

# **PIRATA-21 meeting report**

(Paris, France, December 2, 2016)

The 21<sup>th</sup> PIRATA meeting was held during the joint PIRATA-PREFACE-Tropical Atlantic Variability (TAV)-CLIVAR-Atlantic meeting co-organized in Paris. About 90 people attended these meetings, in which scientific presentations were held during specific sessions from Monday Nov 28<sup>th</sup> to Thursday, Dec 1<sup>st</sup>. The closed yearly PIRATA session, involving SSG and PRB PIRATA members along with invitees, was held on Friday, Dec 2<sup>nd</sup>, during which national status reports were presented before discussions.

## **Attendees to the SSG closed session:**

### **- SSG member participants:**

Bernard Boulrès (IRD, France; co-chair); Moacyr Araujo (UFPE, Brazil; co-chair); Michael McPhaden (NOAA/PMEL, USA); Rick Lumpkin (NOAA/AOML, USA); Paulo Nobre (INPE, Brazil), Hervé Giordani (Météo-France/CNRM, France), and Fabrice Hernandez (IRD/LEGOS, France).

Ramalingam Saravanan (Texas A&M University, USA), was absent and excused.

Peter Brandt (GEOMAR, Germany) was absent (attending to PREFACE parallel sessions) and excused.

Edmo Campos (IOUSP, Brazil) was absent.

### **- PRB member participants:**

David Legler (NOAA, USA) and Janice Trotte (Brazil) were present.

Alexandre Ganachaud (LEGOS) represented IRD.

Philippe Dandin (Météo-France) was absent and excused.

### **- Invitees :**

Sidney Thurston (NOAA ; Overseas Program Development).

Aurélien Carbonnière (IFREMER ; Department for European and International Affairs).

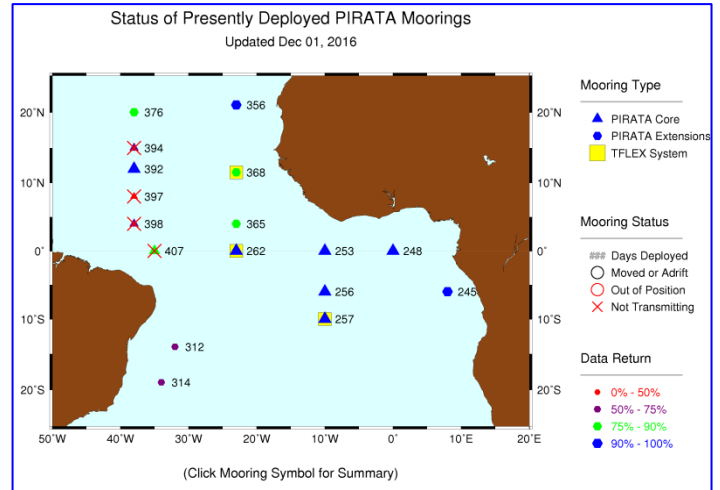
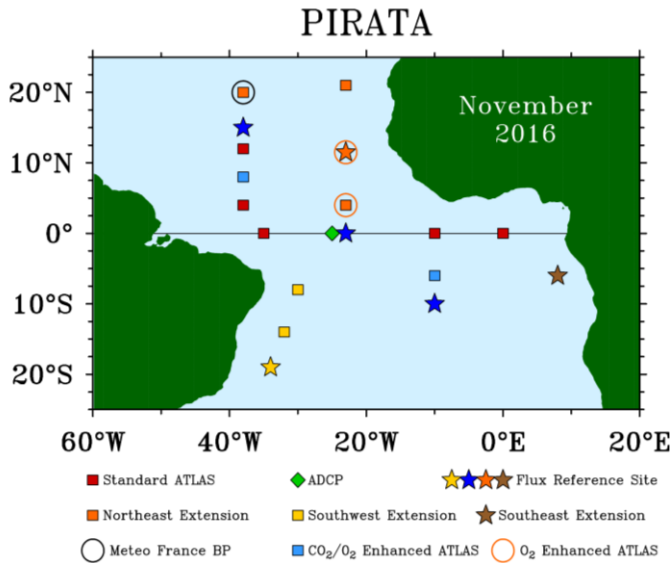
The first part of this report summarizes the overall and national PIRATA status reports.

A summary of the discussion, along with the priority actions for the PIRATA SSG, are then summarized, with a final short summary at the end for the PIRATA PRB.

**PIRATA global and national status:**

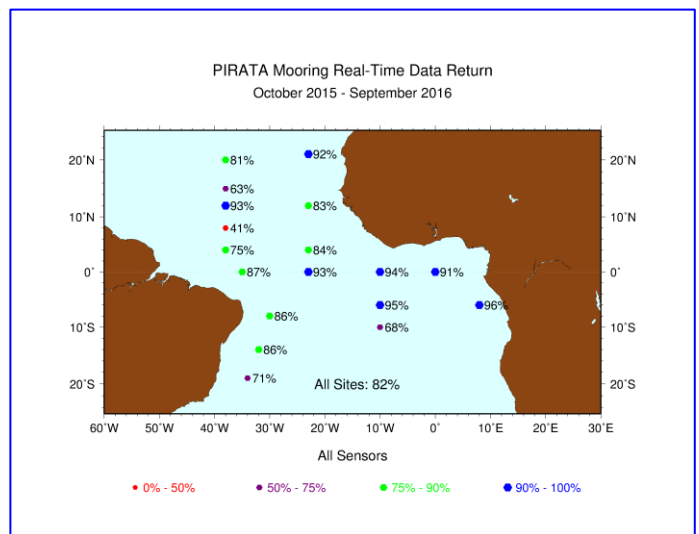
**1) NOAA/PMEL PIRATA overall report (Mike McPhaden)**

