PIRATA-19 meeting report

(Porto de Galinhas-PE, Brazil, November 3-7, 2014)

The 19th PIRATA meeting was held during the joined PIRATA-Tropical Atlantic Variability (TAV)-OceanSITES- Brazil-EU Dialogues in Marine Research meeting organized in Porto Gualinhas, Brazil by Universidade Federal de Pernambuco E (UFPE) (see http://www.tav-pirata19.com/index.php). About 80 people attended these meetings, in which scientific presentations were held during specific sessions on Tuesday through Thursday, November 4-6. An open PIRATA-dedicated session was held on Friday, November 4 in the morning, where national statuses were presented. The closed PIRATA SSG and PRB meetings were held after the open PIRATA-dedicated session.

Attendees to the SSG closed session:

- **SSG member participants:**

Bernard Bourlès (IRD, France; co-chair); Michael McPhaden (NOAA/PMEL, USA); Paulo Nobre (INPE, Brazil); Moacyr Araujo (UFPE, Brazil); Ramalingam Saravanan (Texas A&M University, USA), Hervé Giordani (Météo-France/CNRM, France), Fabrice Hernandez (IRD/LEGOS, France) and Edmo Campos (IOUSP, Brazil).

Rick Lumpkin (NOAA/AOML, USA; co-chair) was absent and excused, and represented by Gregory Foltz (NOAA/AOML, USA), after a prior official agreement of all SSG members.
Peter Brandt (GEOMAR, Germany) was absent and excused.

- **PRB member participants:**

Paulo Nobre for INPE (Brazil; Pdt) ; Janice Trotte-Duha for MCTI (Brazil) ; Frederico Antonio Saraiva Nogueira representing DHN (Brazil); Hervé Giordani, representing Météo-France (France) and replacing the official Météo-France PRB member, Philippe Dandin; Bernard Bourlès representing IRD (France) and replacing the official Météo-France PRB member, Robert Arfi; Diane Stanitski representing NOAA/CPO (USA), replacing David Legler;

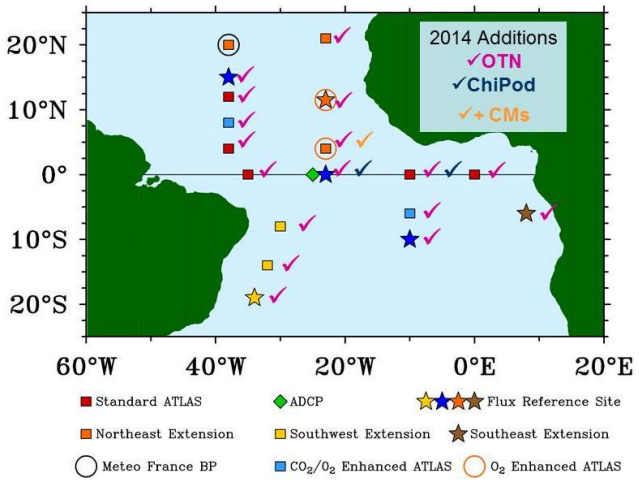
- **Also present and invited to attend:**

Andrei Poljack (MCTI, Brazil); Frédéric Huyhn (IRD representative in Brazil, France); Leticia Cotrim da Cunha (Univ. de Estado de Rio de Janeiro, Brazil).

The first part of this report summarizes the global and national PIRATA status reports.
The main items and recommendations issued from the discussions during the PIRATA SSG meeting are then summarized, and the final page contains a summary for the PIRATA PRB.
A summary of all action items decided at this meeting is presented at the end of this meeting report.

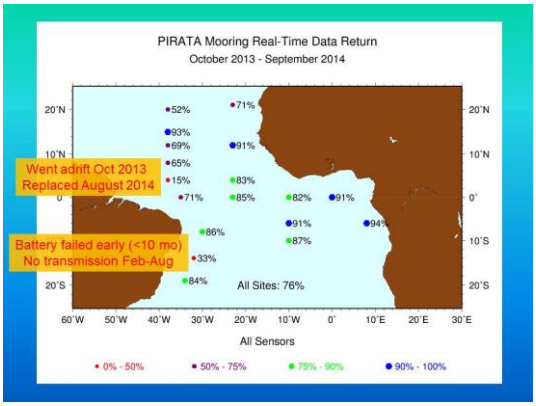
PIRATA global and national status:

1) NOAA/PMEL overall report (Mike McPhaden)



Mike McPhaden presented the current flavor of the PIRATA buoy network. He showed the present status the deployed moorings, along with additions made in 2014, i.e. two currentmeters at 4N-23W and 'piggyback' sensors, i.e. OTN at most of the sites, ChiPods at two sites. He showed that at present some subsurface sensors failed at 3 sites (at two northernmost sites and at 23W-0N), but data are most likely internally recorded.

