# Challenges of Maintaining Time Series in Developing Countries
# The Latin-American Antares network

Vivian Lutz
CONICET - INIDEP Argentina

**Antares** (www.antares.ws)

**ChloroGIN** (www.chlorogin.org)

CONICET MAR DEL PLATA

INIDEP

ANTARES

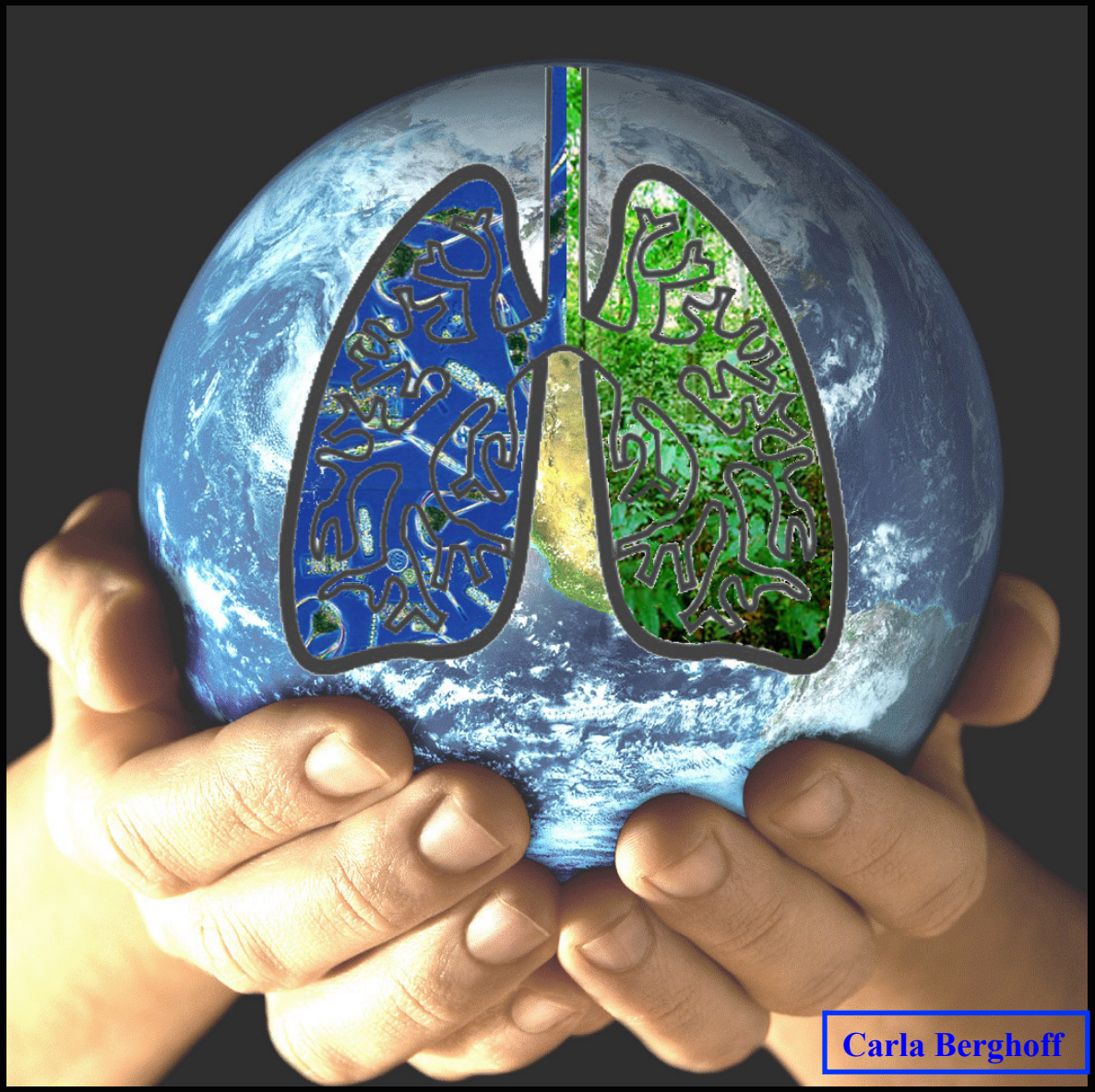
chloroGIN

# Importance Ocean Observations

- Anthropogenic action is affecting the Earth
  - Increase in atmospheric $CO_2$
  - Increase in temperature
  - Decrease in biodiversity or Changes in species distribution
  - ……
- In turn these changes in the ecosystems affect human society (health, food, livelihood,…)
- These effects may worsen as human population increases (~ 1 million/10 days)
- Understand changes occurring on Earth in order to take necessary decisions to:
  - Avoid worsening the damage
  - Design mitigation strategies
- Earth Observations (Ocean & Land)
- Understand processes, predict possible changes (models)

**Translate this scientific knowledge into information usable by decision makers**

# Why pay attention to the Ocean?




If rain forests on land are considered a lung of the planet, phytoplankton in the ocean are the other lung.

# Enhance Ocean Observations

- ALL papers on modelling point out the sparcity and gaps in data. Claiming for more and better oceanic observations to validate and make more robust models.
- Need for data:
  - Remote  Sensing (synoptic, high frequency, economic)
  - *In situ* buoys data (high frequency and allow measurements not able to acquire through satellites)
  - *In situ* ship data (low frequency, but closer to real: high quality, biodiversity, rates, and validation for satellite products and buoy measurements).

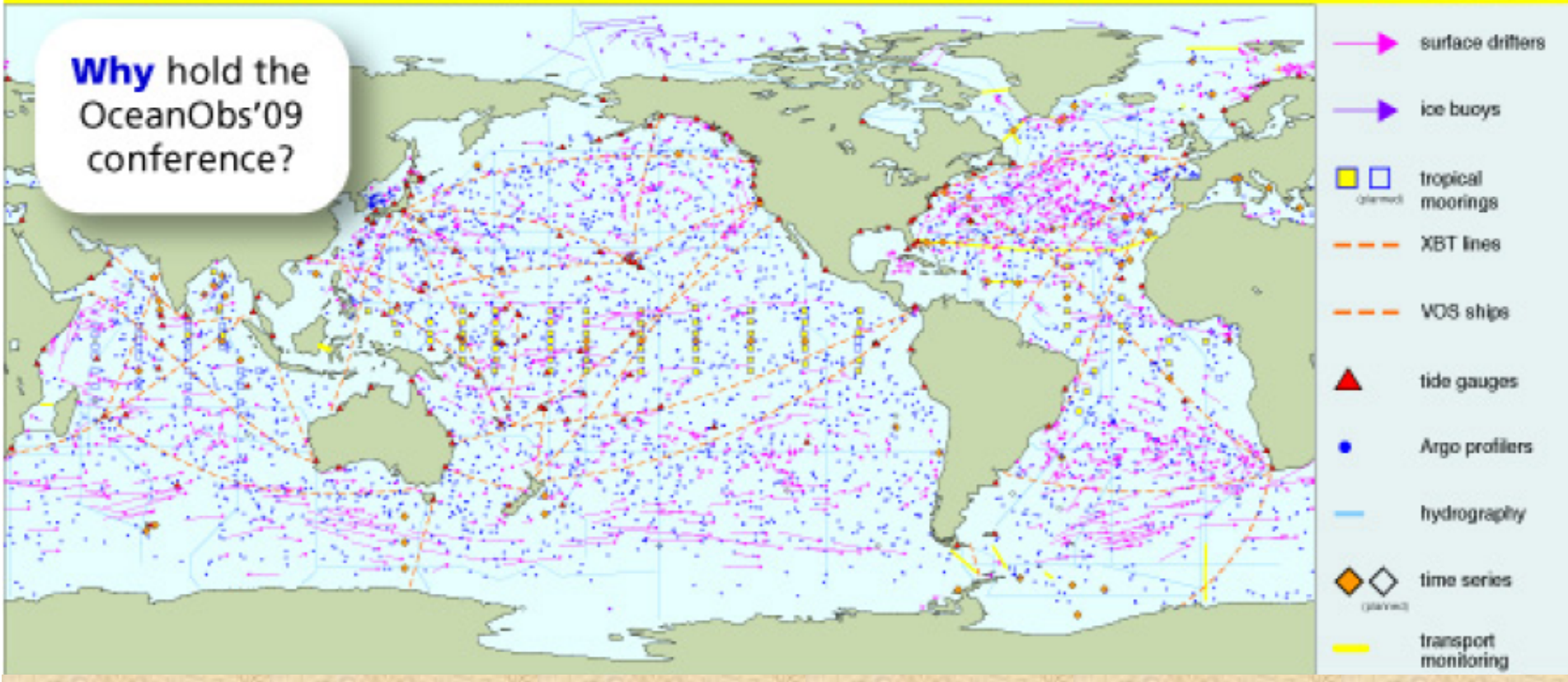
# Importance Networks of Time Series

- If the problem is global,
- and the ocean is a dynamic, complex and interconnected system:
- that means we need measurements from all parts of the ocean to understand the processes affecting it.
- Furthermore since these effects are changing in time,
- then we need to make observations in all regions of the ocean throughout time.

**To understand behaviour of the ocean the concerted effort from all countries involved is required.**

# OceanObs'09

*Ocean information for society: sustaining the benefits, realizing the potential*



- More measurements have /are been carried out in the North Hemisphere, where highly developed oceanographic centers are located.

- Nevertheless, measurements are being carried out in other areas by research centers in developing countries.

  Main difficulty: Less resources dedicated to science.

If measurements are needed in the whole ocean, but in many places the capacity to carry out these observations is lower, what is the solution:

- Expect that developed centers make extensive studies in other geographical areas to cover the gaps?

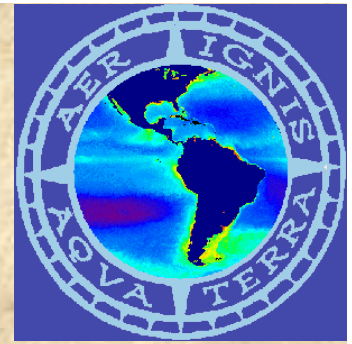
  Not very feasible, nor reasonable, in the case of coastal time-series.

  or

- Try to enhance the capacity of developing countries to carry out ocean observations and **participate actively** in studying this global problem?