Mike McPhaden (MM) presented the current flavor of the PIRATA buoy network (see figures below), including addition of Ocean Tracking Network (OTN: acoustic sensors installed on all ATLAS buoys from 2013) and Chipods (two Chipods installed at 23W-0N & 10W-0N buoys in 2014-2016 then 5 Chipods on each from 2016). He mentioned the three new T-Flex systems (that will progressively replace ATLAS) installed in late 2015 & early 2016 at 23W-12N, 23W-0N and 10W-10S.



MM recalled that new funding has been made available from the EU AtlantOS program to enhance T/C and velocity on moorings (PI: B.Bourlès, IRD), to deploy a new CO<sub>2</sub> system at 8E-6S (with some issue for its installation on new filled T-Flex system; B.Bourlès précises that an adaptation has been made by the provider; PI: N.Lefèvre, IRD), and some new real-time O<sub>2</sub> sensors on 3 sites along 23W (PI: P.Brandt, GEOMAR). Also, 9 new T/C sensors are funded by FUNCEME to be deployed at 38W-8N, 38W-4N, and 35W-0N. The status of the moorings was then presented (number of days since the deployment of each mooring), highlighting some issues in the western part of the basin (keeping in mind that the next BR cruise should be soon, in March 2017, and that the 30W-8S went adrift on Nov 3, 2016 then retrieved by Brazil on Nov 13, 2016) and showed an overall satisfying data return.

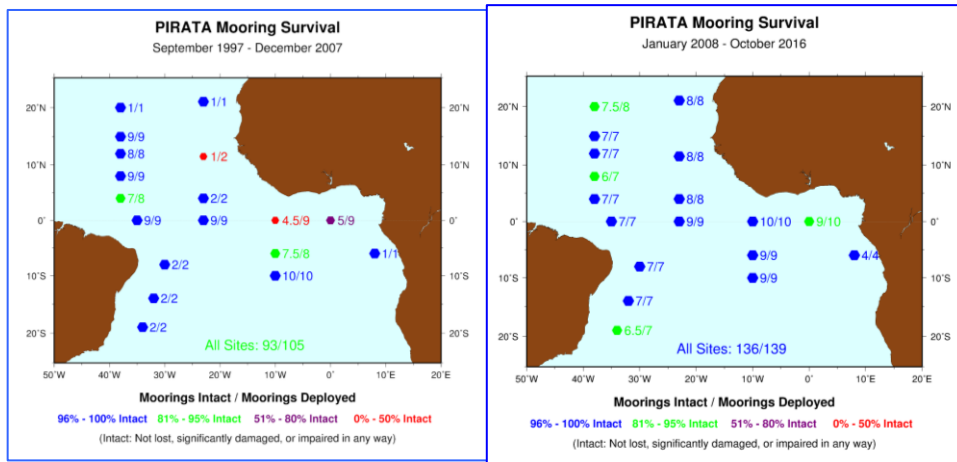
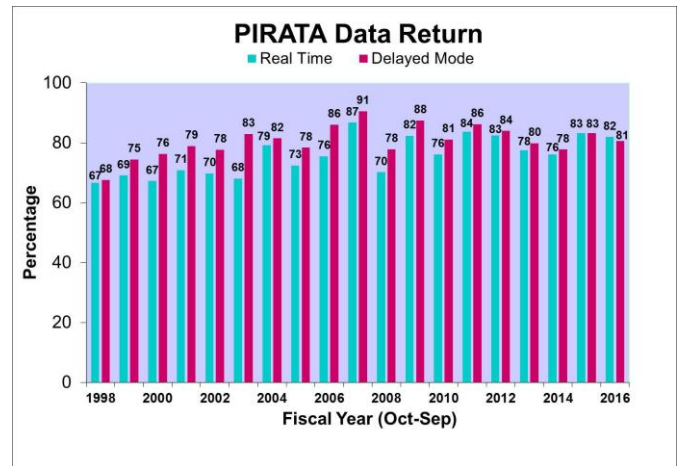
The Real Time (RT) data return during Oct 2015-Sept 2016 was 82% for all sites, of the same order as in previous recent years (see figure). Lowest values are explained at i) 38W-8N by no data transmission from May 2016; ii) 38W-15N by no data transmission from July 2016; iii) 34W-19S by some sensor failures and iv) 10W-10S by ATLAS mooring failure before its replacement by a T-Flex in March 2016 (data return is 94% from this date).



The overall Delayed Mode (DM) data return was 81% during the last US-fiscal year (Oct 2015 – Sept 2016), i.e. very satisfying when compared to previous years (see figure).

Annual data return and number of moorings operating has been steady and similar for several years and, from 2003, dedicated maintenance cruises have kept moorings within their design lifetime.

The overall (1997-2015) mooring survival (i.e. fully recovered/deployed moorings ratio) was 229/244, 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 9 and 10/10 (see figures below) and the overall ratio is 136/139 (i.e. remarkably close to 1). At present, the PIRATA mooring survival rate is 100% for 14 sites (out of 18) from 2008, which is an excellent overall result and a measure of PIRATA’s success.



