

# PIRATA, French national report & status



Photo: A.Kartavtseff



## Members in FRANCE of the PIRATA-SSG:

- Bernard BOURLÈS (IRD-LEGOS, Brest; coordination PIRATA in France)
- Fabrice HERNANDEZ (IRD-LEGOS, Toulouse)
- Hervé GIORDANI (Météo-France, CNRM, Toulouse)

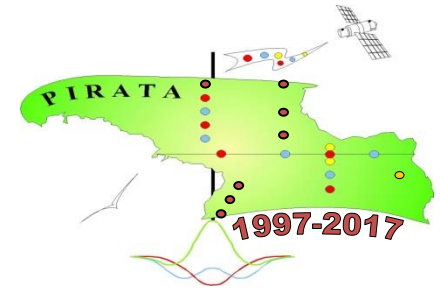


# The 1st PIRATA 20th anniversary gift...

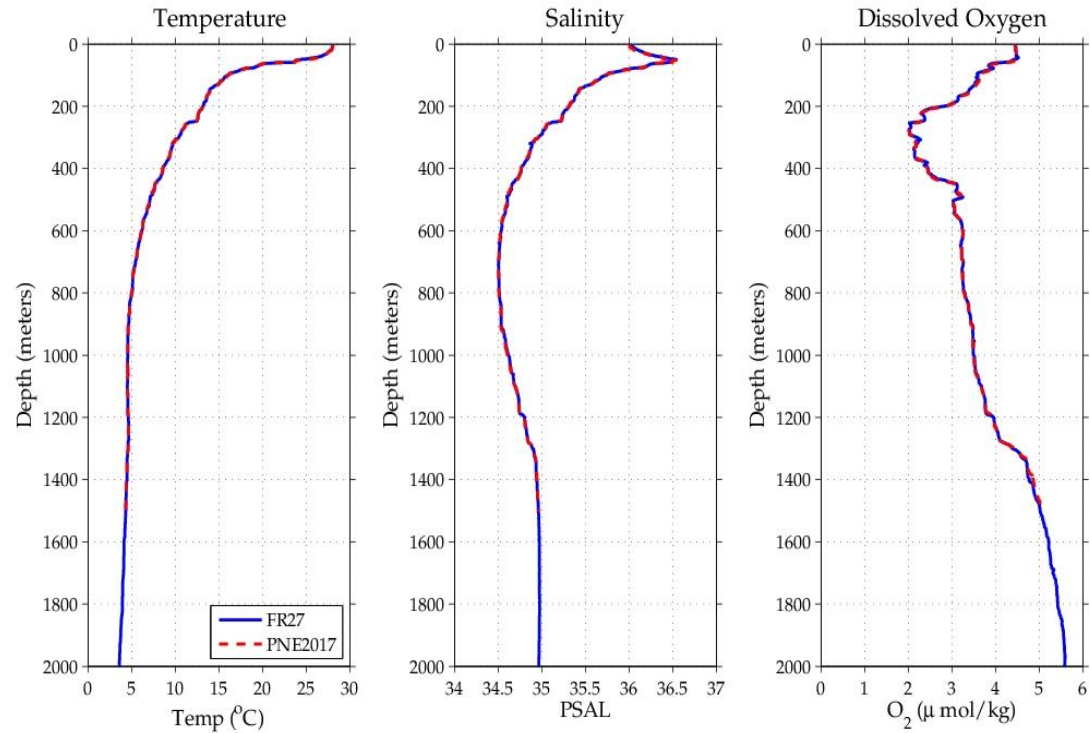
3 March 2017: happy « Pirata » 20<sup>th</sup> birthday

PIRATA-FR27 & PIRATA PNE (US) meeting...

at 23°W-0°40'S : simultaneous CT02 cast.



CTD Comparison (0.75S, 23W)



(courtesy Renellys Perez)

## PIRATA status in France :

**PIRATA-France recognized as a National SO-AO (Service d'Observations Océan-Atmosphère) as part of a larger « Service d'Observations » (CTDO2) dedicated to ocean operational observations (PIRATA, SSS, ARGO, SONEL –tide gauges-, Gliders...) closely linked to CORIOLIS.**

**PIRATA is supported by IRD, Météo France and also by the Observatoire Midi-Pyrénées (Toulouse University; PIRATA mostly supported by IRD/LEGOS, part of the OMP) and by INSU/CNRS (for instruments/sensors) through CTDO2**

=> « **SO label** » important for endorsements of national programs and/or research organisms + potential funding support for material + vessel time + potential dedicated recruitment (no success yet...).

**BUT:**

***Probable re-organization of « Open Ocean Observations » in France  
as a national « Research Infrastructure »  
(probably in 2018-2019)***

## PIRATA status in France :

### PIRATA Fr fundings & support :

#### **IRD**

**METEO-FRANCE** (« convention » for the PIRATA maintenance established between IRD & Meteo-France available until 2020).

**OMP (Observatoire Midi-Pyrénées)**

**INSU/CNRS:** only through call offer for material purchasing (not every year).

+

*National « Research Fleet » Service Unit (Ifremer, CNRS, IRD, ...) for vessel time.*

## PIRATA status in France : « Observatoire de la Recherche en Environnement »

### Fundings since 2003 & perspectives (vessel time & salaries & laboratory infrastructures not taken into account):

	METEO FRANCE	IRD	ORE & SOERE INSU	O.M.P./U.P.S.	<b>Total:</b>
2006:	22,430 €	50,000 €	2,300 €	0 €	74,730 €
2007:	22,430 €	50,000 €	0 €	5,000 €	77,430 €
2008:	22,430 €	49,000 €	0 €	5,000 €	76,430 €
2009:	40,000 €	49,000 €	0 €	5,000 €	94,000 €
2010:	40,000 €	45,000 €	20,000 € (exceptionnal)	5,000 €	110,000 €
2011:	40,000 €	45,000 €	15,000 € (exceptionnal)	4,500 €	104,500 €
2012:	30,000 €	45,000 €	5,000 € (exceptionnal, CTDO2)	4,200 €	84,200 €
			+ exceptionnal inputs by LEGOS: 8,000 € => 92,200 €		
2013:	30,000 €	49,000 €	20,000 € (exceptionnal, CTDO2) (from 2012 remnant funds...)	4,200 €	103,200 €
2014:	30,000 €	45,000 €	5,000 € (exceptionnal, CTDO2)	4,200 €	84,200 €
2015:	30,000 €	45,000 €	0 € (no direct funds)	4,200 €	79,200 €
2016:	30,000 €	45,000 €	26,000 € (exceptionnal)	2,940 €	103,940 €
2017:	30,000 €	52,000 €	0 €	3,500 €	85,500 € + 55,000€
		25,000 €	ADCP mooring material purchase (exceptionnal)		<u>total</u> : 140,500€
		30,000 €	Platform for PIRATA material storage containers at Brest (exceptionnal)		

- Increase by IRD; weak increase of the support by OMP/UPS ; nothing from INSU...

⇒ **potential future problems IF NO additional support (CNRS, EU?...)**

⇒ *due to :*

- consequent material transports & trips (flights) increasing costs

- possible full servicing of ADCP mooring at 0N-23W (with GEOMAR until 2018); to be checked.

## Actual French contribution to PIRATA in 2016 (for cruises) :

### Total costs in 2017:

- vessel time : 65 days (40 for cruise +25 for transits from/to Fr to/from Afr ) of R/V THALASSA  
(at ~21k€/day) => ~1,4 M€  
(more explanations below)...

(paid by several organisms as contribution to the national oceanographic fleet,  
with a high level contribution by IFREMER)

technical support, cruises, transports, material etc... (ie working funds)

- => ~80 k€ (in 2017)

(paid by IRD & Meteo France & OMP & CNRS/INSU)

**Total: almost 1,5 M€ (without salaries...)**

### 2017 Engineers/Technicians PIRATA dedicated time (estimated) :

- participation to cruises (40 days at sea + trips) :

- PIRATA FR27 (P.Rousselot, F.Roubaud, S. Hillion, C.Bachelier) : 180 days

- cruises preparation, cruises data treatment, logistics, etc.

(J.Grelet, F.Roubaud, F. Baurand, S.Hillion, C.Bachelier, D.Lopes) : 120 days

**Total: 300 days**

=> Vessels time availability & R/V

## **VESSEL TIME PROCESSES:**

Yearly vessel time demand forms to fill in order to get vessel time properly scheduled ;  
Vessel time demand evaluation every 4 years =>

*Excellent scientific evaluation made in late 2016 for PIRATA-FR cruises (publications, PhD...).*  
*Prior importance to maintain the time series in the Tropical Atlantic.*  
=> *Vessel time ensured until 2021.*

## **From 2015...**

**PIRACY in the GG => no calls in West Africa => one leg : need an long autonomy R/V**

**the PIRATA-FR cruises carried out with the R/V THALASSA**

### *LA THALASSA:*

*74m length, up to 23 scientists, 6-7 moorings onboard  
45 days autonomy, very safe & comfortable.*

*Also acoustic sensors (initially for fishery dedicated  
research), fluorimeter, and efficient cable reels for  
Mooring operations...*

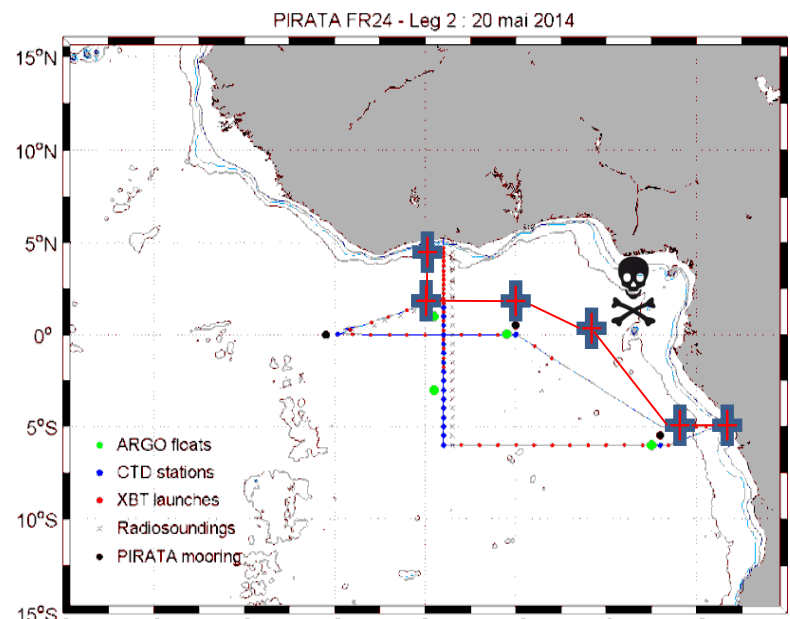


## Major issue for the French PIRATA cruises:

### piracy activities in the north of the Gulf of Guinea:

Piracy events from 2013:  
all the region east of Côte d'Ivoire,  
and north of the equator toward Sao Tomé,  
and off the coast toward 5S,  
are 'security areas' => « exclusion zone ».

📍 = Attempted Attack   📍 = Boarded   📍 = Fired upon   📍 = Hijacked   📍 = Suspicious vessel



⇒ No possible measurements in this area  
of interest from 2012 !

⇒ No calls in the Gulf of Guinea !