AER IGNIS
AQVA TERRA
ANTARES

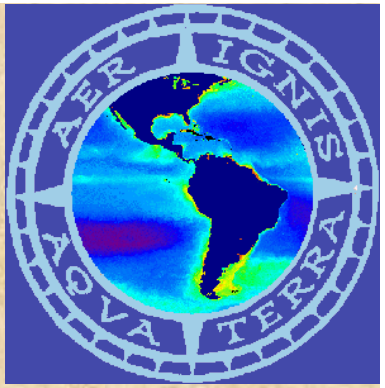
# ANTARES




- *Idea:* Training course IOCCG/POGO University of Concepción (Chile) 2002. Promotors*: Trevor Platt and Shubha*
- *Created:* 2003 initiative IOCCG, POGO
- *Goal:* To study long-term changes in coastal ecosystems around Latin-America to distinguish natural variability from anthropogenic perturbations.
- *Main Components:*
  - *In situ* Time series stations
  - Remote sensing
  - Capacity Building

- It is proposed to link *in situ* data from time series stations with remote sensing observations.
- Create a database of satellite and *in situ* observations for scientific, educational and management purposes.

# ANTARES



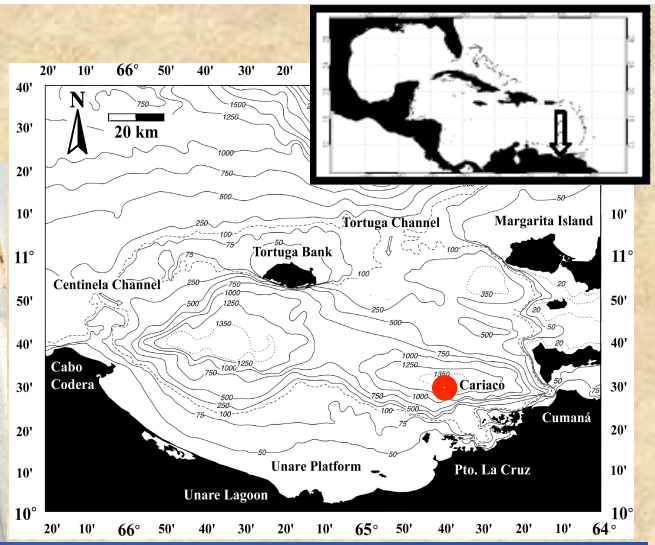

- *Participants:*
  - > 30 researchers
  - 16 institutions
  - 10 countries [Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Venezuela; Canada, USA]

  - Coordinator: Eduardo Santamaria del Angel (UABC, Mexico)
  - Executive Committee: Milton Kampel (INPE, Brazil)
    » Yrene Astor (EDIMAR, Venezuela)

www.antares.ws

# CARIACO (Venezuela)

ww.imars.usf.edu




- Location:10.5° N 64.67° W
- Started: 1995
- Sampling: Monthly
- Funds: FONACIT, NSF, NASA, etc.
- PIs: Yrene Astor,
  Frank Muller-Karger
- Main Goal: *Understanding the Link between the Ocean Surface and the Sinking Flux of Particulate Carbon in the Cariaco Basin.*

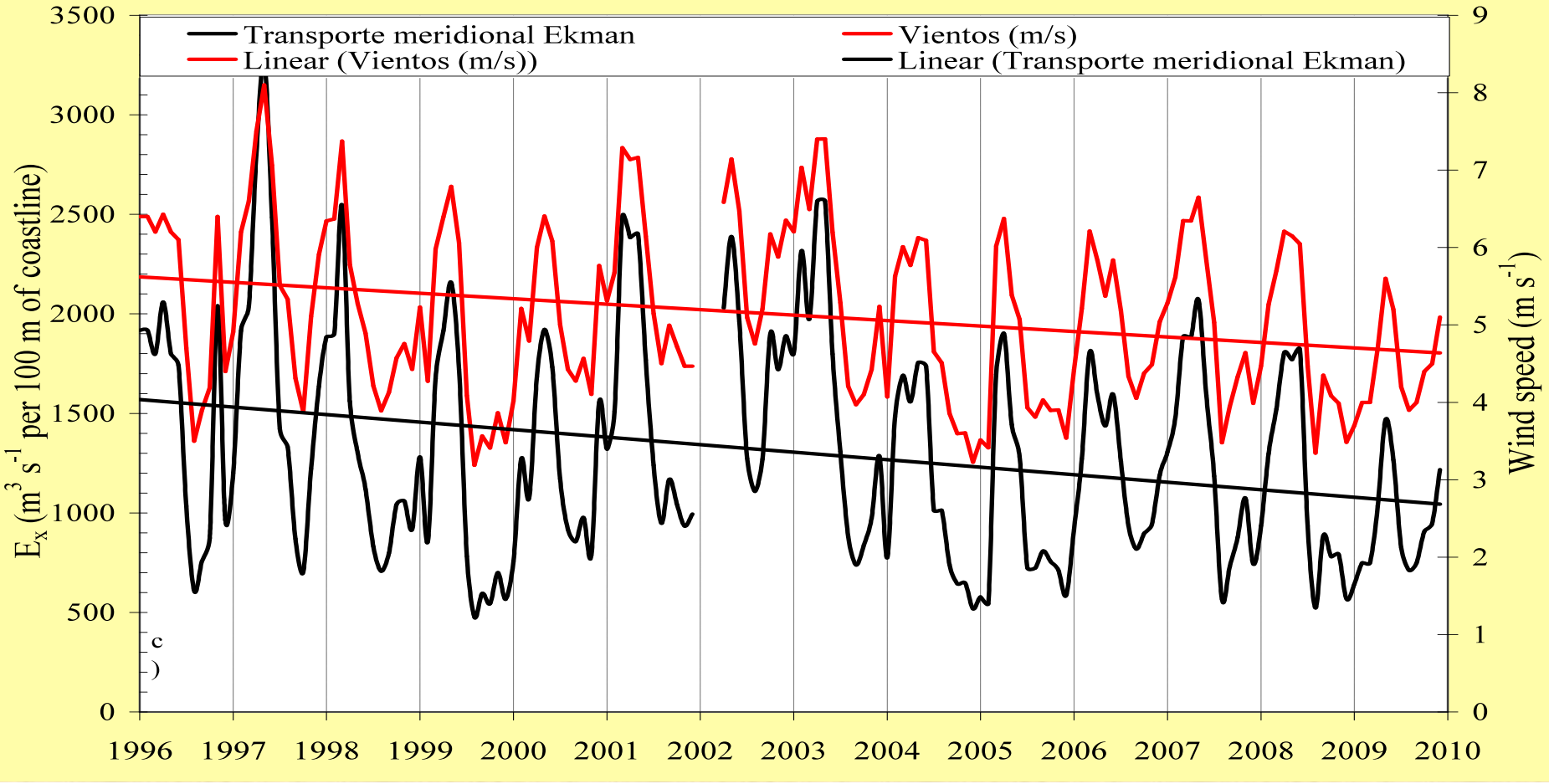
# Interannual variation in upwelling intensity

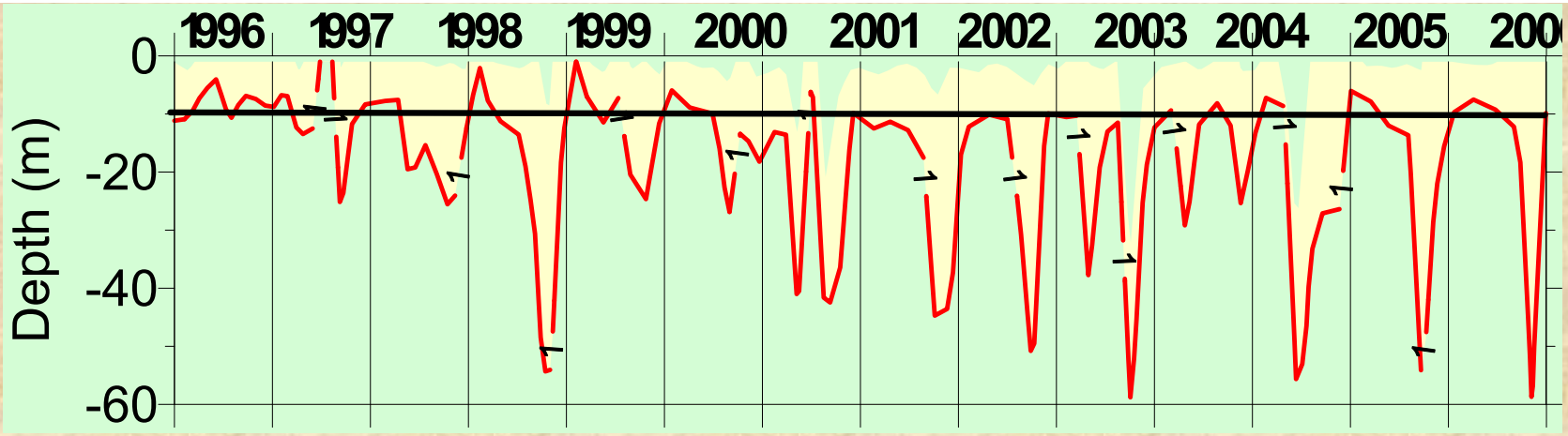
FUNDACIÓN LA SALLE de Ciencias Naturales