Field work since Oct 2015 (the beginning of the past US fiscal year) involved 122 days at sea across all partners. PMEL sent persons to sea for 58 days on the last PNE cruise. This cruise were carried out onboard the NATO’s RV *Alliance*, and MM gave some words about the RV issue for the next PNE cruises (see below, in the PNE report).

Data files delivered through the web decreased from 2013 but were offset by large increase in ftp file downloads (more than 600,000 during the last US fiscal year).

Then, MM showed that the T- Flex testing period is now completed and that T- Flex implementation has begun. T-Flex and ATLAS systems provide equivalent data and T-Flex performance (real-time & delayed-mode data return, record length) is equal to or better than ATLAS. Standalone T-Flex systems are currently deployed in RAMA (6 sites) and PIRATA (3 sites). One evaluation Tech Memo has been published, another is in preparation. Two French technicians have participated in T-Flex orientation training at PMEL in Nov 2015 and independently deployed T-Flex moorings in 2016. PMEL plans to offer T-Flex orientation training to Brazilian technicians in Seattle in Jan 2017 and PMEL technicians are also available to participate on initial Brazilian cruise. MM showed a chart with the T- Flex implementation timing. For 2017, deployment of 7 T-Flex moorings is planned at: 8E-6S (FR cruise), 23W-21N, 23W-4N (US cruise), 35W-0N, 38W-20N, 38W-15N and 38W-4N (BR cruise).

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.

Then MM showed the implementation of the new GTMBA (Global Tropical Moored Buoys Array) website, that concerns the three tropical networks (TAO, RAMA and PIRATA) and developed to replace the existing PMEL TAO web pages that have not been substantially updated in over 10 years. The new website was developed on the Drupal™ open-source content management framework and will improve integration with other PMEL and NOAA websites to improve content, visualization, and user-experience. The new website will go public in early 2017.

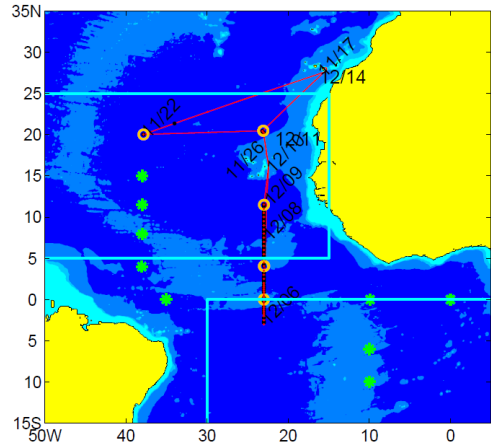
Then, MM presented two scientific works (Wenegrat and McPhaden, 2016, about diurnal cycle; and Scannell and McPhaden, 2016, about the mixed layer heat flux at 8E-6S). To conclude the PIRATA overview, MM presented a list of some major tactical and strategic issues to be discussed (see below).

### NOAA/AOML PIRATA Northeast Extension (PNE) report (Rick Lumpkin)

Rick Lumpkin (RL) presented the most recent PNE cruise, PNE 2015. Because of ship availability problems to maintain TAO, R/V *Ronald H. Brown* was in the Pacific in 2014-2016. The PNE 2015 was conducted on the NATO R/V *Alliance* via charter. It started on November 16<sup>th</sup>, 2015 and ended on December 24<sup>th</sup>, 2015, and the Chief Scientist was Claudia Schmid, NOAA/AOML (see map), with only 6 personnel.

Regarding the mooring work, RL provided the following summary:

- ATLAS recovery/deployment on all 23W sites (20.5N, 11.5N, 4N) and at 38W-20N; 23W-11.5N replaced by a T-Flex;
- T-Flex recovery at 23W-4N;
- Faulty humidity sensor was repaired at 23W-0N. There, a thick line was found tied to lifting line pad-eye and tangled in bridle; left in place to prevent further fouling.
- A fishing vessel was present at 23W-4N. Unresponsive, raced R/V *Alliance* to mooring then fled. An AOML Sontek current meter was added at 22m to supplement the PMEL Sontek at 12m.
- A SWR spritzer, installed at 23W-11.5N in 2014, has been retrieved. This is a cleaning system for the shortwave radiometer, that consists of water reservoir, pump, tubing and control unit; the purpose is to keep the SWR clean from dust and salt accumulation in regions of low precipitation (Dr Greg Foltz, AOML, is the leading PI);
- 42 CTD-O<sub>2</sub>/LADCP casts down to 1500m were done, including 40 along 23W. RL noted that there were significant problems with the Autosol aboard the R/V *Alliance* that resulted in data being poorly calibrated compared to previous PIRATA cruises. 168 XBTs were deployed. The GEOMAR oxygen sensors installed at 300m, 500m on 23W-4N and 23W-11.5N were replaced. Underway ADCP was collected, but only good to 60m (the 75 kHz system not functioning; 300 kHz was OK). Dust was collected for analysis at all four PNE sites, for the analysis (Max Planck Inst.) of dust source sites.



Then RL spoke about the next PNE cruise. The R/V *Ronald H. Brown* will return to the Atlantic from the Pacific in early 2017, and thus will be used to conduct PNE 2017. So, there will be no PNE 2016: the last cruise was in Nov-Dec. 2015; the next cruise will be 12 February-27 March 2017 (Chief Scientist: Renellys Perez, NOAA/AOML-CIMAS).

