



PIRATA 2022 SSG meeting:

French national report & status



Present members in FRANCE of the PIRATA-SSG:

- Jérôme LLIDO (IRD-LEGOS, Toulouse), coordination PIRATA in France from 2022*
- Bernard BOURLÈS (IRD-IMAGO, Brest; coordination PIRATA in France) leaving in 2022*
- Fabrice HERNANDEZ (IRD-LEGOS, Toulouse)*
- Hervé GIORDANI (Météo-France, CNRM, Toulouse)*
- Julien JOUANNO (IRD-LEGOS, Toulouse) from 2022*

PIRATA status in France :

The PIRATA-France label as « National Observations Service for Ocean-Atmosphère » by CNRS ensures vessel time every year.

=> PIRATA-FR cruises ensured in 2020, 21 & 22 despite Covid crisis.

=> The annual vessel time is guaranteed until 2025.

This label along with the MoU commit IRD, Météo France to support & fund PIRATA

A 4 years new convention between IRD and Meteo-France has been signed in July 2022 (for 2022-2025) once the new MoU signed in early 2022 (2021-2025).
(a special 1 year established in late 2021, as the MoU signature was needed to guarantee the support of Meteo-France on a longer term...)

National wish to better organize Open Oceans National Observations Services within an « Research Infrastructure », as are ARGO, Coastal Obs...
(OHIS for In Situ Open Ocean Obs: still in progress...).

PIRATA status in France :

PIRATA Fr fundings & support in 2021 & 2022 :

IRD: 50k€/y + 25k€ in late 2021 (* explanation in next slide)

METEO-France: 30k€/y (delayed in 2021; * in next slide)

OMP (Observatoire Midi-Pyrénées): ~3k€/y

**+ National « Research Fleet » Service Unit (Ifremer, CNRS, IRD, ...) for vessel time (60d).
~1,5M€/y**

CNRS (through « OHIS »): 19k€ in september 2022

**+ purchase of sensors through TriAtlas & AtlantOS & IRD/LEGOS budgets:
6 T/C sensors SBE-37-IMP, 2 SBE37-ODO, 2 Aquadopp currentmeters, 2 fluorometers.**

+ purchase of one CO2 (CARIOCA) by IRD through EuroSEA with Brazil (UERJ)

MoU signature delay & crisis impacts on budgets:

- 2021:

- Delay in the funding support by Meteo-France:

MF budget made available in late novembre 2021, due to time to do a « special 1y convention »

But we had to ensure the paiement of material transport from PMEL to Brest,
=> IRD added 25k€ in october 2021 to certify the paiement to transit agent

- 2 containers sent from PMEL in Fall 2021 for FR32 (instead one usually)
due to the addition of material of 2 additional buoys (as 10S & 20S vandalized in June/July 2021)

Note: many thanks to the German team of Bremen
who retrieved the two drifting buoys from the R/V SONNE...

- Material transport costs strongly increased

MoU signature delay & crisis impacts on budgets:

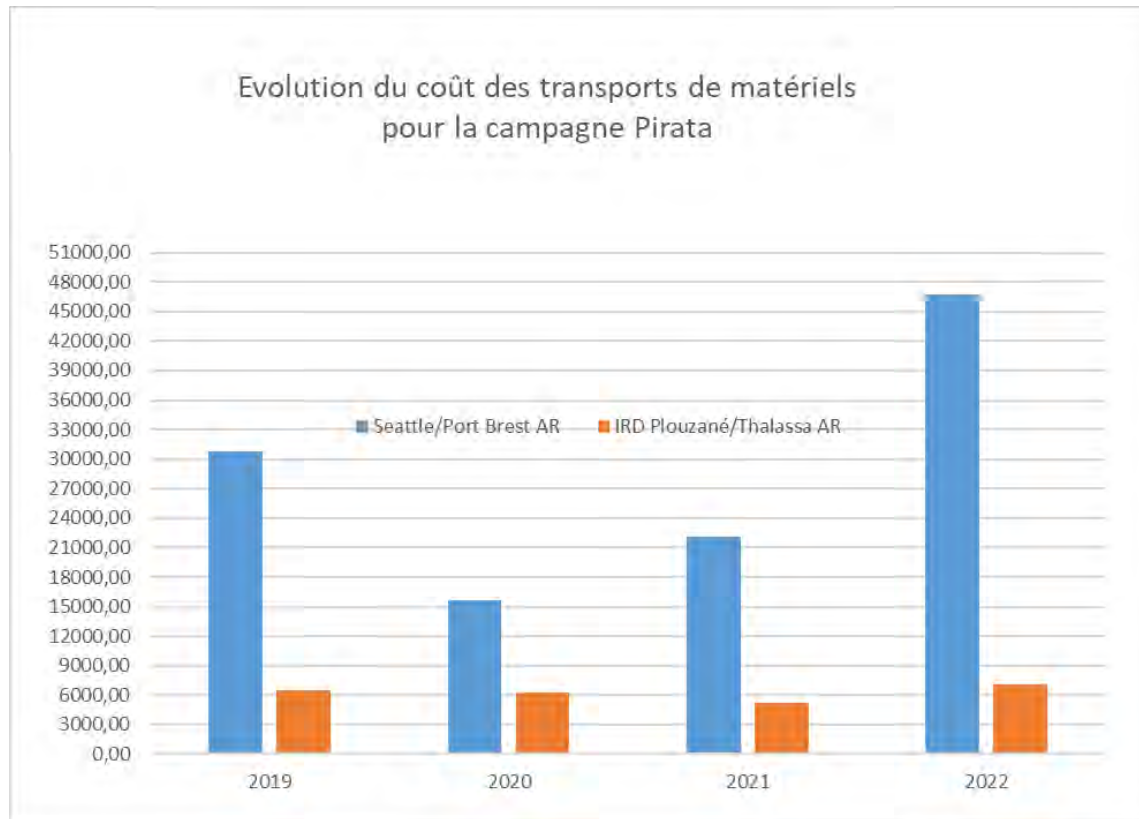
- 2022:

- Material transport costs continue to increase & less commercial vessels for containers
- Part of material finally sent by plane (due to pb with « dangerous items » during the loading in Seattle... new rules & last moment decision by the shipping compagny)
- Electronic & sensors sent back to PMEL by plane (19k€ but cheaper than by vessel...)
- FR23 material also in two containers because weights to be added in the expedition!
TO BE DISCUSSED (PMEL ensured weight expedition until now...)

& the IRD IMAGO unit helped by paying some items (material, chemical products for analysis..)

⇒ Significant overcosts that cannot be ensured on longer term,
& significant budget issues are expected in 2023

Material transport cost evolution until July 2022...



French PIRATA dedicated cruises : 32 cruises from 1997 to 2022

(=> >1000 days at sea)

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 BOURLÈS
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 BOURLÈS
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.BOURLÈS/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.BOURLÈS/J.GRELET
PIRATA FR 22	SUROIT	19/03 – 02/05/2012	B.BOURLÈS/J.GRELET
PIRATA FR 23	SUROIT	09/05 – 20/06/2013	B.BOURLÈS/J.GRELET
PIRATA FR 24	SUROIT	09/04 – 22/05/2014	B.BOURLÈS/Y.GOURIOU
PIRATA FR 25	THALASSA	18/03 – 16/04/2015	Bernard BOURLÈS
PIRATA FR 26	THALASSA	07/03 – 13/04/2016	Bernard BOURLÈS
PIRATA FR 27	THALASSA	27/02 – 03/04/2017	Bernard BOURLÈS
PIRATA FR 28	THALASSA	27/02 – 05/04/2018	Bernard BOURLÈS
PIRATA FR 29	THALASSA	28/02 – 05/04/2019	Bernard BOURLÈS
PIRATA FR 30	THALASSA	16/02 – 31/03/2020	Bernard BOURLÈS
PIRATA FR31	THALASSA	22/02 – 21/04/2021	Bernard BOURLÈS
PIRATA FR32	THALASSA	15/02 – 14/04/2022	B. BOURLÈS / J. LLIDO

=> What has been done in 2022 « on the field » ?

The PIRATA FR32 cruise:

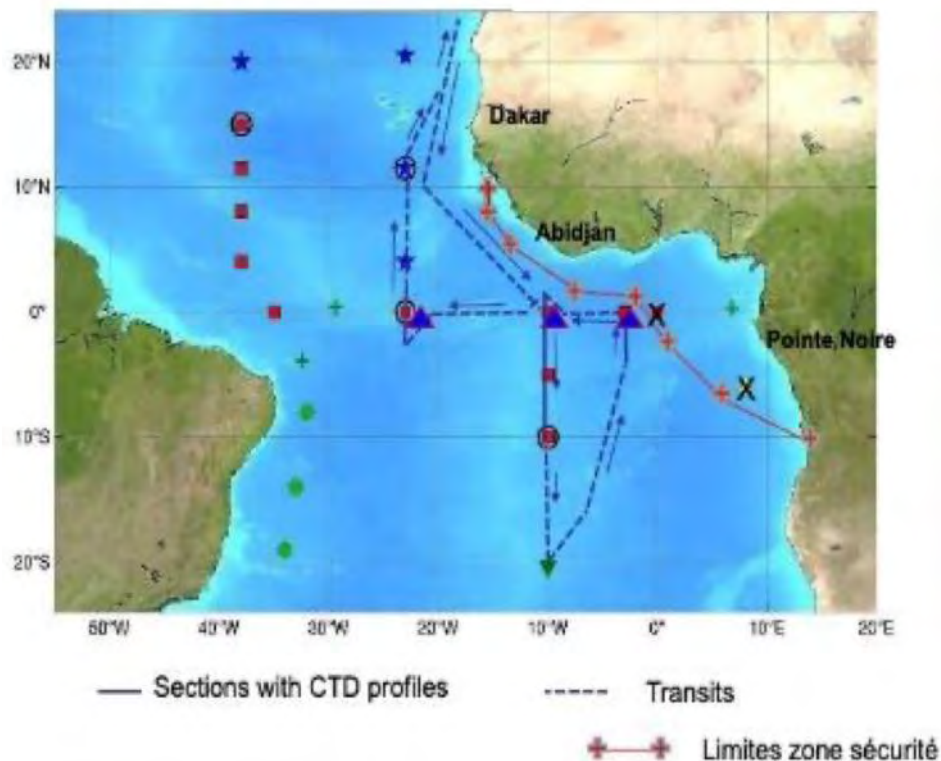
February 23 – April 7, 2022 (i.e. 44 days, from/to Las PALMAS, Gran Canaria)

Delayed departures : - late arrival of equipment in Brest (*departure on February 18th instead of February 16th*)

- Covid on board

⇒ Slightly reduced science due to loss of 5 days at sea (*CTDs to 500m depth along 10°W and 2000m at mooring sites, 48h fixed point at 23°W cancelled ...*)

Effective PIRATA-FR32 : February 28 – April 7, 2022



=> What has been done in 2022 « on the field » ?

