Prediction and Research Moored Array in the Tropical Atlantic - PIRATA

M. Araujo[1] , B. Bourlès[2], P. Brandt[3], E. Campos[4] , H. Giordani[5] , F. Hernandez[6],

R. Lumpkin[7] , M. McPhaden[8] , P. Nobre (&C.Fonseca)[9], R. Saravanan[10]

[1]DOCEAN/CEERMA-UFPE, Brazil;

[2]LEGOS/IRD, France;

[3]GEOMAR, Germany;

[4]IO-USP, Brazil;

[5]CNRM-MeteoFrance, France;

[6]MERCATOR-Ocean&LEGOS/IRD, France;

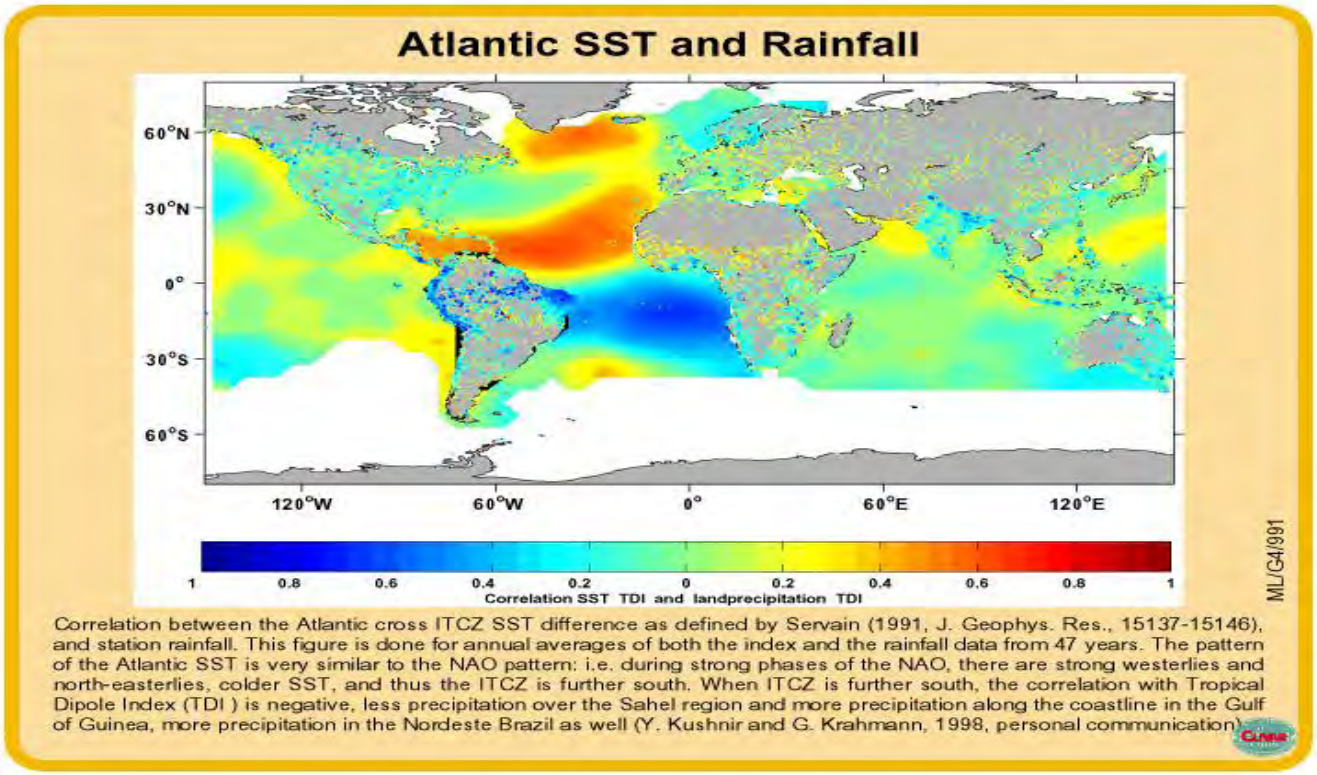
[7]NOAA/AOML, USA;

[8]NOAA/PMEL, USA;

[9]CPTEC-INPE, Brazil;

[10]TAMU, USA.

→ Why tropical Atlantic ?



The variability of the ocean–atmosphere system in the tropical Atlantic, from intraseasonal to multidecadal time scales, strongly influences regional variations in rainfall, and consequently the economies of the adjacent continental regions. For example, variations in the intertropical convergence zone (ITCZ) affect rainfall and droughts in Africa (West African monsoon) and northeastern Brazil & SST in the NETA important for tropical cyclogenesis.

Initiated in 1995-1996…. (by US, FR & BR colleagues)

PIRATA-1 Meeting

February 1996

Natal, Brazil

The Historic PIRATA' Birth …

1st ATLAS buoy deployed on Sept 11, 1997 at 0°N-10°W

PIRATA: several “phases”:

From *Pilot Research moored Array in the Tropical Atlantic* **to**
Prediction and Research moored Array in the Tropical Atlantic

CLIVAR-WCRP & OOPC endorsement

1995
1996
1997 — 1998 — 2000 — 2005 — 2006
2007
2008 — 2009 — 2014 — •••

Setup Planning Phase

Pilot Phase (MoU-1)

Consolidation Phase (MoU-2)

“Sustained” Phase (MoU-3)

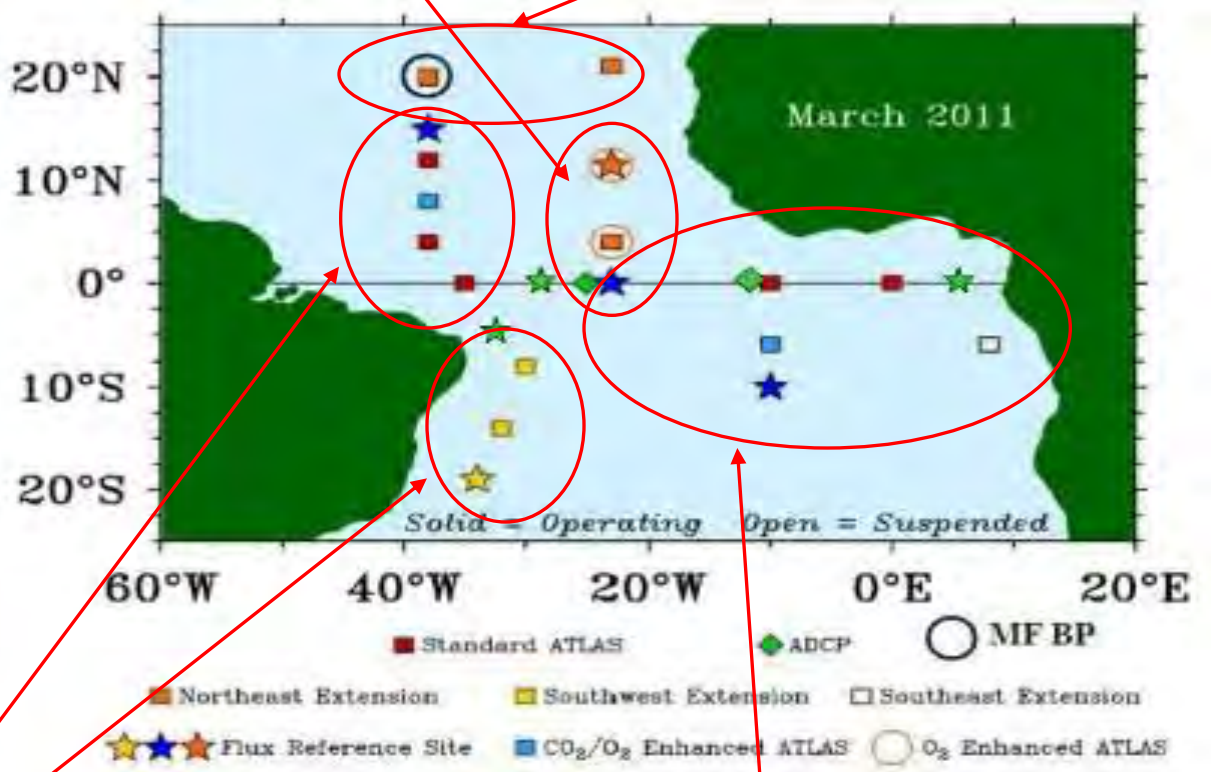
Commitments through the MoU very important…

PIRATA network servicing:

18 ATLAS buoys from 2013

⇒ *Yearly servicing from Research Vessels*

Maintained by USA *: 4 Atlas buoys : 2 deployed in 2006, at 4N & 11N/23W, 2 at 20N/23W & 38W deployed in 2007*



Maintained by Brazil: *8 Atlas buoys*
5 from 1998,
3 as the PIRATA SWE from 2005

Maintained by France *: 6 Atlas buoys from 2013 (5 from 1997)*
+ At 23°W-Equator : surface ADCP mooring since 2001 (serviced by GEOMAR from 2006);
+ at 10°W-Equator: surface ADCP mooring since 2006

- Buoy at 6S-8E deployed in 2006 - 2007 (test period for a Southeastern Extension by South Africa & BCLME) then from 2013, thanks to the contribution of The EU PREFACE programme (purchase of a 2nd ATLAS buoy)

How works PIRATA ?

