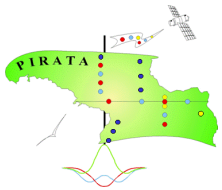


PredIction and Research mooring Array in the Tropical Atlantic

PIRATA

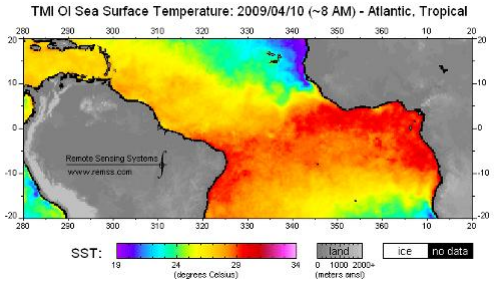
Dr. Domingos Urbano
INPE

62ª Reunião Annual da SBPC
Ciências do Mar: herança para o futuro

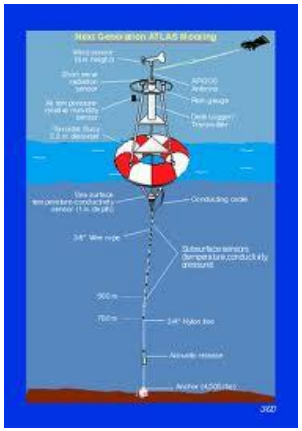
25 a 30 de julho de 2010
UFRN – Natal, RN

Outline

- Introdução
  - A região tropical do Atlântico e sua importância
  - O programa PIRATA: objetivos e compromissos

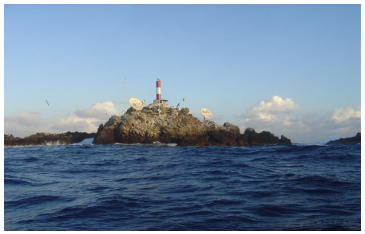


- Parte 1: Fundeios
  - Fundeio, sensores e amostragem
  - Controle de qualidade dos dados
  - Disponibilidade dos dados
  - Telemetria e Distribuição dos dados (GTS)
  - Estatísticas



- Parte 2: Ship data (Cruzeiros)
  - PBR-XI e SWE-IV dados/resultados (2009)

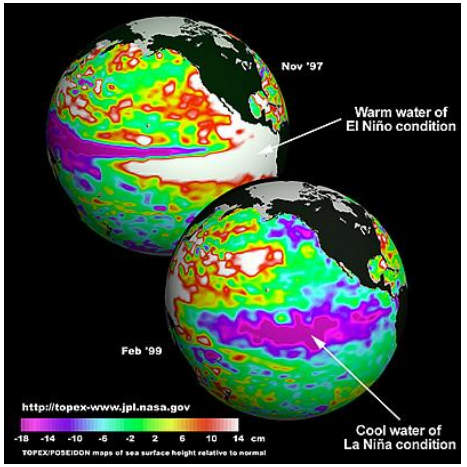
- Parte 3: Ilhas Oceânicas
  - Estações Meteo-maregráficas

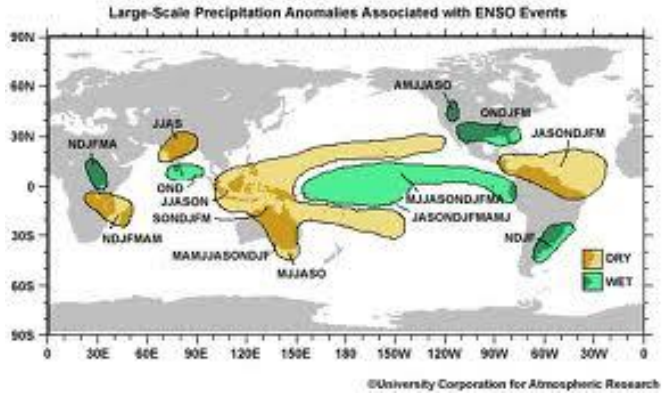


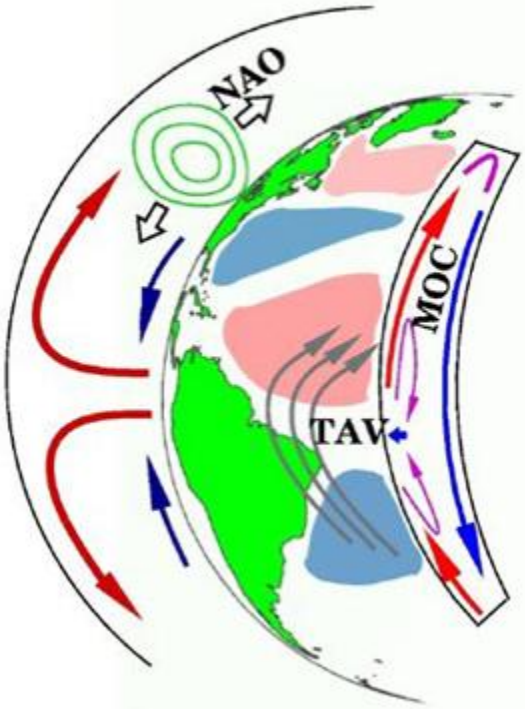
- Futuro
  - Novas tecnologias / instrumentação