The PIRATA FR32 cruise:

*Reminder : Two PIRATA buoys (10°S & 20°S-10W) adrift in July, recovered in September 2021
From the R/V SONNE thanks to the German team of Bremen (thanks again to them...)*

Pirata met-ocean moorings summary :

- 3 ATLAS systems serviced:

0°N-10°W (equipped with CO2 & **9 Xpods**); 20°S-10°W; 0°N-3°W

Note 1: At 0°N-10°W : 2 T/C (at 15m & 25m) and 2 Aquadopp (at 23m & 35m) added (LEFE GMMC PODIOM project, PI : F. Gasparin & S. Cravatte)

Note 2: A fluorimeter has also been serviced at 0°N-10°W (new one purchased in 2021 with EU AtlantOS funds) at 55m depth (max fluo level)

- 3 TFLEX systems serviced:

6°S-10°W (equipped with CO2); 10°S-10°W; 0°N-23°W (equipped with **9 Xpods**)

- 6 OTN acoustic receivers replaced at 200m depth on each buoy;

Only issue: no transmission from underwater sensors due to a cable problem at 0°N-3°W

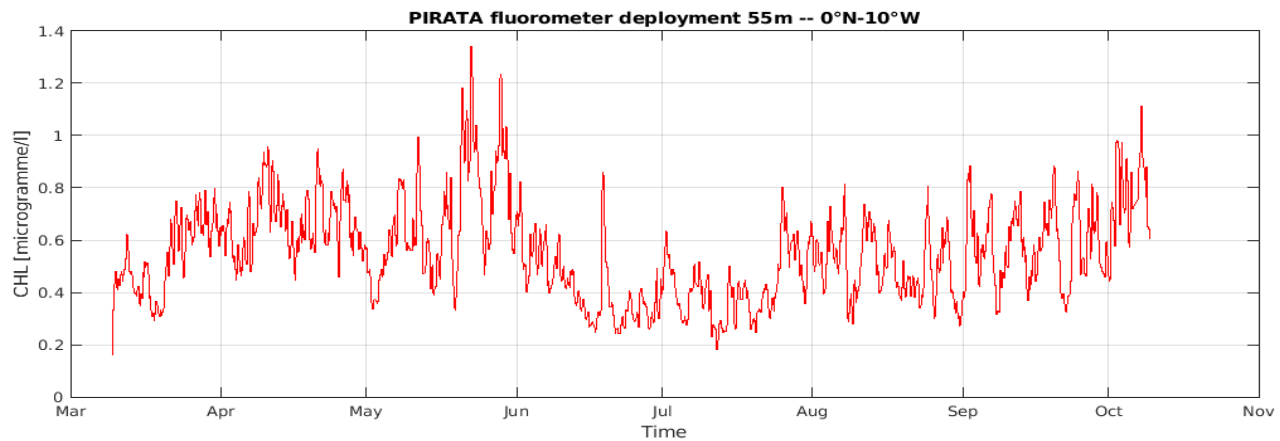
=> What has been done in 2022 « on the field » ?

10°W:

9 Xpods in preparation onboard



fluorimeter measurements at 55m depth



=> What has been done in 2022 « on the field » ?

The PIRATA FR32 cruise:

About ADCP mooring :

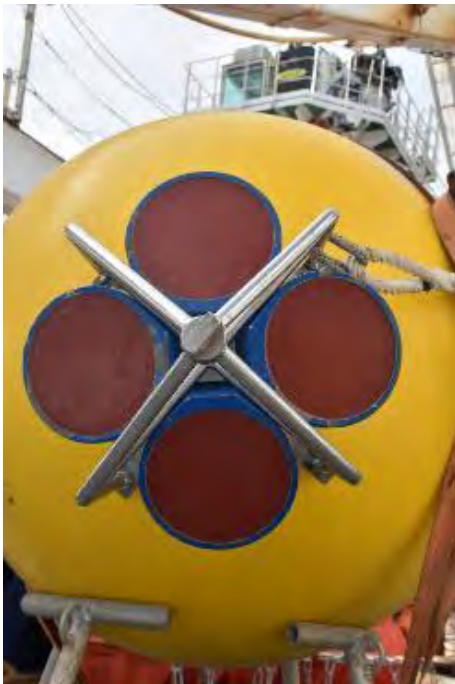
Reminder : *Piracy Security Area extended in the Gulf of Guinea*

The ADCP mooring at 0°-0° was recovered in 2021

It was not expected to replace it (no material onboard)...

=> there is no data available for the 2021-2022 period !

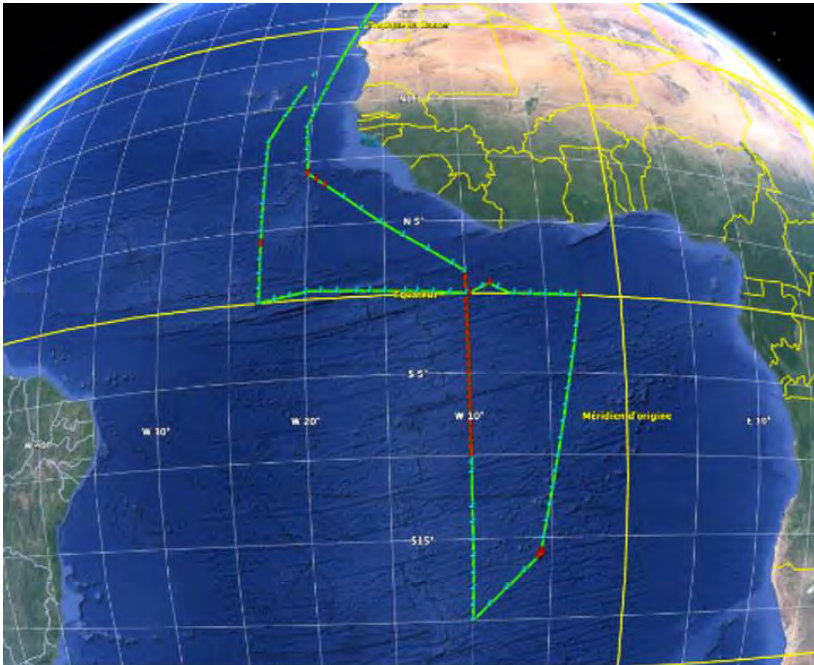
=> ADCP mooring deployed at 0°N-3°W on March 22, 2022



=> What has been done in 2022 « on the field » ?

The PIRATA FR32 cruise:

CTDO2/LADCP casts (in red on the map) :



55 profiles:

1x4000m : 0N-23W

7x2000m : close to mooring & BGC Argo

25x500m : 10W sections & Guinea Dôme
1x400m

15x200m: profiles every 3h during 48h
duration stations at 10W, Equator

6 between 200 & 500m around St Helena

Sea water samplings (> 2500) for:

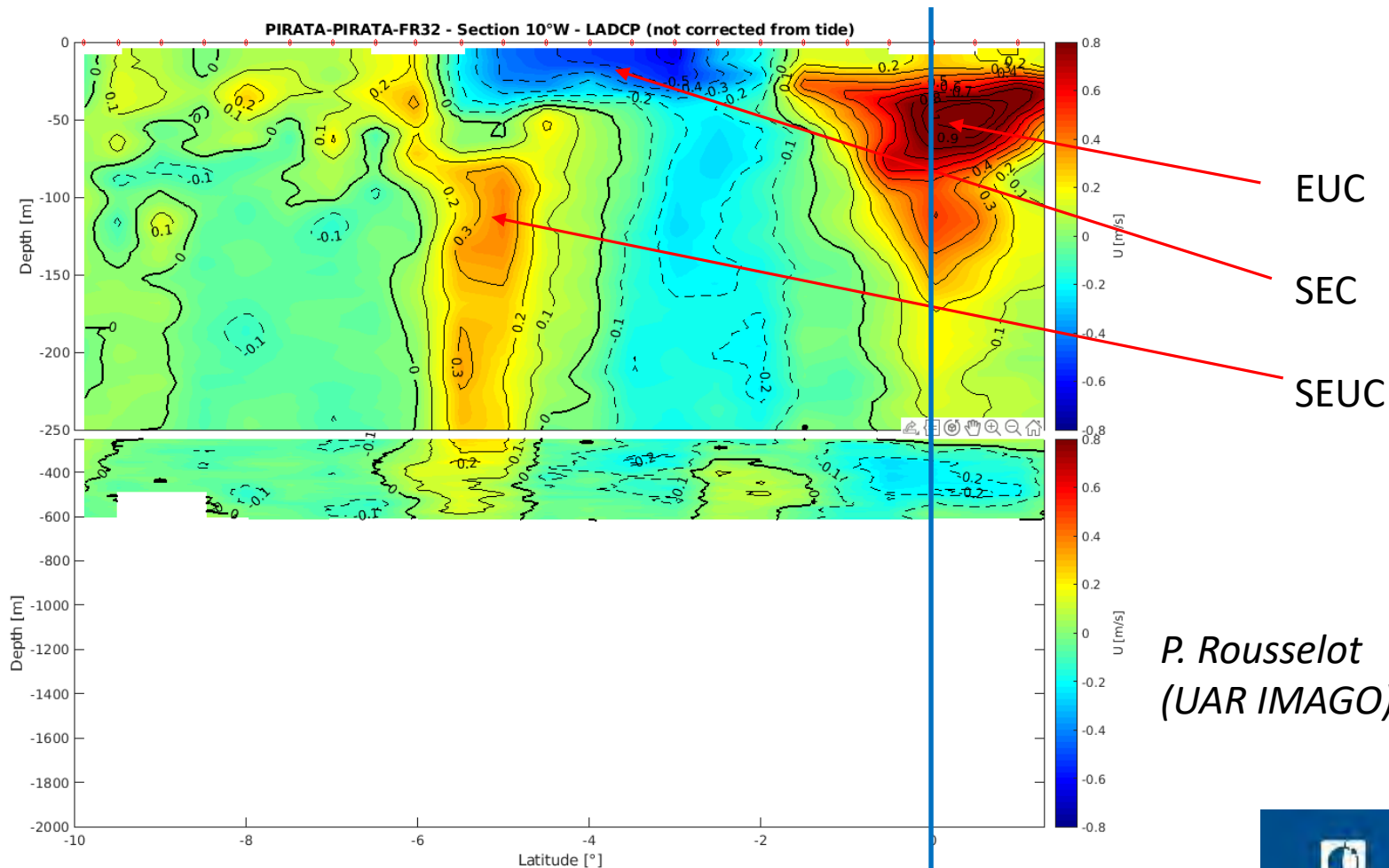
S, O₂, nutrients, Chlorophyll pigments, **pH**
DIC/TA, DIC/C13, O18, POM ...

Sensors: 1 p + 2 (T/C, O₂), 2 fluorimeters,
+ 1 transmissiometer Wetlab, 1 SBE35 (Precise T)
+ 2 LADCP: 300kHz upward, 300kHz downward

=> What has been done in 2022 « on the field » ?

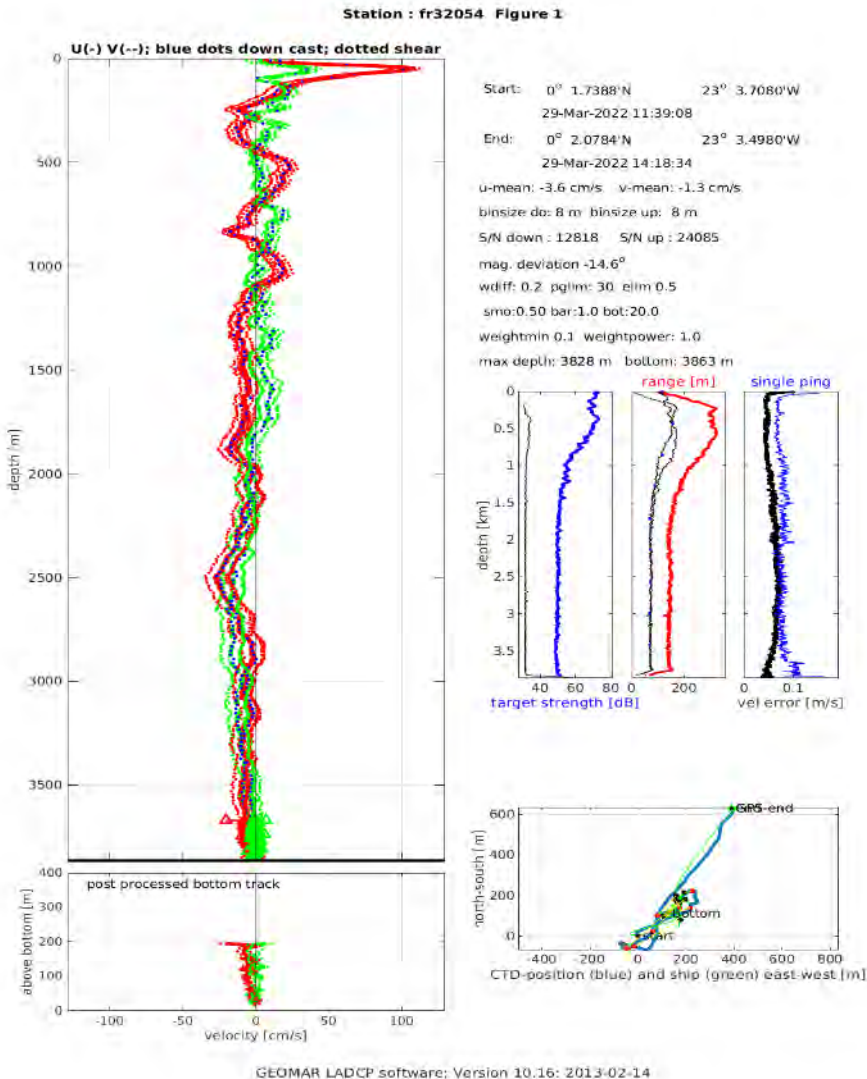
The PIRATA FR32 cruise:

U (from LADCP) along 10°W (10°S-1.5°S)



=> What has been done in 2022 « on the field » ?

The PIRATA FR32 cruise:



CTDO₂ / LADCP profile

Deep profile (0-3850m)

LADCP profile using the VM - USBL acoustic positioning system (Posidonia - Ixblue) and a tag (BUC) mounted on CTD

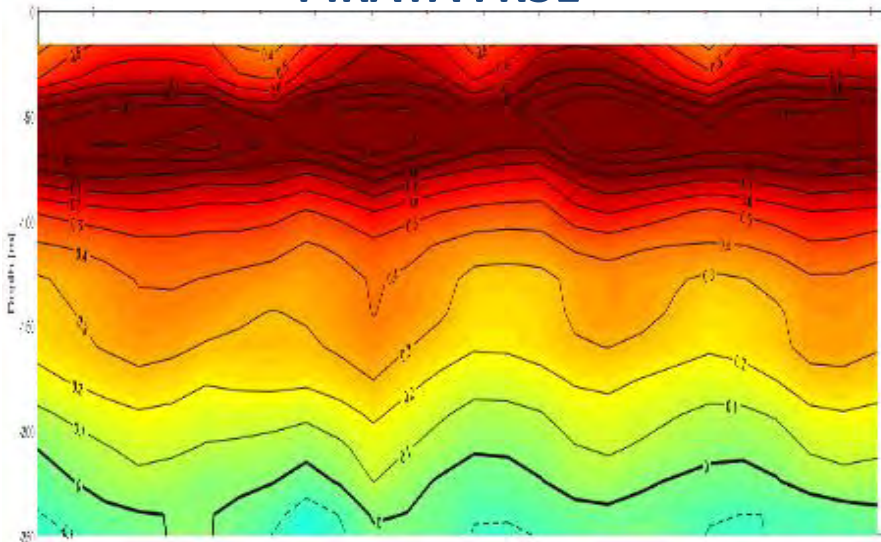
P. Rousselot
(UAR IMAGO)

=> What has been done in 2022 « on the field » ?

