

PIRATA-23 meeting report

(Marseille, France, October 22-24, 2018)



The 23rd PIRATA meeting was held in Marseille, on October 22-24 2018, in association with the 2nd meeting of the Tropical Atlantic Observing System review committee, held on October 25-26, 2018.

This meeting was dedicated to Rémy Chuchla, who efficiently contributed to the Tropical Atlantic observations, from 1971 to 2013 in the framework of CIPREA, FOCAL, NOE, CITHER, ETAMBOT, EQUALANT, EGEE/AMMA and also PIRATA cruises. He was also deeply involved in capacity development in West Africa, notably by contributing to the regional Master 2 in “physical oceanography and applications” in Cotonou, Bénin and by initiating the “Golfocean” association for the students. Rémy passed away on September 27 at 69y.

The present report is limited to the PIRATA SSG and PRB meeting, and the scientific sessions are summarized in the appendix. See also <http://www.brest.ird.fr/pirata/> for other details on the meeting.

This meeting was also the opportunity for organizing a high level meeting of the Brazil-French cooperation in ocean sciences that was held on Tuesday 23rd.

Attendees to the SSG-PRB closed session:

- SSG member participants:

Bernard Boulès (IRD/LEGOS, France; co-chair); Moacyr Araujo (UFPE, Brazil; co-chair); Michael McPhaden (NOAA/PMEL, USA); Gregory Foltz (NOAA/AOML, USA); Paulo Nobre (INPE, Brazil), Hervé Giordani (Météo-France/CNRM, France), Fabrice Hernandez (IRD/LEGOS/Mercator Océan, France), Peter Brandt (GEOMAR, Germany), Leticia Cotrim (UERJ, Brazil), Christina Patricola (LBNL, USA), Regina Rodrigues (UFSC, Brazil).

Nathalie Lefèvre (IRD/LOCEAN, France) and Adrienne Sutton (NOAA/PMEL, USA) were absent and excused.

- PRB member participants:

Janice Trotte-Duhá (DHN, Brazil).

Alexandre Ganachaud (IRD/LEGOS, France).

Philippe Dandin (Météo-France/CNRM, France).

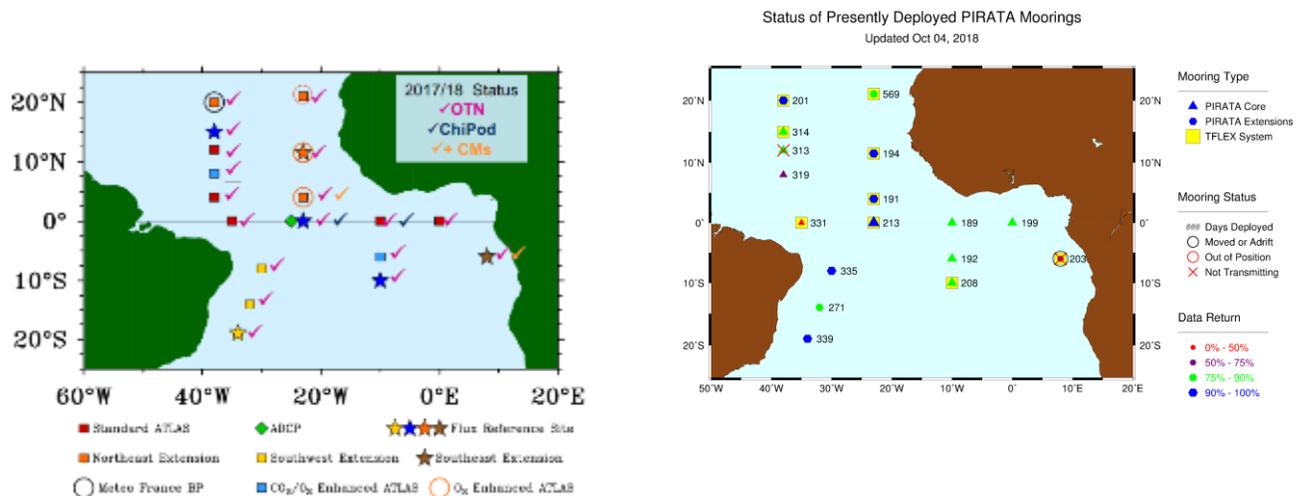
David Legler (NOAA, USA, Chair) was absent and excused; he was represented by James Todd (NOAA, USA). David Legler participated to the SSG/PRB meeting by phone.

Also attended as invited: Renellys Perez (NOAA/AOML), Jacques Servain (IRD/LOCEAN), Jérôme Llido (IRD/LEGOS), and Jacques Grelet (IRD/US IMAGO).

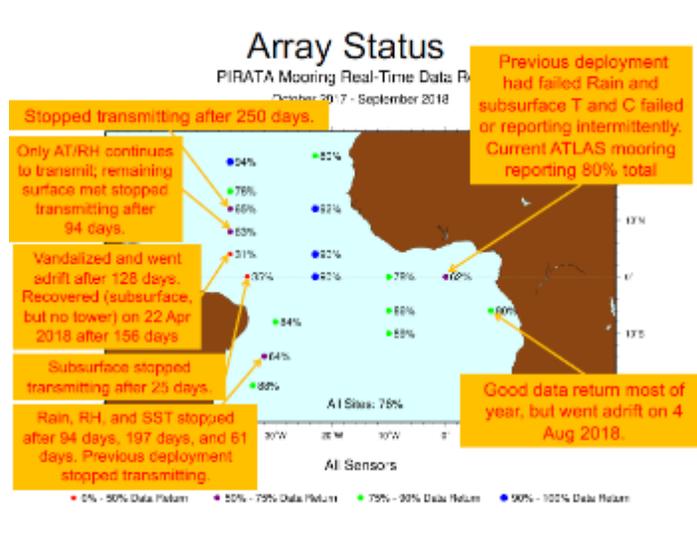
PIRATA global and national status:

1) NOAA/PMEL PIRATA overall report (Mike McPhaden)

Mike McPhaden (MM) presented the current flavor of the PIRATA buoy network (see figures below), including the addition of Ocean Tracking Network (OTN: acoustic sensors installed on all air-sea interactions buoys from 2013), Chipods (two Chipods installed at 23°W-0°N & 10°W-0°N buoys in 2014-2016 then 5 Chipods on each from 2016), and current meters (CMs) at 4°N-23°W, as part of the TACOS experiment.