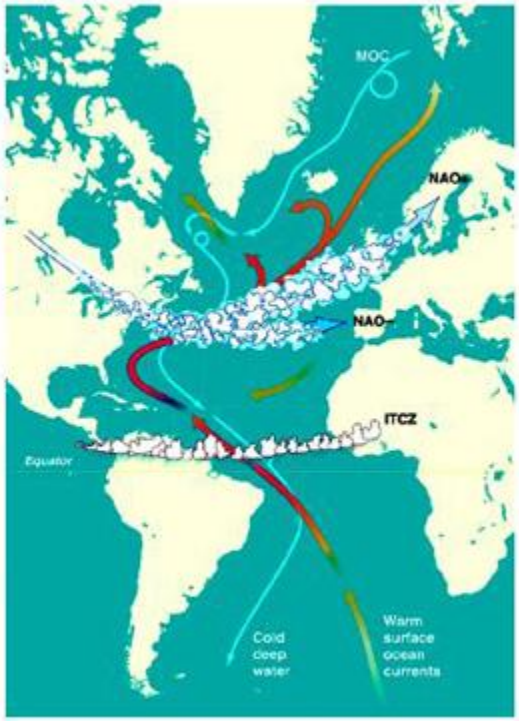
Introdução

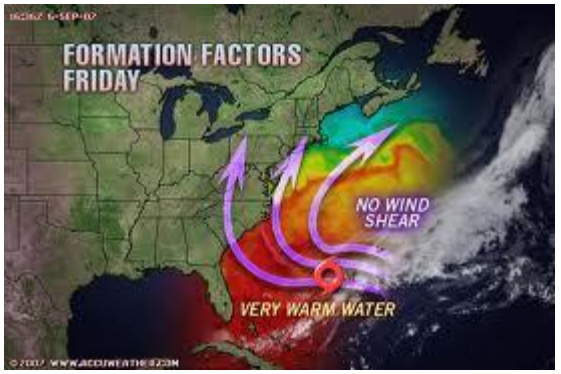
Atlântico Tropical - Importância

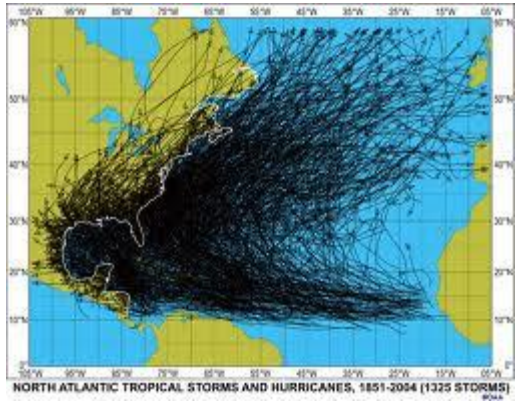




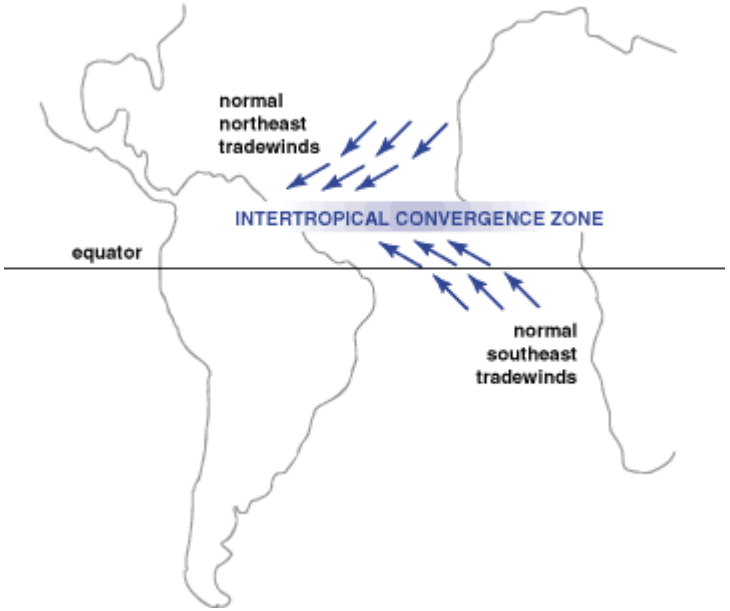


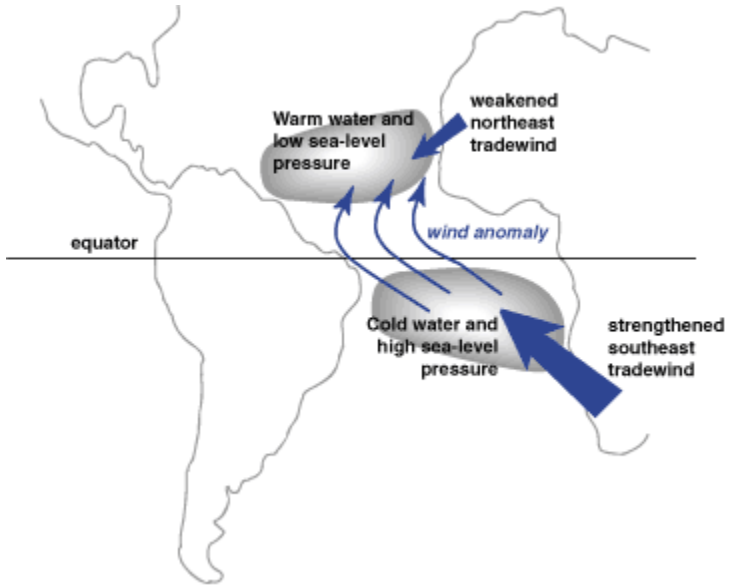


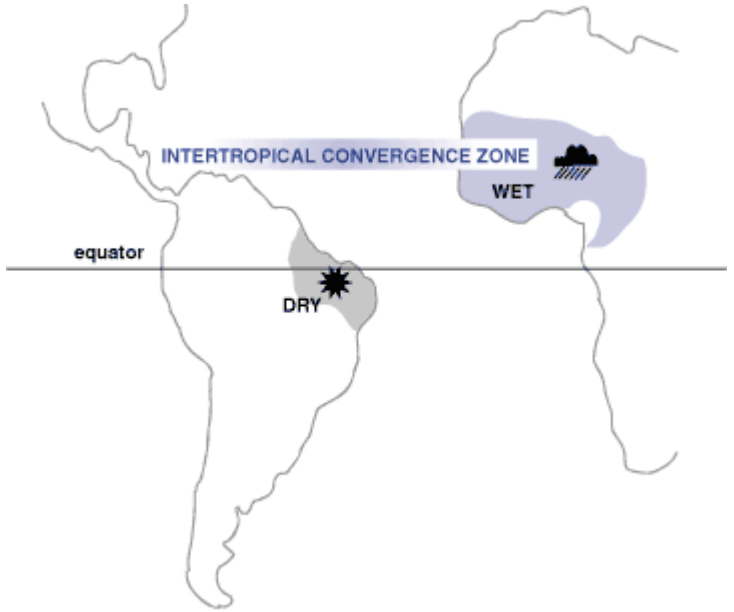




Atlântico Tropical - Importância

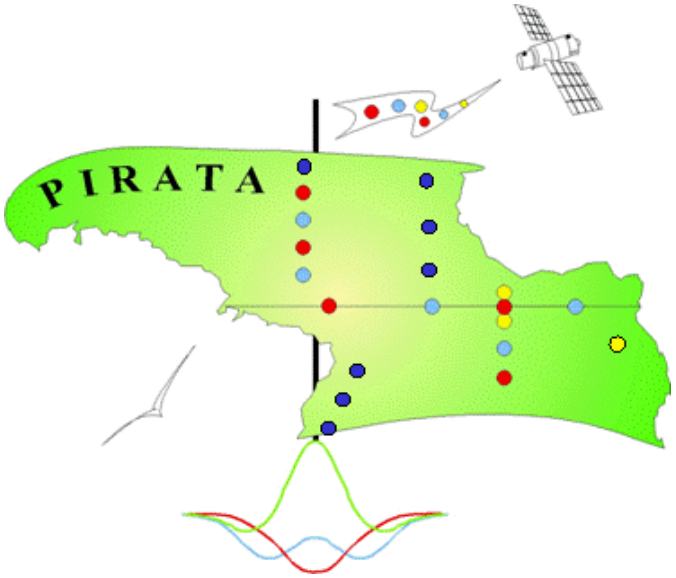






O Programa PIRATA

- Cooperação multi-nacional em suporte aos Programas CLIVAR, GOOS, GCOS e GEOSS.
- Desenvolveu/Mantém rede de bóias ancoradas na região tropical do oceano Atlântico fornecendo dados valiosos para estudos climáticos e previsões desde 1997.
- Apoio financeiro, técnico e logístico é fornecido por várias instituições distribuídas entre Brasil, França e EUA.



