PIRATA-22 meeting report

(Fortaleza, Brazil, November 8-10, 2017)

The 22th PIRATA meeting was held during the joint PIRATA-PREFACE meeting co-organized in Fortaleza. The 2017's PIRATA-22, corresponding to the 20th anniversary of PIRATA, meeting was held in the city of its "birth" and several particular events were specially organized (summer school, scientific meeting, special scientific meeting closure ceremony, joined PIRATA/PREFACE dedicated discussions, special stamp celebration onboard the R/V Vital de Oliveira…). About 40 students and young scientists attended the summer school held from Friday November 3rd to Sunday 5th and 75 people attended the scientific sessions organized from Monday November 6th to Wednesday November 8th in the morning. The afternoon of November 8th was dedicated to an open discussion related to "PIRATA Research Infrastructure: Present, Future Observations and New Technologies for the Next 20 Years" and to the "Tropical Atlantic Observing System international review", that is planned in 2018-2019 before the OceanObs19 event. An official closure ceremony was held after these discussions. The morning of Thursday, November 9th was dedicated to specific discussions, common to PIRATA and PREFACE, *i.e.* the "PIRATA/PREFACE special Issue" for it submission in 2018 and the "PIRATA White Paper for the Tropical Atlantic Observing System review". Then the closed annual PIRATA session, involving SSG and PRB PIRATA members along with invitees, was held on Thursday, November 9th in the afternoon and on Friday 10th, during which national status reports were presented before several important discussions and decisions.

The present report is only dedicated to these PIRATA SSG and PRB sessions, but all other events are summarized in appendixes. See also http://www.funceme.br/pirata22/ for other details on the meeting.

Attendees to the SSG-PRB closed session:

Note that, as agreed by the SSG-PRB during the last PIRATA 21 meeting in Paris, the SSG is from 2017 composed with 13 people, now including three new members from the biogeochemistry community (Adrienne Sutton, USA; Leticia Cotrim, Brazil; Nathalie Lefèvre, France).

- **SSG member participants:**

Bernard Bourlès (IRD/LEGOS, 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), Fabrice Hernandez (IRD/LEGOS/Mercator Océan, France), Peter Brandt (GEOMAR, Germany), Leticia Cotrim (USP, Brazil).

Ramalingam Saravanan (Texas A&M University, USA), Nathalie Lefèvre (IRD/LOCEAN, France) and Adrienne Sutton (NOAA/PMEL, USA) were absent and excused.
Edmo Campos (IOUSP, Brazil) was absent, but attended the previous scientific and discussion sessions.

- **PRB member participants:**

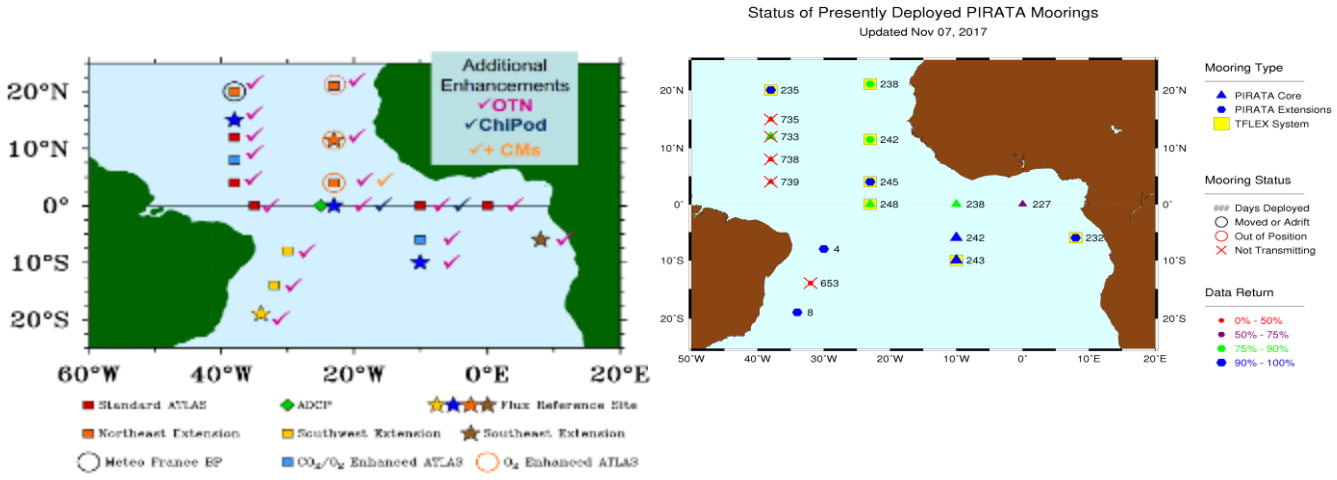
David Legler (NOAA, USA, Chair)
Janice Trotte-Duhá (DHN, Brazil).
Alexandre Ganachaud (IRD/LEGOS, France).
Philippe Dandin (Météo-France/CNRM, France).

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 air-sea interactions buoys from 2013) and Chipods (two Chipods installed at 23°W-0°N & 10°W-0°N buoys in 2014-2016 then 5 Chipods on each from 2016). He mentioned the four new T-Flex systems (that progressively replace ATLAS) installed in 2017 at 38°W-20°N, 23°W-20°N, 23°W-4°N and 8°E-6°S. Thus, seven T-Flex are now operating, and three T-Flex will also be deployed during the next BR cruise.

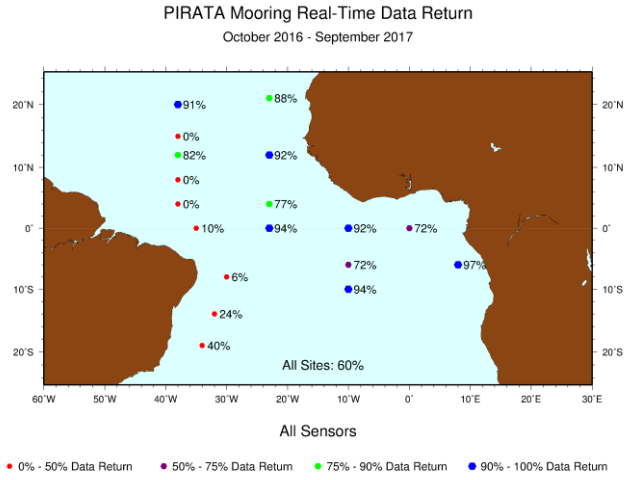


MM listed the enhancements made also possible through cooperation from several years, as:
- 6 Flux Reference Sites (15°N-38°W, 19°S-34°W, 12°N-23°W, 0°-23°W, 10°S-10°W, 6°S-8°E), with the additional sensors: LWR, BP, 10m CM, 2 T (5m, 10m) and 4 S (5m, 10m 60m, 80m)
- Continued enhancement of EU AtlantOS funded sensors (T/C and Velocity, CO_2 and O_2),
- 3 Surface CO_2/O_2 (LOCEAN),
- 8 Subsurface O_2 (IFM/GEOMAR); 6 in real-time now with the possibility of more in the future,
- 1 Surface Pressure (BP) at 20°N, 38°W (Meteo France),
- 2 Sites with 5 Thermal microstructure sensors (10 total) (ChiPods, OSU),
- 18 Acoustic monitors (OTN, Dalhousie University),
- AEROSE (Aerosols and Ocean Science Expeditions, NCAS),
- 10 additional current meters at 4°N-23°W (TACOS, AOML),
- 9 new T/C sensors planned for each of 3 sites (FUNCEME) at: 8°N-38°W, 4°N-38°W, and 0°-35°W.

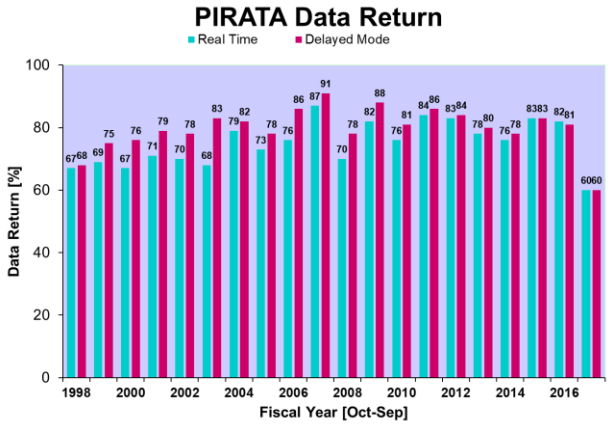
MM informs that T-Flex and ATLAS systems provide equivalent data and T-Flex performance (real-time and delayed-mode data return, record length) are equal to or better than ATLAS. No new T-Flex sites are scheduled for PIRATA in 2018 but additional sites will be converted in 2019. Brazilian Technicians have participated in T-Flex orientation training at PMEL in March 2017 and will independently deploy T-Flex moorings during the next BR XVII cruise (expected from November 2017).

Then MM showed time series of Nortek Aquadopp currentmeters at 4°N-23°W, along with the first time series of dissolved O_2 transmitted in real time at 12°N-23°W and 20°N-23°W. He also showed some atmospheric parameters and SST time series obtained at 20°N-38°W clearly illustrating the signature of the Irma hurricane passage on September 1st, 2017.

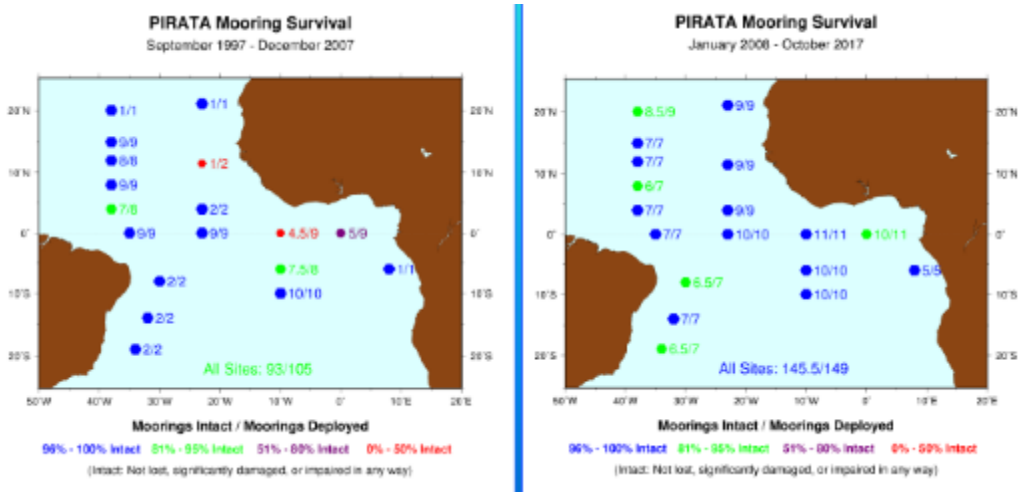
The Real Time (RT) data return during Oct 2016-Sept 2017 was 60% for all sites, *i.e*. very much lower than during previous years (see figure). Such low values are explained by vessel issues in Brazil, where no cruise could be undertaken for almost two years. The 8°S-30W buoy went adrift on Nov 3, 2016 (and retrieved on Nov 16) and 3 buoys along 38°W (4°N, 8°N and 15°N) stopped after less than one year. Buoys at 6°S-10°W and 0°-0° also indicate some transmission failures.