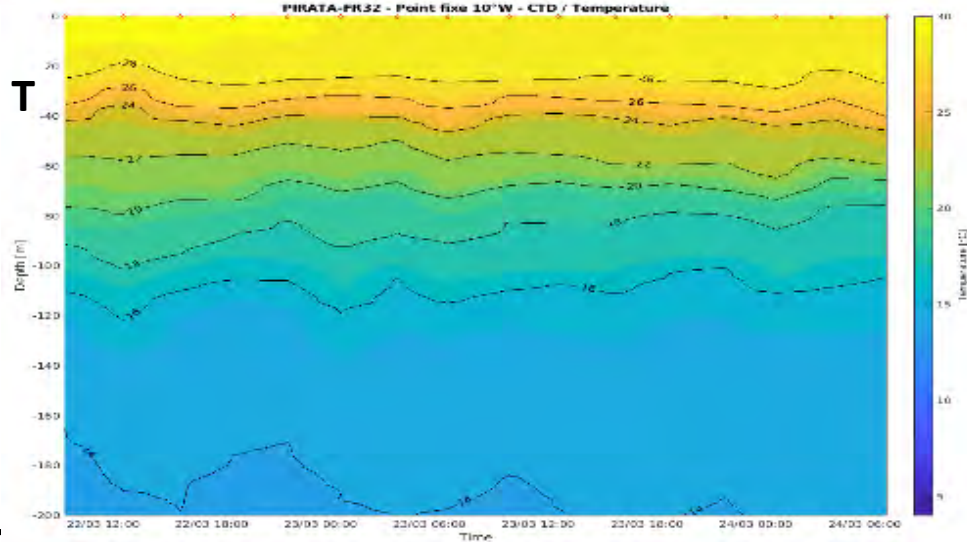
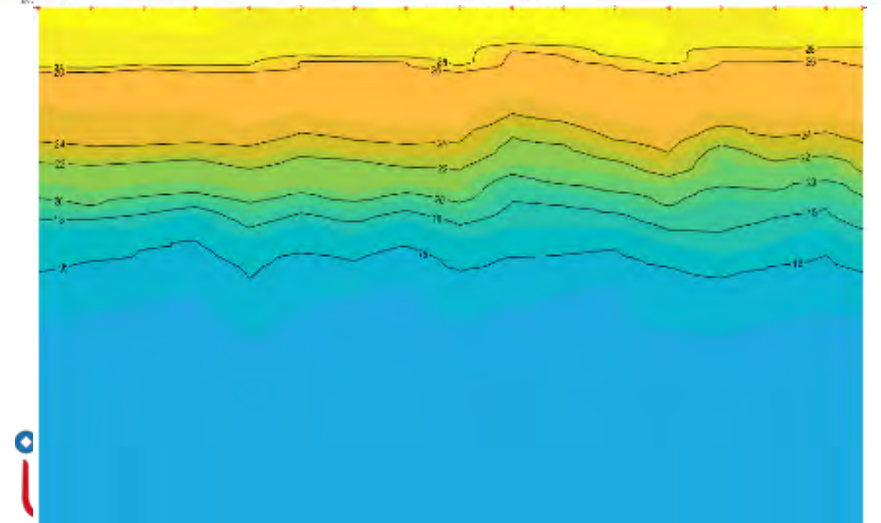
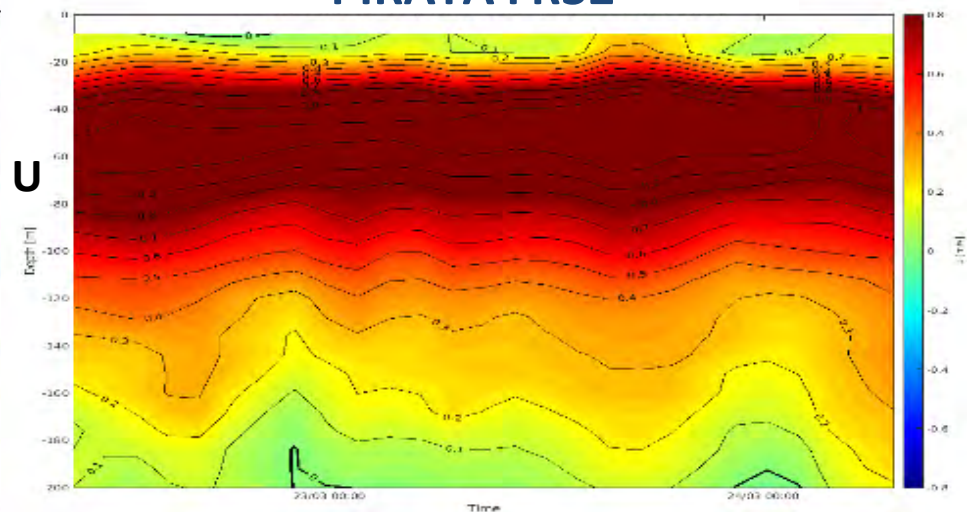
The PIRATA FR32 cruise:

Example of U & T during 48h fixed stations at 0°-10°W

PIRATA FR31



PIRATA FR32

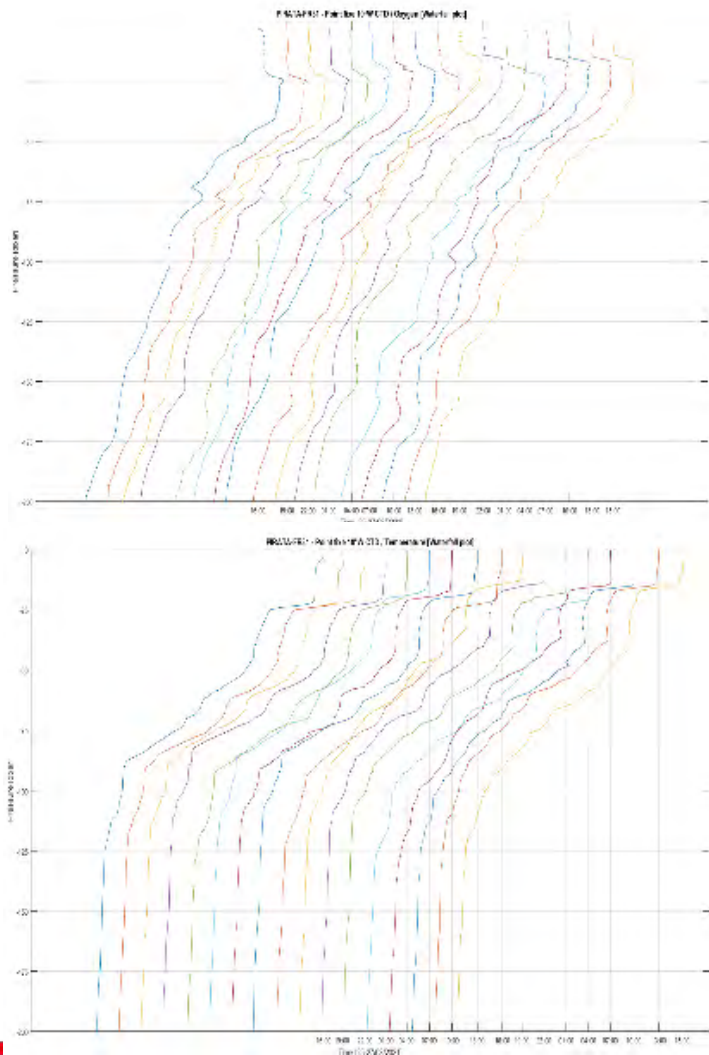


=> What has been done in 2022 « on the field » ?

The PIRATA FR32 cruise:

Example of O₂ & T during 48h fixed stations at 0°-10°W

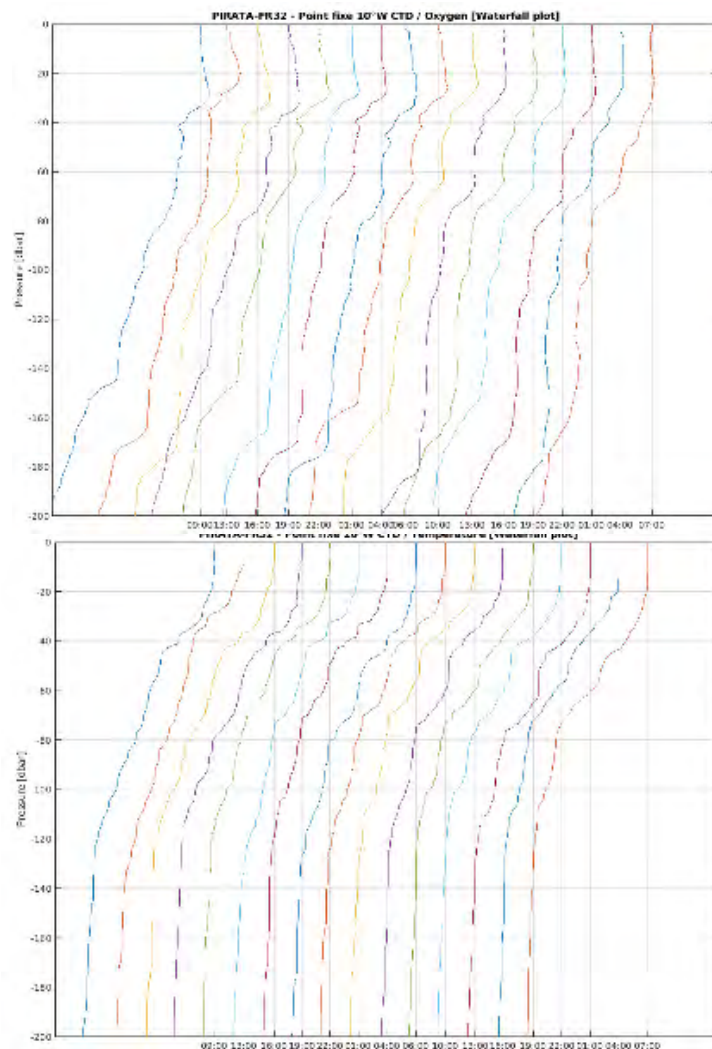
PIRATA FR31



O₂

T

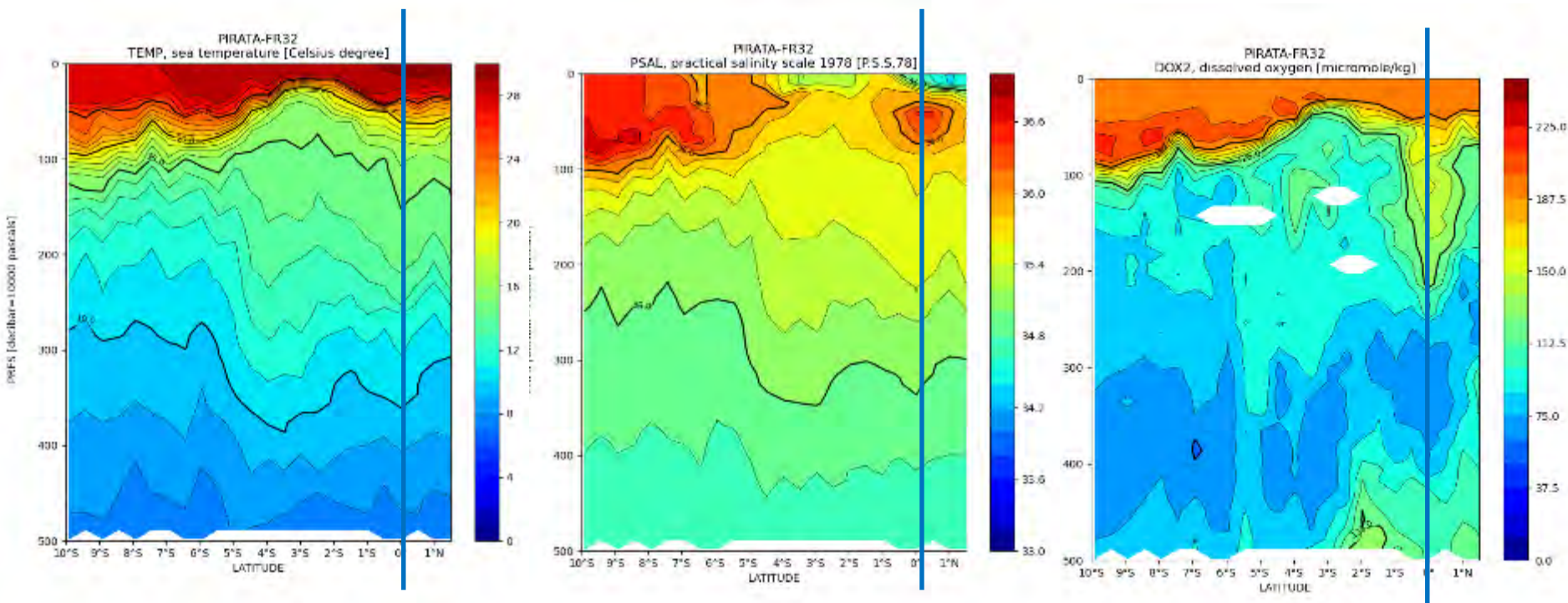
PIRATA FR32



=> What has been done in 2022 « on the field » ?

