

PIRATA-17 SSG meeting report

(Kiel/IFM-GEOMAR, September 10- 13, 2012, Germany)

This PIRATA SSG (Steering Scientific Group) meeting was held during the PIRATA/TACE/TAV meeting organized at Kiel (Germany). After a common agreement between France and German partners, it was exceptionally organized in Germany, instead of France (where it should nominally have been in 2009), as this meeting corresponded to the last TACE meeting. Thus, the location reflects the major contribution of GEOMAR to TACE and also to PIRATA during the TACE years. Météo-France and IRD (France) both contributed to sponsor this meeting, where about 60 people attended. The PIRATA/TACE/TAV scientific presentations were held during specific sessions on Monday 10th, Tuesday 11th and the morning of Wednesday 12th, and the PIRATA dedicated session was held on Wednesday 12th in the afternoon (see the web site: http://tace.geomar.de/tav/index_tav.html).

The PIRATA SSG & PRB met on Thursday 13th after a short PIRATA presentation and discussion at the beginning of the CLIVAR Atlantic International Panel meeting that was held simultaneously. The PRB meeting was held that afternoon.

Attending people were:

SSG member participants:

Bernard Bourlès (IRD, France; co-chair); Rick Lumpkin (NOAA/AOML, USA; co-chair); Fabrice Hernandez (IRD, France); Moacyr Araujo (UFPE, Brazil); Michael McPhaden (NOAA/PMEL, USA); Paulo Nobre (INPE, Brazil);

Ramalingam Saravanan (Texas A&M University, USA) was also present through video/skype system.

Absent were: Peter Brandt (GEOMAR, Germany) who was hosting the CLIVAR-AIP, and was represented by Marcus Dengler;

Hervé Giordani (Météo-France/CNRM, France), due to operations in Mediterranean Sea, and was represented by Guy Caniaux; and Domingos Urbano (INPE, Brazil), who was represented by Guilherme Castelão.

PRB member participants :

Candyce Clark (NOAA/CPO, USA), Paulo Nobre (INPE, Brazil; Pdt); Joel Poitevin (Météo-France);

Absent were Janice Trotte-Duha (DHN, Brazil) represented by Saraiva Nogueira;

Pierre Soler (IRD, France), represented by Yves du Penhoat (IRD, France).

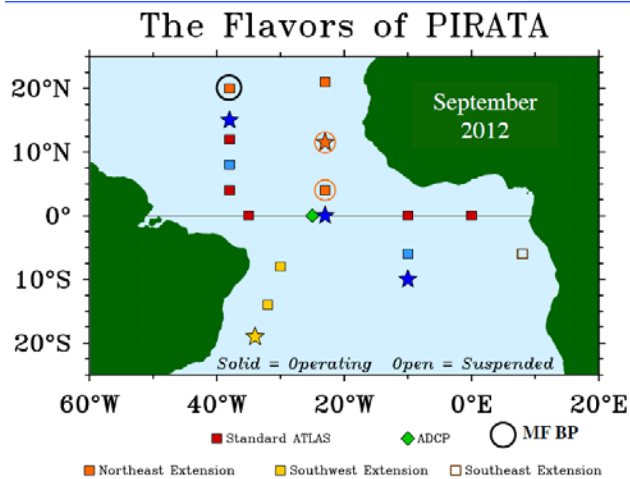
This report summarizes, in the first part, the different presentations of the PIRATA dedicated session (including the global and national PIRATA status), and in the second part, the main items and recommendations issued from the discussions during the PIRATA SSG/PRB meeting. The last page contains a summary for the PIRATA PRB.

INCLUDE THERE THE GROUP PICTURE (done after the dinner)? Who have it?

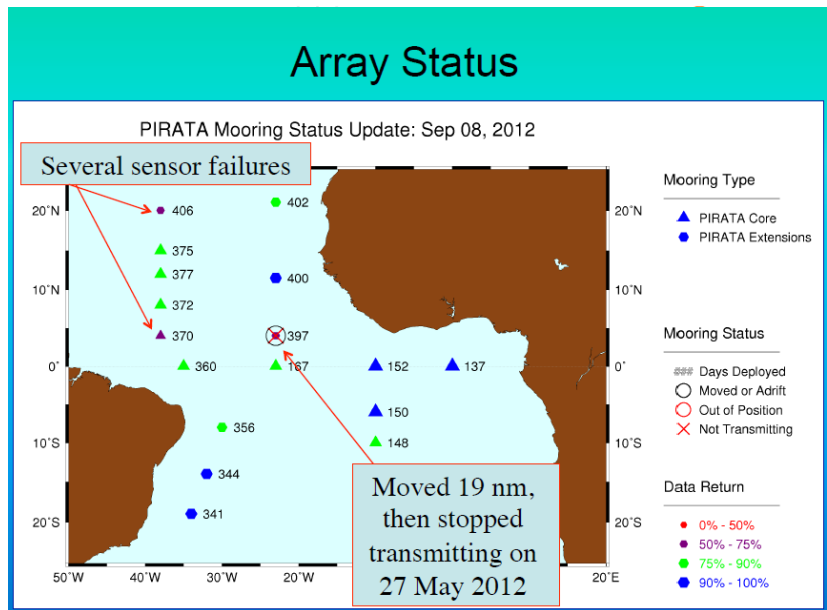
PIRATA dedicated session:

1) NOAA/PMEL report (Mike McPhaden)

Michael McPhaden, after recalling the various “flavors” of PIRATA (see figure below) presented an overview of the network status and the types of observations being collected by the PIRATA array since the PIRATA-16 meeting (March 2011).



Right: The number of days since deployment of each buoy (e.g., days since last servicing) is shown, along with major problems encountered on 3 particular sites.