O Programa PIRATA

Brasil

- Instituto Nacional de Pesquisas Espaciais (INPE)
- Diretoria de Hidrografia e Navegação (DHN)

França

- Institut de Recherche pour le Developpement (IRD)
- Meteo-France
- Centre National de la Recherche Scientifique (CNRS)
- Institut Français de Recherche pour l'exploitation de la Mer (IFREMER)

EUA

- National Oceanic and Atmospheric Administration (NOAA)

O Programa PIRATA

OBJETIVO GERAL:

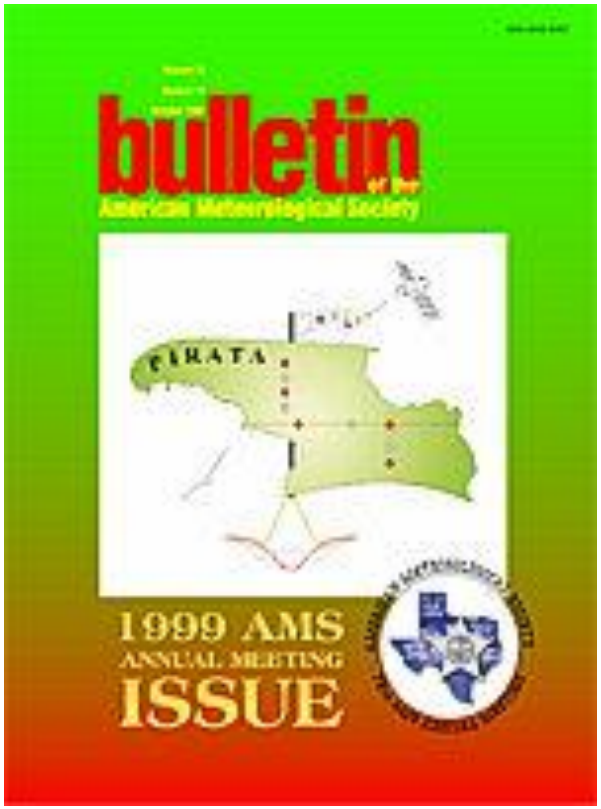
Aumentar o conhecimento sobre a variabilidade intra-sasonal a multi-decadal do sistema oceano-atmosfera na região tropical do oceano Atlântico e melhorar a qualidade das previsões do sistema climático, assim como seu impacto nas regiões continentais adjacentes.