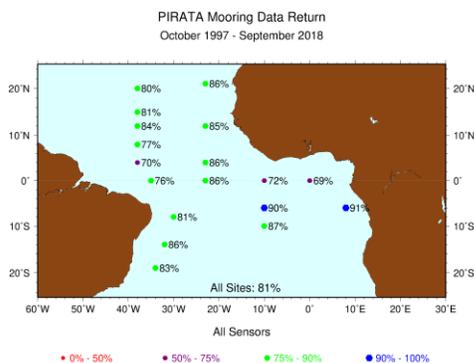
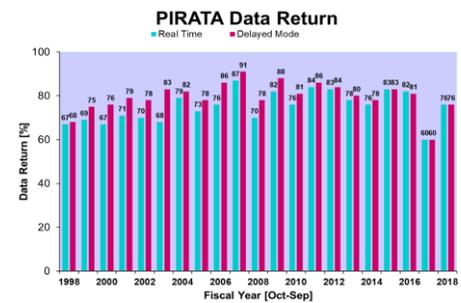


MM showed that 2.5 buoys were lost these last months (see detailed information on map below). All will be replaced during the next cruises, *i.e.* the BR one already going on (Oct-Dec 2018), US (Feb-March 2019) and FR (Feb-March 2019).



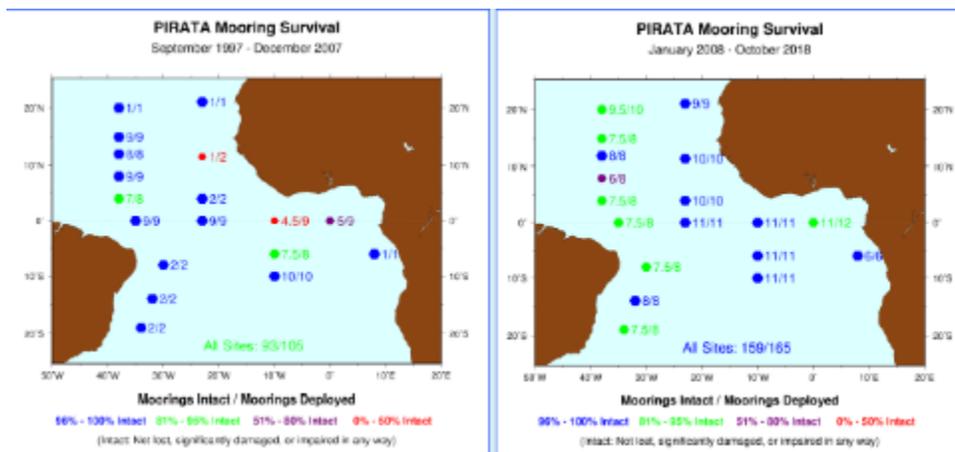
MM showed the fishing trends off Brazil, as detailed in a paper by Da Silva et al, 2018, indicating an increasing fishing pressure around the PIRATA buoys! Such a phenomenon could induce some vandalism acts and one needs to contact the paper’s authors and inform them about the importance of the buoys in order to eventually contact the fishermen community.

Despite the buoys lost, both the Real Time (RT) and Delayed Mode (DM) data return during Oct 2017-Sept 2018 was 76% for all sites (see figure). The RT and DM time evolution from 2008 indicates that the annual data return and number of moorings operating have returned to typical levels following a significant dip in 2017.



The PIRATA mooring data return for the whole period October 1997-September 2018 is 81%, which is an excellent result.

The overall (September 1997-September 2017) mooring survival (*i.e.* fully recovered/deployed moorings ratio) was 253/271, and still shows lowest values for the two equatorial buoys in the Gulf of Guinea due to vandalism. But vandalism due to fishing activity in this area has been considerably reduced in the past decade: since 2008, these two buoys show values of 11/11 and 11/12 (see figures below) and the overall ratio is 159/165 (*i.e.* 96%, compared to 88% during the previous period). At present, the PIRATA mooring survival rate is 100% for 10 sites (out of 18) from 2008, which is an excellent overall result and a measure of PIRATA’s success.



Field work since Oct 2017 involved 142 days at sea across US, BR and FR partners. PMEL sent persons to sea for 98 days on the last PNE cruise onboard the R/V Ron Brown and also on the French R/V Thalassa after the FR28 cruise to service the 20.5N-23W buoy. During these cruises, 17.5 buoys were deployed: 8 ATLAS and 9.5 T-Flex, as only surface instruments were replaced at 20.5N-23W.

Data files delivered through the web strongly decreased from 2013 but were offset by a very large increase in ftp file downloads (more than 700,000 during the last US fiscal year). A grand total of 847,949 files were delivered from 1999 to 2018 through the website, compared to 3,197,426 through ftp from 2007.

Then MM showed the implementation of the T-Flex underway. T-Flex and ATLAS systems provide equivalent data, and T-Flex performance (realtime & delayed-mode data return, record length) is equal to or better than ATLAS. There are currently T-Flex systems at 9 sites in RAMA and at 10 sites in PIRATA. One new T-Flex system will be deployed in PIRATA in 2019 at 6S-10W. Additional sites should be converted in 2020.

About piracy, MM showed that some incidents in Gulf of Guinea continue, but were confined mainly to the coastline, and piracy is abating off the horn of Africa.

MM showed the global enhancements and collaborations achieved from the early PIRATA.

Core measurements on all moorings are:

Wind, AT/RH, Rain, SWR, SST, SSS, 10 subsurface T, 3 subsurface S, 2 subsurface P

Then:

- 6 Flux Reference Sites (15N38W, 19S34W, 12N23W, 0-23W, 10S10W, 6S8E): LWR, BP, 10m CM, 2 add'l. subsurface T (5m, 10m), 4 add'l. S (5m, 10m 60m, 80m)
- Continued enhancement of EU AtlantOS funded sensors (T/C and Vel.)
- 3 Surface CO₂/O₂ (LOCEAN)
- 8 Subsurface O₂ (GEOMAR); 6 in real-time
- 1 Surface Pressure (BP) at 20°N, 38°W (Meteo France)
- 2 Sites w/5 Thermal microstructure sensors (10 total) (ChiPods, OSU)
- 18 Acoustic monitors (OTN, Dalhousie University)
- AEROSE (Aerosols and Ocean Science Expeditions, NCAS)
- 9 new T/C sensors planned for each of 3 sites (FUNCEME) in 2020 at: 8°N, 38°W; 4°N, 38°W; and 0°, 35°W
- 4 additional current meters at 4°N, 23°W (AOML)

- 1 additional current meter at 6°S, 8°E.

MM showed one slide provided by Adrienne Sutton about biogeochemical observation technologies & opportunities. A map was shown with from moored and underway pCO₂ measurements over the last decade, another with recent BGC-Argo profiles, and a picture of saildrones that are presently tested in tropical Pacific, Arctic & Southern Ocean. A table (shown here) summarizes the existing observing technology responding to science requirements (only a subset!).