*Piracy in 2017 (=> Oct 11, 2017)*



# French PIRATA dedicated cruises : 27 french cruises from 1997 to 2017

Nom de la campagne	Navire	Dates	Chef de mission
PIRATA FR1	ANTEA	09/09-16/09 1997	Jacques SERVAIN
PIRATA FR1 bis	ANTEA	30/01-03/02 1998	Jacques SERVAIN
PIRATA FR2	ANTEA	30/10-10/11 1998	Jacques SERVAIN
PIRATA FR3	ANTEA	23/01-01/02 1999	Jacques SERVAIN
PIRATA FR4- EQUALANT 1999	THALASSA	13/07-21/08 1999	Yves GOURIOU
PIRATA FR5	ANTEA	25/10-08/11 1999	Jacques SERVAIN
PIRATA FR6	SUROIT	08/03-19/03 2000	Jacques GRELET
PIRATA FR7 – EQUALANT 2000	THALASSA	23/07-21/08 2000	Bernard BOURLES
PIRATA FR8	ATALANTE	17/11-03/12 2000	Jacques GRELET
PIRATA FR9	ATALANTE	20/10-11/11 2001	Jacques GRELET
PIRATA FR10	ATALANTE	06/12-21/12 2001	Jacques SERVAIN
PIRATA FR11	SUROIT	17/12-03/01 2002-2003	Jacques GRELET
PIRATA FR12	ATALANTE	28/01-19/02 2004	Bernard BOURLES
PIRATA FR13	SUROIT	23/05 - 05/06 2005	Jacques GRELET
PIRATA FR14 – EGEE 1	SUROIT	07/06 - 05/07 2005	Bernard BOURLES
PIRATA FR15 – EGEE 3	ATALANTE	24/05 - 05/07 2006	B.BOURLES/Y.GOURIOU
PIRATA FR16	ANTEA	19/05 - 01/06 2007	Jacques GRELET
PIRATA FR17 – EGEE 5	ANTEA	04/06 – 09/07 2007	Frédéric MARIN
PIRATA FR18	ANTEA	01/09 – 06/10 2008	Jacques GRELET
PIRATA FR19	ANTEA	16/06 – 24/07 2009	Jacques GRELET
PIRATA FR 20	ANTEA	13/09 – 22/10/2010	Jacques GRELET
PIRATA FR 21	SUROIT	01/05 – 16/06/2011	B.BOURLES/J.GRELET
PIRATA FR 22	SUROIT	19/03 – 02/05/2012	B.BOURLES/J.GRELET
PIRATA FR 23	SUROIT	09/05 – 20/06/2013	B.BOURLES/J.GRELET
PIRATA FR 24	SUROIT	09/04 – 22/05/2014	B.BOURLES/Y.GOURIOU
PIRATA FR 25	THALASSA	18/03 – 16/04/2015	Bernard BOURLES
PIRATA FR 26	THALASSA	07/03 – 13/04/2016	Bernard BOURLES
PIRATA FR 27	THALASSA	27/02 – 03/04/2017	Bernard BOURLES

=> ~ 755 days at sea

# What has been done in 2017 « on the field » ?

## PIRATA FR27 cruise:

**February 25 , April 3, 2017**

**(from Cabo-Verde)**

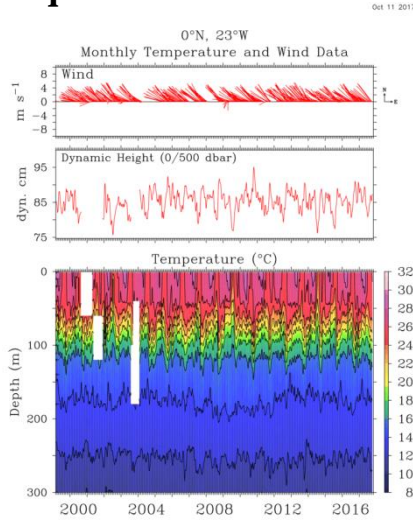
- 6 buoys replaced (+ CO2 sensors replacement at 6S-10W):  
3 ATLAS, 2 T-TLEX and...
  - 1 ATLAS replaced by T-FLEX (at 6S-8E) with new CO2 sensor
  - ADCP mooring at 10W-0N serviced
  - 48 CTD-02/LADCP profiles (0-2000m) :  
sections along 23W (short), 10W, 0E, and 6S
  - 87 XBTs
  - 7 ARGO profilers deployed (*ARGO/CORIOLIS*): 2 with O2 sensors (*OMZ off Congo*)
  - 21 SVP-B deployed (*Meteo-France contribution to AtlantOS & NOAA/AOML/GOOS/DBCP*)
  - 604 sea water samplings  
(surface: SSS, CO2, nutrients, Chl pigments  
& along the vertical during CTD-02 casts: S, O2, nutrients, Chl pigments, CO2 at 6S-10W & 8S-6E )
- +
- OTN sensors replacement at all ATLAS/T-FLEX buoys (*for Dalhousie University, Canada, F. Whoriskey*)
  - Servicing of 10 Xpods at 23W-0N and 10W-0N,  
(*for Oregon Univ., J.Moum; agreement by PIRATA SSG in July 2013*)
  - Continuous ADCP, Tsgraph + ACOUSTIC measurements (vertical & horizontal)
  - Plancton sampling at the buoys positions + close to Sargassum nappe (12 Bongo net profiles: 0-200m)
  - Sargassum samplings



# Status of the 6 PIRATA buoys east of 23° W

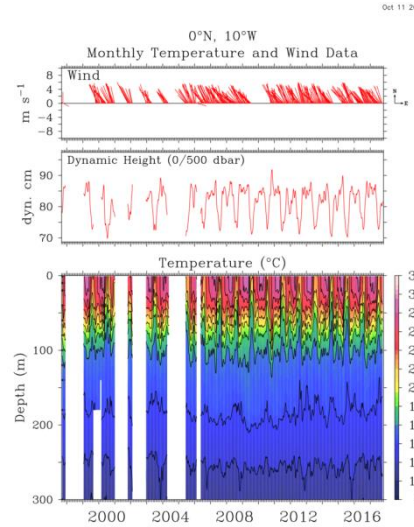
Gaps either due to piracy activities (mostly 0 and 10W-Eq) or sensors failure ; none from 2008!!!

## Eq-23° W



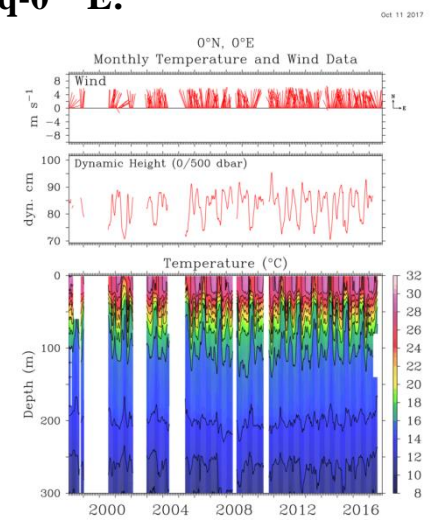
Global Tropical Moored Buoy Array Program Office, NOAA/PMEL

## Eq-10° W



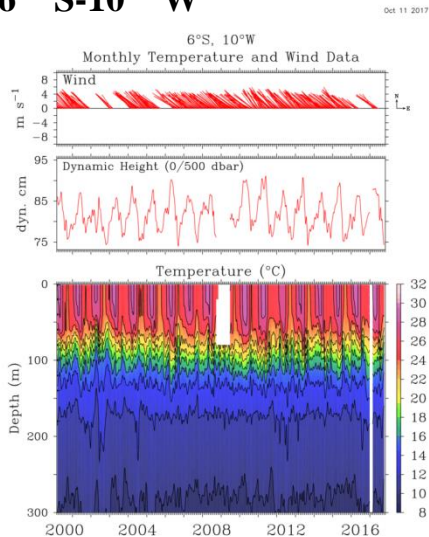
Global Tropical Moored Buoy Array Program Office, NOAA/PMEL

## Eq-0° E:



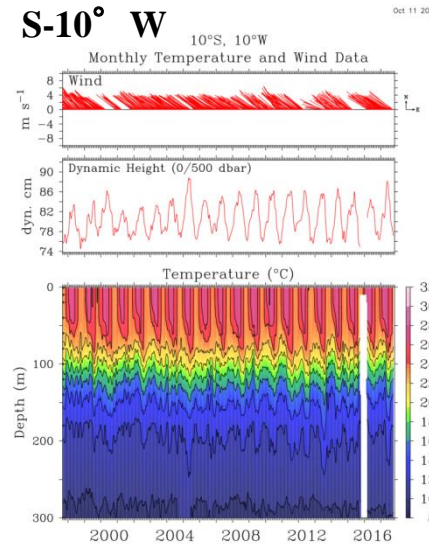
Global Tropical Moored Buoy Array Program Office, NOAA/PMEL

## 6° S-10° W



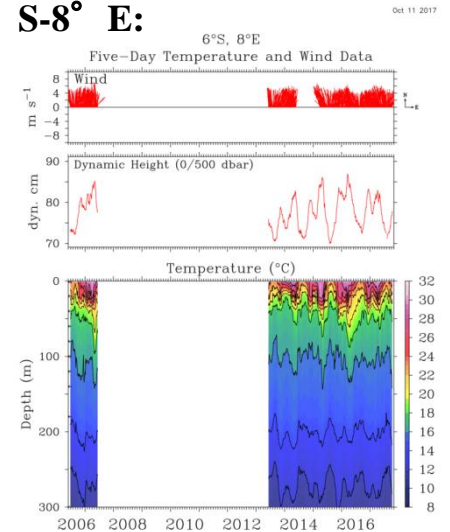
Global Tropical Moored Buoy Array Program Office, NOAA/PMEL

## 10° S-10° W



Global Tropical Moored Buoy Array Program Office, NOAA/PMEL

## 6° S-8° E:

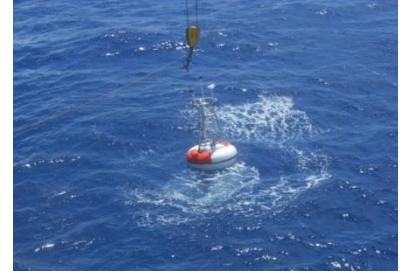


Global Tropical Moored Buoy Array Program Office, NOAA/PMEL

## What has been done in 2017 « on the field » ?

### PIRATA FR27 cruise: About T-Flex

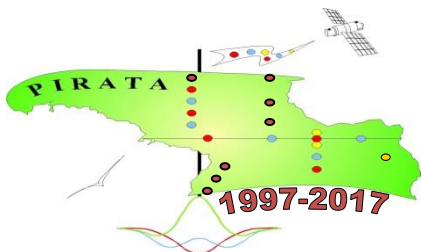
- Training period in Dec 2015 of Jacques Grelet & Fabrice Roubaud (IRD, US IMAGO)
- Successfull deployments of the 3 PIRATA T-Flex systems (at flux Reference sites) at 23W-0N, 10W-10S (2016) & 8E-6S (2017)



Implementation of a « new » CO2 sensor (adapted to T-Flex system).

A few issues that should be solved by feb. 2018 (weights size, location of the GPS & transmission box, etc...).

*+ one additional T/C sensor around 3m depth (on demand by Mike McPhaden) for ML processes*

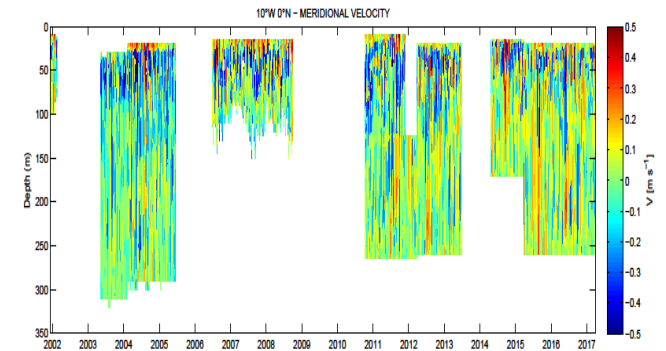
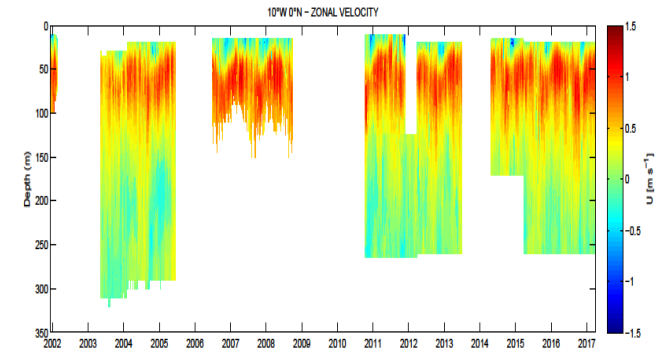
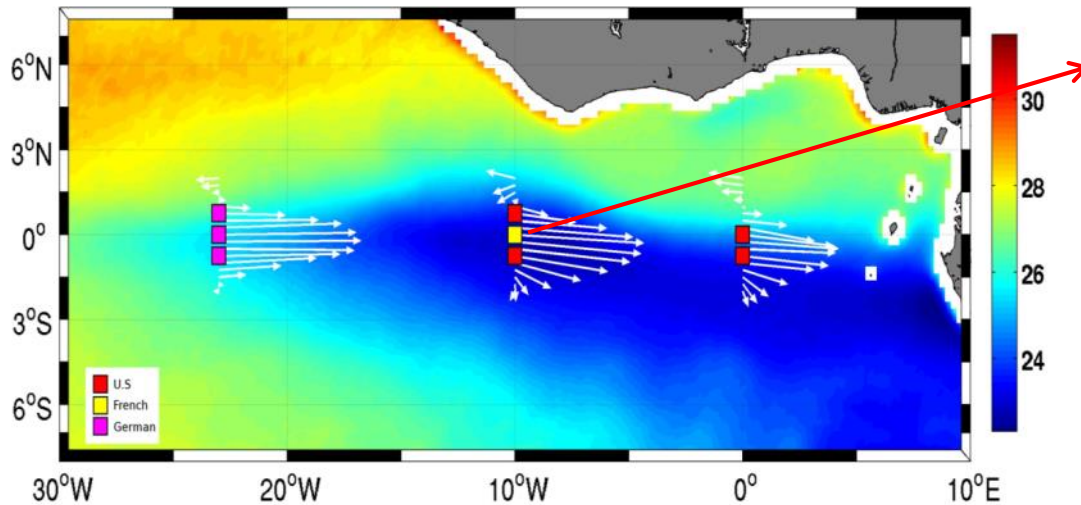


# What has been done in 2017 « on the field » ?

## ADCP moorings:

Servicing of the 10W-0N site.