The subsequent PNE cruise is expected to be conducted on the R/V *Ronald H. Brown* about December 2017, i.e. 10 months after the previous cruise. The *Brown* is then provisionally planned to transit to the Indian Ocean for the International Indian Ocean Expedition-2 in early 2018, then to the Pacific for TAO, then return to the Atlantic. CLIVAR A13.5 is scheduled on around December 2018. This cruise concludes in Cape Town and is the final cruise on the draft FY18 schedule. It is possible that PNE could then be conducted on the R/V *Ronald H. Brown*, approximately 13-14 months after the previous cruise.

Then, RL presented a new PIRATA data product: the ePIRATA (enhanced PIRATA), made available through the website: <http://www.aoml.noaa.gov/phod/epirata/> (manuscript submitted to J. Climate by Foltz et al.). This product contains temperature and salinity mapped to 5m vertical grid using PIRATA and Argo data, gaps filled. All original PIRATA measurements are retained, after removal of questionable data and correction for biases. Mixed layer heat budgets are also provided with error bars.

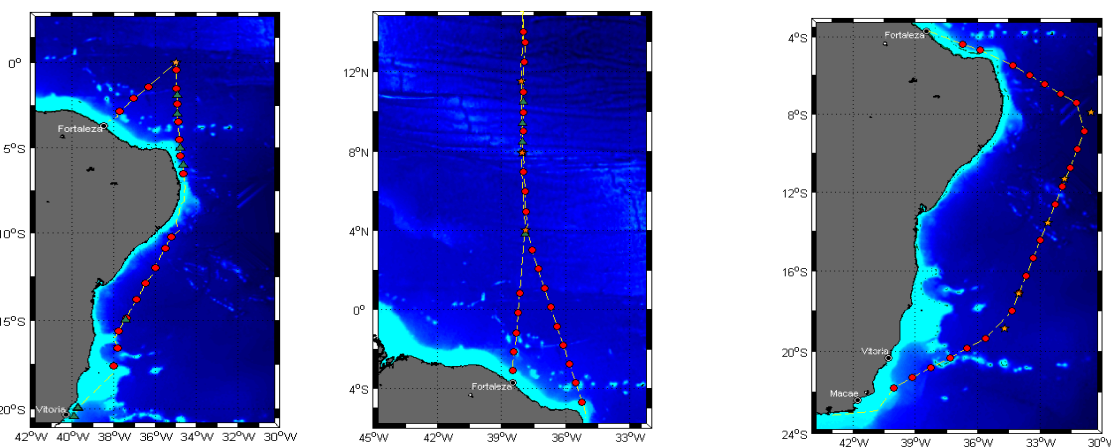
Finally, RL mentioned the updates on the PNE web pages (<http://www.aoml.noaa.gov/phod/pne/>) and on the publication lists, updated on 23 November 2016 ([http://www.aoml.noaa.gov/phod/pne/pdf/PIRATA\\_references.pdf](http://www.aoml.noaa.gov/phod/pne/pdf/PIRATA_references.pdf)). He emphasized the importance of the French and Brazilian Team submitting updates of their publications.

## 2) Brazilian PIRATA report (Paulo Nobre & Moacyr Araujo)

Note : Janice Trotte also presented some input about the next PIRATA 22 meeting. Plans for this meeting are presented below in a dedicated chapter.

The status of PIRATA-Brazil was presented by Paulo Nobre (PN), who began with the most recent PIRATA BR XVI 2015 cruise. This particular cruise was achieved in 46 days in 4 legs from two R/V:

- The 2 first legs were done from the new R/V *Vital de Oliveira* (a brand new R/V constructed/delivered in 2015; possibility of 40 scientists onboard) in October 2015; during these two legs, the ATLAS buoys at 0N-35W and along 38W (4N, 8N, 12N and 12N) were replaced;
- The 3<sup>rd</sup> leg was done from the R/V *Antares*, also in October 2015; during this leg, the 3 southwest ATLAS buoys were replaced.



PIRATA BR-XVI cruise maps: 3 legs (legs 1, 2 & 3 from left to right).

During these 3 legs, 8 CTD casts were done (at the buoys locations), 66 XBTs deployed (respectively, 19, 24 & 23), 16 radiosoundings and 9 MVP (Moving Vessel Profiler: LOPC+CTD+Fluorometer) profiles (during the 2 first legs), and microbiology samplings (leg 2).



PN concluded by showing the financial PIRATA budget for 2015/2016 (~1,9 M\$, including 41k\$ for the recovery operation of the 38W-8S drifting buoy from the R/V *Antares*) and the total cost of the BR XVI cruise (~2,5M\$).

Then, Moacyr Araujo (MA) presented some details about sensor enhancements (funded by AtlantOS and FUNCEME) and data QC. He recalled the scientific arguments for 9 additional T/C along 38W (papers by Hounsou-Gbo et al., 2014, 2015, 2016), funded by FUNCEME, and for current meters (10m and 40m) in the mixed layer at 38W-8N (study by Bruto et al., 2016). Here, B. Bourlès noted that, due to AtlantOS funding possibilities and after exchanges with NOAA/PMEL, only one current meter could be added at 38W-8N at 10m (instead of two, as a second one was initially expected around 40m depth). MA also justified the need for current measurements at 30W-8S and 32W-14S for monitoring the SEC bifurcation and transport (study by Silva et al., 2009a,b), that would need additional moorings material (as independent of ATLAS systems). Two Brazilian ADCPs, initially used by French partners for the 23W-0N site but no more used, will be sent from France back to Brazil very soon.