For the same reasons, the overall Delayed Mode (DM) data return was also 60% during the last US-fiscal year (Oct 2016 – Sept 2017) (see figure). One expects however that Delayed Mode values will be aincreased once the retrieved sensors data are validated and made available a few months after the PIRATA-BR XVII cruise. Over the whole 1997-2017 period, the overall data return is 81% which, in spite of the last bad year, remains very good.



The overall (1997-2017) mooring survival (i.e. fully recovered/deployed moorings ratio) was 238.5/254, 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 10/11 and 11/11 (see figures below) and the overall ratio is 145.5/149 (*i.e.* close to 1). At present, the PIRATA mooring survival rate is 100% for 13 sites (out of 18) from 2008, which is an excellent overall result and a measure of PIRATA's success.



Field work since Oct 2016 (the beginning of the past US fiscal year) involved 73 days at sea across US and FR partners. PMEL sent persons to sea for 70 days on the last PNE cruise. This cruise were carried out onboard the RV Ron Brown.

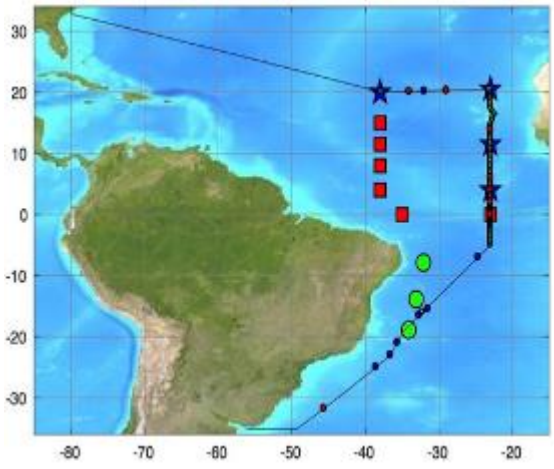
Data files delivered through the web decreased from 2013 but were offset by a very large increase in ftp file downloads (more than 620,000 during the last US fiscal year).

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 went public in early 2017.

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.

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

Rick Lumpkin (RL) fist recalled that PNE is now 10 years old! RL presented the most recent PNE cruise, PNE 2017, after the Nov-Dec 2015 cruise (no PNE cruise in 2016, because of ship availability). The PNE 2017 was conducted on the R/V Ron Brown from February 11st to March 25th, 2017, and the Chief Scientist was Renellys Perez, NOAA/AOML (see map).



RL showed a nice picture of the "rendez-vous" between the RVs Ron Brown and Thalassa, at 0°45S-23°W on March 3rd, both during PIRATA cruises. He also showed the Sargassum sightings along 23°W (11 observations), responding to a demand by B.Bourlès in the frame of Sargassum studies.

Regarding the mooring work, RL provided the following summary:

- ATLAS recovery along 23°W at 20.5°N and 4°N and at 38°W-20°N; all replaced by T-Flex.
- T- Flex replaced at 23°W-11.5°N.
  Thus all PNE sites are now T-Flex moorings.
- Along 23°W, the 4°N, 11.5°N, and 20.5°N T-Flex moorings were deployed with GEOMAR total dissolved oxygen loggers (this has been done since 2009). This year, for the first time, real-time oxygen data is being reported at 11.5°N and 20.5°N.
- The rain gauge was replaced on SEE ATLAS mooring at 19°S, 35°W. Due to CTD problems, the team was unable to obtain a good cast at this mooring. The buoy looked to have been vandalized: the AT/RH shield was bent upward significantly and there were two broken welds on the tower ring.
- All deployments of Nortek Aquadopp currentmeters were done in accordance with the new policy of mounting them inverted on the wire. All were mounted 0.8m shallower than before to maintain constant measurement depth.
- At 4°N-23°W, the SWR shield and TC60 were missing and the nilspin jacketing was cut through to the core below the 80 meter sensor. Fishing line was removed from various depths between 12m and 200m.
- At 20.5°N-23°W, the T40 was missing. The nilspin jacketing had been cut, exposing the steel core just below 40 meters.
- At 20°N 38°W, the T100 was missing.
- All OTN hydrophones were recovered and replaced at each of the four PNE mooring sites (200m depth).
- 61 CTD-O_2/LADCP casts down to 1500m were done, including 59 along 23W. About CTD casts, RL précises that significant problems occurred with the Ron Brown's aft winch; operations were switched

to the forward winch which worked well. Also one cast, at 10°N, 23°W was cancelled to troubleshoot CTD problems, and weld break on the AOML frame occurred after cast 20; the PMEL frame was used after. XBTs were deployed at all CTD casts for intercomparison. 8 Argo floats and 16 surface drifters were deployed; Underway shipboard ADCP was collected and a MAERI system was used to measure skin SST.

- Atmospheric measurements were acquired in the framework of the AEROSE project in collaboration with Howard U. and NOAA/NESDIS. Radiosondes and ozonesondes, as frequently as four times per day, were launched for satellite cal/val.
- During the cruise, an urgent request was received from GEOMAR scientists (Kiel, Germany). A Sloccum glider, deployed two weeks before east of Cape Verde, became non-maneuverable due to a broken fin and drifted SSE. The Ronald H. Brown diverted slightly to the east in order to recover the glider on the afternoon of March 11, 2017 near 16.5°N-22°W. The emergency glider recovery was done directly from the ship's aft deck without any complications.

Then RL spoke about the next PNE cruise. The R/V Ronald H. Brown will be transiting from the Atlantic to the Indian Ocean in late 2017, and will be used to conduct the next PNE cruise (Chief Scientist: Greg Foltz, AOML). It is planed from 13 December 2017 to 22 January 2018 (41 days), from Fort Lauderdale (FL USA) to Durban (South Africa). RL noted that this cruise will be the first to carry the ESRL/GMD XCO_2 air calibration system (PI Colm Sweeney, "Climate Monitoring and Diagnostics Lab gold standard") which will be compared against the pCO_2 underway values. After the PNE2017b/2018 cruise, the Ronald H. Brown will transit to the Indian Ocean for Indian Ocean Exploration 2 in early 2018, then to the Pacific for TAO, then return to the Atlantic. CLIVAR A13.5 is scheduled for December 2018. This cruise concludes in Cape Town and is the final cruise on the FY18 schedule. It is possible that PNE could then be conducted on the Ronald H. Brown, approximately 13-14 months after the previous cruise.

Then, RL provided important information to the SSG, with personal changes at AOML… He announced that, in order to meet other commitments, the original AOML Principal Investigators (Rick Lumpkin and Claudia Schmid) will be stepping down in 2018. The new PIRATA Northeast Extension PIs from AOML will be Renellys Perez (now a federal employee) and Gregory Foltz. Gregory is willing to serve on the Science Steering Group starting in 2018, while Renellys will serve on panels dedicated to reviewing the Atlantic Ocean Observing System. RL was sincerely acknowledged and applauded for his great contribution to PIRATA from the earlier steps of PNE… and the SSG agreed the proposed changes.

Then, RL presented some Tropical Atlantic Currents Observations Study (TACOS; by R.Perez, G. Foltz, R. Lumpkin and G. Foltz; NOAA/AOML) experiment results. As part of that project a PIRATA Northeast Extension mooring at 4°N-23°W has been augmented with 10 additional Nortek Aquadopp current meters between 7 m and 87 m depth in March 2017, in order to resolve the circulation in and below the surface mixed layer. TACOS provides a novel continuous-in-time view of horizontal currents in the tropical North Atlantic (4N, 23W), which influence local temperature and salinity variations from the surface down to the thermocline. So far TACOS allowed to observe:

- Rich vertical-temporal structure in both components of velocity.
- Mean zonal and meridional velocities largest at 37 m depth, with values of 10 cm/sec eastward and 9 cm/sec southward.
- Mean surface flows weaker than long-term means.
- Meridional velocity variance is larger than zonal velocity variance.
- Vertical shears that vary considerably over time.

Assumption that vertical shear is constant above 30m does not hold. Maximum vertical shear squared in spring before Tropical Instability Waves (TIWs) appear, when mixed layer, thermocline, and maximum shear depths are shallow. Three 30-day TIWs were evidenced during late spring/summer with magnitudes of up to 100 cm/sec at 7 m depth and 70 cm/sec at 87 m depth; then shallower 5-day velocity perturbations were also observed in the fall.

Finally, RL mentioned the updates on the PNE web pages (http://www.aoml.noaa.gov/phod/pne/) and on the publication lists, updated on 24 August 2017 with 265 publications (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. From now, this list will be updated by Renellys Perez (renellys.c.perez@noaa.gov).