Science requirements*	Observing technology*
Climate quality CO ₂ and OA tracking	Leverage and expand existing moored and underway pCO ₂ observations
Seasonal to decadal variability of OMZ, biological pump, carbon export	BGC-Argo at 1/3 current Argo density (see BGC-Argo implementation plan)
Spatial variability of coupled air-sea physical and biogeochemical processes	Autonomous surface vehicles (e.g., Saildrone)
High resolution constraint of OMZ for forecasting in fisheries-critical areas	Expand subsurface moored biogeochemistry (e.g., Prawler T, S, O ₂)

* Only a subset, and of course, there are scientific requirements only amenable via ships

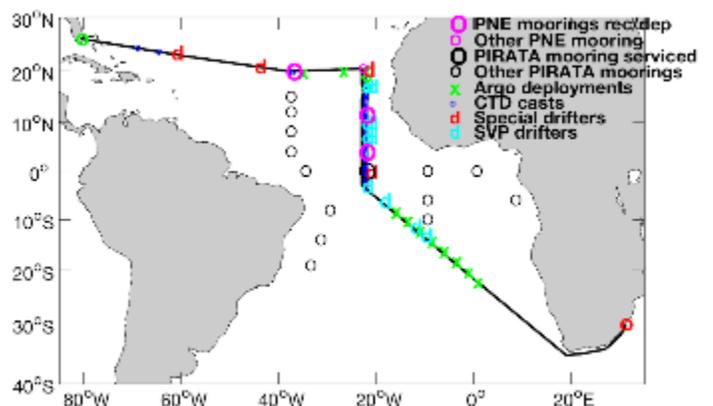
Finally, MM showed the situation encountered on Sept 12, 2018 with 4 simultaneous cyclones! 2 cyclones (Florence & Helen) passed around 20.5N-23W and their signatures were clearly measured by the PIRATA T-Flex. Helene signature with inertial oscillations is impressive, along with the differences between daily and hourly data sets that illustrate the high relevance of high frequency data transmission, made possible thanks to T-Flex system and Iridium system.

2) NOAA/AOML PIRATA Northeast Extension (PNE) report (Renellys Perez)

Renellys Perez (RP) first showed the AOML's PNE webpage that was refreshed, thanks to Jonathan Christophersen and others at AOML (<http://www.aoml.noaa.gov/phod/pne/>). The Cruise CTD data are available in ascii and netcdf files. When available, LADCP and SADCP data are provided as netcdf files. Also a link to ePIRATA data set.

RP is now in charge of updating the PIRATA publication list; it was updated on 10/10/2018 with 306 peer-reviewed publications. Everyone is invited to send email bibliography updates to Renellys.C.Perez@noaa.gov.

RP presented the most recent PNE cruise, PNE 2018, conducted on the R/V Ron Brown from March 7 to April 14, 2018 from Ft. Lauderdale, Florida, US to Durban, South Africa., and the Chief Scientist was Gregory Foltz, NOAA/AOML (see map). The cruise was delayed by 3 months making it about 13 months since the previous PNE 2017 cruise. Two science days were lost due to unexpected ship maintenance/repairs in Ft. Lauderdale.



RP showed an AOML experiment related to Sargassum studies done during the PNE cruise. The experiment's goal is to determine the trajectories of Sargassum and marine debris in the tropical Atlantic using 55 experimental and 10 SVP drifters (PIs: Gustavo Goni, Rick Lumpkin, Ulises Rivero). The 55 experimental drifters (*i.e.* large spheres, medium spheres, cubes, squares, Sargassum, drogued and

undrogued SVP) were deployed around four locations: 23°3'N-61°4'W, 21°8'N-45°3'W, 20°2'N-23°W and 0°N-23°W.

Regarding the mooring work, RP provided the following summary:

- T-Flex replaced at 23°W-4°N, 23°W-11.5°N and 38°W-30°N.
- Due to bad weather/rough seas/ship delays, recovery at 20.5°N 23°W was impossible and only met/surface sensors were changed by France from the R/V Thalassa in April 2018, just after the PIRATA FR28 cruise.
- Along 23°W, the 4°N and 11.5°N T-Flex moorings were redeployed with GEOMAR total dissolved oxygen loggers (this has been done since 2009). Although there were no problems with real-time data tests on deck, there were issues getting data from 11.5°N sensors after deployment.
- Ocean Tracking Network hydrophones were recovered and replaced at the three serviced PNE mooring sites (200m depth).
- Surface radiation and rain gauge replaced on French T-Flex mooring at 0°, 23°W. Due to problems with our rain gauges during entire cruise, the recently recovered 11.5°N, 23°W rain gauge was used. Sea state should be considered when conducting these types of repairs on the T-Flex buoys.
- At 20°N 38°W, 60m TC was not logging, SSC was noted shifted. Rain gauge was a reused sensor that was swapped out from 2017 PNE cruise. Longline fouling was present at the 200m OTN sensor on recovery. Unmarked nylon was recovered with some damage near the bottom thimble and re-terminated.
- At 11.5°N 23°W, many resets were documented during deployment. Minor amounts of fishing line noticed on the bridle above the SSTC sensor. Case screws at the base of the shield were missing from the SSTC but the sensor was uncompromised. Both TP sensors had dead batteries. Some recoverable data at TP300, none at TP500.
- At 4°N 23°W, the mooring was flagged for bad rain data, and failure of AOML Aquadopps at 6.6m, 36.6m, and 86.2m due to low battery power. C60 was reported high and it had reset once. Longline from 40 to 60 meters with the 40m, 56.6m, and 60m sensors fouled by it, and some below 100m sensor. The OTN sensor had been pushed up the nilspin to the bottom of the 180m sensor and there was a gash in the nilspin exposing the core at the original 200m location of the sensor.
- All ten AOML Aquadopps for the Tropical Atlantic Current Observations Study (TACOS) were recovered. Three sensors mentioned above are being sent for repairs. Four loaned PMEL Aquadopps were deployed (26.6m, 36.6m, 56.6m, 86.6m) to provide continuity to TACOS.
- 50 CTD+LADCP casts were carried out down to 1500 db, but one deep cast at 0, 23°W. Every other station cut north of 15.5°N, high density only between 1°S and 1°N, no casts south of 3°S. About 20 planned casts cut.
- DIC was collected from near-surface CTD bottles (one per station)
- 12 Argo floats were deployed.
- 65 surface drifters (55 experimental, 10 SVP; see above about Sargassum experiment) were deployed.
- Underway shipboard ADCP/TSG/pCO₂/M-AERI data were collected.

RP also informed that this cruise was the first to carry the ESRL/GMD XCO₂ air calibration system (PI Colm Sweeney, “Climate Monitoring and Diagnostics Lab gold standard”) which will be compared against the pCO₂ underway values.