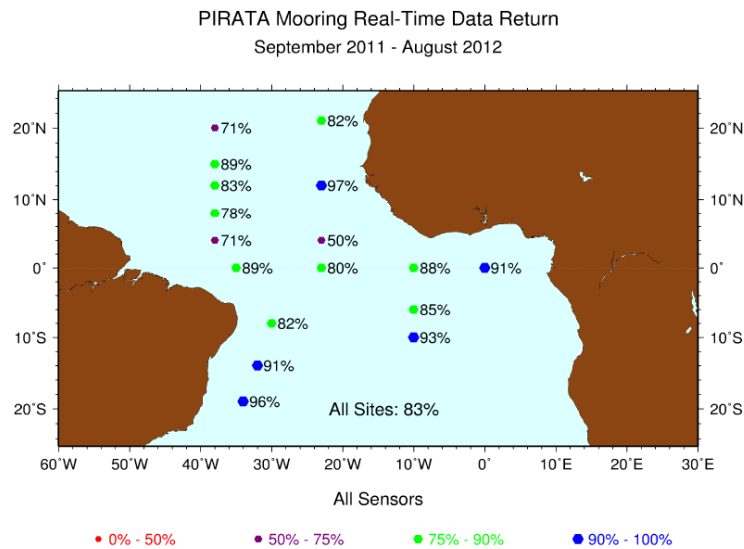
Field work conducted from March 2011 to August 12:

- ATLAS Moorings Deployed: 22
- Cruises: 158 days (SUROIT : 42 days in 2011, 34 in 2012; RON BROWN 32 days in 2011; ANTARES: 38 days in 2011; SUROIT: 44 days in 2012);
- PMEL Person-days at sea: 97 (BROWN: 64; ANTARES: 0; SUROIT: 18 in 2011 and 15 in 2012; for deploying/retrieving a new Iridium currentmeter at 10°W-0°N for experimentation).

Mike also presented the enhancement on the buoy at 20°N-38°W done for SPURS (Salinity Processes in the Upper Ocean Regional Study, a one year program funded by U.S. -NASA, NSF, NOAA-, France & Spain between springs 2011 & 2012), and deployed during the 2011 PNE cruise (to be replaced during the next PNE cruise). These enhancements consisted of meteorological sensors (to make the buoy full flux) and T/C sensors at 5 and 30m depth.

The overall near-real time data return in FY12 from all PIRATA sensors was 83%.

For individual sensor types, this was distributed as follows: 92% for air temperature, 81% for SST, 89% for T(z), 82% for winds, 93% for relative humidity, 66% for rain, 82% for shortwave radiation, 77% for salinity, 40% for currents (at 8 sites), 64% for longwave radiation (at 6 sites), 100% for air pressure (6 sites).



Mike presented the results of the intercomparison between current measurements obtained at 10°W-0°N in 2011-2012 by the 300kHz Sentinel and the transmitted by the Iridium system (high frequency acquisition, up to 5mn). It appears that the fish strongly perturb the Sentinel data sets, and that the diurnal vertical migration of the plankton consequently modifies the quality of the measurements. Systematic evaluation of the record is underway to determine which parts may be salvageable for scientific analysis.

Mike also presented the new generation of buoy, the T (tropical) -FLEX buoys. One was deployed for an experimental phase at 20°N-38°W close to a classical ATLAS buoy and the intercomparison of the measurements shows very good results apart from a slight discrepancy in wind angle, currently being addressed at PMEL. T-FLEX systems could be used in an operational way starting in 2014.

Two people visited PMEL from the University of Sao Paulo related to the development of their ATLAS-B mooring system.

Plans for 2012-2013 are to:

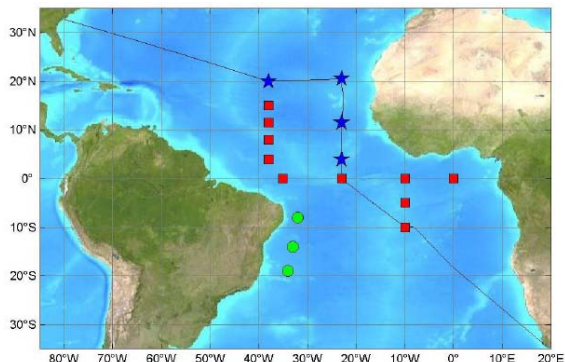
- maintain PIRATA in its present 17 ATLAS mooring configuration.
- maintain internally recording current measurements at 19°S, 34°W that started in 2011.
- continue Flux measurements at 20°N, 38°W to support SPURS.
- replace the existing T-FLEX on the next PNE cruise for continued testing at 20°N, 38°W (tests also scheduled in the Indian Ocean)
- the Tropical Moored Buoy Implementation Panel (TIP) will meet for ½ day in Jarkarta, Indonesia on Oct 25, 2012.

Mike then raised several issues to be discussed during the SSG meeting (see below) and showed the list of publications (6 papers published since March 2011).

2) NOAA/AOML report (Rick Lumpkin)

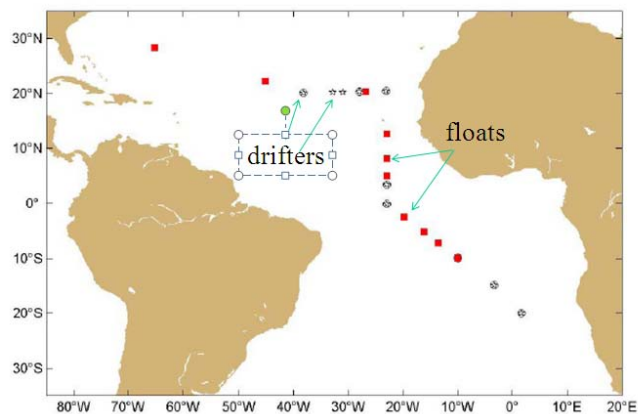
Rick presented the PNE cruise conducted from July 21 to August 21, 2011 from Charleston to Cape Town (see plan).

The cruise was initially planned from February to March 2011. The cruise was postponed due to lack of NOAA funds for FY11 ship time. Thus, the minimum ship time was solely dedicated to ATLAS buoy recovery/redeployment at 4 PNE sites (no extra time for the 23°W CTD section through the Oxygen Minimum Zone).



At 20°-38°W, a T-Flex was deployed close to the ATLAS buoy (see Mike's presentation). During the cruise, two operations were done at 0°N-23°W to repair wind sensor & tube swap and at 10°S 10°W to change the rain gauge and fix data transmission from the ADCP.

At 6 locations (4 at PNE + 1 at Eq-23°W + 1 at 10°S, 10°W) CTD casts were done and the data were transmitted in near-real time on the GTS. 20 Global Drifter Program drifters and 10 Argo floats were deployed (see map). 207 XBT casts were done along with 60 casts (down to 500m max) with an Underway CTD (UCTD). Recommendations for improvements/changes were given in a report to OceanScience, the manufacturer of the UCTD system, who implemented a number of improvements in an upgraded and more robust system planned to be tested on PNE2012.



