REPORT of the

PIRATA-9 Meeting

03-05 February 2003
Angra dos Reis, Rio de Janeiro, Brazil

Introduction

This document contains the summary of the presentations, discussions and main conclusions of the PIRATA-9 meeting, held at the city of Angra dos Reis, Brazil, days 03-05 February, 2003. The final Agenda of the meeting is presented in the Appendix 1. The Scientific Papers Section agenda and the abstracts are found in the Appendix 2.

DAY 1: February 03, 2003
Morning (08:30 – 12:30) Chair: J.A. Lorenzzetti; *Rapporteur: P. Nobre*

Opening Ceremony

João Lorenzzetti: addresses the audience with welcome words, recalls the PIRATA Project objectives and proposes the following PIRATA-9 meeting goals:

- Evaluate how the proposed PIRATA goals are being achieved;
- Verify difficulties faced and propose possible solutions;
- Discuss the adequacy of the proposed extensions, and
- Discuss the operational and logistic problems and the proposed solutions

Jacques Servain: Thanks and says welcome words. Stress the problems of the array that need to be discussed and solved

Janice Trotte (DHN): Thanks words; Brazil has taken part in PIRATA since the beginning, 1st meeting in Natal (PIRATA-1), 1996; PIRATA-SW Extension will offer the opportunity to obtain data sets to increase the knowledge of climate system toward improved predictability of climate.

Carlos Nobre: Thanks words; Then a short story was told: “for about 200 years, Ilha Grande bay was the port of export of Gold from Minas Gerais state to Portugal. Gold transported in back of mules through the sierras to Angra dos Reis, … and this area was infested with pirates… 200 years latter, we welcome the “new pirates”, which will bring the knowledge necessary to have the complete picture of the role of the ocean in the global climate. The success of the PIRATA is important to understand climate predictability and change.”

National and International Status and support of PIRATA (original array)

A) INTERNATIONAL STATUS: J. Servain

Shows the original array configuration: 1997-2001 the 12 sites were maintained; however, due to (fisherman) vandalism in the east, 2N-10W and 2S-10W buoys were discontinued during the consolidation phase (to 2005). Tide gauges were planed for SPSPR and Atol das Rocas but are not operational in real time; Met buoy at 0N-44W is also not operational.

2001 PIRATA cruises
PIRATA-BR-IV cruise: 5 sites maintained by Brazil in the western part of the PIRATA array.
PIRATA-FR-9 and FR-10: 5 buoys replaced in the central and eastern part of the PIRATA array, including a new buoy at 0N-10W (vandalized a few months before); for the first time le site 0N-23W (Jazz) was maintained by the French; Two ADCPs lent by Brazil deployed at 0N-23W and 0N-10W; Showed PIRATA-FR-10 ship tracks and ADCP data picture.

2002 PIRATA cruises
PIRATA-BR-V (two ships; R/V Antares and R/V Amorim do Valle): The 5 PIRATA-BR buoys replaced (four along 38W and one at 0N-35W)
PIRATA-FR-11 (RV Le Suroît): The 5 buoys serviced, including new buoys at 0N-10W (Java) and 0N-0W (Soul) which were previously vandalized (Jan 2002). Removed ADCPs moorings at 0N-10W (Java) and 0N-23W (Jazz); Showed ship track for PIRATA-FR-11; At present, all the 5 PIRATA-FR buoys are operational.

Site to site information
15N-38W “Reggae”: technical failure in Nov/2002, no real time data transmitted,
12N-38W “Forro”: operational,
8N-38W “Lambada”: operational,
4N-38W “Frevo”: operational,
0N-35W “Samba”: mechanical failure from Oct/2002; no real time transmitting from subsurface sensors
0N-23W “Jazz”: operational,
0N-10W “Java”: many missing periods, presently operational; four buoys lost in this site
6S-10W “Valse”: continuous, operational
10S-10W “Gavotte”: gaps due to mechanical failure; presently operational
0N-0W “Soul”: lost 3 buoys at the same site, presently operational

Map of present: 10 sites operational; SEE extension with 3 buoys, NEE with 3 buoys; SWE with 4 buoys; ADCPs at 0N-10W, 0N-23W

2003 cruises
PIRATA-FR-11bis: only visual survey of Soul and Java
PIRATA-BR-VI: R/V Antares, June-July 2003, 5 PIRATA-BR will be processed.

PIRATA FR-12: still not certain, no R/V yet scheduled at the time of the PIRATA-9 meeting; R/V Antea continues to be broken in Abidjan; civil war in Ivory Coast may impede the use of Antea during 2003; Other R/V might be used, but to date French commitment has not been stated.

2001-03 PIRATA meetings
PIRATA-8 + PRB-3 Paris Aug/01
PIRATA-9 + PRB-4 Angra, Feb/03 during the core of consolidation phase ...

B1) PIRATA-FRANCE STATUS: J. Servain

PIRATA-FRANCE 2002-3 FUNDING

Regular PIRATA funding (ship, material , cruises travel, meetings, etc
IRD 55 K $ in 2002
IRD 15 K $ in 2003
Météo-France 24 K$ in 2003
Total = 94 K $

Additional funding: return from 2002 15 K$
French Research Department 40K $
Total = 150 K$

French participation 2002 = 70 K $
23 days ship 23 * 8.1 = 186 K $

Grand total 256 K US $ (excluding salaries and research money)

B2) Cruises data report: Bernard Bourles

PIRATA-FR11 used IFREMER R/V Atalante; launched drifters, deep sounding buoys, ADCPs. Did all 5 “French” moorings in one branch of the cruise
Will do other cruise next week (PIRATA-FR11bis): along eastern equatorial Atlantic; XBT along equator, other experiments.
2003: IFREMER has ships in transit; will travel from French Guiana to Africa. Will not be able to serve 6S-10W and 10S-10W.
“I hope that in 2004-05, it will be possible to service PIRATA eastern (but not 0N-23W).”
São Tomé Island will be instrumented with a meteorological tower with the same sampling parameters as the ATLAS buoys.
PIRATA data during the cruises: ADCP, XBT, CTD available in the PIRATA anonymous ftp site in France.
Salinity data at 6S-10W underestimation of surface salinity: sensor should be placed at depth 20m .
Data recovery of the four Eastern sites present several gaps, but 6S-10W and 10S-10W are good (continue)

Figure shows heavy tuna catch along the eastern equatorial region; Tuna fish catch has inter annual, as well as, seasonal variations.

Problems: Antea availability (no way to take it from Ivory Coast); sfc salinity sensor.

Question: of the three (?) types of failure: stop transmitting, mechanical failures, which is due to vandalism?

B3) ADCP Mooring Report: C. Provost

Moorings at 0N-10W 12/1999-12/2000 (Equalant mooring); Showed Equalant ship track 1999 and 2000 cruises; ADCP was very shallow because WH 300 Hz (sampled only the top of the undercurrent); PIRATA ADCP: 0N-23W and 0N-10W; Only 23W comprises deep current meters (?); 0N-10W recovery shows primary productivity, still too shallow sampling; Showed one year of 23W current data plot.
What next?
0N-23W ADCP with deep current meters
0N-10W the same, plus CTD…
During 2005: a proposal was placed, and accepted, to maintain the 23W and 10W ADCPs (Jacques: verify this, it is obscure the writing)

M.McPhaden: we should prioritize the sampling of continuous ADCP time series, for example, using the two ADCPs in one single site (0; 23W, e.g.) instead trying to sample two sites, but risking to have big gaps and no continuity in any place.

