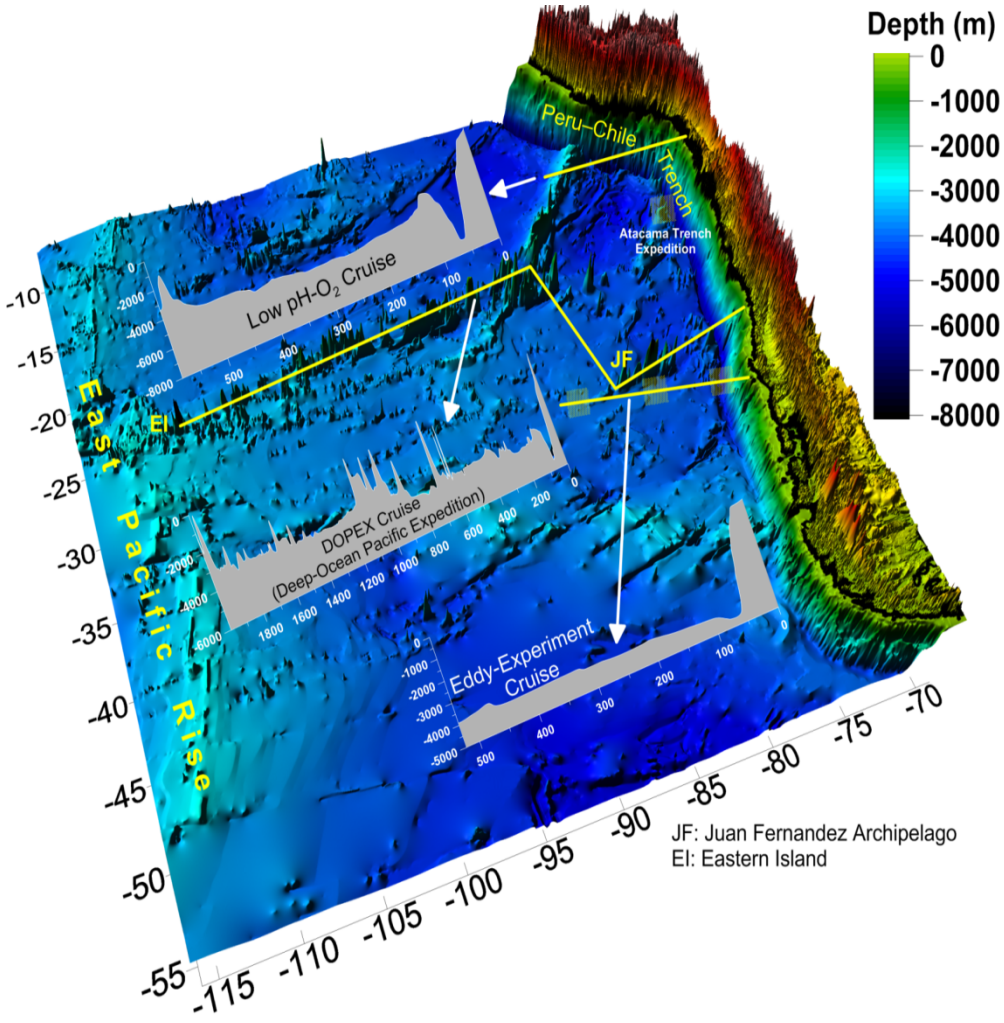
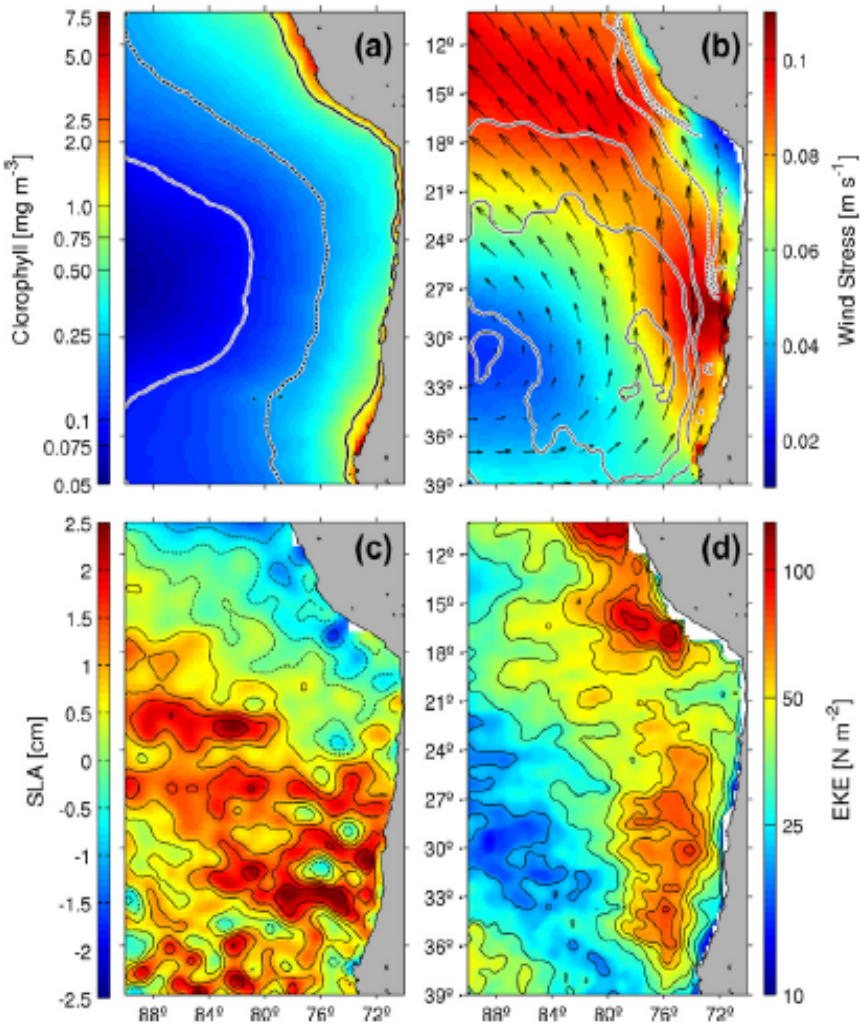
WIDENING WIND-OWS IN THE EASTERN SOUTH PACIFIC (ESP)





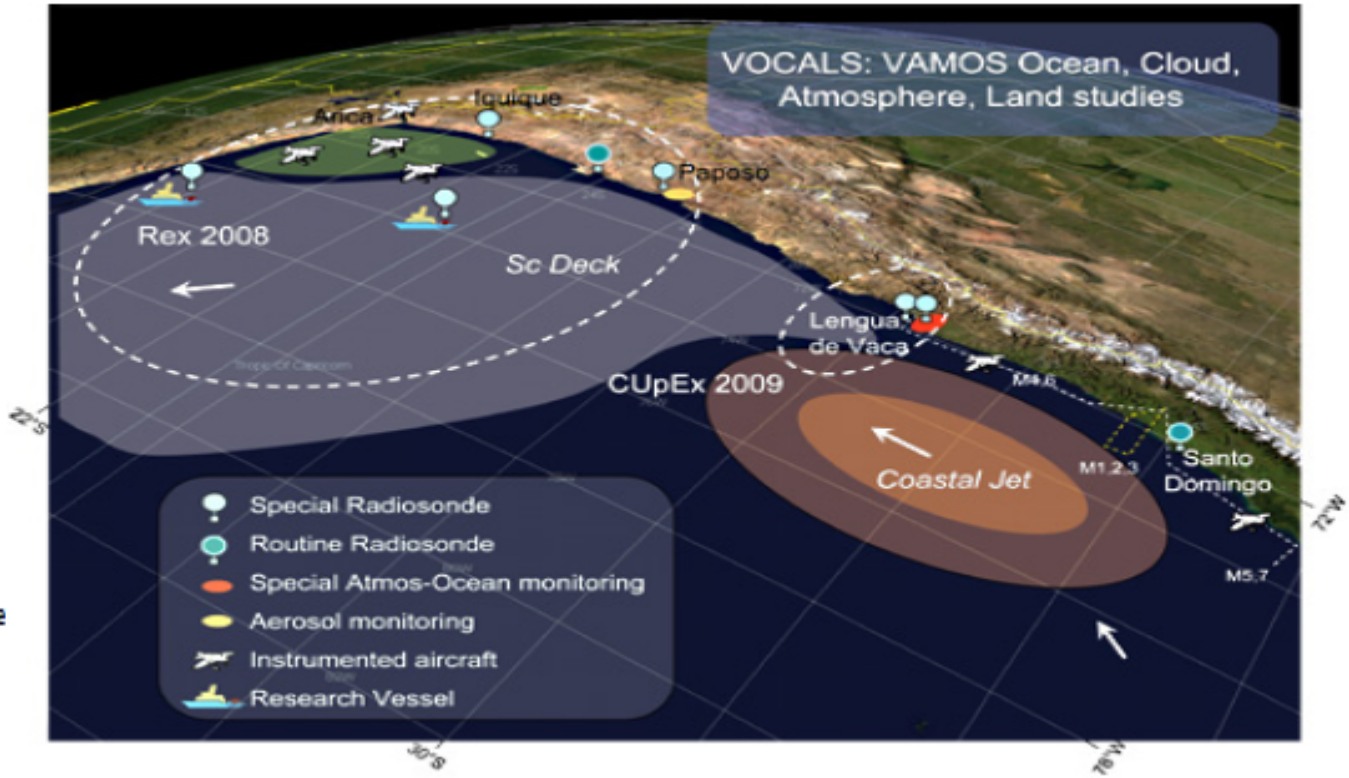
MARINE BIOPHYSICAL INTERACTIONS & DYNAMICS OF UPWELLING SYSTEMS
CLIMATE VARIABILITY

INITIATIVES
PRESENT AND FUTURE
INTERNATIONAL AND NATIONAL (CHILE)

CLIVAR INVOLVEMENT IN THE ESP

VAMOS

Atmos. Chem. Phys., 11, 2015–2029, 2011
www.atmos-chem-phys.net/11/2015/2011/
doi:10.5194/acp-11-2015-2011
© Author(s) 2011. CC Attribution 3.0 License



VOCALS-CUpEx: the Chilean Upwelling Experiment

R. D. Garreaud[1], J. A. Rutllant[1,2], R. C. Muñoz[1], D. A. Rahn[1], M. Ramos[2,3], and D. Figueroa[4]

VAMOS Ocean-Cloud-Atmosphere-Land Study (VOCALS)
Improving understanding of the subtropical SEP coupled ocean-atmosphere-land system on diurnal to interannual timescales.

A major regional experiment: VOCALS-Rex (Oct-Nov 2008) off N-Chile and S-Peru. Special volume: Atmos. Chem. Phys. 11 (2011).