2) Brazilian PIRATA report (Paulo Nobre)

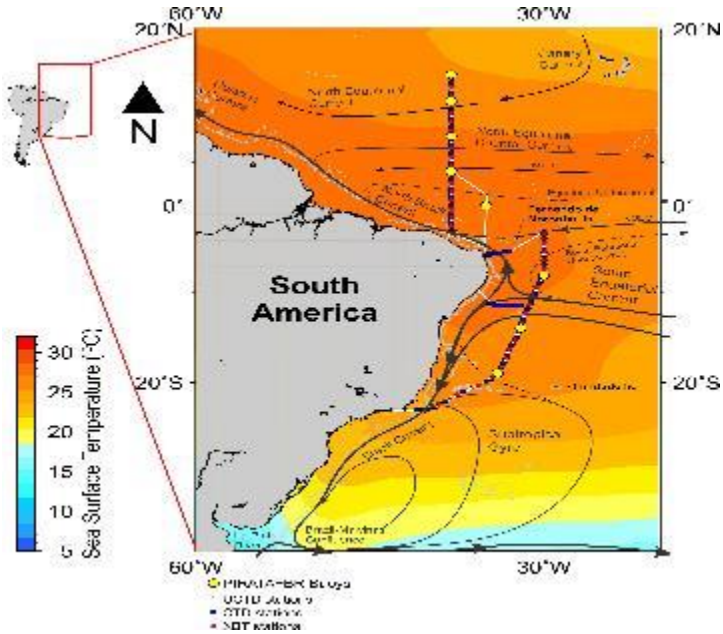
The status of PIRATA-Brazil was presented by Paulo Nobre (PN), who began by presenting the new R/V *Vital de Oliveira*, a brand new R/V constructed/delivered in 2015. This R/V has a possibility of 60 scientists onboard, equipped with 2 ADCP, ROV, 2 Lateral Winches and A-Frame, capacity of CTD/UCTD/pCO2, radiosondes/SFC Meteorology...

PN presented the PIRATA-BR XVII that was planned for April but started on 25 October 2017 due to engine problems on the Vital de Oliveira. This PIRATA-BR XVII is a multi-science cruise (underway) with 60 sea days spread out over 80 calendar days. He informed that:

- 8 ATLAS Buoys stopped transmission during the year;
- 3 moorings was already serviced at this date (2 ATLAS at 19°S-34°W and 8°S-30°W, and 1 TFLEX at 0°N-35°W);
- 4 remaining moorings at 38°W line will be serviced during the period 11/14-12/06/2017;
- 14°S-34°W mooring will be serviced during the period 01/03-15/2018.
- 8 extra nylon reels were dispatched by PMEL and transported by plane, as a security measure due to possible failure of acoustic releasers 2 years in the water.

During the PIRATA-BR XVII cruise, 10 Principal Investigators from 8 different institutions are involved: 1) INPE – Paulo Nobre; 2) INPE – Ronald Buss; 3) UFPE – Moacyr Araujo; 4) UFBA – Vanessa Hatje; 5) UFBA – Gisele Rocha; 6) UERJ – Leticia Cotrim; 7) UFF – André Belém; 8) UFC – Antonio Geraldo; 9) FURG – Felipe Niencheski; 10) CHM – Marcio Borges.

The planned works are:
180 T-S profiles;
66 radiosoundings;
9,000 km underway with: currents, pCO_2,atmospheric particles deposition; marine microbiology;
Micrometeorology turbulent fluxes;
60 CTD-LADCP stations down to 10m of the ocean floor: Currents, Temperature, Salinity, Oxygen, CO_2, Marine Biology, Rare earths and Bottom mixing layer.



PN informed that all CTD profiles from PIRATA-BR cruises have been processed and are available at INPE/PIRATA web page at http://pirata.ccst.inpe.br/en/data-2/

PN informed that Brazil received 2 ADCP back from IRD (these ADCPs were bought by Brazil in 1999-2000 for their use in the frame of PIRATA, and then used by IRD -one looking upward, one downward- during some years for servicing the ADCP site at 0°N-23°W).

PN said a few words about the summer school that was organized just before the meeting (see dedicated appendix), about the status of the presently deployed moorings (see previous MP's report) and the 1st T-Flex just deployed by Brazil at 0°N-35°W.

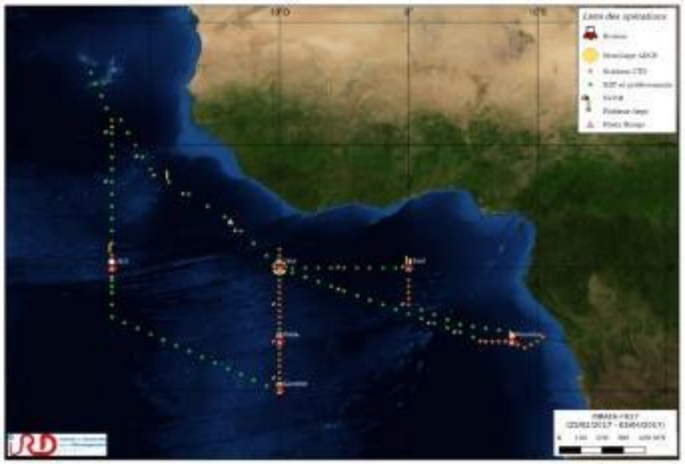
Then PN presented the acquisition process of 54 T/C SBE37IMP sensors, initiated in April 2016 and completed on November 2017, by FUNCEME to be deployed at 8°N-38°W, 4°N-38°W and 0°N-35°W. The total cost was 349,141 US$. He also showed the current time-series obtained at the 19°S-34°W site.

PN concluded by showing the financial PIRATA budget for 2016/2017 (~3,2 M$), most of expenses dedicated to the R/V Vital de Oliveira (~3 M$).

3) French PIRATA report (Bernard Bourlès)

B. Bourlès (BB) first shows, as did RL, a picture of the exceptional "rendez-vous" at 0.45°S-23°W between the two PNE and FR27 cruises, on March 3rd, 2017, during which CTD casts were carried out from both vessels at almost the same time/location for intercomparison. The CTD profiles, provided by Renellys Perez just before the meeting, look perfectly superimposed! This event was a nice PIRATA "20th anniversary gift"!

BB 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 $CTDO_2$) dedicated to ocean operational observations (PIRATA, SSS, ARGO, CORIOLIS). A process is going on in France to re-organize the national Observatories toward an "Infrastructure of Research" dedicated to the Open Sea (probably by 2019). Then, BB presented the different PIRATA-France funding supports and the evolution of the PIRATA-FRANCE budget. In 2016 the contribution by Météo-France was 30k€, by IRD 52k€ (i.e. larger than previous years), and by the Observatoire Midi-Pyrénées (OMP) 3,5k€. CNRS/INSU did not provide any support in 2017 but IRD completed exceptionally its support by additional 25k€ for material purchase (releases for ADCP moorings) and 30k€, that will be used in 2018 to build a new platform and purchase containers for PIRATA material storage (this is induced by installation changes in the IFREMER campus). Thus the total amounted to 110.5k€ (+30k€ to be used in 2018). BB mentions the potential funding issues due to consequent material transports & trips (flights) increasing costs and possible full servicing of ADCP mooring at 0N-23W from 2019 (with GEOMAR until 2018). The total cost, including the vessel time, is about 1.5M€.
The number of engineer days dedicated to PIRATA is estimated around 300 (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.



As in 2016, the PIRATA-FR27 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 25 to April 3. The 2 T- Flex at 0°N-23°W and 10°S-10°W and the 2 ATLAS at 0°N-10W, 6°S-10°W (equipped with CO_2 sensor) were serviced. The ATLAS at 6°S-8°E was replaced by a T-Flex equipped by a new CO_2 sensor (funded by AtlantOS), specially adapted to the T-Flex system (however a few issues should be solved before the next FR cruise, as weights size, location of the GPS & transmission box, etc.). An additional T/C has also been installed around 3m depth, as demanded by MM for scientific motivations. The ADCP mooring at 0°N-10°W was also successfully serviced and a full 2 year time-series has been registered.

A total of 48 $CTDO_2$/LADCP (0-2000m) were carried out (along sections at 10°W, 0°E and 6°S), along with 87 XBT profiles. 7 Argo profilers (including 2 new prototypes equipped with O_2 sensor and with double programming) and 21 SVP-B were deployed (11 for Météo-France contribution to AtlantOS and 10 for NOAA/AOML/GDP). BB recalls that from 2013 all Argo profilers deployed during PIRATA-FR cruises have a 1m vertical resolution in the first 100m depth. 604 sea water samples for diverse biogeochemical and physical parameters were collected during the cruise (at the surface and during $CTDO_2$/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 12 sites, including the buoy locations, between the surface and 200m depth. Also, Sargassum algae were sampled for their analysis (taxonomic and genetic). The following additional operations were carried out at some moorings: i) Replacing of 5 χpods 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 4°N-23°W and 12°N-23°W.

BB shows some figures of i) trajectories of SVPs deployed during FR27, ii) ADCP time-series, iii) O2 profiles from the 2 Argo profilers deployed off Congo (close to the 6°S-8°E buoy), iv) acoustic measurements, v) plankton samples, vi) Sargassum samplings and their locations; micro-plastics will be analysed from these samplings (significant amount of plastic objects are observed on Sargassum maps).

Then, BB recalled the PIRATA links with the EU program AtlantOS that allowed to purchase number of material (T/C, current, O_2 and CO_2 sensors).

BB provided some information about PIRATA-FR cruises and data sets. As already shown in 2016, all PIRATA-FR cruises have now a DOI (http://dx.doi.org/10.18142/14) and S-ADCP data (from 2007) have also a DOI (http://doi.org/10.17882/44635). In 2017, and thanks to the recruitment of a technician in the IRD IMAGO Unit Service (Pierre Rousselot), the CTD-O_2 data treatment (Cascade) has been renewed and validated; all data sets have been treated and gathered with a DOI: http://doi.org/10.17882/51534. Also, mooring ADCP data (0-300m) have been fully treated and have a DOI (http://doi.org/10.17882/51557). Such a process is also planned for L-ADCP. Finally, all chemical data from samplings (salinity, oxygen, nutrients, Chl pigments) have been put under an unique file and format and made available (a DOI is planned by late 2018). 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 (9 published or in press since fall 2016 including French "pirates"). 3 PhD are running since 2015-2016. BB showed that 11 articles published from 2015 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. However, BB explained that, in spite of its successes, this regional M2&PhD program in West Africa is still endangered due to funding issue (50k€/year needed, with no more sponsor but IRD from 2016!). 6 African young scientists or PhD attended the PIRATA summer school and contributed to the scientific sessions of the present PIRATA-22/PREFACE meeting.

The next PIRATA FR28 cruise is scheduled for February 27 to April 5, 2017, also from the R/V *Thalassa* and from Cabo-Verde. During this cruise, 5 Argo profilers will be deployed (two equipped with O2 sensors), along with 23 SVP drifters (13 SVP-B for Météo-France, as contribution to AtlantOS, and 10 SVP for NOAA/AOML/GDP). The new 0°N-0°E ADCP mooring, deployed in 2016 and partly funded by the EU PREFACE program, should be serviced for the 1st time.