C) PIRATA-BRAZIL STATUS: J. Lorenzzetti

Mentioned Amorim do Valle as a second DHN ship to service PIRATA array; Shows PIRATA Brazil cruises history: 1998-2002; Cruises generally start and end in Fortaleza, with mooring materials stored in Natal; Shows history of PIRATA Brazilian sites 1999: 4N-38W mooring lost at sea; Subsurface sensors are showing a large amount of real time data lost (stored internally, though); Showed PIRATA-BR-V ship track; indicating which ships (Antares and Amorin do Valle) serviced each buoy; Showed ADCP velocities collected by Antares at several levels (sfc to 125 m).

Logistic problems:
Large loads of equipment need to be shipped to/from Seattle; Bureaucratic import/export problems with customs in Brazil; Documentation prepared by NOAA do not match the shipped material. Some equipment are brought in and/or taken out to USA in hand, without documentation. DHN ONLY oceanographic ship (Antares) has other cruises to service, and this represents a major bottleneck to secure PIRATA maintenance cruises; Brazil is working to equip Amorim do Valle as a second ship. If another ship from NOAA or the France could be available it will help.

Brazil's ship time for 2003-2004 has been committed by DHN

PIRATA Budget: DHN and INPE are using inside money to fund PIRATA
2002 expenses: DHN ~ US $ 140 K, INPE ~ US$ 25K
PIRATA-BR is organizing an expanded National Committee, involving other institutions (IOUSP, FUNCEME,…)
Shows some points of the Terms of References of the proposed new PIRATA National and Logistics Committees.

A plot of Fernando de Noronha met station wind speed time series handed by P. Nobre was presented.

D) PIRATA-USA STATUS: C. Beaverson

Cruise activity since PIRATA-8
92 person-day at sea;
Optical sensors (Ajiit) at 8N-38W, 3.6 and 9.6 m depth, transmitter went down one month after deployment. Hopefully, data is being recorded internally;
Equip. inventory: Brazil 2 complete buoys, France 1 buoy, Nigeria 1 buoy
Shipments: successful to/from France and Africa
Delayed shipment from Brazil: April 2001 cruise (PIRATA-BR-IV) returned Jan 02
Apr-02 cruise (PIRATA-BR-V): partly received

Shipping issues:
Problems: insufficient detail and errors in manifest; Time delays associated with customs. Current system is inflexible in problematic situations, for example, when recovery of drifting mooring occurs from other vessels.
Potential solution proposed could be in-bound shipment directly to the vessel
Real time date return Oct/01-sept/02:
- ✓ ~90% over western ATL
- ✓ 20-80% over eastern ATL
- ✓ average: 71%

Last 5 years:
- ✓ average 70%
- ✓ western: ~80%
- ✓ eastern 20-80%

Vandalism: problem sites: 0N, 0W; 0N, 10W
PIRATA web page statistics:
- ✓ 2002: 100 K accesses.
- ✓ Total user requests 979
- ✓ Total data files delivered: 5313

Data delivery and display is going to appear in one page
Salinity processing: post recovery module calibration: calibrate as recovered, compare sensor data with CTD…
PMEL publications: 4
Global Eulerian Observatories working group formed: PIRATA plays an important role
Objectives: integrate ocean observing system that includes time series stations…
PMEL 2003 activities

Staff and equip PIRATA cruise BR-VI (Antares)
TAO transition: transferring TAO-PIRATA array from PMEL to National Data Buoy Center.

M. McPhaden: GEO group feels that the PIRATA buoys should be upgraded to include sfc flux measurements and biological sensors.

J. Trotte: Pie charts showing the kind of the users of PIRATA data are useful to demonstrate the relevance of the PIRATA array to society.

M. McPhaden: Standard PMEL web page statistics can be used to display such information. Bad PIRATA salinity dataset used by a French researcher (with drift inside), was raw data, not post processed after recovery.

E) International and national institutions supporting PIRATA

Cm. L. Oliveira, DHN:
Organization chart, Amorim do Valle, DHN at Niteroi, Rio de Janeiro; Chronology of PIRATA BR-V; Statistics: Antares/Amorim do Valle: 3/2 buoys launch/recovery.
Presented detailed report of PIRATA BR-V operations.

J. Trotte (IOC/GOOS):
IOC opened an IOC/GOOS office in Brazil (at DHN); has an officer in charge (in part time basis). Is willing to serve as the technical secretary of the PIRATA. Will work together with local and regional institutions linked to PIRATA.

T. Bussalacchi (CLIVAR):
Shows main panels within the project: VAMOS, PACS, …; Shows slide depicting TAV, MOC, NAO, ENSO interactions. PIRATA provides the Atlantic background to link the various projects.
South America projects: LBA, PATIN, SALLJ, VEPIC…
Shows South Atlantic monsoon modulation by SSTA
Shows AMMA study area over Africa – Observation period: 2004/05, in collaboration of Western Africa Monsoon Project
Atlantic major projects taking place; PIRATA array: what observations are necessary over the South Atlantic that can help understand the processes over the continents?

J. Boulégue (IRD):
This year (2003) IRD has done efforts to obtain funding within France: IRD is part of the AMMA project; through which some of the PIRATA activities are being done; IRD is participating in the formation of the “Nordeste Climate research center…”
Concerns with the R/V Antea: Political turmoil in Ivory Coast, might hamper the use of Antea in the near future.
IFREMER is hindered to participate in PIRATA due to circumstantial use of its naval resources (“Prestige” ship tanker sunk off the coast of Spain)

Within the 4-5 years, IRD is willing to increase its contribution to PIRATA, with Brazil and the USA.

G. Caniaux (Météo-France):
Will continue participation in PIRATA. Needs the data coming from PIRATA for operational forecast systems in France and by ECMWF.
Specific research campaign (Equalant cruises), SST measurements to validate PIRATA measurements

M. Johnson (OGP/NOAA):
Support to PIRATA is stronger than it has ever been. Priority of the present NOAA´s director is to strengthen the global climate observation program.
Priority to build and sustain a global climate observation system that will respond to the long term observation required by operational forecast centers, international community…
Initial System Design of the system (PIRATA-SWE included in the figure); 40% is now in place. In the Atlantic, PIRATA is the backbone of the observational system.
Partnership is central to assemble a global climate observing system: integration along 3 axis:

- Climate services
- US integrated ocean obs system
- International implementation: PIRATA is an important component to be part of the global oceans observing system.

Afternoon (14:00 – 18:00) Chair: B. Bourles; *Rapporteur*: G. Caniaux

Presentation of the Science and Implementation Plans of the PIRATA Extensions

PIRATA-SEE:
A presentation of main aspects and scientific justifications of the PIRATA-SE Extension proposal was given by M. Rouault as the Chairman of the PIRATA South East extension committee. The Draft document of this extension proposal was provided during the meeting.
Basically 2 or 3 ATLAS moorings are proposed in the areas of the “Benguela El Niño” and immediately at the North of the Benguela Front. The main objective is to follow the occurrences of the “Atlantic El Niños” along the South Eastern African coast and to provide operational elements of the climate observing system in this region which is well related with the rainfall anomalies in the Southern Africa.

PIRATA-NEE:
Jacques Servain read the following statement prepared by D. Azzedine and A. Orbi *Co-Chairs of PIRATA-NEE* who could not be present to the meeting.
“The PIRATA-NEE Project rose from the PIRATA-NEE-1 Workshop of Casablanca 29-31 March 2000 when the countries of Morocco, Mauritania, Sénégal, Côte d’Ivoire, Guinea and Capo Verde declared their adhesion with the objectives of the

original PIRATA Program and their agreement of participation in the extension of buoys towards the North-East of its original network.