The PIRATA FR32 cruise:

Section along 10W : T, S, O₂ (from CTDO2 / LADCP)



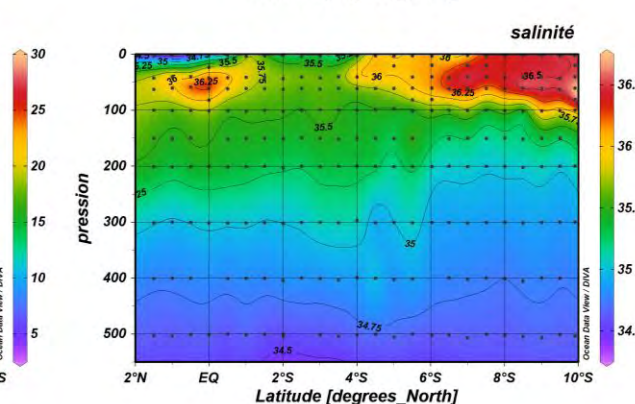
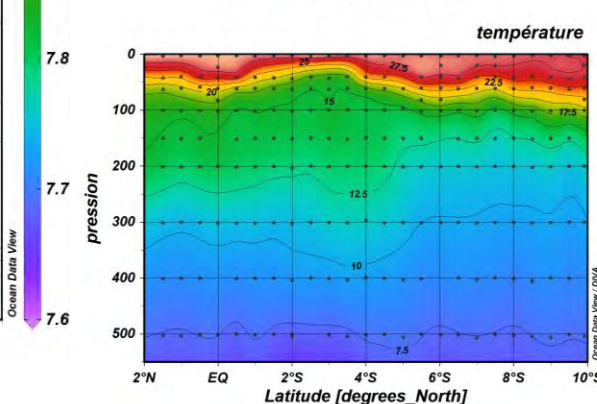
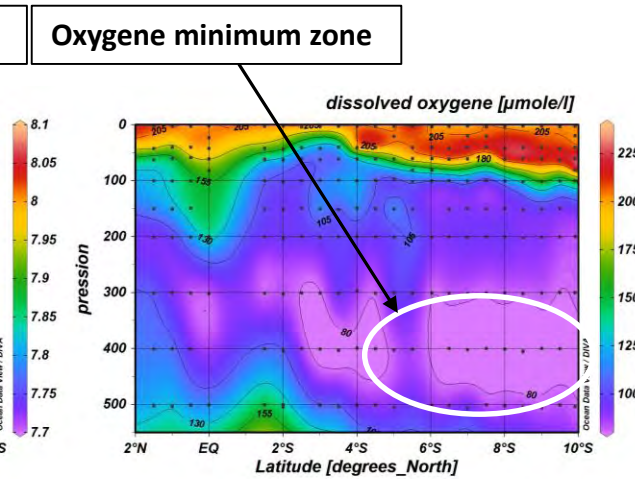
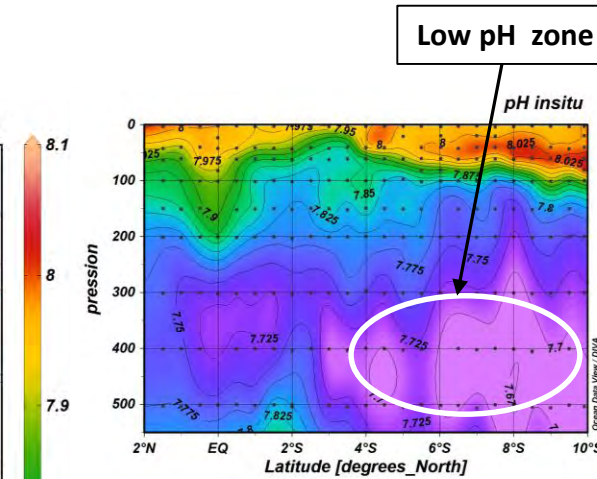
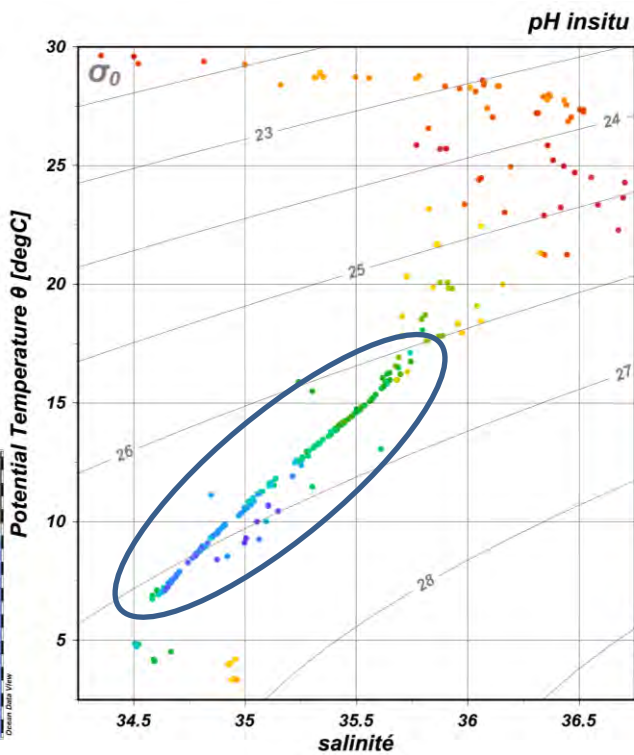
Max S & O₂ within EUC
Min S surface Equator
Max S surface South
Min O₂ 300m (eq) - 400m (10°S)

=> What has been done in 2022 « on the field » ?

The PIRATA FR32 cruise:

NEW : 1st time pH during PIRATA cruise !!

Along 10°W (10°S-1.5°S)

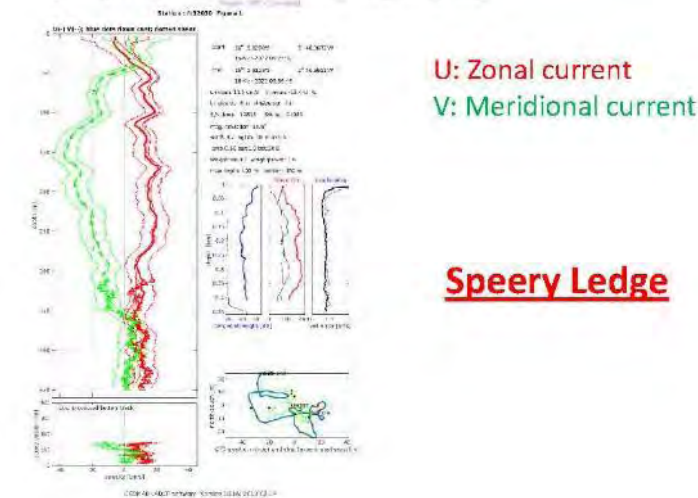
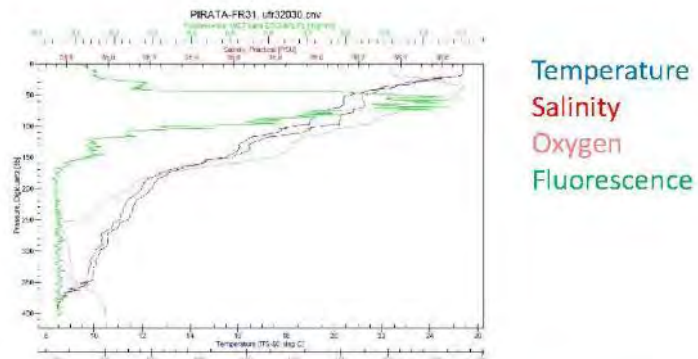
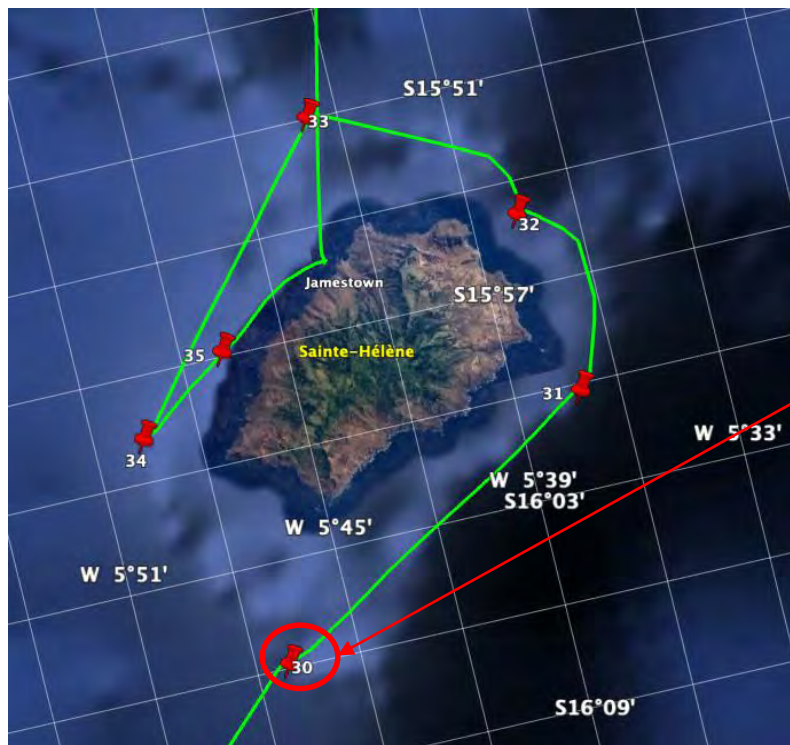


T. Cariou
(UAR IMAGO)

⇒ What has been done in 2022 « on the field » ?