The Real Time (RT) data return during the last US fiscal year (Oct 2013-Sep 2014) is 76% for all sites, lower than previous recent years partly due to postponing of the US cruises. The 4N-38W buoy went adrift in October 2013 and replaced in August 2014, explaining the very low value there. The RT data return per sensor is lower than in previous years (by about 2% on average). Individual sensor values differ (2014-2013) by -11% (currents) to +22% (LWR).RT Sontek current data has historically been low compared to most other observations, but data return increased compared to last year to about 57% for the 8 currentmeters.



The overall Delayed Mode (DM) data return was 74% during the last US fiscal year (Oct 2013-Sep 2014). However, these values (RT and DM) will most likely increase once the US PNE cruise concluded.

The global (1997-2013) data return for all buoys was 81% (see figure) and still shows lowest values for the two equatorial buoys in the Gulf of Guinea, due to vandalism, which has been considerably reduced these last years (no piracy from 2008). This remark also applies for the PIRATA mooring survival rate at these sites (12 and 12.5 out of 17 deployed), while it is 100% for 11 sites (and 201.5/216 for all 18 buoys from September 1997). 81% is an excellent overall result and a measure of PIRATA's success.

Field work during the US fiscal year (Oct 2013-Sep 2014) involved 106 days at sea across all partners. Field work on the French and Brazilian cruises was conducted entirely by national technicians as in the past several years. PMEL sent only one person to sea for 28 days on the last PNE cruise in October-November 2013. Data files delivered through the web slightly decreased in 2014 compared to 2013 (when it strongly increased).

Then, Mike McPhaden described the improvements of the T-Flex buoys (e.g. new modular design, off-the-shelf electronics, and transmission through Iridium instead of Argos) through 7 side-to-side ATLAS comparisons. Systems have generally worked well, providing long time series, and ATLAS/T-Flex produce comparable data. There has been one unexplained failure at the 20N-38W PIRATA site that will be recovered during the December 2014 PNE cruise. Also, the RAMA ATLAS mooring at 12S-67E test

site went adrift and the T-Flex data is now reported as primary source (with a 99% currentmeter data return after 15 months). PMEL is now able to place T-Flex data on GTS and standalone T-Flex implementation is expected to begin in 2015. Atlantic phase-in will require that French and Brazilian engineers/technicians receive training of a few days to a week at PMEL in 2015.

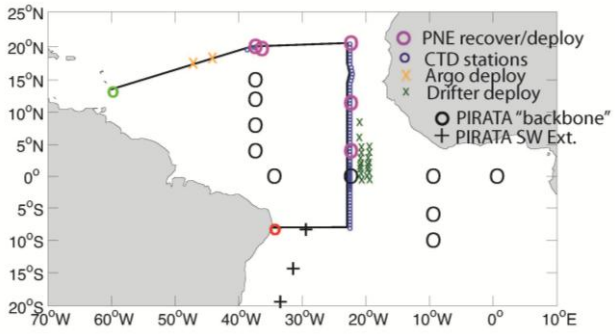
Mike McPhaden informed us that the next PNE cruise will be from December 28, 2014 to February 11, 2015 from the R/V Endeavor, smaller than the Ron Brown, thus limiting the possible operations (e.g. no aerosol sampling due to less space). A T-Flex test will be deployed at 4N-23W with additional 10 AOML Aquadopp current meters in upper 100m, all reporting in real time. Also, an AOML short wave radiometer (SWR) cleaning system (sprayed daily with fresh water to remove Saharan dust) will be installed at 12N-23W. There will be 2 SWR on 4N-23W mooring, 1 standard PMEL type and 1 with AOML cleaner.

McPhaden also presented a planned proposal to NOAA to support MAPCO$_2$ systems on three PIRATA flux reference stations at 10^{o}S, 10^{o}W; 0^o, 23^{o}W and 15^{o}N, 38^{o}W. The primary goal of this proposal is to analyze tropical Atlantic CO_2 variability and flux and to make comparison to tropical Pacific CO_2. There are potential synergies through collaboration with Nathalie Lefèvre and others on existing CO_2 observations to capture spatial variability in the tropical Atlantic and understand how open ocean tropical Atlantic dynamics impact coastal/coral biogeochemistry (i.e., connection to Brazilian OA island observatories).

To conclude the PIRATA overview, McPhaden presented five recent PMEL publications relevant for PIRATA and listed a summary of particular achievements and some issues that are discussed below (see discussion chapter), i.e. MOU Extended to 2019, piracy, smaller ship for PNE 2014, Moored Aerosol Collector proposal, PMEL CO_2 plans, data availability, and T-Flex training for INPE/IRD techs.

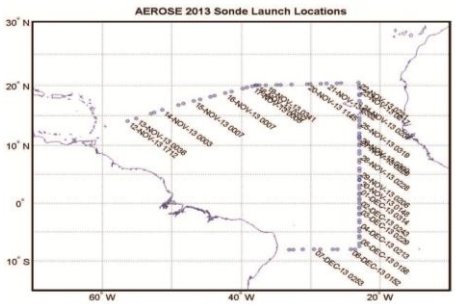
2) NOAA/AOML PIRATA Northeast Extension (PNE) report (Gregory Foltz)

Gregory Foltz, who replaced Rick Lumpkin during the meeting, recalls the two PNE cruises carried out 2013, *i.e.*: i) the January PNE 2013a cruise was conducted on the R/V *Ronald H. Brown* from January 8 to February 12, 2013 (see PIRATA-18 report), and ii) The PNE 2013b cruise carried out aboard the *Ron Brown* from November 11 to December 8, 2013, from Barbados to Recife (Brazil).