After having shown a list of issues to be discussed (see next chapters) BB ended about manpower in France and informed that he could be in charge of the IRD US IMAGO from July 2018 due to the retirement of its present responsible person. This would reinforce the strong need of a PIRATA dedicated position in 2017.

4) PIRATA summer school (Fabrice Hernandez):

Fabrice Hernandez (FH) presented a summary and pictures of the summer school organized back to back with the present meeting. This summer school, is spite of its late organization but that could organized thanks to the contribution of the CMEMS, was very successful. A full report is provided in the dedicated Appendix 1. FH noted that CMEMS would like to renew such an event in Brazil, with a wider audience that could also be performed again in the scope of PIRATA, as follows:

- During a PIRATA meeting in Brazil
- With maybe one week to take advantage of high level scientists to provide 1h lectures
- With one afternoon for training in parallel to SSG/PRB business as usual
- In an isolated place, with all people together;
- With up to 50-70 attendees;
- With support for student meals and lodging.

5) SSG issues and discussion:

Several important subjects were discussed, but some of them were already discussed during the three previous sessions organized after the scientific plenary sessions (summarized in Appendix 2): one open session related to i) PIRATA research infrastructure: present, future observations and new technologies for the next 20 years (Wednesday 8th, afternoon), and two sessions, common with the PREFACE program colleagues, dedicated to ii) the PREFACE/PIRATA "special issue" and iii) the TAOS/PIRATA international review (Thursday 9th, morning).

The first of these three sessions is presented in Appendix 3. To summarize, this open discussion allowed to make statements about new measurement opportunities and potential enhancements and extensions of PIRATA. It underlined the need to make PIRATA more visible toward a larger community (including weather services, modelling and satellite community…) and to target developing agencies, and to think more about benefits to society and economy. Dr Jean-Paul Moatti (Chief Executive Officer of the

French IRD) attended to this special session (held before the official closure ceremony); at the issue of this session, he enthusiastically invited the PIRATA SSG-PRB to organize the next meeting in Marseille, France, where the IRD headquarter is located.

In the following are summarized the main discussed issues.

i) PIRATA/PREFACE special Issue:

The European PREFACE program will end in April 2018. Due to the strong connection of PIRATA in PREFACE, the decision to submit a common Special Issue was discussed during the last PREFACE/PIRATA 21 meeting in Paris and finalized in 2017. Prior mail exchanges allowed to draft some major topics for papers, as was summarized by Noel Keenlyside (PI of PREFACE) to introduce the debate, and the present discussions allowed to define the plan of the Special Issue, even some authors and titles remain to be confirmed. Papers can be free structured, but contributions should include a discussion on what was achieved, what is missing in terms observations/understanding, and future perspectives. The time line is: Paper sketches and author lists to be confirmed by February 1st; complete drafts by early summer of 2018 before submission in autumn. The plan and papers could be as follows:

1. Societal Benefits of an Atlantic observing system, include capacity strengthening. Authors: Divino Moura et al. (PIRATA "mother and fathers");
2. Atlantic observing system. Authors: Bernard Bourlès et al.
3. Ocean circulation in the tropical Atlantic: observations and models including AMOC. Authors: Peter Brandt, Fabrice Hernandez, Edmo Campo, Moacyr Araujo et al.
4. Tropical Atlantic climate variability (to include ocean-atmosphere-land interaction, coupled climate models, Amazon outflow, salt fluxes, effect of river discharge variability on climate variability). Authors: Paulo Nobre, Ingo Richter, Marcus Dengler, Mathieu Rouault, Aurore Voldoire, Shunya Koseki, Joke Luebbecke, Jacques Servain, + PREFACE authors currently not here.
5. Prediction and future projections of tropical Atlantic climate. Authors: Noel Keenlyside, Emilia Sanchez Gomez, Elsa Mohino, Chloe Prodhomme, Tina Dippe, Teferi Demissie et al.
6. Role of the tropical Atlantic in the climate system. Authors: Regina Rodrigues, Belen Rodriguez Fonseca, Teresa Losada, Marta Martín del Rey, Noel Keenlyside et al.
7. Extreme weather events in the tropical Atlantic, Authors: Ping Chang, Moacyr Araujo et al.
8. Tropical Atlantic marine biogeochemistry and carbon cycle. Authors: Leticia Cotrim, Moacyr Araujo et al.
9. Review of the status of fisheries important stock and impacts of climate and other stressors. Author: Patrice Brehmer, Jörn Schmidt, Hashali Hamukaya, Brazilian colleagues et al.

Each paper first author should disseminate around to define the contributors and begin the work. Guest editors and the journal have still to be determined…

ii) Tropical Atlantic System Observation (TAOS) and PIRATA review:

The TAOS review process has been decided more precisely from October-November 2017 and led by the CLIVAR-Atlantic Region Panel (ARP). The 1st dedicated meeting will be on 9-10 February 2018 in parallel to the Ocean Sciences meeting at Portland, USA. In this framework, it has been decided to edit a dedicated "PIRATA White Paper" (that should also help to draft the PREFACE Deliverable 4.4 ("suggestions for a sustainable long term monitoring system in the tropical Atlantic"). The previous open sessions allowed to discuss about observation systems available in the Tropical Atlantic, and to underline the complementarity of different types of data sets: in situ (PIRATA, Argo, drifters, moorings, regular cruises…), satellites (SST, SSS, wind, sea level), and their relative relevance for climate studies & operational systems. They also allowed (see Appendix 3) to show a number of additional operations and measurements conducted during some PIRATA cruises. As an introduction, BB showed different studies

using and utilizing the various PIRATA data sets, through satellite measurements validation, some preliminary studies of the impact of PIRATA data i) in operational climate simulations (ECMWF), ii) in the Mercator system, iii) the NEMO ocean data assimilation system and HYCOM, iv) in the Spatial Ecosystem and Population Dynamic Model. Discussions raised several issues (vessel time; quantitative evaluation of the use of PIRATA buoy data by climate simulations; use for satellite community…) and stated that rather little information are available in some cases. This underlines the need to extend the visibility of PIRATA in order to get more feedback on PIRATA data use, their usefulness, societal impacts etc. But also numerous benefits of PIRATA have been listed and finally the plan of the PIRATA White Paper has been decided along with each chapter main contributors. BB will initiate the draft and ask each contributor for their inputs, in order to get a first draft by late December, and a finalized fist version at least two weeks before the Portland meeting. MA and Renellys Perez (NOAA/AOML) will attend the kickoff TAOS review meeting, and they will prepare, with BB and solicited contributors presentations.

iii) PIRATA costs:

PIRATA is involved in the EU AtlantOS that has to provide a number of Deliverables, one of them being related to the Observing Systems costs. PIRATA was contacted to provide these values by late 2017, and this issue could be also discussed during the next AtlantOS General Assembly (organized in Las Palmas, in November 20-25, 2017), where some PIRATA members will attend (B.Bourlès, M.Araujo, J. Trotte). General discussions were about i) the potential reluctance to do the exercise without knowledge of the ultimate purpose of the exercise, ii) how to estimate material "depreciation costs", iii) the importance of paying attention to European Institutions because they want a global picture, and Ocean observing systems are in competition with many other observatories, iv) the different costs for each involved nation and institutions, v) the consideration of the PIRATA value for other programs (eg Argo, GDP…); etc. The way to estimate the costs have been agreed (ie, estimates per involved country, with two estimates for US by distinguishing AOML for servicing operations and PMEL for moorings). Values will be gathered and B.Bourlès, M.Araujo, and J. Trotte will have a dedicated meeting in Las Palmas during the AtlantOS GA with the people in charge of the Deliverable to clarify before providing the final PIRATA costs

iv) Next Memorandum of Understanding (MoU):

Part of the discussion was dedicated to the next MoU that will have to be signed by July 2019. However, due to time limitations, the PRB continued alone while the SSG discussed separately other issues. The questions were mostly around the potential changes (more nations? what should be changed? Enhancement -sensors, new parameters including biogeochemistry measurements, processes studies, consider possible extensions, need to clarify data policy and dissemination, mostly biogeochemistry ones - *e.g.* present issues with the availability of CO_2 data has been raised, status of the meteorological stations, Capacity building), adding some sentences on more general context (*e.g.* Sustainable Development Goals; World Meteorological Organization…), re-organization and actualization of some paragraphs, better definition of some mooring tasks etc.

After these parallel SSG and PRB discussions, PRB informed SSG that it will work on the MoU and be back to the SSG during the next months.

During this discussion, it is also clarified that Brazil has to keep servicing the northernmost buoy at 20°N-38°W, as USA already furbish buoys material and so will not ensure more vessel time during PNE cruises.

v) Piggy back proposals:

During the Wednesday afternoon open discussions, PN presented a new proposal by André Belem (Universidade Federal Fluminense, Niteroi - RJ, Brazil), the Vertical Particle Flux -PIRATA (VPAX-

PIRATA) that would consist in adding a Vertical Particle Trap in the 700-1000m depth at two sites: first 0°N-35°W, then 8°S-30°W. MM informed that such an experiment was already attempted 20 years ago with Woods Hole, and problems were encountered; there is technical issue of having a trap on a surface mooring line because it is too energetic; MM rather suggested a second subsurface mooring. This could be however technically attempted. Biogenic particles but also plastic can be assessed by sediment traps. PN supported this proposal and said that only nylon is the missing, finally easy and cheap to get.

vi) Data dissemination and DOI:

There are still some apparent issues with CO_2 data dissemination, not made available to CLIVAR. BB contacted, and will contact again N.Lefèvre about this. Some of these data are however available through the CDIAC and SOCAT data bases. Also, a link from the PIRATA website is necessary. French PRB members (P.Dandin and A.Ganachaud) will raise this issue with INSU.

Data policy specifies that data can only be published when calibrated. But one needs to clarify what is and is not PIRATA data. It seems to all that data acquired from recurring operations during (and thanks to) PIRATA cruises and logistics (or from PIRATA moorings) should be associated to the PIRATA Observatory, funded with national resources. If data are recognized with a PIRATA label, their PIs have to disseminate them.

BB suggested to make available through the INPE, AOML and IRD websites not only CTD and ADCP data sets, but also XBT, thermosalinograph, possible chemical parameters, that are also relevant and acquired thanks to PIRATA. He notes that INPE and AOML websites are not actualized from 2014 and 2015 respectively.

