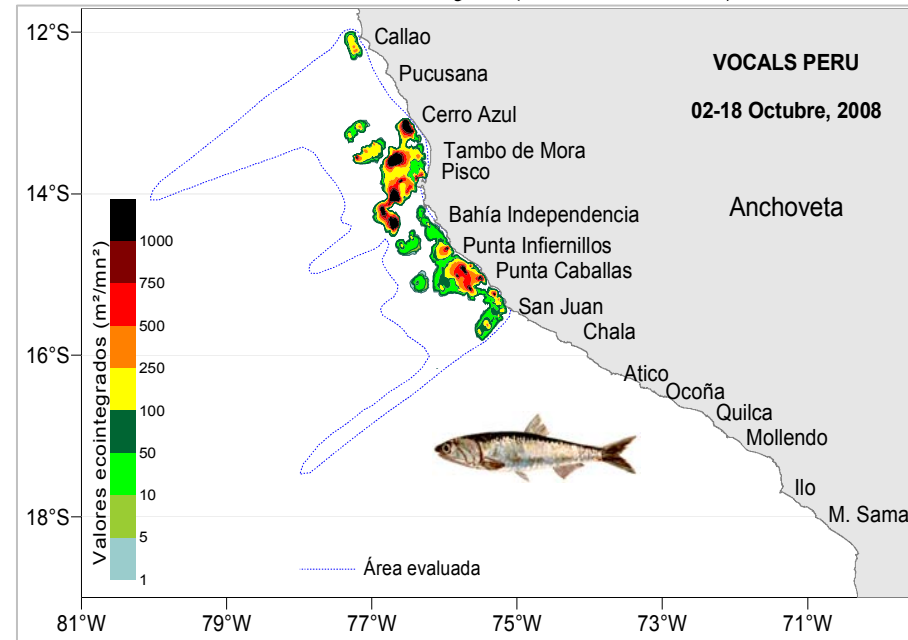
-Anchovy eggs and Fish distributions-



Anchovy eggs (egg m⁻³)



Anchovy (m² nm⁻²)