During this cruise, 4 ATLAS buoys were replaced, 1 T-Flex retrieved/redeployed at 20N-38W, and 70 CTD casts, most with LADCP, were conducted to a depth of 1500 m. Calibrated data relayed to PMEL and available on web.
During this cruise, 20 surface drifting buoys were deployed, 48 pairs of XBTs launched, two Argo floats deployed (WHOI), skin sea surface temperature was measured from Marine-Atmospheric Emitted Radiance Interferometer (MAERI) (U. Miami, RSMAS),

along with underway ADCP, pCO2 and TSG. The German oxygen sensors were replaced at 300 m and 500 m on 4N, 23W and 11.5N, 23W moorings.



Nine people from Howard Univ., NOAA/NESDIS were also onboard in the context of AEROSE, the atmospheric component of PNE. These personnel launched 97 Vaisala sondes, 19 Ozone sondes, and measured aerosol optical depth, downwelling shortwave and longwave, surface O_3 and NO-NO_x, particle counts, and collected biological samples. AEROSE data are available on ftp/web servers at NESDIS and NOAA/ESRL/PSD.

The PNE 2014 (chief scientist: Rick Lumpkin) will be conducted aboard the R/V Endeavor, a smaller and slower vessel than the Ron Brown. This represents a significant cost savings since U.S. NSF paying for almost half the charter costs in exchange for subsurface mooring recoveries. The cruise will be from December 28, 2014 to February 11, 2015, and from Bridgetown, Barbados, a call at Praia, Cape Verde, to San Juan, Puerto Rico. The PNE 2015 should be in October 2015 - March 2016.

Then, Gregory Foltz showed the solar radiometer rinser that will be installed on 12N, 23W mooring, justified by the impact of Saharian dust on sensors inducing a 125Wm/2 biais when compared with climatology. He said that aerosol samples taken from buoys during PNE2013a cruise have been analyzed by colleagues at Max Planck Institute in Germany (A. Andreae) and Scripps (A. Evan). Isotope analyses are consistent with dust found in Cape Verde, Barbados and also signature of Bodele depression. It is planned to continue taking samples during future PNE cruises (also 38W with help from Brazilians).

Also, he presented the "Enhanced current shear experiment" (Preliminary acronym: TACOS = 'Tropical Atlantic Currents Observational Study') that will be carried out at the same location as initial experiment (4N, 23W), by installing 10 additional current meters (meter at 10 m provided by PMEL), with a 5 m spacing from surface to 40 m, and 10 to 20 m between 40 m and 100 m. An undergraduate NOAA Hollings Scholar has been selected for internship with G. Foltz (AOML) and R. Perez (AOML/CIMAS) in summer 2015 to analyze data.

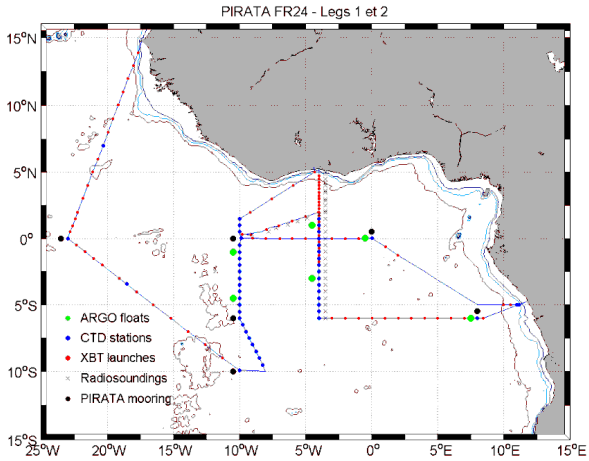
Gregory Foltz concluded by mentioning the PIRATA PNE webpage maintained at AOML (http://www.aoml.noaa.gov/phod/pne/) which includes the PIRATA bibliography, to be regularly updated (http://www.aoml.noaa.gov/phod/pne/pdf/PIRATA_references.pdf).

3) **French report (Bernard Bourlès)**

Bernard Bourlès first recalled the national status of PIRATA as it is recognized as a national observatory (Système d'Observation Océan-Atmosphère) as part of a larger SOERE (Service d'Observation et d'Expérimentation, sur le long terme, pour la Recherche et l'Environnement CTDO2) dedicated to ocean operational observations (PIRATA, SSS, ARGO, CORIOLIS). Such a SO label is important for endorsements of national programs and/or research institutions, plus potential funding support for material and vessel time. Thus, the vessel time is ensured yearly (thanks to the "Observatory" status) and PIRATA cruises have been successfully conducted in 2012 (scientific evaluation every four years). Since 2011, all cruises are carried out with the R/V LE SUROIT.