IRD recently applied a DOI to most of data sets. About buoy data, MM noted that DOI are not trivial for updated real-time data, and is not convinced that it is worth it. RL said that DOI requires sending the data to Data Centers, and Peter Brandt and BB confirmed that this is the appropriate way in Germany and France. It is also (again) suggested to go forward a unique PIRATA Data Center for cruise measurements, with same data formats.

Status of meteorological stations and tide gauges need to be clarified.

vii) Miscellaneous:

- Material transportation: the weights for T-Flex (2T instead of 1.4T for ATLAS) may induce additional costs, as may need one more container in some case. PN also mention the payment for the CO_2 related transport to Brazil that should be paid by France (to be checked with N.Lefèvre).

- The "Belem Statement on Atlantic Research and Innovation Cooperation" (see https://www.atlanticresource.org/aora/belem-statement) is invoked, in the framework of the potential future of PIRATA and enhancements. This Belem statement could be opportunity for attempting to enhance what is already in place with PIRATA and SAMOC. Capacity building activities were also invoked, as concerning South Atlantic boardering countries (Africa, Brazil) involved in the Belem statement, along with Summer Schools etc. Organizing another one in France with African students during the next PIRATA meeting in Marseille was also mentioned.

- Human power in France was (again) underlined. BB could take the head of the IRD IMAGO unit from July and PIRATA-France does need a dedicated recruitment (unsuccessful until now). In the same way, the succession of M.McPhaden at PMEL is a key issue, and the same situation appears for Janice

Trotte in Brazil who could retire in two years from now. Such a situation is frightening and clearly illustrates the human power problem for a progressive replacement of PIRATA involved people in each country... This is also stressing due to the important the two coming years for PIRATA (TAOS Review, OceanObs19, PIRATA involvement in AtlantOS and probably other future EU H2020 projects…). PRB is well aware and will address this problem by first sending a letter to MoU agencies.

PRIORITY ACTIONS SSG:

- Editing the PIRATA White Paper for the Tropical Atlantic Observing System review.
- Preparing presentations for the kickoff meeting of the TAOS review in Portland (February 2018).
- Special Issue of PIRATA & PREFACE papers.
- Next PIRATA 23 meeting in Marseille. BB will organize a Doodle as soon as possible to define the dates (done: dates will be 20-26 of October 2018).
- PRB feels PIRATA is too invisible and SSG should do more to promote PIRATA.

Summary to PRB:

- No new T-Flex implemented in 2018 because of NOAA funding limitations. 10 (over 18 buoys) until now.
- PIRATA 23 meeting in Marseille (October 22-26, 2018). Support asked to IRD. Meteo-France sponsoring (2k€). Enlarge to the satellite and weather service institutions, along with to societal and economy agencies.
- MoU to finalize, with rapid report to SSG before exchanges/feedbacks (network description and tasks).
- The "PIRATA Children's Book" could be launched during the Marseille PIRATA meeting. Need to find co-authors and illustrators by March 2018.
- PRB will send a letter to MoU agencies.
- PRB will send letter to IRD about human resources… also to all sponsors about the context and success of PIRATA.
- PRB will send a letter to the Brazilian Navy (DHN) to recognize its important role.

January, 31st, 2018

by Bernard BOURLÈS & SSG contributors.

APPENDIX 1: THE PIRATA SUMMER SCHOOL

(Friday 3rd – Sunday 5th of November, 2017)

As decided during the last PIRATA 21 meeting in Paris, the special PIRATA 20th anniversary meeting had to be an opportunity to organize a back-to-back Summer School. Thanks to the local support by Funceme, Labomar, Universidad Federal do Ceara and the ARX company, and the support and funding of the Copernicus Marine Environment Monitoring Service (CMEMS; COPERNICUS is the European Earth Observation and Monitoring Programme), a Summer School has been held on 3-5 November 2017 at the same location than the meeting, that aimed at introducing Tropical Atlantic Ocean key scientific questions to early career scientists, professionals and students. It has also been an outstanding possibility for Mercator Océan to introduce the CMEMS products, tools and capacities to a relevant and interested audience in Brazil. This audience of scientific excellence is a prime target for Mercator Océan and has to be informed about Copernicus Marine Service activities, capacities and future prospects.

In practice, the Summer School has been organized over a very short period from end of July to September, thanks to the local organizer: Prof. Antonio Geraldo Ferreira, helped by Prof. Carlos Teixeira, from University of Ceara, Labomar, and on the CMEMS side, by Dr. Fabrice Hernandez (IRD/LEGOS/Mercator Océan). All the PIRATA Resource Board (PRB) and Scientific Steering Group (SSG) members reacted very positively, and some tried to support with dedicated funds (in particular Dr. Bernard Bourlès, IRD ; Prof. Moacyr Araujo, UFPE ; and Dr. Paulo Nobre, INPE) ; or some intended to actively participate to the Summer School.

Preparation of the lecture room, and configuration of the 20 computers was carried on by Prof. Teixeira (UC), Dr. Law Chune and Mr Bazin (CMEMS) on Thursday 2/11/2017. 38 persons (mostly Master and PhD students but also young scientists, mostly from Brazil but also from West Africa) attended the Summer School (see list below) and 10 lecturers (SSG members and PIRATA associated scientists) contributed to this Summer School (see list below). The Summer School provided high level lectures and training on CMEMS and operational oceanography (*i.e.* understanding and analysis of reanalyses and forecast CMEMS products, Lagrangian tools…).

The CMEMS training material (the Jupyter Notebook tool) offered a very efficient way to inform and demonstrate through scientific analysis the usefulness and access to CMEMS products for ocean studies. These tools can be considered as mature, they came for more than one year of development, and use/test in different training events. These tools have been made available to all attendant. This training material, with additional one are freely accessible on http://marine.copernicus.eu/ . It is also important to note that for most participants, the Jupyter Notebook tool was a discovery, and the kind of tool to be discovered and used in the future. The full program is provided below.

A satisfaction questionnaire was then asked to all attendant at the end of the Summer School, and a 100% satisfaction was expressed. A final closing ceremony was then organized, with all available lecturers and PIRATA SSG and PRB members, during which certificate of attendance were distributed.

The total cost of the Summer School was 14137€, and the CMEMS contributed to 7500€. In addition, IRD contributed to 7000€ for supporting 5 African young scientists and students (3 coming from Côte d'Ivoire and Benin, 2 coming from UFPE in Recife where they are as PhD) to attend the PIRATA 22 Summer School and meeting.

From the PIRATA PRB and SSG point of view, this initiative was a strong success, due in particular to the effort of the local organizers, Mercator Océan, and the opportunity offered to CMEMS training initiative. They consider that such an event should be encouraged and reproduced, in Brazil or Africa in the very near future.

List of lecturers :

Name :	Institution :	Course Title :
Prof. Antonio Geraldo Ferreira	UFCE/Labomar (Br)	Day 1 - Introduction
Prof. Carlos Teixeira	UFCE/Labomar (Br)	Day 1-2-3 - Organisation
Prof. Edmo Campos	IOUSP/LABOMAR (Br)	Day 1 – General Circulation in the Atlantic Ocean
Dr. Rick Lumpkin	NOAA/AOML (USA)	Day 1 – Ocean Surface Circulation and Drifters
Dr. Fabrice Hernandez	IRD/LEGOS/Mercator Océan (Fr)	Day 1-2-3 – Operational Oceanography & CMEMS training
David Bazin	Mercator Océan (Fr)	Day 1-2-3 – CMEMS training
Dr. Stéphane Law Chune	Mercator Océan (Fr)	Day 1-2-3 – CMEMS training
Prof. Mathieu Rouault	UCT - South Africa	Day 2 – East Tropical Atlantic variability and Benguela Niños
Prof. Leticia Cotrim da Cunha	UERJ (Br)	Day 2 – Carbon in the Atlantic Ocean and GLODAP international program
Dr. Janice Trotte Duhá	DHN (Br)	Day 3 – Managing the PIRATA Array, historical and societal point of view

List of attendees:

	Name	Institution	Country
1	Adilson Matheus Borges Machado	UFMA	Brazil
2	Alina Nathanaël Dossa	UFPE	Benin / Brazil
3	Ana Carolina de Azevedo Mazzuco	UFES	Brazil
4	Ana Leticia Melo dos Santos	FUNCEME	Brazil
5	Ana Paula Morais Krelling	LABOMAR/UFC	Brazil
6	Antonio Vasconcelos Nogueira Neto	CNRM - Météo France	Brazil / France
7	Bruno Dias Rodrigues	FUNCEME	Brazil
8	Carlos Eduardo Peres Teixeira	LABOMAR/UFC	Brazil
9	Carlos Alessandre Domingos Lentini	UFBA	Brazil
10	Clarissa Akemi Kajiya Endo	INPE	Brazil
11	Dayse Suellen dos Santos Moraes	FUNCEME	Brazil
12	Diógenes Passos Fontenele	FUNCEME	Brazil
13	Djoirka Minto Dimoune	UFPE	Brazil
14	Dóris Veleda	UFPE	Brazil
15	Douglas Medeiros Nehme	UFRJ	Brazil
16	Francis da Silva Lopes	UFPE	Brazil
17	Frédéric Bonou	CIPMA	Benin
18	Gustavo Lauton de Oliveira	UFBA	Brazil
10	Humberto Lazaro Varona Gonzalez	UFPE	Brazil
20	Isabelle Maria Vilela de Oliveira	UFPE	Brazil
21	Julia Martins de Araujo	UFPE	Brazil
22	Laisa Alves Malheiros Soares	UFMA	Brazil
23	Leandro Valente Jacinto	FUNCEME	Brazil
24	Léo Costa Aroucha	UFPE	Brazil
25	Leonardo Bruto	UFPE	Brazil
26	Marilia Kabke Wally	FURG	Brazil
27	Marisa Francisca de Novato Macuéria	UFPE	Brazil
28	Maurício Rebouças Rocha	UFCG	Brazil
29	Maytê Duarte Leal Coutinho	FUNCEME	Brazil
30	Mesmin Awo	ICMPA	Benin
31	Pedro Henrique Lima Silva Morais	IO/USP	Brazil
32	Pedro Tyaquiçã	UFPE	Brazil
33	Ramilla Vieira de Assunção	UFPE	Brazil
34	Rodrigue Anicet Imbol Koungue	University of Cape Town	Cameroon / South Africa
35	Sandrine Djakoure	LAPA-MF/UFHB	Côte d'Ivoire
36	Thaysa Portela de Carvalho	SPSP TRANS	Brazil
37	Victor Cesar Martins de Aguiar	IO/USP	Brazil
38	Adilson Wagner Gandu	LABOMAR	Brazil