In the frame of AEROSE, sonde launches were carried out all along the cruise (data available at ftp/web servers at NESDIS and NOAA/ESRL/PSD). Ancillary data are listed below (including AEROSE operations):

- IFM-GEOMAR oxygen sensors at 300m, 500m on 4°N 23°W, 11.5°N 23°W sites.
- Hydrophone moorings deployed at 4 sites along cruise track.
- Shipboard TSG, meteorological observations
- 107 Vaisala RS92 rawinsondes launched, 26 with ozone sondes
- Continuous measurements of ozone, carbon monoxide and sulfur dioxide
- Surface-level aerosol mass and number distribution characteristics
- Continuous radiometric broadband flux measurements (SW, LW)
- Air samples taken for biological and chemical properties

The PNE 2012 cruise was planned for September 2012. However the R/V Ronald H. Brown starboard propulsion motor failed, deemed “not reliable for operations” on 30 August. The Ron Brown returned to Charleston, SC for repairs. Two plans were being considered for the PNE cruise:

- Plan 1: conduct PNE cruise in January 2013 at earliest aboard the R/V Ronald H. Brown.
- Plan 2: charter another vessel such as the French R/V LE SUROIT.

Issues:

- 4°N 23°W: last transmission 27 May 2012.
- 20°N 38°W (supporting SPURS): missing SSC, T/C at 20m, 40m and 80m, SWR, LWR.
- 20°N 23°W, 11.5°N 23°W: subset of sensors failed.

Then Rick mentioned that the PNE web pages were recently updated

(<http://www.aoml.noaa.gov/phod/pne/>)

The PIRATA bibliography is distributed from the PIRATA Northeast Extension web page.

Other pages can make a direct link: http://www.aoml.noaa.gov/phod/pne/pdf/PIRATA_references.pdf

Last update: 7 September 2012. Peer-reviewed:

<u>YEAR</u>	<u>Number References</u>	<u>YEAR</u>	<u>Number References</u>
2012	13 (so far)	2006	11
2011	13	2005	10
2010	11	2004	10
2009	17	2003	10
2008	17	2002	4
2007	8	2001	4

All Pirates are invited to check it and indicate new inputs to Rick relative to the bibliography... Finally, Rick showed the new monthly mean climatology of surface currents in the tropical Atlantic done from drifter trajectories (1/2° resolution).

3) French report (Bernard Bourlès)

Bernard Bourlès first indicated that PIRATA is recognized as 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 organisms + potential funding support for material + vessel time. The convention for the PIRATA maintenance established between IRD & Meteo-France has been renewed in 2012 for 4 years. This convention IRD/MF + international MoU are absolutely needed! 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.

About the funding, PIRATA recurrent resources are mainly by IRD and Meteo-France. Contribution by Meteo-France decreased from 40k€ to 30k€/year in 2012. IRD contributes by 45k€ OMP contributed by 4,5k€ in 2011 and 4,2k€ in 2012. INSU/CNRS also exceptionally provides some funds, mostly for replacing some material. Thus, a full ADCP has been bought in 2011 & 2012, but the recurrent resources decreased subsequently from 2009... and could yield to potential future problems due to consequent transports & missions costs...

The cost for vessel time is about 900k€/per year (cruise time plus transits, ie 67 days of vessel) and 80k€/ year for each cruise technical support, material transport, missions, ie a total of about 1M€/year (salaries not taken into account). The total engineers/technicians dedicated time is about 160 days / year at cruise + 45 days/year in labs, thus about 200 days/year. The vessel time is now ensured yearly (thanks to the status of Observatory) but PIRATA cruises will be however evaluated in 2012 (every four years).

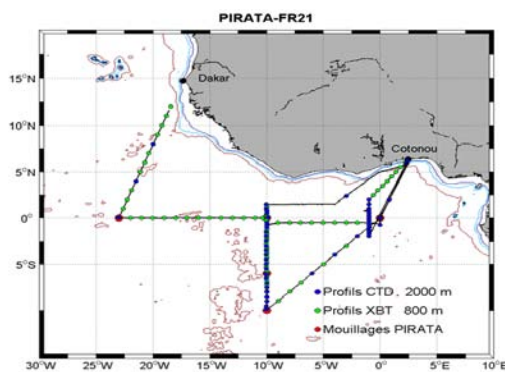
The last two cruises (2011 & 2012) were carried out onboard the R/V LE SUROIT (larger and more secure than the ANTEA for mooring operations). This vessel should also be used in the following years.

In 2011, the cruise was carried out from Dakar to Cotonou, from May 1 to June 16. The usual operations were:

- 47 CTD-02/LADCP profiles
- 84 XBTs
- 6 profilers (Arvor) deployed (*for ARGO/CORIOLIS*)
- 5 SVP-BS deployed (*INSU; G.Reverdin*)
- CO2 sensors replacement at 6°S-10°W (*IRD; N.Lefevre*)
- Sea surface water samplings (*CO2, nutrients, pigments*)

But this cruise was also specific as:

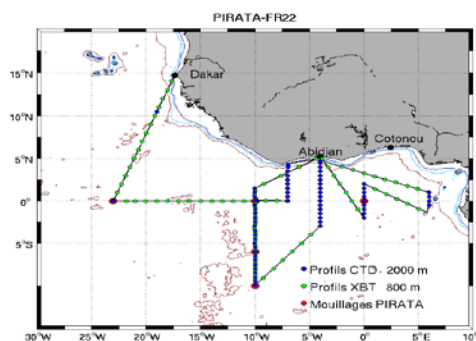
- quasi simultaneous with an IFM-GEOMAR cruise done between 23°W & 10°W;
- 3 glider were deployed (2 from IFM-GEOMAR, 1 from INSU) (+ 6 other gliders by IFM-GEOMAR between 23°W and 10°W)
- the 4 RSMAS ADCP moorings were retrieved (*contribution to TACE; PI: B.Johns*)
- it was done earlier than previous ones (to be there during the equatorial upwelling/cold tongue onset) (*following Amma & Tace recommandations...*)
- Additional TC sensors at 2 ATLAS moorings were added:
 - => vertical resolution for TS with 9 depths at 0, 5, 10, 20, 40, 60, 80, 100, 120m at 10°W-6°S & 10°S (bought by IRD in late 2010);
- Addition of 2 HR real time RDI sentinels at 10°W (0°N and 10°S) for a 1 year test (*by PMEL: one scientist of PMEL onboard*)
- + 2nd leg with 9 west African students (of the Master 2 Cotonou) for training on board...