PIRATA structure & responsabilities sharing:

1) **PIRATA Resources Board**: => committee with one representative of each organism
⇒ 1 from NOAA/USA ; 1 from INPE ; 1 from IRD/France & 1 from Meteo-France/France

=> Major tasks:
To coordinate resources that may be applied to the Program;
To encourage scientific and technological initiatives in the participating countries to meet the objectives of PIRATA;
To report on its activities to the Heads of the institutions providing resources.

2) **PIRATA Steering Scientic Group**: *3 members of each initial country (Br, Fr, USA) + 1 of Germany (GEOMAR, from 2008).*

=> Major tasks :
- *To ensure accomplishment of the scientific and technical objectives ;*
- *To coordinate the technical and logistic support necessary to maintain the array;*
- *….*
- *To invite collaborations with other nations and institutions…;*
- *To cooperate with international organizations ;*

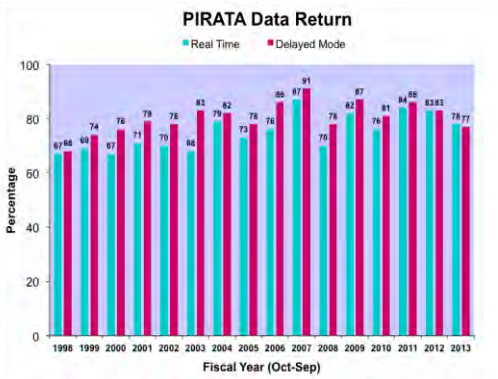
(To report regularly to the PRB,..)

PIRATA data: ATLAS buoys and cruises data

ATLAS data => Real time & Delayed time:

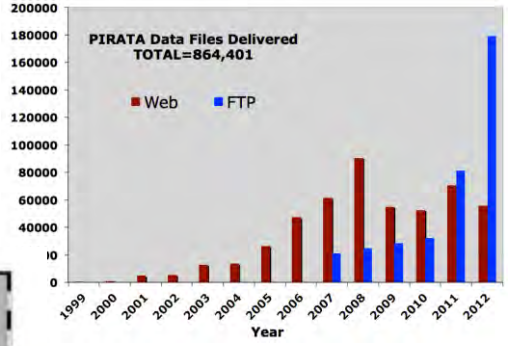
- PIRATA ATLAS data return over the period 1998-2013:

~>82% in average



- ***PIRATA files delivered over the period 1999-2013:***

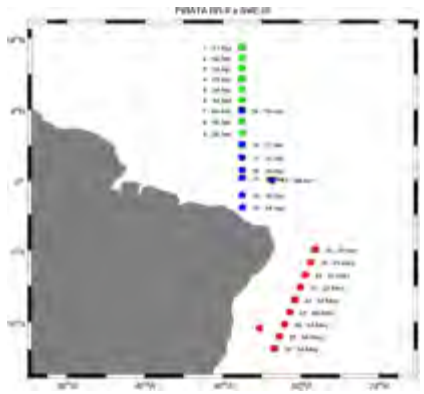
Through website & ftp : noticeable increase

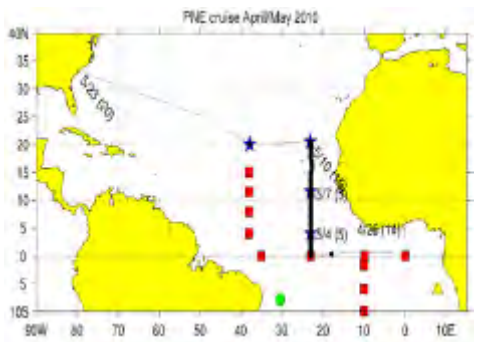


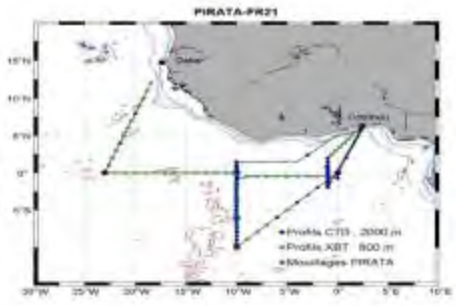
Open Data Policy

YEARLY CRUISES => repeated sections (ctdo2/ladcp…)

38°W section: Brazil 23°W section: USA 10°W section: France



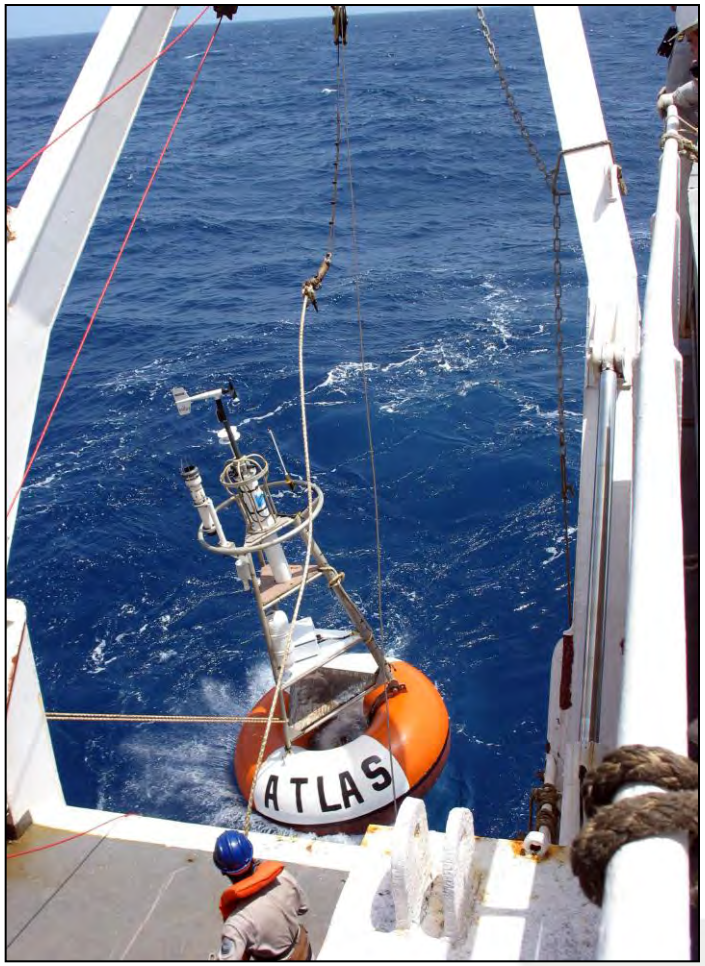


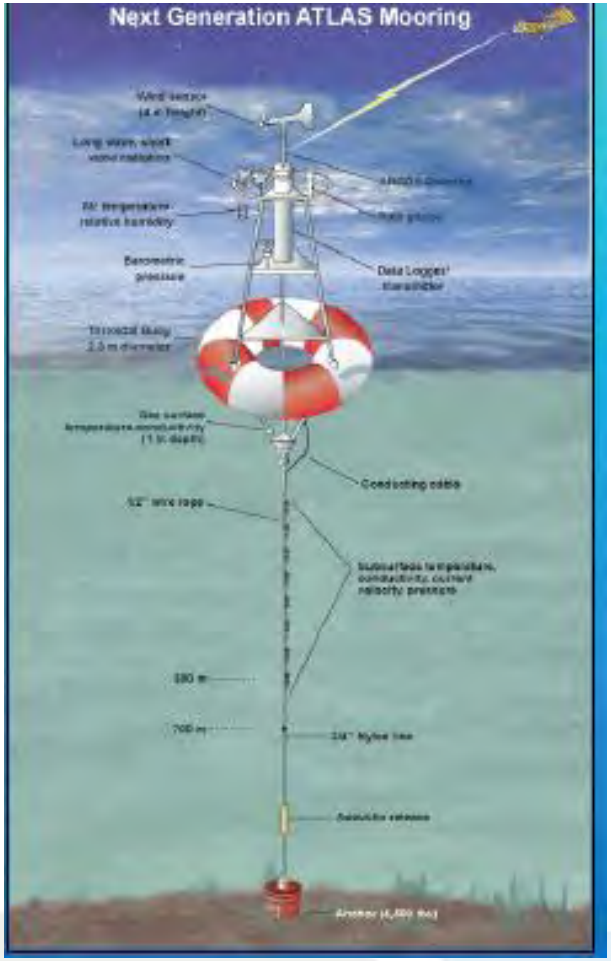


~150 vessel days

Yearly cruises = OPPORTUNITIES for: Deployement of ARGO profilers; surface drifters; CTDO2 & XBT: with possible transmission in quasi-real time for operationnal services Atmospheric measurements (Radiosoudings…) + « piggy-back operations »!