## Wind speed decrease:

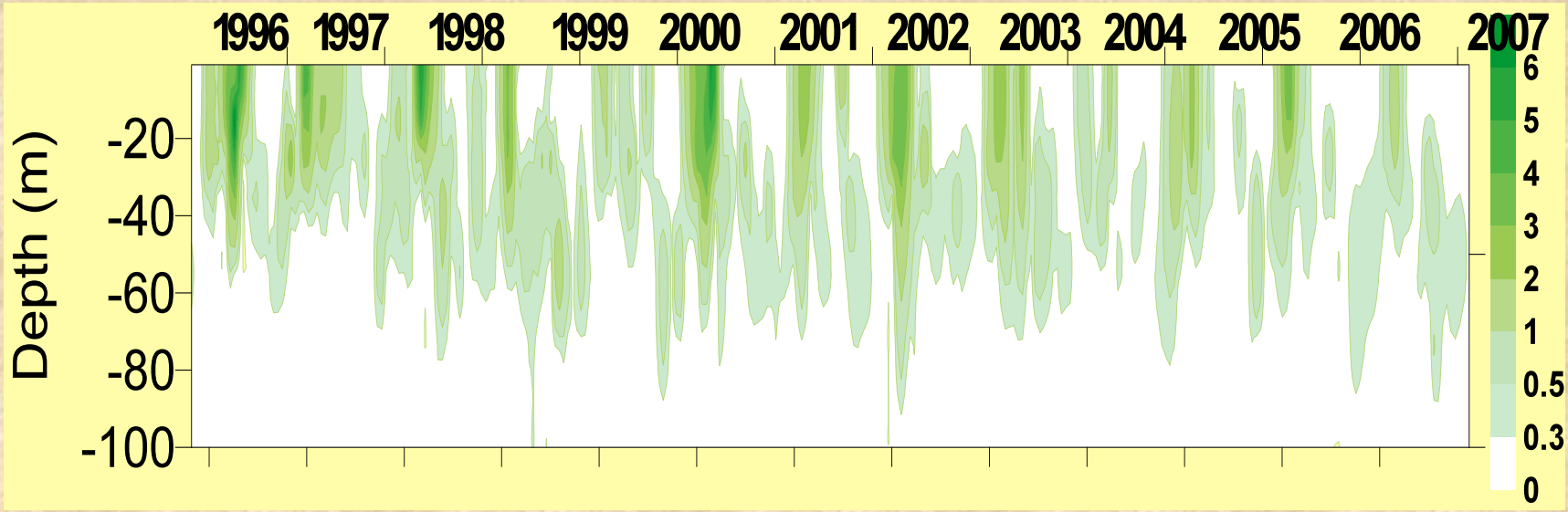
## -0.05 ± 0.02 m $s^{-1}$ per year

Astor et al., 2010; 2011





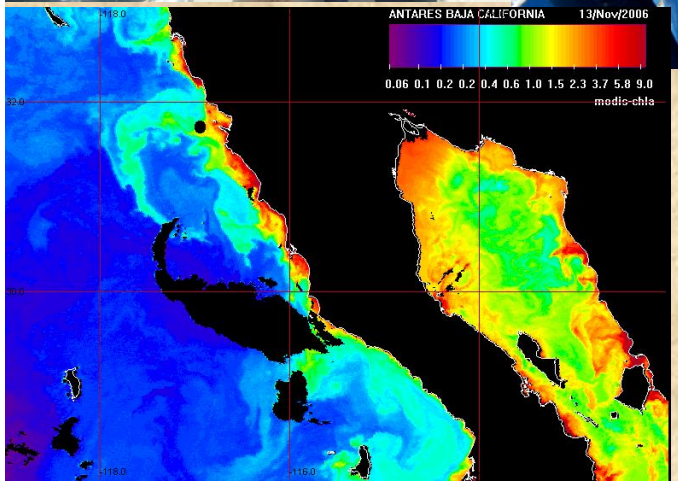

- **Upwelling intensity decreases**
- **Nutricline below mixed layer level, not reaching surface waters**




**Annual phytoplankton productivity has declined over same period**

Astor et al., 2010; 2011

**PhytOPlankton EcologY tEam POPEYE**

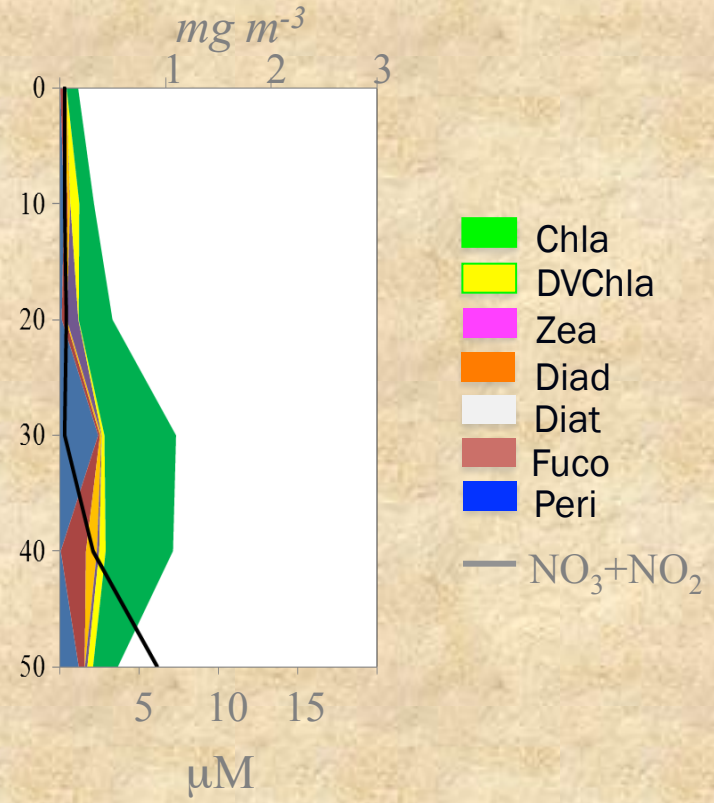


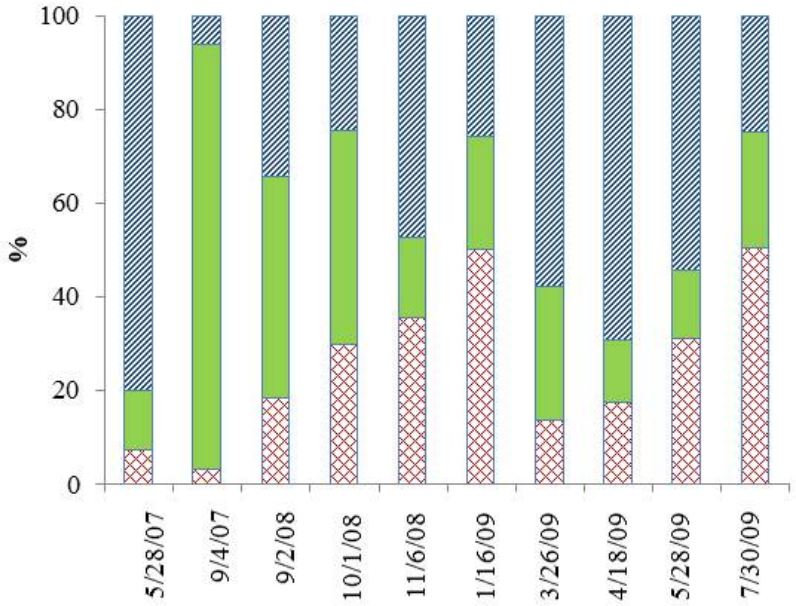

# Ensenada (México)

UNIVERSIDAD AUTONOMA DE BAJA CALIFORNIA

- Location: 31.75ºN 116.96ºW.
- Started: May 2007
- Sampling: ~ monthly (with some gaps).
- Funds: UABC Grant.
- PIs: Eduardo Santamaria-del-Angel
  Adriana Gonzalez Silvera
  Roberto Millan-Nunez
- Main Goal: *To study time variability (seasonal, interanual and decadal changes) and mesoscale structures in optical and biological* properties.