Then RL spoke about the next PNE cruise. The R/V Ronald H. Brown will be used to conduct the next PNE cruise (Chief Scientist: Renellys Perez, AOML). It is planned from 14 February to 26 March 2019 (41 days), from and to Fort Lauderdale (FL USA), with 20-22 scientists onboard. AEROSE team will join (Howard University, NOAA/NESDIS) the cruise along with Brazilian DHN participants

Then, RP presented some info about the Tropical Atlantic Currents Observations Study (TACOS; by R.Perez, G. Foltz, R. Lumpkin and G. Foltz; NOAA/AOML). During its present 2nd phase TACOS provides current data in real time. During the next PNE 2019 cruise, AOML will redeploy Aquadopps at

4°N-23°W with 7-10 sensors, depending on repair speed (TACOS-3 phase), that will be recovered in 2020. Then the TACOS experiment could be redeployed either at 11.5°N, 23°W to observe OMZ, or at 20°N, 38°W to observe main hurricane development region. RP presented TACOS time series from January 1st to present (650 days).

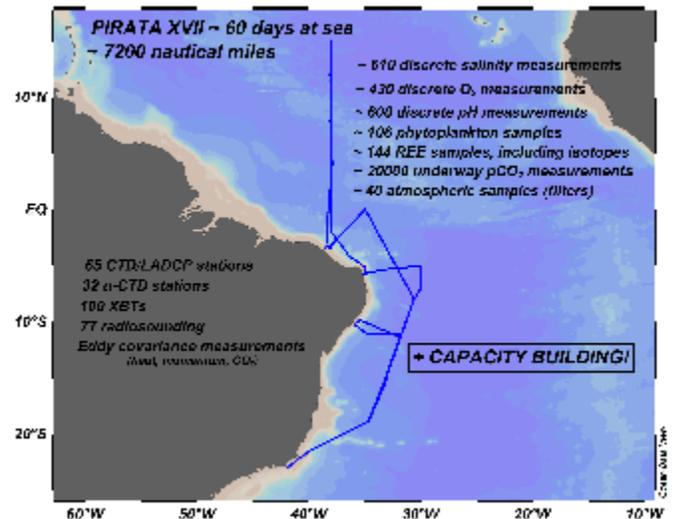
Finally, RP presented last information about e-PIRATA. The e-PIRATA has been updated through 2017 and will be updated every summer to include daily data through the end of the previous year. The ePIRATA heat budget residuals have been useful for diagnosing seasonal cycles of turbulent mixing (Hummels et al., Nature Comm., submitted; Foltz et al., JGR, to be submitted). She informed that hourly ePIRATA data could be possible when combined with an 1-d mixed layer model to fill in vertical gaps in ocean T, S, velocity. This is something to consider for the future.

3) Brazilian PIRATA report (Paulo Nobre)

The status of PIRATA-Brazil was presented by Paulo Nobre (PN), with contributions by Leticia Cotrim, André Belem, Moacyr Araujo and Yaci Alvarez. PN presented the PIRATA-BR XVII carried out from the R/V Vital de Oliveira, from 25 October 2017 to 15 January 2018. This PIRATA-BR XVII was a multi-science cruise (underway) with 60 sea days spread out over 80 calendar days.

During this cruise (see map):

- 8 ATLAS Buoys were replaced; the 14°S-32°W mooring line was lost due to long fishing line attached to the mooring.
- 66 full depth CTDO₂/L-ADCP/nutrients stations were done:
 - o CTDO₂ profiles already were Quality Controlled
 - o L-ADCP profiles are in process
 - o Nutrients samples were analyzed
 - o data to be published on Scientific Data Journal
 - o 68 scientists and students embarked.



The T-Flex at 4°N, 38°W went adrift (again!) on March 25th 2018 and rescued by the R/V NOC. Antares on April 22nd, 2018 at 4.5°N, 40°W.

PN showed some PIRATA-BR XVII results, as the pH vertical section along 38°W, a bottom topography map,

Then PN presented the PIRATA BR-XVIII (2018) cruise that is underway, onboard the R/V Vital de Oliveira from October 22, 2018 to December 5, 2018. The planned works are:

- 100 XBT profiles (XBTs provided by NOAA);
- 55 radiosoundings (provided by INMET, Brazil)
- Microplastic sampling along all CTD stations;

PN said that two whales were observed around 11°S, 35°W and 5°S, 33°W.

About logistic aspects, PN mentioned some difficulty for scheduling ocean shipment from Seattle (demanded truck transportation from Seattle to Miami and then from Santos to Natal, in order to match R/V Vital de Oliveira availability for PIRATA).

PN listed the scientific material and sensors used onboard: ADCP (75&150KHz), CTD/Rosette, Autosal, XBT, U_CTD, L-ADCP, thermosalinograph, pCO₂, WAMOS, VAISALA Radiosonde, Gravimeter, Navigation

PN concluded by showing the financial PIRATA budget and vessel time for 2018 in Brazil: 50k\$ for material transportation between PMEL & Brazil, 130k\$ for logistics, 13k\$ for expendables; and a total of 10 days at sea for the R/V Antares plus 60 days for the R/V Vital de Oliveira.

4) French PIRATA report (Bernard Bourlès)

BB first reminded the overall status of PIRATA in France and presented the different PIRATA-France funding supports and the evolution of the PIRATA-FRANCE budget. In 2018 the contribution by Météo-France was 30k€, by IRD 52k€, and by the Observatoire Midi-Pyrénées (OMP) 3k€ (i.e. decreasing). IRD completed exceptionally its support by additional 40k€ for material purchase (in addition to 30k€ provided in 2017 that will be used in 2019 to build a new platform and purchase containers for PIRATA material storage; this is induced by installation changes in the IFREMER campus and was expected in 2018 but delayed for administrative issues). CNRS/INSU and IRD also provided support of 56k€ and 34k€ respectively in 2018 through a national call offer for Observatories national Systems PIRATA applied to. The 34k€ by IRD will be used in 2019. Thus the total amounted to 215k€. The total cost, including the vessel time, is about 1.7M€ (without salaries). The number of engineer days dedicated to PIRATA is estimated around 345 (cruise material preparation, logistics, cruise time and data analysis) and the total sea days (65, including transits from France to the port of call) dedicated to the PIRATA-France cruise and its preparations.