The PIRATA FR32 cruise:

CTDO2/LADCP casts (in red on the map) :

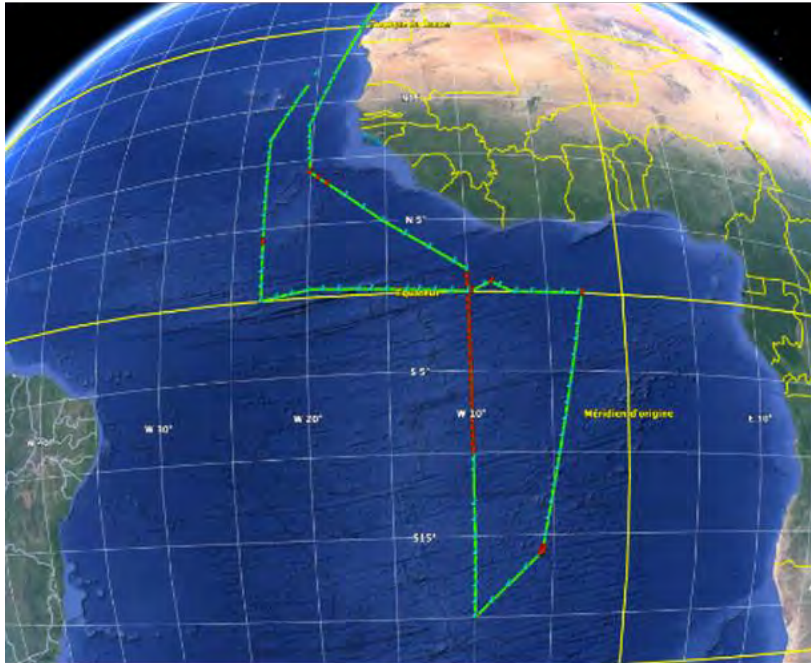


⇒ Contribution to the Management Plan Marine Protected Areas & the Marine Blue Belt program

=> What has been done in 2022 « on the field » ?

The PIRATA FR32 cruise:

Other profiles & samplings :



84 XBT profiles (in green on the map)

+

73 sea surface water samplings (S, nutrients, Chl pigments, DIC/TA, DIC/C13, O18, POM)

+

200 biological samplings at the buoys:

Barnacles: 135 (for microplastics & isotopes)

18 crabs, 6 worms,

41 tuna pieces (for Hg analysis in the food chain)

=> What has been done in 2022 « on the field » ?

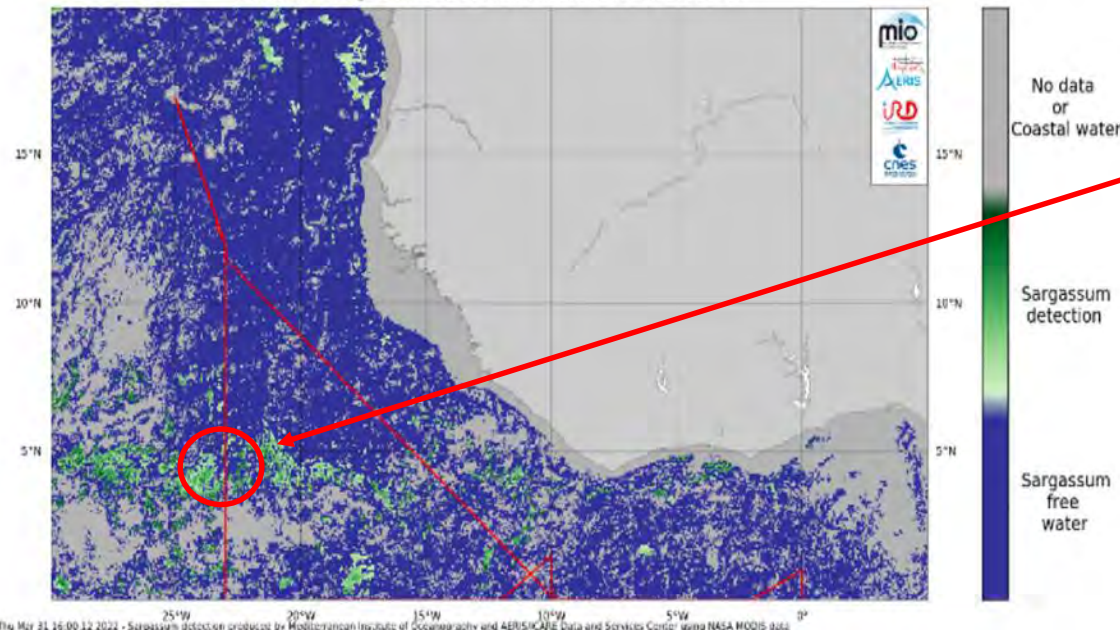
The PIRATA FR32 cruise:

Other samplings :

Sargassum observation:



Cumulative Sargassum detections from 20220320 to 20220329



17 samplings on one slick at 3.52N - 23W (within eastward NECC flow):
- 2 for pollutants,
- 15 for chimio-taxonomy,

+ sea surface water samplings:
S, nutrients, Chl pigments, POM

2 labs involved:

LEMAR in Brest (V. Stieger)

MIO in Marseille (T. Thibaud,

V. Michotey, L. Berline, F. Ménard)

=> What has been done in 2022 « on the field » ?

The PIRATA FR32 cruise:

Underway continuous measurements :

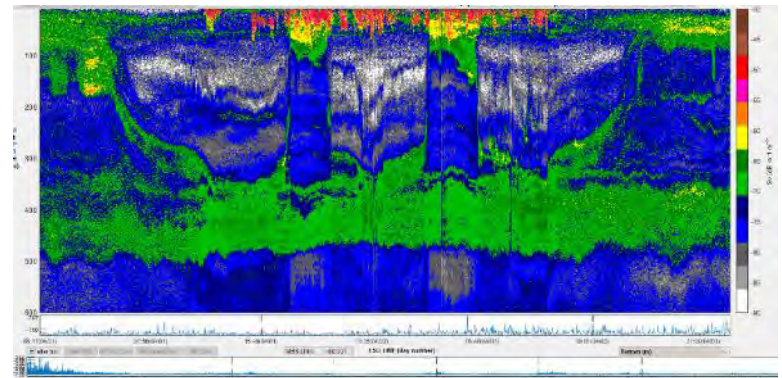
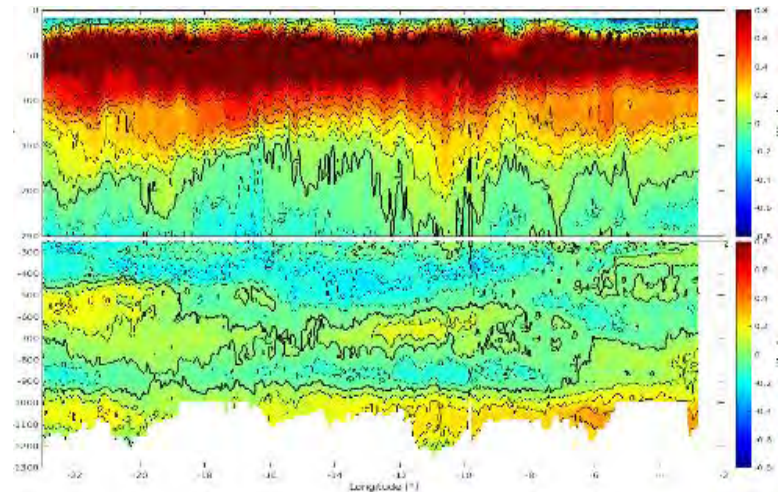
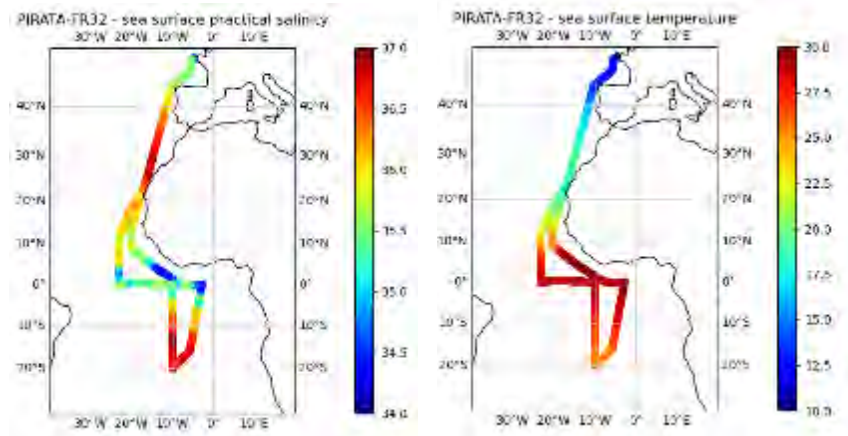
- S-ADCP: 38kHz, 150kHz & DVL 600kHz

Ex: U along the equator between 3W and 23W

- Acoustic measurements (EK80, 6 frequencies):

Ex: Measurements at 0N-23W during 48h in 2021

- TSG measurements :