In 2012, the cruise was carried out from Dakar to Abidjan (due to pirate activities off Nigeria, Benin and Togo in 2011 and security reasons), from March 19 to May 2. The usual operations were:

- 68 CTD-02/LADCP profiles (0-2000m)
- 86 XBTs
- 8 profilers (Apex) deployed (*ARGO/CORIOLIS*)
- 5 SVP-BS deployed (*INSU; G.Réverdin*)
- CO2 sensors replacement at 6°S-10°W (*IRD; N.Lefèvre*)
- Sea surface water samplings (*CO2, nutrients, pigments, but also O18 and C13*)

During this cruise, a new LADCP has been installed at 300m depth (same as 23°W) on the ADCP mooring at



10°W. The two former LADCP (located around 120m depth) were retrieved; unfortunately, the one looking upward stopped to work (batteries failure) in November 2011. 5 SADCP & 2 CTD-O2/LADCP sections were carried out off Côte d'Ivoire (1st time from 2000), along with two cross-equatorial sections at 0°E and 6°E to sample the EUC farther east. Bernard also showed some measurements obtained from SVP-BS illustrating the SST diurnal cycle and impact of precipitation (rapid and strong SSS decrease) on SST (rapid increase). He indicates that the CTD sensors calibration coefficients for the two last cruises were just obtained and that calibrated CTD will be available soon and sent to PMEL.

For several years, all CTD and XBT profiles have been transmitted in quasi-real time through GTS from the vessel (CTD vertical resolution reduced to 5m). SSS are also measured all along the trackline for TSgraph calibration and the "SSS observation service".

About São Tome instrumentations: Bernard indicated that both the tide gauge and the met station have not transmitted any data since 2010. Both are out of order and should be totally replaced. Due to funding resources at hand, and also to bias in wind measurements (orographic effect) and some lack of scientific background on its relevance, the met station cannot and will not be replaced. However, a new fully equipped tide gauge (with Argos transmission) can finally be funded (exceptional inputs from LEGOS and contribution of INSU) and will be installed at São Tome in 2013.

Then, Bernard showed the last 12 months real time data return (see figure first shown by McPhaden) and pointed out the excellent values observed in the Gulf of Guinea (91% for the 1st time at 0-0), without any major vandalism activities in the last 3 years.

The next PIRATA FR23 cruise is scheduled for May-June 2013. All PIRATA cruises are platforms for ancillary operations. Thus, radiosonde launches are planned during one of the next cruises (2013 or 2014) for MeghaTropics validation in the Gulf of Guinea (already planned in 2011 but delayed, due to similar operation in the Indian Ocean in 2011). Surface drifters will be deployed, some including salinity measurements for SMOS validation. High resolution CTD profiles around an ATLAS buoy has been considered to estimate vertical velocity, but would also need simultaneous ADCP measurements at fixed points...

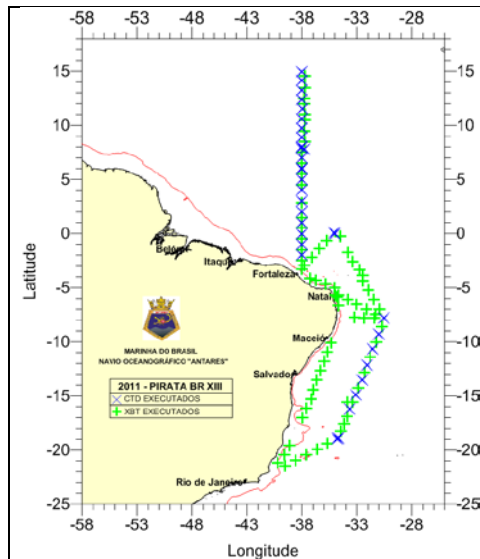
Bernard Bourlès provided some inputs about the PIRATA Southeastern Extension, in "stand by" from 2007, due to the absence of any funding for a 2nd buoy needed for its maintenance. The 1st buoy was funded in 2005 by the BCLME (South Africa, Namibia & Angola) through the PIRATA-SEE proposal (PI: Mathieu Rouault, Univ. of CapeTown). He indicated that the French, committed to provide the needed vessel time for such an extension (45 days available) for its maintenance, but only IF the buoy is located at the same location, ie 6°S-8°E and not farther in the south. He noted that a new EU proposal will be submitted to the FP7-ENV, a TAV proposal (PI: Noël Keenlyside, UiB, Norway), in which the purchase of a new buoy was requested (by P.Brandt & B.Bourlès). Another way such a system could be supported is by a proposal from Brazil & France, recently suggested by Paulo Nobre (see his message sent to the PIRATA SSG on September 11, 2012 during the present TACE/PIRATA meeting). See the summary of the PIRATA SSG, below, about this issue.

Then, Bernard Bourlès recalled that the French PIRATA website: <http://www.ifremer.fr/ird/pirata/>, informed that 1 PhD has been defended in 2012, 5 are presently running (mostly by African students issued from the regional Master 2 program initiated in 2008 at Cotonou/Benin), and 1 will begin in October at Météo-France/CNRM. Finally, he presented the list of 15 papers to his knowledge related to PIRATA published or in revision in 2011/2012 involving French scientists.

4) Brazilian report (Paulo Nobre)

Paulo Nobre presented a summary of PIRATA Brazil activities 2011-2012 since the PIRATA 16 meeting at Fernando de Noronha:

- Tide Gauge at Fernando de Noronha installed [Mar2011]
- The PIRATA BR-XI and SWE-VI cruises [Jul-Sep2011] (see figure below)
 - All ATLAS mooring systems replaced, CO₂ sensor at 38w8n
 - Hydrography: CTD-O2, ADCP, UCTD, U CO₂
- ATLAS sensors and electronic shipped to PMEL [Oct2011]
- PIRATA-BR Workshop at Fernando de Noronha [Nov2011]
- Trindade Island Tide Gauge & Meteorological Station installed [Aug2012]
- PIRATA-BR Hydrography data available on the website: <http://pirata.ccst.inpe.br>



Paulo Nobre showed the PIRATA BR 11 cruise map (CTDO₂, CBT, U-CTD) along with some vertical section of O₂, temperature and salinity along the 30-34°W and 38°W sections. First data from the Trinidad Island (30°W-19°S) tide gauge were shown.