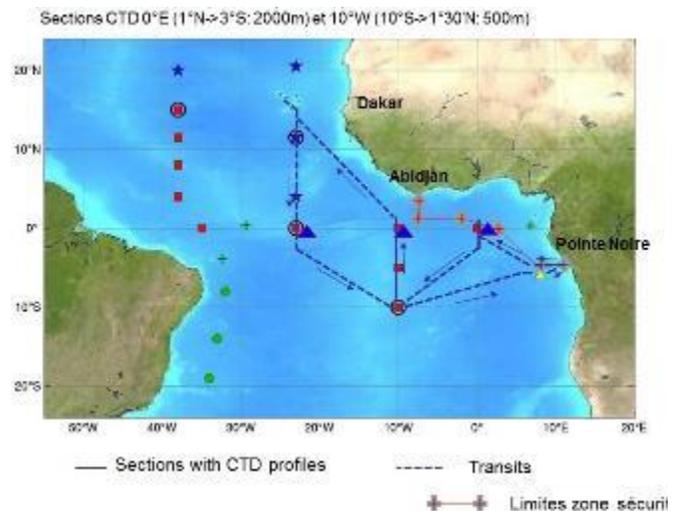
BB informed that (at least...) one research engineer was recruited in September 2018 by IRD at LEGOS, Jérôme Llido, for PIRATA. The last year support letter by PIRATA PRB was important and certainly greatly helped for this...

As during previous years, and due to piracy activities in the Gulf of Guinea, the PIRATA-FR28 cruise had to be organized in one leg from Cabo-Verde without any call in continental West Africa. It was thus done from the R/V Thalassa and conducted from February 27 to April 5.

ATLAS tubes & some T-Flex sensors (rain & solar radiation) stayed in Le Havre (due to a transboarding error...) and ATLAS tubes had to be sent to Pointe Noire by plane. Thus, the cruise plan was modified in order to first replace T-Flex systems before retrieving the ATLAS tubes, off Pointe Noire (Congo).

The 3 T-Flex at 0°N, 23°W, 10°S, 10°W and at 6°S-8°E (with a CO₂ sensor) were replaced, but rain & solar radiation sensors that were only kept in place.

The passage off Pointe Noire was made possible due to better security conditions encountered within Congo region area from a few months. This also allowed some measurements and 4 CTDO₂/LADCP casts along the continental platform and slope. Then the 3 ATLAS at 0°N, 0°E, 6°S, 10°W (equipped with CO₂ sensor) and 0°N, 10W were serviced.



The following additional operations were carried out at some moorings: i) Replacing of 5 χ pods at 0°N, 23°W and 0°N, 10°W (5 at each site); ii) OTN sensors from Dalhousie University were replaced on all meteo-oceanic buoys, iii) measurements close to the PNE buoys at 4°N, 23°W and 12°N, 23°W.

The ADCP mooring at 0°N-0°E was, for the 1st time, also successfully serviced and a full 2 years time-series has been registered. This mooring was deployed also in contribution to PREFACE in 2016 and will be maintained as long as possible in the frame of PIRATA-FR.

BB showed that the T-Flex at 6°S, 8°E went adrift on August 4th! It was equipped with additional T/C and Aquadopp subsurface sensors and a new CO₂ sensor... It stopped its course off Nigeria where data (only GPS and surface sensors) transmission stopped, on September 15th. Thanks to NIOMR (partners in Lagos, Nigeria) Ms Regina Folorunsho went in the area where she achieved to retrieve the tube and met sensors. She drove them to Cotonou and be sent to France, before being sent back to PMEL in late April 2019 along with the next PIRATA FR cruise material... It has to be noticed that i) Ms Regina Folorunsho already helped PIRATA by retrieving sensors in 2002, and ii) it is the first time that such an event happened since 2008 in the Gulf of Guinea and at this particular site.

A total of 44 CTDO₂/LADCP (3x0-4000m, 23x0-2000m and 17x500m, along 10°W for saving time) were carried out (along sections at 10°W, and 0°E and around 6°S, 8°E and off Congo), along with 97 XBT profiles. 604 sea water samples for diverse biogeochemical (and also CO₂ at 6°S, 10°W and 6°S, 8°E) and physical parameters were collected during the cruise (at the surface and during CTDO₂/LADCP profiles) together with continuous underway ADCP (38kHz only; the 150kHz was unfortunately out of order during the cruise...), TSG, FerryBox and acoustic measurements (the R/V Thalassa is equipped with a SIMRAD EK80 6 frequencies acoustic sensor + 120kHz for the horizontal, and such measurements are of great interest for biotic and abiotic ecosystem components). Also, Sargassum algae (43 samplings) and fauna (47 samplings: gooseneck barnacles, crabs, shrimps, worms...) samples were collected for taxonomy, biological and microplastic analysis.

5 Argo profilers were deployed:

- for the 1st time in the Tropical Atlantic, 2 Deep-Argo equipped with 02 sensors (justifying the casts down to 4000m depth), were deployed at 6°37'S, 5°E and 0°N, 10°W. These deployments contribute to Euro-Argo and AtlantOS.
- 3 ARVOR along 0°E at 0°30'S, 0°N and 0°30'N

BB recalls that from 2013 all Argo profilers deployed during PIRATA-FR cruises have an 1m vertical resolution in the first 100m depth.

13 SVP-B (as Météo-France contribution to AtlantOS) and 10 SVP (NOAA/AOML) were deployed.

BB also mentioned the servicing operation at the PNE site at 20°N-23°W carried out after the FR28 cruise by the R/V Thalassa crew and two PMEL engineers, who embarked in Mindelo. The weather was still rough, but the operation was successful. IFREMER and, through UNESCO-IOC, CNRS and IRD, received the Official NOAA's acknowledgments for his particular operation...

Then, BB showed some inputs related to CO₂ measurements provided by Nathalie Lefevre. It is reminded that the adaptation of the CARIOCA CO₂ sensor to the T-Flex mooring induced the shortening of the submarine part of the sensor and the implementation of new electronics. The 1st installation of a new CARIOCA sensor was achieved at 6°S, 8°E in March 2017, as a contribution to the ATLANTOS project. At 6°S, 10°W, the sensor was ok in 2017, and data will be processed when HR SSS available; unfortunately, due to sensor connection failure, there is no data in 2018. At 8°N, 38°W, the sensor was lost in November 2017, and another sensor was deployed again, but malfunctioning; there is no data in 2018. At 6°S, 8°E, the sensor was deployed in 2017 but impacted by biofouling. The sensor was lost in early August 2018 (see

above); there is some data in 2018 but also with biofouling. So, after the loss of two CARIOCA sensors, only two moorings can be equipped from now on. Thus, the two old CO₂ sensors (at 8°N, 38°W and 6°S, 10°W) not transmitting data will be retrieved and both adapted to T-Flex. These new CO₂ sensors (adapted to T-Flex) will be kept for the 6°S-10°W and 6°S, 8°E sites. Also, measurements of pCO₂ underway is planned during the next PIRATA FR29 cruise.