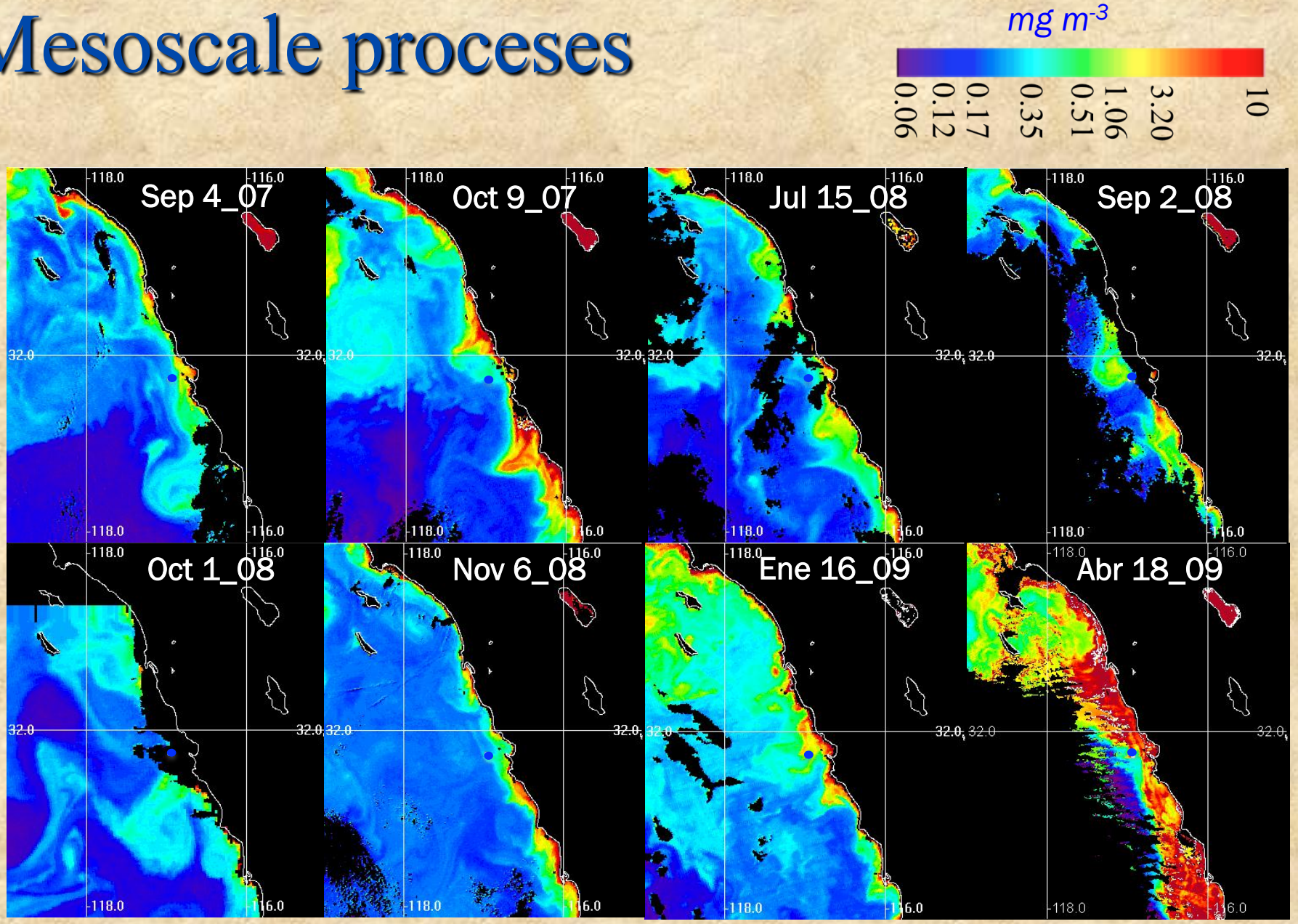
# Pigments Composition



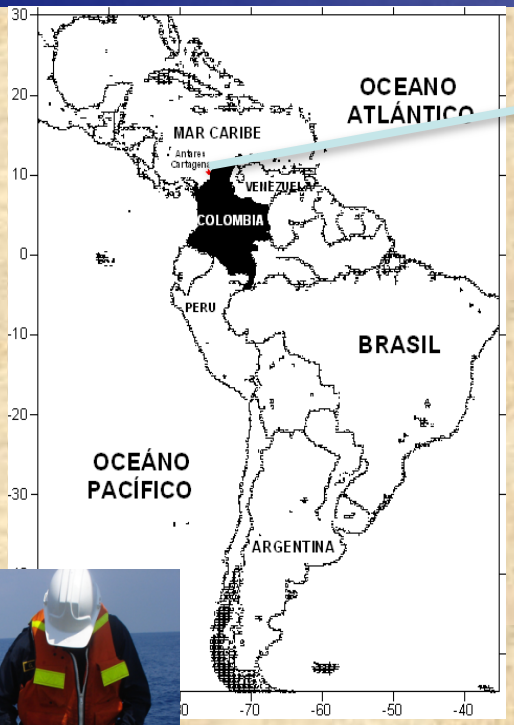

% contribution of $a_{ph}(440)$ (green), $a_d(440)$ (red), and $a_{CDOM}(440)$ (blue) to total absorption.

# Mesoscale proceses



# ANTARES CARTAGENA (Colombia)

Centro de Investigaciones Oceanográficas e Hidrográficas (CIOH)



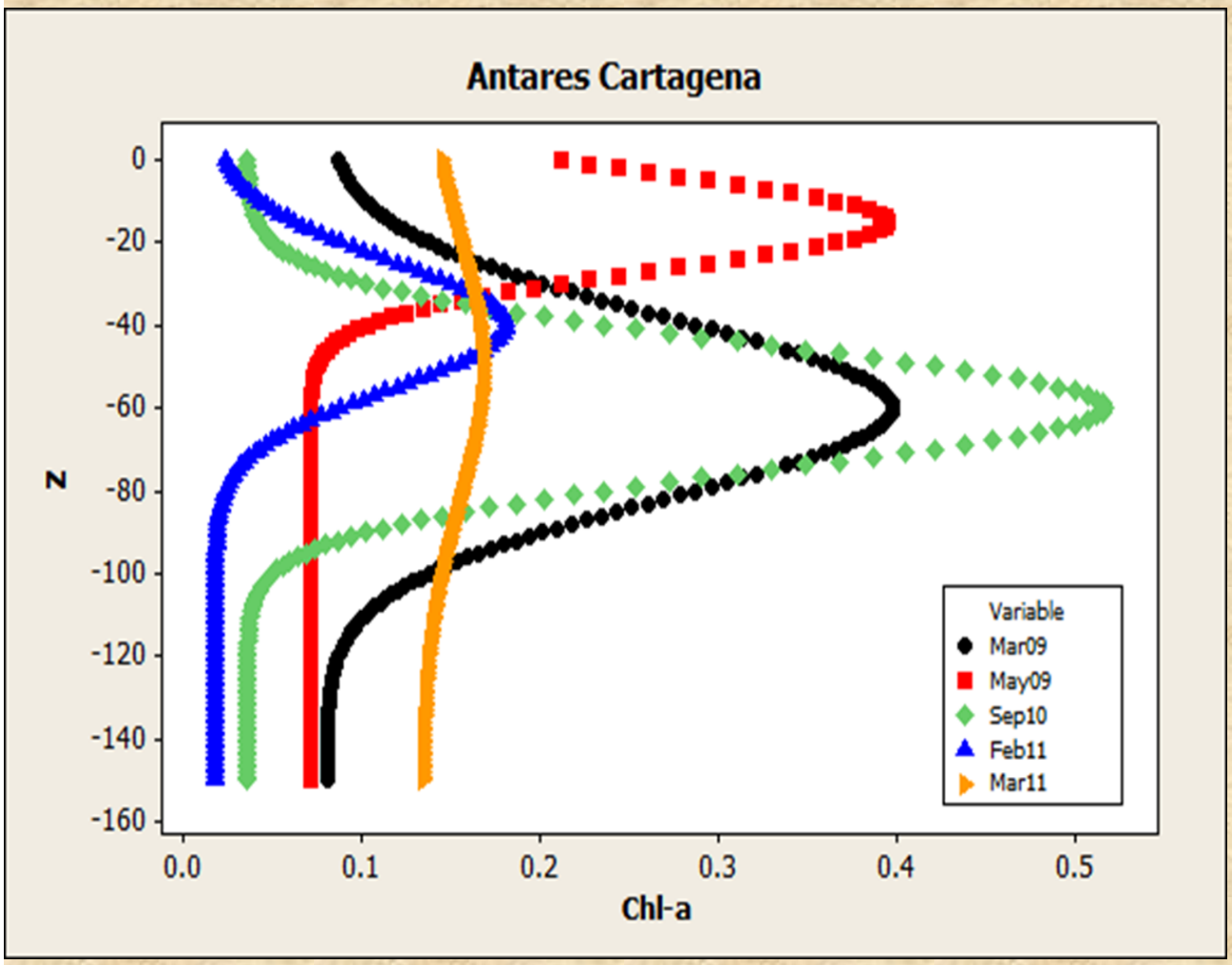

- Location: 10°22´32´´N - 76°00´34´´W
- Started: July 2008
- Sampling: not fixed frequency.
- PIs: Mary Luz Cañón Páez
  Juan Acosta

Other participants: Gustavo Tous, Javier Llamas, Johana Arregoces, Joaquín Rivero

- Goal: *To develop a data-base from the time-series to contribute to studies on: climate change, biological oceanography and marine optics.*

MCanon@dimar.mil.co

# Preliminary Results

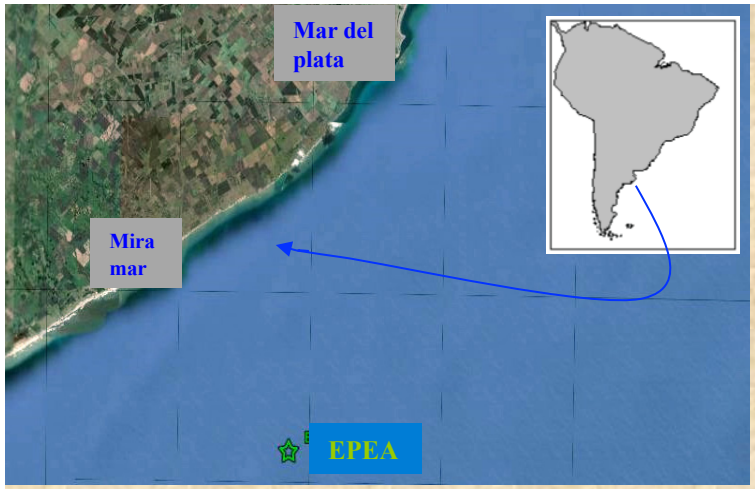



***Chlorophyll-modelled*** **profiles show deep maxima.**

**Changing throughout the year in magnitude and depth.**

**The highest peak corresponding to the rainy season.**

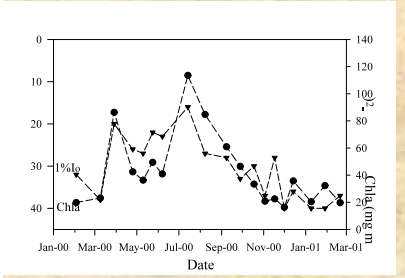
MCanon@dimar.mil.co



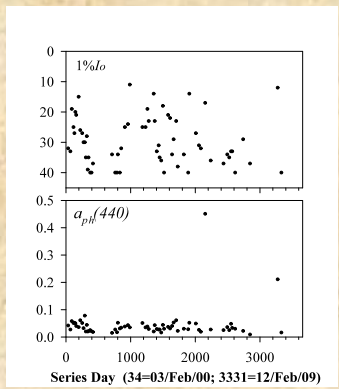

# EPEA (Argentina)

- Location: 38º 28’ S, 57º 41’ W.
- Started: February 2000
- Sampling: ~ monthly (unfortunately with big gaps).
- Funds: INIDEP, project ‘Plankton Dynamics (DiPlaMCC)’
- PI: Ruben Negri
- Main Goal: *To understand the variability in the dynamics and the diversity of plankton and environmental conditions in relationship to climatic changes.*

# Annual cycle 2000 - 2001




# Inter-annual cycle 2000 - 2009




***Z 1% Io*** Deeper in summer:

- •stratified,
- •low phytoplankton biomass,
- •low re-suspension of sediments.