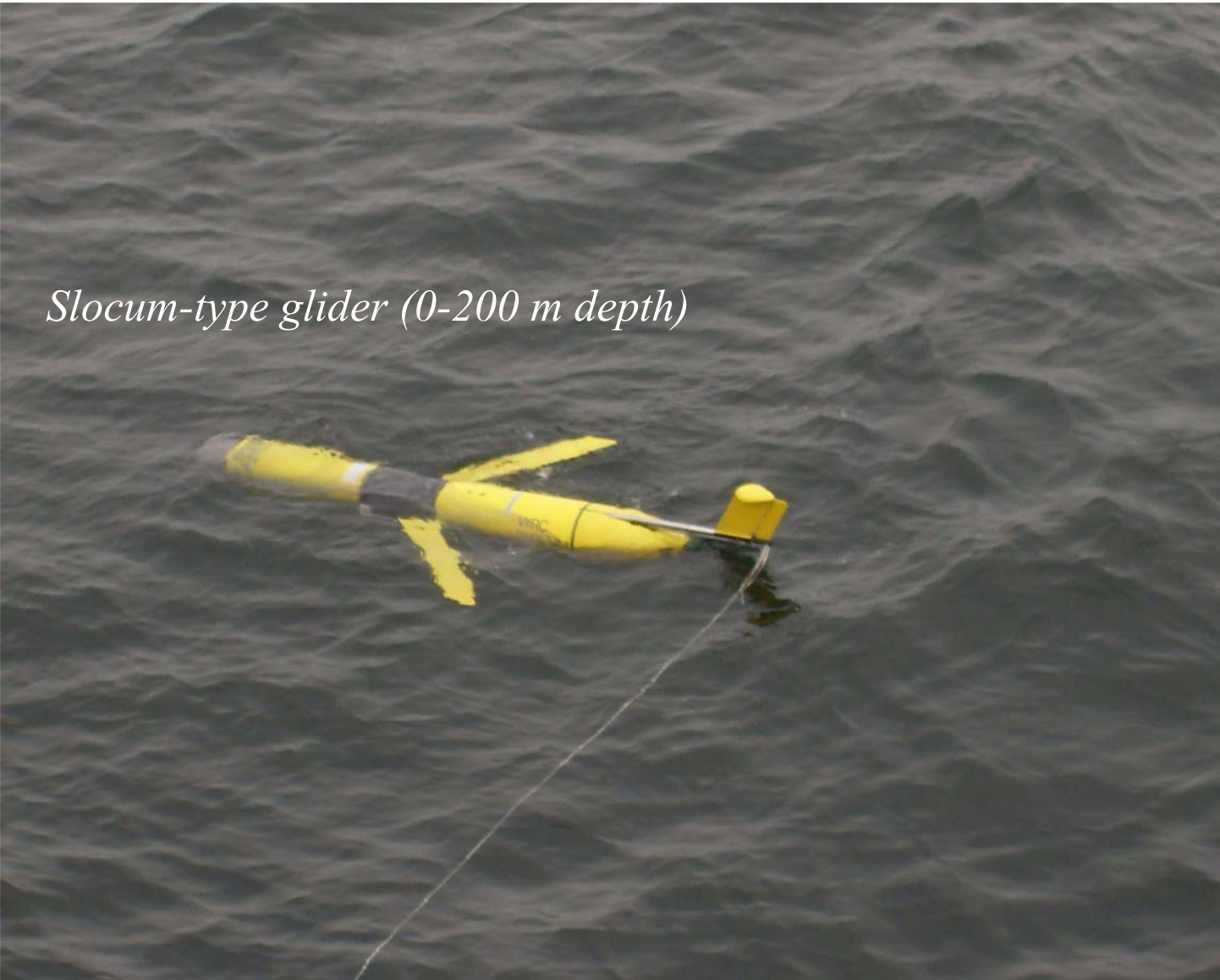


Simrad EK-60 echosounder, 120kHz

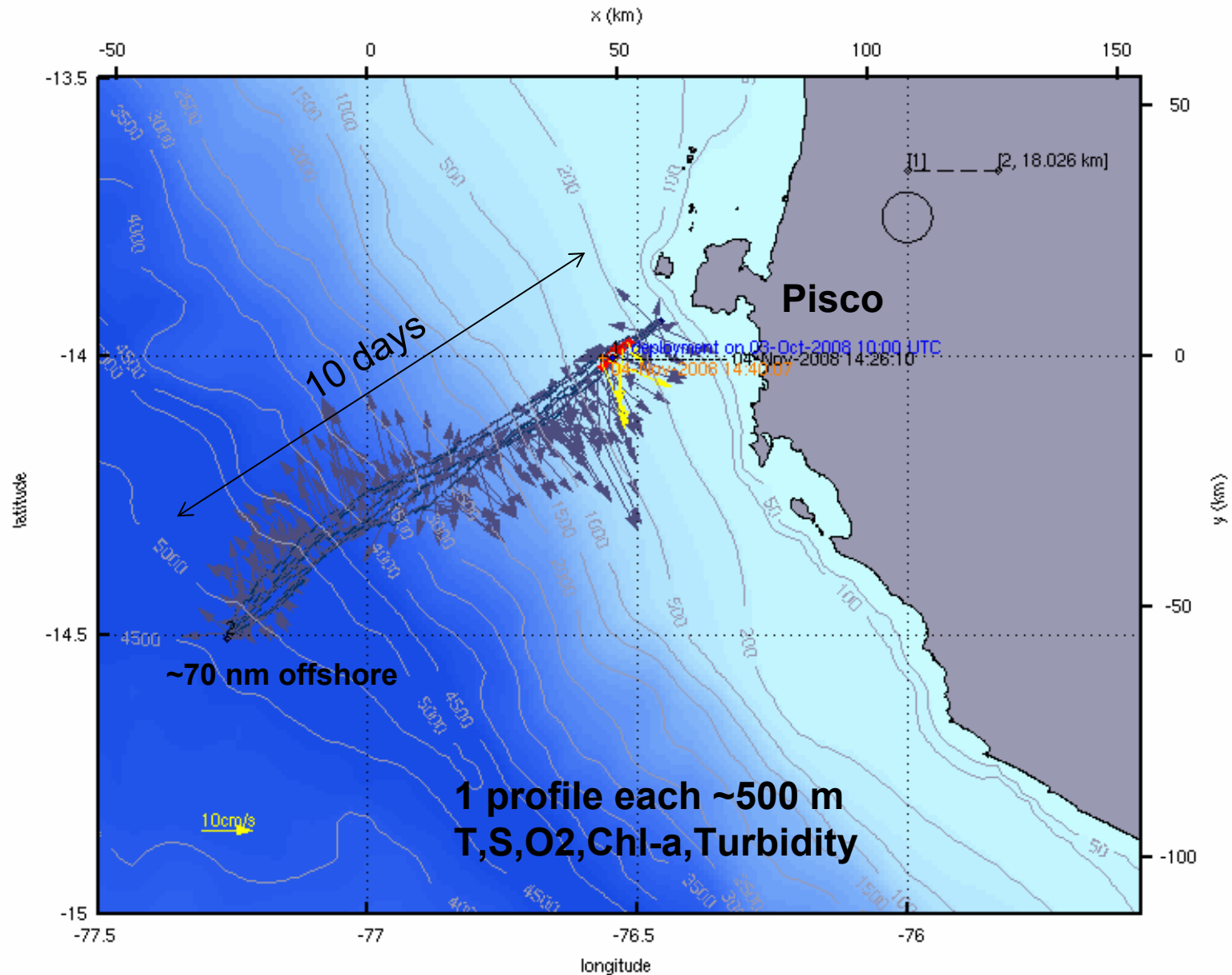
Glider “Pytheas” deployment

European Gliding Observatories (EGO)/IMARPE/LOCEAN/LEGOS