Then, Paulo Nobre indicated that 2 papers are in press and 5 submitted, related to PIRATA and done by Brazilian scientists. Finally, he indicated that the cost of PIRATA in Brazil in 2011 was 500kUS\$ for instrumentation and 1,5M\$ for vessel time (36 days ANTARES ship time), i.e. a grand total of 2M\$ in 2011.

5) Hydrographic data from PIRATA Brazil (Guilherme Castelão)

Guilherme Castelão presented the data treatment and quality control developed at INPE, applied to the PIRATA BR cruises CTDO₂ data. The quality control is based on: position and data/time verifications, global range, digit rollover, gradients, spikes, & climatology anomalies. An artificial neural network was presented along with the anomaly detection. The quality controlled data are available with the regular flags, and the new anomaly index. Formats are: PyDAP, ASCII and NetCTF. He indicated that this work has been also done for the REVIZEE data (362 profiles) and that the BD also contains hundreds of BNDO historical profiles. See the web site: <http://pirata.ccst.inpe.br>

6) The REVIZEE program & data set in Brazil (Moacyr Araujo)

Moacyr Araujo presented the “Brazilian Program for Assessing the Sustainable Potential of the Live Resources of the Exclusive Economic Zone” (REVIZEE Program) and the REVIZEE Dataset (SCORE-N and SCORE-NE), as presented at a PIRATA BR meeting held at INPE (San Jose dos Campos) in July 2012. The REVIZEE program was achieved in 1997-2003 over an area of 3.5 million

km², off the Northeastern coast of Brazil. Cruises were done between 1995 & 2001 in the north area (SCORE-N) and between 1995 and 2000 in the northeast (SCORE-NE). Several maps & vertical sections were shown (different parameters as temperature, salinity, pH, nutrients, etc.).

Use of PIRATA by operational oceanography (Fabrice Hernandez)

Fabrice Hernandez noted that PIRATA allows real time transmitted data, and along with other mooring arrays (TAO, RAMA, OceanSite moorings), are processed by Global Data Assembly Centers (like Coriolis) and used in real time by most operational oceanography centers. He presented the organization of the GMES marine core service, in the framework of MyOcean 2. After MyOcean (2009-2012), the EC FP7 now funds MyOcean2 (2012-2014):

- In real time PIRATA data are:
 - Collected, processed, archived and disseminated by Coriolis;
 - Used by Thematic Assembly Centers (TACs) for validation and Observed Products;
 - Assimilated in the operational system by Mercator;
 - Used for validation purposes (Class 4 metrics).
- In delayed mode PIRATA data are used for:
 - Careful database preparation: CORA3, EN-3 ;
 - Observational products (ARIVO..., SURCOUF3D) ;
 - Global ocean reanalysis projects during MYO, followed in MYO2: GLORYS (Fr), CMCC (It), UREAD (UK) based on NEMO/ORCA025.

Fabrice presented the GODAE (Global Ocean Data Assimilation Experiment) OceanView Scope and Objectives:

- Leading the Scientific Development on the Implementation of Operational Ocean Forecasting Systems ;
- Improving the accuracy and utility of ocean analysis and forecasting products:
- Promoting the development of downstream use of ocean data and information products from GODAE OceanView systems;
- Supporting the transition to operational services => Links with JCOMM/ET-OOFS;
- Demonstrating the value of the observing systems.

- GODAE is organized in the following task teams:
 - Intercomparison and Validation ;
 - Observing system impact ;
 - Coastal and shelf seas ;
 - Marine Ecosystem prediction.
- The global in-situ network (including PIRATA), in real time or delayed mode, is used by all GOV (GODAE Ocean View) members, and is a key-concern for all task team;
- Observing System Experiment (OSE) – Task Team (TT) workplan
 - Regional impact of particular dataset;
 - Global: several centers (UKMO, Mercator) are running OSE in parallel to the operational suite on monthly basis (altimetry, Argo...);
- Intercomparison and Validation (IV) – TT workplan (F. Hernandez co-chair) 2010 -> 2013:
 - Real time assessment: few centers (NCEP, NRL, UKMO, Mercator, BoM) share surface fields forecasts => intercomparison, forecasting skill, ensemble approach, comparison to INS data;

- Class 4 assessment: INS, SLA data used as reference. Centers interpolate hindcast (hcst), forecast (fcst), persistency on data => intercomparison;
- GSOP initiative (GOC/CLIVAR): assessment of essential ocean variables and indices, ensemble approach: SSH, D20, MLD, Steric Height, Heat Content, Salt Content, MOC/transports, Sea Ice.

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To conclude, Fabrice noted that:

- PIRATA data transmitted in real time are mandatory information for operational oceanography, as well as all other moored information, that provide constraints at key location for the water masses/dynamical description (complementary to Argo or other drifting measurements)
- PIRATA data, as part of this global observing network are key data to reduce errors in Past Oceanic Description (reanalysis) in the tropical Atlantic
- To be addressed among panels (ie PIRATA SSG with OceanObs community):
 - How PIRATA program sustainability can be better supported by operational oceanography?
 - => Venice meeting (20yr alti+Argo), GODAE meetings....

7) German contribution to, and collaboration with, PIRATA (Peter Brandt)

Peter Brandt presented different programs and/or projects going on at GEOMAR and with close relations with some PIRATA objectives, all related to climate-biogeochemistry interactions in the Tropical Ocean, with focus on the oxygen minimum zones of the tropical North Atlantic & South Pacific.

- SFB754, Project Area A: Circulation and Oxygen. Carried out mostly along the 23°W section between 5°S and 15°N in the Atlantic ocean, the 1st phase of this program has been achieved from 2008 to 2011, the 2nd phase from 2012 to 2015 and a 3rd phase is possible.

Different aspects:

- o Simulating variability of the Oxygen Minimum Zone (OMZ) from holocene into anthropocene;
- o High resolution modeling;
- o Atlantic O₂ inventory and supply (also in the Pacific: water masses & O₂);
- o Tracer release experiments;
- o Transport across bottom boundary layer;
- o Millennial-scale time changes in OMZ nutrient conditions;
- o Onset of cretaceous anoxia.