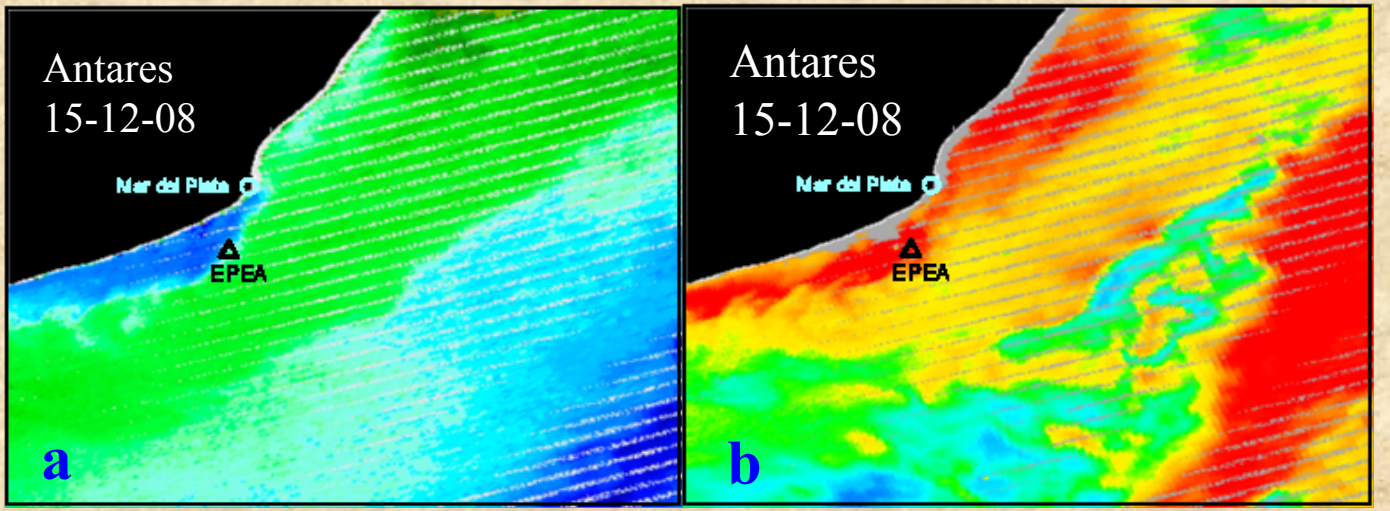
(Lutz et al., 2006)

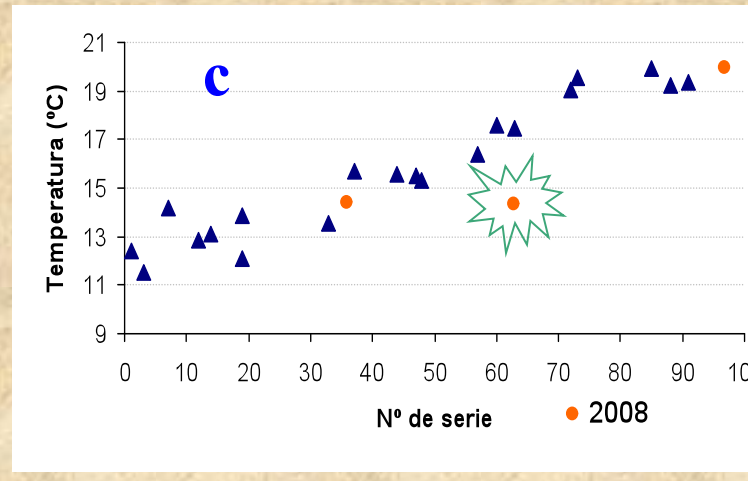
***Z 1% Io***

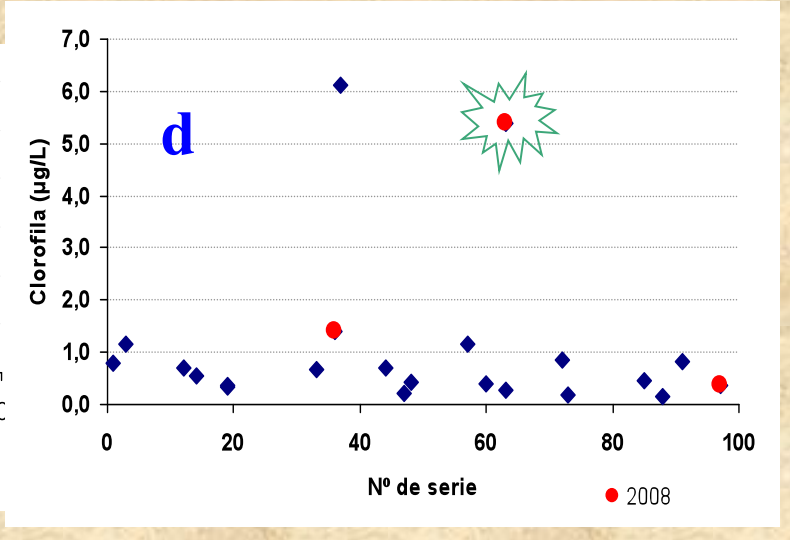
- •Higher variability
- •December 2008
  - •Shallow ***Z 1% Io***
  - •High Phytoplankton absorption

(Lutz et al., 2010)

# Especial Bloom Events



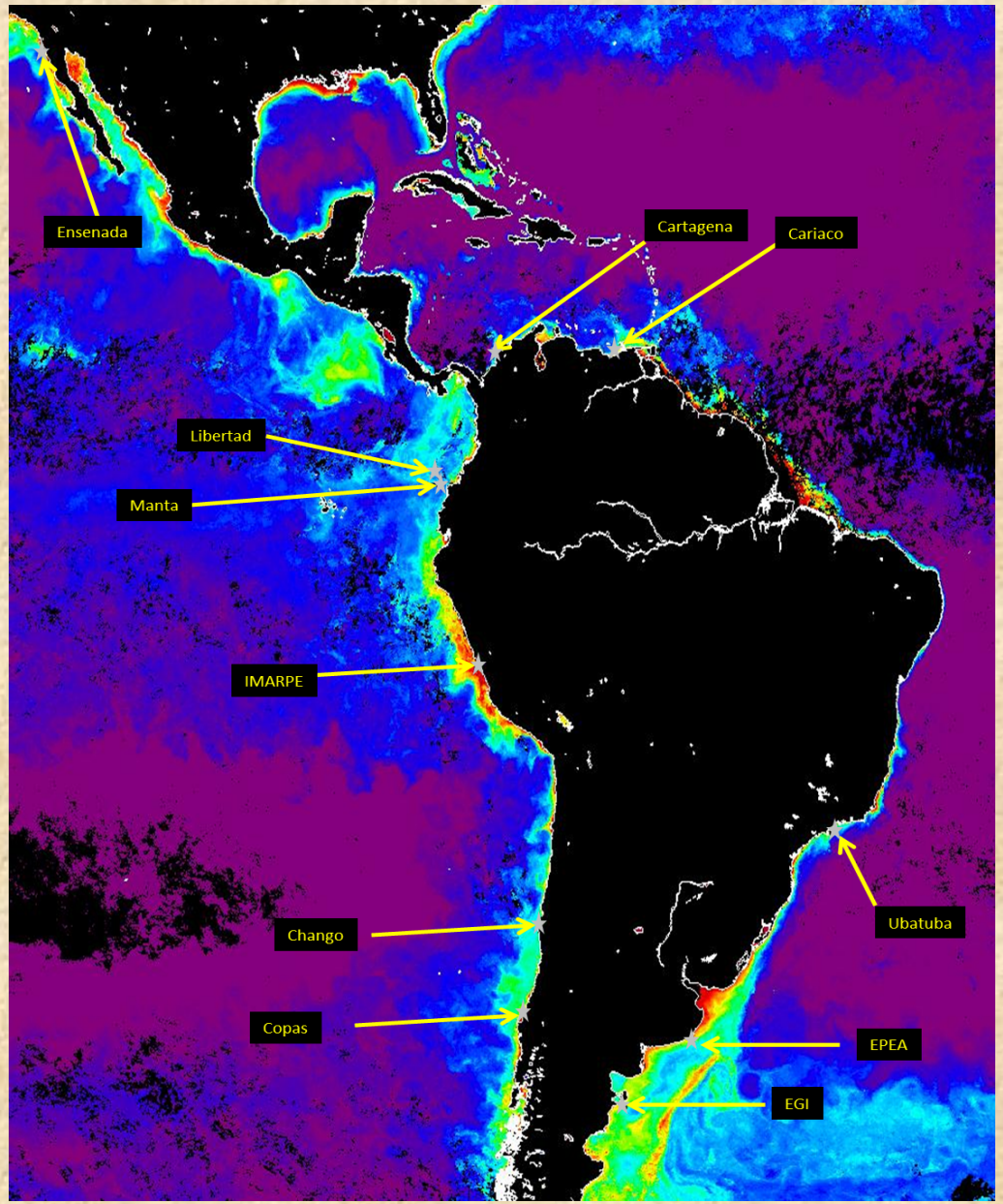



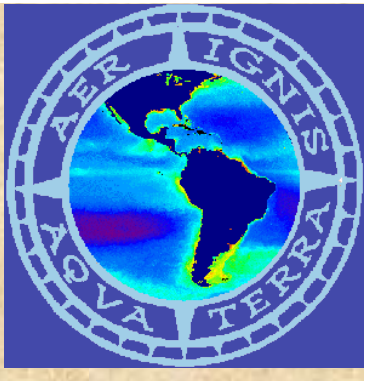

SST and Chla from MODIS (www.antares.ws), for the 15 December 2008.
Variations in *in situ* values for the months October to January (2000-2009).