The PIRATA-NEE Project has as a strategic objective to study the ocean-atmosphere interactions on the West African regions and their impacts on the climatic variability. It will allow, in particular, to study the influences of this interaction to the West African areas (precipitation mode, fisheries, currents etc).

The DMN of Morocco, which chairs the group PIRATA-NEE, has prepared in 2001 a first draft (in French) of a "Scientific plan of implementation" document which gathered argumentation and scientific interest of such extension. This document also presented some elements of an operational plan of implementation with a financial estimate of the operations within the framework of the project.

Currently the efforts must be focused with an aim of reactivating the adhesion of the Member States around the project and of seeking the possibilities of financing.

Casablanca, Morocco
27 January, 2003"

PIRATA-SWE:

A presentation was given by P. Nobre which was complemented by E. Campos stating the main scientific and practical points related to the Brazilian proposal. The final document is being finilized and a draft version of it was handed to the audience.

Basically four new ATLAS moorings are being suggested at the following positions :

a) 8 S-30 W
b) 8 S-25 W
c) 14 S-32 W
d) 20 S-34 W

Open discussion on the adequacy between the 3-extended projects and the original array

-J. Servain puts the word "adequacy" in terms of increasing the capability of explaining the variance of the signals captured by the array. Considering the original configuration of the PIRATA array, privileging the meridional and zonal components of the SST variability, it is expected that it could capture nearly 40% of the variance of spatial-temporal patterns; are the proposed extensions able to improve the explained variance to, for example, some 60 or 70%? One problem to address is the weak signal of the Atlantic basin compared to the Pacific due to the complexity of processes influencing the SST.

-T. Busalacchi addresses the question of number of moorings positions and insists on the flux variability, on the outcropping zone in the Southeastern basin (far from the Brazilian coast and the planed mooring locations), and if this variability downstream is able to modify the SST fields.

-P. Nobre evokes the partition (bifurcation) of the currents near the Brazilian coast, this region impacts on the climate scale; the transport partitioning

should have an impact on SST. The four SWE moorings coverage is suggested in order to catch the SAC divergence zone.

-T. Busalacchi insists on the following points: where does the maximum of variability of the fluxes occur? Is the SST variability forced by ITCZ, or the contrary?

-C. Nobre asks then the problem of the complex response of the SST and if there is a real coupling between SST and the atmosphere, and thus insists on the necessity of data in this particular area.

- M. Rouault asks the question of investment in moorings (what occurs if they get funding?) and the relation with PIRATA data policy.

- M. McPhaden answers that the moorings have to be paid at this stage, and that the ATLAS buoys data center will be transferred from PMEL/Seattle to the National Data Buoy Center (NDBC). According to M. Johnson, this transfer will be, however, transparent for the scientific community and the partnership will be preserved to continue to support PIRATA.

1) Discussion on the context setting for PIRATA input to the SACOS meeting (T. Busalacchi / E. Campos)

Motivations of SACOS:

- To provide an overview of the scientific understanding of the South Atlantic (SA) influence on the regional and global climate.
- To discuss existing, and identify needed elements for SA observing system required for a more complete understanding of the climate system in regional and global scales.
- To integrate the region's diagnostic, modeling and observational communities and to develop join actions and principles for a long term observing strategy.
- To identify potential funding sources and associated operational partners.

DAY 2: February 04, 2003
Morning (08:30 – 12:30) Chair: A. Busalacchi; *Rapporteur*: A. Lazar

Scientific Papers related to PIRATA *(15 + 5 min. each one)*

This Section was devoted to the presentation of scientific papers related to the main scientific goals of PIRATA. A total of 12 papers were presented. See the abstracts in Appendix 2b.

Afternoon (14:00 – 18:30) Chair: C. Nobre; *Rapporteur*: J. Todd

PIRATA Consolidation Phase (to 2005): Needs/Problems/Suggestions *(Open Discussion)*

José Nilson Campos (FUNCEME, Brazil) - The Climate Forecasting and Applications

- The scientific Director of FUNCEME made a presentation of FUNCEME´s main mission and activities related to climate forecasts and hydrology and the social impact of such areas of activity in the Nordeste region of Brazil

J. Servain - "The PIRATA Main and Small Problems (2002 and 2003) and some solutions"

NOTE from the Chair/Rapporteur: "Some of the following solutions" described below are those of J. Servain, and are NOT necessarily the opinion of the gathered plenary participants

- Still have ATLAS buoys lost or damaged in 2001-02 by vandalism
    - Java – ended Dec 2001 (about 2 months after deployment) total loss
    - Soul – beginning Jan 2002 (about 1 month after deployment partially lost
    - Solution: a dedicated ship with a 6 month survey cycle, as in the Pacific, would attenuate the data gaps
    - M. McPhaden – sending ships twice as frequent may mean we lose twice as many moorings
    - B. Bourlés – need moorings for 2005 experiment, though

- Still have ATLAS mechanical failures
    - Example: Gavotte, Reggae and Samba: the problem was the connection between the mooring line and conducting cable
    - Solution: Use heavier bolts on top section; moorings with new hardware are working well
    - This was a one-time problem; it should not happen again (M. McPhaden)
    - What are alternatives to moorings in the eastern tropical Atlantic? (J. Lorenzzetti)
    - Is there any other scientifically sound way of getting the same information?
    - High risk region (vandalism, fishing)
    - J. Servain: need to wait until the end of consolation phase in 2005 to change tactics
    - J. Lorenzzetti: data return is minimal in some places, so moving the mooring would not result in significant the loss of data continuity!
    - C. Nobre : Are you consolidating anything (if you can't keep the instrument there)?
    - M. McPhaden: agrees that we need to keep on trying in these difficult-to-study regions
    - Perhaps subsurface package (fisherman will still find them) only
    - Very feasible in the near term, use existing floats with no surface met package
    - Surface float, subsurface instrumentation and Argos transmitter
    - Longer term solution is a smaller buoy
    - T. Busalacchi: Why not use John Toole's moored profiling system?

    - How long does mooring last before failure? Need these numbers for every mooring and then you can set your threshold; do all the mooring sites deserve a remedy?

- Still weak use of PIRATA data in the modeling assimilations (assimilation in the numerical models is complicated with intermittent and extensive data gaps in the time series)
    - Solution: the availability of a dedicated ship with two maintenance cruises per year would, probably, result in less and smaller data gaps. The better data stream could also improve assimilation process(J. Servain).
    - T. Busalacchi: doesn't agree that Servain has justified a dedicated ship. The rationale behind the claims for a dedicated ship is not clear at a time when the operational demands for the data are uncertain. This discussion should also contrast the situation in the Atlantic versus the evolution in the Pacific and the phasing of a dedicated ship in parallel with an operation demand for the data.