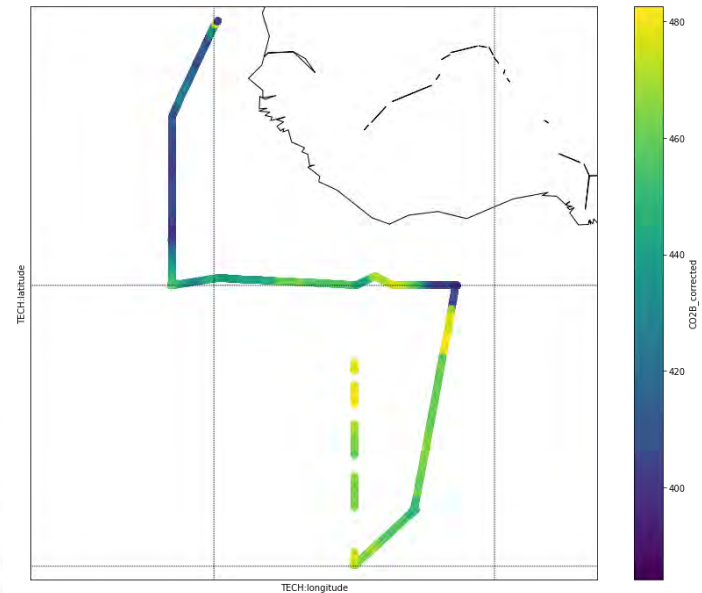
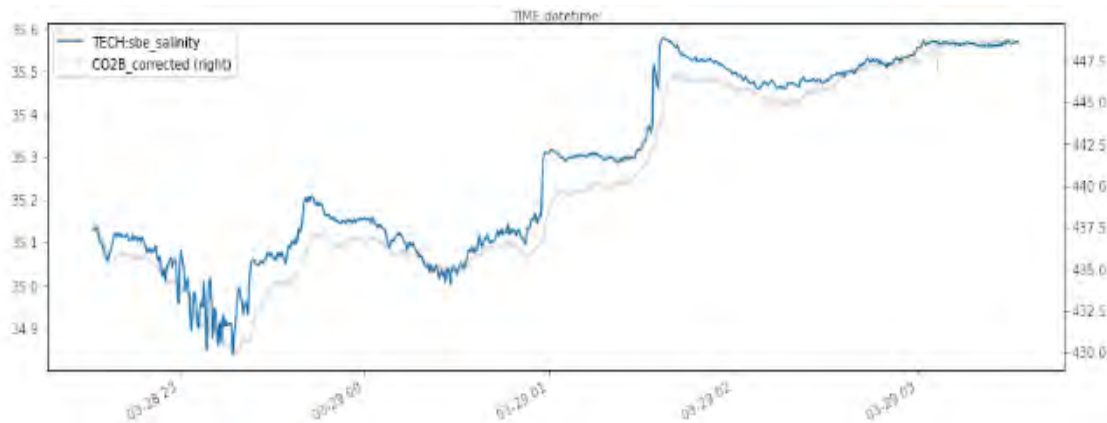
+ Ferrybox, meteo.

=> What has been done in 2022 « on the field » ?

The PIRATA FR32 cruise:

Underway continuous measurements :

- Continuous pCO₂ measurements (prototype development)



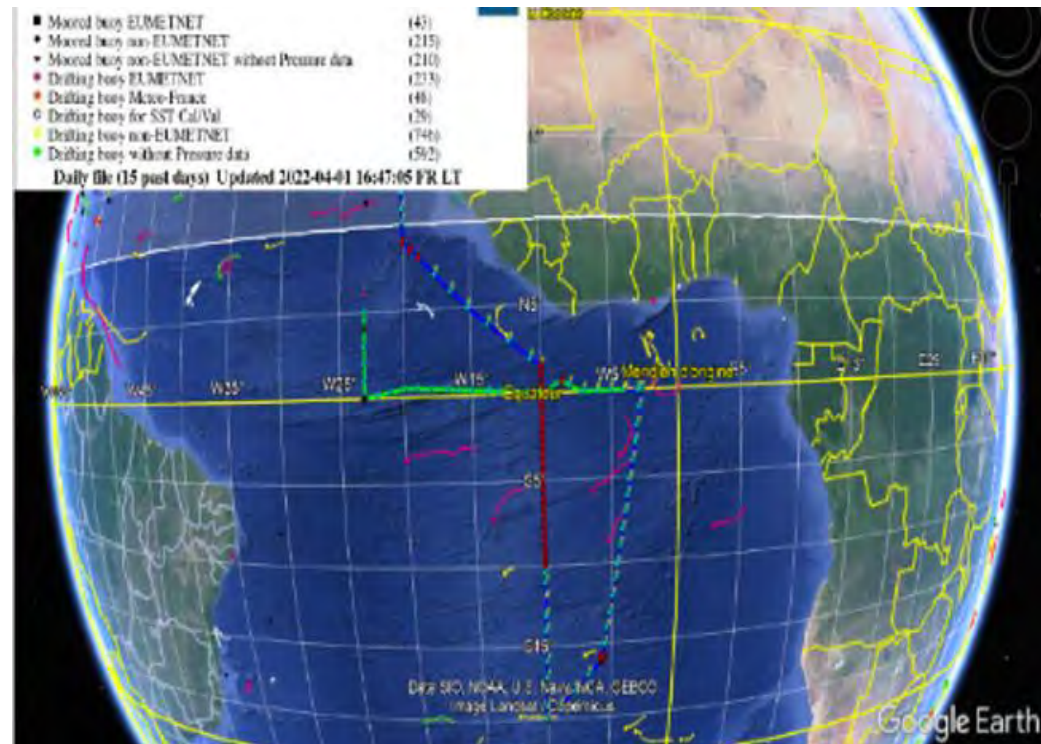
(PI : N. Lefèvre with C. Noisel)

=> What has been done in 2022 « on the field » ?

The PIRATA FR32 cruise:

In contribution to other programmes & observation systems:

1) 8 SVP-B deployments (Meteo-France contribution to DBCP)



Trajectories between March 5th to April 3rd 2022

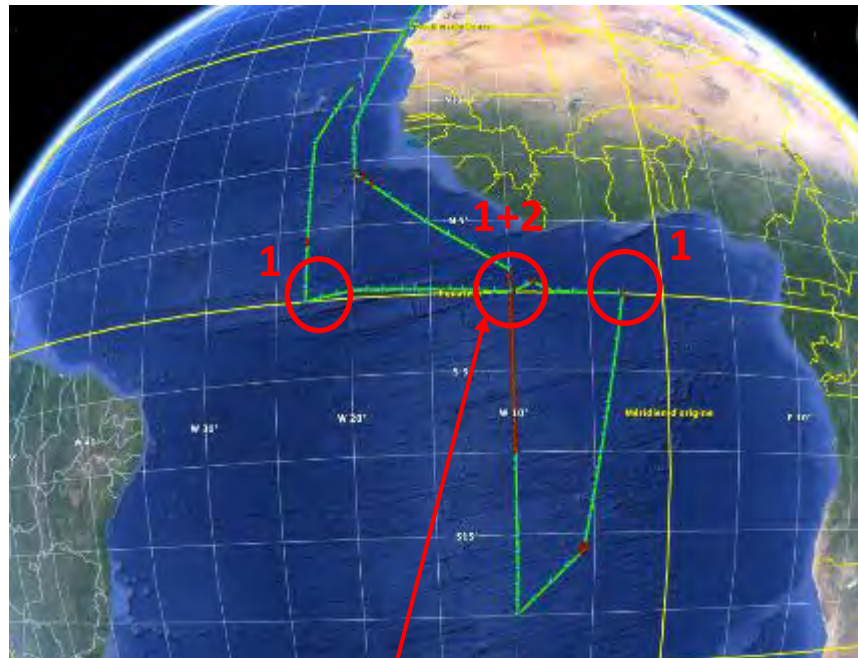
=> What has been done in 2022 « on the field » ?

The PIRATA FR32 cruise:

In contribution to other programmes & observation systems:

2) ARGO profilers deployment: 5 ARVOR T/S Iridium ⇔ contribution to PODIOM project
diurnal cycle influence on mixed layer (French funded LEFE; PIs: F.Gasparin & S. Cravatte LEGOS)

=> at 0-10W, 0-3W & 0-23W; profiles (0-120m) every 3h during 5 days, repeat every month
for 5 months before classic programming with a profile every 10 days



48h fixed stations

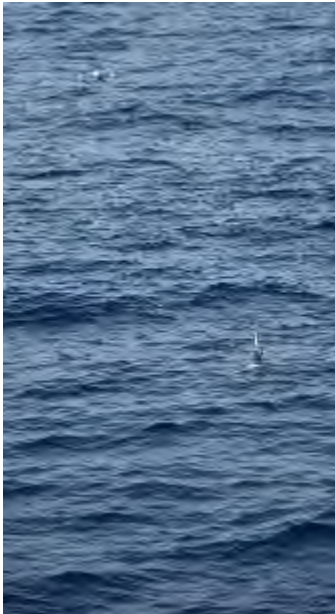
=> What has been done in 2022 « on the field » ?