(Negri et al., 2009)

# ANTARES *In situ* Time Series

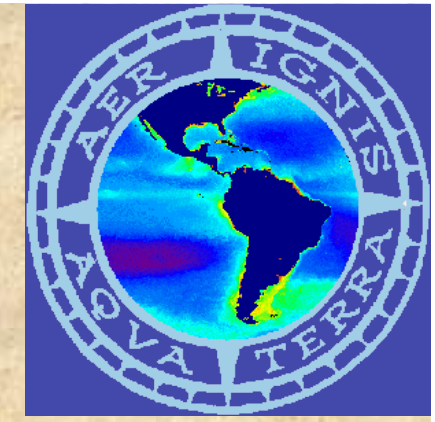


# Approach




- The *in situ* component of the ANTARES network is built on ongoing initiatives in different countries in Latin-America.
  - No common financial support for the network.
  - It relies entirely on local funds at each site.
  - Different main objectives at each site.
  - Different level of development at each site.
  - Common core of shared measurements:
    - **Surface Seawater Temperature**
    - **Surface Chlorophyll-a concentration**

# Challenges of running in situ Time series stations in Latin-America

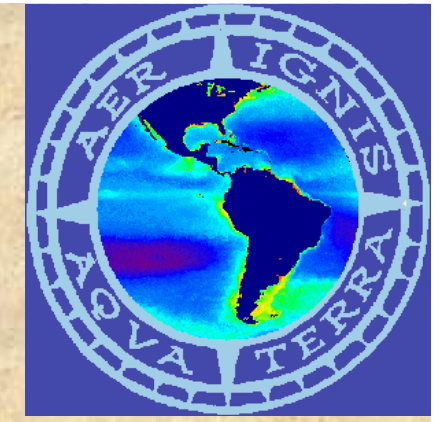



**Maintaining continuity in the frequency and improving field sampling.**

Main difficulty: Less resources dedicated to science

- Less people being trained (difficulty to get scholarships and jobs in oceanography)
- Not everywhere they have research vessels, or difficult to mantain them
- Instruments and supplies have to be imported at ~ doble the price.
- Difficult to get some supplies even if you have the budget.
- Extremely difficult (close to impossible) to send an instrument for calibration or reparation to the USA or Europe.
- **Lack of political will**.

# Challenges at ANTARES Field Stations
# Possible Solutions?



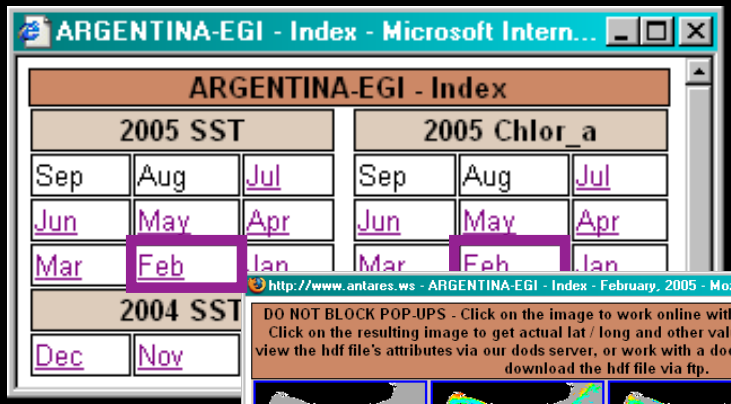

- **International grants, Antares obtained modest funds through:**
  - The 'Inter-American Institute for Global Change Research (IAI)' **IAI SGP in 2003 (30,000 USD)**

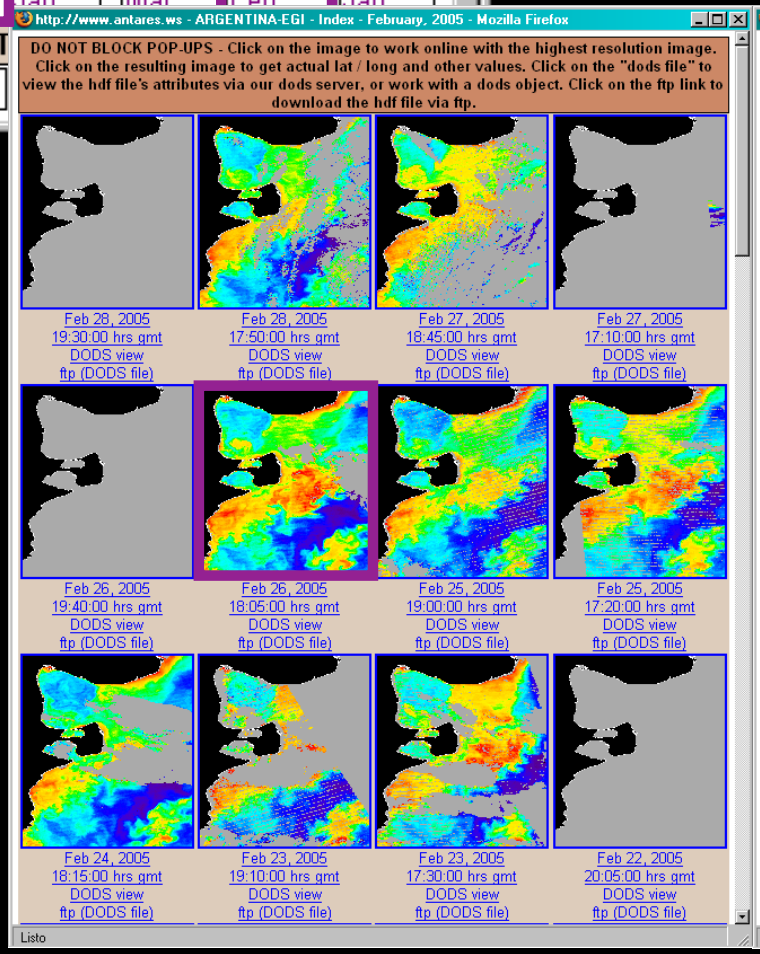
    **Implemented a system to process and distribute remote sensing information through its webpage. Generously developed by the Institute of Marine Remote Sensing (University of South Florida, USA).**