PIRATA is supported by IRD, Météo-France and also by the Observatoire Midi-Pyrénées (Toulouse University; as PIRATA mostly help by IRD/LEGOS, part of the OMP*)* and occasionally by INSU/CNRS. In 2014 the contribution by Météo-France was 30k€, by IRD 45k€, by OMP 4.2k€, and by INSU/CNRS 5k€ for replacing some material (mooring buoyancy, releases, Argos material, etc). Thus, total supports amounted to 84,2k€, i.e. far less than in 2013 when 103,2k€ were available. The cost for vessel time was about 1M€ in 2013 (43 cruise days plus 23 transits days, i.e. 68 days of vessel) and ~85k€ / year for each cruise technical support, material transport, missions, i.e. a total of about 1.1M€/year (salaries not taken into account). The total engineers/technicians dedicated time was about 170 days in 2014.

The 2014 PIRATA-FR24 cruise was conducted from April 9 to May 22, from Dakar (Senegal) to Abidjan (Côte d'Ivoire) (see figure).



the 6 buoys at 23°W-0°N, 10°W-0°N,6°S,10°S, 0°E-0°N, and 6°S-8°E (PIRATA SEE) were serviced. The ADCP mooring at 10W-0N was also replaced.

The usual operations were:
- 48 CTD-0_2/LADCP profiles (0-2000m)
- 92 XBTs
- 6 profilers (Arvor) deployed (ARGO/CORIOLIS)
- 4 SVP-BS deployed (INSU; G. Reverdin)
- CO_2 sensors replacement at 6°S-10°W (IRD; N. Lefèvre)
- 34 sea surface water samplings (CO_2, nutrients, pigments, and also C13)
- underway ADCP, meteo and TSG measurements.

The vertical resolution of the 6 Argo profilers deployed in the undersampled South-East of the Gulf of Guinea was increased to 1m in the 0-100m upper layer, and to 5m from 100 to 200m (also as contribution to PREFACE).

All CTD and XBT profiles were transmitted in quasi-real time through GTS from the vessel (CTD vertical resolution reduced to 5m). SSS are also sampled/measured all along the trackline for TSgraph calibration and the "SSS observation service".

Several additional operations were also carried out during this cruise:

1) 2 hydrophone moorings were retrieved at 5S–16W & 10S-8W (for NOAA/PMEL, R.Dziak); this induced the 10°W section to be shifted to the east in the South and about 2 days of vessel time dedicated to…

2) 2 "Chipods" (turbulence sensors) added at 20m depth on ATLAS lines at 0N-23W and 0N-10W (for Oregon Univ., J.Moum); piggy-back operation agreed by PIRATA SSG in July 2013;

3) 6 OTN added at 200m depth on each ATLAS lines (for Dalhousie University, Canada, F. Whoriskey) -to follow sea mammals- also agreed by PIRATA SSG in 2013;

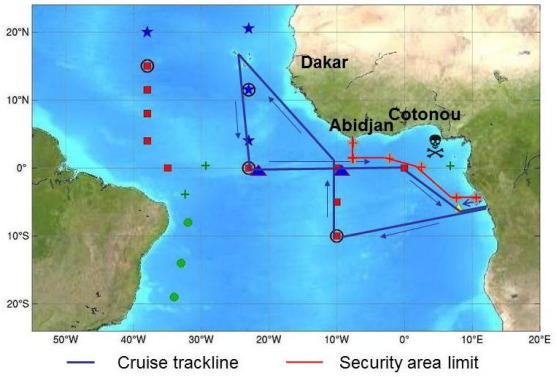
4) 33 Radiosoundings and continuous measurement of atmospheric H2O & O18/O16 (Picarro) during the leg 2 (for G.DeCoetlogon, LATMOS, French LEFE national program related to PIRATA , AMMA & PREFACE; *done for the study of ocean/atm boundary layers and atm convection)*.

Major issues & problems during this cruise were: i) the CO2 sensor at 6S-10W does not work; ii) one ARGO profiler failed after its deployment (close to the PIRATA SEE location); iii) some problem with the wind sensor at 6S-8E from May 24th (*Bad data transmitted; to be checked).*

About other operations under French responsibility, Bernard Bourlès mentioned that:

- the ADCP moorings at 23°W were replaced in May 2014 by GEOMAR;
- the tide gauge in São Tomé (offline since late 2010) was replaced on October 28-30, 2013, with a full new system built in 2013 at INSU-Brest. Due to some problem, a 2nd mission was achieved in May 2014 (also for GPS positioning), but there is still some problem with the tide gauge and data transmission. Another mission is expected in early 2015 to solve the problem (or make another choice, as this issue becomes rather expensive…)!
- no major vandalism activity has been noticed for several years in the Gulf of Guinea and the data return for these buoys is now rather good.
- the equivalent (in term of funds) of a full ATLAS buoy system for PIRATA SEE has been bought in 2014 through the EU-PREFACE program, so ensuring the maintenance of this site over the long term;
- a new ADCP is being purchased thanks to PREFACE, to be deployed at 0-0 in 2015.