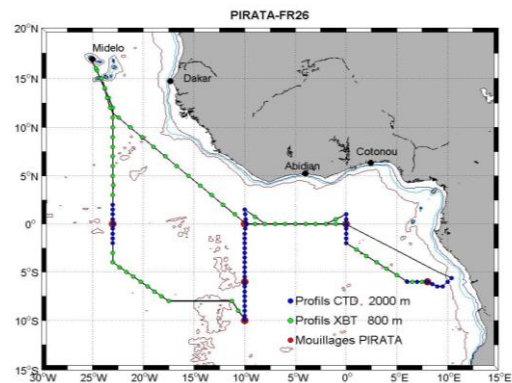
MA also indicated that the Quality Control of the PIRATA-BR cruises CTD data is now ensured for all PIRATA-BR cruises (from 1998 to 2015) along with some details on the QC protocol.

### 3) French PIRATA report (Bernard Bourlès)

B. Bourlès (BB) first recalled the French status of PIRATA as it is recognized as a national observatory (Système d'Observation Océan-Atmosphère) and part of a larger SOERE (Service d'Observation et d'Expérimentation, sur le long terme, pour la Recherche et l'Environnement CTDO<sub>2</sub>) dedicated to ocean operational observations (PIRATA, SSS, ARGO, CORIOLIS). PIRATA has been successfully evaluated in 2015 at a national level in order to maintain this SO label, and also got the "Observatory for the South" label by IRD. However, a process is going on in France to re-organize the national Observatories toward an "Infrastructure of Research" dedicated to the Open Sea.

BB informed that the institutional convention/agreement between IRD and Météo-France has been renewed in 2016. He presented the evolution of the PIRATA-FRANCE budget, as well the financial costs for fiscal year 2016, and the total sea days (65, including transits from France to the port of call) dedicated to the PIRATA-France cruise and its preparations. In 2016 the contribution by Météo-France was 30k€, by IRD 45k€, and by the Observatoire Midi-Pyrénées (OMP) 3k€. CNRS/INSU provided an exceptional support of 26k€ for material purchase (mostly for ADCP moorings) and thus the total amounted to ~104k€. The engineers number of days dedicated to PIRATA is estimated around 300 (cruise material preparation, logistics, cruise time and data analysis).

As in 2015, the PIRATA-FR26 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 March 7 to April 13. The 6 buoys at 23W-0N, 10W-0N, 10W-6S (equipped with CO<sub>2</sub> sensor), 10W-10S, 0E-0N, and 6S-8E were serviced, and the two ATLAS at 23W-0N, 10W-10S replaced successfully by new T-Flex systems. A new ADCP mooring at 0E-0N was deployed in the framework of the EU-PREFACE program. A total of 50 CTDO<sub>2</sub>/LADCP (0-2000m) were carried out, along with 77 XBT profiles. 6 Arvor profilers (including 3 new prototypes with double programming) and 15 SVP-B were deployed, these last ones as a Météo-France contribution to AtlantOS. 615 sea water samples for diverse



biogeochemical and physical parameters were collected during the cruise (at the surface and during CTDO<sub>2</sub>/LADCP profiles) together with continuous underway ADCP, TSG, fluorimeter and acoustic measurements (the R/V *Thalassa* is equipped with a SIMRAD EK60 6 frequencies acoustic sensor + 120kHz for the horizontal, and such measurements are of great interest for biotic and abiotic ecosystem components). Plankton (Bongo net) samplings were also collected at the buoy locations between the surface and 200m depth. The following additional operations were carried out at some moorings: i) Replacing of 5  $\chi$  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 ATLAS buoys, iii) measurements close to the PNE buoys at 23W-4N and 23W-12N.

The next PIRATA FR27 cruise is scheduled for February 25 to April 3, 2017, also from the R/V *Thalassa* and from Cabo-Verde. During this cruise, one additional T- Flex will be deployed at 8E-6S, possibly equipped with an additional CO<sub>2</sub> CARIOCA sensor (funded through AtlantOS). For the 1<sup>st</sup> time since 2006, continuous CO<sub>2</sub> measurements will be acquired all along the cruise (PI: N.Lefèvre). 6 new Argo profilers will be deployed (two equipped with O<sub>2</sub> sensors), along with 21 SVP drifters (11 for Météo-France, as contribution to AtlantOS, and 10 for NOAA/AOML/GDP).

BB provided some information about PIRATA-FR cruises and data sets: all PIRATA-FR cruises have now a DOI (<http://dx.doi.org/10.18142/14>); S-ADCP data (from 2007) have also a DOI (<http://doi.org/10.17882/44635>) ; L-ADCP and mooring ADCP data should be fully treated by mid-2017 and a DOI is also planned for these data sets. Also, all chemical data from samplings (salinity, oxygen, nutrients, Chl pigments) are put under an unique file and format and should be made available in 2017 (along with a DOI). O<sub>2</sub> from the CTD-O<sub>2</sub> profiles will finally also be quality controlled by 2017...