PIRATA





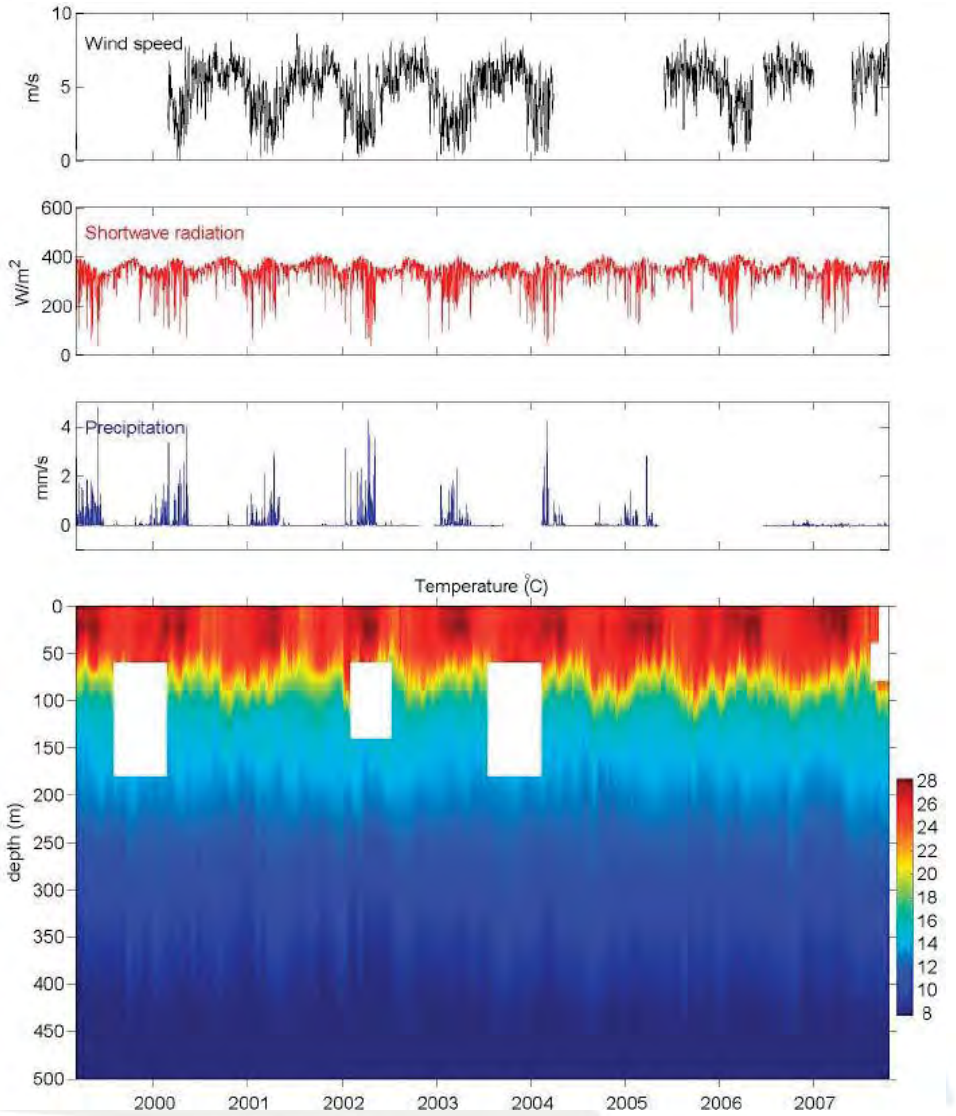
PIRATA

Meteorological data:

Tar, Rain, RH, W, SWR, LWR, Patm

Oceanographic data (0-500 m):

T(z) (11 levels), S(z) (5 levels), Currents



US NOAA/PMEL TAO / PIRATA /RAMA website:

http://www.pmel.noaa.gov/pirata/

⇒ Information about ATLAS buoys (sensors, status, data calibration processes…)

⇒ Plots

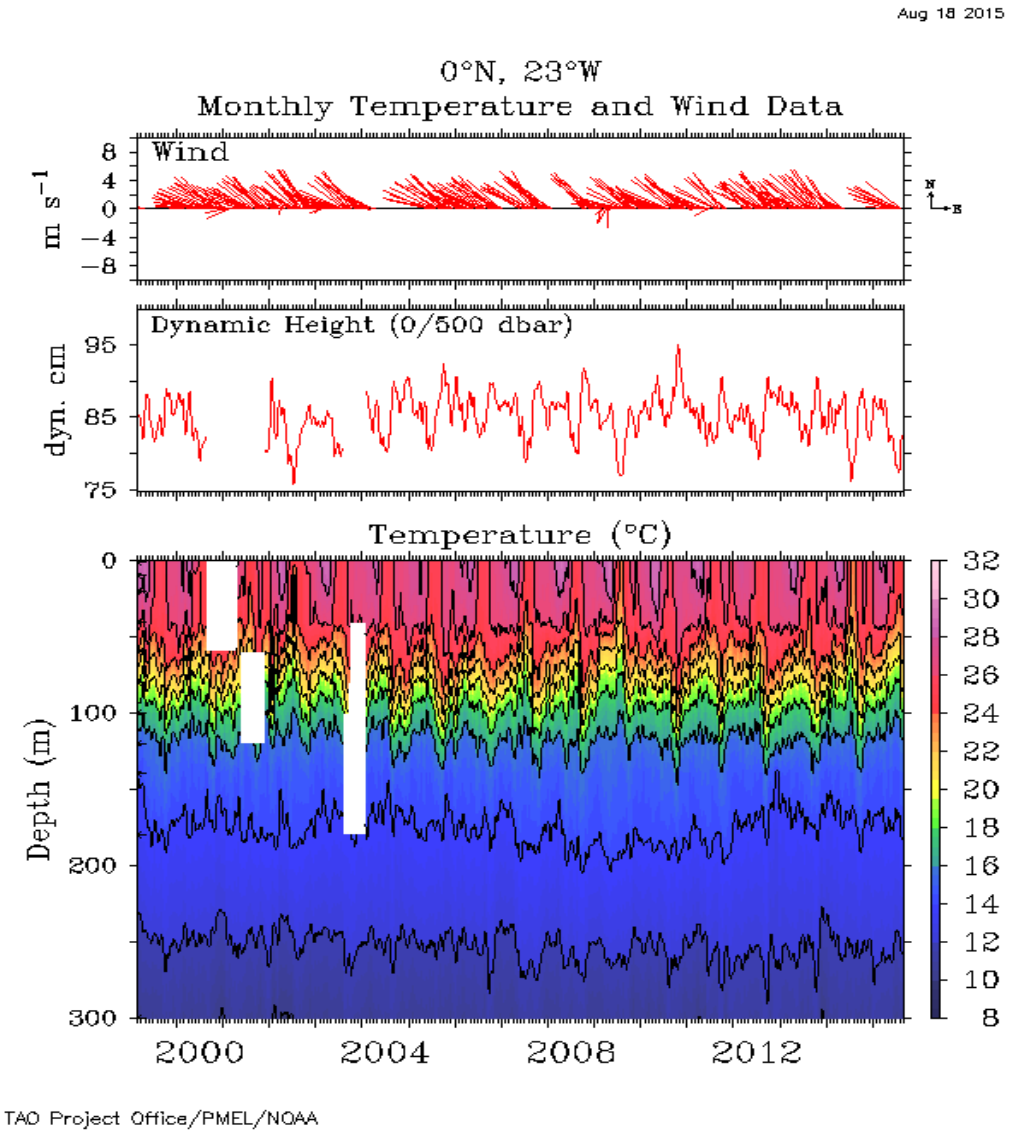
⇒ Access to data

PIRATA Home | Station Plots | Data Display & Delivery | Technical Information | Meeting Reports | Sensor Status | Cruises

Prediction and Research Moored Array in the Atlantic (PIRATA)

PIRATA is a program designed to study ocean-atmosphere interactions in the tropical Atlantic that affect regional climate variability on seasonal, interannual and longer time scales. The array was originally developed in the mid-1990s and has undergone expansions and enhancements since 2005 to improve its utility for describing, understanding, and predicting societally relevant climate fluctuations. PIRATA has been implemented through multi-national cooperation in support of CLIVAR, GOOS, GCOS, and GEOSS. Financial, technical and logistic support are provided by France (IRD in collaboration with Meteo-France, CNRS and IFREMER), Brazil (INPE and DHN) and the USA (NOAA). Data are freely available for research and operational applications via the World Wide Web and the Global Telecommunications System.