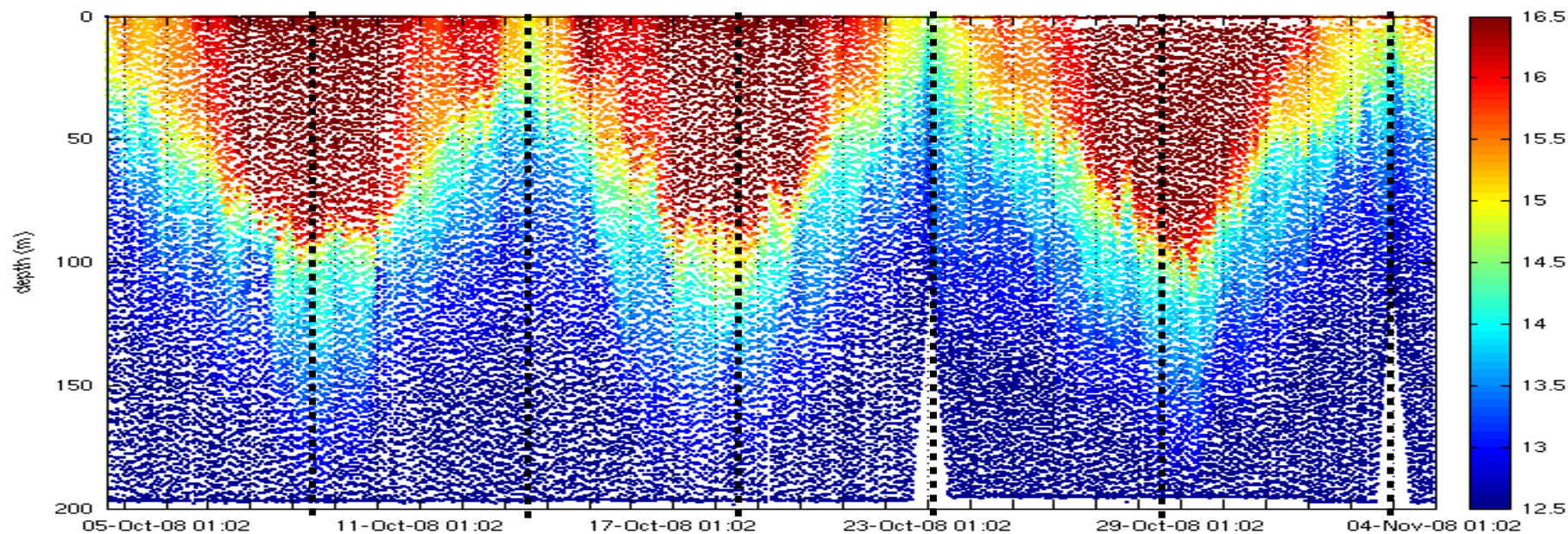
Slocum-type glider (0-200 m depth)



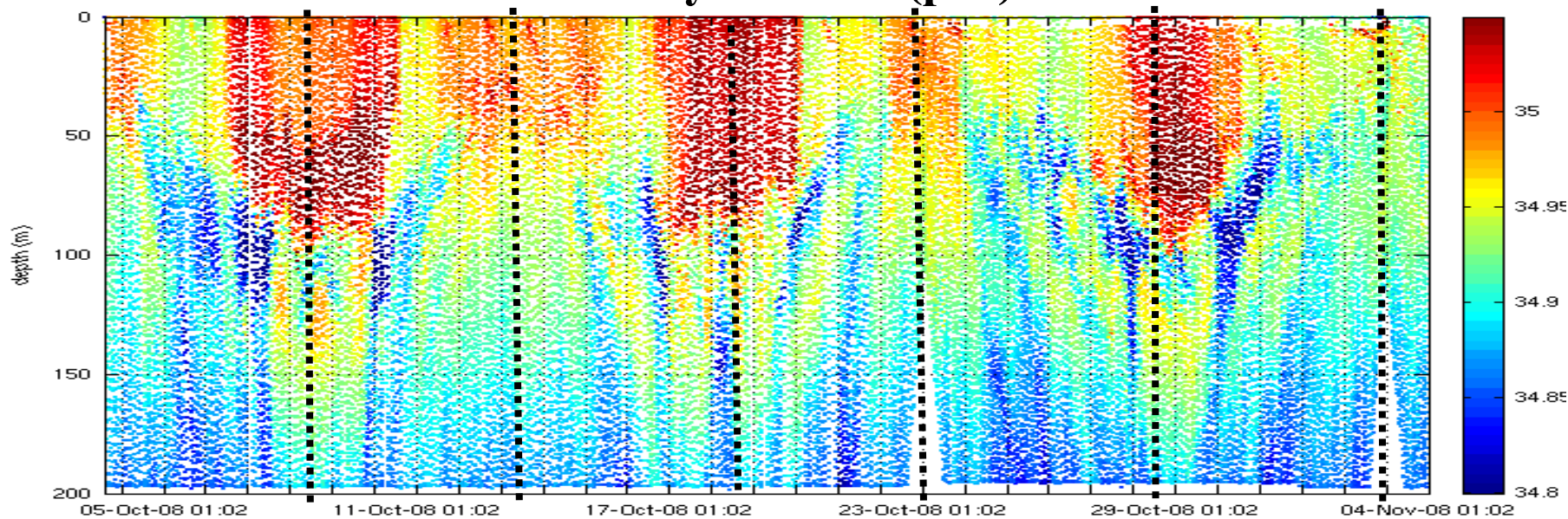
First 6 sections of glider Pytheas and averaged currents for the 0-200m layer