- Raw daily data transmitted by Argos not easy to access and process in real time by other institutions besides PMEL
    - Solution: availability of the processing and quality control software used by PMEL
    - T. Busalacchi: ECMWF uses it right off the GTS!
    - C. Nobre: has had similar problems with the data
    - M. McPhaden: about 1.5 years ago corresponded with J. Lorenzzetti about using the Brazilian satellites to capture PIRATA data.
    - J. Lorenzzetti: in principle it is possible to capture Argos data transmissions from the Brazilian satellites but still some problems have to be solved:
    - Didn't go as fast since Brazil's Argos reception station is too far away from PIRATA array;
    - Brazilian satellites pass 14 times a day over the region but can't use all uplinks because PMEL sets the Argos transmission to only a few times a day according to NOAA satellite passes;
    - M. McPhaden: concerning changes in configuration of the system, massive undertaking; took 20 yrs to develop; need to think how to do this; involves technical staff sharing and a lot of monetary support (JAMSTEC did this with TRITON); How many versions of PIRATA data do we want?
    - C. Nobre: if PIRATA doesn't last beyond 2005, then it would not be worth it. If it exists after 2005, it's worth it.
    - M. McPhaden: suggests small steps first, NOT GIANT STEPS!
    - Brazilian technicians need to learn how to deploy ATLAS systems; this is very important
    - Lots of small steps could move us more meaningfully into the future
    - J. Lorenzzetti: at this point in time, Brazil doesn't have people that can be dedicated to this task in the same way as PMEL; hopefully

Brazil will have with the emerging structure he spoke about yesterday; an improvement in this regard is expected working together with University of Sao Paulo and other Brazilian institutions.
    - C. Nobre: CPTEC has funding to send one person to PMEL for training and hope to get funding for more.
    - J. Servain: mentioned a course made by a PIRATA-French engineer being offered to process the PIRATA data (in June 2003 at DHN)
    - one solution is to make a center for this activity in Brazil
    - Still few and sparse ADCP data.
    - Solution: to buy other materials (e.g. WH 75 KHz) more adapted and more numerous; fund the real-time transmission of data
    - M. McPhaden: mentioned the ADCPs in the Pacific; not real-time data; likes the instrument now, after 4 years; US $ 7,000 from manufacturer and then PMEL modifies it for the application. Agrees to more velocity measurements, but with the ones we have, strongly recommends that we need to make a priority of a continuous record at 0N-23W. When the ADCP data will be made available?
    - C. Provost: the data is not yet in a clean processing stage. A six month period for priority use will be put, when a joint effort between France and Brazil participants will be analyzing and preparing the first papers on the data. After this period, the data will be delivered to be put in the Web.
    - J. Lorenzzetti: are there any other groups who might have ADCPs that they would want to install in the PIRATA region? Most expensive part is the shiptime that is already available.

- Still delay in the return of the Brazilian cruise sensors (and high frequency PIRATA data)
    - Main cause = customs complications; a major problem (PMEL Invoices is sometimes a problem)
    - Solution: a single dedicated PIRATA Center with routine import/export of material. This could reduce delays and improve the PIRATA procedures
    - McPhaden: we're in trouble if we have to wait for a center to move equipment into and out of Brazil!!! Waiting for a center is not a strategically worthwhile idea
    - C. Nobre: Amazon experiment has about 20 times more equipment than PIRATA and they learned how to do this well. There is a dedicated LBA Office at Goddard Space Flight Center that has helped.
    - T. Busalacchi: LBA is a multi-national experiment. They have a track record that precedes PIRATA, so we can learn from this! PIRATA needs to learn to work with the customs situation.

- Meteorological station at 0,44W, tide gauges at St. Peter-St. Paul Rock (SPSPR) and Atol das Rocas not installed
    - Solution: no real solution yet

- PIRATA-France cruise in 2003 is not yet resolved
    - Solution: no solution yet
    - B. Bourles/Provost: they will get a cruise but not sure what the time schedule is.
    - M. McPhaden: Bernard (Bourles), you mentioned R/V Atalante could go along the equator but not to 6S-10W and 10S-10W; our philosophy should be that we service ALL of the array; even if more ship time need to request it.
    - B. Bourles: he agrees with M. McPhaden's statement

- A lack of visibility of the PIRATA data use and a relative ignorance in the published works using the PIRATA data set
    - Solution: a sensitive question; a need for a thorough search into existing technical published papers database
    - T. Busalacchi: a lot of papers may not acknowledge PIRATA. Data download requests this on PIRATA web site (McPhaden), but it doesn't mean everyone does this.
    - M. McPhaden: This is more than an accounting question. How is data being used? Is it making an impact?
    - T. Busalacchi: recent meetings he has attended have mentioned PIRATA data, but the ones who are using it don't know it is, in fact, PIRATA data (e.g., scatterometer meeting)
    - C. Nobre: developing countries need to be incorporated in data workshops for PIRATA data visibility; this is a capacity building issue; they did this for TOGA/COARE and it was hosted by Météo-France (T. Busalacchi)
    - J. Trotte: Brazil should look to sponsor a data processing/analysis meeting
    - Tide gauge: Brazil is revising its network
    - J. Lorenzzetti – operational centers should be asked what use of the PIRATA data is being done.
    - T. Busalacchi: As you may recall, we heard Tim Stockdale's talk (in Paris); Stockdale said that PIRATA data is used operationally at ECMWF

- Still a lack of security of funding (France, Brazil, U.S.) year after year
    - Solution: funding coming from operational sources independent of research
    - J. Lorenzzetti: PIRATA is somewhat peculiar in that it is not truly operational and is not a typical research project; this makes it difficult to convey to funding agencies in Brazil
    - T. Busalacchi: how come we never have a Mercator/Coriolis person at PIRATA meetings?
    - M. McPhaden: PIRATA funding is reasonably secure, although year-to-year, through the consolidation phase

- B. Bourles: brief overview of the Coriolis Project
  - 2000-2005
  - Linked to Mercator and Jason Projects
  - Focus on the Atlantic
  - PIRATA is key in the framework of Coriolis
  - T. Busalacchi: need better collaboration with this group!!
  -
- M. McPhaden: 2005 is very near. Need specific list of objectives to be used in an evaluation at the end of the consolidation phase. Acceptable data rate, for example (Busalacchi)

- T. Busalacchi: Also need to establish criteria for the extensions to the array

- M. McPhaden: a good goal would be to have the Brazilians being able to deploy ATLAS moorings by the end of consolidation phase

- P. Nobre: not helping to sustain PIRATA if we get too rigorous scientifically; Extensions shouldn't be treated any differently than the original array (T. Busalacchi)
  - J. Trotte: What have we not done with respect to the SWE and CLIVAR?
  - White paper has not been done yet, T. Busalacchi said that M. Visbeck, as Chair of the International CLIVAR Atlantic Implementation Panel even asked several months ago about status about white paper. His impression was that the authors of the extensions were not serious (T. Busalacchi)
  - Need to look for a middle-ground, and not make criteria too rigorous, so that we don't exclude countries that see a project's benefits close to home (C. Nobre)

Pending issues (continued after coffee break)

J. Servain (IRD): Maintenance of PIRATA array
- PIRATA extensions
  - NEE – in standby
  - SWE – document in progress
  - SEE – document in progress
- Atlantic Observations Working Group (AOWG)
  - Define needs for a dedicated ship, operational center
  - Work in tropical and south Atlantic
  - Guarantee the Argo program in the South Atlantic
- Improve integration of PIRATA with other ocean climate observing systems in the tropical and south Atlantic

PIRATA Long Term/Operational Phase (after 2005): Needs/Problems/Strategies

- J. Lorenzzetti: Proposes a workshop at the end of the consolidation phase to discuss what should be modified
- C. Nobre: strategy should be to get other countries involved in operational oceanography; mid-ocean arrays; PIRATA is a good example

DAY 3: February 05, 2003
Afternoon (14:30 – 16:30) Chair: J. Servain; *Rapporteur*: J. Lorenzzetti

PIRATA Resources Board (PRB) Meeting report, conclusions

The following is the summary report of the PRB Meeting held February 03, 2003 at Angra dos Reis presented by Mike Johnson, the Chairman of that Board.

i) Long-term ship requirements: Established a special Working Group to "define the needs for ocean observations in the Tropical and South Atlantic, options for meeting those needs, and associated ship requirements."