BB showed a list of recent publications (13 published or in press since fall 2015 including French “pirates”). 2 PhD were achieved in late 2015/early 2016; 3 are running since 2014-2015 and two new ones just began at UFPE/Recife with students issued from the Master 2 in Cotonou, Benin. BB underlined the important involvement of UFPE-Recife in the capacity building program, and showed that 10 of the 13 publications involved African PhD students or post docs! However, BB explained that, in spite of its successes, this regional M2&PhD program in West Africa could stop in fall 2017 if not funded anymore (50k€/year needed, with no more sponsor from this year!).

Then, BB presented some PIRATA links with the EU programs PREFACE & AtlantOS. The post docs (G.Herbert, J.Habasque) will end by mid-2017. In the framework of PREFACE, a deliverable entitled “Suggestion for a sustainable long term monitoring system” for the tropical Atlantic is due by November 2017. In the same way, in the framework of AtlantOS, a deliverable entitled “Organization & sustainability of PIRATA network” is due in November 2018 (after two other technical ones, in March 2017 and March 2018 respectively, related to “PIRATA network improvement” and “O<sub>2</sub> and CO<sub>2</sub> new sensors”). This last deliverable will have to be established in close collaboration with the PIRATA SSG and other partners in charge of other potential “piggy-back” operations/sensors (Xpods, biogeochemistry, OTN...), and after a rigorous evaluation of additional needed funding/human powers (for different kinds of sensors, their servicing, data QC & transmission, network extension). It is thus closely related to the definition of “PIRATA in the future” we have to draft by 2018 in perspective of the future MoU! Also, during a recent AtlantOS workshop (November 2016, Las Palmas, Canarias), it has been established that “the 3 fixed moored networks involved into AtlantOS (ie FixO<sub>3</sub>, Transport/Rapid & PIRATA) should concentrate on tropical issues to justify/consider additional sensors in the tropical Atlantic”.

BB continued about manpower in France and informed about the recruitment in February 2016 of an engineer at the IRD “Unité de Service: Instrumentation, Moyens Analytiques, Observatoires en Géophysique et Océanographie” (US IMAGO), who will be able to contribute to PIRATA cruises for the moorings operations. A second recruitment is planned in early 2017 for in situ data treatment &

management at the IRD US IMAGO, who could also be helpful for PIRATA. Finally, there is a possible recruitment (after recruitment contest) of a PIRATA dedicated position in 2017 (in Toulouse). This recruitment is far to be ensured, but BB informed that he will ask recommendation letters to some partners for the candidates.

#### **4) Sea Surface Salinity (Fabrice Hernandez).**

Fabrice Hernandez (FH) briefly presented a few slides from work by Tony Lee (NASA/JPL) on Sea Surface Salinity (SSS) presented at the last GODAE OceanView Science Team-7 meeting (7-11 Nov. 2016, Kochi, India). This work aimed at evaluating the relative accuracy of SSS estimates from SMOS, Aquarius and SMAP satellite missions, by comparison to Argo salinity profiles at 2,5m and tropical moorings surface salinity measurements. This comparison offered an opportunistic way to demonstrate biases from mooring salinity sensors when all satellite retrievals showed consistent discrepancies. FH underlined some bad mooring data, mostly induced by bio-fouling. This work suggests that, in such case, SMOS & SMAP SSS time series could be used in order to see when the sensors began to drift. This approach could be used by GDAC in NRT QC in order to identify mooring SSS estimates that should be discarded for assimilation by operational forecasting centres. For delayed mode SSS observation reprocessing, Aquarius could also be added to provide bias/drift verification of all tropical mooring surface salinity measurements since 2009.

#### **5) SSG issues and discussion:**

##### **- PIRATA 20<sup>th</sup> anniversary: PIRATA 22 meeting in Brazil.**

The 2017 year coincides with the 20<sup>th</sup> anniversary of PIRATA.

Brazil will host the meeting, and Janice Trotte (JT) provided the following information:

- i) Fortaleza, as the location of the 1<sup>st</sup> PIRATA meeting, will be the location of the meeting, hosted by FUNCEME. The meeting will be held at the Hotel Marina, Fortaleza. JT proposed three periods, and after discussion (taking into consideration other already planned meetings, as AtlantOS in Las Palmas on November 21<sup>st</sup>-23<sup>rd</sup>, GODAE OceanView, JCOMM...) the dates are fixed from November 5 to November 10/11, 2017. The number of participants should be about 60 (70 maximum), with No Registration Fee.
- ii) JT proposed an icebreaker on Sunday and a PIRATA Bar festivity on Monday. A PIRATA 20-year commemorative postal stamp could be launched. Also, the launching of a PIRATA Science Book for children (refer to Diane Stanitski previous suggestion) and an e-book in different languages are expected. A PIRATA 20-year logo will be also launched.
- iii) This meeting will have to include Scientific Sessions, and dedicated SSG & PRB meetings.

During the following discussions, it was decided to:

- Invite all former PRB & SSG members;
- Collect scientific papers for a "PREFACE & PIRATA" (possibly JGR) special issue (a message has to be sent to Noël Keenlyside & Peter Brandt);
- Collect personal reflections of PIRATA members, that could be gathered in a CLIVAR-Exchanges special Issue (a message has to be sent to CLIVAR-Exchanges);
- Organize/split the meeting as follows: 2-3 days for the scientific conference; 1,5 day on PIRATA review (see below); 1 day dedicated to the future MoU; 1 day with preliminary feedbacks followed by the PRB meeting; 1 day for internal presentations and the SSG meeting.