Successful & full time series for 2015-2017.



2002-2017: J.Habasque, IRD

(Kolodziejczyk et al., 2009; Johns et al., 2013; Perez et al., 2014...)

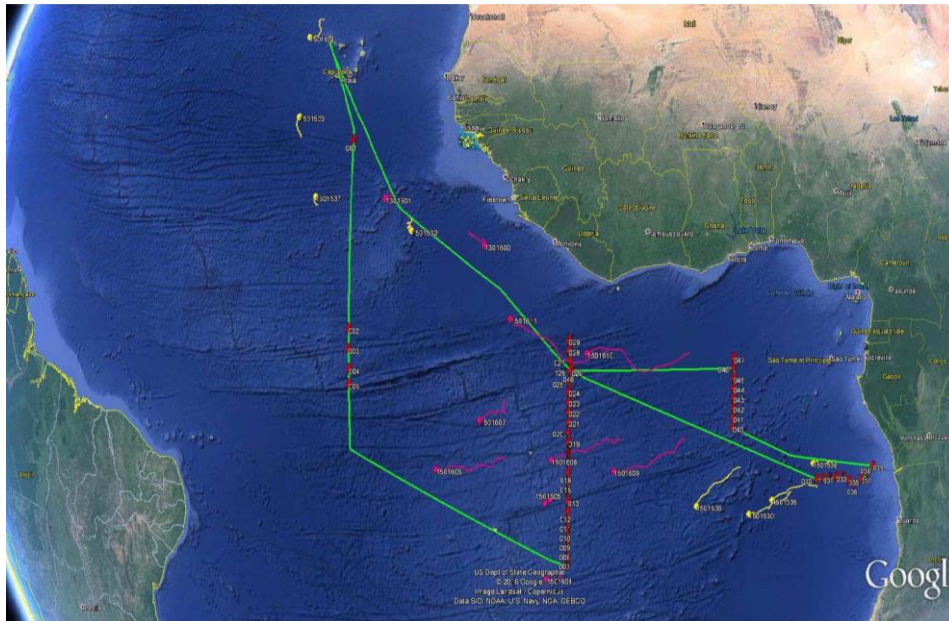
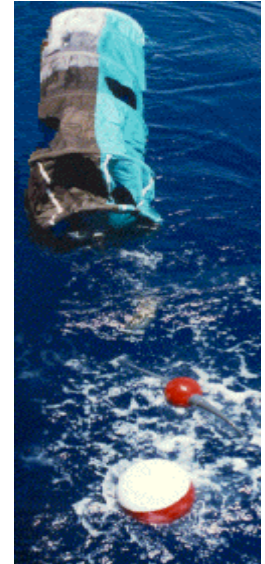
# What has been done in 2017 « on the field » ?

## Deployment of 21 surface profilers in the eastern Tropical Atlantic

(SVP-B)

11 for NOAA/AOML/GDP (contribution to Global Drifter Program (GOOS) )

10 for Meteo-France (contribution to AtlantOS)

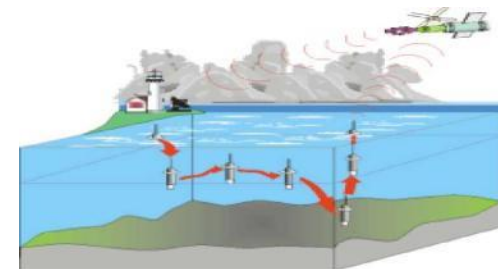


*Trajectories of the 21 SVP-B  
from their launch in March 2017  
during PIRATA FR27,  
as contribution to AtlantOS & NOAA GDP  
(date: June 15, 2017; M. Le Garrec, pers. comm.)*

# What has been done in 2017 « on the field » ?

## Deployment of 8 ARGO profilers

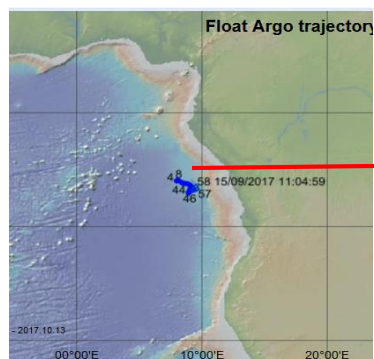
Contribution to ARGO, through CORIOLIS.



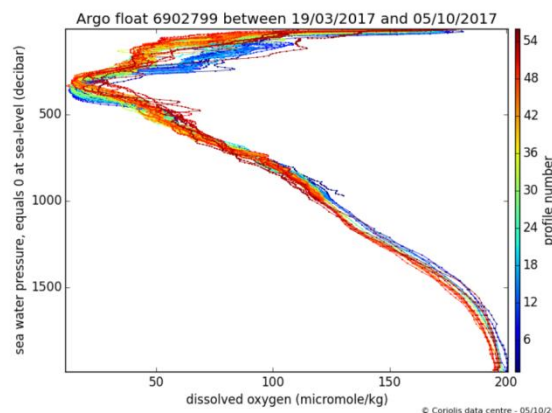
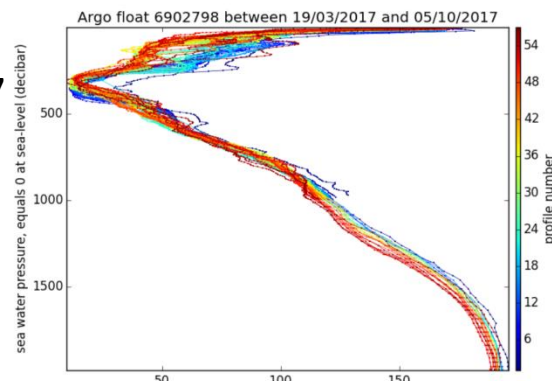
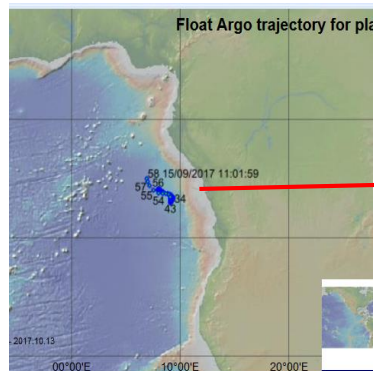
From 2013 : ARGO profilers with enhanced vertical resolution (1m)

From 2016: profilers with « double » programmation

In 2017: 2 profilers with O2 sensors, deployed at 6S-8E, 1 profile/day during 3 months then as usual...



O2 profiles  
from March 19, 2017

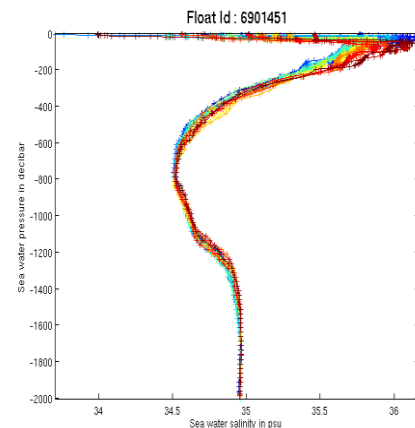


**High vertical resolution:**

0-100m = 1m

100-200m = 5m

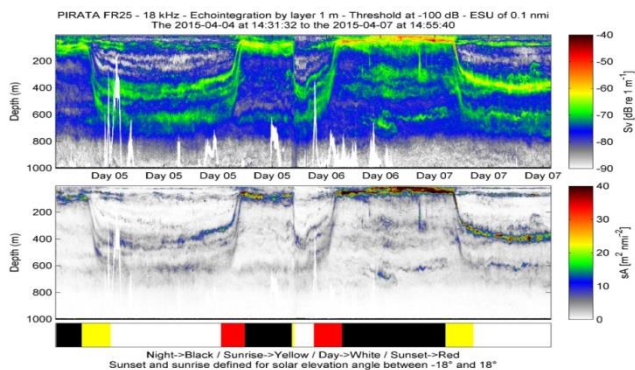
200-2000m = 25m



⇒ All CTD-O<sub>2</sub> profiles are down to 2000m depth for ARGO profilers validation.

# What has been done in 2017 « on the field » ?

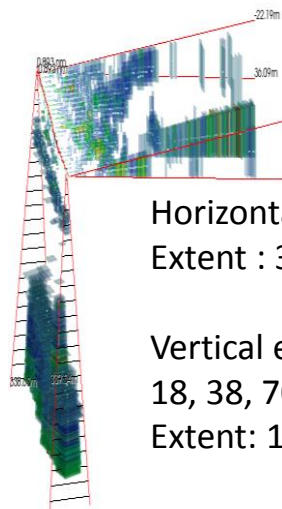
Acoustic measurements ensured during PIRATA-FR cruises from 2015 (from the R/V Thalassa) :  
Vertical & horizontal sounders



Multifrequency acoustic data (18, 38, 70, 120, 200 and 333 kHz) => *information on biotic and abiotic ecosystem components; diurnal vertical migration;*

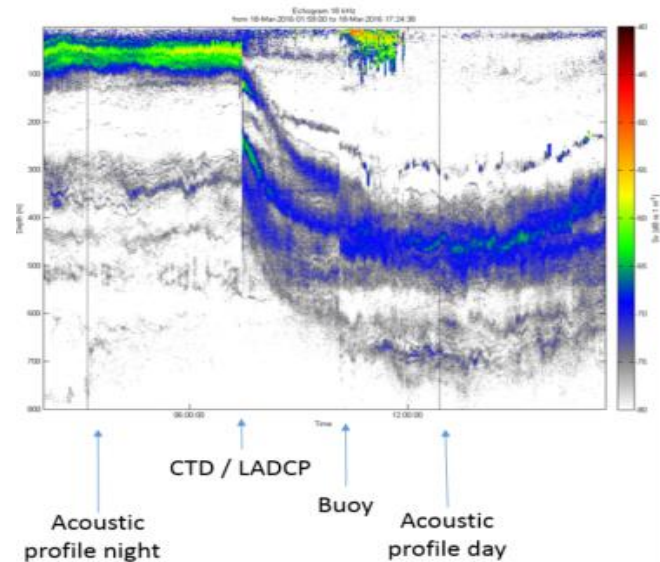


3 days 18kHz measurements along 10°W in March 2015  
(J.Habasque, IRD-Brest)



Horizontal echosounder EK60 120kHz  
Extent : 300 m

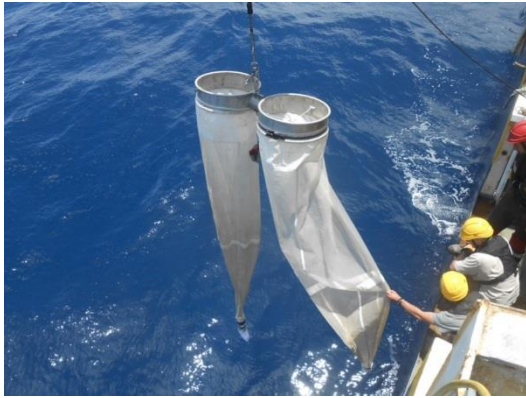
Vertical echosounders EK60  
18, 38, 70, 120, 200 et 333 kHz  
Extent: 1000m