- Evaluate the NOR-50 prospectus and other possible solutions.

- Consider PIRATA and other international programs for operational oceanography
  - SACOS Workshop will provide significant foundation for defining requirements.
- The working group is a committee of approximately one-year term for the purpose of delivering a special report to the PIRATA institutions.

- Recommendations for PIRATA institutions, but other interested institutions/countries will be invited to review and comment.

ii) Near-term ship requirements.

- DHN has scheduled ship support for the next two years in the west with ANTARES as primary and AMORIM DO VALLE as contingency.

- IRD has obtained French Navy support for the east.
  - New Naval oceanographic vessel – BEAUTEMPS-BEAUPRE – maiden voyage in 2003

iii) Accelerated field technician training for Brazil to maintain in-country expertise similar to France and USA.

- Two engineer/technicians -- probably INPE plus University of Sao Paulo.

- PMEL will invite technicians for lab training and experience aboard TAO ship.

iv) The PRB encourages the SSC to consider alternate technologies to replace ATLAS in high vandalism locations.

Final discussions & recommendations

1 – Cruises – 2002 / 2003 (a recall …. see before)
2 – Data Return
- Statistics (still too low data return)
- Vandalism (again and again …)
- Technical failures (was a problem in 2001-2003 …)

Decision: to continue with Java (0N-10W) and Soul (0N-0E) sites up to 2005 (end of the Consolidation phase)

Decision: investigate alternative technologies that could decrease vandalism.

Task: PMEL is already working in the issue and will continue doing so.

3 – Training (POGO, …)

Need for speed the training of personal for maintenance of mooring.

Task: CPTEC should lead the actions to select and get appropriate funding to send Brazilian technician/engineers to PMEL for training.

4 – Recommendation to comply with the following planning
- Tide gauge at SPSP Rock
- Tide gauge at Atol das Rocas
- Meteorological Buoy at 0N-44W

Task: this issue has not yet be solved; a particular effort must be done by PIRATA-BR Committee

5 – Suggestion for the implementation of a PIRATA Data Analysis Workshop in 2004 with support of sponsoring organizations.

Task: INPE/CPTEC and IOUSP should organize the event in Brazil

6 – A more close relationship with Operational Agencies, users of PIRATA data; an effort should be done to have their participation in next meetings.

Task: this is to be done by the Chairman of the SCC

7 – PIRATA could benefit from the EU “Framework Program VI”, where substantial funds are likely to be assigned operational oceanography initiatives to developing nations that are partners to European countries.

Task: J. Trotte will be the contact to verify the real possibility of this opportunity in PIRATA

8 – Action should be done to stimulate the publication of papers using PIRATA data set.

9 – Extensions
- NEE in stand-by
- SEE and SWE were presented and drafts of White Documents were handed during the plenary session.

- A guidelines document is being prepared by the SSC (see Appendix 3): all proposals for extensions to the original back-bone array should be evaluated according to these guide lines.

10 – The new compositions of the SSC was presented

- Paulo Nobre replaces Ilana Wainer
- Edmo Campos replaces Antonio D. Moura

11 – PIRATA-10 meeting scheduled tentatively to be hosted by University of Maryland in 2004, or in Cape Town (South Africa); decision will be taken latter .

Closing ceremony

J. Lorenzzetti asked C. Nobre to address the audience on behalf of CPTEC/INPE, thanked again all the participants and declared closed the Meeting.

Appendix 1

PIRATA-9 Meeting

03-05 February 2003
Angra dos Reis, Rio de Janeiro, Brazil

AGENDA

DAY 1: February 03, 2003

Morning (08:30 – 12:30) Chair: J.A. Lorenzzetti; *Rapporteur: P. Nobre*

1) Opening ceremony
2) National and International Status and Support of PIRATA (original array)
   a. Introduction - J. Servain
   b. PIRATA-France:
      b1 Status and national report - J. Servain
      b2 Cruises data report - B. Bourles
      b3 ADCP Mooring report – C. Provost
   c. PIRATA-Brazil: Status and national report - J. Lorenzzetti / P. Nobre

Coffee Break

   d. PIRATA-USA: Status and national report + ATLAS data report (C. Beaverson)
   e. International and National Institutions Supporting PIRATA: DHN (Comm. L. Oliveira/J. Trotte), IOC/GOOS (J. Trotte), CLIVAR (T. Busalacchi), IRI (A. Moura), IRD (J. Boulégue), Météo-France (G. Caniaux), OGP/NOAA (M. Jonhson)

Afternoon (14:00 – 18:00) Chair: B. Bourles; *Rapporteur*: G. Caniaux

2) Presentation of the Science and Implementation Plans of the PIRATA Extensions
   - PIRATA-SEE (+ discussion) (M. Rouault)
   - PIRATA-NEE (+ discussion) (J. Servain)
   - PIRATA-SWE (+ discussion) (P. Nobre)

Coffee Break

3) Open discussion on the adequacy between the 3-extended projects and the original array.
3) Discussion on the context setting for PIRATA input to the SACOS meeting (T. Busalacchi / E. Campos)

DAY 2: February 04, 2003

Morning (08:30 – 12:30) Chair: A. Busalacchi; *Rapporteur*: A. Lazar

Scientific Papers related to PIRATA *(15 + 5 min. each one)*

Afternoon (14:00 – 18:30) Chair: C. Nobre; *Rapporteur*: J. Todd

a) PIRATA Consolidation Phase (to 2005): Needs/Problems/Suggestions
b) PIRATA Long Term/Operational Phase (after 2005): Needs/Problems/Strategies

DAY 3: February 05, 2003

Morning (08:30 – 12:30) Chair: M. Johnson; *Rapporteur*: (tbd)

PIRATA PRB Meeting (On invitation only)

Afternoon (14:30 – 16:30) Chair: J. Servain; *Rapporteur*: J. Lorenzzetti

1) PRB Meeting report, conclusions
2) Final discussions & recommendations
3) Closing ceremony

Appendix 2
PIRATA-9 Meeting

03-05 February 2003
Angra dos Reis, Rio de Janeiro, Brazil

Scientific Papers related to PIRATA *(15 + 5 min. each one)*

AGENDA
DAY 2: February 04, 2003

Morning (08:30 – 12:30) Chair: T. Busalacchi; *Rapporteur*: A. Lazar

1. "How do subsurface teleconnections affect low latitude thermocline and SST?"
A. Lazar, LODYC/France
2. "Southeast Tropical Atlantic warm event and South African rainfall."
M. Rouault, Univ. Cape Town, South Africa
3. " Origin of warm and cold events in the Southeast Tropical Atlantic."
P. Florenchie, Univ. Cape Town, South Africa
4. "Modes of decadal variability in the South Atlantic. Results of coupled Ocean-Atmosphere models."
E. Campos, IOUSP, Brazil
5. "Sources of errors in seasonal climate predictions for Northeast Brazil."
Claudine Pereira, CPTEC, Brazil
6. "The use of PIRATA data for climate monitoring and predictions in Brazil."
P. Nobre, CPTEC, Brazil