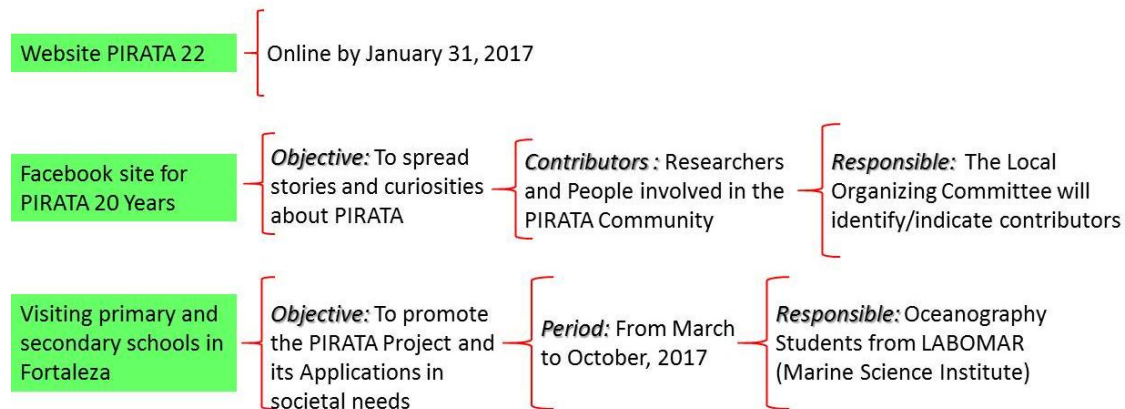
- **PIRATA 20<sup>th</sup> anniversary: PIRATA 2017 summer School and related events.**

It has been decided that the summer school will be organized during 10 days before the PIRATA 22 meeting, including two week-ends.

JT informed about the idea to organize a Recife-Fortaleza leg cruise on board NPqHo “Vital de Oliveira” that will also stay in Fortaleza for public visitation.

JT showed an agenda with different steps for 2017 (special dedicated website...), as follows:

## PIRATA 20 Years Outreach



The organization of such an event needs a “champion”. JT and MA will lead the organization with FUNCEME. Exchanges have to be organized (videoconf) on a regular schedule to well define objectives, courses and training, cruise, and to mobilize the partners and sponsors. All contributions and expertise are welcomed. In particular, Ramalingam Saravanan sent a message to say that he looks forward to contributing to the 20 year celebration and the summer school organizing.

- **PIRATA 20<sup>th</sup> anniversary: PIRATA review**

20 years after its early steps, and 10 years after the international review by OOPC and CLIVAR, all agreed that PIRATA has to be evaluated again in 2017. However, in spite of its enhancements and important evolution, the review of PIRATA should be considered by taking also into account other observing systems, and thus with the whole Tropical Atlantic Observing System (also considering Argo, satellite missions, drifters, etc.). We have to consider that PREFACE and AtlantOS deliverables will also concern suggestions for a sustainable long term monitoring system in the tropical Atlantic and the organization & sustainability of PIRATA network in about the same time frame. An AtlantOS task is dedicated to how to quantify the value of data sets etc. In 2017, IndoOOS (Indian Ocean Observing System) and TPOS2020 (Pacific Observing System) will also be evaluated and exchanges with these communities would be relevant and helpful. The CLIVAR Atlantic Region Panel should be involved in such a process (MA is part of it). Also, an internationally developed Blueprint of Integrated Atlantic Ocean Observing Systems will be developed for the OceanObs19 conference (during which will be defined the next 10 years of Observation Systems).

Such a review could take place in Brazil during the PIRATA 22 meeting, with invited representatives of the concerned communities (CLIVAR Atlantic, AtlantOS, PREFACE, OOPC, Argo, data users, forecasters from operational systems...). The interest and goal will not be to compare data sets (as, e.g.,

with Argo or satellites) but to identify their usefulness, uniqueness, see how one can reinforce already working systems, and identify opportunities for better efficiency and relevant enhancements. PIRATA is now clearly seen as a great opportunity for biogeochemical observations enhancement, and also as a successful and well managed program that allowed raising new scientific questions and to serve as a springboard for other international programs (as TACE or PREFACE)... One of the successes of PIRATA is obviously induced by the fact that it is mostly headed by scientists, rather than managers and technicians, that allowed its evolution, enhancements and extensions.

One thus has to list some key questions and issues to rise for the review and (or to be defined as) Terms of References (ToR). ToR were already defined in TPOS2020 (and IndoOS?), that has similar (scientific and resources) issues in some ways in the tropical Pacific (and Indian?). These can serve as inspiration, as well as the recent AtlantOS “International Scientific and Technical Advisory Board” (ISTAB) review process (MA is part of ISTAB). A draft has to be sent to CLIVAR-Atlantic and OOPC informing them about the process, the next meeting with a dedicated session, a list of invited/involved people etc. in order to keep PREFACE and AtlantOS in the loop. It must be stressed that this process will serve and influence the definition of a future Tropical Atlantic Observing System, as a base for physical (and possibly biogeochemistry, as CO<sub>2</sub>) climate and oceanic observations, in complement with other observing components (biology, biogeochemistry, fisheries resources...). All agreed that PIRATA’s evolution toward biogeochemistry measurements implies three new specialist members (one per partner country) in the SSG at short term (PIRATA internal recommendation mentioned in the review document), who could be first involved in the review process.