This involved in situ operations through gliders survey, mooring array, cruises... etc, and motivates the continuation of the mooring work at the equator-23°W until 2015 including the deployment/servicing of the PIRATA ADCP mooring, along with oxygen measurements at 300m/500m at the ATLAS buoys located along 23°W at 4.5°N and 11°N. So, oxygen time series at the PIRATA buoys along 23°W will be continued (already 2 year time series are available).

- SFB754, BMBF Nordatlantik: Equatorial mooring at 23°W includes deep measurements for studies of the Equatorial Deep Jets.

Peter Brandt showed the gliders experiment (MicroRider) done in November 2009 around 23°W and in May-June 2011 around 10°W. Three MicroRider/Glider missions were carried out at PIRATA buoys. The Gliders circle the buoys collecting CTD-O₂, Chlorophyll, and microstructure data. He presented results of temperature, dissipation rates, and figures illustrating the diurnal cycle of these two parameters.

- BMBF RACE, Subproject 1.1. This project concerns the western boundary circulation off Brazil (Brandt, Dengler, Fischer), in cooperation with SAMOC and PIRATA Brazil. The mooring array at 11°S already deployed from 2000-2004 will be repeated, and first deployment is scheduled for July 2013 with mooring exchange cruises in 2014 and 2015.

Then Peter Brandt presented the EU FP7 Proposal in preparation, led by N. Keenlyside (University of Bergen, Norway). This proposal involves 4 themes: 1) Ocean processes; 2) Climate modelling and mechanisms; 3) Prediction and 4) Impacts on fisheries and economies. PIRATA interests are through: i) enhancing prediction of tropical Atlantic climate and its impacts, and ii) possible funding request for the PIRATA Southeast extension at 6°S, 8°E (the location of the largest SST bias in coupled models).

Finally, Peter Brandt presented the project: BMBF SACUS-SPACES. This BMBF Joint Project is called “ Southwest African Coastal Upwelling System and Benguela Niños” (SACUS), and planned from 2013 to 2015. This project has four themes:

- SP 1: Connectivity of the southeast Atlantic coastal upwelling system to the equatorial current system (Brandt, Kanzow, Visbeck, GEOMAR, Kiel)
- SP 2: Variability of poleward transports in the eastern boundary current of the Southeast Atlantic (Mohrholz, Schmidt, IOW, Warnemünde)
- SP 3: Upwelling filaments near Lüderitz and their interaction with the South Atlantic eastern boundary circulation (Quadfasel, Jochumsen, Universität Hamburg)
- SP 4: Tropical Atlantic climate and predictability (Greatbatch, Latif, GEOMAR, Kiel).

PIRATA SSG session:

The PIRATA SSG meeting was held along with the PRB members present at the meeting after a short presentation of PIRATA to the CLIVAR-Atlantic International Panel (AIP). After this presentation, an about 30' discussion raised the issues of i) the strong biases observed in the South Eastern part of the tropical Atlantic (and thus the strong need of observations there, i.e., re-establishment of the PIRATA SE extension...) and ii) capacity building. CLIVAR-AIP could write a "letter of intention", by mid-2013 (i.e. one year before the end of the present PIRATA MoU), to support the PIRATA SSG for reinforcing the PIRATA visibility and to underline the need of servicing an additional ATLAS buoy in the South-East.

Several issues has been raised, either during national report presentations or proposed before and during the discussion. Major issues (without detailing all the debates) are summarized in the following:

1) PIRATA South-Eastern Extension:

Such an extension becomes more and more a priority. All scientific arguments exist (biases in coupled models, mixed layer, links between equatorial and southeastern tropical regions, Congo discharge, fluxes...). Equipment for one buoy already exists, funded by BCLME in 2005-2006 and in the PIRATA ATLAS buoys pool.

- A 2nd buoy is needed for regular servicing of the site. Two possibilities exist to fund this second system: one by Brazil and by one an EU (FP7-ENV, PI. N.Keenlyside) proposal (to be submitted in October 2012).
- The ATLAS buoy deployed in 2006-2007 has not been vandalized during this one year test, and the location at 6°S-8°E is strongly relevant. Furthermore, France already has vessel time to service this site (although not if it is located farther in the South).
- This site deserves to be full flux instrumented and include one current meter.
- This site (along with others, see below) could also be upgraded with high T/C vertical resolution in the upper layers (mixed layer), but that will depends upon funding resources....

About funding: Funding in the US is highly uncertain at present. But re-establishment of the Southeast extension with an ATLAS mooring is a priority given level funding in the US. If additional funds are available, this buoy should be made a full flux site with additional sensors in the ocean for higher resolution in the mixed layer.

NOAA cannot accept foreign funds. A solution for 2014 and later may be the occupy 6°, 8°E with an ATLAS B mooring in 2014, assuming that field tests are successful before then. ATLAS-B is an Atlas-type mooring made in Brazil from commercially available components. However, it is still under development. Another possibility is to use the new PMEL T-Flux mooring. It is intended as a replacement for the aging ATLAS and is under development at PMEL. Field tests are underway and the mooring should be operational in 2014. It is based on commercially available components that others could purchase and send to PMEL for assembly.

In Brazil, funding could be available for the SEE (as written in the Br-Fr proposal sent by Paulo) but the problem is administrative delay. Paulo says that an Atlas B mooring demonstration could be launched in 2013 in the PIRATA Southwestern extension for verification purposes. In 2014, a real deployment could be possible.

Another issue (minor) concerns the potential over cost for material transport (6 buoys instead of 5) from Seattle to Africa, paid by France. This has to be checked.

Anyway, it is clearly decided that the PIRATA SEE is the top priority, as a full flux buoy with high T/C resolution, if at all possible. It could be deployed as early as 2013 during the next PIRATA FR23 cruise (May-June). We have one year (until same period in 2014) to fund a 2nd buoy and that could/should be done (through Brazil, EU-FP7 proposal or PMEL).

France also notes that, if US can service the 23°W-0°N site (US services the 4°N-23°W buoy), the saved vessel time during the PIRATA-FR cruises could be used to make measurements and operations in the South Eastern part of the basin. This would be especially valuable if a 2nd extension can be funded farther in the south...