Coffee Break

7. "On the oceanic impact of a data assimilation method over the tropics."
C. Tanajura, LNCC/MCT, Brazil
8. "How good are Quikscat winds to estimate surface heat flux components during PIRATA wind gaps?"
J. Lorenzzetti, INPE, Brazil
9. "Surface heat flux estimates for the Tropical Atlantic using PIRATA data"
G. Castelão, Graduate Program Phys. Oceanogr., IOUSP, Brazil.
10. "Seasonal mixed layer heat balance in the Tropical Atlantic Ocean."
M. McPhaden, NOAA/PMEL, USA
11. "On the relationship between the Tropical Atlantic heat flux variability and the convective systems."
B. Durand/J. Servain, FUNCEME, Brazil/IRD, France
12. "Ocean Color and its Impact on Tropical Atlantic Ocean Circulation"
A. Busalacchi, ESSIC/UM, USA

Appendix 2 bis
PIRATA-9 Meeting

03-05 February 2003
Angra dos Reis, Rio de Janeiro, Brazil

PIRATA-9 Meeting

03-05 February 2003
Angra dos Reis, Rio de Janeiro, Brazil

Scientific Papers related to PIRATA *(15 + 5 min. each)*

DAY 2: February 04, 2003

Morning (09:00 – 12:30) Chair: T. Busalacchi; Rapporteur: A. Lazar

1. How do subsurface teleconnections affect low latitude thermocline and SST?
A. Lazar (LODYC, Paris, France)

An Atlantic ocean GCM forced with NCEP-NCAR Reanalysis data indicates that there exists a subsurface advective bridge for large heat or salt anomalies from the southern tropics to the equator (a $\overline{V}$ T' mechanism). Positive and negative anomalies of various intensity constantly feed the equatorial thermocline during the entire simulation period. Consequently, the interanual variability of the temperature and salinity characteristics of a given density layer of the equatorial undercurrent can be inferred from tropical SST and sea surface salinity (SSS) about a year earlier. The amplitude of this variability appears to reach one degree depending on the period. It is however still unknown if a subsurface heat anomaly can surface at the equator with a significant intensity, especially after its mixing with various water masses through the equatorial upwelling process itself.

2. Southeast tropical Atlantic warm event and South African rainfall
M. Rouault (Oceanography Dept, University of Cape Town, Rondebosch, South Africa)

From January to May 2001, several countries of Southern Africa experienced above normal rainfall and floods. 23 000 people were displaced in Southern Angola after a flood in April. In March, an inundation killed several people and displaced 5,000 others in eastern Zambia's. The situation in Zambia was aggravated when authorities had to open the spillway gates at the Kariba Dam, the main source of electricity for Zambia and Zimbabwe. Water discharged from the Kariba dam ran into neighboring Mozambique, aggravating floods in that country. At the same

time warm sea surface anomalies were measured off the Angolan and Namibian coast. Warm events in the Southeast Tropical Atlantic off Angola and Namibia called "Benguela Nino" are known to affect the fisheries of the region but they also affect the rainfall. In 1995, the warmest recorded Benguela Nino happened with anomalies off up to 8°C extending 300 km offshore with a southward extension to 27°S. During the 1984, 1986, 1995 and 2001 warm events, above average rainfall occurred near the sea surface temperature anomalies and extended inland from the coast to an extent that appeared to depend on the intensity of the regional moisture convergence and atmospheric circulation anomalies. The significance of the warm events occurring during the February to April period is that this is the time when SST reaches its maximum in the annual cycle (up to 28^{o}C off northern Angola) and this favors more intense local evaporation and convection and a greater impact on late austral summer rainfall. This provides a scientific rationale for the extension of PIRATA in the Tropical South East Atlantic Ocean.

3. Origin of warm and cold events in the Southeast tropical Atlantic

P. Florenchie (Univ. Cape Town, South Africa)

Extreme warm episodes in the South-east Atlantic Ocean - Benguela Niños - have devastating environmental impacts and have been shown to be remotely forced. To place these extreme events into perspective, the investigation is here extended to minor as well as cold episodes. To this end different sets of observations have been combined with outputs from a numerical simulation of the tropical Atlantic for the period 1982-1999. It is shown that both warm and cold surface events develop regularly in the same specific region along the coast of Angola and Namibia. Some cold events compete in magnitude with major warm episodes. Most warm and cold episodes are large-scale events despite their limited surface signature. They appear to be generated by wind anomalies in the western and central equatorial Atlantic in the same way as are Benguela Niños. Seasonal fluctuations of the depth and shape of the tropical thermocline seem partly to control the way subsurface anomalies eventually impact the surface. During austral summer surface anomalies create a specific pool centered near 15ºS, whereas in winter they show an elongated pattern along the coast stretching towards the equator. Local upwelling- or downwelling-favourable wind regimes may modulate the surface expression of events.

4. Modes of Interdecadal SST variability in the South Atlantic

Edmo Campos (Univ. of São Paulo), Reindert Haarsma (KNMI, Netherlands)

Using an atmospheric model of intermediate complexity and a hierarchy of ocean models we investigate the dominant modes of interannual and decadal variability in the South Atlantic Ocean. The atmosphere model SPEEDY (Molteni, 2002) has T30L7 resolution. The physical package consists of a set simplified physical parameterizations schemes, based on the same principles adopted in the schemes of state-of-the-art GCM's. It is at least an order of magnitude faster,

whereas the quality of the simulated climate compares well with those models. The hierarchy of ocean models consists of simple mixed layer models with an increasing number of physical processes involved such as Ekman transport and dynamical evaluation of the mixed layer depth. Finally the atmosphere model is coupled to a regional version of MICOM ocean model covering the South Atlantic with a horizontal resolution of 0.5 degree and 15 vertical levels. The goal of this study is to understand the dominant physical mechanisms responsible for the spatial structure and time evolution of the modes as analyzed from data by Venegas et al.(1997) and Sterl and Hazeleger(2002). Primary results show that horizontal Ekman transport, wind mixing and latent heat fluxes are the principal mechanism for generating the dominant modes of variability in SST.

5. Sources of errors in seasonal climate predictions for Northeast Brazil

Claudine Pereira Dereczynski (Federal University of Rio de Janeiro, Rio de Janeiro, RJ, Brazil), Carlos Nobre (Center for Weather Forecasting and Climate Studies/National Space Research Institute, Cachoeira Paulista, SP, Brazil)

An evaluation of sources of errors that limit predictability in seasonal ensemble predictions for the Northeast Brazil (NEB) wet season generated by a T062L28 version of the CPTEC/COLA atmospheric general circulation model is presented. For each year from 1995 to 1999, a 25-member ensemble of simulations was carried out. The initial conditions for each of the ensemble member were consecutive 12Z NCEP's global model analyses one day apart (from 4 to 28 December) and the simulations were run for 6 months (December to May). During the simulation period December, January and February observed global sea surface temperatures (SST) were used as lower boundary conditions. For the forecast period (March, April and May) SST fields were prescribed as persisted February SST anomalies globally.

It is already known that slowly varying anomalous lower boundary forcings, such as SST anomalies, are more relevant than short timescale fluctuations of the daily weather variations in determining seasonal mean atmospheric states. Therefore, potentially higher predictability is expected for regions where seasonal climate variability can be explained by variations in SST patterns. Northern NEB is one of these regions. There, the weather conditions during the wet season are mostly controlled by the Intertropical Convergence Zone (ITCZ) position and intensity. However, the region is also influenced by transients such as frontal systems, upper level cyclonic vortices, easterly waves and instabilities lines. We want to test the following hypothesis: If the model is able to reproduce well the main raining transient systems on a mean statistical sense, could we expect more skilful seasonal forecasts?