Bernard Bourlès next presented the major challenges caused by piracy activity in the Gulf of Guinea and now by Ebola fever. Due to piracy, work north of 2°N, east of 0°E and south of the equator in the east are no longer allowed. Due to the Ebola fever potential extension, at present no call in any West African port can be planned by IFREMER… Thus, the next PIRATA-FR25 cruise (currently scheduled from March 7 to April 12, 2015) is planned with the R/V THALASSA (i.e. larger than the SUROIT, 74m long, and with a longer autonomy at sea, more than 45 days), will be done in one leg only, from Cape-Verde Island (i.e. 40 days at sea, see map).



During the PIRATA FR25 cruise, the works will be:

- Servicing of the 6 Atlas buoys;
- Servicing the ADCP mooring at 10°W-0°N
- Deploying of a new ADCP mooring at 0°E-0°N close to the ATLAS buoy. This mooring was also planned in the framework of the EU-PREFACE (it constitutes one Deliverable for this programme).
- Adding 5 Chipods along both 23°W and 10°W-0°N ATLAS mooring lines, between 20 and 80m depth, for Oregon Univ., J.Moum (program funded by NSF for five years);
- Replacing OTN on each ATLAS mooring lines, for Dalhousie University, Canada, F. Whoriskey.
- Deploying ARGO profilers, with high vertical resolution in the upper layer.

Bernard Bourlès then indicated that two post-docs, have been recruited at IRD/LEGOS for 2 years in the frame of PREFACE, Gaëlle Herbert in Brest from July 2014 and Olga Hernandez in Toulouse from September 2014, who will work on PIRATA related issues (coastal upwelling generation processes in the eastern Tropical Atlantic and Impact of freshwater fluxes on Tropical Climate from TATL025 regional simulations respectively). Gaëlle Herbert first works on PIRATA-FR ADCP data treatment.

He also informed that the EU AtlantOS project directly concerns PIRATA, through the possibility to add i) classical sensors (T/C, current, flux) to some particular sites (IRD/LEGOS), ii) one CO2 sensor at PIRATA SEE (IRD/LOCEAN), and iii) O2 sensors along 23W at 300m & 500m along 23W (GEOMAR). EU final decision about the AtlantOS support & funding will be known by late 2014.

Then, he presented some work carried out or conducted in France in collaboration with CORIOLIS and SOERE CTDO2 (contributions by Gilles Reverdin and Jérôme Gourrion).

- One P sensor data was added for one year in 2013-2014 at 10°W-0°N at 100m depth to check the eventual vertical migrations of T/C sensors induced by large vertical shears. A first glance on these P data at 100m depth, along with data at 500 and 300m depth indicate that vertical migrations are in phase all along the mooring line, rather with weak amplitude at 100m (in spite of the EUC), and that one can feel a priori reassured that vertical displacements around the thermocline and impact of T/C data are small. This analysis will however be continued.
- One analysis consists in comparing PIRATA moorings T/S data with ARGO opportunity observations, to check what can be learnt from comparison with ARGO observations in the neighbourhood of the moorings and to see impact of PIRATA salinity on climatologies (e.g. ISAS = done from ARGO data at CORIOLIS; see *http://www.coriolis.eu.org/Science2/Global-Ocean/ISAS*)

Then Bernard Bourlès present a new French potential proposal to add "black carbon" sensors on buoys off Africa (PI: Benjamin GUINOT, CNRS, Laboratoire d'Aérologie/Observatoire Midi-Pyrénées; Xavier MARI –IRD, MIO), as carbon particles have impact on climate (through radiations) and also biochemical impacts in the ocean (as proven in New Caledonia). Idea is to use ATLAS buoys as plateforms to add Carbon sensors, and so extending on the Ocean the network already existing in Africa (IDAF, see: *http://medias.obs-mip.fr/idaf/*). Sensors have first to be tested in Mediterranean Sea (in 2015); they are autonomous in energy, in data transmission through satellite, with weak sizes and weight. These data could allow the monitoring of the continental emission off West Africa & in the Gulf of Guinea and also monitoring desert black carbon & aerosols at long distance.