The next PIRATA FR29 cruise will be from Mindelo (Cabo Verde) from around February 28th. The new situation in Congo could allow the end of the cruise in Pointe Noire, so possibly reducing the cruise duration to about 30 days (to be confirmed, depending upon the situation evolution there...). During this cruise, the ATLAS system at 6°S-10°W will be replaced by a T-Flex. Argo profilers will be deployed (two equipped with O₂ sensors), along with several SVP-B and SVP drifters. The 0°N-10°W ADCP mooring will be serviced. In addition to usual operations and measurements, pCO₂ underway and possibly samplings for organic carbon will be done.

BB provided some information about PIRATA-FR cruises and data sets and DOI (CTD-O₂, S-ADCP, ADCP moorings, and chemistry soon). L-ADCP measurements are still under process. All data sets are available through the renewed and actualized PIRATA-FR website (<http://www.brest.ird.fr/pirata/>), which contains more documents, reports, presentations etc.

BB showed a list of recent publications (7 published since January 2018 including French “pirates”, 3 submitted, including the PIRATA “20y” paper). Most of the papers involved African PhD students or post docs issued from the Master 2 in Cotonou, Benin, and underlined the important involvement of UFPE-Recife in this capacity building program. Also, Master training periods and 3 PhD were or are going on in the frame of PIRATA.

BB also raised some potential issues with SSS data provided in Delayed Mode that must be checked. He also raised the question from several scientists about the feasibility to get easier access to long times in High Resolution to PMEL: at now available through ftp on demand, could they be directly accessible?

After having shown a list of issues to be discussed (see next chapters) BB ended by informing that he changed his position, as now in charge of the IRD US IMAGO from July 2018. Jérôme Llido will progressively take in charge the PIRATA-FR related tasks.

5) SSG issues and discussion (with PRB):

Several important subjects were previously defined through email exchanges. During these discussions, David Legler was at phone and thus participated to the meeting. The different issues are detailed in the following.

1. Review of progress of PIRATA and any issues raised by the SSG.

Vandalism & fishery: It is reminded that 2.5 buoys were lost in 2018. One first and new major concern is the problem of fishery off Brazil. There is clearly no easy solution concerning fishing issues, and it seems pessimistic but realistic to think that fishers do not care about the importance of the buoys. However, one has to pass the information to the fishing community. It is suggested to contact colleagues involved in the PADDLE program (Marie Bonnin, IRD/LEMAR) related to societal issues, and the ones involved in LMI-TAPIOCA in Recife, who work with fishers. Also evoked is to invite some people from the fishery community, and particularly the authors of the Brazilian paper (Da Silva et al., 2018) for one next meeting.

Jim Todd and Moacyr Araujo well know the first author (Guelson Batista Da Silva, who was Chair of ICCAT –“ The International Commission for the Conservation of Atlantic Tunas”-) and will contact him.

CO₂ issue: The 10 year CO₂ data time series at 8°N, 38°W are scientifically relevant, and long time series are valuable. For some reasons (see above), a CO₂ sensor will not be maintained at this location. Several questions and potential solutions are raised. *E.g.*, could the PIRATA system directly transmit CO₂ data in real time? Could we state, in the future, that PIRATA is capable of measuring CO₂? What do we do to continue? Who could be PI ? Funding ? MMP said that the NOAA CO₂ sensor system is not adapted to T-Flex, contrarily to the one developed in France with Nathalie Lefevre. The SSG has to think about strategy (and potential resources) to maintain such measurements at 8°N-38°W. Nathalie Lefevre will be questioned about costs, and if she would still be interested to contribute if this site is funded and ensured by others.

PN also mentioned the issue about material shipping between PMEL and Brazil, and issues with batteries (customs requirements). MMP will check the details.

About additional sensors: PIs are designed for additional sensors and parameters, and SSG needs feedbacks. For example, one would need the yearly status about OTN & Xpods, maintained from several years, in order to get info on their relevance ...

2. TAOS Review. Goals: assess review status and anticipated outcomes. Discuss approach to engaging in TAOS meeting discussions.

PIRATA is an example of solid collaboration among three nations, albeit the infrastructure required and the prospects for enhancement into a system of observations. PIRATA is strongly involved, from the last PIRATA 22 meeting, in the TAOS review process. PIRATA SSG members contribute to the TAOS review committee and participated to the 1st TAOS review meeting in Portland. The 2nd meeting will be hold during the two next days and most of the PRB/SSG members will attend. At present, PIRATA partners edited a “White Paper” in early 2018 that helped to edit the submitted PIRATA paper (in Earth and Space Sciences); some are involved in the TAOS White Paper submitted for OceanObs19. Some views about possible enhancements and extensions have been proposed.

3. PIRATA MOU Renewal ; Goals: review proposed changes to PIRATA MOU; identify timeline for finalizing (e.g. country internal review, finalization); identify opportunity for signing ceremony.

Considering the present context and the TAOS review process by the OceanObs19 conference, it has been unanimously agreed that the previous plan to re-edit the MoU document was no more relevant. Thus, it was decided to develop and sign a 2-year renewal of the current MOU (for the period 2019-2021), that would include just a set of short statements and signatures of MOU representatives (thus not requiring new review or higher-level approvals). Such an extension will allow to consider the TAOS review and the OceanObs19 in a future MoU. A letter will be proposed as soon as possible; then NOAA (David Legler) will have to send the signed letter to get it signed by other parties: the 4 organizations (NOAA, INPE, IRD and Météo-France) have to sign. Then, in 2020, we will have to start working on a new MOU, considering review inputs, etc., that would be signed and come into effect around July 29, 2021.

4. PIRATA Children's Book ; Goals: discuss status of this project and decide if it should continue? Next steps?

In a previous email exchanges, Janice Trotte recalled that the idea is shared as a good one among partners. There are authors already identified in the US and keen to do it. Brazil has offered financial support (by then....) to cover some publication costs and the translation to Portuguese. Fabrice Hernandez, on 20

November, had summarised the subject, via e-mail, stating: i) 5k\$ are given by NOAA for paying some edition/illustration; ii) Fabrice would search on funding opportunities under Mercator, for operational oceanography central pages; iii) PRB/SSG members would have to perform the translation in different languages that would require volunteers and time (NB: Brazil has already agreed to do that in Portuguese); iv) there were no final picture regarding financial implications to pay for publication and shipping. A rough estimate called for 185 k\$ for 75,000 copies, that has been seen as the main issue for discussion since budget in a few agencies were already frozen for 2018.

There had clearly some disconnect about this project in 2018. Diana Stanitski is still willing to do it. It is noticed that such a book could be also useful for other aspects, *e.g.* as sensibilization of fisher's communities to limit vandalism, through officers, also through education use, as information can first go through the children then their parents. Such a project could also be of great interest for social scientists (*e.g.* possibilities with TAPIOCA UFRP-IRD laboratory).

About funding: is NOAA ready to fund? Would it have published as eBook? Will it be freely distributed or commercially sold?