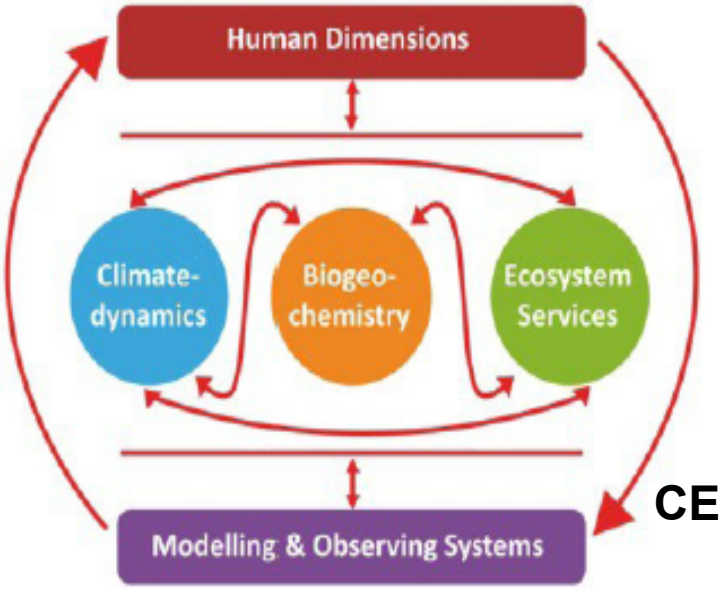
WCRP INVOLVEMENT IN LATIN AMERICA

The WCRP Conference for Latin America and the Caribbean,
Developing, linking, and applying climate knowledge

Montevideo, Uruguay on 17-21 March, 2014.

CHILE: ONGOING INITIATIVES RELATED TO CLIVAR OBJECTIVES

2012- (10 years scale)



CENTER FOR CLIMATE & RESILIENCE RESEARCH

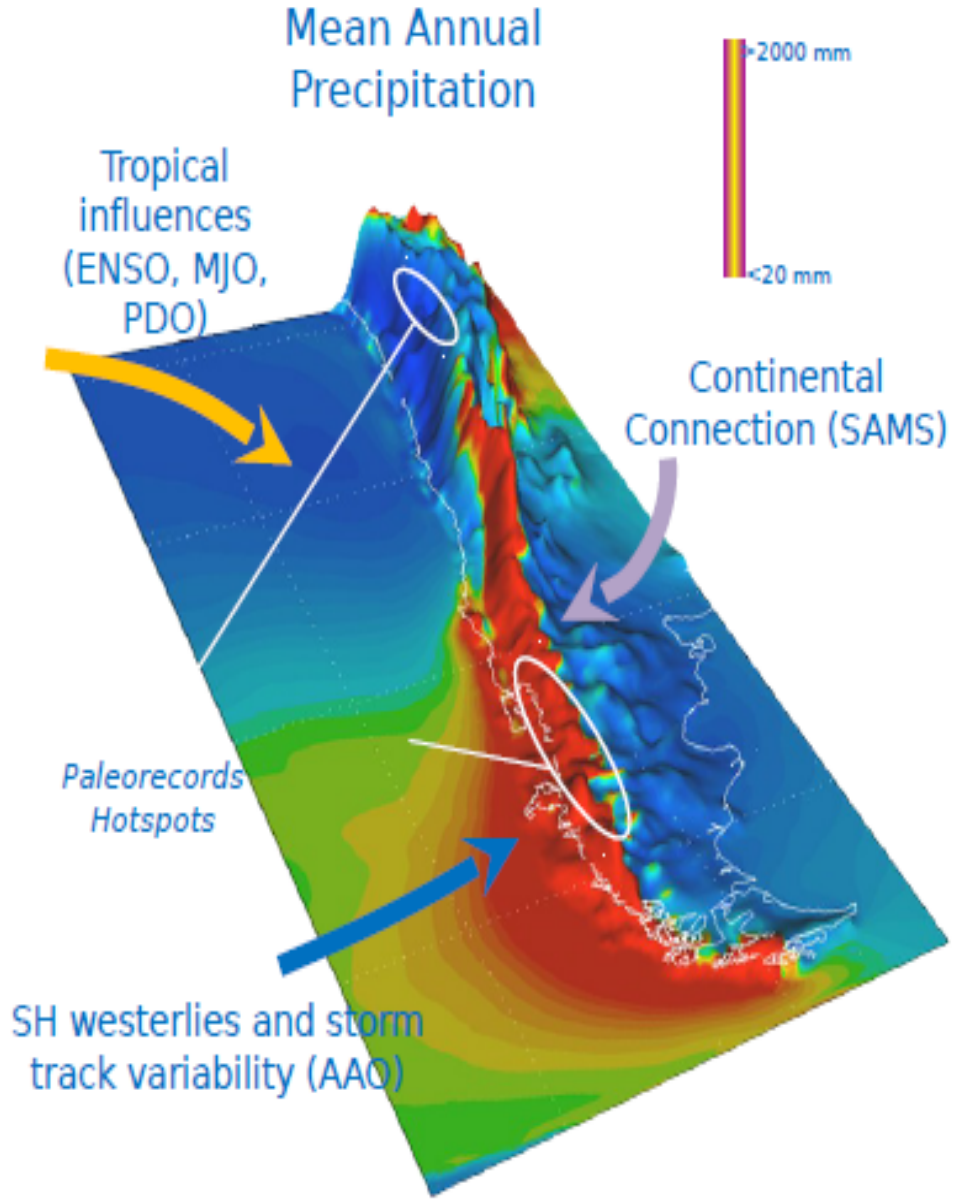
Mission: to develop Earth System Science in Chile to increase our understanding of the functioning of the climate system and look into new approaches to create resilience to climate change.

Integrative studies, centered around 3 regions in Chile:

- **Northern and central Chile, focus on water resources**
- **Central and Southern Chile, focus on rapid land use change & increasing urbanization.**

Five main research areas: Biogeochemistry, Climate Dynamics, Ecosystem Services, Human Dimensions and Modeling and Observation Systems.

CR² RELATION TO CLIVAR AND OTHER ONGOING INT. PROGRAMS



CLIMATE DYNAMICS
- **Decadal and centennial variability**
- **Present-day cooling ocean and warming land pattern**
- **Hydrological response to climate change**

BIOGEOCHEMISTRY
- **Oceanic CH4, NO2, MDS**
- **Effects and interactions of coastal cities**

MODELLING AND OBSERVING
- **Towards integrated models**
- **Observing systems**
- **Probabilistic climate change scenarios and climate services**

OTHERS

SPICES History and Current status

Stewart Frusher & Carolina Parada, SPICES report January 2013

First SPICES Symposium in Concepcion, 7-9 January 2013
Climate Variability and Change: impact on Marine Resources and Fisheries

•Six sessions

Towards **climate** indices and regional models (downscaling) to study climate variability and change in the South Pacific

Assessing **species-specific** responses to Climate variability and Change

Assessing **ecosystem** responses to climate variability and change

Climate variability and change: Impact on **fisheries and coastal communities**

Managing fisheries and ecosystems under a variable and changing climate

Marine and Antarctic ecosystem programs: EBFM, MPA, Policies and governance in a changing climate framework

Workshop: South Pacific Integrated Ecosystem (SPICES) network: Towards an International program to study climate variability and change on Marine Resources and Fisheries" Objective: to address the need of an integrative & coordinated program for the South Pacific region.

Outcomes and agreements:

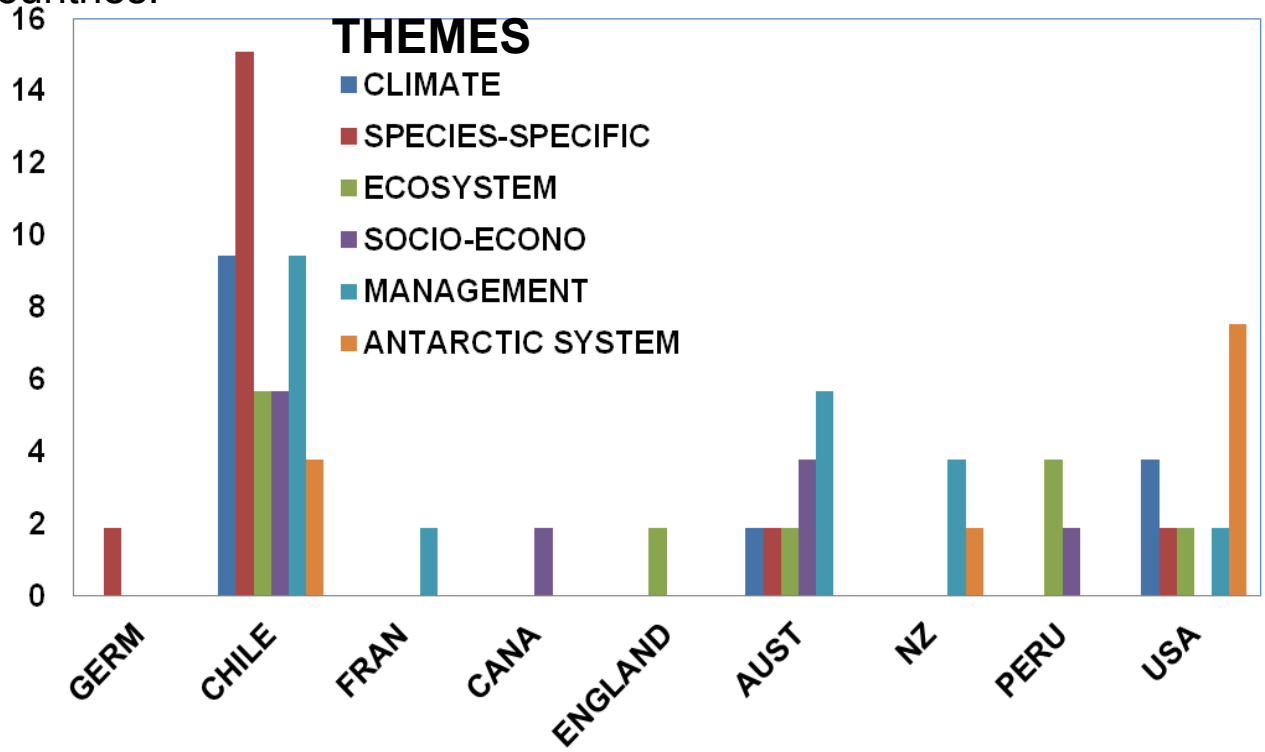
- **A Steering committee is being formed at present**
- **A workshop will be held to discuss SPICES terms of reference**
- **A Second SPICES symposium will be held in Hobart, March 2015.**