Aurélien Carbonnière informed that the “Atlantic Ocean Research Alliance” (AORA) should launch a call for proposals by 2018, closely related to the Galway process (EU, US and Canada collaborations). PIRATA constitutes an important platform for the AORA goals, with the potential for extending observations toward the South Atlantic (a priority raised by the AtlantOS community, among others). He also underlined that such a PIRATA review process will be coincident with EU calls for proposals, that one has to keep in mind in order to be ready to apply (as contribution to the future “Atlantic Observing System Blueprint 2019”). PIRATA review works could thus be used for drafting such an Atlantic Observing System ... AtlantOS works and results along with the implication of PIRATA in AtlantOS should be very helpful for this. Sydney Thurston also indicated that the issues listed for the Global Drifter Program (GDP), that was reviewed in October 2016 by an international external Panel of experts, could be of interest. Sydney Thurston also provided (by mail just after the meeting) the GDP Review preparation documents with the hope that some aspects may be constructive. BB informed that a call for expert nominations for the Author Team of the “Atlantic Ocean Observing System Blueprint 2019” has recently been launched; it is important that PIRATA members to be involved in such a team!

All these works will also be important for drafting an actualized (or new) MoU. One special day will have to be dedicated to the MoU during the PIRATA 22 meeting.

How about economic impacts of PIRATA? Where are information sources? These issues were briefly discussed, and it was noted that they are important but difficult, and that more discussion is necessary. The PIRATA review should address these questions, i.e. to estimate/evaluate societal benefits from PIRATA observing system/products. WP9 of AtlantOs is working specifically on « Societal benefits from observing/information systems ». We should invite someone with this expertise to be part of PIRATA reviewer board.

**- PIRATA & the ‘European Multidisciplinary Seafloor and water-column Observatory’:**

BB informed that, during the last AtlantOS meeting (held in November 2016 at las Palmas; summary on : [https://www.atlantos-h2020.eu/download/Atlantos\\_2016\\_PLOCAN\\_Visbeck\\_Summary\\_v2.pdf](https://www.atlantos-h2020.eu/download/Atlantos_2016_PLOCAN_Visbeck_Summary_v2.pdf) ), a recognition of PIRATA by the ‘European Multidisciplinary Seafloor and water-column Observatory’ (EMSO; see <http://www.emso-eu.org/> ) European Research Infrastructure Consortium (ERIC), was

strongly wished. This would allow a better “visibility” of PIRATA at the EU level, better ensure the PIRATA-FR funding resources in the future, and get easier collaborations for defining a more multidisciplinary Observing System in the Atlantic (with some EMSO components, as F1xO3). For this, a first step is for PIRATA-FR to be recognized by the French EMSO Research Infrastructure and BB initiated the process by informing the concerned people. Such discussions are going on between French research organisms and the research ministry and BB will inform the PRB and SSG about this process.

- **Miscellaneous:**

- i) The presentation of PIRATA to the EGU (Vienna, April 2017) during the session “Advances in water column and seafloor fixed point observatories” would be relevant and important. FH will attend this meeting and agrees to present PIRATA. BB will draft an abstract asap to be submitted to the SSG.
- ii) Brazil engineers will have a training period to PMEL in early 2017 for T-Flex operations.
- iii) Discussions are still going on between NOAA and IFREMER about Research Vessels.
- iv) Data availability: there are still some apparent issues with CO<sub>2</sub> data dissemination. BB will contact Nathalie Lefèvre about this. These data are however available through the CDIAC and SOCAT data bases. A link from the PIRATA website is wished.
- v) Impact of additional sensors (conductivity, current...) for the PMEL team; the contribution of other laboratories for conductivity/salinity calibration could be envisaged (Seabird sensors are now used with T-Flex). It is clear that additional C sensors have to be scientifically justified (as until now) at prioritized sites.
- vi) The R/V Antares in Brazil will be retired rather soon, that could induce vessel time issues.

**PRIORITY ACTIONS SSG:**

- Organization of the 20<sup>th</sup> anniversary summer school.
- Organization of the 20<sup>th</sup> anniversary PIRATA 22 meeting.
- Organization of the review process, in relation with the Tropical Atlantic Observing System.
- Draft a 15pp for the Review (outline structure & key issues).
- Check the TPOS2020 and IndoOS ToR.
- Letter to CLIVAR-Atlantic, OOPC, with cc to AtlantOS & PREFACE, about the review.
- Special Issue of PIRATA & PREFACE papers. Letter to JGR editor.
- Special CLIVAR Exchanges volume with “pirates” personal reflections. Letter to editor.
- SSG possibly extended to 3 new members representative of the biogeochemistry community (one per partner country). Propose/nominate 3 people.
- List of all the PRB & SSG members from the early steps of PIRATA.
- Scientific book for children.

**Summary to PRB:**

- 2017 20<sup>th</sup> PIRATA birthday. Special meeting & PIRATA focused summer school.
- PIRATA review.
- PRB recommendation for the next MoU?
- Lead for a Scientific Book for children?
- T- Flex systems will continue to be implemented in an operational way during the next BR, FR & PNE cruises, with 7 new systems in 2017.
- T/C enhancement at 3 buoys in the west (0N-35W, 4N-38W, 8N-38W) thanks to a Brazilian/FUNCEME.
- T/C, Aquadopp (current), O2 and CO2 enhancements through AtlantOS.
- New GTMBA website at PMEL.
- Informations about PIRATA's economic impacts?

January, 16<sup>th</sup>, 2017

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