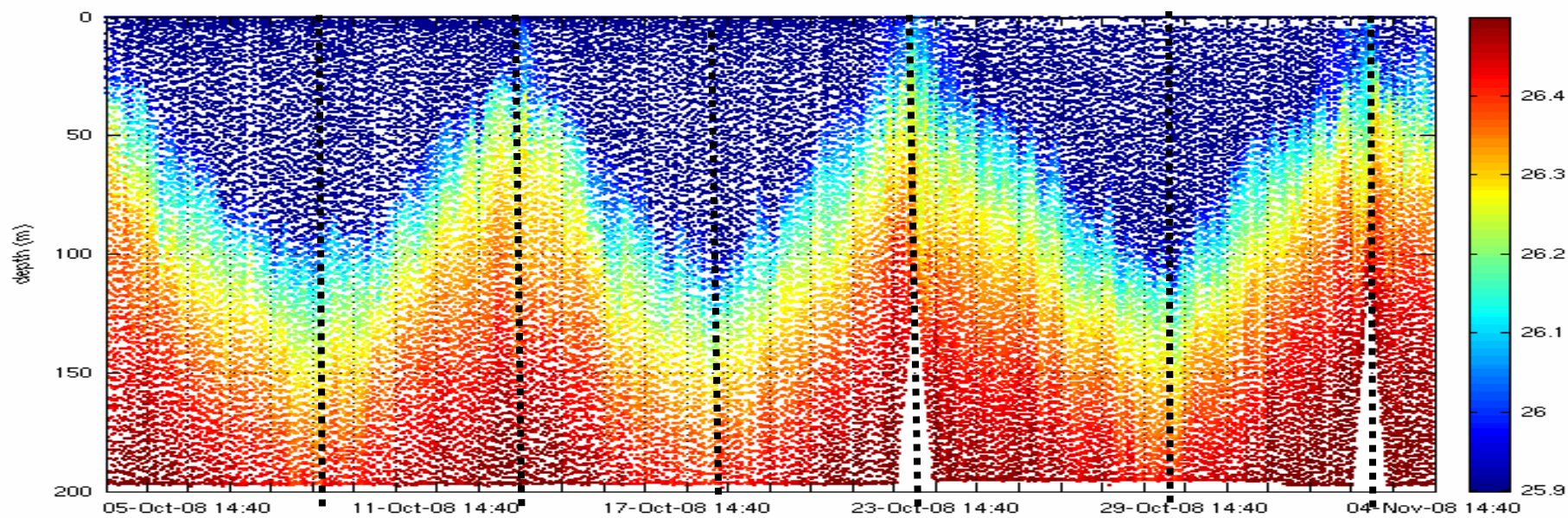
Temperature sections (°C)