O Programa PIRATA

Objetivos específicos:

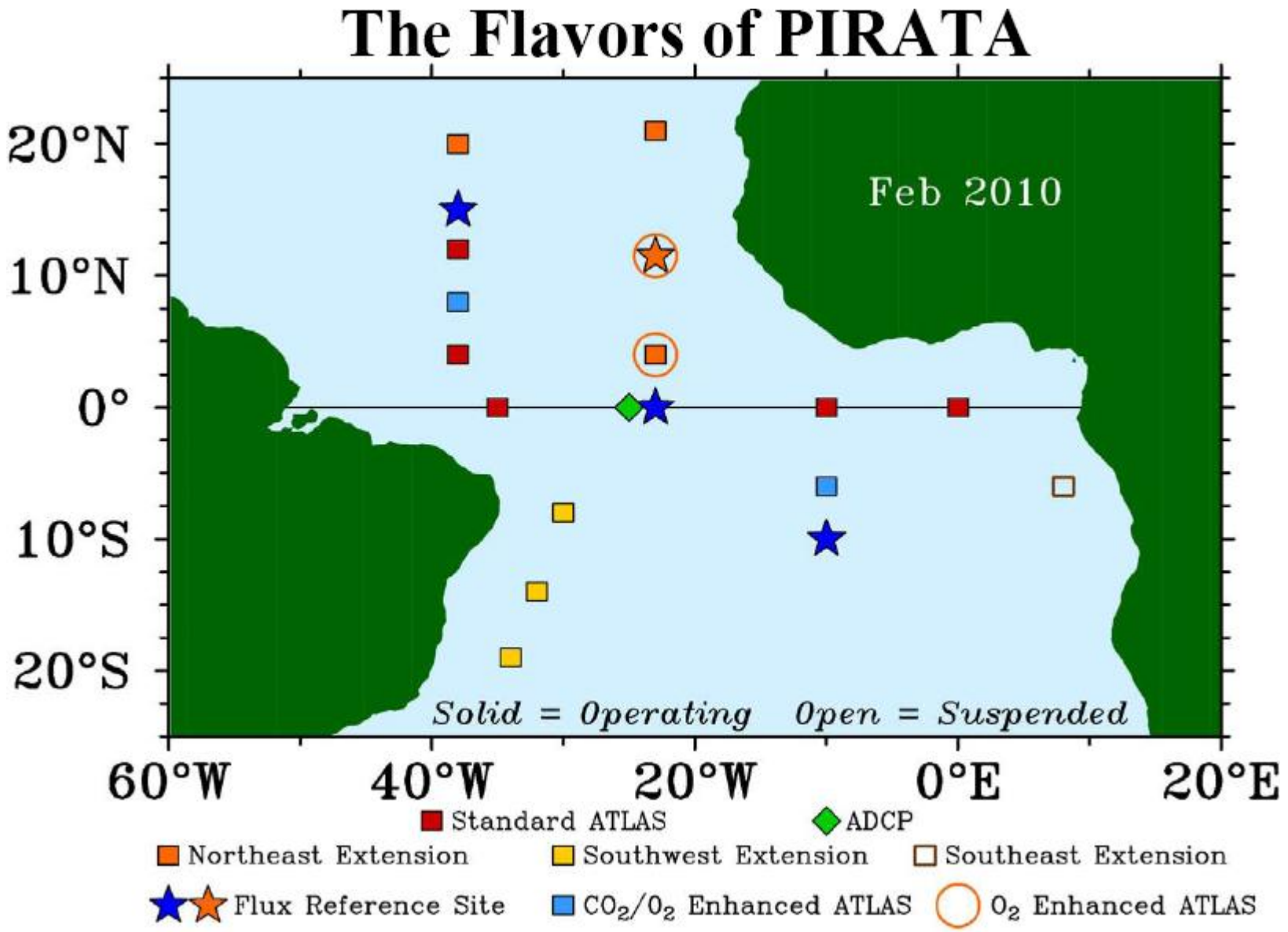
- Melhorar a descrição da variabilidade intra-sazonal a inter-anual nas camadas de contorno atmosféricas e oceânicas na região tropical do Atlântico;
- Melhorar nosso conhecimento sobre as contribuições dos fluxos ar-mar e das dinâmicas oceânicas na variabilidade da temperatura da superfície do mar (TSM) e do conteúdo de calor em sub-superfície, em escalas intra-sazonal a inter-anual;
- Fornecer um conjunto de dados adequado para o desenvolvimento de modelos acoplados oceano-atmosfera e consequente melhoria das previsões;
- Documentar as interações entre o clima da região tropical do Atlântico e a variabilidade em regiões remotas (i.e. El Niño e Oscilação Sul – ENOS ou a Oscilação do Atlantico Norte – OAN); e
- Projetar, instalar e manter um arranjo de bóias oceânicas fundeadas e coletar e transmitir um conjunto de dados oceânicos e atmosféricos via satélite, em tempo real, para monitorar e estudar a região superior do oceano e a atmosfera na região tropical do Atlântico.