ORGANIZERS

SPONSORS

INTERNATIONAL SYMPOSIUM/WORKSHOP:
CLIMATE VARIABILITY & CHANGE ON MARINE RESOURCES & FISHERIES IN THE SOUTH PACIFIC (SPICES)
7-10 JANUARY 2013 -CONCEPCION

- 91 attendants from 10 countries:
  - Mexico
  - Uruguay
  - Peru
  - USA
  - Germany
  - England
  - Australia
  - New Zealand
  - Canada
  - Chile



SPICES Symposium Report: CHALLENGES AND FUTURE ACTIONS
Stewart Frusher & Carolina Parada, SPICES report January 2013

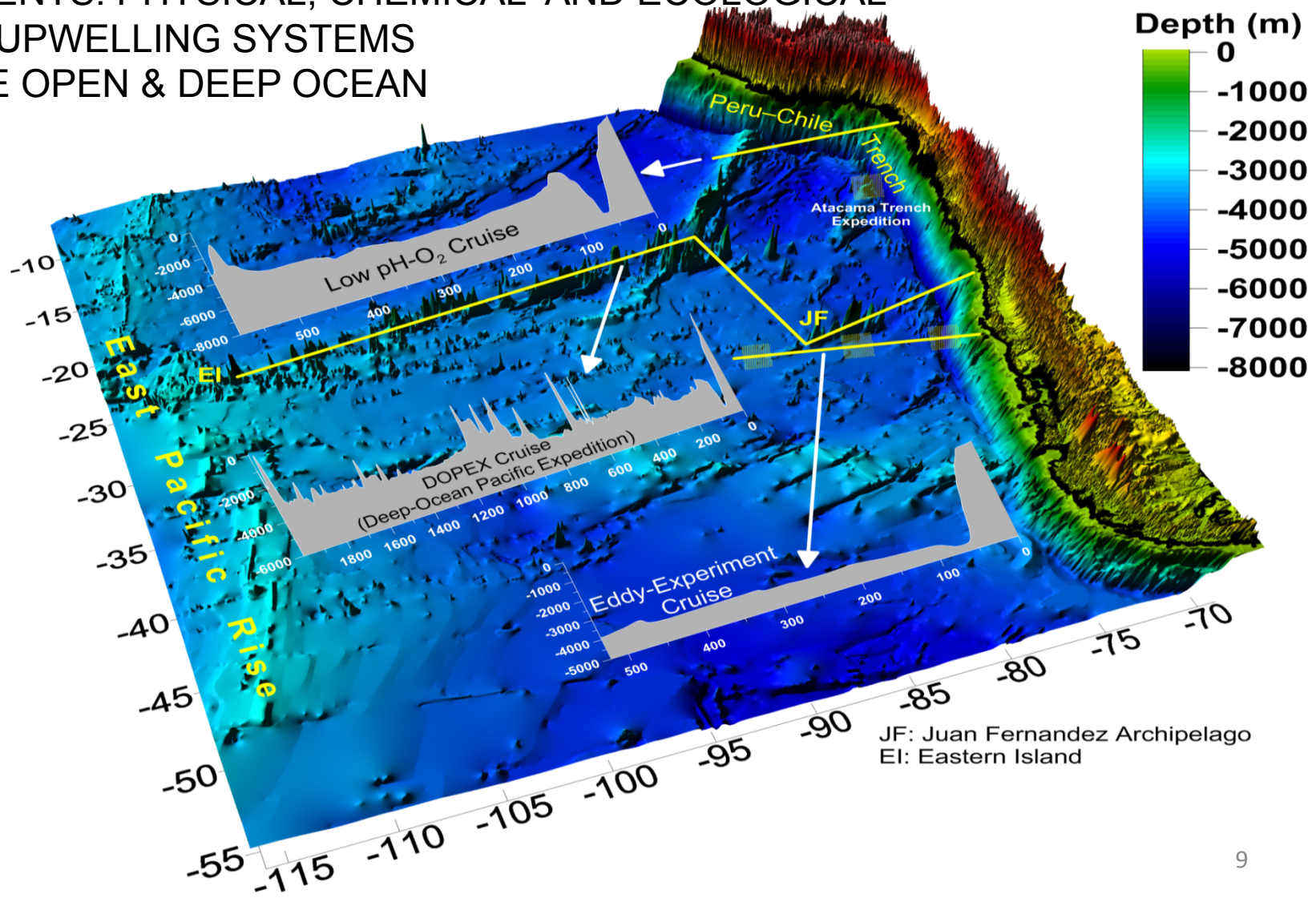
SUGGESTED PP ACTION: SUPPORT THIS INITIATIVE???

POTENTIAL INITIATIVE

MILLENIUM INSTITUTE – FOR INTEGRATIVE OCEANOGRAPHY

(under international peer review since May 2013; 10 year scale)

GRADIENTS: PHYSICAL, CHEMICAL AND ECOLOGICAL
FROM UPWELLING SYSTEMS
TO THE OPEN & DEEP OCEAN



OCEAN OBSERVING SYSTEMS IN THE ESP – CHILE

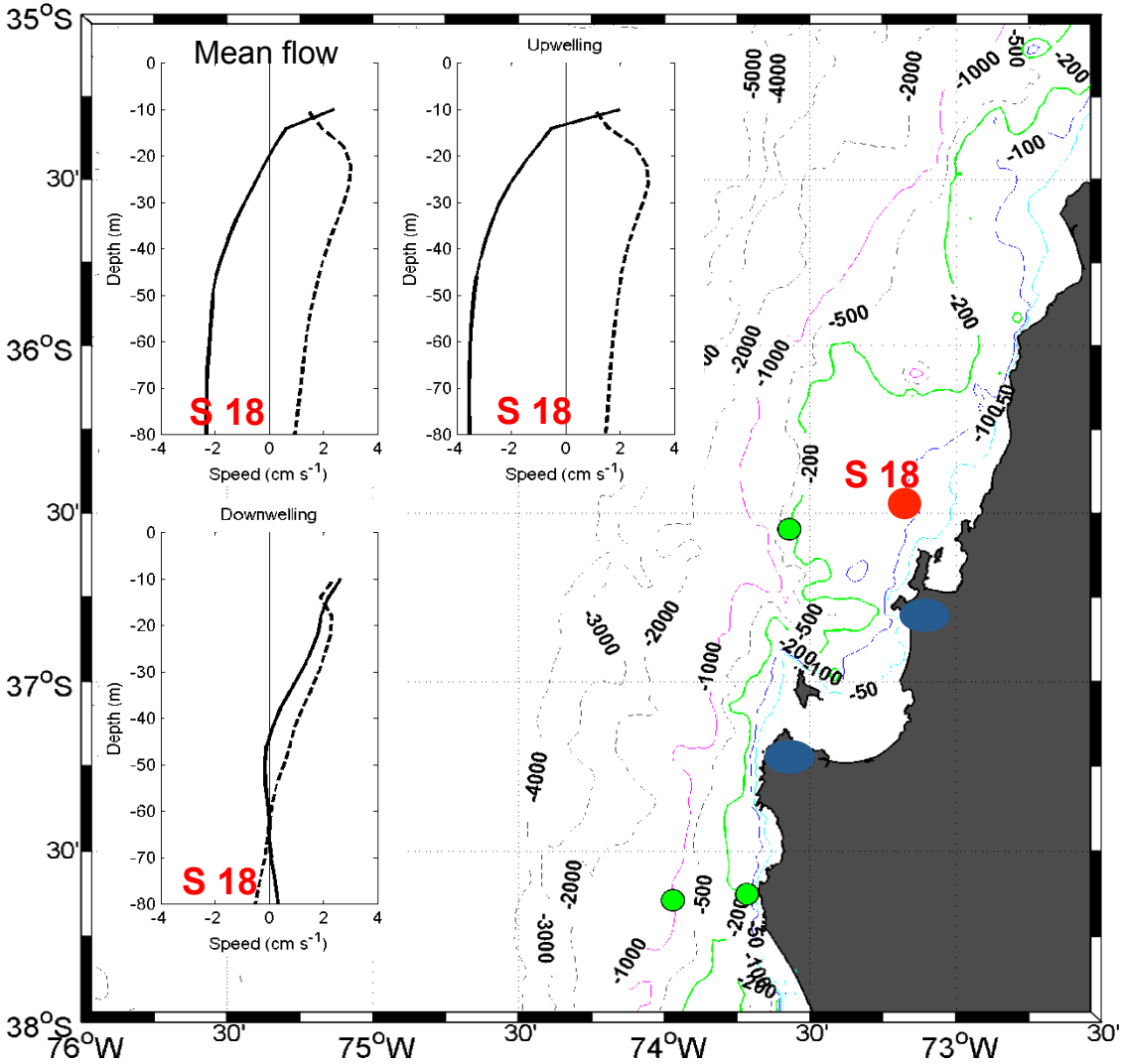
examples

OBSERVATION SYSTEMS – IN SITU - COPAS CENTER

TIME SERIES OBSERVATIONS
COASTAL UPWELLING SHELF AREA
OFF CONCEPCION

STATION 18 (~36°30'S)
FROM MID-2002 ON
MONTHLY SAMPLING

PHYSICAL
CHEMICAL
BIOGEOCHEMICAL
BIOLOGICAL (PLANKTON + BENTHOS)



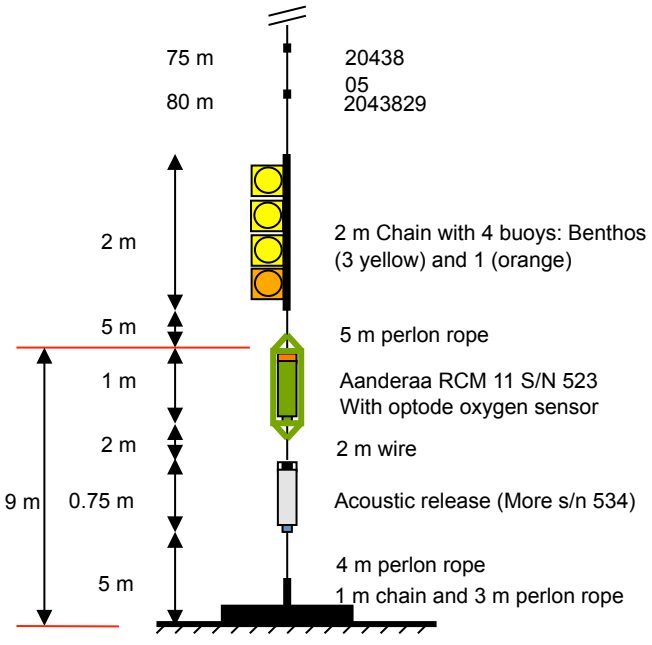
O. Pizarro (unp. data):
Mean along- (solid line) and cross- (dashed lines) shore profiles of speed during a typical year and for upwelling and downwelling seasons. Blue: meteo-stations.