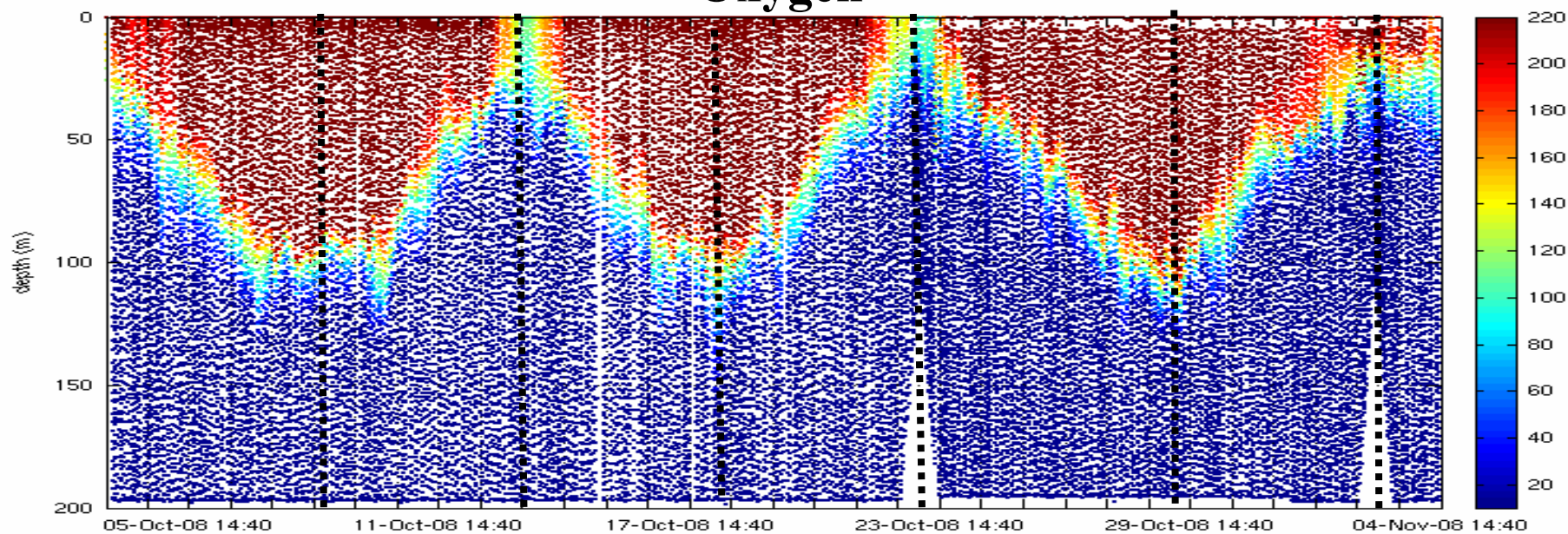
Salinity sections (psu)



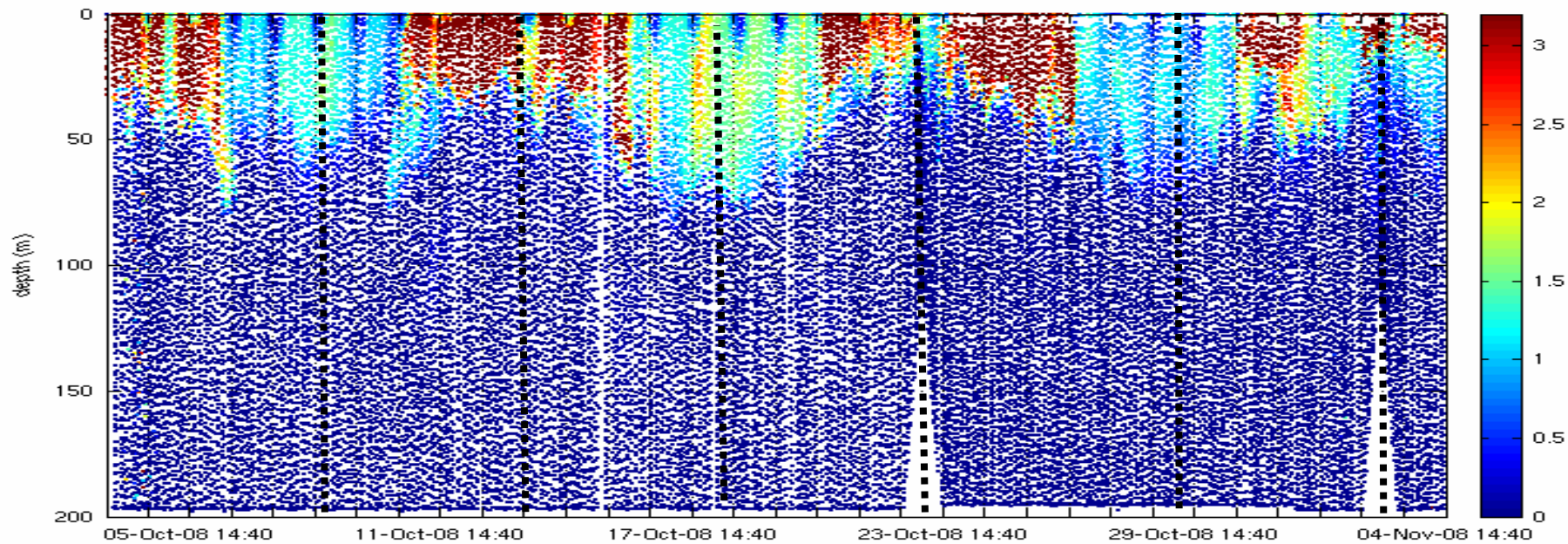
Density sections (kg m^{-3})