2) High T/C vertical resolution:

For funding reasons, this issue is closely linked to the previous one. Adding T/C sensors resolution and funding permits more improvements at several sites is also a major priority. Thus, if the SEE is deployed with high T/C resolution, the buoys at 38°W at 8°N (first priority) and at either 4°N or 12°N, 38°W (second priorities) should also be enhanced for salinity measurements in the upper ocean, mainly to trace variability of the Amazon plume and impact of its discharge on the mixed layer & fluxes. The 12°N site could be more relevant than the 4°N one for tracking the Amazon plume and which is the best requires more study before making a final decision. Funding of additional T/C sensors in the West could be ensured by PIRATA-Brazil.

The 0°-0° site enhancement is also justified as it is representative for the eastern equatorial Atlantic. It is in a different regime compared to the already enhanced equatorial 23°W buoy, having a shallow mixed layer and thermocline. Funding of additional T/C sensors could be ensured by PIRATA-France (depending upon resources!).

The most important factor is to underline the strong priority for T/C enhancement, which is clearly justified. Potential order of priority: 6°S-8°E (Congo plume) at the SEE, along 38°W at 8°N and 12°N (and/or 4°N) (Amazon plume), then 0°E-0°N. According to the number of additional T/C sensors, attention has to be paid of the depths (eg: 10m in the mixed layer but also 80m at some locations, e.g. 12°N, to also monitor salty central waters responsible for barrier layer effect).

3) ADCP moorings:

An ADCP mooring has been maintained at 0°N-10°W since 2006 by France, initially deployed in the framework of AMMA & TACE. A new ADCP has been installed, at a depth of 300m, during the last PIRATA FR22 cruise. France suggests maintaining this mooring in the frame of PIRATA. If the usefulness of such current measurements is obvious along the equator in the east, arguments exist to shift this ADCP mooring at 0°E-0°N, where i) different dynamics are active (if compared to 23°W and 10°W), ii) a shallow but more diffuse thermocline is present, and this location being more sensitive to monitor anomalies. It was suggested to maintain the existing ADCP moorings at both 10°W and 23°W while adding an ADCP mooring at 0°E, but France has neither resources nor human power to provide a third ADCP mooring. It was thus suggested to involve GEOMAR and/or RSMAS to see if they could provide a full equipped ADCP mooring that could be serviced during the French PIRATA cruises, at least for a few years. If this is not possible, maintaining the 10°W-0°N is *a priori* a better solution, as a long time series already exists there and would better fit with a proposal by Jim Moum to add χ -Pods (see paragraph 6) on the ATLAS mooring for turbulence measurements (strong vertical shear and mixing at 10°W). This issue will be discussed as soon as possible between partners (IRD, GEOMAR & RSMAS). The proposal by Jim Moum will be submitted to NSF by late 2012 and,

if funded, χ -Pods could then be added (as done in the Pacific) on the 23°W and 10°W site along the equator and close to the ADCP moorings.

4) PIRATA data:

Data availability from the PIRATA cruises is still an issue. Currently, new post-processing routines are developed in Brazil to calibrate the CTD data and all CTD data could be gathered in Brazil (even some calibrated CTD data are still not available through the ftp site from 2010, needed for sensors calibration at PMEL). Attention has to be paid to data format (all cruise data should have the same format). It is suggested that all CTD data could be made publically accessible on the INPE/PIRATA web page, and INPE could provide different data formats (some standard formats are needed, at least NetCTF).

The PIRATA database should also include vessel-mounted acoustic Doppler current profiler (VMADCP) data. There are possibilities to additionally store the VMADCP data on a web site, but the calibrated data will be needed to do that. At present, VMADCP data cannot be adequately processed in Brazil, but a Matlab based post-processing software -VMDAS- has been developed at IFM-GEOMAR, that works for all German research vessels. IFM-GEOMAR is willing to provide the software and teach someone how to use it. One person from Brazil (e.g. Domingos Urbano) should visit GEOMAR for approximately one week as soon as possible to learn how to post-process the VMADCP data. The processed VMADCP data (with at least navigation corrections) should then be sent to AOML to be put on the PIRATA cruise data web site (AOML agreed to serve the data base for the PIRATA ADCP cruise data). France will also send the PIRATA FR data cruises (CTD and VMADCP already treated). A better visibility of the PIRATA program will be ensured once all shipboard data (CTD & ADCP) are gathered in these INPE/PIRATA and AOML data centers.

5) Memorandum of Understanding (MoU) and capacity building:

Do we have to change the content of the MoU by July 2014 (end of the present MoU)? In the future, it is important that PIRATA keeps its flexibility to keep up with the evolving science. PIRATA needs to fit in the scientific programs. The MOU could be modified such that it fits the needs in science in the future. Such a modification could be to allow for more flexibility of the buoy positions, enhancements, etc. or to prolong the commitments of the three countries. Presently, PIRATA supports research and operations, but resource limitations (and human power) are difficult in France and could be critical in the next years if only maintained at this level (or even reduced!). Also, we have to contend with finding ship time and vessel problems etc... PIRATA has to ask to increase support for a new initiatives. It is thus important to make more mention of our relations and collaborations with international 'operational' programs such as GODAE that are also demonstrating the value of PIRATA. PIRATA first needs sustainability (it works mainly because well organized and with good collaborations).

Another issue is capacity building (e.g., refer to CLIVAR AIP recommendations and priorities!). It was suggested that a coordinated effort could be made within PIRATA (perhaps including RAMA and TAO/TRITON) to set up combined programs for PhDs and/or Postdocs. This would require a web site announcement. Fellowships would be excellent to attract students to work with PIRATA data. The Brazilian government is seeking to fund students. As a capacity building program, Brazil can attract African students to Brazil. A tri-lateral supervision of the students should be organized. However, we

have to know if this approach could work. This is a very different approach from the French involvement in Benin (regional Master 2 in physical oceanography and applications created in 2008). Many details need to be clarified, such as the potential number of lead supervisors of the students. The program needs to be detailed in some formal letter or agreement. It seems important to first do a general review about “what is presently done or planned” for capacity building within our community, then a web page could be presented, dedicated to students from everywhere.

However, it is unclear that changing the MoU by adding this capacity building aspect would help to get more support by agencies supporting PIRATA (furthermore, we have to keep in mind that each country has its own priorities and resource limitations).