Summer School program:

DAY 1 – Friday (03/11/2017)		
TIME	**TOPIC**	**LECTURER**
08:30 – 09:00	Opening ceremony	
09:00 – 10:00	**Theoretical Part** Atlantic Interhemispheric Circulation	Edmo Campos – IOUSP/LABOMAR (Brazil)
10:00 – 10:30	Coffee break	
10:30 – 11:30	**Theoretical Part:** Surface Dynamics, Drifters	Rick Lumpkin – NOAA (USA)
11:30 – 12:00	**Theoretical Part:** General Overview of Operational oceanography and CMEMS	Fabrice Hernandez – IRD (France)
12:00 – 14:00	Lunch	
14:00 – 15:30	**Practical Part:** How to download / handle CMEMS product	David Bazin – Mercator (France)
15:30 – 16:00	**Practical Part:** CMEMS Training With Reanalysis: Regional and Global, for Scientific Analysis	Fabrice Hernandez – IRD & Stéphane Law Chune – Mercator (France)
16:00 – 16:30	Coffee break	
16:30 – 18:00	**Practical Part (cont):** CMEMS Training With Reanalysis: Regional and Global, for Scientific Analysis	Fabrice Hernandez – IRD & Stéphane Law Chune - Mercator
DAY 2 – Saturday (04/11/2017)		
TIME	**TOPIC**	**LECTURER**
08:00 – 08:45	**Theoretical Part:** Benguela Niños, Atlantic Niños and the PIRATA array	Mathieu Rouault – UCT (South Africa)
08:45 – 09:30	**Theoretical Part:** GLODAP and Carbon in the Tropical Atlantic	Leticia Cotrim – UERJ (Brazil)
09:30 – 10:15	**Practical Part:** CMEMS Training with Forecast / Hindcast Near the Surface, Impact of Surface Forcing	Fabrice Hernandez – IRD & Stéphane Law Chune - Mercator
10:15 – 10:45	Coffee break	
10:45 – 12:30	**Practical Part (cont):** CMEMS Training with Forecast / Hindcast Near the Surface, Impact of Surface Forcing	Fabrice Hernandez – IRD & Stéphane Law Chune - Mercator
12:30 – 14:00	Lunch	
14:00 – 16:30	**Practical Part:** CMEMS Training: 3D Ocean View	Fabrice Hernandez – IRD & Stéphane Law Chune - Mercator
DAY 3 – Sunday (05/11/2017)		
TIME	**TOPIC**	**LECTURER**
08:00 – 08:30	**Theoretical Part:** Ocean Technology and innovation	Janice Trotte Duhá – DHN (Brazil)
08:30 – 10:00	**Practical Part:** CMEMS Training with Data Assimilation and Observing Network impact	Fabrice Hernandez – IRD & Stéphane Law Chune - Mercator
10:00 – 10:30	Coffee break	
10:30 – 12:30	**Practical Part (cont):** CMEMS Training with Data Assimilation and Observing Network impact	Fabrice Hernandez – IRD & Stéphane Law Chune - Mercator

CMEMS - Copernicus - Marine Environment Monitoring Service
IOUSP – Instituto Oceanográfico da Universidade de São Paula
DHN - Diretoria de Hidrografia e Navegação – Marinha do Brasil
IRD - Institut de Recherche pour le Développement
LABOMAR – Instituto de Ciências do Mar
NOAA – National Oceanic and Atmospheric Administration
UERJ - Universidade do Estado do Rio de Janeiro
UCT - University of Cape Town

Final group picture of the PIRATA Summer School

Same ones… but on the Fortaleza beach!

APPENDIX 2:

Scientific Plenary Sessions
(Monday 6th - Wednesday 8th of November, 2017)

The scientific sessions were previously defined between the SSG and PREFACE colleagues, with four initial sessions:

1: Mechanisms of tropical Atlantic Climate Variability and Change
2: Oceanic and Atmospheric Processes Affecting Biogeochemical Interaction in the Tropical Atlantic
3: Predictability, Coupled and Uncoupled Model Biases
4: Towards Realizing Socio - Economic Researches on Damages and Benefits of Climate Prediction in the Tropical Atlantic for Marine Ecosystems, Fisheries, and Continental Climate.

Due to the rather late announcement of the meeting, the number of submitted abstracts, the low amount of available funding for supporting potential attendees, and the weak number of abstracts for the session 4, the program has been limited to the three first sessions. A total of 94 people attended to the meeting scientific sessions (see list below)…

For each scientific session, plenary oral and poster sessions were organized. The scientific sessions were preceded by an official launching ceremony with short speeches/slides by Eduardo Martins (FUNCEME, UFC), Paulo Nobre (INDP), Moacyr Araujo (UFPE), Bernard Bourlès (IRD/LEGOS), Mike McPhaden (NOAA/PMEL), Meiry Sayuri Sakamoto and Geraldo Ferreira (LABOMAR, UFC). Eduardo Martins began the scientific presentations as key lecturer, with a presentation about Climate monitoring in Ceara and Nordeste, along with a brief history of forecast climate system at Funceme.

The oral presentations were organized as follows:

Monday 06, 2017

TITLE	FIRST AUTHOR	PRESENTATION HOUR	CHAIRS
Key-lecture Session 1: ENSO diversity and the Tropical Atlantic	Regina R. Rodrigues	11:00 - 11:30	Peter Brandt & Hervé Giordani
Trends in the Agulhas Leakage and the Relationship with the Western Tropical Atlantic	Paula Castellanos	11:30 - 11:50	
Forcing of the Atlantic equatorial zonal velocity variability on seasonal to interannual time scales by intraseasonal variability	Peter Brandt	11:50 - 12:10	
An oceanic mechanism for the generation of interannual climate variability in the tropical Atlantic	Martin Claus	12:10 - 12:30	
LUNCH			
Air-Sea Exchanges and Precipitation in the Tropical Atlantic during June 2010	Hervé Giordani	14:00 - 14:20	
Turbulent entrainement rate estimate at the mixed-layer base from Argo floats in the western tropical Atlantic	Antonio V. Nogueira Neto	14:20 - 14:40	
The Tropical Atlantic Current Observations Study (TACOS) at 4N, 23W	Renellys C. Perez	14:40 - 15:00	
Upper-ocean mixing processes in the central equatorial and northern tropical Atlantic	Marcus Dengler	15:00 - 15:20	
South tropical Atlantic variability and impacts on Rainy Seasons Over the Brazilian Northeast	Aubains Hounsou-Gbo	15:20 - 15:40	
Bidecadal modes in the tropical Atlantic and subtropical teleconnection	Mario Manna	15:40 - 16:00	

Tuesday 07, 2017

SESSION 1

Mechanisms of tropical Atlantic Climate Variability and Change (Continue)

TITLE	FIRST AUTHOR	PRESENTATION HOUR	CHAIRS
Linear trends on PIRATA data and IPSL-CM5A-LR CMIP5 Historical run	Paulo Nobre	08:30 – 08:50	Paulo Nobre & Moacyr Araujo
Seasonal to interannual evolution of the Tropical Atlantic Warm Pools	Marcio M. Cintra	08:50 - 09:10	
Sea Surface Salinity signature of the interannual climatic modes in the Tropical Atlantic	Mesmin Awo	09:10 - 09:30	
A Teleconnection between Atlantic Sea Surface Temperature and Eastern and Central North Pacific Tropical Cyclones	Christina M. Patricola	09:30 - 10:00	
Break			
Role of interannual Kelvin wave propagations in the equatorial Atlantic on the Angola-Benguela Current system	Rodrigue Aricer Imbol Koungue	11:00 - 11:20	Rick Lumpkin & Mike McPhaden
Seasonal Upwelling in the Eastern Tropical Atlantic	Athanasia Papapostolou	11:20 - 11:40	
SAMOC: An International Initiative to Study the MOC in the South ern Tropical Atlantic – Some Scientific Results	Edmo Campos	11:40 - 12:00	
Amazon Plume Salinity Answers Teleconnections	Pedro Tyaquiçã	12:00 - 12:20	
LUNCH			
Impact of intraseasonal wind bursts on SST variability in the far eastern Tropical Atlantic during boreal spring.	Gaëlle Herbert	14:00 - 14:20	
The extension of PIRATA in the tropical South East Atlantic experiment	Mathieu Rouault	14:20 - 14:40	
What caused the warming in the Southeastern Tropical Atlantic in early 2016?	Ioke F. Ubbecke	14:40 - 15:00	
Vertical structure of water vapor over the tropical South Atlantic in an extreme rainfall episode in eastern Northeast Brazil	Thiago Luiz do Vale Silva	15:00 - 15:20	

Wednesday 08, 2017

SESSION 2

Oceanic and Atmospheric Processes Affecting Biogeochemical Interaction in the Tropical Atlantic

&

SESSION 3

Predictability, Coupled and Uncoupled Model Biases

TITLE	FIRST AUTHOR	PRESENTATION HOUR	CHAIRS
Key-lecture Session 2: Variability of the NEUC and its impact on the oxygen minimum zone of the eastern tropical North Atlantic	Kristin Burmeister	09:00 – 09:30	Leticia Cotrim & Geraldo Ferreira
On the potential causes of the recent Pelagic Sargassum bloom events in the tropical North Atlantic Ocean	Sandrine Djakouré	09:30 - 09:50	
Impact of mesoscale eddies on physical and carbon parameters in the tropical Atlantic Ocean	Frédéric Bonou	09:50 - 10:10	
Break			
Key-lecture Session 3: Relating model bias and prediction skill in the tropical Atlantic	Noel Keenlyside	11:00 – 11:30	Fabrice Hernandez & Noel Keenlyside
SST bias development in the Tropical Atlantic in coupled ocean-atmosphere PREFACE coordinated experiments	Aurore Voldoire	11:30 - 11:50	
Comparing PIRATA array data with a coupled seasonal forecast model outputs in the aim of identify systematic errors	André Lanfer	11:50 - 12:10	