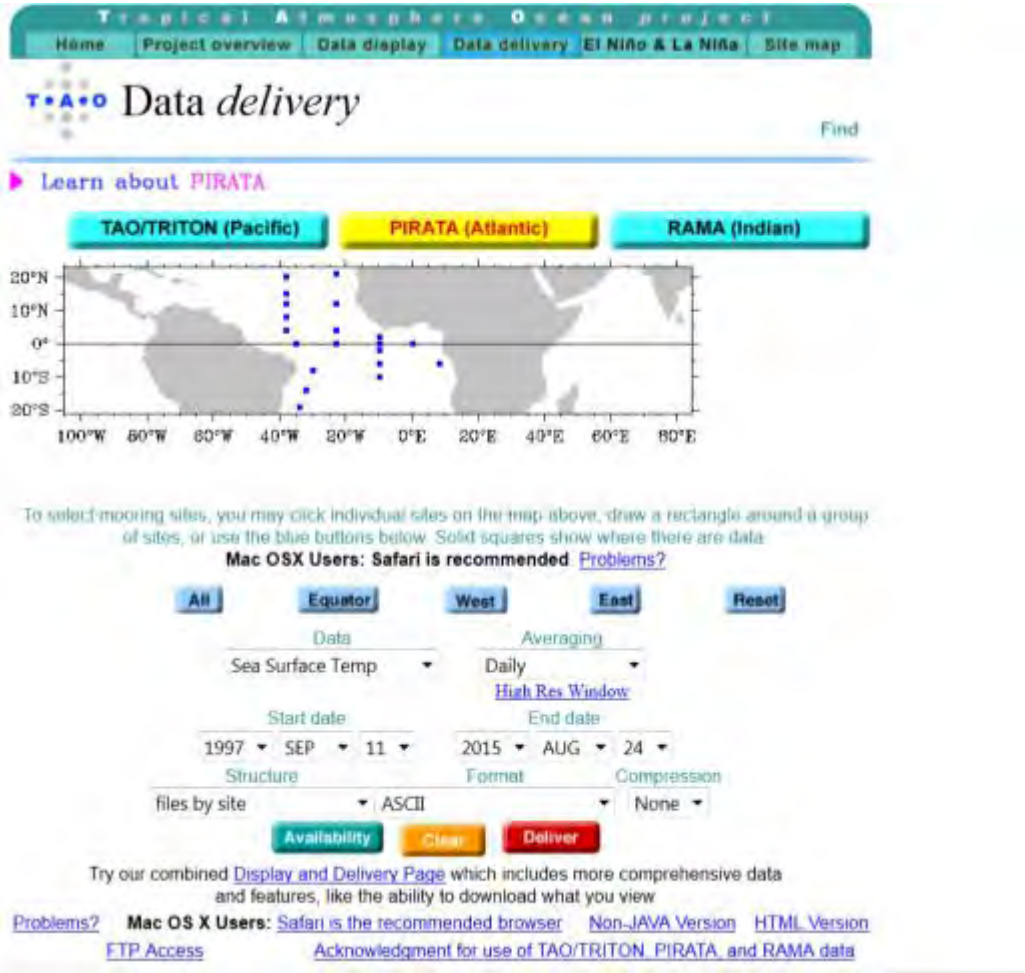
Eg: some parameters evolution from 1997 at 23°W-0°N (real time data)



US NOAA/PMEL TAO / PIRATA /RAMA website:

http://www.pmel.noaa.gov/tao/data_deliv/deliv.html

=> FREE and easy access to buoys data (Real time & Delayed time)



US PNE PIRATA website:

http://www.aoml.noaa.gov/phod/pne/cruises.php

=> Information about cruises

⇒Easy access to in situ Pirata cruises data sets

⇒ Pirata related reports & documents (SSG…).

⇒PIRATA BIBLIOGRAPHY (peer reviewed paper references)

www.aoml.noaa.gov/phod/pne/cruises.php

pirata pne aoml

Les plus visités

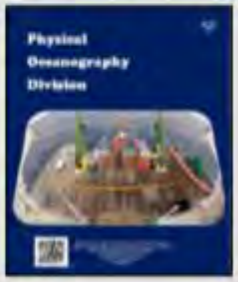
PIRATA Northeast Extension

Tropical Atlantic Observations for Climate and Weather

NOAA AOML Physical Oceanography Division

NOAA AOML PhOD PNE Cruises

quick search ... Popular topics... Go

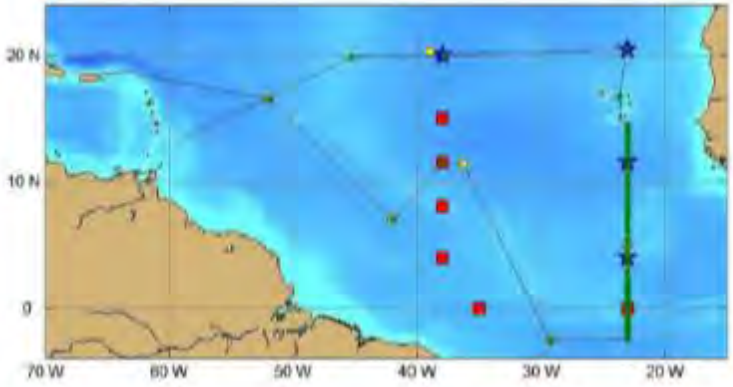


Cruises

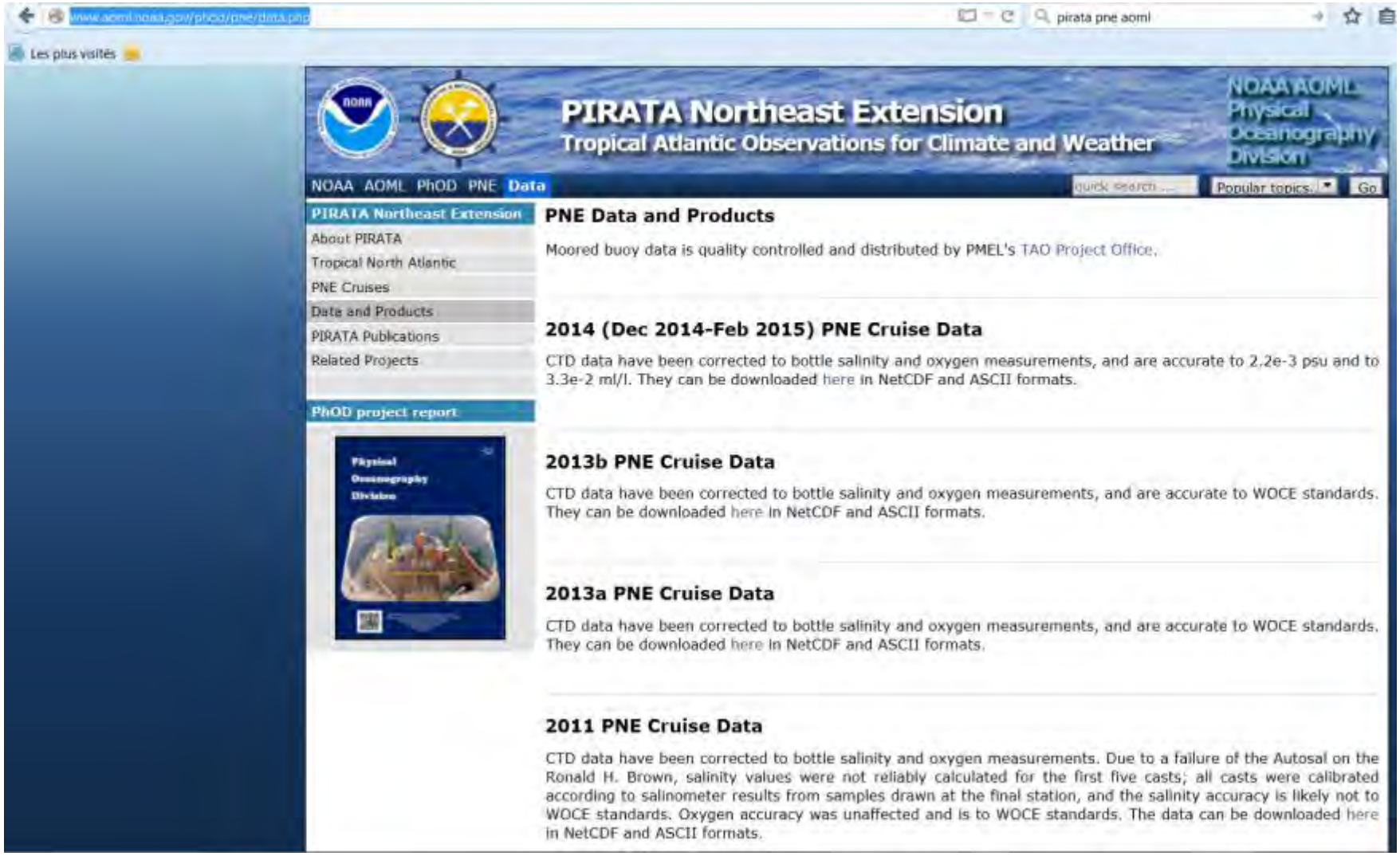
2014 PNE Cruise

The 2014 PNE cruise was conducted from 28 December 2014 to 12 February 2015, Bridgetown, Barbados to San Juan, Puerto Rico, aboard the UNOLS R/V Endeavor. The chief scientist of PNE 2014 was Rick Lumpkin (NOAA/AOML). During this cruise, the four PIRATA Northeast Extension buoys were serviced and a T-FLEX mooring was deployed within five miles of the PNE mooring at 4N-23W with 10 point acoustic current meters to study upper ocean shear (lead PI Renellys Perez). An experimental washer system was installed at the 11.5N-23W site to clean dust off a second shortwave radiometer. 51 CTD stations were conducted, most of them along 23W. Five subsurface hydrophone moorings deployed in an NSF-funded project were also recovered. Due to ship space constraints, the AEROSE team was not able to participate in this cruise.

- Cruise report
- Cruise data



PIRATA PNE cruises data:
http://www.aoml.noaa.gov/phod/pne/data.php



Brazilian PIRATA website:

http://www.pirata.ccst.inpe.br/
/

=> Information about cruises

⇒Easy access to in situ Pirata cruises data sets

⇒ Pirata related reports & documents (SSG…).