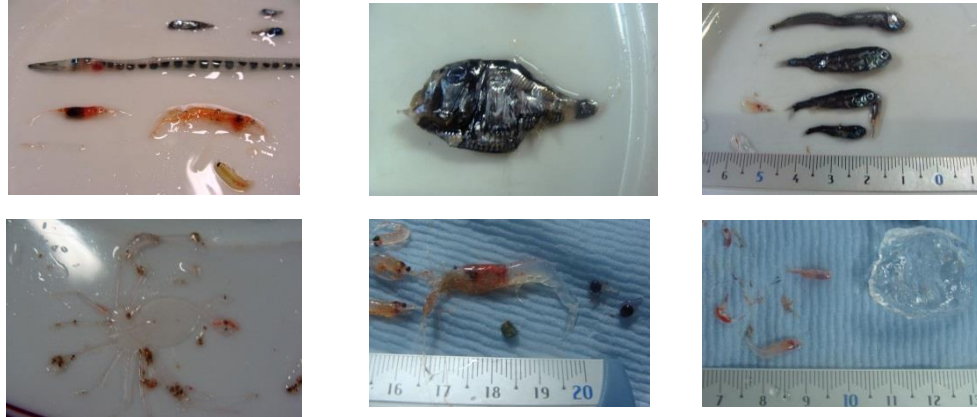


# What has been done in 2017 « on the field » ?

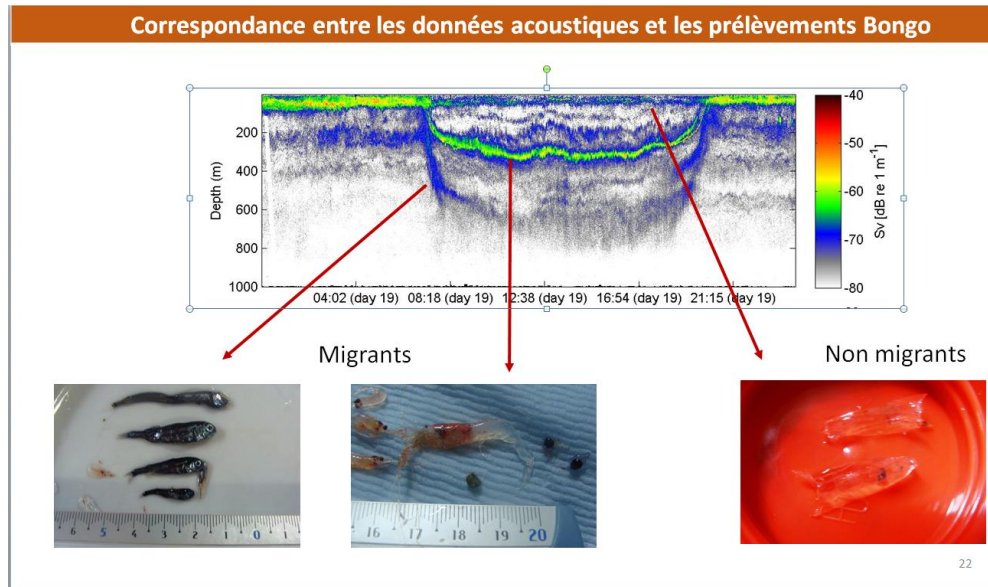
Plankton...



Plankton sampling with a « Bongo » net.



Link with acoustic data (and T/S/O2/ADCP/nutrients/Chl pigments data...):



# What has been done in 2017 « on the field » ?

## and also...: Sargassum algae observation & samplings (from 2011)

*Refer to presentation by Djakouré et al...*

often encountered off West Africa within eastward flows,

sampling (for taxonomy, biological & possibly microplastic analysis).

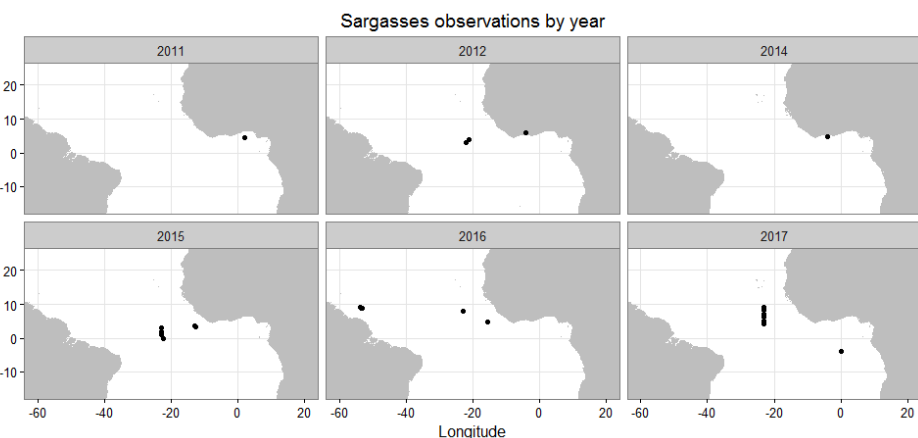


*Pictures: Frédéric Marin March 2017*

large areas of Sargassum on which significant amount of plastic objects are observed...



Also observed during PIRATA PNE along 23°W



AtlantOS =

“Optimizing and Enhancing the Integrated Atlantic Ocean Observing System ”

*<https://www.atlantos-h2020.eu/>*

WP3 = “Enhancement of autonomous observing networks”

WP3.5 = PIRATA:

- **addition of Classical sensors (T/C, current)** to some particular sites (IRD, B.Bourlès)
  - i) at 0N-10W 2 T/C sensors at 5m and 10m, + 1 currentmeter at 10m,
  - ii) at 8N-38W & 0N-35W : add 1 currentmeter at 10m depth,  
; done in 2017 at 0N-10W (Sontek currentmeter; Aquadopp in 2018)
  
- **addition of one CO2 sensor at 6S-8E** (IRD, N.Lefèvre); done in 2017
  
- **addition of O2 along 23W at 300m & 500m** with (for 12N & 20N sites)  
data transmission in real-time (GEOMAR, P.Brandt)  
done in 2017

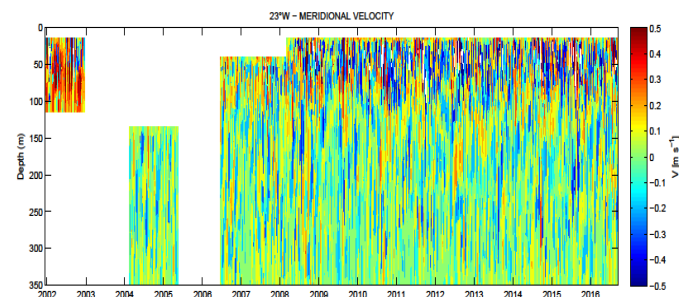
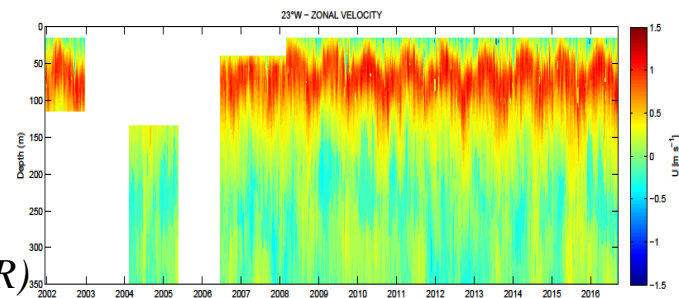
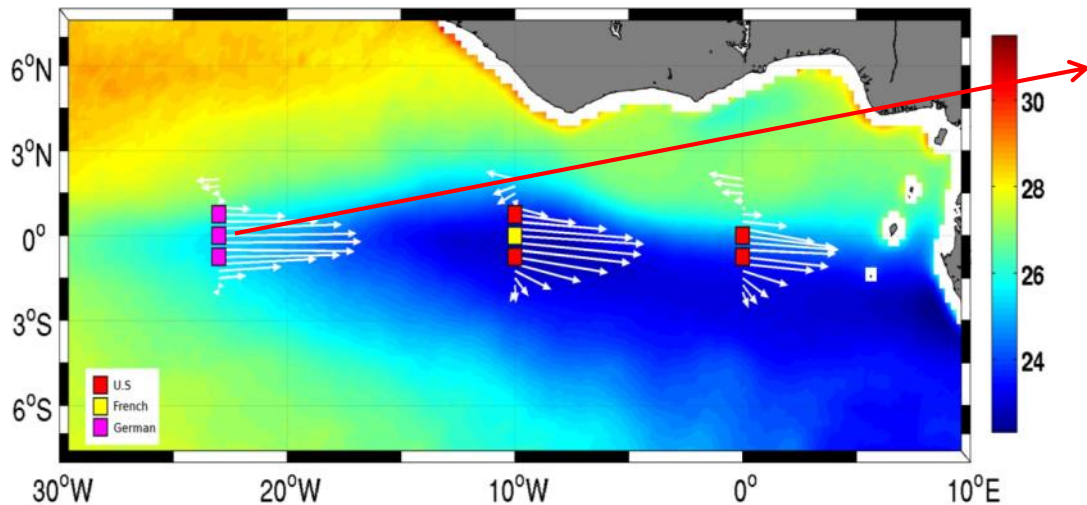
What have been done in 2017 « in the lab » ?

## ADCP moorings data gathering & treatment:

All data (0-300m) available for the 23W & 10W moorings.  
0-0 will be serviced in 2018.

⇒ DOI: <http://doi.org/10.17882/51557>

*Possible servicing at 23W after 2018:  
looking for funds (mooring material) - (to be checked with GEOMAR)*



2002-2017: J.Habasque, IRD

(Kolodziejczyk et al., 2009; Johns et al., 2013; Perez et al., 2014...)

## What have been done in 2017 « in the lab » ?

### CTD data new treatment: *P.Rousselot & J.Grelet, IRD*

Recruitment (early 2017) of one technician for data acquisition & treatment (Pierre Rousselot) at IRD/Service Unit IMAGO (Brest)

CTD-02 data treatment (Cascade) renewed & validated; all data treated & gathered  
(*but transmissiometer & fluorimeter profiles data*)

⇒ DOI: <http://doi.org/10.17882/51534>

Detailed calibration reports (from PIRATA FR23, 2013) (*but in French...*)

#### **Rapport de Calibration des données CTD-02**

#### **De la campagne PIRATA-FR27**

DOI : 10.17600/17001800

Septembre 2017

#### *Abstract*

*CTD-02 data issued from this rapport have been adjusted using pre- and post-campaign calibration coefficients, taking into account the sensor drift. Dynamic corrections applied from model have been checked and optimized, and, based on the difference between chemical analysis and sensor measurements, polynomial have been applied and calibrations coefficients have been optimized using statistical methods to adjust the salinity and the oxygen concentration CTD-02 data. The profiles have been carefully examined and corrected from each anomaly. Except for the transmissometer and fluorimeter profiles, these data are consistent with the international WOCE standard. Concerning fluorimeter data, only the relatives' measurements along a profile make sense. An offset have been applied to the fluorimeter measurements in the view to pass the validation tests. The circuit 1 sensors have been preferred because sensors drift is less important than the circuit 2 sensors.*

What have been done in 2017 « in the lab » ?

**Actualized & completed French PIRATA website:**

*<http://www.brest.ird.fr/pirata/>*

*or*

*<http://www.ifremer.fr/ird/pirata/>*

⇒ More information about cruises

⇒ Pirata related reports, presentations & documents (SSG...).