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

Monday 06, 2017

TITLE	FIRST AUTHOR	PRESENTATION HOUR	E-Poster
Amazon River plume influence in the Western Tropical Atlantic dynamic variability	Humberto L. Varona	16:00 - 17:00	TV 1
Precipitation distribution over the Tropical Atlantic during June 2010	Antonio V. Nogueira Neto	16:00 - 17:00	TV2
Intraseasonal Variability of the Equatorial Atlantic Ocean	Franz Philip Tuchen	16:00 - 17:00	TV3
The FUNCEME's tropical Ocean monitoring and forecasting system	Diogenes Passos Fontenele	16:00 - 17:00	TV4
Wind spatiotemporal variability in the western equatorial Atlantic Ocean	Pedro Henrique Lima Silva Morais	17:00 - 18:00	TV1
Control of SST in the Senegalese Upwelling: Paradoxical Results from in-situ Observations	Alban Lazar	17:00 - 18:00	TV2
No Title: West African Monsoon / ITCZ/ AMV & GW	Roberto Suárez-Moreno	17:00 - 18:0	TV3
Pre and post ocean conditions in the western tropical north Atl. During the trajectory of the Matthew hurricane in Sept 2016	L. C. Aroucha	17:00 - 18:00	TV4

Tuesday 07, 2017

TITLE	FIRST AUTHOR	PRESENTATION HOUR	E-Poster
Investigation of the genesis and development of a TC into a category 5 hurricane using the COAWST model	Doris Veleda	10:00 - 11:00	TV1
ML seasonal & decadal variability in th SWTA inferred from PIRATA & Argo floats	S.L. Francis	10:00 - 11:00	TV2
Comparative study of Meto-Oceanogr parameters on the Eq. Atl. Ocean and the coast of the NE region of Brazil	F. R. L. Xavier	10:00 - 11:00	TV3
Mixed layer heat/salt budget and EUCt dynamics in the tropical Atlantic from a joint model-observations approach	O. Kom	10:00 - 11:00	TV4
Mechanisms Controlling the Seasonal Mixed Layer Temperature and Salinity Balance in the Southeast Tropical Atlantic	H. Scannell and M. J. McPhaden	16:00 - 17:00	TV1
Variability of CO2 fugacity at the western edge of the tropical Atlantic Ocean from the 8°N to 38°W PIRATA buoy	Leonardo Bruto	16:00 - 17:00	TV2
A new breath for PIRATA	Leticia Cotrim da Cunha	16:00 - 17:00	TV3
Observations of oxygen variability in the eastern tropical North Atlantic	Johannes Hahn	16:00 - 17:00	TV4
The flux of CO2 in the equatorial Atlantic for May 2009 - 2010	Itele Eduardo dos Santos	17:00 - 18:00	TV1
Evaluation of the radiative fluxes and precipitation seasonal cycles described by BESM coupled ocean-atmosphere simulations and the PIRATA buoy data array	Marcus Jorge Bottino	17:00 - 18:00	TV2
The Atlantic EUC at 0o N, 23o W: Seasonal variability according to the PIRATA ADCP data and the Brazilian Earth System Model historical experimen	Emanuel Giarolla	17:00 - 18:00	TV3
Evaluation of model performance BESM-OA2.3 for air temperature and ocean in the Tropical Atlantic Ocean region	Douglas Lindemann	17:00 - 18:00	TV4

Wednesday 08, 2017

TITLE	FIRST AUTHOR	PRESENTATION HOUR	E-Poster
Bacterial abundance and diversity in the sea surface microlayer and marine bioaerosols on intertrop. Atl. Ocean, NE from Brazil	Jamille da Silva Rabelo	10:00 – 11:00	TV1
Evaluation of the ocean pCO2 representation in the Brazilian Earth system model	Helena Cachanhuk Soares	10:00 – 11:00	TV2
Comparison between SODA and PIRATA buoys for the Equatorial Atlantic Ocean	E. Z. Solha	10:00 – 11:00	TV3

List of attendees:

	Name	Institution	Country
1	Adilson Matheus Borges Machado	UFMA	Brazil
2	Adilson Wagner Gandu	LABOMAR	Brazil
3	Alexandre Ganachaud	IRD/LEGOS	France
4	Alina Nathanaël Dossa	UFPE	Benin / Brazil
5	Ana Carolina de Azevedo Mazzuco	UFES	Brazil
6	Ana Leticia Melo dos Santos	FUNCEME	Brazil
7	Ana Paula Morais Krelling	LABOMAR/UFC	Brazil
8	Andre Lanfer Marquez	UFPE	Brazil
9	Andre Luis Belem	UFF	Brazil
10	Antonio Geraldo Ferreiro	UFC/LABOMAR	Brazil
11	Antonio Vasconcelos Nogueira Neto	CNRM - Météo France	Brazil / France
12	Aubains Hounsou-Gbo	UFPE	Benin / Brazil
13	Aurore Voldoire	Météo-France/CNRM	France
14	Bernard Bourlès	IRD/LEGOS	France
15	Bill Johns	RSMAS/Univ. Miami	USA
16	Bruno Dias Rodrigues	FUNCEME	Brazil
17	Carlos Eduardo Peres Teixeira	LABOMAR/UFC	Brazil
18	Carlos Alessandre Domingos Lentini	UFBA	Brazil
19	Clarissa Akemi Kajiya Endo	INPE	Brazil
20	David Legler	NOAA/CPO	USA
21	Dayse Suellen dos Santos Moraes	FUNCEME	Brazil
22	Diógenes Passos Fontenele	FUNCEME	Brazil
23	Divina C. Saores	INPE	Brazil
24	Divino Moura	CPTEC/INPE	Brazil
25	Djoirka Minto Dimoune	UFPE	Brazil
26	Dóris Veleda	UFPE	Brazil
27	Douglas Medeiros Nehme	UFRJ	Brazil
28	Edmo Campos	IO-USP / UFC	Brazil
29	Eduardo dos Santos	UFC	Brazil
30	Eduardo Martins	FUNCEME	Brazil
31	Emmanuel Giarolla	INPE	Brazil
32	Fabrice Hernandez	IRD/LEGOS-	France
33	Francis da Silva Lopes	UFPE	Brazil
34	Francisco Quixaba Filho	INMET	Brazil
35	Francisco Rafael de Limo Xavier	UFC	Brazil
36	Franz Philip Tuchen	GEOMAR	Germany
37	Frédéric Bonou	CIPMA / IRHOB	Benin
38	Gaël Alory	LEGOS	France
39	Geraldo Ferreira	LABOMAR	Brazil
40	Gustavo Lauton de Oliveira	UFBA	Brazil
41	Henri-Luc Thibault	IRD	France
42	Hervé Giordani	Météo-France/CNRM	France
43	Humberto Lazaro Varona Gonzalez	UFPE	Brazil
44	Isabelle Maria Vilela de Oliveira	UFPE	Brazil
45	Jacques Servain	IRD/FUNCEME	France/Brazil
46	Jamille Rabelo	UFC/LABOMAR	Brazil
47	Janice R. Trotte-Duhà	DGDMTN / MB-RJ	Brazil
48	Jean-Paul Moatti	IRD	France
49	Joao Costa	UFPE	Brazil
50	Joke Lübbecke	GEOMAR	Germany
51	Jose Burton Berezza Vrona Filho	UFC	Brazil
52	Julia Martins de Araujo	UFPE	Brazil
53	Kristin Burmeister	GEOMAR	Germany

54	Laisa Alves Malheiros Soares	UFMA	Brazil
55	Leandro Valente Jacinto	FUNCEME	Brazil
56	Léo Costa Aroucha	UFPE	Brazil
57	Leonardo Bruto	UFPE	Brazil
58	Leticia Cotrim da Cunha	FAOC/UERJ	Brazil
59	Liana Pacheco Bittancourt	FUNCEME	Brazil
60	Marcia Andréa Trumeau	IRD	Brazil
61	Marcio Machado Cintra	UFRN	Brazil
62	Marcio Viana	VM	Brazil
63	Marcus Dengler	GEOMAR	Germany
64	Marcus Jorge Bottino	INPE	Brazil
65	Maria Berenice Da Silva	FUNCEME	Brazil
66	Marilia Kabke Wally	FURG	Brazil
67	Marisa Francisca de Novato Macuéria	UFPE	Brazil
68	Marjorie Kreis	FUNCEME	Fra:ce/Brazil
69	Martin Claus	GEOMAR	Germany
70	Mathieu Rouault	UCT	South Africa
71	Maurício Rebouças Rocha	UFCG	Brazil
72	Maytê Duarte Leal Coutinho	FUNCEME	Brazil
73	Mesmin Awo	ICMPA	Benin
74	Michael McPhaden	NOAA/PMEL	USA
75	Moacyr Araujo	UFPE	Brazil
76	Noël Keenlyside	UC	Norway
77	Oscarina Viana de Sousa	UFC/LABOMAR	Brazil
78	Oumarou Malam Issa	IRD	France
79	Paulo Nobre	INPE	Brazil
80	Pedro S. Calisto	FUNCEME	Brazil
81	Pedro Henrique Lima Silva Morais	IO/USP	Brazil
82	Pedro Tyaquiçã	UFPE	Brazil
83	Peter Brandt	GEOMAR	Germany
84	Philippe Dandin	Météo-France/CNRM	France
85	Ramilla Vieira de Assunção	UFPE	Brazil
86	Raul Fritz Beditel Texeira	FUNCEME	Brazil
87	Regina Rodriguez	UFSC	Brazil
88	Rick Lumpkin	NOAA/AOML	USA
89	Rodrigue Anicet Imbol Koungue	University of Cape	Cameroon / South
90	Sandrine Djakouré	LAPA-MF/UFHB	Côte d'Ivoire
91	Sarra Kchouk	FUNCEME	Tunisia/Brazil
92	Stephane Law Chune	MERCATOR	France
93	Thaysa Portela de Carvalho	SPSP TRANS	Brazil
94	Victor Cesar Martins de Aguiar	IO/USP	Brazil

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 the increasing number of presentations by young scientists, including 6 African young scientists and students (3 coming from Côte d'Ivoire and Benin where they work as 1 scientist, 1 post-doc and 1 PhD; and 3 working at UFPE in Recife: 2 PhD -1 Togolese and 1 Beninese- and 1 post doc -Beninese-).