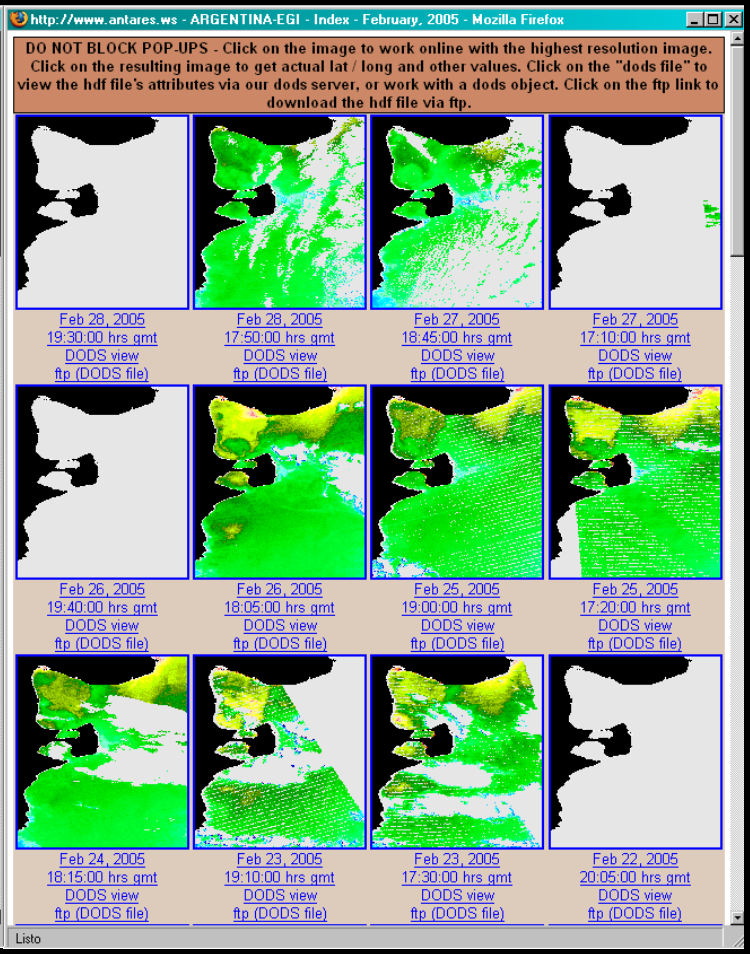
# Argentina – Chla & SST

SST

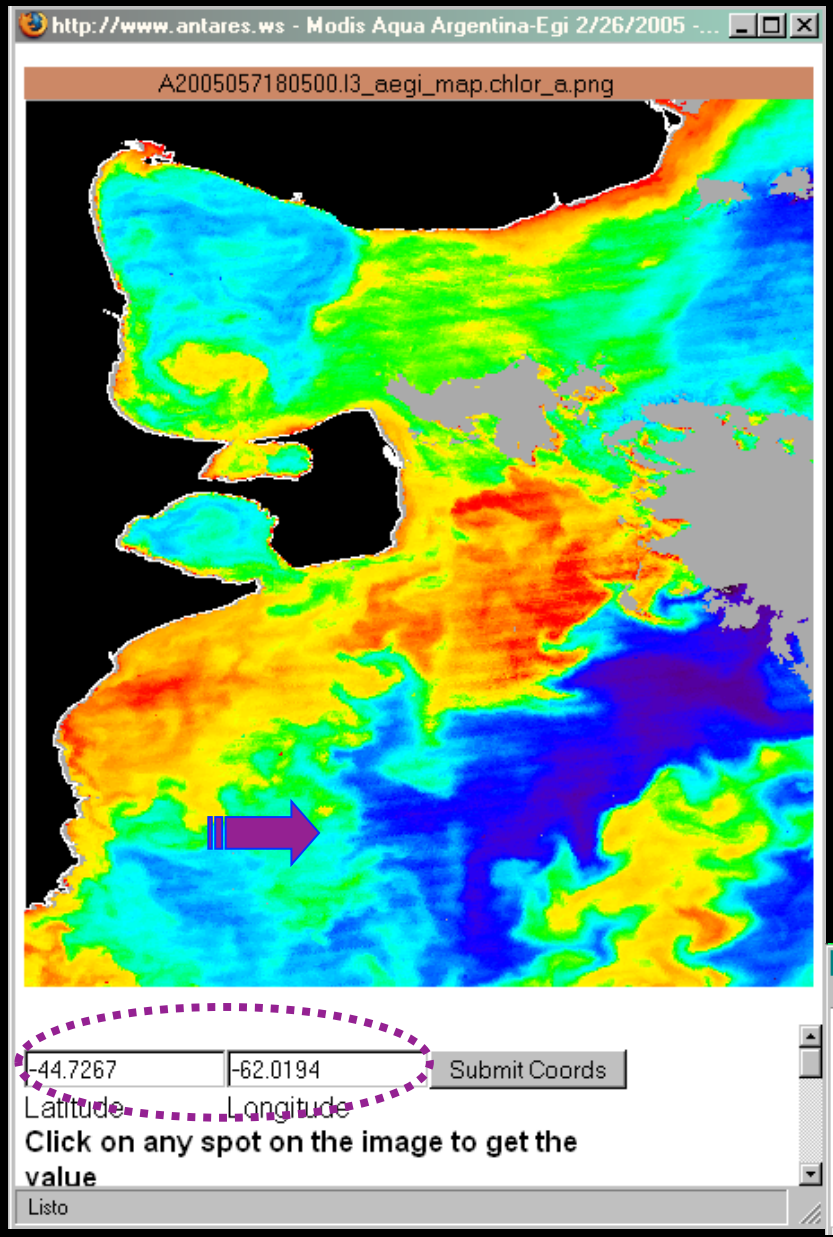
Chla

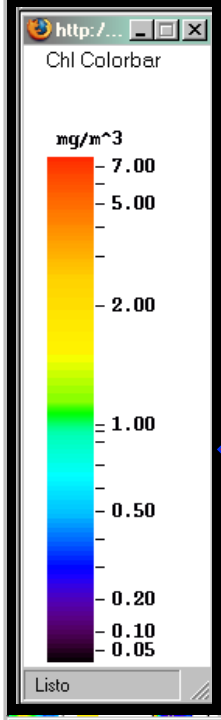


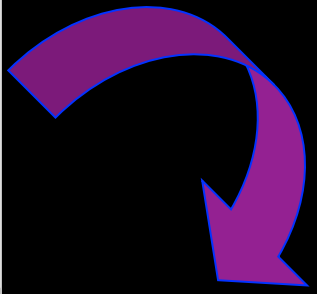



# ANTARES:Argentina
# February 26 2005



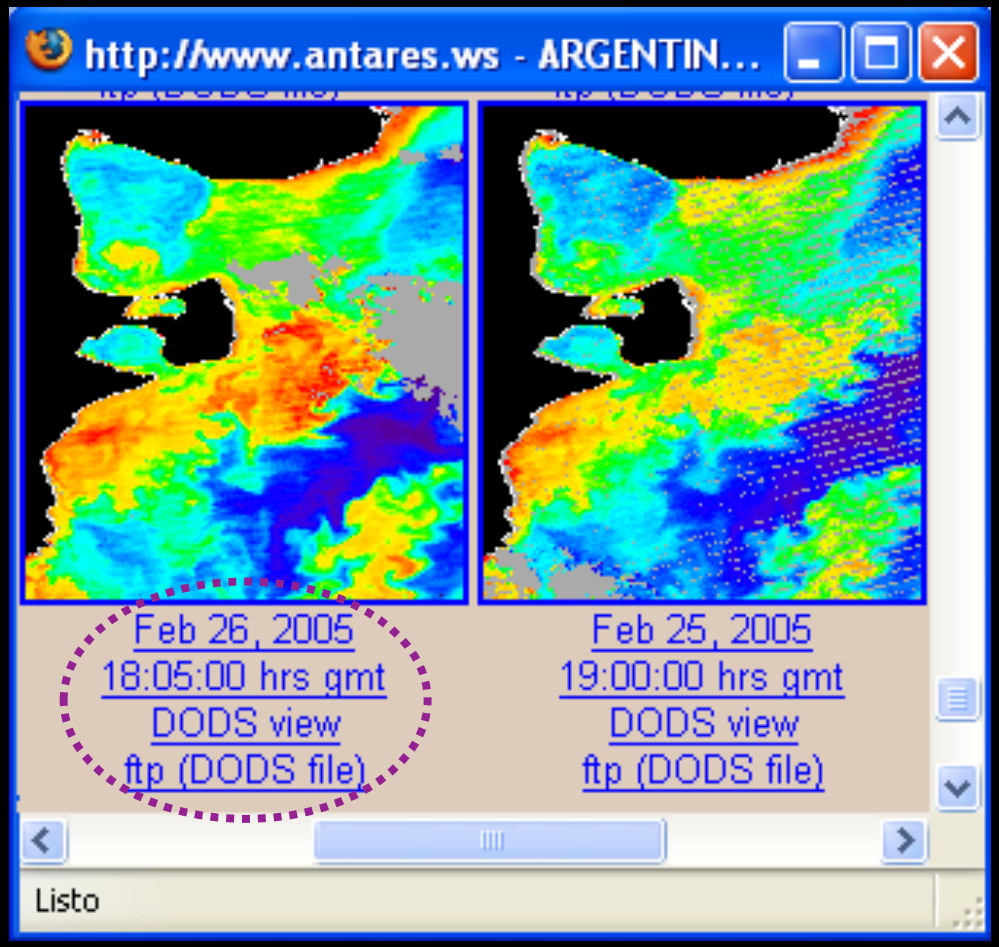



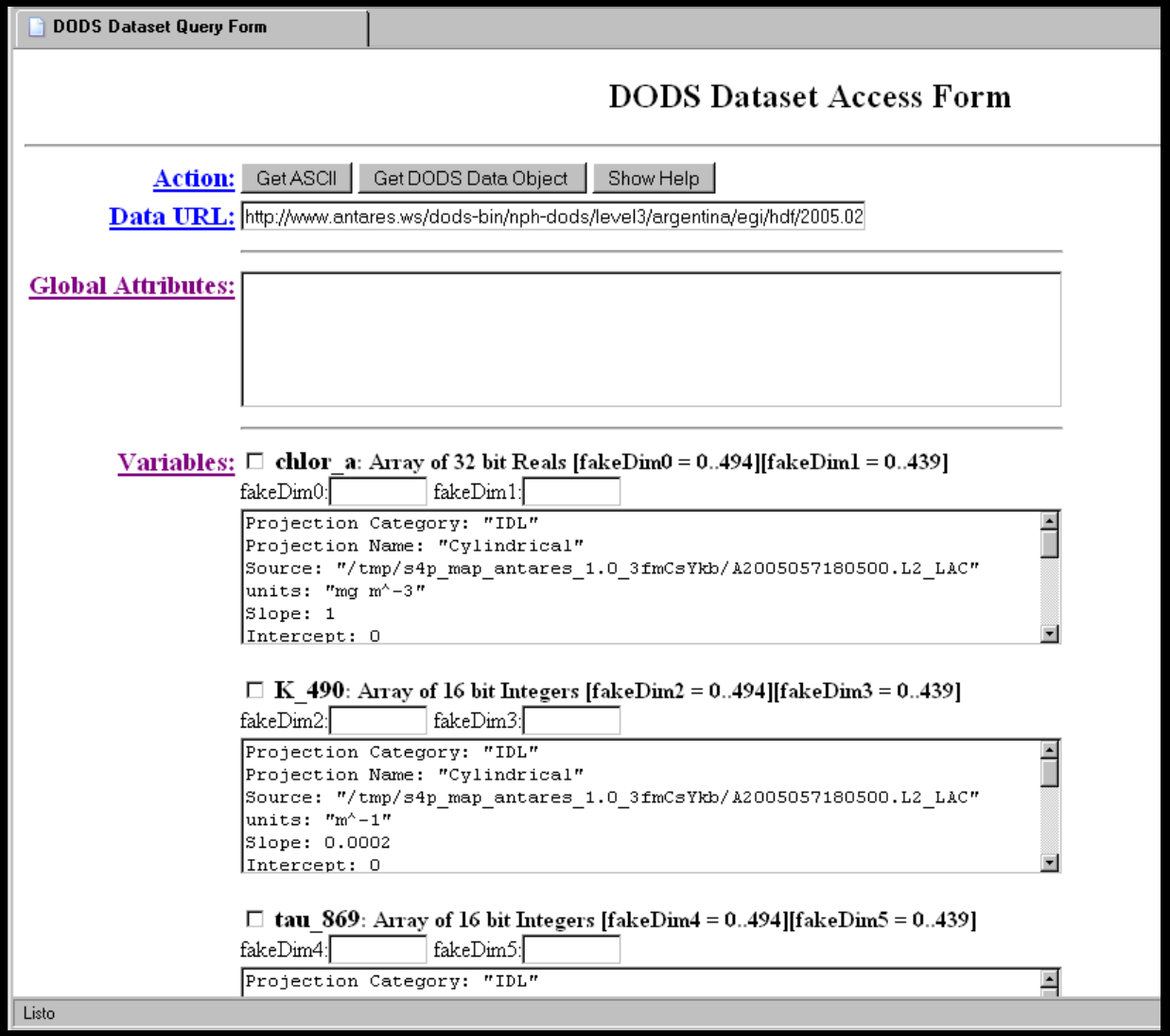

Modis Aqua A2005057180500.l3_aegi_map.hdf

| Click | Lat. | Lon. | chlor_a | sst | l2_flags |
|---|---|---|---|---|---|
| 4 | -44.7267 | -62.0194 | 3.72891 | 18.02 | |
| 3 | -44.0800 | -64.1970 | 0.787325 | 19.125 | |
| 2 | -43.0233 | -62.7847 | 6.92477 | 19.215 | Lw < 0 |
| 1 | -43.7702 | -62.7665 | 0.255918 | 19.19 | |

# DODS
# (Distributed Ocean data System)

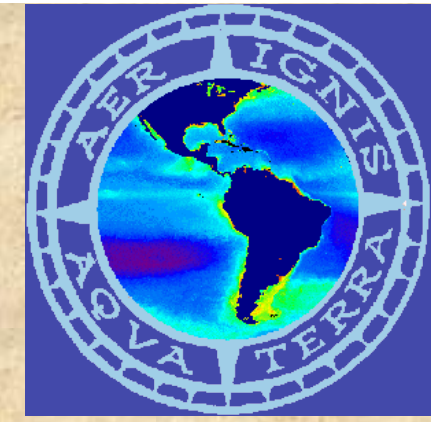


# DODS Data Access




ANTARES

# Challenges at ANTARES Field Stations
# Possible Solutions?




- International grants, Antares obtained modest funds through:
  - GEO, to carry out a workshop in 2006 'The Chlorophyll Pilot Study (Enhanced Antares Network)'

    Output:

    -Creation of 'ChloroGIN' global network (www.chlorogin.org)

    -Chlorophyll-a intercalibration exercise

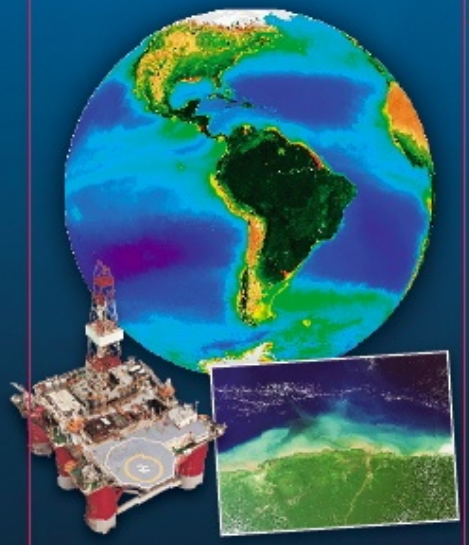
Chlorophyll Globally Integrated Network

# ChloroGIN

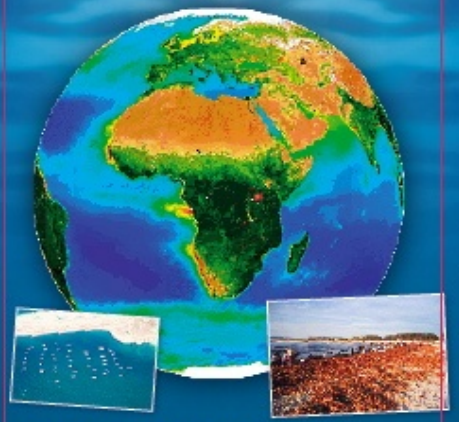
## Case Study: Americas

ChloroGIN-ANTARES is a Latin American network created in 2003, with the main goals of studying long-term changes in coastal ecosystems.