O Programa PIRATA

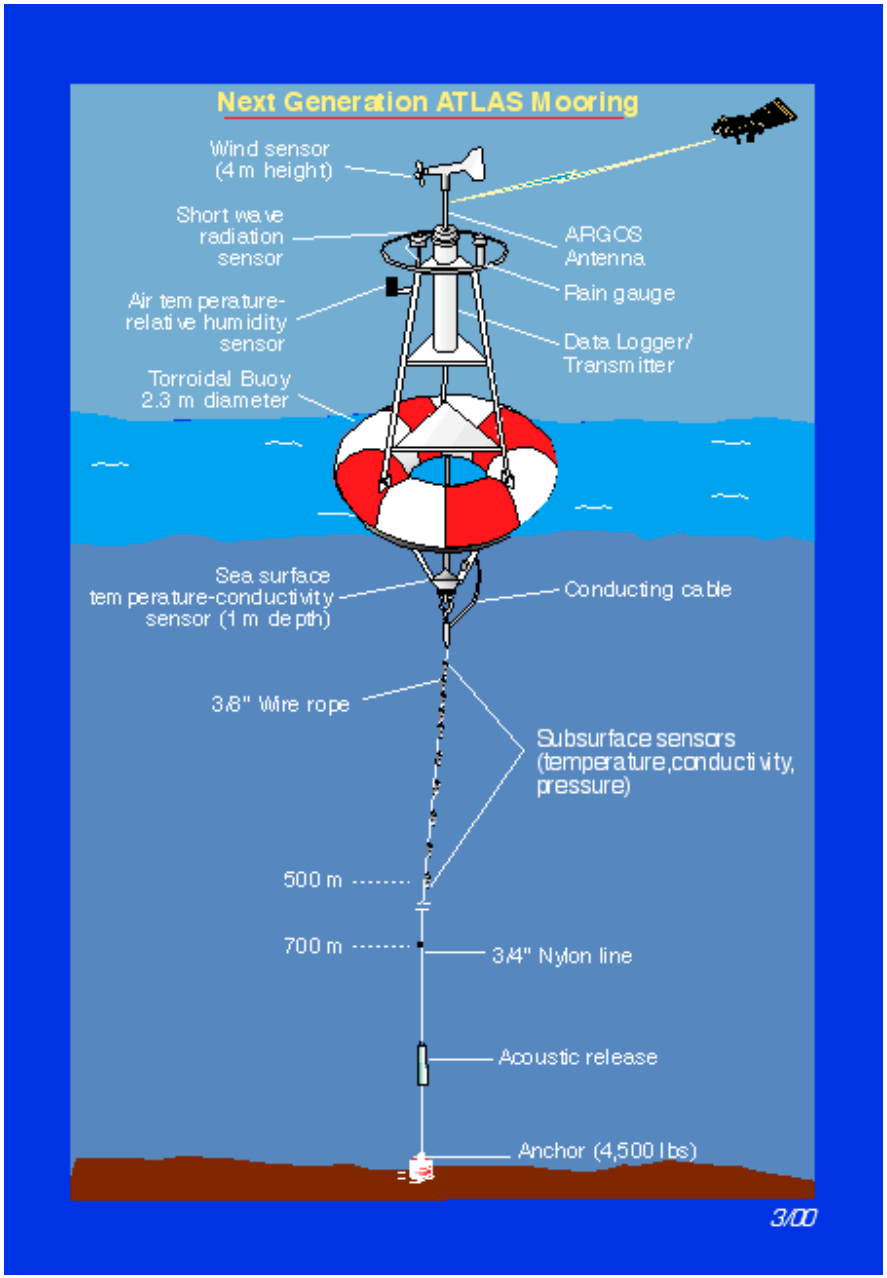


Parte 1
FUNDEIOS

FUNDEIOS


The Flavors of PIRATA
Feb 2010
20°N
10°N
0°
10°S
20°S
60°W
40°W
20°W
0°E
20°E
Solid = Operating
Open = Suspended
Standard ATLAS
ADCP
Northeast Extension
Southwest Extension
Southeast Extension
Flux Reference Site
CO2/O2 Enhanced ATLAS
O2 Enhanced ATLAS