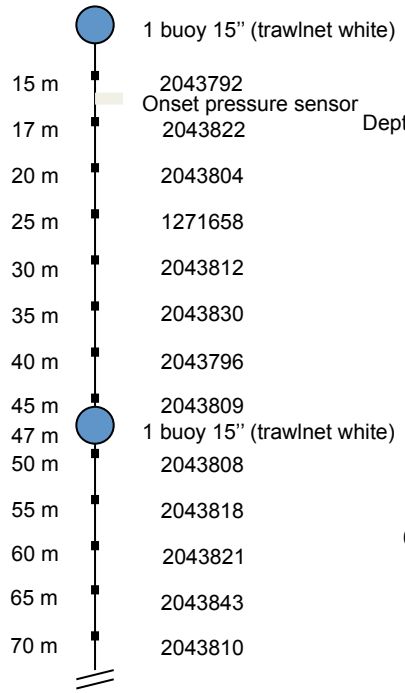
OBSERVATION SYSTEMS: COPAS TIME SERIES COASTAL ST 18 - ESP

Central-southern Chile off Concepcion

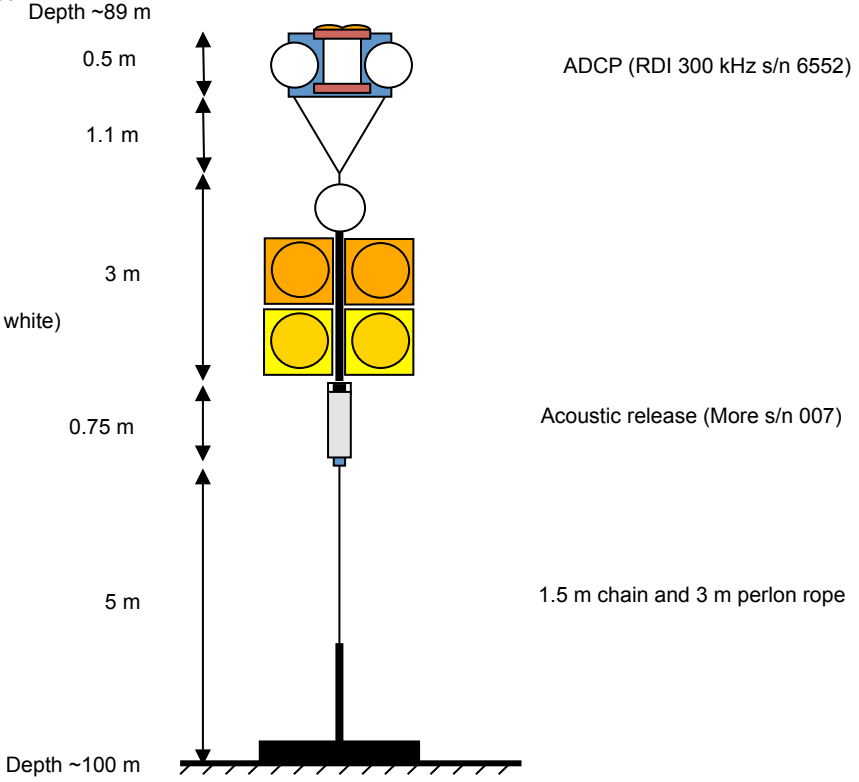
Lat: 36° 27.86' S
Lon: 73° 10.12' W
Depth: 103 m
Date: 2009-07-12

TERMISTOR CHAIN





ADCP Coastal Mooring
Lat: 36° 27.96' S
Lon: 73° 10.19' W
Depth: 103 m
Date:



At present: no sustained funding to maintain the 10 year old time series at ST 18 after 2013. Rest of 2013 supported by individual projects

Looking for ways to maintain it! CLIVAR PP SUPPORT???

TIME SERIES ST 18 – WINDS AND OCEANOGRAPHIC IN SITU DATA

O. PIZARRO (unp. data)

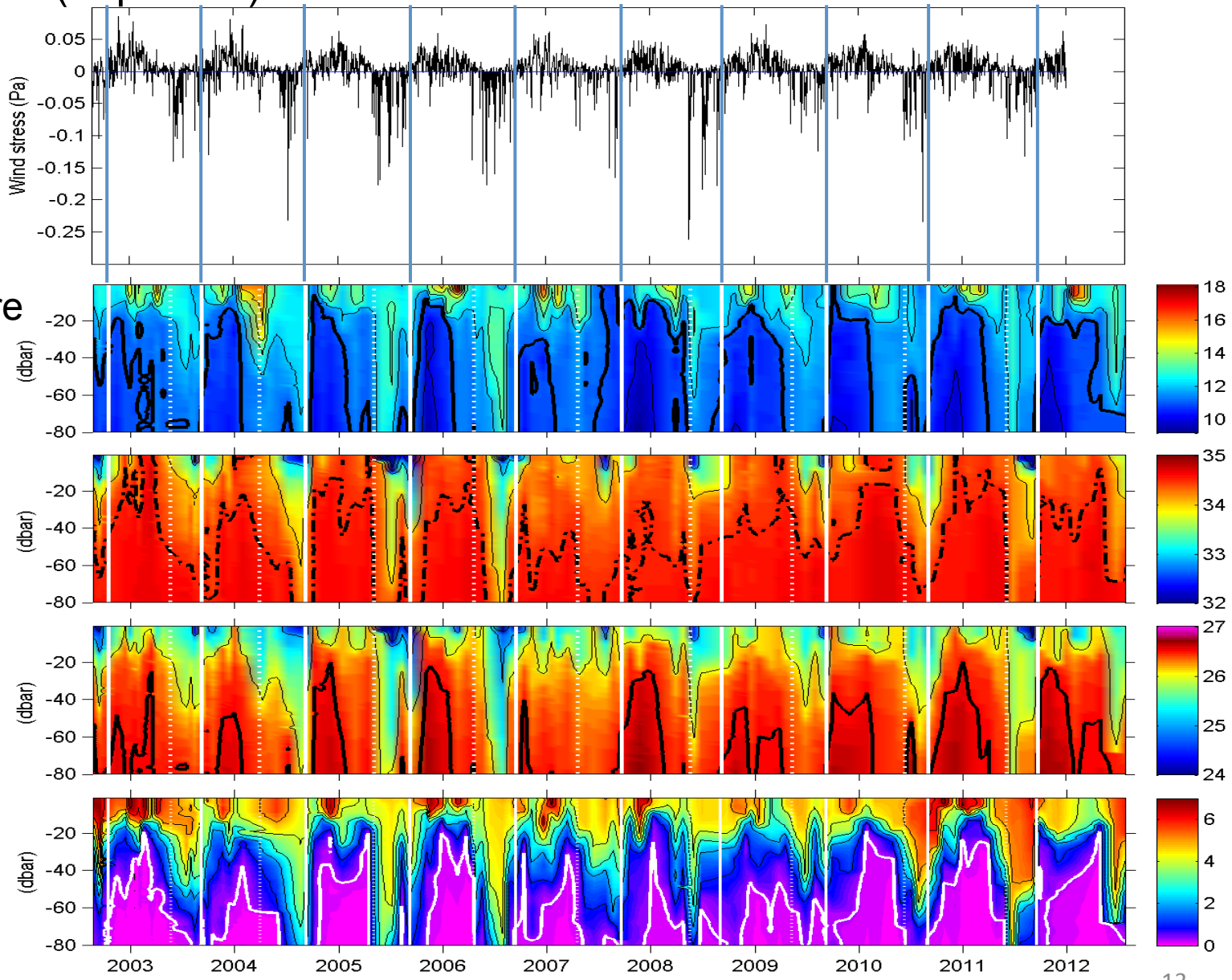
Alonshore wind stress

Temperature

Salinity

Density

Oxygen

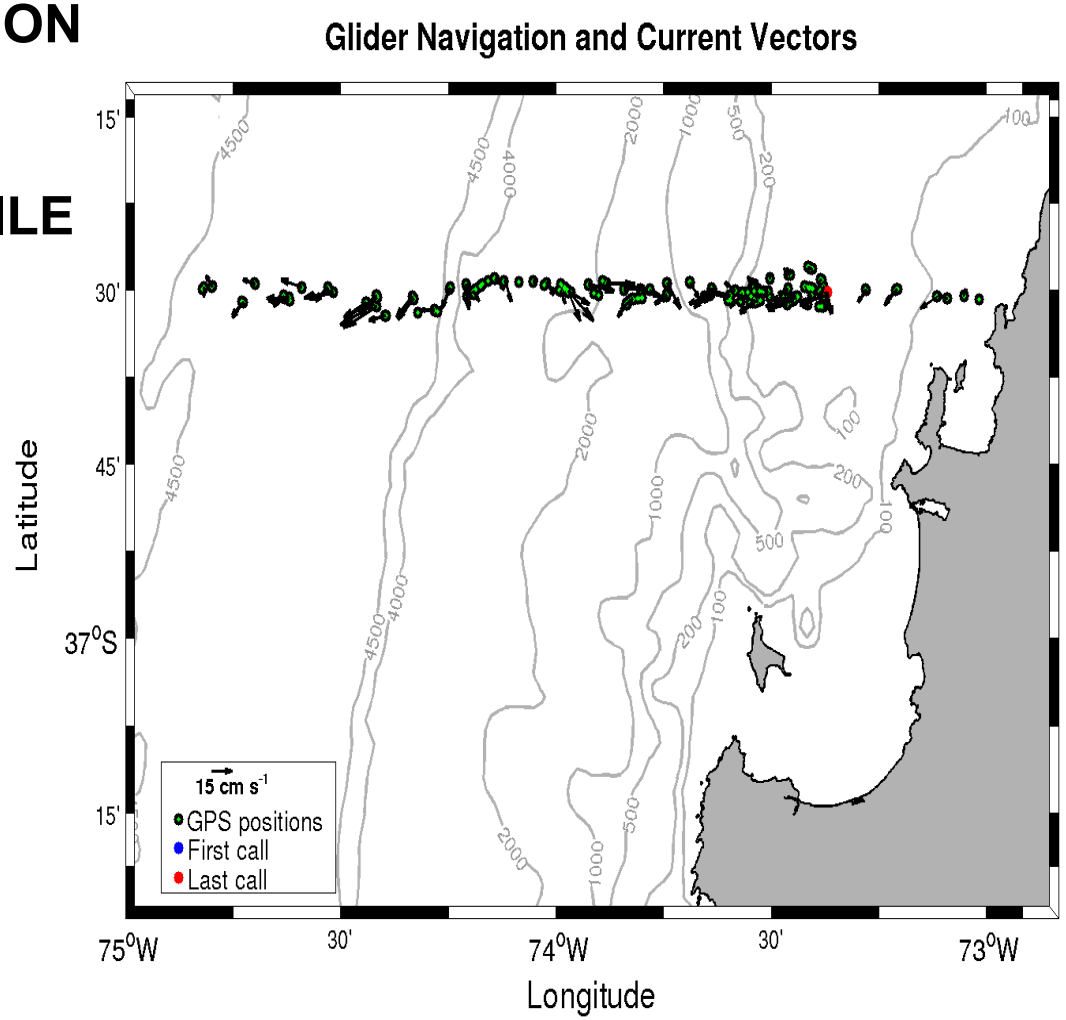


OBSERVATION SYSTEMS: TIME SERIES COASTAL DATA – O. PIZARRO

REPEATED GLIDER SECTION
Quaterly since June 2010
COASTAL SECTION OFF
CENTRAL-SOUTHERN CHILE