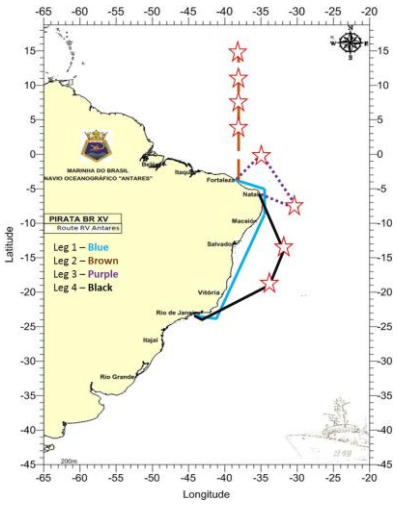
Bernard Bourlès presented a list of PhD students, 6 at present related to PIRATA with French supervisors, and recent publications (14 published, in press or submitted in 2014 involving French co-authors). Finally, he mentioned the issues in France about:

i) not enough manpower (engineers/technicians) in France, impacting data treatment (O2, ADCPs, pigments, nutrients…) validation and distribution. One engineer retired in 2014, only two engineers/technicians, also involved in several other cruises each year, are in charge of all technical aspects of PIRATA… Perspectives of positions recruitment appear very weak at short term, and contribution of other organisms/laboratories would be helpful! This is also a major issue in the context of additional operations planed with PREFACE & AtlantOS.

ii) resources/funding in France at short & mid-term (with concern about the Meteo-France support amount after 2016, term of the present convention with IRD).

4) Brazilian report (Moacyr Araujo)

The PIRATA BRXV cruise was completed in Mar-Jun 2013 with the NOc. ANTARES from July 10th to September 2nd 2014, in four legs (Rio-Fortaleza-Natal-Rio; 40 days at sea). During this cruise (8



scientific persons onboard per leg), 7 ATLAS mooring systems were replaced, and the ATLAS system at 4N-38W redeployed (after it went adrift and was recovered by NHo Cruzeiro do Sul in October 2013). ATLAS sensors and electronic are being exported to PMEL. The major issue during this cruise was that CTD deck-unit broken during the first profiling. XBT were launched on buoys sites, but unfortunately no salinity profiles for sensors calibration are available. Data QC have been performed. During the 1st leg, 15 U-CTD profiles were performed. 74 XBT profiles (every 60nm) and 27 radiosondes were launched during the whole cruise. During the 2nd leg from Fortaleza, the CARIOCA CO_2 sensor at 38ºW-8ºN has been retrieved and continuous *u-pCO2* measurements were acquired, thanks to a new system constructed by Brazil (that clearly allowed capturing the Amazon & ITCZ signatures along 38°W). Moacyr Araujo informed that an Automated Flowing *pCO2* Measuring System (General Oceanics Model 8050) has been purchased and already installed on the NOc. Antares. This new device is designed to operate fully automatically, and will be available during the next PIRATA BR 2015 cruise.

Also, Moacyr Araujo noted that 8 OTN were added at 200m depth on each ATLAS lines (for Dalhousie University, Canada, F. Whoriskey) as agreed by PIRATA SSG in 2013.

Total cost dedicated to PIRATA in Brazil in 2014 is about $1,9M, $250K for instrumentation and $1.65M for the 40 days shiptime and transport of equipment and scientific staff.

Then, Moacyr Araujo mentions efforts carried out in Brazil for capacity building, through the M2 & PhD program existing at UFPE, with one PhD student (granted by CNPq/CAPES), and also thanks to relationships/collaborations with France (UPS, Toulouse) and Benin (UAC, Cotonou), materialized by the co-supervision of 3 African PhD students (granted by FACEPE) issued from the Cotonou regional M2 at UFPE. This could lead to a graduate "tri-partite" Program in Oceanography (with emphasis on TAV), important in the frame of the "South Atlantic Peace and Cooperation Zone" - ZOPACAS.

5) ATLAS-B report (Edmo Campos):

Edmo Campos showed the status of the ATLAS-B system "Guariroba" (a clone of the TAO/PIRATA ATLAS buoy) that was entirely assembled in Brazil, and deployed in April 2013 at 28.5°S-44°W for a 6 month test. Unfortunately, the ATLAS-B went adrift in November 2013 and the 700m upper part recovered in a emergency operation. All was almost ok but meteorological sensors were broken. The deeper part has been successfully retrieved in June 2014. This ATLAS-B includes 2 microCATs at 300 & 500m (one stopped transmission after 40 days), and one near-bottom MicroCat at 3650m (T/C SBE) in compliance with OceanSITES recommendations.

Edmo Campos presented some issues with the ATLAS-B, related to i) the batteries and/or too high energy consumption (maybe also due to sampling scheme), and ii) inadequate hardware. Also, the deep microcat measurements show high pressure variation events of 10dB amplitude, that are not explained, and should be checked with colleagues from OceanSITES.

Edmo Campos said that the next ATLAS-B launch is expected by mid-2015. The Atlas-B is a pilot experiment, with the long-term goal of becoming a contribution to the overall PIRATA Program.

6) Ocean Climate Monitoring and Observation Impact Studies (Fabrice Hernandez):

Fabrice Hernandez first recalls that the TAO array suffers from several years now a lack of ressources, with the consequence of a reduced amount of moored array data available. In this framework, an international initiative called TPOS2020 arose in 2013 in order to address the main issues linked with this problem:

- Highlight the impacts of the tropical Pacific observing system on information/services of societal relevance. In particular, ENSO monitoring and prediction;
- Evaluate existing and potential requirements for sustained observations of ocean variables in tropical Pacific Ocean – uncertainties in ocean estimation in tropical Pacific;
- Evaluate the adequacy of existing observing strategies;
- Recommend revisions and/or adjustments to enhance resilience, efficiency, integration;
- Evaluate logistical requirements for implementation of the recommended Tropical Pacific Observing System;
- Assess readiness of new technologies, their potential impact and feasibility in addressing requirements, and/or lowering costs per observation.