FUNDEIOS: sensores



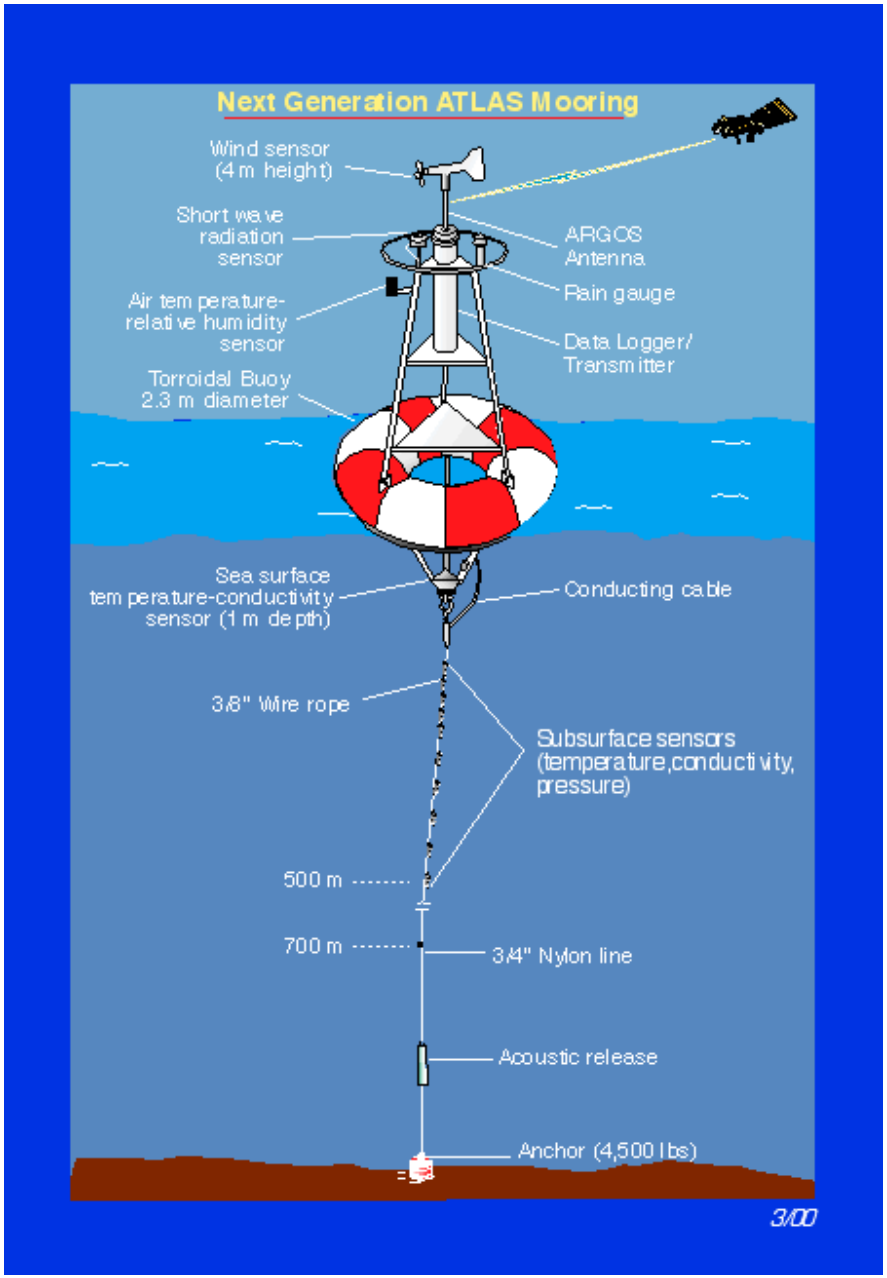
Sens. Meteo.	Wind	LWR	SWR	Rain	ATRH	BP
Height (m)	4	3.5	3.5	3.5	3	3

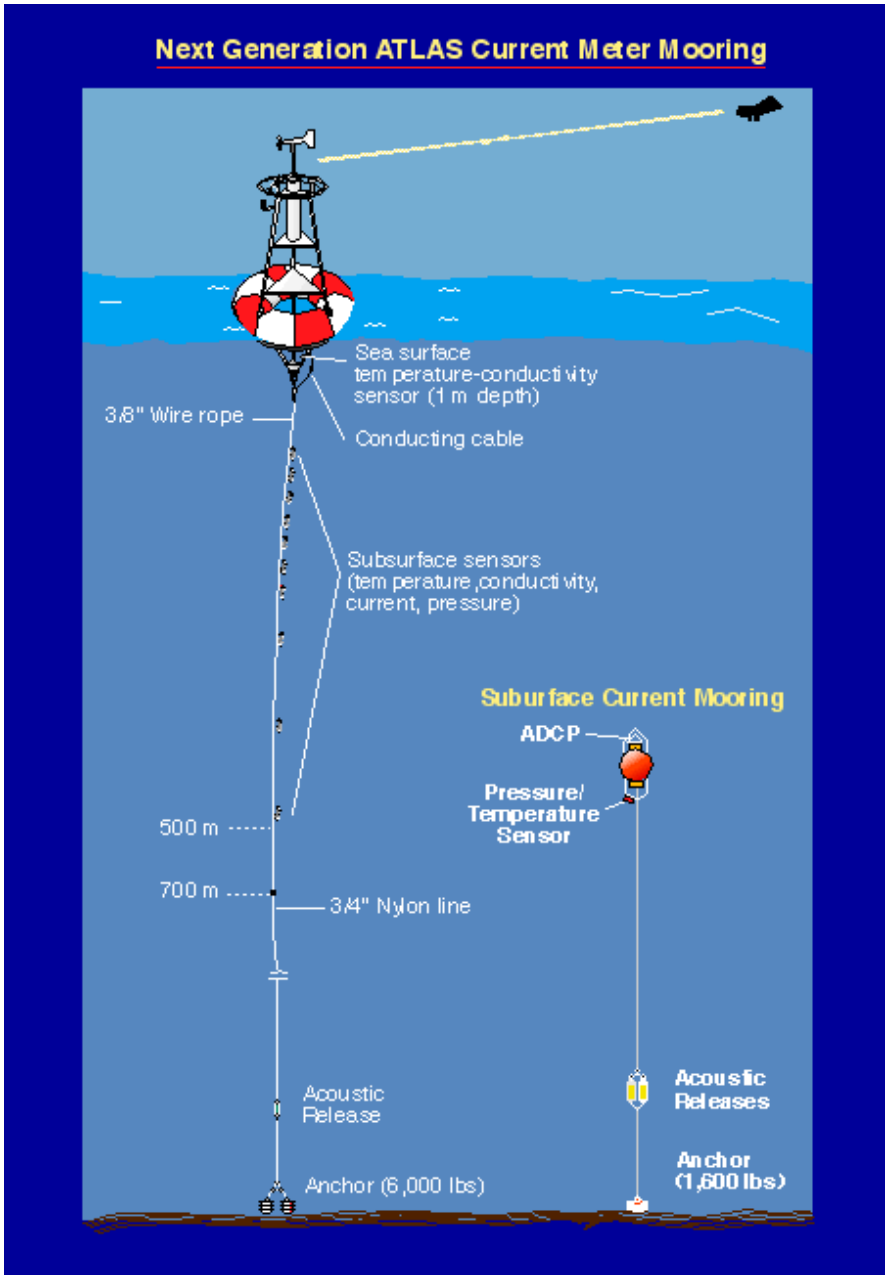
Sens. Ocean.	Depths (m)
SST/C	1
TC1	20
TC2	40
T3	60
T4	80
T5	100
TC6	120
T7	140
T8	180
TP9	300
TP10	500