The results showed that when the simulated outgoing longwave radiation over the Equatorial Atlantic Ocean, representative of the ITCZ, is not well predicted, the model skill for wet season (March-April-May) rainfall over northern NEB is poor. Moreover, the model shows deficiencies to predict the correct amount of rainfall, position and intensity of upper level vortices over NEB, overestimating

rainfall. In cases where the model predicts correctly the ITCZ and there are few cases of upper level cyclonic vortices, limit of predictability will be related to the number of frontal systems penetrating into southern NEB. In some cases, the simulation of fewer cold fronts than observations is compensated by simulation of many easterly waves bringing rain from the Atlantic Ocean into the continent. Another important result is that model produces in general fewer cold fronts in comparison to the observed number of such systems reaching southern NEB, but this is compensated by intensification of the low level convergence associated with these frontal systems over southern NEB. After reaching NEB, the simulated frontal systems produce large amounts of precipitation. That, in turn, is followed by an intensified convergence and lower surface pressure. As a result, under this synoptic situation, a new cyclonic center is formed. These low level cyclonic vortices have no counterpart in observations, that is, they are a spurious feature of the model. It travels from north to south, counterclockwise near the Brazilian coast, producing additional rainfall.

Seasonal predictability in northern NEB seems to be mainly dependent on the ITCZ position and intensity and in southern NEB it seems to depend mostly on transient systems (e.g., cyclonic vortices and cold fronts), as is expected from theory, therefore the predictability in southern is not as high as for northern NEB. In sum, regardless of the systematic errors related to model-produced vortices, the model presents a satisfactory skill in predicting seasonal precipitation over NEB.

6.Ocean color and its impact on tropical atlantic ocean circulation

A.J. Busalacchi, R. Murtugudde, A. Subramanium, and J. Christian

The effects of the coupled ocean-atmosphere climate system impact marine ecosystems from primary production all the way to the highest trophic levels of the marine food chain. As such, modes of natural variability provide a useful construct for studying interactions between climate variability and marine ecosystems. However, such interdisciplinary research need not, and should not, be viewed solely in a forced or one-way scenario of atmosphere-ocean coupling impacting marine ecosystems. Rather the potential exists for true interactive coupling between marine ecosystems and the physical climate system via the influence of phytoplankton distributions on the depth of penetrating radiation and the upper ocean heat budget. This presentation discussed the effects of a more realistic treatment of the penetration depth of solar radiation in ocean models of the tropical Atlantic, representation of this effect in coupled ecosystem models, and observational efforts to enhance the PIRATA array with optical sensors to complement remotely-sensed retrievals obscured by clouds and aerosols.

In the discussion following this talk, it was suggested to implement the optical devices more generally in PIRATA in order to distinguish between dust variability and oceanic physics regarding to the variability of the Chlorophyle.

7. A new data assimilation method based on the Fokker-Planck equation and its application in the tropical oceans

Clemente A. S. Tanajura (LNCC, Petropolis, RJ, Brazil)

A new data assimilation (DA) method proposed by K. Belyaev in 2000 is presented. The method is based on the Kalman filter theory. However, differently from the classical formulation, it calculates the covariance matrix of the error in phase-space, and the Fokker-Planck equation to provide the joint probability distribution of the error.

Applications of the method are presented with the Center for Ocean-Land-Atmosphere Studies (COLA) coupled ocean-land-atmosphere model and the PIRATA data for 1999, and with the Max-Planck-Institut fur Meteorologie (MPIMET) HOPE ocean model and the TAO data for 1997. In these experiments, only the vertical temperature profiles were assimilated in each model layer separetely. The results show that the DA method is able to correct the ocean state by warming the mixed layer and cooling the layer immediately below it. This method is computationally efficient in the sense that the evolution of the joint probability density of the error is calculated only among the points of observation. This makes the DA method feasible to application in forecasting and monitoring systems.

8. The use of PIRATA data for climate monitoring and predictions in Brazil

Paulo Nobre (CPTEC, Brazil)

An overview of the importance and use of PIRATA data time series for monitoring and experimental seasonal climate prediction activities in CPTEC is presented.

One of the most important atmospheric phenomena modulating interannual rainfall variability over Nordeste Brazil is the Atlantic Intertropical Convergence Zone (ITCZ). It presents an annual cycle with maximum southward displacement during March-April, which is coincident with the rainy period over Nordeste, as well as the warm SST season over the southern tropical Atlantic. During wetter then normal years over Nordeste, the southern tropical Atlantic presents positive SST anomalies, the northern tropical Atlantic presents either negative or neutral SST anomalies, northeast trades are stronger then the mean, SE trades are weaker, and the southward component of the surface winds over the equatorial Atlantic is stronger then the mean. The opposite pattern is often observed during dry years over Nordeste.

Several atmospheric GCMs have already demonstrated capable to simulate the annual mean and a large fraction of rainfall interannual variability over the Nordeste. One of the reasons for the AGCMs' good performance over the Nordeste is their ability to simulate the latitudinal displacements of the Atlantic ITCZ. The results of a long (10 years) integration of the CPTEC AGCM in ensemble mode show that the model presents a systematic bias of the ITCZ position that is longitude dependent, varying from approximately 1.5 degrees over

the occidental portion of the basin, to almost zero bias over the oriental portion of it. Also, the ITCZ position bias is approximately invariant along the seasons.
PIRATA data relevant to the monitoring of the ITCZ position and strength are the wind direction and speed, rainfall, air and sea surface temperatures and relative humidity. Time series of the PIRATA data departures from the 1998-2002/3 time mean for each variable are presented. First, a five day running mean daily climatology of the PIRATA data (all surface variables and T-S data at depths) are computed. Due to the short period of observations, and the large time gaps for some variables and sites, a reasonable estimate of the variables annual cycles were possible only for the buoys over the western portion of the array and, to some extent, for the buoy at 10W 10S.

Next, daily anomalies were computed by subtracting the mean values for each variable and each site from the respective daily values recorded, thus generating anomaly time series..

The exercise revealed that while computing daily anomalies of the PIRATA data transmitted via GTS is feasible and potentially useful for operational activities at CPTEC, the short length of the time series and the large gaps of the data make the mean estimates (and thus, the computed anomalies) not reliable enough for operational use. Also, the analysis of the rainfall data recorded at 8N, 38W has shown, since June 2002, values that are one order of magnitude larger then the data recorded at that site previous to that date.

It is pointed out that the PIRATA data may become potentially useful as an ancillary data set to help monitor, and eventually predict, ITCZ positioning over the equatorial Atlantic. However, longer and steadier data time series are needed as to provide stable statistics of the variables mean state. Also, the frequent interruption of the data time series, principally the wind and rainfall data, represents a major obstacle to using the PIRATA data in an operational basis at CPTEC, along the need of more stringent data quality control performed at the processing data centers, before they are made available in the GTS.

9. How good are Quikscat winds to estimate surface heat flux components during PIRATA wind gaps?

J. Lorenzzetti, G.P. Castelão, O.T. Sato and P.S. Polito (INPE and IOUSP)

Large wind gaps have been observed in most PIRATA mooring sites. If sensor failures occur not long after buoy maintenance, the yearly cruise schedules can result in gaps of several months. In these cases, interpolation techniques are not a solution. We present here the results of the impact of filling those wind gaps using Quikscat scatterometer winds on heat flux calculations. In order to compare PIRATA to satellite winds, the buoy data (at a nominal height of 3 m) was correct to the standard 10 m using neutral stratification (Large and Pond and Smith formulations) and using the stratification function Ψ_u. A global RMS = 0.9 m s^{-1} wind magnitude difference between both data sets was determined associated with a linear correlation C = 0.86. A comparison of latent heat flux calculation using PIRATA data against Quikscat winds revealed a global RMS difference of 14 W m^{-2} and a R^2= 0.9. An analysis done indicate that the uncertainty introduced by

complementing PIRATA wind gaps with Quikscat data are within expected error bars associated with *in situ* sensor errors itself for all wind dependent flux components in the array.