⇒ Easy access to in situ Pirata cruises data sets (*with some DOIs*)

⇒ DOI for all PIRATA-FR cruises

⇒ new S-ADCP data set with DOI (G.Herbert)

⇒ new ADCP moorings data set with DOI (J.Habasque)

⇒ new CTD-O2 data set with DOI (P. Rousselot, J. Grelet)

⇒ new Chemistry data sets (B.Bourlès, F.Baurand, S.Hillion, P.Rousselot)

# What have been done in 2017 « in the lab » ?

French PIRATA website: [http://www.ifremer.fr/ird/pirata/index\\_fr.php](http://www.ifremer.fr/ird/pirata/index_fr.php)

*Informations,  
reports,  
presentations,  
technical info*

**PIRATA**  
Prediction and Research Moored Array in the Tropical Atlantic

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

**Project resources**  
Data and Products  
Mooring status  
Reports  
Publications  
Latest news  
Talks  
Miscellaneous  
Technical documentations  
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...

**French PIRATA cruises DOI informations**

From early 2016, informations about all PIRATA-FR cruises have been made available through a "DOI" (Digital Object Identifier) 10.18142/14 through the French Oceanographic Portail.

Each PIRATA-FR cruise has its own DOI number. Each DOI gives access to cruise information, data sets, publications, etc...

**News !**

**PIRATA FR27 cruise in March-April 2017 aboard the R/V Thalassa**

The last PIRATA cruise in March-April 2017 aboard the R/V Thalassa with 3 T-FLEX mooring that have been successfully deployed in the French Pirata area.

**PIRATA-FR27 cruise report**


New T-FLEX mooring : sensor specifications















IRD  
MÉTÉO FRANCE  
OMP


Acknowledgment for use of data PIRATA website


## French PIRATA website: Data access


Index de ftp://ftp.ifremer.fr/ifremer/ird/pirata/pirata-data/


 [Vers un rép. de plus haut niveau](#)


Nom	Taille	Dernière modification	
 ADCP-moorings		17/05/2017	10:09:00
 CO2		08/06/2017	08:59:00
 README	11 KB	10/07/2017	11:27:00
 README~	10 KB	10/07/2017	11:22:00
 Read-me-first.doc	28 KB	08/06/2017	13:58:00
 Read-me-first.txt	2 KB	08/06/2017	13:58:00
 Sao-Tome_meteorological-station		08/06/2017	09:00:00
 Sao-Tome_tide-gauge		30/05/2017	10:15:00
 adcp		14/01/2016	00:00:00
 chimie		08/06/2017	13:59:00
 code_roscop.csv	22 KB	19/01/2009	00:00:00
 ctd		14/09/2017	11:38:00
 surface		15/06/2017	16:36:00
 xbt		28/11/2012	00:00:00

**new** →  ADCP-moorings


 CO2


 README


 README~


 Read-me-first.doc


 Read-me-first.txt


 Sao-Tome\_meteorological-station


 Sao-Tome\_tide-gauge


 adcp

 chimie

 code\_roscop.csv

 ctd

 surface

 xbt

L-ADCP data (0-2000m; from 2005) treatment process going on; data expected in 2018...







# What have been done in 2017 « in the lab » ?

## Chemistry data sets:

- S, O<sub>2</sub>, nutrients & Chl pigments (from bottle samplings)

Index de <ftp://ftp.ifremer.fr/ifremer/ird/pirata/pirata-data/chimie/>

 [Vers un rép. de plus haut niveau](#)

Nom	Taille	Dernière modification	
 EXCEL		04/10/2017	14:21:00
 ODV		04/10/2017	14:20:00
 <a href="#">Read-me-first.doc</a>	27 KB	07/06/2017	17:06:00
 <a href="#">Read-me-first.txt</a>	2 KB	08/06/2017	08:58:00

=>

Analysis from CTD-O<sub>2</sub> profiles bottles => ODV files

Analysis from surface « en route » bottles => Excel files

*All available from 2004 (1st years with such measurements; along with EGEE cruises 2005-2007)*

## What is going on « in the lab » ?

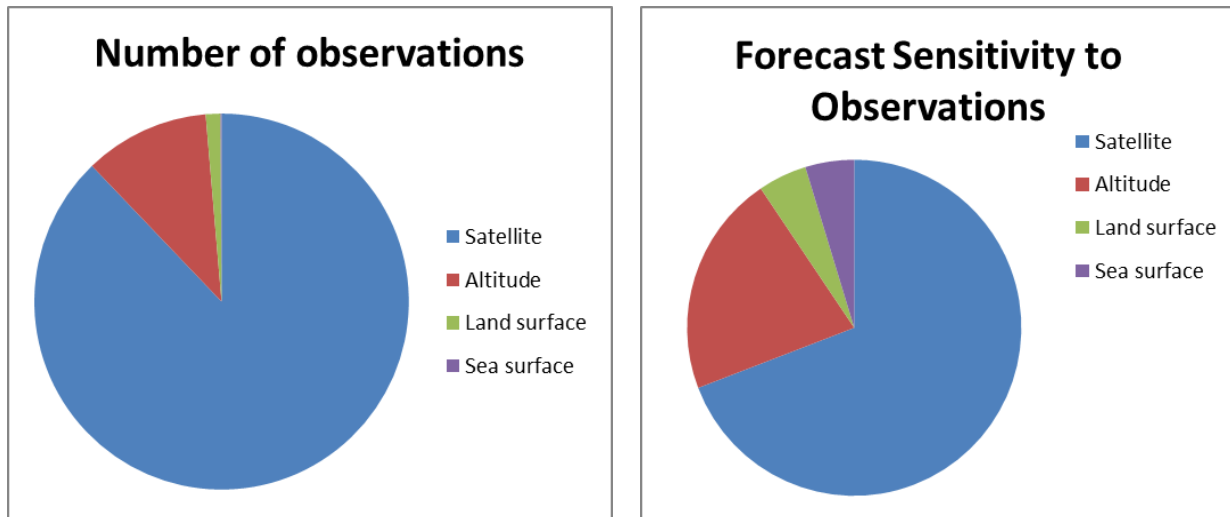
### Use of PIRATA buoys data for climate simulations (ECMWF): potential usefulness of Patm in tropical areas...

*Inputs by Paul Poli (EUMETNET & Météo France; pers. comm.)*

To assess the impact of observations on weather forecasts, a common approach is to withdraw them from the assimilation, and conduct Observing System Experiments. This requires dedicated and costly numerical experiments.

Another approach is to consider results from the operational ECMWF system, whereby the individual Forecast Sensitivity to Observation (Cardinali, 2009) is computed, and stored within the observation feedback, for each assimilated observation.

Between May 2015 and April 2017, for the first day of each month, one finds that the observations assimilated operationally by ECMWF come from (in decreasing order) satellites, upper-air (radiosondes, aircraft), land-surface, and sea-surface. The last observations are not even visible on the pie chart below (a), because the sea-surface observations are so seldom, compared to other observing systems. However, if one considers the contribution of observations to improving the forecasts (by reduction of the 24-hour forecast error via the data assimilation), one finds a different picture (b).



## What is going on « in the lab » ?

### Use of PIRATA buoys data for climate simulations (ECMWF): potential usefulness of Patm in tropical areas...

*Inputs by Paul Poli (EUMETNET & Météo France; pers. comm.)*

If one investigates further to individual platforms, the PIRATA moored buoys, on average, contributed, in the ECMWF operational data assimilation and prediction system:

0.000055 % of the total number of observations assimilated,

0.006076 % of the total 24-hour global error forecast reduction.

This places the impact factor (the inverse ratio between the two quantities above) of PIRATA observations of surface pressure at around **110**; this is less than for the average of drifting buoys reporting surface pressure in the vicinity (at **128**), or drifting buoys on the surface of the globe (at over **400**, most platforms being away from the Tropics). This result is consistent with the wise meteorological expectation that surface pressure observations have comparatively less impact when collected near the Equator than in the mid-latitudes.

However, this number still exceeds that obtained for all other components of the global observing system. For comparison, over the same time period and in the same global prediction system:

the impact factor for other surface marine observations is around **5**;

the impact factor for surface land-based observing systems is near 4;

the impact factor for upper-air observing systems (including aircraft and radiosondes) is around 2;

the impact factor for satellites is around 0.8

**These results suggest that the collection of surface pressure data from moored and drifting buoys in the Tropical Atlantic delivers valuable benefits to global weather predictions.**

#### Reference

Cardinali, C., 2009: Monitoring the observation impact on the short-range forecast. *Q.J.R. Meteorol. Soc.*, **135**: 239–250.  
doi:10.1002/qj.366

# What is going on « in the lab » ?

Other independant work: study about incoming solar radiations & use of Pirata data for products validation (EGU 2017)

Comparison of several databases of downward solar daily irradiation data at ocean surface with ePIRATA measurements

Mélodie Trolliet  
Lucien Wald

Mines ParisTech  
PSL Research University  
Sophia Antipolis, France



## 1 Motivation

- Sea Surface Irradiance is recognized as **Essential Climate Variable**
- High quality** and **high resolution** (spatial and temporal) **irradiance data** are needed for a good representation of climate system
- Satellitederived surface irradiance data** have these characteristics, but are **not extensively validated for ocean domain**
- This study **compare** different satellite dataset against in situ measurements made on buoys
- Challenges** :
  - Soiling (including sea salt and dust)
  - Buoy roll and pitch
  - Missing periods, due to maintenance issues

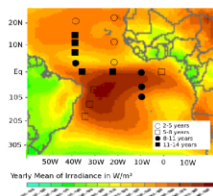


## 3 Results

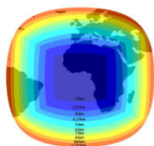
Mean 17 stations	Bias W/m <sup>2</sup> (relative)	RMSE W/m <sup>2</sup> (relative)	Cor Coef
HC - 3 v4	29 (13 %)	45 (20 %)	0.812
HC - 3 v5	14 (6 %)	35 (15 %)	0.831
CAMS RAD	8 (4 %)	29 (13 %)	0.862

More detailed description of atmospheric constituent (aerosol and water vapor)  
Change in modelling cloud proprieties

## 2 In situ sea surface irradiance measurements : PIRATA network and ePIRATA database



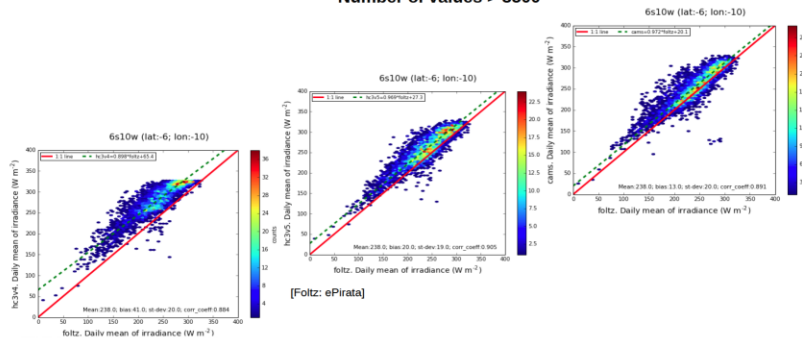
- PIRATA: mooring network of **17 ATLAS buoys** with 20+ years of data
- Measure **near-surface meteorological and subsurface oceanic parameters** (temperature, salinity, downward solar irradiance...)
- Quality check using NASA procedure
- Resolution: 2 min, on 1997 - 2016**
- Correction of PIRATA dataset for aerosol : **ePIRATA database**
- Resolution: daily**



### HelioClim and CAMS-RAD

- HelioClim-3** and **CAMS RAD** databases are derived from **Meteosat images**, using **Heliosat-2** and **Helosat -4 methods**
- Resolution: 15 min, on 2004 - 2016**

Number of values > 3500



## Conclusion

In taking **ePirata dataset as reference** :

- Each dataset exhibits a tendency to **underestimate the irradiance**
- For a given station, performances vary notably from a dataset to another
- Conversely, for a given dataset, performances vary from station to station

**CAMS RAD dataset is more appropriate for describing the downwelling solar radiation at ocean surface in this region**



### CONTACT

melodie.trolliet@mines-paristech.fr  
www.ole.mines-paristech.fr



## What is going on « in the lab » ?

Biology (other laboratories: LEMAR, Brest; MIO, Marseille)

Analysis for microplastics, genetics, taxonomy...