APPENDIX 3:

SESSION "PIRATA Research Infrastructure: Present, Future Observations and New Technologies for the Next 20 Years"

(Wednesday 8th of November 2017).

Such an open discussion was decided in order to share points of view on present observations and potential enhancements of the observations that could be ensured thanks to PIRATA, in the frame of the future optimized and enhanced Observing System beyond OceanObs19. This discussion was expected to be limited to in situ measurements (from buoys and servicing dedicated cruises). Representatives of the NOAA, DHN, INDP, University of Ceara, FUNCEME, Météo-France and IRD institutions attended to this discussion, and an IRD delegation accompanied the IRD Chief Executive Officer, Dr Jean-Paul Moatti.

The discussion began by an introductory presentation by Bernard Bourlès (BB), who presented the present status of the PIRATA network and of the different kind of measurements carried out during cruises. BB showed the progressive evolution of the ocean-atmosphere interaction buoys from ATLAS to T-Flex systems, the evolution of sensors installed on the buoys, their enhancement with additional T/C and current sensors, biogeochemistry sensors -CO_2 and O_2- at some sites and the sensors deployed for other programs (as acoustic receivers for OTN, Xpods for turbulence at the equator etc). BB showed that PIRATA also services 3 ADCP moorings (0-300m depth) along the equator. BB then showed the various parameters that are, or can be, measured during PIRATA cruises, as O_2, nutrients, CO_2 parameters, Chlorophyll pigments, or along the trackline ("en route" ADCP, thermosalinograph, meteo but also acoustic), in addition to classical Essential Ocean Variables (temperature, salinity, currents) during stations. BB also showed the contribution of PIRATA to other international programs, as Argo through the deployment of autonomous profilers, and Global Drifter Program through the deployment of Surface Velocity Profilers. PIRATA cruises are also opportunities for sampling plankton, Sargassum algae etc. for biological analysis and studies (taxonomic, genetics, micro-plastics…).

Then Paulo Nobre (PN) presented a new proposal by University Federal of Fluminense: the Vertical Particle Flux (VPAX)-PIRATA, that consists in adding sediment traps around 1000m depth on moorings (first at 0°N-35°W and 8°S-30°W), which could also get microplastics. MM informed that such an experiment was already attempted 20 years ago with Woods Hole, and problems were encountered; there is technical issue of having a trap on a surface mooring line because it is too energetic. Mike McPhaden (MM) rather suggested a second subsurface mooring because, as already attempted 20 years ago and raised technical issue of having a trap on a surface mooring line because too energetic. This could be however technically attempted. PN supported this proposal and said that only nylon is the missing, finally easy and cheap to get. Fabrice Hernandez (FH) added that it would be interesting to implement such systems in both north and south.

Peter Brandt (PB) presented results of new O_2 sensors installed in PIRATA buoys along 23°W, some now with real-time transmission. Such O_2 measurements are going on from 12 years now, some in cooperation with PIRATA, and are very important for monitoring and studying ecosystems, acidification etc. PB notably showed O_2 concentration trends and a significant ocean loss of O_2 since 20 years in the eastern tropical Atlantic, along with dead zone eddies around 18°N. Such results confirm the need of long term measurements, from moorings and from CTD-O_2 casts during cruises. BB asked about the commitment of GEOMAR that owns these data (partly funded by AtlantOS), for ensuring such measurements on the long term. While GEOMAR is convinced and has an interest for long term strategy, this issue will also depend upon the PIs. PN suggested to make O_2 data available in the PIRATA online directly and not only through GEOMAR distribution as it is now... Alexandre Ganachaud (AG) asked how

about a long term strategy for sampling if sensors are installed on moorings, if targeted for different ecosystems/dynamics, dead zones (Oxygen Minimum Zone -OMZ-), upwelling? BB précises that the southeastern tropical Atlantic (buoy at 6°S-8°E) would also be of great interest (OMZ, even stronger than in the north). FH and Leticia Cotrim (LC) underlined the great interest of O_2 measurements by PIRATA (time series and cruises) and asked about such measurements along 35-38°W in the western part of the basin (path of the OMZ and processes controlling the OMZ, its impact of ecosystems, impact of Amazon River, role on algae and Sargassum, Oygen saturation related to pH and Amazon plume productivity…) as there is very few ones available through the World Ocean Data Base. Presently, there is a SCOR Working Group on marine chemistry speciation (145) and pH.
The importance of such data sets for stakeholders is underlined (fishing, ecosystems, governments, tourism -*e.g.* Sargasso stranding versus tourism-) but one have to define some priorities (costs of measurements). LC said that O_2 is certainly the most reliable as directly impacting fisheries and tourism, but also EOVs, Chlorophyll-A and CO_2 during servicing cruises. pH sensors can be installed, they are already operational on RAMA buoys in the Indian Ocean, but the challenges are sponsors and scientific oversights. The issue for PIRATA to add non-physical new sensors is principally (even only) the extra funding. MM recalled that PIRATA is funded by several national agencies, so limited.

Then the discussion turned about new measurement opportunities. Jacques Servain (JS) recalled the need of additional buoy in the South Atlantic, and asked if not feasible if USA can service the buoy at 15°N-38W and Brazil in exchange can maintain a new buoy in the South. Rick Lumpkin (RL) recalled that USA already surveys the whole 23°W section. Vessel time is limited and costly and thus limits and conditions such eventualities.

At this point Jean-Paul Moatti (JPM) raised the importance to find a trade-off between extension and enhancement of existing sites. PIRATA is of great importance not only for science but also for major services and one needs to target developing agencies, thinking about benefits to society and economy. PIRATA is already a development project and should explore the fact to sell some of its aspects not only for science but also for society to be sponsored (e.g. Green Funds). Thus, funds are limited as only academic organisms pay for it… Janice Trotte précised that infrastructures (vessel time) is far the most expensive, and Brazil (but other countries too) is already at the limit.

AG suggested to referring to OOPC framework for ocean observing system design, and the importance to distinguish between process experiments or testing new data systems and long term measurements. He said to decide very early about potential optimization of measurement sites to be ready to continue with long term time series. FH also suggested to think about dedicated PIRATA moorings for calibration for Argo or glider measurements. However, MM recalled that priority is to be given to full flux references sites that need higher vertical resolution in the mixed layer (e.g. T/C and current sensors). PN recalled the importance of improving vertical resolution and target money for adaptation and climate change. Rick Lumpkin (RL) said that methodology exists to enhance data sets, *e.g*. the ePIRATA product, and that one can also use other data sources (e.g. surrounding Argo profiles) to make more intelligent interpolations. There, Noel Keenlyside informed that most model biases mostly come from the atmosphere and vertical structures in the troposphere, but mixed layer temperature and salinity measurements (for heat and salt budgets) and thermocline feedback are very important and needed. FH said that PIRATA should evidence how it helps to monitor the marine boundary layers and ocean impact of atmospheric conditions, and that there is still problems with temperature and salinity data for their monitoring (quality data control). FH also raised the need for wave measurements on buoys if feasible that will be probably more and more important. PN added that such data should help to improve the coupling ocean-atmosphere. However one already mentioned that waves measurements are not possible from PIRATA buoys (that moorings are tense anchorages will disturb measurements).

Aurore Voldoire and MM underlined the need to consider climate scale and thus the need to maintain as much as possible the continuity of existing time series and measurements. Aurore précised that PIRATA data has not been used enough for climate studies and could become more & more important; at now, they are mostly used for interannual variability studies. MM illustrated this by recalling the problem encountered in the Pacific a few years ago when buoys time series were interrupted!

Philippe Dandin then recalled that Weather forecast centers integrate PIRATA data and that it is possible and needed to evaluate the benefit of a given dataset into the system. It has been shown that value of new barometers have been estimated high. Thus PIRATA needs more links with modelling and satellite community to regularly asses the added value of PIRATA data, atmospheric ones in particular. PIRATA barometers are expansive (5k€) and target should be to equip all buoys with barometers. Météo-France values and supports PIRATA for both science and users. In the same way, David Legler said that NOAA supports and will continue supporting PIRATA for both research and operations issues. He also suggested to more refer to TPOS2020 and related reports; there are commonalities to be exploited and connections to be made (e.g. marine boundary layer, vertical resolution, satellite/Argo combination). MM précised that the same questioning is going on for RAMA in the Indian Ocean. BB said that AtlantOS also works on these issues (*e.g*. through Observation System Simulation Experiments) and that the next PIRATA 2018 meeting could be the opportunity to invite people involved in satellite, climate and weather services, modeling communities, as EUMETSAT, CNES, COPERNICUS, climate and weather centers etc. Mathieu Rouault added that South Africa could be interested in PIRATA science and PIRATA could also invite government representative, in particular for ship time issues.

Finally, the issue of human power was underlined, with the strong need for recruitments and for training and motivating a new generations to take over the leadership.

After this fruitful discussion, the official closure ceremony was held, with speeches by Divino Moura (INPE), Jean-Paul Moatti (IRD), Philippe Dandin (Météo-France), David Legler (NOAA), Eduardo Martins (FUNCEME) and Antônio Gomes de Souza Filho (PRPPG/UFC) (from left to right on picture below). Jean-Paul Moatti concluded by inviting PIRATA in Marseille for the 2018 meeting, that was very enthusiastically appreciated by every attendees.

APPENDIX 4:

Official ceremony: stamp celebration onboard the R/V Vital de Oliveira

(Thursday 8th of November, 2017)

The Brazilian meeting organizers and PIRATA-Brazil decided to launch a special PIRATA stamp for the 20th anniversary of the program, "born" at Fortaleza (and more precisely in the PIRATA bar, where a special evening was also organized during the meeting on Monday 5th). The presence of the R/V Vital de Oliveira that stopped in Fortaleza during the PIRATA-BR XVII cruise, was the opportunity to welcome the meeting attendees onboard and to organize an official ceremony dedicated to the PIRATA-20 stamp celebration.

This ceremony began by the PIRATA-BR XVII cruise presentation by Paulo Nobre in the vessel conference room. Then, the launch of the stamp was celebrated, during which the representative of the Ceara State post office offered "first day stamp" to several people representative of administrative and research institutions, including the Secretaries of Water Resources and Science and Technology of the Ceará State Government, UFC, Brazilian Navy, INPE, NOAA, IRD and Météo-France. Then, a cocktail was proposed on the vessel. This was also a great opportunity for some of the attendees to visit the R/V Vital de Oliveira.