In the framework of TPOS2020, Y. Xue (NOAA/NCEP), Y. Fujii (JMA) and M. Balmaseda (ECMWF) proposed to gather existing estimates of the thermal content from several operational centres, from the last 2-3 decades, until present. And then perform a Real-Time Ocean Renalyses Inter-comparison. With the main objectives:

- Extend CLIVAR-GSOP/GODAE OceanView Ocean Reanalyses Intercomparison Project (ORA-IP) into real time;
- Assess uncertainties in temperature analysis of tropical Pacific in support of ENSO monitoring and prediction;
- Explore any connections between gaps in ocean observations and spreads among ensemble ORAs
- Articulate needs for sustained ocean observing systems in support of TPOS2020;
- Monitor signal-to-noise ratio in the global ocean temperature, 300m heat content, depth of 20C isotherm.

This exercise has been initiated with 6 operational centres involved in short-term, seasonal or decadal prediction, using ocean-atmosphere coupled systems: NOAA/NCEP, ECMWF, JMA, GFDL, NASA and Bureau of Meteorology. A reference 1981-2010 climatology period has been chosen, and monthly average temperature anomalies are collected and analyzed each month. A multi-model ensemble approach allows to analyse signal/noise ratio. All results are posted every month at: http://www.cpc.ncep.noaa.gov/products/GODAS/multiora_body.html. The ensemble average is used to monitor the ocean climate. In particular, these past months, the possible onset of a Niño event has been studied, and compared to previous events.

This initiative has been officially endorsed by the GODAE OceanView programme, and will be discussed at the next "Observing System Evaluation Task Team" meeting of GODAE OceanView in Toulouse, December 2014. Two other operational centres: UK-Met and Mercator Ocean have joined this

initiative (changing the climatology reference period to 1993-2013). The issues proposed to be discussed for extending this initiative will be:

- Extension of the ocean monitoring outside the Tropical Pacific;
- Extend to other parameters: salt content ? heat transport ? (still on monthly averages).

7) Biogeochemitry (Leticia Cotrim da Cunha):

Leticia Cotrim presented the creation of the new research group in Brazil, the BrOA (for Brazilian Ocean Acidification Research Group). Missions and objectives are to i) create a network of scientists working on Ocean Acidification in Brazil in order to ii) establish a Long Term Observation of CO2 and related parameters in marine ecosystems. Intereested are 7 institutions, 33 researchers, 16 students, all certified by CNPq. Main topics are: marine biogeochemistry (coastal and open ocean), response of marine organisms to OA effects, paleoceanography: proxies to past ocean acidification events and carbonate system, biogeochemistry modeling, and physical and biogeochemical processes controlling sea.

Collaborations with PIRATA could be established in open ocean areas about marine biogeochemistry, through observations of surface pCO2, O2 (not only at surface), fluorescence (proxy for Chl), pH. BrOA (www.broa.furg.br) and PIRATA should keep in contact, as adding such types of sensors has already be done in the past (so, no major issues from a technological point of view).

SSG discussion:

The following topics were discussed during the (closed) PIRATA SSG session:

One point was to raise the issue of potential problems in France related to human power and resources in the next years. This issue has to be raised at high level, and the PRB will do it (also taking into account discussions during the EU-Brazil dialogues session).

One other point was about the H2020 EU AtlantOS project (Optimizing and Enhancing the Integrated Atlantic Ocean Observing System). PIRATA is directly concerned as part of it (through the Working Package 3: "Enhancement of autonomous observing networks" that includes the Task 5 "PIRATA" head by Bernard Bourlès). Janice Trotte-Duhá said that AtlantOS should be one of the rare proposals that could be chosen within the EU "Blue Growth" BG8 (for info, see http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/2463-bg-08-2014.html ; decision very soon, by late November). AtlantOS, if purely EU at this stage for funding, concerns more than 60 partners including USA, Canada and Brazil, and this could be the first step for a broad international project, and the context for additional observation extensions, and at least a help in preserving PIRATA as the backbone structure of AtlantOS. It is however noted that PIRATA (in term of tripartite program, SSG & PRB) will not have to provide reports to AtlantOS, but only the PI of the WP3.5 (i.e. Bernard Bourlès) will have to report on the yearly milestones (e.g., related to the purchase and implementation of additional sensors). However, Bernard Bourlès noted that if accepted, additional classical sensors (i.e., T/C, atmospheric, current) will have to be chosen in a common way (type of sensors, locations, depths…). He will let the SSG informed about this.