PIRATA | Prediction and Resear...

pirata.ccst.inpe.br

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Pirata

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PIRATA

The Prediction and Research Moored Array in the Tropical Atlantic (**PIRATA**) is a international observing network to improve both knowledge and understanding of the ocean-atmosphere system along the the tropical Atlantic Ocean. Launched in the framework of the international program CLIVAR (CLImate VARiability and predictability), PIRATA operates by an array of moored buoys supported finacial, technical and logistically by France (IRD in collaboration with Meteo-France, CNRS and IFREMER), Brazil (INPE and DHN) and the USA (NOAA). For more information, see about, PIRATA

Southwest Extension

The PIRATA Southwest Extension project is an effort to expand the PIRATA array of tropical Atlantic ATLAS moorings into the southwestern sector of the Tropical Atlantic Ocean. Links below provide access to data from the extension, published articles and more information about the PIRATA project.

Data

Data from yearly maintenance Brazilian oceanographic cruises are available for download through here.

Documents

Articles and reports from the yearly cruises are available for download as PDFs.

Rod. Pres. Dutra km 40
Cachoeira Paulista, SP
12630-000
BRAZIL.

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E INOVAÇÃO
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

pirata.ccst.inpe.br/wp-content/uploads/2015/08/foto3.png

PIRATA BRAZIL cruises data: http://www.pirata.ccst.inpe.br/data-2/

Data download | PIRATA

pirata.ccst.inpe.br/data-2/

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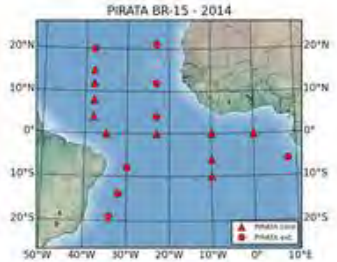
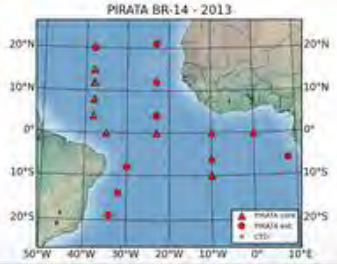
Data download

2014 – PIRATA BR-15 Cruise



Cruise Report (Portuguese)

2013 – PIRATA BR-14 Cruise



Data

Here are available only PIRATA data retrieved during the Brazilian maintenance cruises, that includes CTD, ADCP, Radiosondes and XBT. All data can be freely accessed, except for XBT, which distribution is under development.

Other PIRATA data resources

There are other PIRATA data distributors partners, which have different data from the ones here presented.

- » GOOS – Brazil
- » Ifremer – IRD
- » NOAA – AOML – PNE
- » NOAA – PMEL – TAO (via GTS)

French PIRATA website:

http://www.brest.ird.fr/pirata/
or
http://www.ifremer.fr/ird/pirata/

=> Information about cruises

⇒Easy access to in situ Pirata cruises data sets

⇒ Pirata related reports & documents (SSG…).

http://www.brest.ird.fr/pirata/

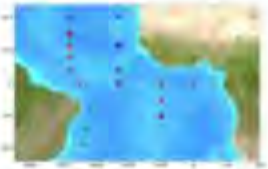
PIRATA
Prediction and Research Moored Array in the Tropical Atlantic

PIRATA France
- Welcome
- About PIRATA
- PIRATA-FR Cruises
- São Tomé Island
- French team

Project ressources
- Data and Products
- Reports and Publications
- PIRATA links

Contact
- Contact Information

About PIRATA



The PIRATA project is a joint effort between Brazil, France and the United States to collect oceanic and meteorological observations in the tropical Atlantic.

The experimental program PIRATA (initially « Pilot Research moored Array in the Tropical Atlantic » and named « Prediction and Research Moored Array in the Tropical Atlantic » from 2008) has been implemented in 1997 in the Tropical Atlantic Ocean (Servain et al. 1998). It has been launched in the framework of the international program CLIVAR (CLImatic VARiability and predictability) and implies scientific teams from three countries: France (**IRD**, in charge of coordination and oceanic cruises, **Météo France**, with contributions by **IFREMER** and **CNRS/INSU**), Brazil (**DHN** and **INPE**) and USA (**NOAA/PMEL**). Financial supports for the program are from the **IRD**, **Météo France**, and **Observatoire Midi-Pyrénées/Université Paul Sabatier**.

More...

News !

PIRATA status

French national report & status 2011-2014

Last PIRATA FR24 cruise in April-May 2014

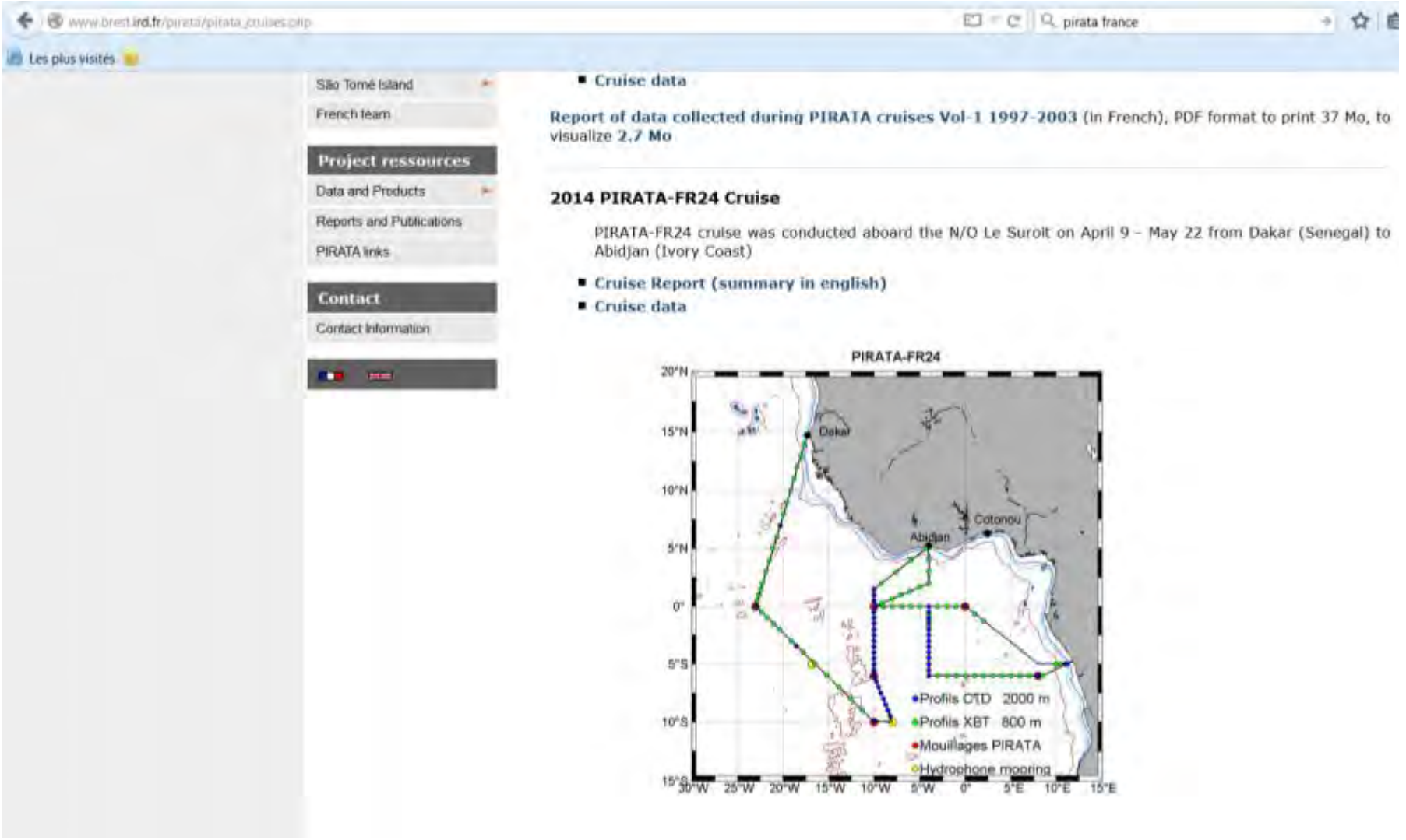
The last PIRATA cruise from Dakar-Senegal to Abidjan (Ivory Coast)

PIRATA-FR24 cruise summary (in english)

IRD news: **PIRATA-FR244 cruise**

Last PIRATA FR25 not documented yet…

=> on: http://www.brest.ird.fr/pirata/pirata_cruises.php



New PIRATA-FR S-ADCP data treatment:

Work done by Gaëlle Herbert (refer to her presentation), funded by PREFACE.
All 2007-2015 cruises SADCP data treated through the CASCADE software.

Publication:
G. Herbert, C. Kermabon, J. Grelet, B. Bourlès, French PIRATA cruises S-ADCP data processing, Mercator Ocean—Coriolis Quarterly Newsletter - Special Issue, #52-May 2015

only for cruises from 2007…

Data archiving and data access

The set of SADCP processed data from these 8 PIRATA oceanographic cruises are made available on the ftp website: ftp://ftp.ifremer.fr/ifremer/ird/pirata/pirata-data/ . For each cruise, different files are available:

- NetCDF data files - Raw data and processed data (date/time, latitude, longitude, depth, horizontal and vertical absolute current, navigation data...).
- UNIX tar files containing figures (section map, images and vector plots of the sections).
- Report which contains information about data collection, quality checks, processing procedures applied to data and problems encountered with the data.

go to: adcp/sadcp_cascade

The files are also archived and directly downloadable on the SISMER portal (under Data access http://www.ifremer.fr/sismer/index_UK.htm)

New PIRATA-FR TSgraph data treatment

- French Research vessels have been collecting thermo-salinometer (TSG) data since the early
2000 to contribute to the Global Ocean Surface Underway Data (GOSUD) programme.