Alexandre Ganachaud (AG) asked when we will have a first English edition (even unformatted) so that we can translate in French. One needs Agreement on copyrights so that IRD can edit and produce the French version (do one have to refer to MOU?). If distributed in France, two processes are possible; one need to collaborate with a specialized Editor for Children's books who will know how to reach children... For African countries: one need to identify appropriate structures: ministries, PIRATA partners, IRD representatives... How many books? Printed in which country? Who supervises? Who sells books/networks (*e.g.*: Editions Tombouctou, at very low price)?

One first need the source files from NOAA. Editorial works by IRD can be done for no charge (proofread and technical editing). To be determined are: printing fees (depending on charges) and distribution fees.

5. PIRATA partner status and views (future challenges/opportunities of sponsoring agencies?)

How about partners future?

About NOAA, David Legler (DL) precised that NOAA will continue its support from research and weather service sides.

About IRD, AG precised that IRD will obviously continue its funding and supports, as PIRATA is the frame of the IRD's interest to sustainable development goals, and of the Sustainable Development Goals (Goals 14: Oceans). AG mentioned the recent new position at IRD with the recruitment of Jérôme Llido in Septembre 2018. AG also mentioned the creation this year of the TAPIOCA UFRP-IRD laboratory in Recife, and the assignment of Fabrice Hernandez in Recife for a 2 years period. IRD also contributes to ship time. The engineers of the IRD's IMAGO Service Unit also largely contribute to PIRATA in France. IRD, UPS and CNRS fund activities and equipment, systematically every year plus extras, and funded PIRATA by ~185k€ in 2018.

One question is the way for IRD to continue to develop capacity building. IRD efficiently contributes to training and capacity building, in particular in Benin and Gulf of Guinea countries with lectures from Brazilians colleagues and hosting PhD students in Recife. IRD continues collaborating with these former students (ex: Christine Karine Tchamabi is at present an IRD post-doc working at LEGOS on the tropical Atlantic Sargassum near the Amazon plume; Sandrine Djakouré is a former student who holds a position in Côte d'Ivoire and now visiting LEGOS laboratory to work on Sargassum drifts...). One should maybe define more precisely the reasons for involving Benin into PIRATA... What are PIRATA interests and the IRD mission? Do we need a strategy PIRATA fellowships?

About Météo-France, Philippe Dandin ensured secured funding in 2019. He then raised the works by Paul Poli (who presented his work during the scientific sessions) at EUMETNET and ECMWF, on the weight of observations in prediction systems. His results are a great benefit for PIRATA. Philippe Dandin

precised that the intense hurricane season in 2017 made the deciders to be more convinced about the importance of Tropical Atlantic Climate and thus of the Meteo-France contribution to PIRATA.

In Brazil, Janice Trotte said that Brazil will continue to support PIRATA as long as possible... The new R/V allows a lot of research works. The budget will continue to be almost the same. Brazil is also part of the TAOS review. She raised again the issue of shipping equipment, but MMP will check this. She said that the 2018 PRB letter sent to IRD was very useful to get a position dedicated to PIRATA in France, and asked how about letters to Brazil & NOAA... PN précised the good support of INPE director. The agreement between INPE and DHN is signed that will get easier R/V time.

6. Discussion: Future opportunities for PIRATA

Moacyr Araujo informed about a new Research Vessel in Angola: the “Baia Farta” (possibly 22 scientists and 29 crew onboard; dynamic positioning, ROV...). The contact in Angola is Paulo Coelho from Angola. They are willing to approach PIRATA and could contribute to add a buoy.

7. PIRATA SSG Membership and next meeting; Goals: review any membership issues (e.g. need for new members on SSG)

Philippe Dandin informed the attendees that BB was recently awarded by the French “Académie de Marine”, and got the Price “Alain Giret” (navigation and oceanology). Such award is considered as valuable also for PIRATA...

BB informed that Nathalie Lefevre retired from the SSG, raising the issue of her possible (and needed) replacing. USA & Brazil informed about the incoming of Regina Rodrigues (UFSC) for Brazil (replacing Edom Campos) and of Christina Patricola (LBNL) for USA (in place of Ramalingam Saravanan). Both SSG and PRB approve and applaud.

8. Any other business...

The next PIRATA 2019 meeting should be organized by USA. It is stated that it could be organized as coupled with OceanObs19 (OO19) in Hawaii (16-20 September). In this case, it would not be a scientific meeting, but rather only a SSG/PRB meeting. US colleagues will contact OO19 organizers and see. The issue of cost is raised (mostly a watch for travel budget uncertainties for Brazil).

Fabrice Hernandez also informed that GODAE will change name. A meeting is scheduled in Halifax 6-10 May, with an abstract call for a dedicated session on Ocean Observation.

No news of the VPAX proposal in Brazil (refer to the previous PIRATA 22 meeting report).

About cruises data: Brazil and US website should be actualized. Buoys data could be with a DOI but all data sets with same DOI, or one DOI per parameter?

PRIORITY ACTIONS SSG:

- Contact fishery community in Brazil.
- Continue efficiently to contribute to OO19 and TAOS review.
- Think about strategy (and potential resources) to maintain CO₂ measurements at 8°N-38°W.
- Check the organization of the next PIRATA 24 meeting in Hawaii.
- Contact with Angola?
- Look for one specialist in biogeochemistry in FR/EU to replace Nathalie Lefevre.

Summary to PRB:

- MoU extension signature process. To be signed by OO19.
- “PIRATA Children’s Book”.
- PRB should send a letter to MoU agencies in Brazil and USA for human resources, as done to IRD.

January 22nd, 2019

by Bernard BOURLÈS & SSG contributors.

APPENDIX 1:

Scientific Plenary Sessions (Monday 22nd - Wednesday 24th of October, 2018)

- The scientific sessions were previously defined by the SSG colleagues, with four sessions:
- 1: Oceanic and Atmospheric Mechanisms Affecting Tropical Atlantic Climate
 - 2: Simulation and Predictability of Tropical Atlantic Climate Variability and Change
 - 3: Physical-Biogeochemical Interaction
 - 4: Societal impacts and benefits of the Tropical Atlantic Observing System

Most of the presentations have been made available through the PIRATA-FR website at:
<ftp://ftp.ifremer.fr/ifremer/ird/pirata/talks/PIRATA-23/>

A total of 60 people attended to the meeting scientific sessions.

For each scientific session, plenary oral and poster sessions were organized. The scientific sessions were preceded by an official launching ceremony with a short speech by Frédéric Ménard (IRD), on behalf the IRD CEO Jean-Paul Moatti, Mike McPhaden (NOAA/PMEL) and Paulo Nobre (INDP), as representatives of each institution supporting PIRATA. Then Moacyr Araujo (UFPE) and Bernard Bourlès (IRD/LEGOS) introduced the PIRATA meeting and Bill Johns introduced the TAOS review 2nd meeting.