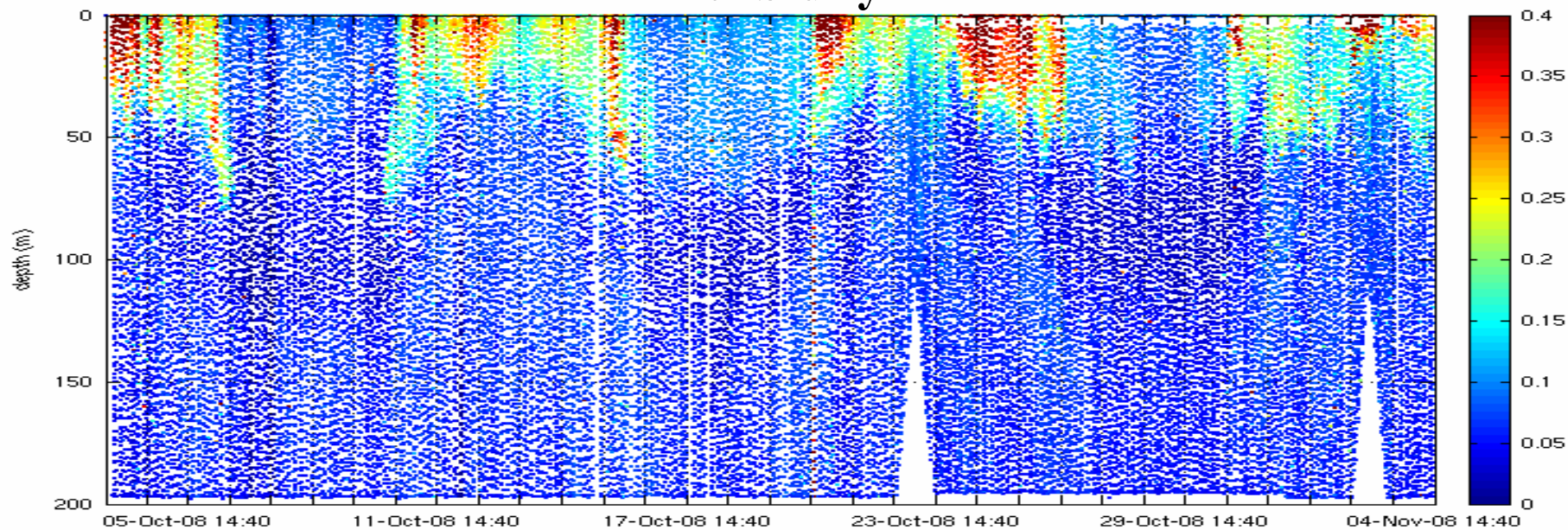
Oxygen



Fluorescence



Turbidity



Trajectories of 8 surface drifters deployed during VOCALS Peru Cruise

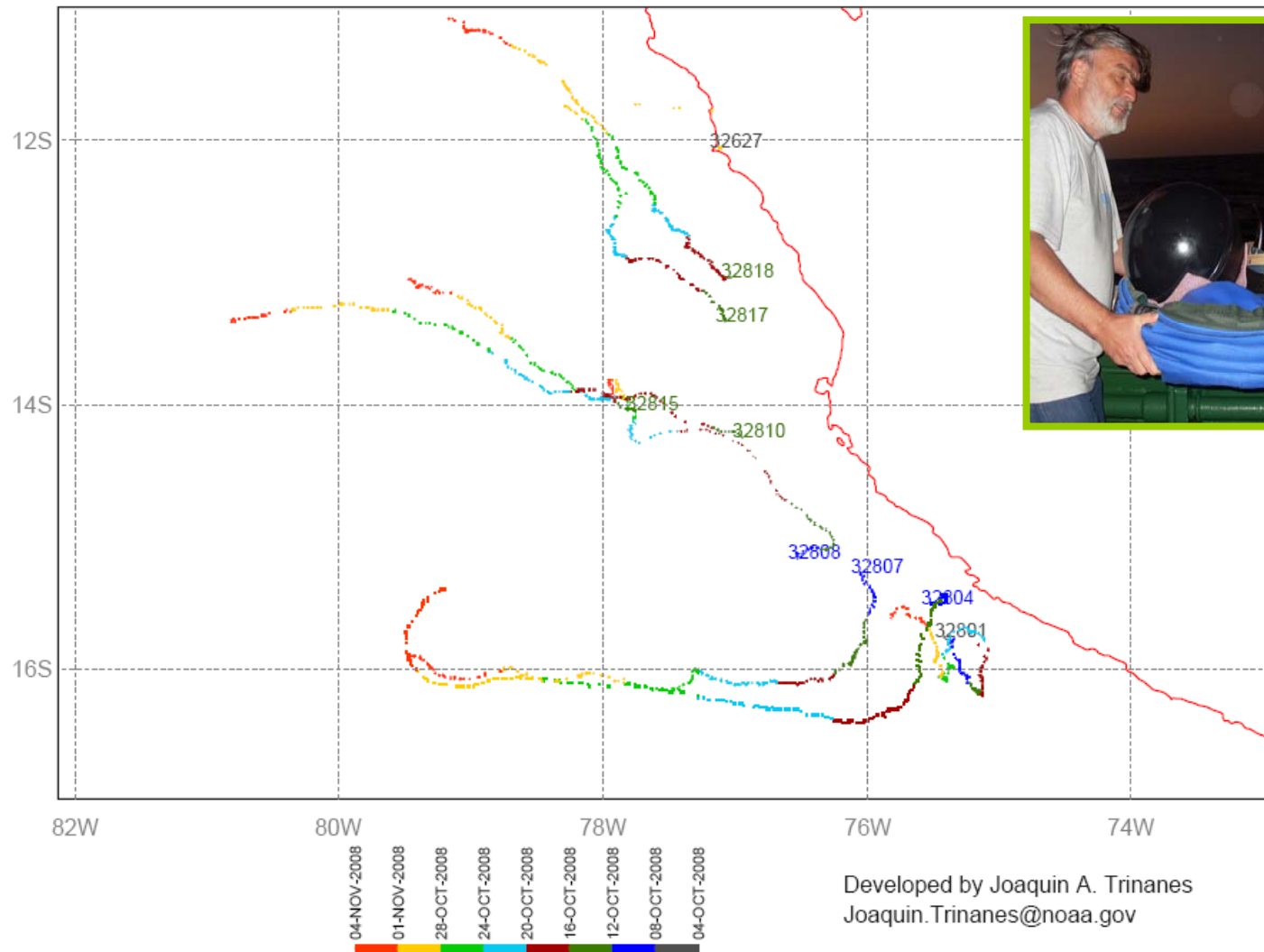
GOOS/CoastWatch NOAA/AOML