Slocum Glider
SBE CTDA
Anderaa optode sensor – O2
Wet Labs sensors:
fluorescence (chl-a) and turbidity (FLNTU)

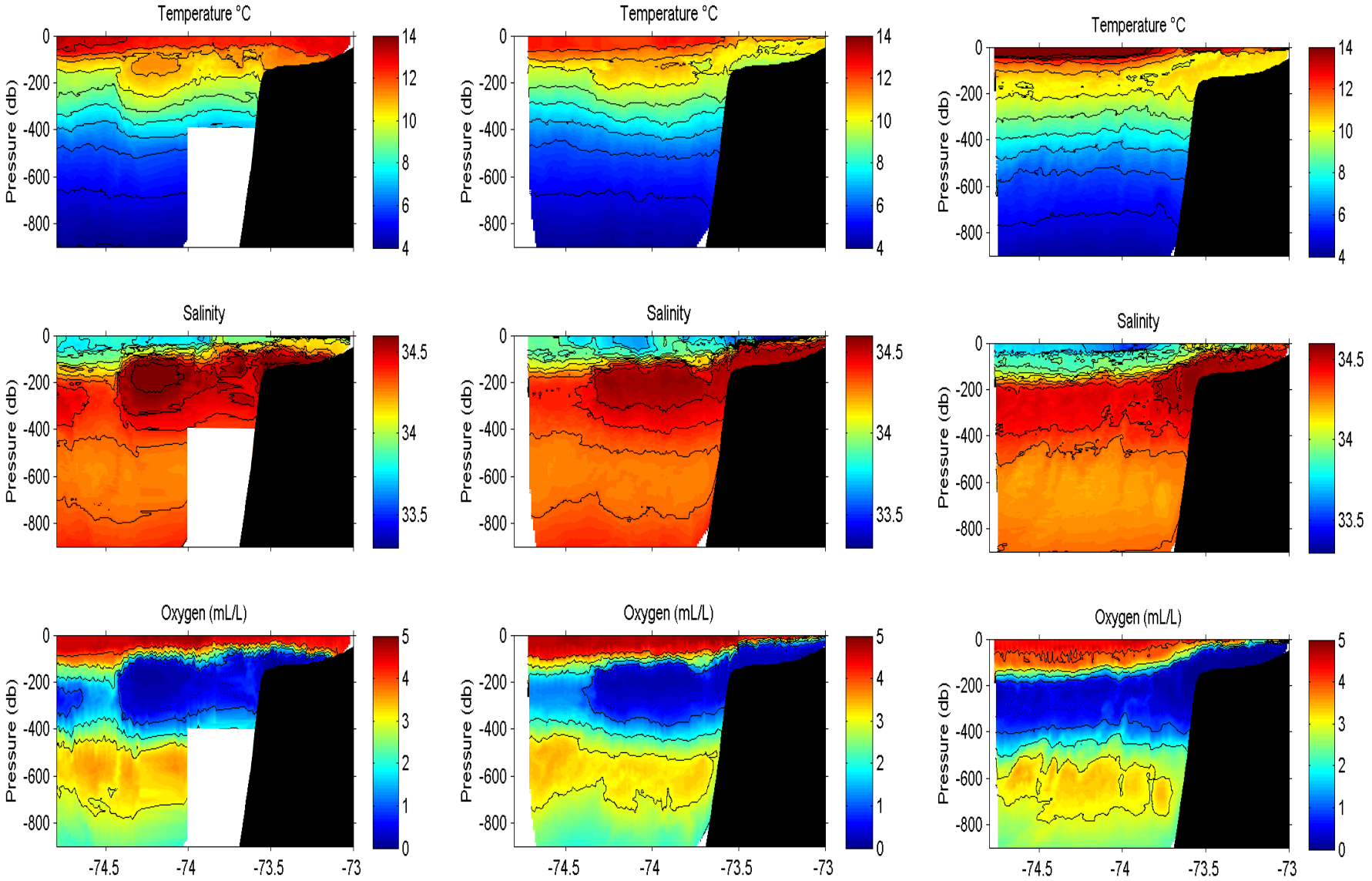
Funding maintained by individual projects and project-based international collaboration



Central-southern Chile off Concepcion

GLIDER DATA: MESOSCALE EDDIES GENERATED IN THE COAST

June 2010 - WINTER | September 2010 - SPRING | January 2011- SUMMER

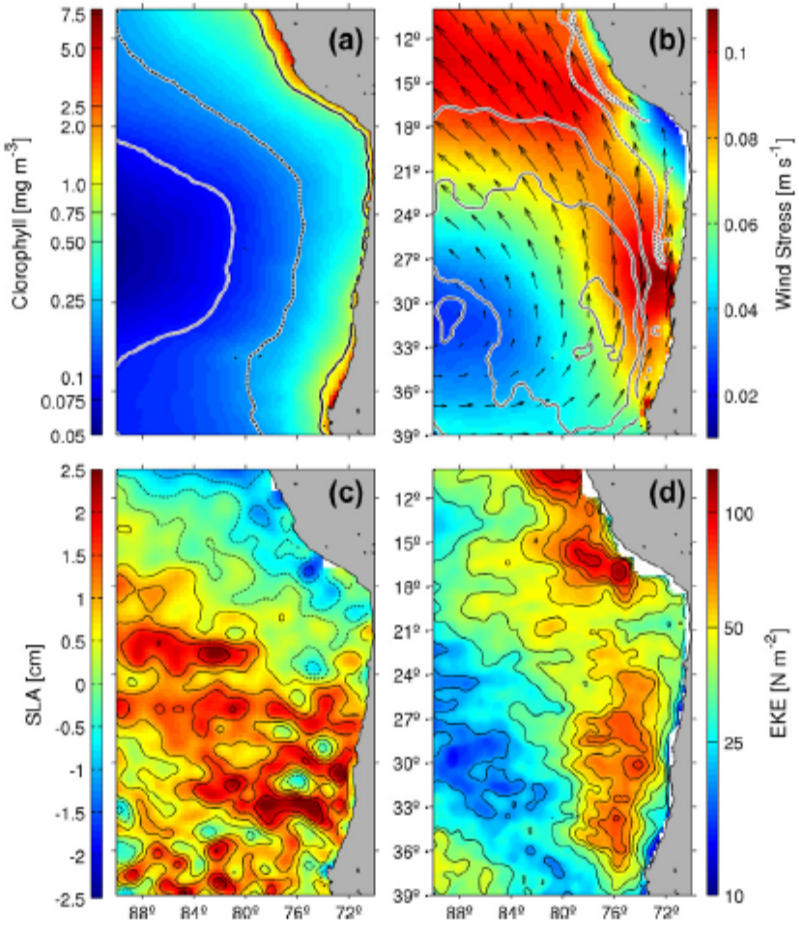


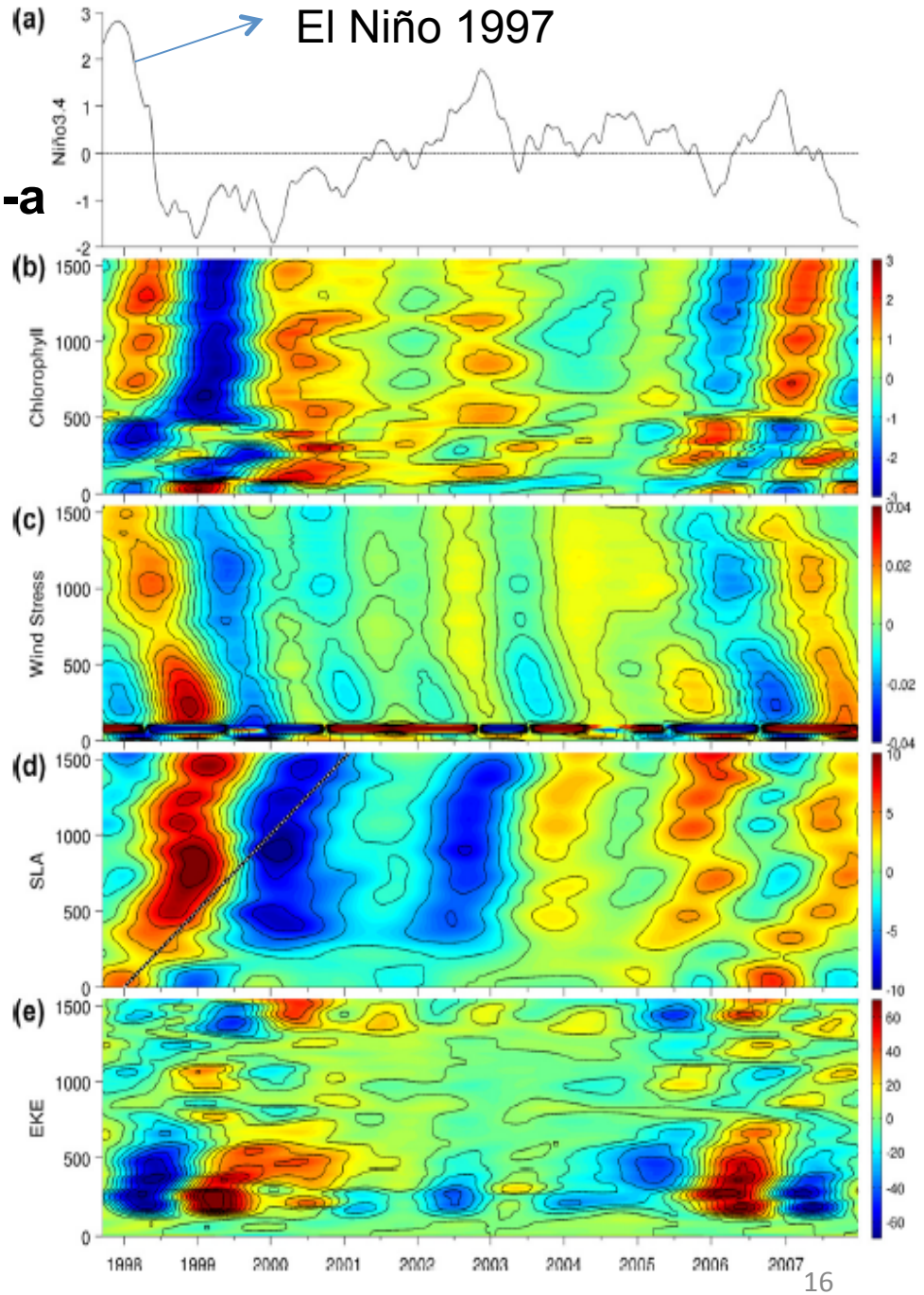
O. PIZARRO et al. (unpub. data)