Next point was about the SSG membership. It has been suggested to have 3 co-chairs, one per country (US, Fr, Br). This is rather complicated, as the country of the PRB chair has also to be taken into account, and two co-chairs seem enough, as acting more or less as "executive committee" on issues as necessary between annual sessions. Due to its involvement in EU PREFACE and AtlantOS programs and capacity building, it is wished that Bernard Bourlès stays as co-chair. Then, present PRB members suggest the PRB be headed by the US through David Legler (NOAA), so admitting one Brazilian as SSG co-chair. Thus, Brazilian members suggested Moacyr Araujo to co-chair. In parallel discussion, Mike McPhaden informed us that US colleagues discussed about and that Rick Lumpkin was fine with stepping aside as SSG co-chair, but staying on the SSG as a valued member. Then, the discussion was about enlarging the SSG to biogeochemistry/carbon experts, as PIRATA is science drivenand will more and more extend towards new measurements such as carbon & aerosols.. It is suggested to continue discussing this issue with SSG free to invite other experts as necessary.

The next issue was about additional salinity sensors. Mike McPhaden reminded us that funds are limited and there is no money for extra sensors at the moment. The need of enhancement of salinity sensors has already been recognized, evaluated and agreed to in PIRATA (refer to previous study in 2011 by Fabrice Hernandez), with additional funding possible through H2020.

Then the discussion turned toward recommendations from OceanSITES that requests deep Microcat (T/C) measurements installed on ATLAS moorings. It is recalled that PIRATA would be happy to host deep T/C sensors by OceanSite PIs or anyone else. However, PIRATA priorities are focused main objectives in the upper 500 m as detailed in the MoU, so that any surplus T/C sensors will be deployed in this depth range first. Specific proposals to instrument PIRATA moorings with deep T/C sensors pass through the usual PIRATA review process.

OceanSITES also recommended that PIRATA make deep (near bottom) CTD casts at selected locations. PIRATA endorses this proposal and identifies the six Flux Reference Stations as default locations for

deep CTD casts, if time permits on PIRATA cruises. There are good reasons to routinely make deep CTD casts when possible, including calibration of Argo salinity and establishing a historical record of deep ocean variability and change.

OceanSITES also requested that PIRATA data be submitted to the OceanSITES Global Data Assembly Centers (GDACS) at Coriolis and NDBC. Mike McPhaden pointed out that PIRATA data have been available from the GDACS for some time, so that this requirement has already been met.

It was also discussed about adding sensors and current measurements at some sites all along the water column. Ramalingam Saravanan said that the AMOC community would like that at western boundaries (also to constrain the numerical climate models). Mike McPhaden added that this should be placed at the German sites, where they maintain an ADCP monitoring in the Brazil Current. Thus, one would need a leader to defend a deep mooring proposal toward SSG then PRB. That would also provide to PIRATA more visibility as being a program that pushes toward new science. It is finally suggested that Edmo Campos and Uwe Send should write a proposal to be submitted to the SSG. Ramalingam Saravanan added that such a proposal could be broader because northern countries are involved in MOC studies. Mike McPhaden concluded by accepting to be committed for following this deep mooring proposal… and that deep CTD could also be performed at several sites (positions to be discussed with OceanSITES).

Then, the discussion was about new proposals related to black carbon and aerosols measurements, as presented during US and French national reports. It is agreed that such measurements and time series would be very relevant, but that the SSG has to receive from PIs a few pages on science, technology and benefits, keeping in mind that mooring design cannot be significantly modified, and that these proposals cannot imply additional costs for PIRATA (also suggesting that there may be a need for specialists onboard the cruises). Others two proposals should be about a CO2 sensor in the equatorial Atlantic cold tongue (could be at 23°W-0°N) and install microplastic traps in some specific PIRATA buoys.

The last discussion was about the 2015 PIRATA meeting. As Bernard Bourlès stated earlier, it would be relevant to organize both PIRATA & PREFACE meetings together. This could be at CapeTown (important to engage Africa too, as several African countries are involved in PREFACE and concerned by PIRATA & related Capacity building) instead in France. Such a common meeting was agreed to and Bernard Bourlès will inform PREFACE and check with PREFACE if it is possible to organize this meeting at a time that will ensure maximum attendance of PIRATA principals. One possibly is in early December 2015 but other dates will be explored.

Summary to PRB:

- Future PIRATA support concerns in France.
- H2020 AtlantOS proposal. Potential for additional sensors through EU funding and stronger collaborations.
- Future possible proposals related to black carbon, aerosols, CO2, microplastics and deep sensors by OceanSITES PIs at some sites.
- New SSG composition: Bernard Bourlès (IRD, co-chair), Moacyr Araujo (UFPE, co-chair), Rick Lumpkin (NOAA), Paulo Nobre (INPE), Mike McPhaden (NOAA), Hervé Giordani (Météo-France), Ramalingam Saravanan (Texas A&M University), Fabrice Hernandez (IRD), Edmo Campos (IOUSP).

December 5th, 2014

Bernard BOURLES & al.