NRT Drifter Database



CoastWatch
Caribbean

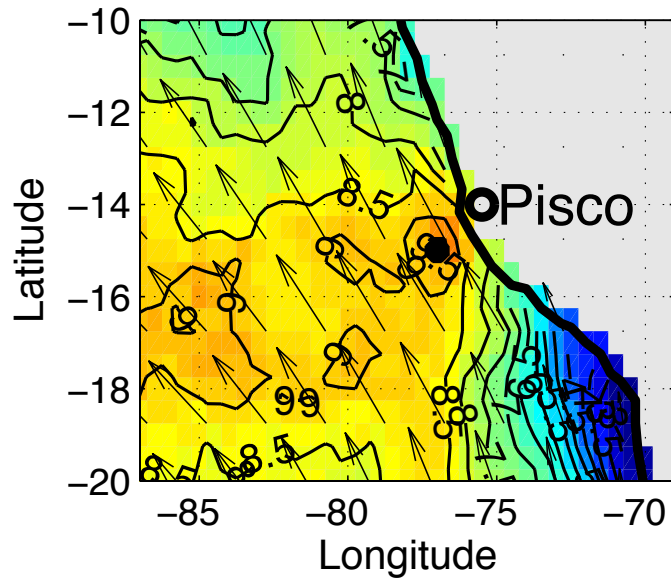
OCT-4-2008 to NOV-4-2008



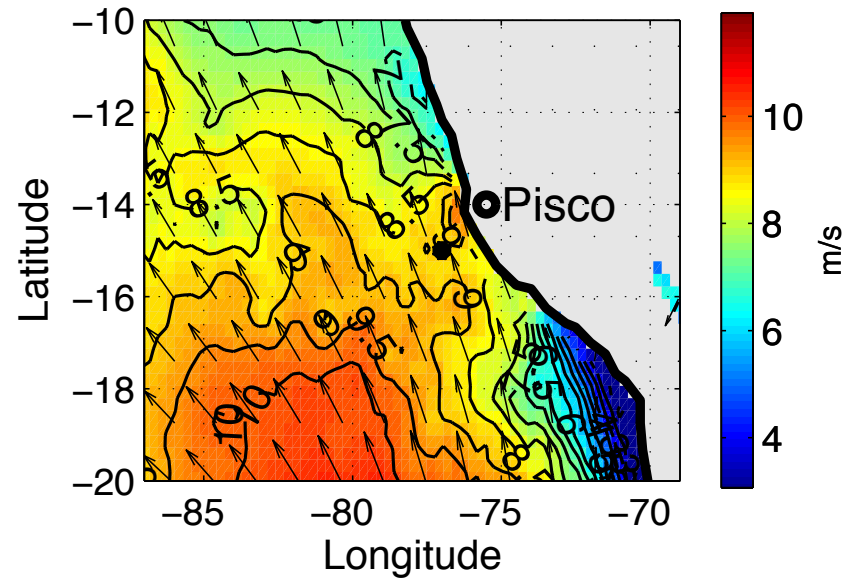
Developed by Joaquin A. Trinanes
Joaquin.Trinanes@noaa.gov