10. Surface heat flux estimates for the tropical Atlantic using PIRATA data"

G. Castelão, J. A. Lorenzzetti, O.T. Sato, and P. S. Polito (INPE and IOUSP)

Each component of the surface heat balance (Qo) in the tropical Atlantic was estimated using PIRATA data according to the methodology of Fairall et al. (1996). First order balance at surface was dominated by a gain of short wave (Qsw) and a loss of latent heat (Qlat). At buoys far away from the equator, these two components were in phase and the surface heat balance, Qo, showed higher amplitudes. Using the Lomb-Scargle technique for time series analysis, an amplitude of 55 Wm-2 was found for annual component of Qo at 15°N and 38°W, the most distant buoy from the equator. At the other buoy positions, due to the large data gaps in the time series, it was not possible to distinguish any statistically significant signal for Qo. However, time series suggest a smaller amplitude of Qo near the equator that seems to be caused by a out of phase behavior of Qsw and Qlat. A long linear trend was observed in the sensible heat flux (Qsen) series extending from mid 1999 to early 2002 at buoy 15°N 38°W. Air and sea surface temperatures at that position were relatively similar to da Silva et al. (1994) climatology, but the air-ocean temperature differences showed that the observed trend was caused by an anomalous surface air heating that inverted the normal sea to air Qsw flux. The influence of Qo in the mean surface mixed layer temperature was analyzed converting it to a time rate of temperature change in the layer. The higher frequency mixed layer temperature variations, in the scale of weeks, are weakly accounted by Qo, except for short periods at buoys 15°N and 12°N and 38°W. On the other hand, the seasonal signal showed a good relationship with Qo. Therefore to better understand the temperature variability of the mixed layer of this region, particularly at shorter time scales, the advective heat transports and therefore internal ocean dynamics must be incorporated in the heat budget.

11. Seasonal mixed layer heat budget of the tropical Atlantic Ocean

Gregory R. Foltz, Semyon A. Grodsky, James A. Carton, and Michael J. McPhaden

This presentation addresses the atmospheric and oceanic causes of the seasonal cycle of sea surface temperature (SST) in the tropical Atlantic based on direct observations. Data sets include eight moored buoys of the Pilot Research Array in the Tropical Atlantic (PIRATA), near-surface drifting buoys, and a blended satellite-in situ SST product. We find that the seasonal cycles of latent heat loss and absorbed shortwave radiation are responsible for seasonal SST variability in the northwest basin (along 38ºW). Along the equator contributions from latent heat loss are diminished, while horizontal temperature advection and vertical entrainment

contribute significantly. Zonal temperature advection is especially important during boreal summer near the western edge of the cold tongue, while horizontal eddy temperature advection, which most likely results from tropical instability waves, opposes temperature advection by the mean flow. The dominant balance in the southeast (along 10ºW) is similar to that in the northwest, with both latent heat loss and absorbed solar radiation playing important roles.

- Uncertainties related to the mixed layer depth and entrainment estimates
- Interannual variability expected not to be very high, except, in instance, in the eastern basin where there are no moorings.

12. On the relationship between the tropical Atlantic heat flux variability and the convective systems: The pertinence of some PIRATA sites

B. Durand [1], Jacques Servain [2,1], Luis Augusto Machado [3] , Henri Laurent [2,3]

[1] FUNCEME (Fundação Cearense de Meteorologia e Recursos Hídricos), Fortaleza, Brasil;[2] IRD (Institut de Recherche pour le Développement), France;[3] CTA/IAE/ACA (Centro Técnico Aeroespacial / Instituto do Aeronáutico e do Espaço /Divisão de CiênciasAtmosféricas), São José dos Campos, Brasil

The objective of this study is to evaluate the influence of the latent heat flux interanual variability in some PIRATA sites on the convective cloud coverage (specifically over the Brazilian Northeast). Ten years of monthly data are used here (1984-1993), on a 2.5-degree grid. The latent heat flux data set is the one developed by da Silva (1994), which is a processing of ship data, and the convective cloud coverage data comes from the ISCCP (*International Satellite Cloud Climatology Project*). We calculate correlation between the normalized anomalies of the latent heat flux and the convective cloud coverage, without lag, and with one month-lag, during the rainfall season of the Brazilian Northeast (FMAM). The correlation is calculated between the spatial mean of the latent heat flux in ten-degree boxes localized around some PIRATA moorings, and the convective cloud coverage over the Tropical Atlantic and South America. The selected heat flux areas are centered on: *Reggae* site (15N-38W), *Gavotte* site (10S-10W), and the possible South-West extension (around 15S-25W).

The results are more significant without lag. Over the Brazilian Northeast, the convective cloud coverage anomalies are positively correlated with the latent heat flux of *Reggae* site and the SW extension, and lightly negatively correlated with the latent heat flux of *Gavotte* site. With these results, we calculated also:

- the difference between the *Reggae* and the *Gavotte* heat flux anomalies (dipole), and then the correlation with the convective cloud anomalies.
- the sum between the *Reggae* and the SW-extension heat flux anomalies and then the correlation with the convective cloud anomalies.

These two calculations gave also a significant positive signal over Brazilian Northeast. And with more advanced studies (for instance using a better temporal resolution, comparing with other data set), this could lead to prevision applications, based on sea surface data.

Appendix 3
PIRATA-9 Meeting

03-05 February 2003
Angra dos Reis, Rio de Janeiro, Brazil

PIRATA Extension Evaluation Process and Review Criteria

- Each proposal should be composed of a science section and an implementation/resource section

- PIRATA SSC to perform preliminary review of proposal according to guidelines to determine if the overall quality is ready for external review

- Each proposal to be reviewed by at least one external reviewer in each member country and proposing country, based on evaluation criteria (see below). Reviews to be distributed to SSC.

- Upon completion of reviews (3 month time limit), SSC based on own reading and external reviews to accept, reject, or return for revision based on simple majority of SSC. Decision to be forwarded to PRB
- Final decision on Implementation/Resources to be decided by PRB

1) Science Evaluation Criteria

- Ability to complement the original goals and objectives of PIRATA pertaining to Tropical Atlantic Variability
- Relevance to climate variability and predictability
- Relevance to regional climate and applications
- Sound justification for array design (moorings, floats, locations, viability, etc.)
- Synergy (e.g., with other programs, time scales, etc.)
- Data management plan consistent with PIRATA data policy (e.g., free and open access, priority on real-time data)

2) Implementation/Resource Criteria

- Identification of infrastructure needed for implementation (ship time, laboratory, technical support, etc.)
- Implementation must occur on a not to interfere basis with the backbone
- Schedule of implementation
- Funding requirements/cost justification
- Identification/source of funding

The SSC acknowledges the expressed interests of BR and SA to propose SW and SE extensions to the backbone. At PIRATA 9, the SSC received draft versions of White Papers for these two extensions. Once the final corresponding proposals are received they will be evaluated according to the criteria accepted unanimously by the SCC at PIRATA 9.