FULL-FLUX

10-13m TV (correntógrafo)

FUNDEIOS: sensores

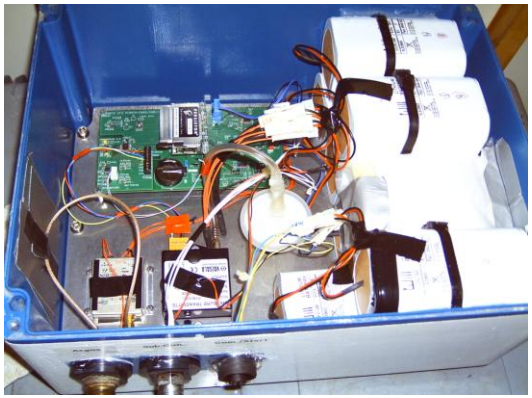


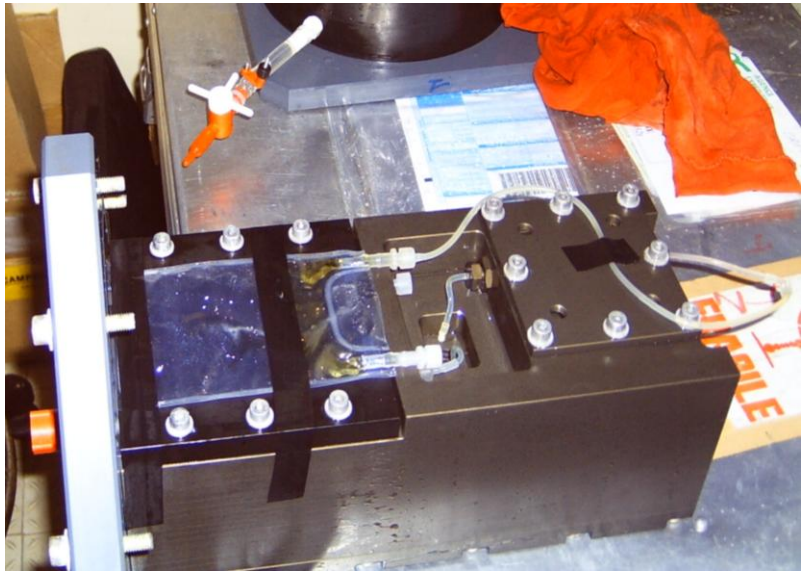


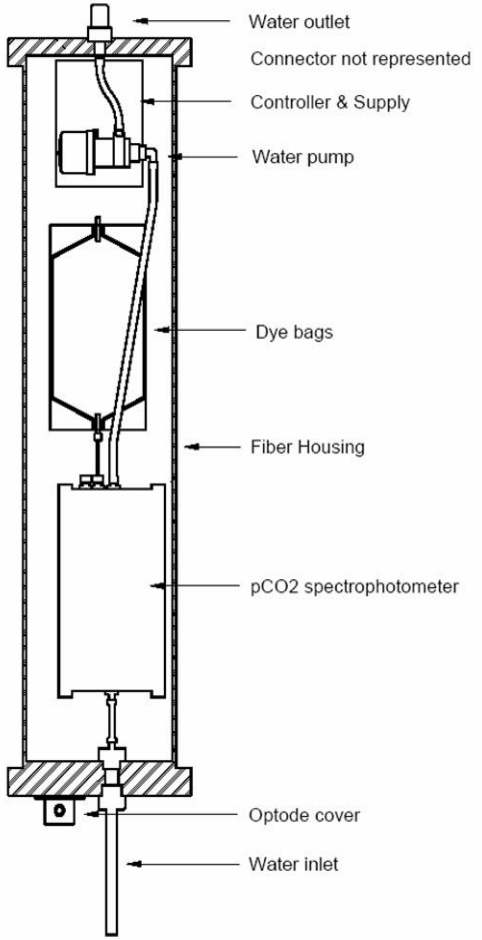
FUNDEIOS: amostragem

Medições	Taxa amostral	Período amostral	Hora da amostra	Gravado memória	Transmitido
Wind AT RH	2-hz	2 min	2359-0001 0009-0011,...	10 min	Média diária Média 2-min (última H)
Rain	1-hz	1 min	0000-0001 0001-0002,...	1 min	Média diária Desvio padrão “percent time raining”
SWR	1-hz	2 min	2359-0001 0001-0003,...	2 min	Média diária Desvio padrão
LWR	1- hz	2 min	2359-0001 0001-0003,...	2 min	Média diária