Mean Wind – 13–>18 October 2008

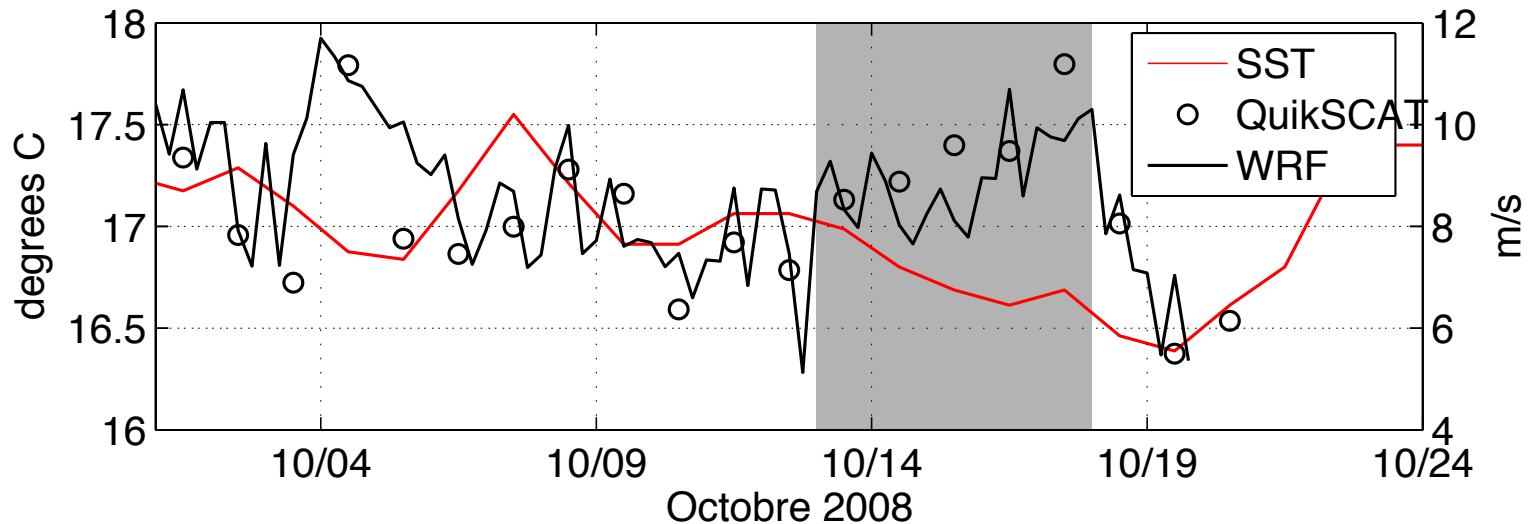
QuikSCAT



WRF 30km



SST and Wind timeseries, 77W–15S



Conclusions

Present results are still preliminary, however there are some features that can be drawn from the presented data set:

1. There exists very strong coastal winds in the first 50km from the coast.
2. The thermal inversion is constant between 1000-1500 m.
3. There seems to be a good interaction between some physical and biogeochemical/ biological variables: strongest winds confined in the nearshore 35 nm with the lowest SST, very low dissolved-oxygen concentrations associated with strong productivity in terms of fluorescence (also observed in glider data), very large concentrations of chlorophyll-a, plankton volumes, anchovy eggs and dense concentrations of anchovy.
4. After further data processing, we will get better knowledge of the interactions presented, and we would be able to evaluate the level and mechanisms of these interactions.

Words of Appreciation ...

Photo by C. Grados

To the VOCALS-Peru Cruise funding institutions:

Instituto del Mar del Perú (IMARPE/Peru)

Institut pour les Récherches et Développement (IRD/France)

National Science Foundation (NSF/United States)

Institut National des Sciences de l'Univers (INSU/France)



Thank you !



**From the VOCALS Peru cruise participants and colleagues (Yves du Penhoat (Toulouse/LEGOS), Vincent Echevin, Pierre Testor, Lionel Renault (Paris/LOCEAN), Patricia Ayon, Michelle Graco, Jesus Ledesma (Lima/IMARPE), Ken Takahashi (US/IGP), Yamina Silva & Kobi Mosquera (Lima/IGP), and...
...the 00-04:00/12-16:00 hrs watch)**