It provides coastal in situ and satellite data (temperature and chlorophyll) from around Latin America to network members and the public. Capacity building, and scientific and technical collaboration are major aims of the network.

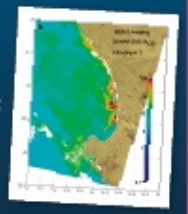


## Case Study: Africa



The Benguela system frequently suffers from harmful algal blooms, with severe impacts as toxins enter the food chain, or mass faunal mortalities as blooms collapse and hypoxia occurs.

Satellites and in situ data allow the rapid assessment of bloom extent and magnitude; and their potentially harmful nature and impact.

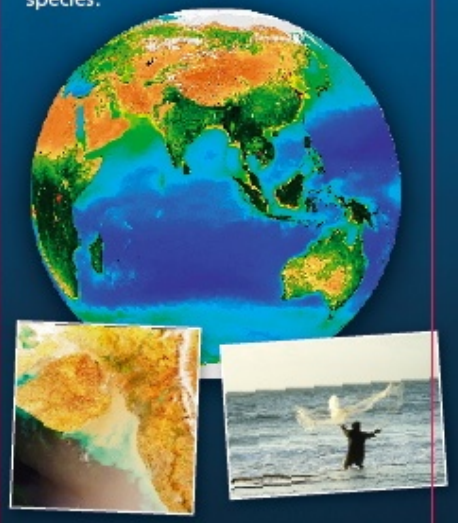


chloroGIN
Chlorophyll Globally Integrated Network

## Case Study: Asia

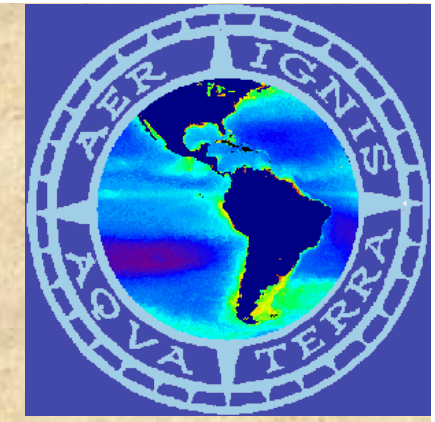
India has developed a system of scientific indicators of potential fishing zones using information from satellite-derived measurements of ocean colour and sea surface temperature

Oceanographic features such as fronts, meanders, and eddies are mapped in real time. These are used to disseminate Potential Fishing Zone (PFZ) advisories for the Indian fishing community, which includes almost 6 million fishermen catching both pelagic (e.g. sardine and tuna) and demersal (e.g. cod and flat fish) species.



Chlorophyll Globally Integrated Network

# Challenges at ANTARES Field Stations
# Possible Solutions?




- International grants, Antares obtained modest funds through:
  - Nippon Foundation and POGO for Capacity Building:
    - Two training courses in Brazil (2006 and 2009)
    - Small grant for the Alumni Network (NANO)

      Project Latin-American NANO (1 year; started April 2012; USD 25 K)

# The Project

Objectives:

1. Strengthen the interaction between the NANO and ANTARES networks.
2. Incorporate the estimation of pigment concentrations by HPLC in 6 ANTARES stations (as a first step).
3. Collect the relevant satellite information from the dates corresponding to the proposed HPLC-pigments sampling.

# Participants

nano

NF-POGO Alumni Network for Oceans

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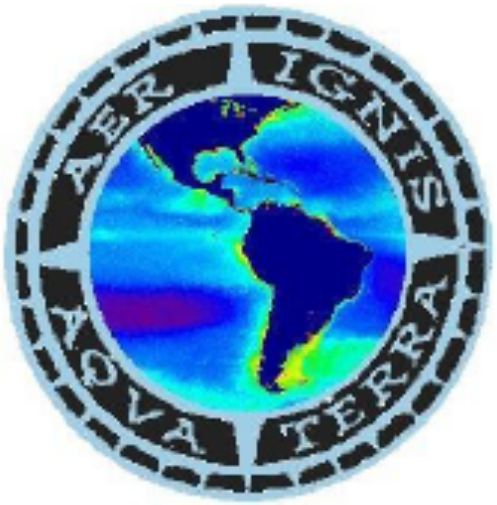


# Participants

6 ANTARES time series stations:

- Argentina
- Brazil
- Venezuela
- Mexico
- **Colombia**
- **Peru**

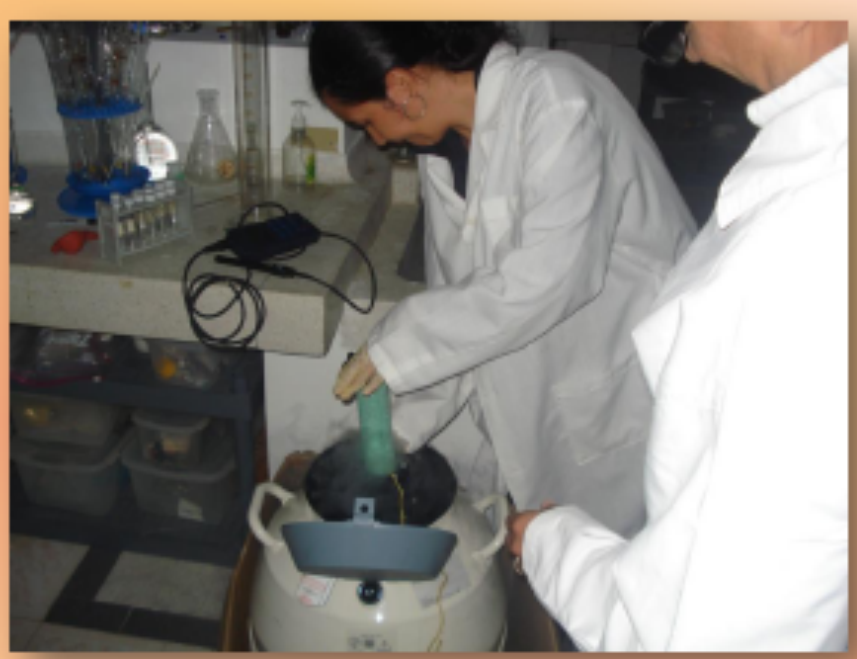
# Protocol discussion

- Sampling
  - Dark container
- Filtration
  - GF/F 0.7 µm; about 40 minutes; 5 PSI; dim light
- Sample storage on board
  - Liquid nitrogen or dry ice
- Sample storage at the laboratory
  - Liquid nitrogen or ultra-freezer

# New equipment acquired

**Thermo Fisher Scientific Biocane CK509X3**

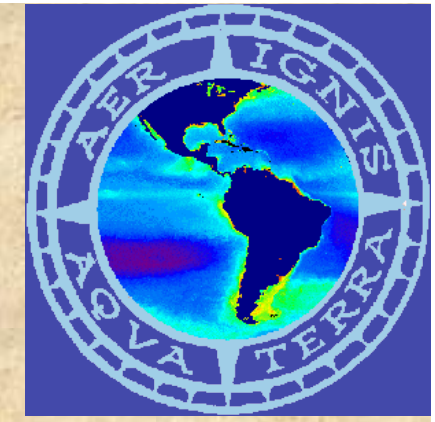
**Cartagena PI Dr Mary Luz Páez Cañón**



# Sample shipment to NASA

- Samples will be gathered at SIO by Dr Robert Frouin and then he will sent them to GSFC, NASA.
- Estimated shipment date: December 2012.

# Challenges at ANTARES Field Stations
# Possible Solutions?

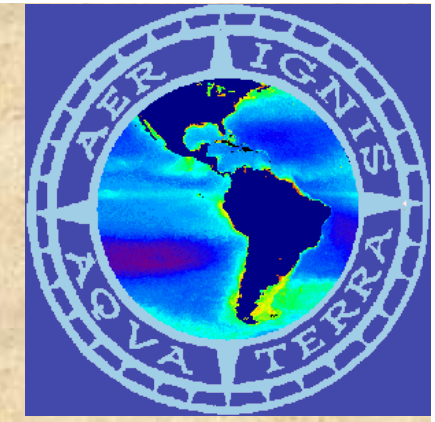



## How to enhance the network?

– Few opportunities to apply for large international grants. Just submitted a proposal to IAI (9 countries, 5 years, 700 K USD).

– National funds very different situations.

# Challenges at ANTARES Field Stations
# Possible Solutions?




- Convey to decision makers in developing countries (ministries of environment, science..) through international, intergubernmental programs that ocean observing is relevant.
- Show the use of this scientific knowledge to decision makers and stakeholders.
- Offer international grants to promote or enhance time-series studies in developing countries.
- Offer scholarships for graduate students from developing countries to develop their thesis work using time-series data. (SCOR Capacity Building, Nippon Foundation..)


¡Gracias!