- Water samples are taken on a daily basis by the crew and later analysed in the laboratory.

(coll. IFREMER, IRD, CNRS, SHOM… in the frame of CORIOLIS).

= > ***delayed mode processing of the 2001-2013 dataset almost achieved****!*

(at now, only for PIRATA cruises done from Ifremer Vessels, ie Atalante & Suroit; Antéa soon!)

=>

Data available on:

ftp://ftp.ifremer.fr/ifremer/doi/gosud_tsg_frenchVessels_2001to2013/GOSUD_TSG_FRV_DM_201502.zip

These data will also be made available through the Pirata-Fr data website.

Other operations/collaborations/observations from NOW to the FUTURE :

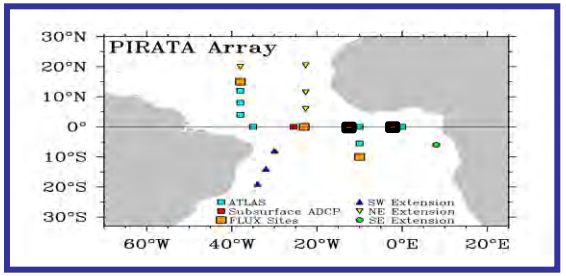
Contribution to CO_2 parameters measurements (PI: N.Lefevre, IRD/Locean)
- from 2006 : 2 French « Carioca » systems at 8N-38W & 6S-10W transmitting in real time
- sea water sampling analysis during some Pirata cruises.

Contribution to the acoustic Ocean Tracking Network (for Dalhousie University, Canada, F. Whoriskey)
- addition of OTN at 200m depth on each ATLAS lines -to follow sea mammals- from 2014

Contribution to a USA/NSF program (PI: J.Moum, Oregon Univ.):
- 5 turbulence sensors (Chipods) installed at 23W and 10W-Equator (from 20 to 80m) from 2015 for 5 years. (2 already installed in 2014 for one year)

Involvement/Contribution to the EU PREFACE (FP7-ENV, from 2013):
- Atlas SEE; ADCP mooring at 0-0…

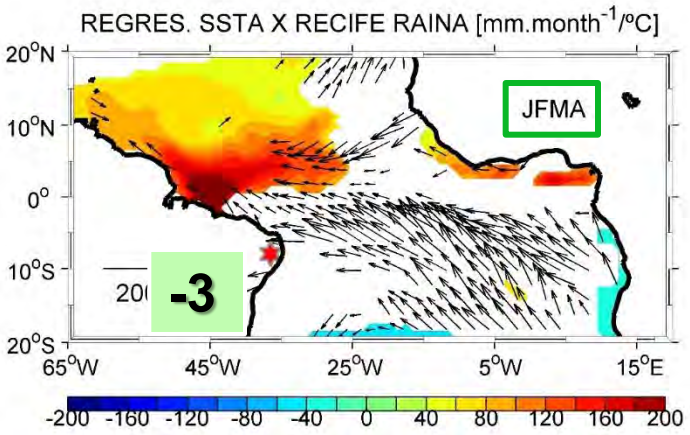
Involvement/Contribution to the EU AtlantOS program (H2020, from 2015):
- addition of Classical sensors (T/C, current, flux) to some particular sites (IRD)
- addition of one CO2 sensor at PIRATA SEE (IRD)
- addition of O2 sensors along 23W at 300m & 500m (GEOMAR)

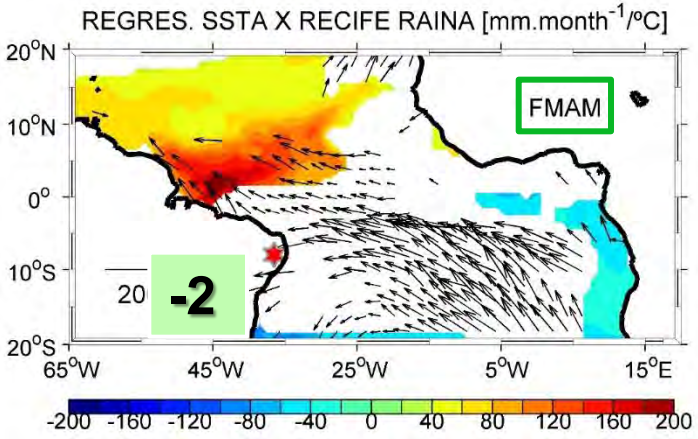


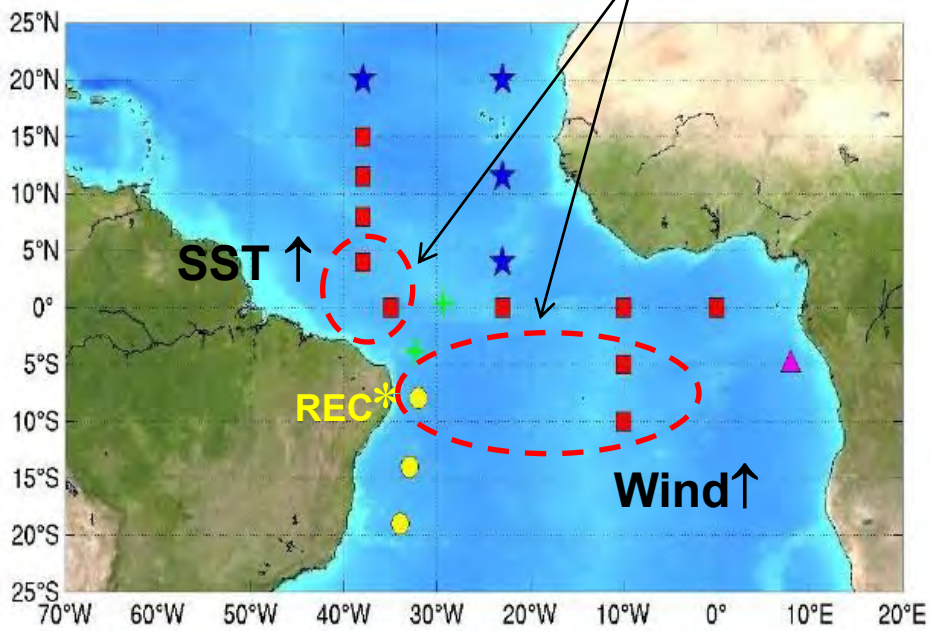
→ Environmental and societal impacts

1. Extreme rainfall events

Recife rainfall (ENEB)



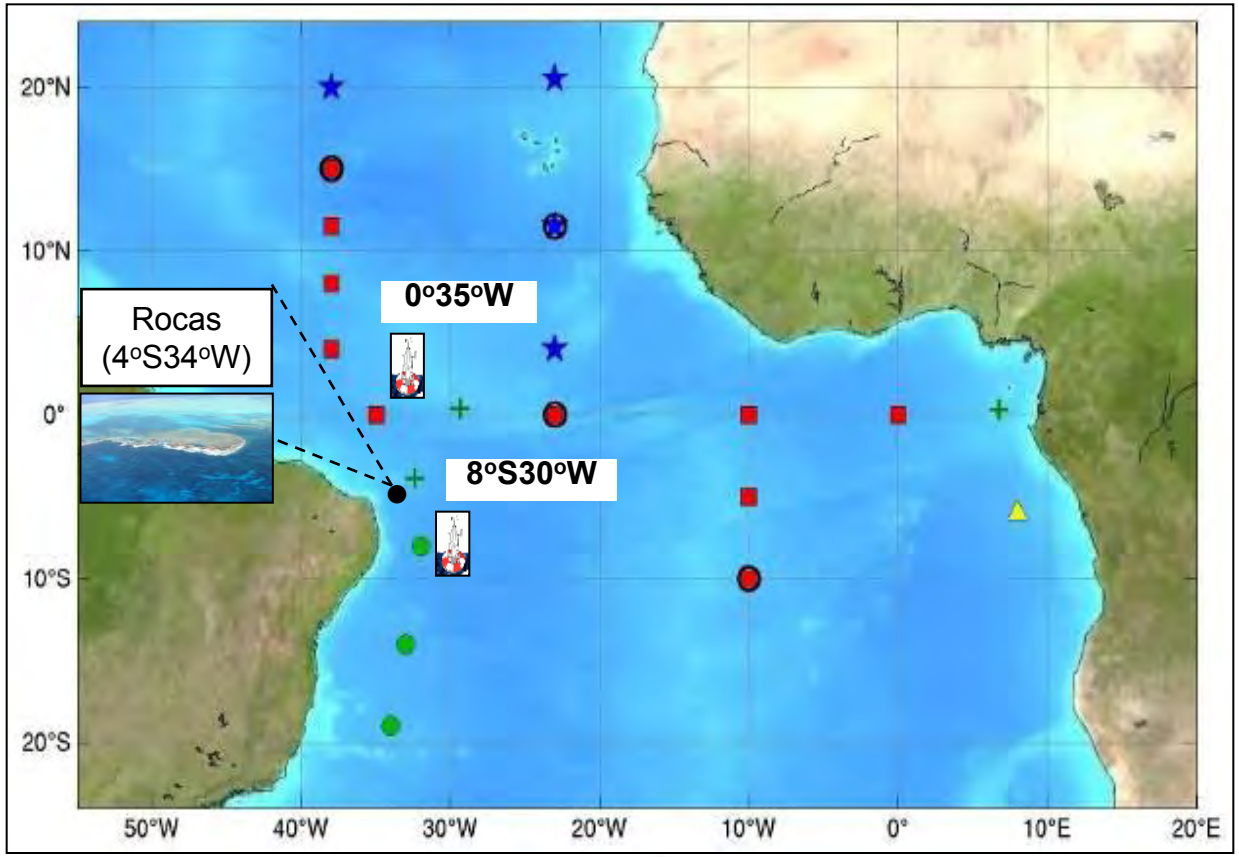




Hounsou-gbo et al. (2012, 2014)