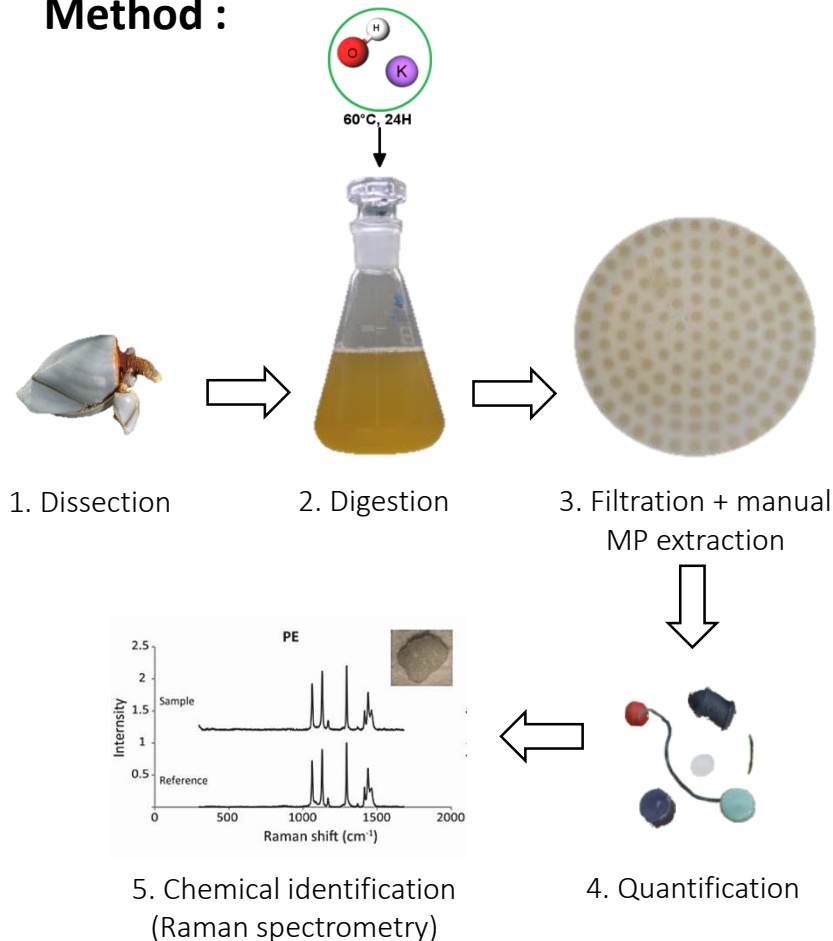
# What is going on « in the lab » ?

**Ex: Do « gooseneck barnacle » ingest microplastics debris in the Eastern Tropical Atlantic ?**

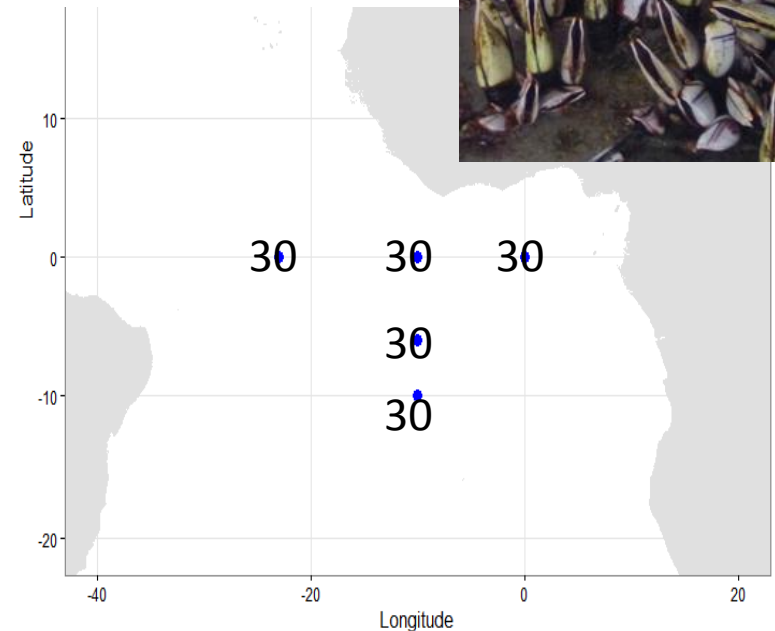
## Objectives :

- To detect if crustacean *Lepas anatifera* attached on PIRATA buoys ingested microplastics
- To compare microplastics concentration between each mooring
- To investigate the path of microplastics drifted by surface currents from the source to the buoy

## Method :



## Data



*Works planed at LEMAR, Brest (Ika Paul-Pont)*

# What is going on « in the lab » ?

inputs by Florent Gasparin (MERCATOR)

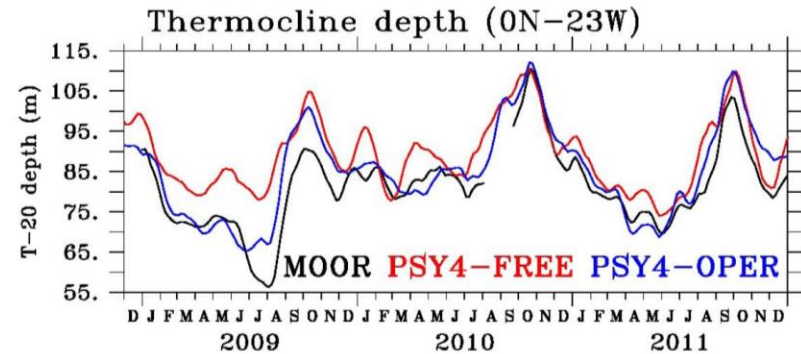
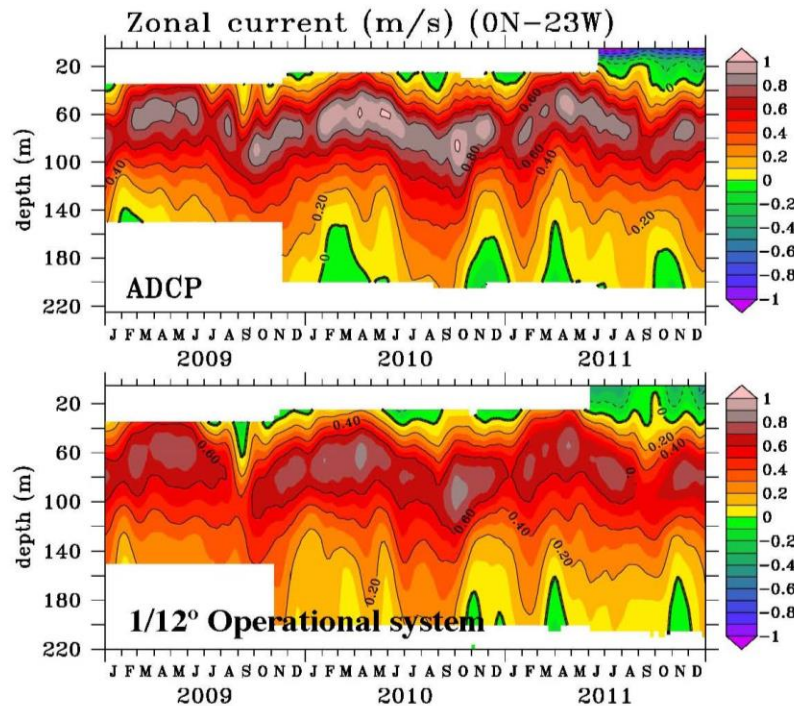
## The significant role of the PIRATA array for the Mercator system

Several initiatives have been conducted for evaluating impacts of the Tropical Mooring Array on monitoring systems in the GODAE framework (only few have been published)

International projects motivate coordinated efforts for assessing the tropical moorings contribution on monitoring systems (e.g, TPOS2020, AtlantOS)

Such impact studies are required for (i) supporting the evolution of an integrative global ocean observing system, and (ii) refining data assimilation schemes in ocean reanalyses and monitoring systems

### 1. MAJOR CONTRIBUTION OF PIRATA FOR SYSTEM VALIDATION



- Comparisons of fixed-point PIRATA observations with the monitoring system demonstrate the critical need of observations for representing essential variables
- The availability of direct current measurements allows comparisons with non-constrained variables (=independent datasets)

# What is going on « in the lab » ?

inputs by Florent Gasparin (MERCATOR)

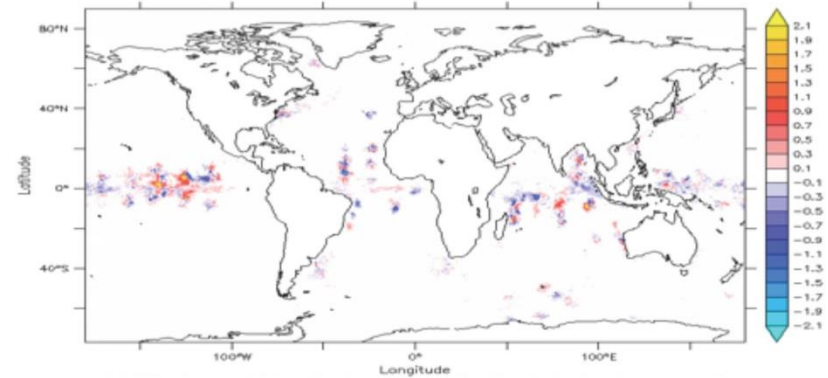
## 2. PAST EFFORTS HAVE BEEN UNDERTAKEN TO ASSESS TROPICAL MOORINGS IMPACTS ON MONITORING SYSTEMS

*Recent exemple (March 2013, E. Remy) - Impact of existing observations, with/without data assimilation (Observing System Experiment, OSE)*

- A version of the  $\frac{1}{4}^\circ$  operational system have ran in parallel with and without moorings during 4 cycles (7-day) in March 2013
- Thermocline level and in the mixed layer are mostly affected
- Amplitudes of changes are important but local
- After one month, changes are already propagated by the ocean tropical dynamic away from the mooring points

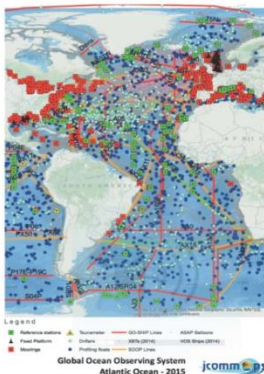
- As part of an integrative observing system, tropical moorings impact on the monitoring and analysis system
- Refinements of assimilation schemes are required in this complex region for optimising benefits from PIRATA

Temperature differences at 100 m in March 27, 2013 between simulations with/without moorings assimilation



## 3. DEDICATED DESIGN EXPERIMENTS ARE CURRENTLY CONDUCTED IN THE ATLANTOS AND TPOS2020 PROJETS

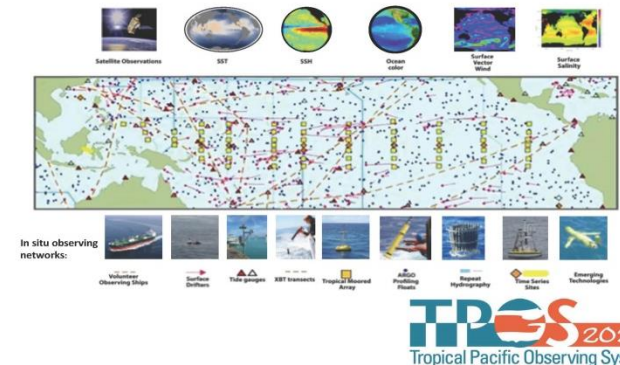
Benefits of enhancements in the North Atlantic (H2020 AtlantOS project - 2015-2019)



A unique coordinated effort implying several ocean forecasting centres for a more integrated and more sustainable Atlantic Ocean Observing System



The Tropical Pacific Observing System (TPOS2020, 2014-2020)





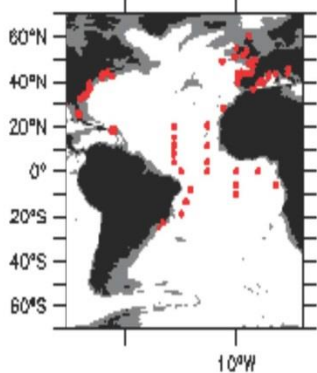
# What is going on « in the lab » ?

inputs by Florent Gasparin (MERCATOR)

*Preliminary results from the AtlantOS dedicated experiments - Impact of new observations prior to development, with/without synthetic data assimilation sampled in a realistic simulation (Observing System Simulation Experiment, OSSE)*