SATELLITE TIMES SERIES DATA

TIME-SPACE VARIABILITY OF CHL-a PERU-CHILE REGION

CORREA-RAMIREZ et al. 2012





SATELLITE TIME SERIES DATA

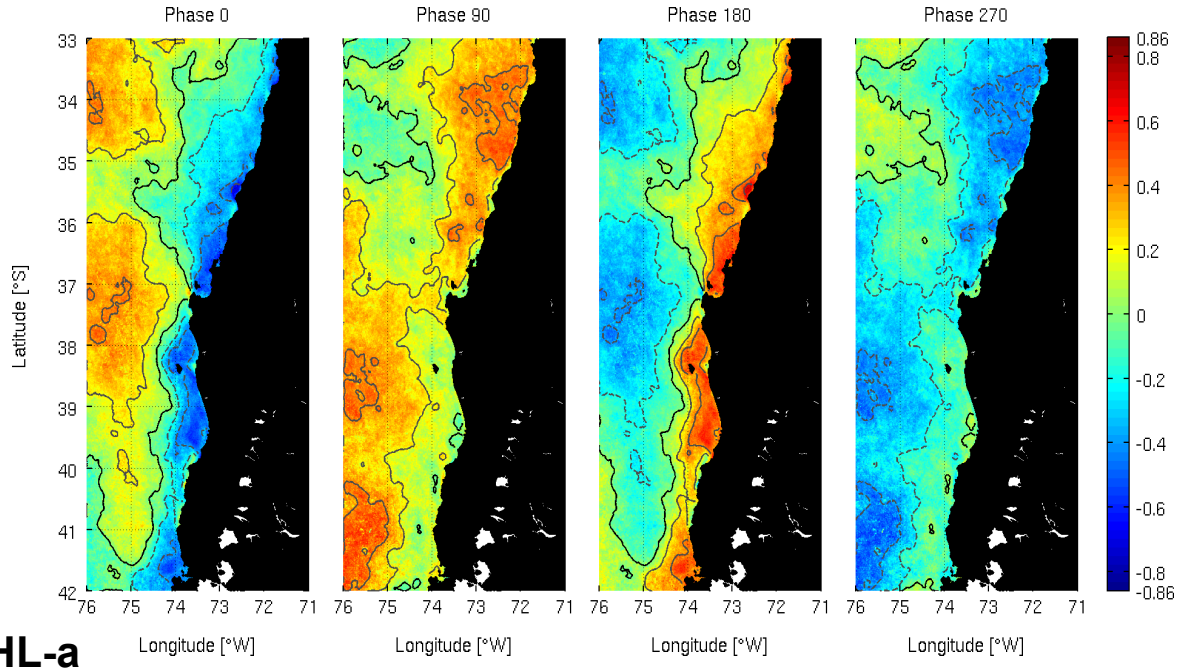
SMALL SCALE TIME-SPACE VARIABILITY IN CHLOROPHYLL-a DISTRIBUTION

CENTRAL-SOUTHERN CHILE

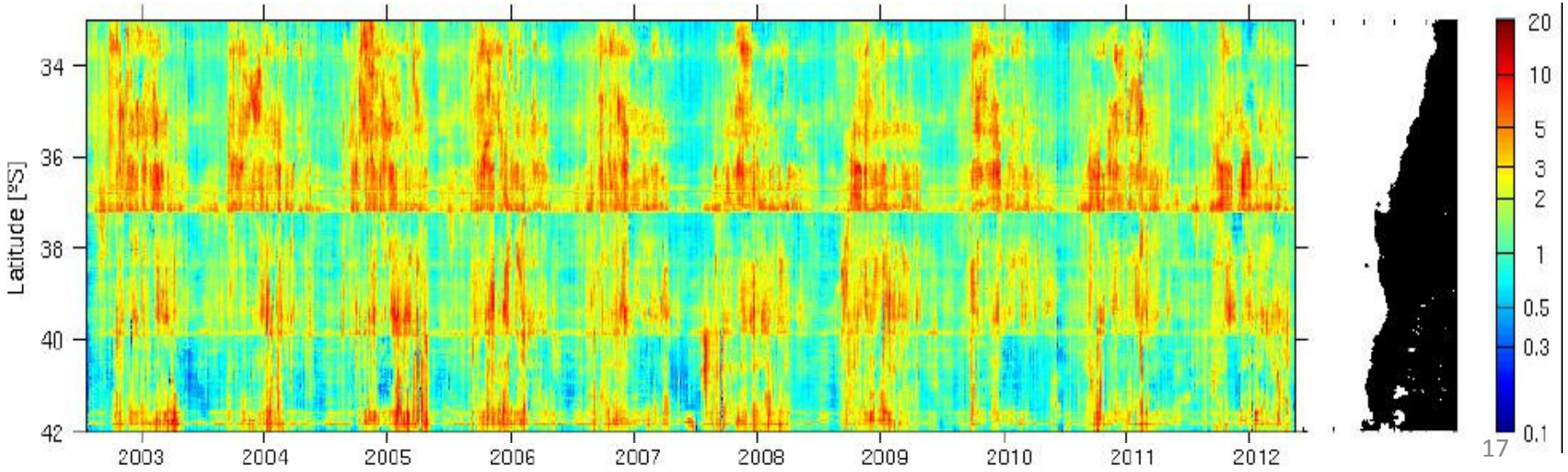
CE MORALES –
S HORMAZABAL et al.
(in preparation)

PHASES OF THE ANNUAL CYCLE OF CHL-a (anomalies)

WINTER **SPRING** **SUMMER** **AUTUMN**



TIME-SPACE VARIATION OF CHL-a



UPWELLING INTENSITY INTERANNUAL CHANGES IMPACT ON ECOSYSTEM AND FISHERIES

Example: Gomez et al. (2012) Central-southern Chile → impact of spring upwelling variability on common sardine (*Strangomera bentincki*) recruitment . Fisheries Oceanography.

Methods: Satellite and coastal station winds, satellite chlorophyll, and common sardine recruitment from a stock assessment model.

Results: In austral spring, intensity of wind-driven upwelling is related to SST from the Niño 3.4 region, being weak during warm periods (El Niño) and strong during cold periods (La Niña). Interannual changes in both spring upwelling intensity and SST from the Niño 3.4 region are related to changes in remotely sensed chlorophyll over the continental shelf. In turn, year-to-year changes in coastal chlorophyll are tightly coupled to common sardine recruitment.

Proposition: Interannual changes in the intensity of spring upwelling affected the abundance and availability of planktonic food for common sardine, and consequently determined pre-recruit survival and recruitment strength. However, the importance of density-dependent factors on the reproductive dynamic cannot be neglected.

Predictions: Coastal chlorophyll, upwelling intensity, and SST anomalies from the Niño 3.4 region could potentially help to predict common sardine recruitment scenarios under strong spring upwelling and El Niño Southern Oscillation (ENSO)-related anomalies.

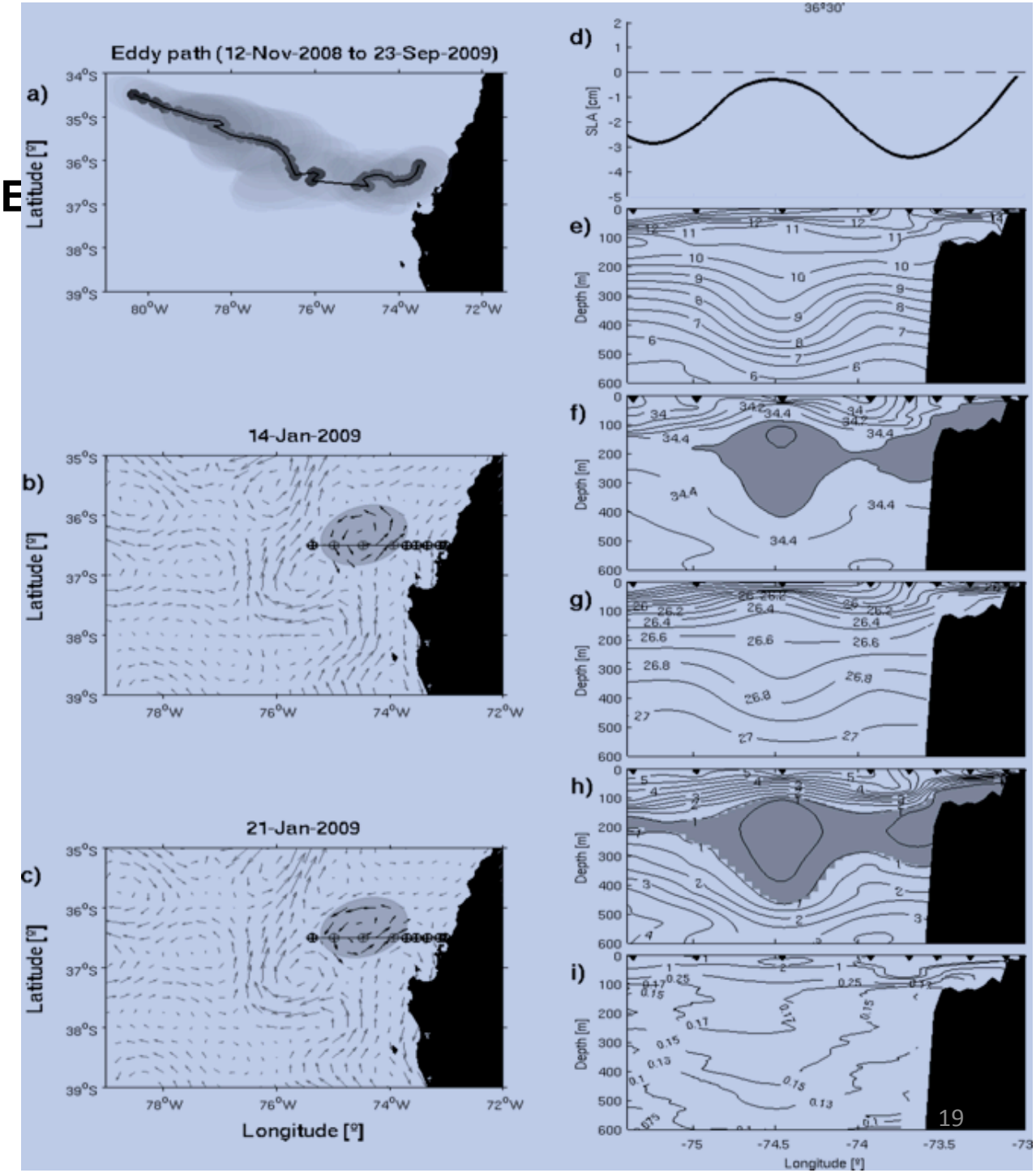
MESOSCALE INTRATHERMOCLINE EDDIES (ITEs)