The four scientific sessions were organized as follows:

MONDAY OCTOBER 22nd:

SESSION 1: Oceanic and Atmospheric Mechanisms Affecting Tropical Atlantic Climate

Chairs: Marcus Dengler and Regina Rodrigues

11:00-11:30	Rebecca Hummels (key lecture)	Near inertial wave induced mixing in the tropical Atlantic
11:30-11:50	Hervé Giordani	What processes control the wind convergence in the boundary layer of the ITCZ in the equatorial Atlantic ?
11:50-12:10	Gregory Foltz	Vertical turbulent cooling of the mixed layer in the tropical North Atlantic ITCZ and trade wind regions
12:10-12:30	Renellys Perez	Upper ocean horizontal velocity and vertical shear in the tropical North Atlantic
12:30-14:00	<i>lunch break</i>	
14:00-14:30	Kristin Burmeister (key lecture)	Oxygen response to changes in the North Equatorial Undercurrent
14:30-14:50	Marcus Dengler	Seasonal variability of the Mauritania Current
14:50-15:10	Mathieu Rouault	New results from the extension of PIRATA in the tropical South-East Atlantic experiment
15:10-15:30	Mike McPhaden	Mean seasonal cycle of surface heat balance at 6°S, 8°E

15:30-16:00	<i>Coffee break</i>	
16:00-16:20	Odilon Joël Houndegnonto	Characterization of Niger and Congo river plumes in the Gulf of Guinea
16:20-16:50	Regina R. Rodrigues (key lecture)	Marine heatwaves in the tropical South Atlantic
16:50-17:10	Franz Philip Tuchen	Characteristics of the Atlantic Subtropical Cells inferred from ARGO data
17:10-17:30	Joke Lübbecke	Drivers of the Atlantic Niño II – the role of warm water volume changes
17:30-18:00	Open discussion	

TUESDAY OCTOBER 23rd:

SESSION 2: Simulation and Predictability of Tropical Atlantic Climate Variability and Change

Chairs: Christina Patricola and Noel Keenlyside

9:00-9:30	Hyacinth Nnamchi (key lecture)	Interannual SST—precipitation relationship in the equatorial Atlantic
9:30-9:50	Richter Ingo	Examining the role of model bias in limiting tropical Atlantic prediction skill
9:50-10:10	Noel Keenlyside	Impact of reducing climatological bias on seasonal prediction skill
10:10-10:30	Christina Patricola	The Response of Atlantic Tropical Cyclones to Suppression of African Easterly Waves
10:30-11:00	<i>Coffee break</i>	
11:00-11:30	Posters Sessions 1 & 2 introduction	6 posters, 5' each
11:30-12:30	Posters Sessions 1 & 2	
12:30-14:00	<i>lunch break</i>	

SESSION 3: Physical-Biogeochemical Interaction:

Chairs: Peter Brandt and Marie-Hélène Radenac

14:00-14:30	Xavier Capet (key lecture)	On Nearshore hypoxia and oxygen ventilation in the Eastern tropical North Atlantic
14:30-14:50	Peter Brandt	Oxygen changes in the tropical North Atlantic in connection to meridional overturning circulation and subtropical cell variability
14:50-15:10	Johannes Hahn	Eddy-driven oxygen supply to the eastern tropical North Atlantic oxygen minimum zone
15:10-15:30	Martin Claus	Ventilation of the eastern tropical North Atlantic oxygen minimum zone by latitudinally alternating zonal jets in a shallow water model

15:30-16:00	<i>Coffee break</i>	
16:00-16:30	Paulo Nobre (key lecture)	The PIRATA-BR XVII Multiscience Expedition
16:30-16:50	Jérémie Habasque	Environmental forcing of marine organisms as revealed by underwater acoustics in the eastern tropical-equatorial Atlantic
16:50-17:10	Marie-Hélène Radenac	Seasonal cycle of nitrate in the euphotic layer of the Atlantic Cold Tongue
17:10-17:35	Posters sessions 3 & 4 introduction	5 posters, 5' each
17:35-18:00	Open discussion	
18:30 - 21:00	<i>Icebreaker (Golden Tulip Hotel, 2nd floor)</i>	

SESSION 4: Societal impacts and benefits of the Tropical Atlantic Observing System:

Chairs: Moacyr Araujo and Paul Poli

9:00-9:30	Paul Poli (key lecture)	Tropical Atlantic data buoys in the global observing system: Impact on global weather forecasts
9:30-9:50	Abdoulaye Sarre	Early warning for food security in North-West Africa: spatial shift of small pelagic fish related to intense warming
9:50-10:10	Alban Lazar	COCA: A Coastal Ocean Observatory for marine Climate, CO2 & Acidification in the Atlanto-Pacific region.
10:10-10:30	Posters sessions 3 & 4	
10:30-11:00	Coffee break	
11:00-11:10	Rise of PIRATA: 1995-2005	Jacques Servain
11:10-12:00	Update on the OO TAOS White Paper	Gregory Foltz & discussions
12:00-12:30	Toward TAOS review, OceanObs and closure ceremony	Moacyr, Noel, Peter, Bill

The poster presentations (as e-posters) were organized as follow:

Session 1:	
Alina Nathanaël Dossa	Ocean circulation over the continental slope of Northeast Brazil
Ioana Ivanciu	What causes the Atlantic Niño mode to vary on decadal timescales?
Jérémie Habasque	Inter-comparison of surface current in situ measurements in Tropical Atlantic Ocean

Kanga Désiré Kouamé	Determination of surface mixed layer depth in East Equatorial Atlantic waters using 40 years of in situ data
Session 2:	
Gbekpo Aubains Hounsou-Gbo	Oceanic index vs. numerical model to forecast the rainy season in the Northeast Brazil
Swantje Bastin	Forcing the Atlantic equatorial deep jets: A basin-wide reconstruction of the intraseasonal eddy momentum flux
Session 3:	
Christine Carine Tchamabi	Investigating the variability of the upper ocean biogeochemical content of the tropical Atlantic
Jacques Servain	Climatic Constraints on Growth Rate and Geochemistry of the Rocas Atoll's Coral
Ndague Diogoul	Effect of environmental variables on the vertical structure of micronektonic layers over the continental shelf
Session 4:	
Mélodie Trolliet	Monthly solar radiation in the tropical Atlantic Ocean: Can its spatial variations be captured by the current configuration of the PIRATA moorings?
Anne Mouget	ocean surface with PIRATA measurements

All presentations were of high scientific level and these sessions were very successful. They also allowed to feed the next discussion sessions. To be noticed is significant number of presentations by young scientists.