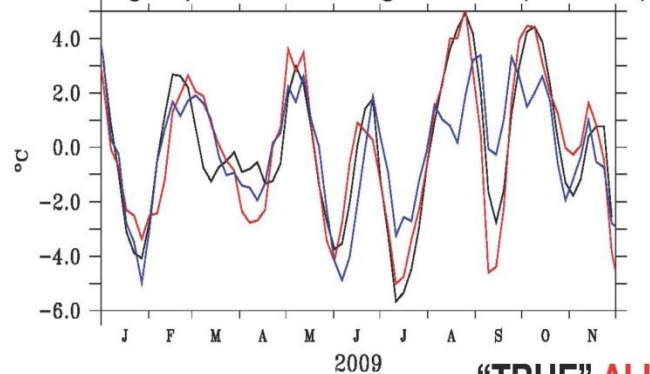
- Compared with most previous short-period experiments, Mercator have performed a set of 3-year OSSE experiments
- OSSE have a high numerical cost, and can be hardly conclusive - NEED RIGOROUS REQUIREMENTS & INTERPRETATION

Daily data considered in OSSE  
from CORIOLIS database

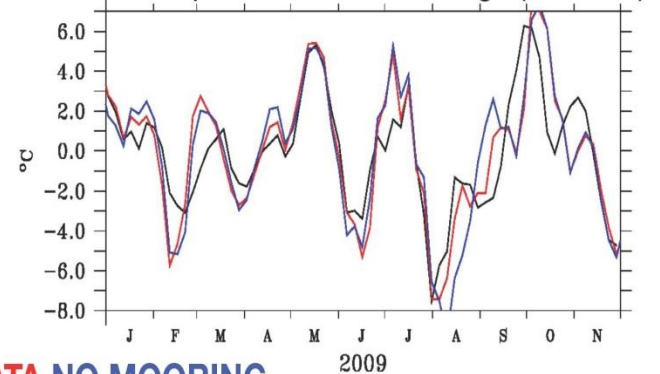


Representing intraseasonal variability of the thermocline depth (15-60 days)

Strong impact at mooring location (35W, 0N)



Limited impact between moorings (15W, 0N)



**“TRUE” ALL DATA NO MOORING**

- Removing mooring would preferentially impact close to mooring sites, at higher frequencies
- Dedicated metrics are needed for evaluating where PIRATA observations impact on ocean state estimate in the context of an integrated observing system, including satellites and *in situ* observations

## What is going on « in the lab » ?

inputs by Florent Gasparin (MERCATOR)

=>

- 
- The PIRATA array is critical for ocean monitoring and forecasting system, by providing high-frequency multi-variables datasets at fixed points, for assimilation and independent validation
  - Impact studies are more and more involved in design strategy of maintenance, enhancement and extension of *in situ* networks and require implication of research community
  - Important challenges are remaining for gaining the highest possible benefits of PIRATA
  - The evolution of assimilation schemes and monitoring systems (e.g., improved covariances scales, shorter assimilation window) should increase the added-value of high-frequency fixed point PIRATA obs.

**AtlantOS 3<sup>rd</sup> annual Meeting 21 – 23 November 2017, Gran Canaria**  
**+ OSSE meeting in 24th November including metrics discussion**

**AtlantOS**  
EU Horizon 2020 project

# What is going on « in the lab » ?

## Use of acoustic data for biological numerical simulations (1/3):

1

### OSS Experiments in SEAPODYM-MTL

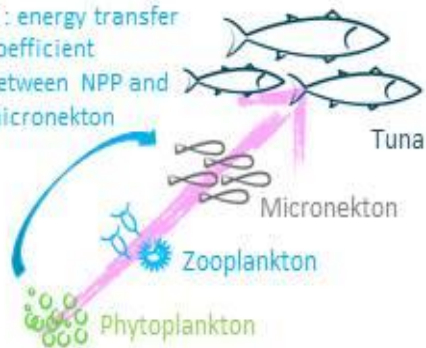
Audrey Delpech, Anna Conchon, Olivier Titaud & Patrick Lehodey

#### Spatial Ecosystem And POpulation DYnamic Model (Mid-Trophic Level component)

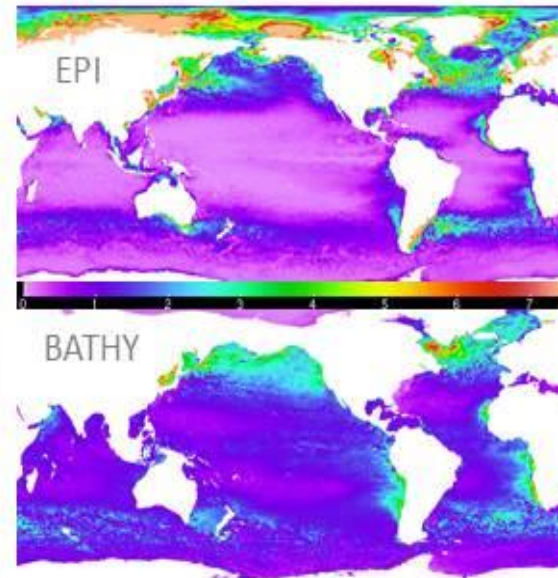
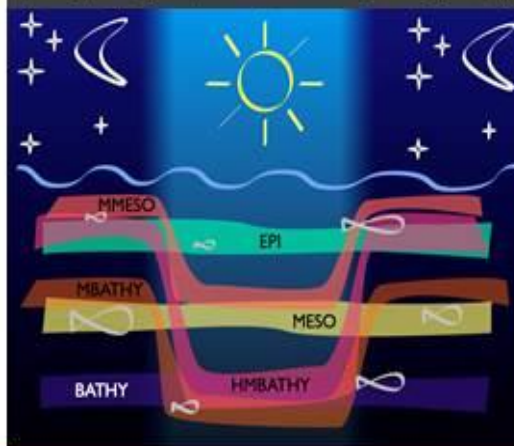
⇒ Biomass distribution of micronekton (species group in functional groups not according to taxonomy)

Trophic chain seen as a transfer of energy from primary producers toward top predators

$E$  : energy transfer coefficient between NPP and micronekton



6 functional groups of micronekton based on their DVM behavior (3 migrant groups and 3 non-migrant groups)



Maps of micronekton biomass:  
Non-migrant epipelagic and bathypelagic group (in gWW/m<sup>2</sup>)

Unknown

$E_i$ : energy distribution coefficients between the six functional groups

$E_i$  estimations are done through assimilation of 38kHz acoustic data



## What is going on « in the lab » ?

### Use of acoustic data for biological numerical simulations (2/3):

2

## OSS Experiments in SEAPODYM-MTL

Audrey Delpech, Anna Conchon, Olivier Titaud & Patrick Lehodey

### Observing System Simulation Experiments

1. Create synthetic observations using SEAPODYM-MTL (at the position of existing observation networks)
2. Perturbate model inputs
3. Estimate model parameters using those synthetic observations (target value is known) in a non-idealized case (biased model inputs)
4. Calculate metrics of parameter estimation error for the different observation networks

GOAL

Assess the benefit of using different observation networks in data assimilation procedures  
(Estimation of  $E_i$  in SEAPODYM-MTL)



# What is going on « in the lab » ?

## Use of acoustic data for biological numerical simulations (3/3):

3

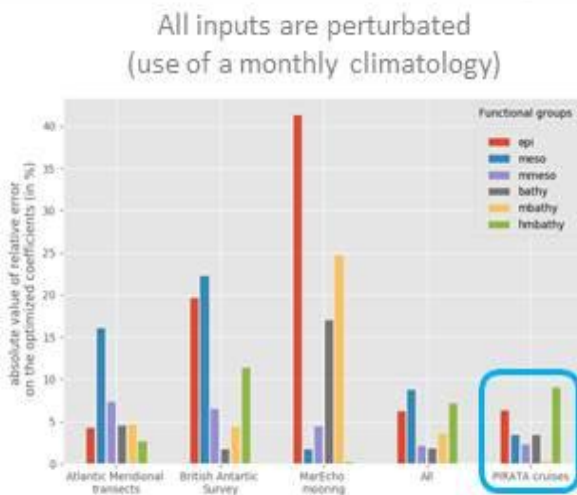
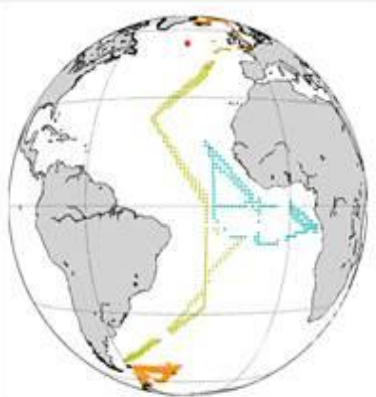
### OSS Experiments in SEAPODYM-MTL

Audrey Delpech, Anna Conchon, Olivier Titaud & Patrick Lehodey

### Results

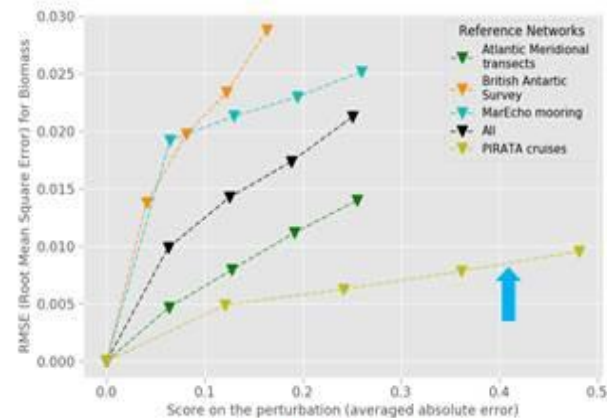
Observation networks compared in this study

- Atlantic Meridional Transects
- Pirata Cruises
- British Antarctic Survey
- MarEcho Mooring



One of the smallest parameter estimation errors

Only the temperature is perturbed  
(5 experiments with different magnitudes of perturbation)



The smallest output errors  
(for all magnitude of perturbation)

Conclusions : PIRATA network is one of the best observation network for data assimilation in SEAPODYM-MTL (due to its localisation and its sampling scheme )



# What is going on « in the lab » ?

## Master or Engineer School Training Periods in 2017:

- *Mélodie TROLLIET, M2 Univ. Marseille & Mines Paris Tech, Estimation de l'éclairement solaire en surface et de sa variabilité temporelle et spatiale de l'océan Atlantique tropical, June 2017.*
- *Odilon Joël HOUDEGNONTO, M2 UAC-UPS, Cotonou, Caractérisation des panaches des fleuves Niger et Congo dans le Golfe de Guinée, September 2017.*
- *Olivia Estelle KOM, M2 UAC-UPS, Cotonou, Comparaison modèle/observations dans l'Atlantique tropical: Bilans de chaleur / sel et sous-courant équatorial, September 2017.*

## PhD:

- *Antonio VASCONCELOS, Diagnostic et quantification de la contribution océanique à l'occurrence d'événements de précipitations extrêmes dans la région côtière du Nord-Est du Brésil, Meteo-France, CNRM/UPS (2015-2018, dir. H.Giordani).*
- *Mesmin AWO: Oscillateurs climatiques de l'Atlantique tropical; LEGOS, Toulouse & CIPMA, Cotonou (2015-2018; dir.: G. Alory & E. Baloitcha)*
- *Mélodie TROLLIET: Comparison of several databases of downward solar radiation data at ocean surface with PIRATA measurements, (Mines Paris Tech, dir. L. Wald)*

## + One IRD grant apply in 2018 for:

- *Odilon Joël HOUDEGNONTO: Barrier Layer & short scales thermohaline variability in the Gulf of Guinea; LOPS, Brest & CIPMA, Cotonou (2018-2021, dir. N.Kolodziejczyk & C.Y. Da Allada).*

+ 1 achieved in 2017 & 2 going on at UFPE, Recife...