It was thus suggested that the MOU should not be modified to specify a student program. It is possible that amendments could be added (e.g., T/C enhancements, ADCP mooring at 10°W-0°N, suppression of the meteorological station at São Tomé, support to biogeochemical measurements –see below-, etc.). In order serve the longer term, the MoU should be extended for another 5 year term from 2014 to 2019, even 10 years if possible.

6) Additional measurements, biogeochemistry and data

Even not discussed in detail during the SSG meeting, it is important to mention here that Jim Moum (COAS, Oregon Univ.) contacted M.McPhaden & B.Bourlès a few months ago to evaluate the feasibility to make measurements of turbulence on ATLAS moorings. A fairly reliable method has been developed (and yet validated for several years in the Pacific on TAO moorings). It consists by attaching to the mooring line turbulence sensors (χ -Pods; about the size of a current meter), that internally record all data. This requires no extra ship time and sensors are easy to set up. As shown two days ago during the PIRATA/TACE/TAV meeting (Moum’s presentation, but also Dengler and Hummel’s ones), such measurements are of prior interest to address turbulence and shear-induced mixing (notably in the cold tongue region), and such a proposition has to be welcomed (PIRATA moorings also being platforms for “piggyback” measurements if they do not perturb PIRATA instrumentations & data transmission). Jim Moum will submit a proposal to NSF and, if accepted, χ -Pods could be installed from 2014 along the ATLAS buoys at 23°W and 10°W at the equator, close to the ADCP moorings. Such additional data also offer interesting possibilities for collaboration.

Since 2006, CO₂ sensors are installed on two ATLAS buoys (PI: N.Lefèvre, IRD). These data are made publically available, but they have not yet been included on the PIRATA data web site... So far, no requirements for collecting CO₂ data have been defined in the framework of PIRATA. Moacyr Araujo sent a proposal (by a NOAA/PMEL scientist) requesting support from Brazil, USA and France to buy CO₂ sensors (one each) to be added to ATLAS buoys... In addition to the lack of scientific arguments in the document, this proposal was not acted on by the SSG as CO₂ data are not a central theme of PIRATA as originally conceived and because the partners do not have additional resources for such sensors.

If CO₂ measurements should be done within PIRATA, sustained biogeochemical measurements would require someone on the PIRATA board who has experience with these measurements, and a change in focus of PIRATA (currently PIRATA is a purely physical oceanography and climate array, but one that offers opportunity for “piggyback” sensors and measurements). PIRATA could however evolve to be a more practical/larger view network by extending to biogeochemistry measurements without changing its original vision, by trying to

establish closer contacts with the CO₂ community. So, while adding biogeochemical variables is definitely the way to go in the future (and measuring CO₂ at the buoys is scientifically justified), it is suggested that an expert should be invited to discuss requirements for data sampling during a next meeting. It is clearly recognized that the PIRATA structure allows contributing ship time and a measuring platform as well as a physical interpretation of the CO₂ data. Consequently, exchanges are needed between the three countries of PIRATA and the CO₂ community, in order to get funding for additional CO₂ sensors and then enlist CO₂ experts to join a PIRATA meeting for final agreement. Moacyr Araujo volunteered to draft a response to the PMEL letter encouraging more interaction and dialogue about the opportunity to make CO₂ measurements on PIRATA buoys as part of a systematic long term collaborative program.

7) A few other issues.

Place of the next meeting: the present meeting was organized in Germany, instead of (but in agreement with) France. The 2013 meeting should be in USA. Some wished to have it located in Seattle (and also to visit PMEL) but that seems difficult (security, far in the west, etc.). Furthermore, it is very important to continue, as done since 2009 in Toulouse, to join the PIRATA and Tropical Atlantic (TACE/TAV) communities in joined meetings. Also, US CLIVAR members (more “climate”) could also be invited and potentially more and more interested to look at the Atlantic Ocean. Mike McPhaden suggested organizing it in Europe, with preference in Venice, and will keep in contact with CLIVAR (Atlantic & US) colleagues to confirm the precise location. But it should be around the same period of the year, i.e. in fall (from September to November).

The idea to organize a PIRATA meeting with the “operational” community was also suggested. Some inputs could be provided by Fabrice Hernandez in the next months.

Much work is needed to improve the PICO system, and its operational use is not planned for some years (in contrast, T-FLEX systems, that can transmit in real time all additional T/C sensors could be used in a routine way starting in 2014).

About the TIP Technical Coordination Group (for logistic and technical issues...): this is still a good idea the proposal is at present on standby (everyone is too busy!). Effectively the work envisioned by this group is being done, but on basin by basin level rather than cutting across all basins by one group.

Vessel time is still an issue (Ron Brown problem in US, more due to the vessel maintenance than vessel time availability...). This is an internal US issue, but has to be mentioned to the PRB.

Candyce Clarke recalls (already suggested during the last 2011 SSG meeting) the need to draft a document to provide a vision of the future entitled “PIRATA 2020” (taking into consideration other kinds of measurements, additional sites & instrumentation...).

About the PIRATA SSG composition: all agreed with the present SSG composition.

SHORT SUMMARY for the PIRATA PRB:

- 1) The PIRATA Southeastern Extension is the major priority, and to be endorsed (e.g. the Brazil/France proposal). It could be done as early as 2013 during the next PIRATA FR23 cruise. Funding could be found to buy a 2nd buoy in 2013/2014 to replace it in 2014 and service it in the long term. This site should be a full flux site with current measurements (even internal recorded).
- 2) A second priority is the temperature/conductivity (Salinity) sensors enhancement on the ATLAS buoys, with a 1st priority given to the buoys located on the route of large rivers discharges (Amazon, Congo/Niger), ie SEE and along 38°W (north of 4°N) then at 0°-0°.
- 3) Attention has to be paid to vessel time (or vessel maintenance), resource and human power in each partner country. The case could become serious in France in the short term...
- 4) It is important to consider capacity building, but it is not especially relevant to mention it in the PIRATA MoU. The MoU should be extended without changes (but maybe amendments) for 5 to 10 years. Administrative expediency should be given consideration given how difficult and long the process can be for approving new MOUs.
- 5) Extension of PIRATA to CO₂ (and more generally to biogeochemistry) measurements has to be taken into consideration, but PIRATA is not initially developed for this. Closer collaborations have to be established with the CO₂ community in order to develop a more systematic CO₂ program in PIRATA.