→ Environmental and societal impacts

2. Coral reefs bleaching

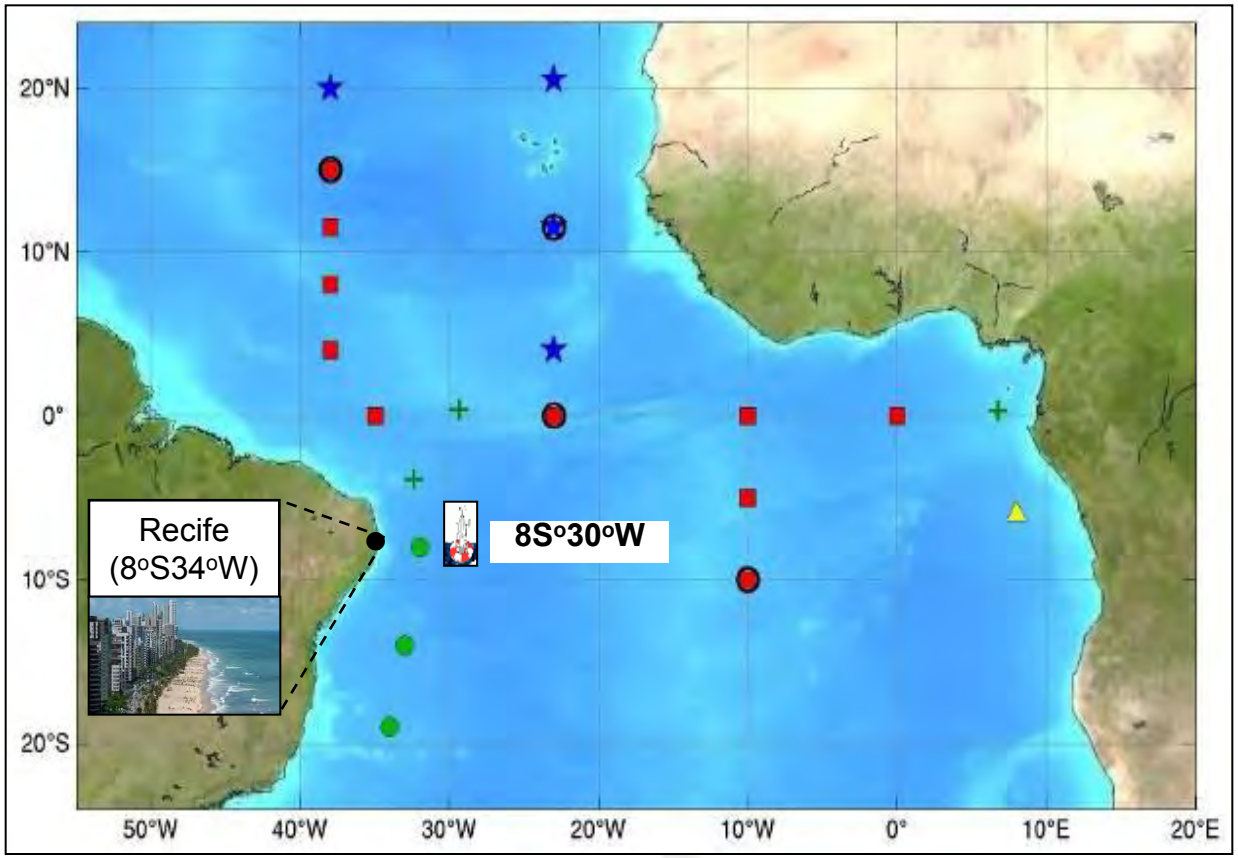


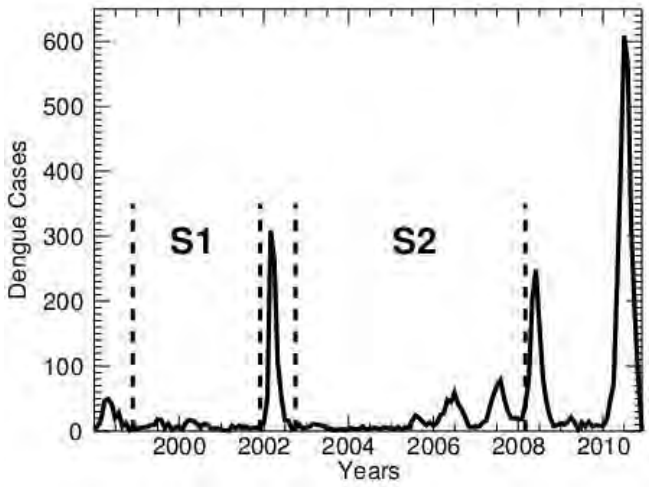
SST ↑

Ferreira et al. (2010, 2012)

→ Environmental and societal impacts

3. Tropical diseases (dengue)





Araujo et al. (2014)

Capacity building in Africa related to PIRATA

& *collaborations with UFPE/Brazil & UCT/South Africa*

United Nations Educational, Scientific and Cultural Organization

INTERNATIONAL CHAIR IN MATHEMATICAL PHYSICS AND APPLICATIONS (ICMPA)
UNESCO CHAIR IN MATHEMATICAL PHYSICS AND APPLICATIONS
established in 2006 at the University of Abomey-Calavi (Republic of Benin)
UNITWIN/UNESCO Chairs – Twinning networks and university networks
University of Abomey-Calavi

MULTI-UNIVERSITY MASTER'S DEGREE AND DOCTORAL TRAINING PROGRAMME IN *PHYSICAL OCEANOGRAPHY AND APPLICATIONS*

Considering the needs of capacity building in environmental sciences, climate and coastal environment, a regional master in "Physical Oceanography and Applications" is being organized by the International Chair of Mathematical Physics and Applications (ICMPA-UNESCO Chair) of the University of Abomey-Calavi at the Faculty of Sciences and Technology, involving the following universities, research institute and organizations:

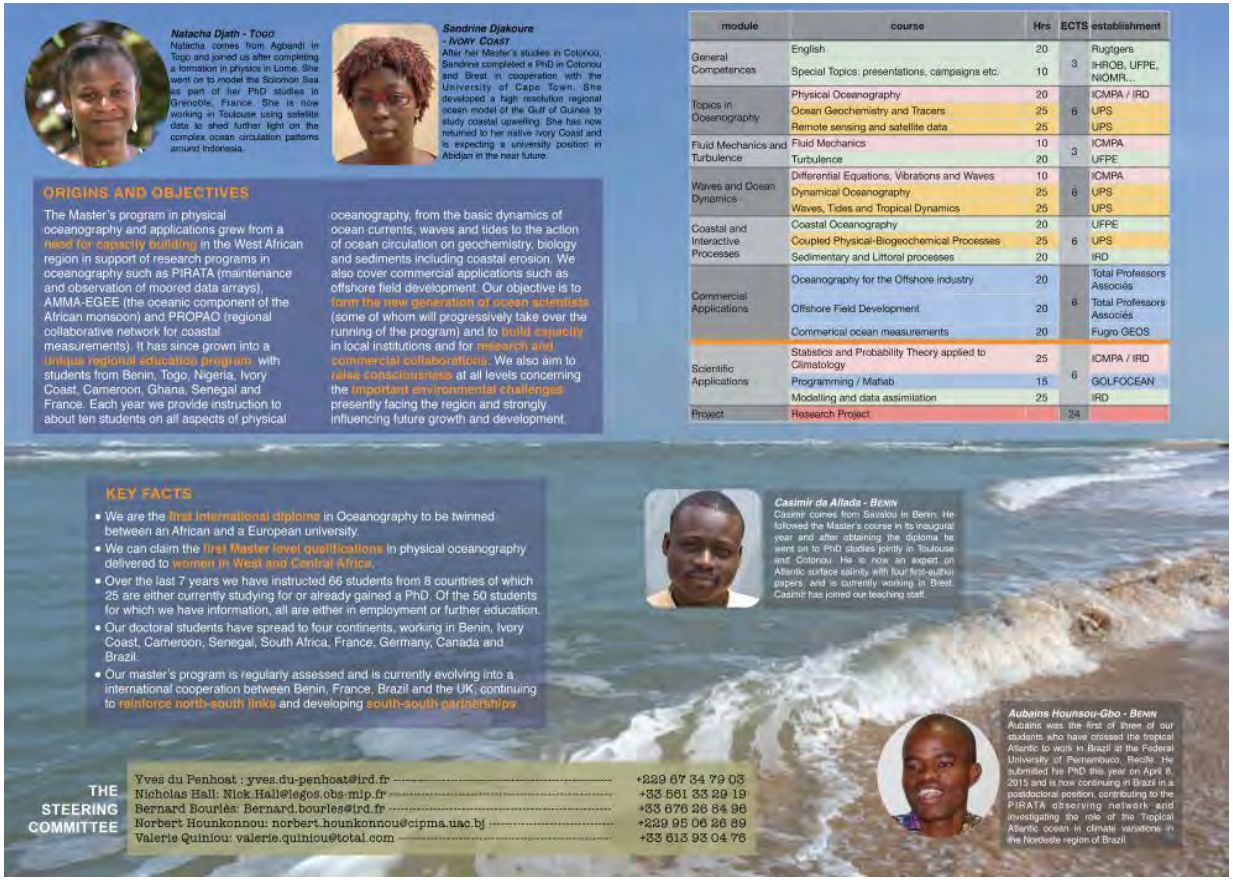
Intergovernmental Oceanographic Commission (IOC) of UNESCO Mr Justin Ahanhanzo, Coordinator and Team Leader, Intergovernmental Oceanographic Commission of UNESCO (IOC/UNESCO) UNESCO, 1 Rue Miollis, 75732 Paris Cedex 15, France Tel: +33 1 45 68 36 41 Fax: +33 1 45 68 58 10/12/13 E-mail: j.ahanhanzo@unesco.org http://ioc.unesco.org	Paul Sabatier University (France) Prof. Nicholas Hall, Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS), 18 Avenue Edouard Belin, 31401 Toulouse cedex 9, France Tel: +33 5 61 33 29 19 Fax: +33 5 61 25 32 05 E-mail: Nick.Hall@legos.obs-mip.fr	University of Abomey-Calavi (Benin) Prof. Mahouton Norbert Hounkonnou, International Chair of Mathematical Physics and Applications (ICMPA-UNESCO Chair), 072 B.P. 50 Cotonou, Republic of Benin, Tel: +229-21 38 61 27/ +229 95 06 26 89 Fax: +229-21 31 31 38 E-mail: norbert_hounkonnou@cipma.net or hounkonnou1@yahoo.fr	Institut de Recherche pour le Développement (France) Dr Bernard Bourlès, Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS) Centre de Recherches Halieutiques et Océanologiques du Bénin (CRHOB), Représentation IRD de Cotonou, 08 BP 841 Cotonou, Republic of Benin Tel: +229 21 30 03 54 / + 229 90 08 94 56 Fax: +229 21 30 88 60 E-mail: bernard.bourles@ird.fr	Total (France) Mme Valérie Quiniou-Ramus TOTAL S.A. DGEP/TDO/TEC/GEO – 21E09, Tour Coupole, 2, Place Jean Millier La Défense 6 - Cedex 45 92078 Paris La Défense, France Tel: +33 1 47 44 44 83 Fax: +33 1 47 44 49 48 E-mail: Valerie.Quiniou@total.com

Official languages: English and French. English is the preferred choice, though, given the international attendance

INITIATED IN 2008

- Joint operation between IRD, the UNESCO International Chair in Mathematical Physics and Applications with the University of Abomey Calavi, Cotonou, Benin, the University of Toulouse (UPS) and then (from 2009) the energy company Total.
-Students from all over West Africa to study the physics, chemistry and biology of the ocean.
- Only formation on the African continent that specialises in physical oceanography and its applications.
- Diploma jointly offered by the two universities of Toulouse (Fr) & Cotonou (Bénin).

- 66 students formed (Benin, Ivory Coast, Cameroon, Togo, Ghana, Senegal, Nigeria)
- Of the 50 students for which we have information, all are either in employment or further education:
- 25 (at least) continued in PhD: in France, Brazil (UFPE), South Africa (UCT), Germany (GEOMAR), Canada, Cameroon, Benin….



Natacha Djath - Togo
Natacha comes from Agbandi in Togo and joined us after completing a formation in physics in Lome. She went on to model the Solomon Sea as part of her PhD studies in Grenoble, France. She is now working in Toulouse using satellite data to shed further light on the complex ocean circulation patterns around Indonesia.

Sandrine Djakoure - Ivory Coast
After her Master's studies in Cotonou, Sandrine completed a PhD in Cotonou and Brest in cooperation with the University of Cape Town. She developed a high resolution regional ocean model of the Gulf of Guinea to study coastal upwelling. She has now returned to her native Ivory Coast and is expecting a university position in Abidjan in the near future.

ORIGINS AND OBJECTIVES

The Master's program in physical oceanography and applications grew from a need for capacity building in the West African region in support of research programs in oceanography such as PIRATA (maintenance and observation of moored data arrays), AMMA-EGEE (the oceanic component of the African monsoon) and PROPAO (regional collaborative network for coastal measurements). It has since grown into a unique regional education program, with students from Benin, Togo, Nigeria, Ivory Coast, Cameroon, Ghana, Senegal and France. Each year we provide instruction to about ten students on all aspects of physical oceanography, from the basic dynamics of ocean currents, waves and tides to the action of ocean circulation on geochemistry, biology and sediments including coastal erosion. We also cover commercial applications such as offshore field development. Our objective is to form the new generation of ocean scientists (some of whom will progressively take over the running of the program) and to build capacity in local institutions and for research and commercial collaborations. We also aim to raise consciousness at all levels concerning the important environmental challenges presently facing the region and strongly influencing future growth and development.

module	course	Hrs	ECTS	establishment
General Competences	English	20	3	Rugtgers
	Special Topics: presentations, campaigns etc.	10		IHROB, UFPE, NIOMR…
Topics in Oceanography	Physical Oceanography	20	6	ICMPA / IRD
	Ocean Geochemistry and Tracers	25		UPS
	Remote sensing and satellite data	25		UPS
Fluid Mechanics and Turbulence	Fluid Mechanics	10	3	ICMPA
	Turbulence	20		UFPE
Waves and Ocean Dynamics	Differential Equations, Vibrations and Waves	10	6	ICMPA
	Dynamical Oceanography	25		UPS
	Waves, Tides and Tropical Dynamics	25		UPS
Coastal and Interactive Processes	Coastal Oceanography	20	6	UFPE
	Coupled Physical-Biogeochemical Processes	25		UPS
	Sedimentary and Littoral processes	20		IRD
Commercial Applications	Oceanography for the Offshore Industry	20	6	Total Professors Associés
	Offshore Field Development	20		Total Professors Associés
	Commerical ocean measurements	20		Fugro GEOS
Scientific Applications	Statistics and Probability Theory applied to Climatology	25	6	ICMPA / IRD
	Programming / Matlab	15		GOLFOCEAN
	Modelling and data assimilation	25		IRD
Project	Research Project		24	

KEY FACTS

- We are the first international diploma in Oceanography to be twinned between an African and a European university.
- We can claim the first Master level qualifications in physical oceanography delivered to women in West and Central Africa.
- Over the last 7 years we have instructed 66 students from 8 countries of which 25 are either currently studying for or already gained a PhD. Of the 50 students for which we have information, all are either in employment or further education.
- Our doctoral students have spread to four continents, working in Benin, Ivory Coast, Cameroon, Senegal, South Africa, France, Germany, Canada and Brazil.
- Our master's program is regularly assessed and is currently evolving into a international cooperation between Benin, France, Brazil and the UK, continuing to reinforce north-south links and developing south-south partnerships.

Casimir da Allada - Benin
Casimir comes from Savalou in Benin. He followed the Master's course in its inaugural year and after obtaining the diploma he went on to PhD studies jointly in Toulouse and Cotonou. He is now an expert on Atlantic surface salinity with four first-author papers, and is currently working in Brest. Casimir has joined our teaching staff.

Aubains Hounsou-Gbo - Benin
Aubains was the first of three of our students who have crossed the tropical Atlantic to work in Brazil at the Federal University of Pernambuco, Recife. He submitted his PhD this year on April 8, 2015 and is now continuing in Brazil in a postdoctoral position, contributing to the PIRATA observing network and investigating the role of the Tropical Atlantic ocean in climate variations in the Nordeste region of Brazil.

THE STEERING COMMITTEE

Yves du Penhoat : yves.du-penhoat@ird.fr	+229 67 34 79 03
Nicholas Hall: Nick.Hall@legos.obs-mip.fr	+33 561 33 29 19
Bernard Bourlès: Bernard.bourles@ird.fr	+33 676 26 84 96
Norbert Hounkonnou: norbert.hounkonnou@cipma.uac.bj	+229 95 06 26 89
Valerie Quiniou: valerie.quiniou@total.com	+33 613 93 04 76

TOTAL STOPS ITS SPONSOR IN 2015
IRD WILL ENSURE IN 2015-2016… (last week info!)
=> BUT NOT ENSURED AFTER 2016… => 50k€/year needed!