# What is going on « in the lab » ?

## Publications (from Dec 2016) :

- *Tchamabi, C.C.*, M. Araujo, M. Silva, and B. Bourlès. A study of the Brazilian Fernando de Noronha Island and Rocas Atoll wakes in the tropical Atlantic, *Ocean Modelling*, 2017, 111, 9-18, doi 10.1016/j.ocemod.2016.12.009.
- Benetti, M., H.C. Steen-Larsen, G. Reverdin, Á.E. Sveinbjörnsdóttir, G. Aloisi, M.B. Berkelhammer, B. Bourlès, D. Bourras, G. de Coetlogon, A. Cosgrove, A.K. Faber, J. Grelet, S. B. Hansen, R. Johnson, H. Legoff, N. Martin, A.J. Peters, T.J. Popp, T. Reynaud, M.N. Winther. Stable isotopes in the atmospheric marine boundary layer water vapour over the Atlantic Ocean, 2012-2015, *Nature Sci. Data*, 2017, 4, 160128, doi:10.1038/sdata.2016.128.
- *Da-Allada, C.*, J. Jouanno, F. Gaillard, N. Kolodziejczyk, C. Maes, N. Reul, B. Bourlès. Importance of the Equatorial undercurrent on the sea surface salinity in the eastern Equatorial Atlantic in boreal spring, *J. Geophys. Res.-Oceans*, 2017, 122, 521–538, doi10.1002/2016JC012342
- *Djakouré, S.*, P. Penven, B. Bourlès, V. Koné. Respective roles of the Guinea Current and local winds on the coastal upwelling in the northern Gulf of Guinea, *Journal of Physical Oceanography*, 2017, 47, 6, 1367-1387, doi: 10.1175/JPO-D-16-0126.1.
- *Djakouré S.*, M. Araujo, B. Bourlès, A. Hounsou-Gbo & C. Noriega, On the potential causes of the Sargassum bloom events in the tropical Atlantic Ocean, *Biogeosciences Discuss.*, <https://doi.org/10.5194/bg-2017-346>, in review, 2017.
- *Hounsou-Gbo, A.*, J. Servain, M. Araujo, G. Caniaux, B. Bourlès, D. Fontenele, Impacts of the South Tropical Atlantic on Rainy Seasons Over the Brazilian Northeast, *submitted to J. of Climate*, 2017.
- Herbert G., and B. Bourlès, Cold intraseasonal events in Spring/Summer 2005 and 2006 in the far Eastern Equatorial Atlantic and their forcing mechanisms from numerical simulation and satellite data, *Ocean Sciences Discuss.*, <https://doi.org/10.5194/os-2017-74>, in review, 2017.
- *Tchamabi, C.C.*, M. Araujo, M. Silva, B. Bourlès, and C. Noriega. An assessment of biogeochemical properties variations around Fernando de Noronha Archipelago and Rocas Atoll in the tropical Atlantic, *submitted to Journal of Oceanography*, 2017.
- Mélodie Trolliet, Bernard Bourlès, Alexandre Boilley, Jakub Walawender, Philippe Blanc, Mireille Lefèvre, Lucien Wald  
Estimating downward solar irradiance at the surface of the tropical Atlantic Ocean:  
A comparison of PIRATA measurements against several re-analyses and satellite-derived data sets; *submitted to Ocean Sciences*.

## Pub. in prep.:

- *Dossa A.N.*, *C.Y. Da-Allada*, G. Herbert, and B. Bourlès,  
Seasonal cycle of salinity barrier layer revealed in the North East of Gulf of Guinea, in preparation for AJMS.

# Just an highlight about publications:

## => Contribution of former Cotonou M2-OPA African students to PIRATA related publications ...

### Recent (2015-2017) publications : 11 published (to my knowledge!)

- Da-Allada**, C., J. Jouanno, F. Gaillard, N. Kolodziejczyk, C. Maes, N. Reul, B. Bourlès. Role of the Equatorial undercurrent salinity maximum in the seasonal variability of sea surface salinity in the Equatorial Atlantic Cold tongue, *J. Geophys. Res.-Oceans*, 2017, 122, 521–538, doi10.1002/2016JC012342.
- Djakouré**, S., P. Penven, B. Bourlès, J. Veitch, V. Koné. Coastally trapped eddies in the north of the Gulf of Guinea, *J. Geophys. Res.*, 2014, 119, p. 6805-6819, doi 10.1002/2014JC010243.
- Djakouré**, S., P. Penven, B. Bourlès, V. Koné. Respective roles of the Guinea Current and local winds on the coastal upwelling in the northern Gulf of Guinea, *Journal of Physical Oceanography*, 2017, 47, 6, 1367-1387, doi: 10.1175/JPO-D-16-0126.1.
- Hounsou-Gbo**, A., M. Araujo, B. Bourlès, D. Veleza, J. Servain. Tropical Atlantic contributions to strong rainfall variability along the Northeast Brazilian coast, *Adv. Meteor.*, 2015, 2015, 13p., doi 10.1155/2015/902084.
- Hounsou-Gbo**, A., J. Servain, M. Araujo, E.S. Martins, B. Bourlès, G. Caniaux. Oceanic indices for forecasting seasonal rainfall over Northern Northeast of Brazil, *American Journal of Climate Change (AJCC)*, 2016, 5, 261-274, doi 10.4236/ajcc.2016.52022.
- Nubi**, O.A., B. Bourlès, C.A. Edokpayi, and N. Hounkonnou. On the nutrient distribution and phytoplankton biomass in the equatorial Gulf of Guinea as inferred from in situ measurements, *J. Oceanogr. Mar. Sci. (JOMS)*, 2016, 7(1), 1-11, doi 10.5897/JOMS2016.0124.
- Koungue** R.A.I., S. Illig, and M. Rouault, Role of interannual Kelvin wave propagations in the equatorial Atlantic on the Angola Benguela Current system, 2017, *J. Geophys. Res. Oceans*, 122, 4685–4703, doi:10.1002/2016JC012463.
- Rouault, M., S. Illig, J. Lübbecke & R.A.I. **Koungue**, Origin, development and demise of the 2010–2011 Benguela Niño *Journal of Marine Systems* (2017), <http://dx.doi.org/10.1016/j.jmarsys.2017.07.007>
- Tchamabi**, C.C., M. Araujo, M. Silva, and B. Bourlès. A study of the Brazilian Fernando de Noronha Island and Rocas Atoll wakes in the tropical Atlantic, *Ocean Modelling*, 2017, 111, 9-18, doi 10.1016/j.ocemod.2016.12.009.
- Tchamabi**, C.C., M. Araujo, M. Silva, B. Bourlès, and O. Travassos. Ichthyoplankton transport in the Brazilian tropical islands, Fernando de Noronha archipelago and Rocas Atoll: Is there any connectivity patterns?, *in press in Indian Journal of Marine Sciences*, 2017.
- Tchilibou** M., T. Delcroix, G. Alory, S. Arnault, and G. Reverdin. Variations of the Tropical Atlantic and Pacific SSS minimum zones and their relations to the ITCZ and SPCZ rain bands (1979-2009). *J. Geophys. Res. Oceans*, 120, 5090-5100, doi:10.1002/2015JC010836, 2015.

### + Contributions during this PIRATA 22 meeting: 6 presentations

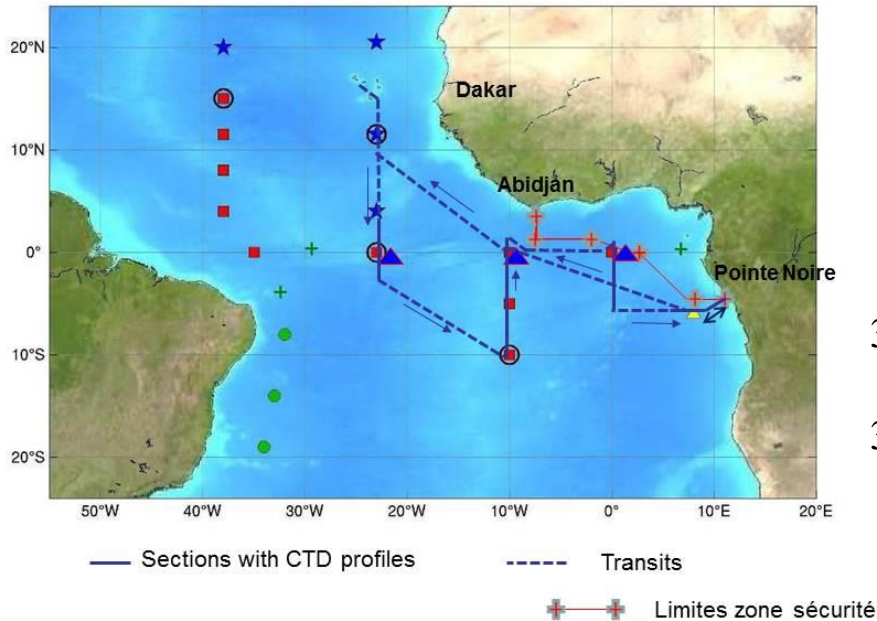


# Next 2018 PIRATA cruise : February 27 – April 5, 2018

~40 days, one leg only from Mindelo (Cabo Verde)...

Thalassa => acoustic measurements (possibly)

PIRATA FR28 : Départ Cap-Vert; option sans escale Abidjan  
Sections CTD 23W, 10W, 0E et 6E



*Material boarding on the R/V  
Thalassa scheduled on  
February 15-16, at Brest.*

3 ATLAS  
&  
3 T-FLEX

0-2000m CTDO2-LADCP profiles, XBT, ARGO profilers, SVP-B drifters,  
salinity/O2/nutrients/pigments/CO2 analysis, 1st ADCP mooring servicing at 0E-0N...

## DISCUSSIONS:

A few issues to be discussed (to be completed...):

TAOS/PIRATA review:

White paper & perspectives: possible enhancements, technical aspects (new param. sensors...)  
(consider previous discussions)

PREFACE Deliverable D4.4 (“suggestions for a sustainable long term monitoring system in the tropical Atlantic”), due March 2018... Ideas & suggestions (consider previous discussions)?

New T-Flex implementation plan (NOAA budgets...) ?

PIRATA costs (asked by AtlantOS, but also needed for PRB...).

New piggyback proposal: VPAX by Dr. Ana Luiza S. Albuquerque & Col.

Future MoU:

Questions to PRB;

how about after 2019? Will/can PIRATA continue as it is (without considering EU H2020 calls...)  
national funding resources? Issues?

Vessel time sharing & buoys responsibility (will we keep the same buoys number for each country)?

SSG composition : new biogeochemistry members + any changes?

Material expedition from PMEL:

extra-charges with T-Flex weights (2t instead 1,4t => 2 containers instead 1)  
=> extra-costs... how to deal with?

DOI: Pirata buoys data ? (all data sets with same DOI, or per parameter?). Cruises data from US & BR?

Cruises data (Br: website not actualized from 2014 & US: website not actualized from 2015 -if not wrong-)

How about BR tide gauges & met stations? (exist? data sets ?).

Issue of « researcher » man power in France (French issue but SSG/PRB has to be informed)...

Issue to deal with all next Pirata related tasks (linked with EU Preface & AtlantOS programs, Deliverables, future H2020 proposals, etc) + possible heading the US IMAGO by B.Bourlès from June 2018!  
=> need of a dedicated position in France !

? Discuss about scientific works using buoys/cruises data sets by “Pirates” => avoid same works done in // + collaborations

Next 2018 meeting (France)



***OBRIGADO / THANKS / MERCI***

PIRATA 22 / PREFACE Meeting, Fortaleza, Nov 5 – 10, 2017

## Next steps ( about the future of PIRATA & PIRATA-FR ...):

- PIRATA is recognized as *“the backbone for observations in the Tropical Atlantic for both climate research and operational climate and ocean prediction”* (CLIVAR)

### enhancement demands (AtlantOS, CLIVAR, OOPC, ...toward OceanObs2019):

*e.g. biochemistry sensors, aerosols, O<sub>2</sub>, CO<sub>2</sub>, currents, fluxes, time series in the South...*

### To keep in mind :

- vessel time, funding resources & human power limited (*some are decreasing!...*)
- data still « sleeping »... (*too few use of in situ data!... but for operationnal*)

### ⇒ PIRATA review process as part of Tropical Atlantic Observing System Review:

Will begin in November 2017; White paper expected as input to the review.

### ⇒ **NEED INPUTS/INFOS from the operational community (ocean, climate) about Real Time Observations assimilation impacts**

**The French SNO works with very few people & needs more support & human power,  
+ involvements (use of in situ data & their « valorization »)  
to be efficiently sustained on the long term...**