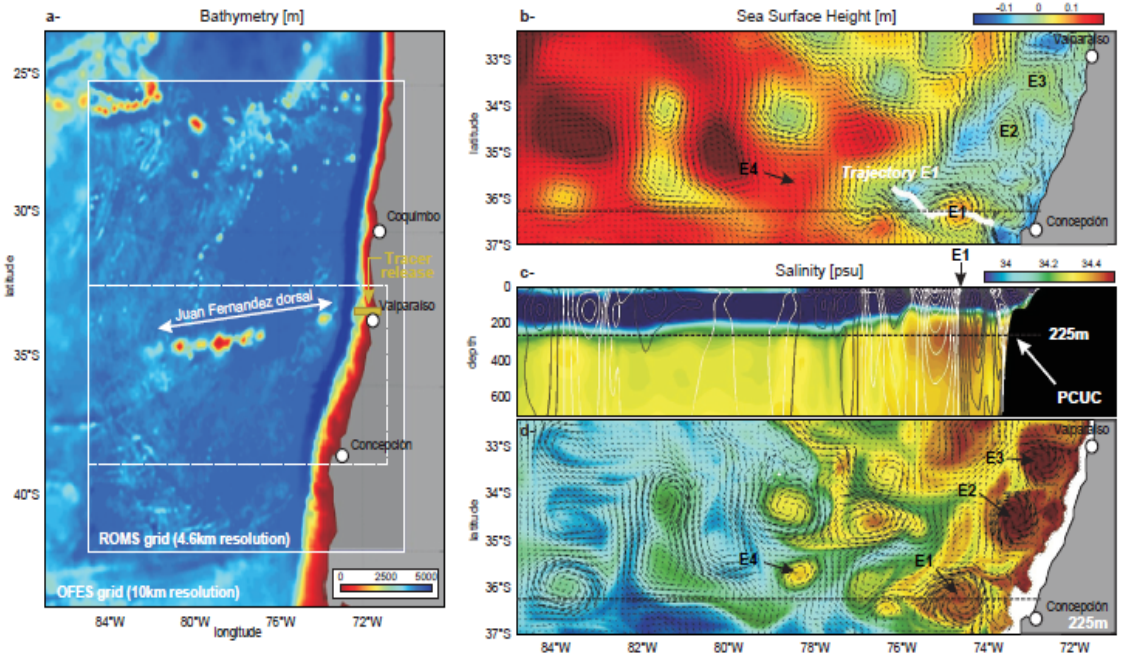
Transport of:
Heat, salt,
Low oxygen,
Nutrients,
Matter
Organisms

Upwelling: nutrients

S. HORMAZABAL et al. (in review)

SATELLITE & HYDROGRAPHIC DATA - CRUISES

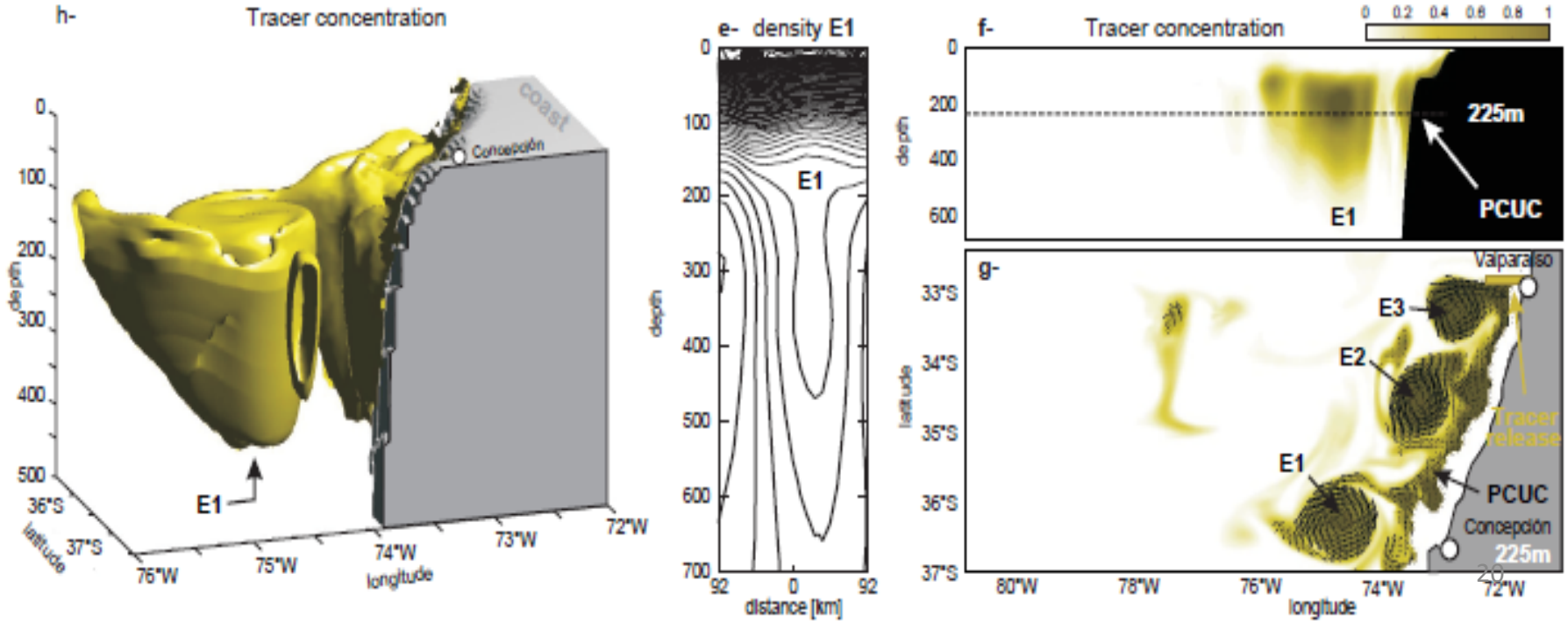




SATELLITE DATA & MODELLING + TRACER EXPERIMENT

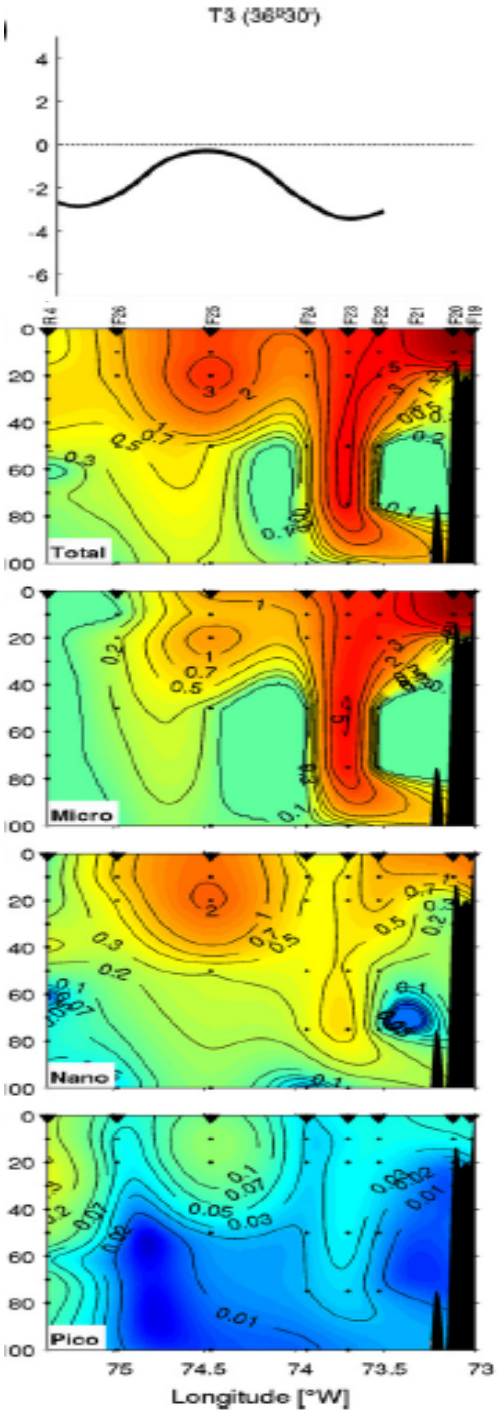
MESOSCALE INTRATHERMOCLINE EDDIES

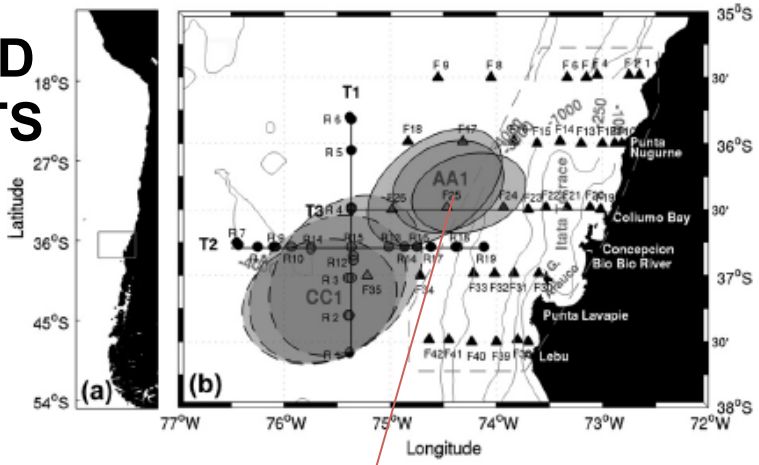
S. HORMAZABAL et al.
(in review)