The PIRATA FR32 cruise:

In contribution to other programmes & observation systems:

3) ARGO profilers retrievals :

- A Deep-ARGO profiler, deployed in 2020 during PIRATA-FR30
- A « prototype » BGC-ARGO profiler with UVP6 sensor, deployed in July 2021 (with BGC sensors failures)

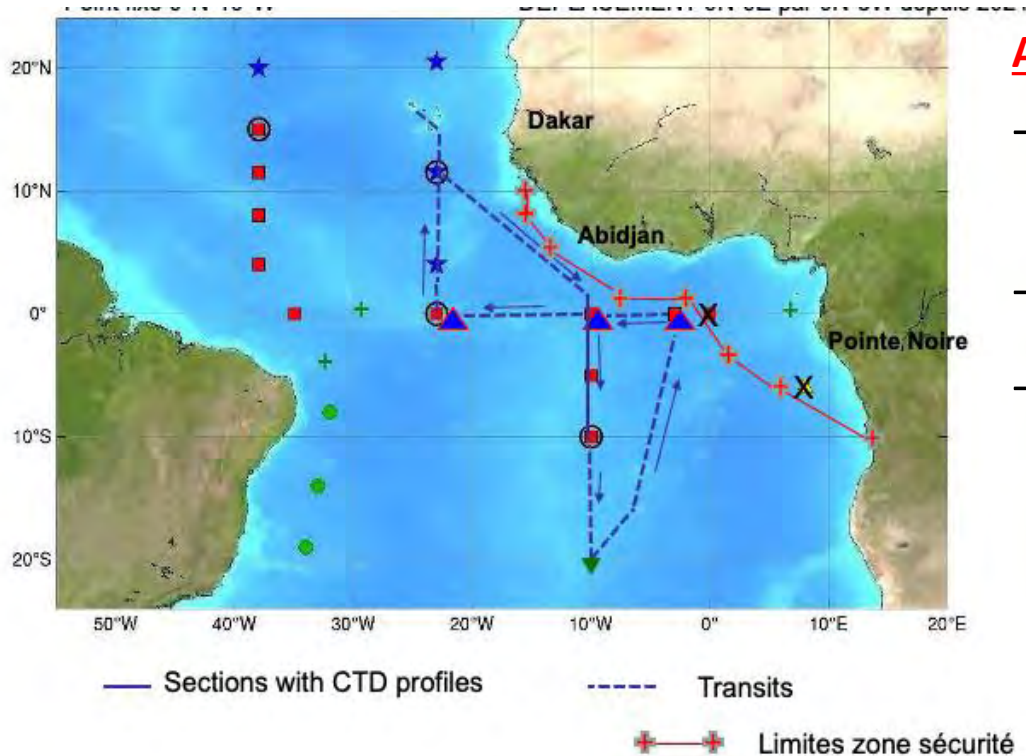


Under
Vision
Profiler 6

=> Perspectives for 2023 « on the field » ?

The next PIRATA FR33 cruise:

March 4th – April 9th, 2023 (i.e. 37 days, from/to Mindelo, Cabo Verde)



Additional sensors on moorings

- 1x SBE39 T/C-ODO at 0-10W (299m)
- 2 x SB37 T/C at 0-3W (5m & 10m)
- 1 x SB37 T/C at 6S-10W (5m)

⇒ SAME PROGRAM EXPECTED + **NEW MEASUREMENTS OF TOTAL ALKALINITY**

What have been done in 2021-2022 « in the lab » ?

French PIRATA website:

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

- ⇒ Information about cruises
- ⇒ Pirata related reports, presentations & documents (SSG...).
- ⇒ Easy access to in situ Pirata cruises data sets **through DOI**:
 - ⇒ DOI for all PIRATA-FR cruises (yearly actualized)
 - ⇒ S-ADCP data set (B.Bourlès, et al. yearly actualized)
 - ⇒ ADCP moorings data set (B.Bourlès, et al. yearly actualized)
 - ⇒ CTD-O2 data set (B.Bourlès, et al. yearly actualized)
 - ⇒ Chemistry data sets (B.Bourlès, et al. yearly actualized from 2018)
 - ⇒ L-ADCP data set (B.Bourlès, et al., yearly actualized from 2019)
 - ⇒ Carbon parameters in the eastern tropical Atlantic (N.Lefevre & al., 2019)
 - ⇒ Acoustic data (J.Habasque et al., yearly actualized from 2020)
 - ⇒ Water isotopes data set with DOI (G.Reverdin et al., 2022)
 - ⇒ DIC isotopes data set with DOI (V. Racapé et al., 2022)
 - ⇒ DOI for pH data set on going

PIRATA-FR data DOI : 10.18142/14

<https://campagnes.flotteoceanographique.fr/series/14/>

What have been done in 2021-2022 « in the lab » ?

Some scientific activities (not exhaustive...):

⇒ Related (Pirata and/or Tropical Atlantic) publications:

- Ariza, A., et al., Global decline of pelagic fauna in a warmer ocean, nature climate change, <https://Article.doi.org/10.1038/s41558-022-01479-2>
- Alory, G., et al., Coastal Upwelling Limitation by Onshore Geostrophic Flow in the Gulf of Guinea around the Niger River Plume. 2021, *Frontiers in Marine Science*. 10.3389/fmars.2020.607216.
- Berlin L. et al., Hindcasting the 2017 dispersal of Sargassum algae in the Tropical North Atlantic. 2021, *Marine Pollution Bulletin*.
- Gévaudan, M., et al., Influence of ocean salinity stratification on the tropical Atlantic Ocean climate. 2021, *Clim Dynamics*.
- Giordani, H., & Peyrillé, P., Dynamics of the Atlantic Marine Intertropical Convergence Zone. *Journal of Geophysical Research: Atmospheres*, 127, e2021JD036392. <https://doi.org/10.1029/2021JD036392>, 2022
- Houndegnonto, O. J., et al. Seasonal variability of freshwater plumes in the eastern Gulf of Guinea as inferred from satellite measurements, *J. Geophys. Res.-Oceans*, 2021, doi : 10.1029/2020JC017041
- Jouanno et al., Evolution of the riverine nutrient export to the Tropical Atlantic over the last 15 years: is there a link with Sargassum proliferation ?. 2021, *Env. Res. Letters*.
- Lefevre, N., et al., Ocean Circulation Drives the Variability of the Carbon System in the Eastern Tropical Atlantic, *Oceans* 2021, 2, 126–148. <https://doi.org/10.3390/oceans2010008>.
- Moum, J. M. et al., Deep cycle turbulence in the Atlantic and Pacific cold tongues, *Geophysical Research Letters*, 49, e2021GL097345, doi:10.1029/2021GL097345, 2022.
- Reverdin, G., C. Waelbroeck, C. Pierre, C. Akhoudas, G. Aloisi, M. Benetti, B. Bourlès et al., The CISE-LOCEAN sea water isotopic database (1998-2021), *Earth System Science Data*, <https://doi.org/10.5194/essd-2022-34>
- Tuchen, F. P., et al., Two decades of full-depth current velocity observations from a moored observatory in the central equatorial Atlantic at 0°N, 23°W, *Front. Mar. Sci.* 9:910979, 2022

What have been done in 2021-2022 « in the lab » ?

Some scientific activities (not exhaustive...):

PhD (defended):

- Manon Gévaudan, LEGOS (J. Jouanno & F. Durand), December 2021. TA salt stratification & BL.
- Houndegnonto, J.O., UBO (N. Kolodziejczyk, C. Maes), December 2021. Fresh Water Plumes in the GG.
- Djoirka M. Dimoune, UFPE (M. Araujo, F. Hernandez), January 2022. West Tropical Atlantic Circulation

PhD (going on):

- Ngakala, R., UAC (Cotonou; G. Alory, C. Da-Allada). Congo upwelling (2020-2023),

Post docs:

- Dante Napolitano (Br; LEGOS): EUC and island effects in the GG

Training periods :

- 2022 M2, Marseille :Cardot, C, Dynamique de méso-échelle dans le Golfe de Guinée (I.Dadou).

Involvements of the IRD IMAGO unit in 2022

- 1) The IRD « IMAGO » Unit (in Brest) provides the « human and technical » support for PIRATA (material preparation & logistics, cruises, data treatments...).
- 2) IRD IMAGO team (Only 4 engineers...) ensures onboard all operations:
 - moorings operations (ATLAS/TFLEX & ADCP)
 - data acquisition (CTDO2, ADCP, TSG, meteo...) & treatments
 - S, O2, nutrients, Chl, pH analysis + pigments/CO2/C13/O18/TOC samplings...
- 3) Recrutement of Mr Thierry CARIOU (chemist) in October 2020:
 - => he ensures the nutrients analysis
 - => he allowed an extension of the lab and ADDITIONAL parameters analysis: pH measurements in 2022 & Total Alkalinity in 2023

Involvements of the IRD IMAGO unit in 2022

4) Jacques Grelet, who just retired, made a 2 months visite in Recife in spring 2022
=> training on data acquisition onboard, data treatments, etc.

e.g.: free softwares developed by IMAGO:

- CRDAP GITLAB : tool for material & information system management onboard & automating of acquired data treatment:

<https://forge.ird.fr/us191/crdap>

- generic tool for transforming all data into Ascii, NetCTD & ODV format:

<https://github.com/jgrelet/oceano2python>

- generic plotting tool (profiles, sections) from NETCTD files:

<https://github.com/jgrelet/Python-plots>

5) 2 recrutements expected by December 2022:

- 1 electronician (to replace Jacques Grelet)

- 1 chemist

6) New LADCP treatment by adding the POSIDONIA positioning system developed by Pierre Rousselot

Some changes for PIRATA in France

1) Changes in the PRB composition;

- IRD: Frédéric Marin replaced Alexandre Ganachaud in the PRB
- Meteo France: Hervé Roquet replaced Philippe Dandin in the PRB

2) Florent Gasparin has been recruited at IRD as researcher at LEGOS (research project linked to PIRATA & Trop Atlantic)

3) Julien Jouanno (IRD/LEGOS) joined the team

4) Changes in the SSG composition:

- Bernard Boulès retires
- Jérôme Llido is now coordinator of PIRATA-FR and joins the SSG.
- Julien Jouanno joins the SSG

⇒ A new « PIRATA scientific team » at LEGOS/Toulouse with:

Fabrice Hernandez, Julien Jouanno, Jérôme Llido & Florent Gasparin along with Hervé Giordani at CNRM/Meteo-France/Toulouse & coll.



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