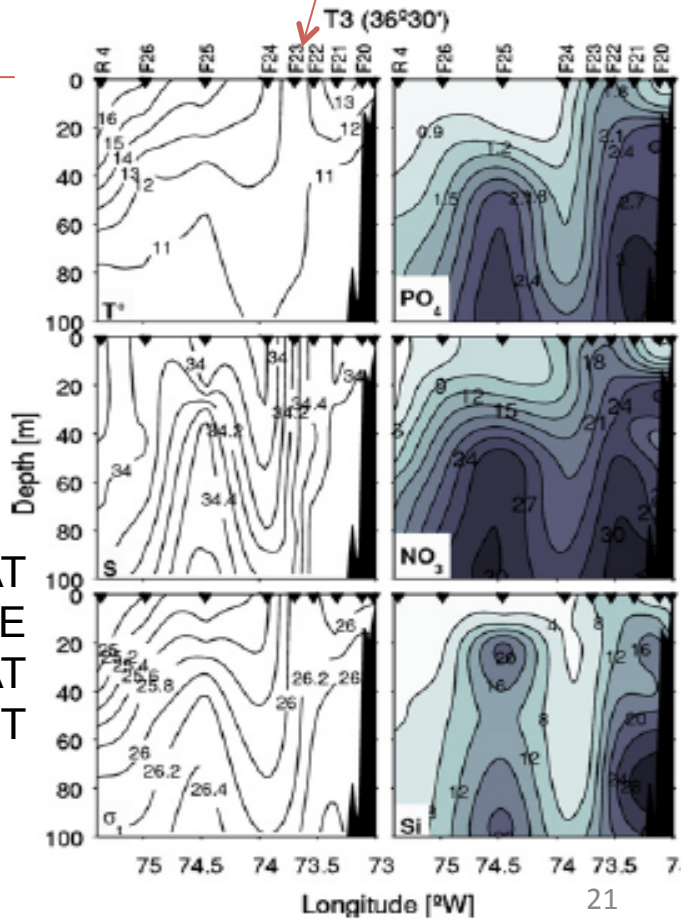


IMPACT OF ITEs AND UPWELLING FRONTS ON NUTRIENTS & PLANKTON

SATELLITE & HYDROGRAPHIC DATA - CRUISES







CHL-A DISTRIBUTION AND SIZE CLASS COMPOSITION

→NO OFFSHORE ADVECTION BY ITE

→ SUBDUCTION AT FRONT

NUTRIENT UPWELLING AT ITE

NUTRIENT SUBDUCTION AT FRONT

CE MORALES ET AL (2012)

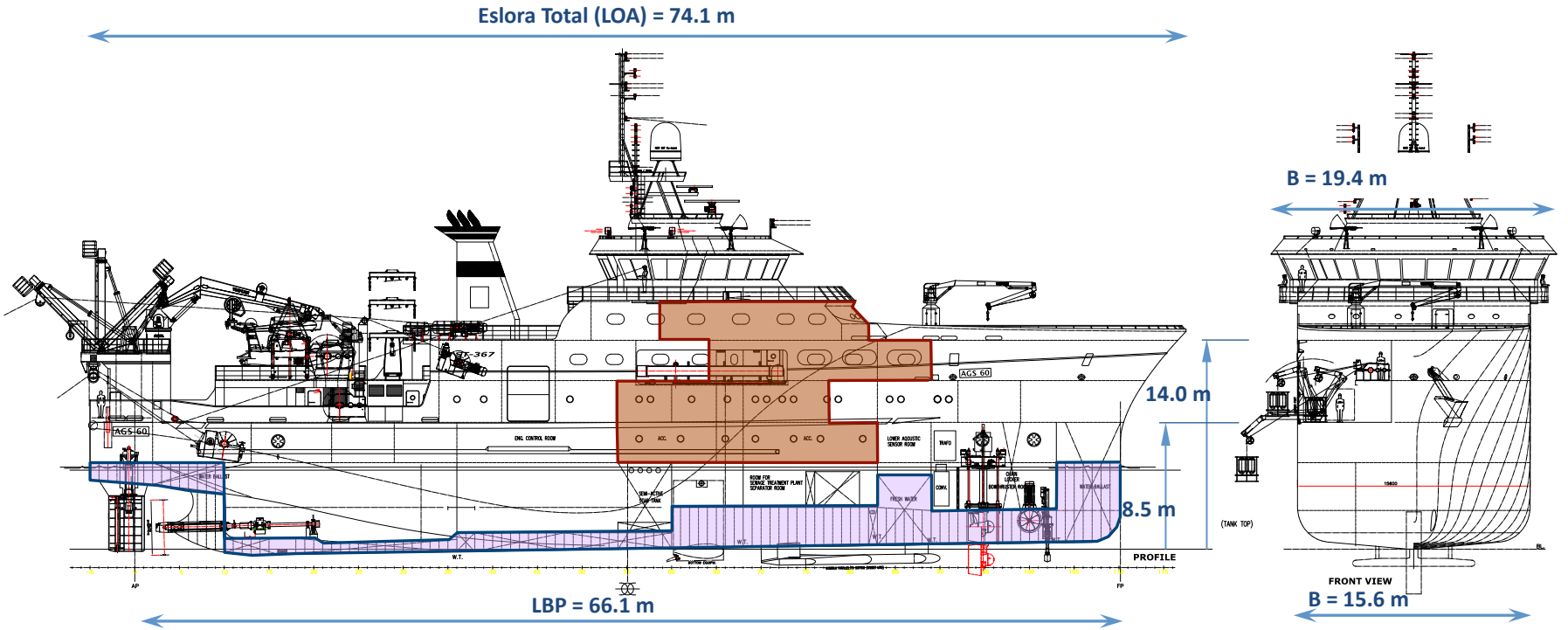
OCEAN OBSERVING SYSTEMS IN THE ESP – CHILE NEW PLATFORM (2013-)

CABO DE HORNOS

OCEANOGRAPHIC AND FISHERIES RESEARCH PLATFORMS

Capacidades

CARACTERISTICAS PRINCIPALES



ESLORA TOTAL (Largo) = 74.10 m

ESLORA ENTRE PERP. = 66.10 m

MANGA MOLD. (Ancho) = 15.60 m

MANGA EN PUENTE = 19.14 m

PUNTAL CUB 1 (PPAL) = 8.5 m

PUNTAL CUB. 02 = 14.0 m

Calado Promedio = 5.8 m

CAPACIDAD DE PERS. (TOT. 68+HOSP.) = 9 OFICIALES
34 GENTE DE MAR
25 CIENTIFICOS (17+8)

AUTONOMÍA:

35 días navegando sin reabastecimiento
6.240 millas náuticas a 10,5 nudos y 62 estaciones de 4 horas (DP).
Velocidad máxima +14,5 nudos

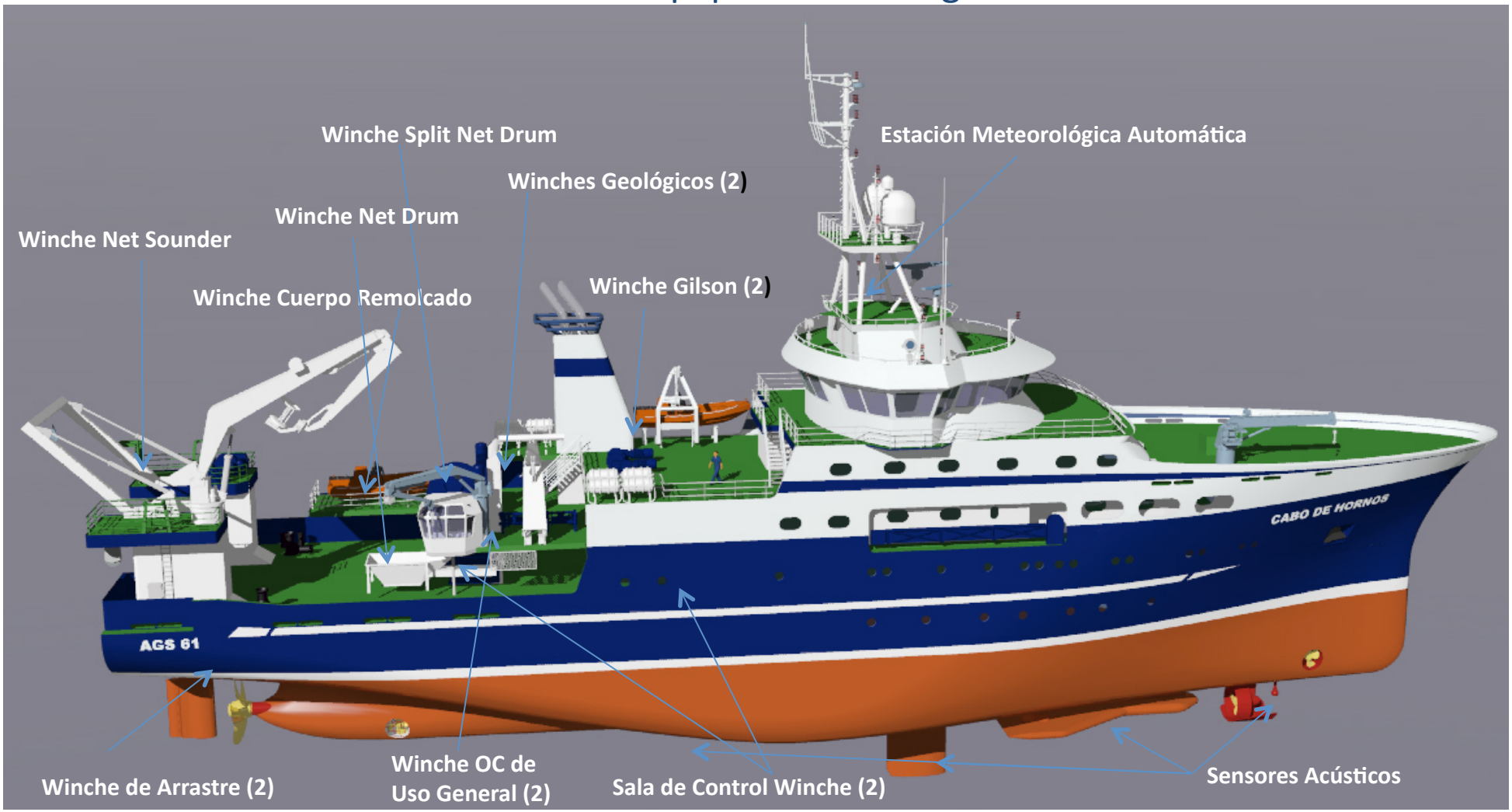
CAPACIDAD DE LIQUIDOS:

COMBUSTIBLE = 438 m^3
AGUA DULCE = 138.8 m^3
AGUA DE LASTRE = 491.8 m^3
ACEITE LUB. = 5.56 m^3
ACEITE HIDR. = 4.2 m^3

DESPLAZAMIENTO: +3000 TONS.

Capacidades

Ubicación de Equipos de Investigación



TRAINING OCEAN OBSERVING SYSTEMS IN THE ESP - CHILE

GRADUATE EDUCATION IN OCEANOGRAPHY - LATIN AMERICAN (UdeC)

→ OPENING TO INTERNATIONAL CO-DEGREES & CO-TUTORING

UNECSO-IOC Chair in LA

POGO TRAINING INTERNATIONAL SUPPORT