Pressão Barométr.	2-hz	2 min	2359-0001 0059-0101,...	Horário	Média diária Média 2-min (+ recente)
SST/T/C	1 per 10 min	Instant.	0000, 0010,...	10 min	Média diária
Veloc. Corrente	1-hz	2-3 min	2359-0001 0009-0011,...	10 min	Média diária
ADCP	0.333-hz	15-min	0000-0015 0100-0115,...	15 min	nenhum

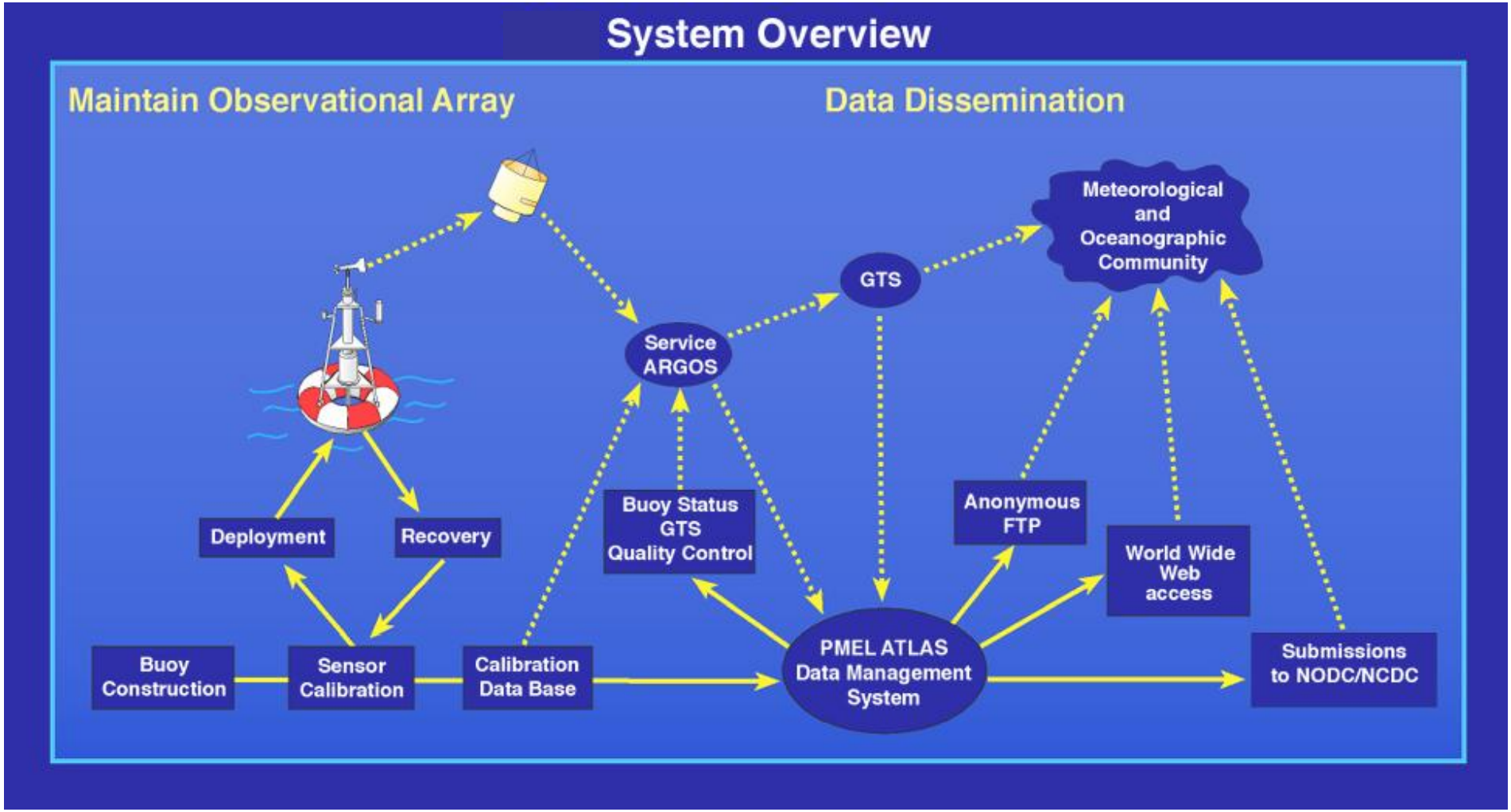
CO2 na bóia ATLAS







Telemetria e Distribuição



As bóias ATLAS transmitem dados durante 16 horas por dia:

00:00-04:00, 06:00-10:00, 12:00-16:00 and 18:00-22:00 local time.
4 8 12 16

FUNDEIOS: controle de qualidade

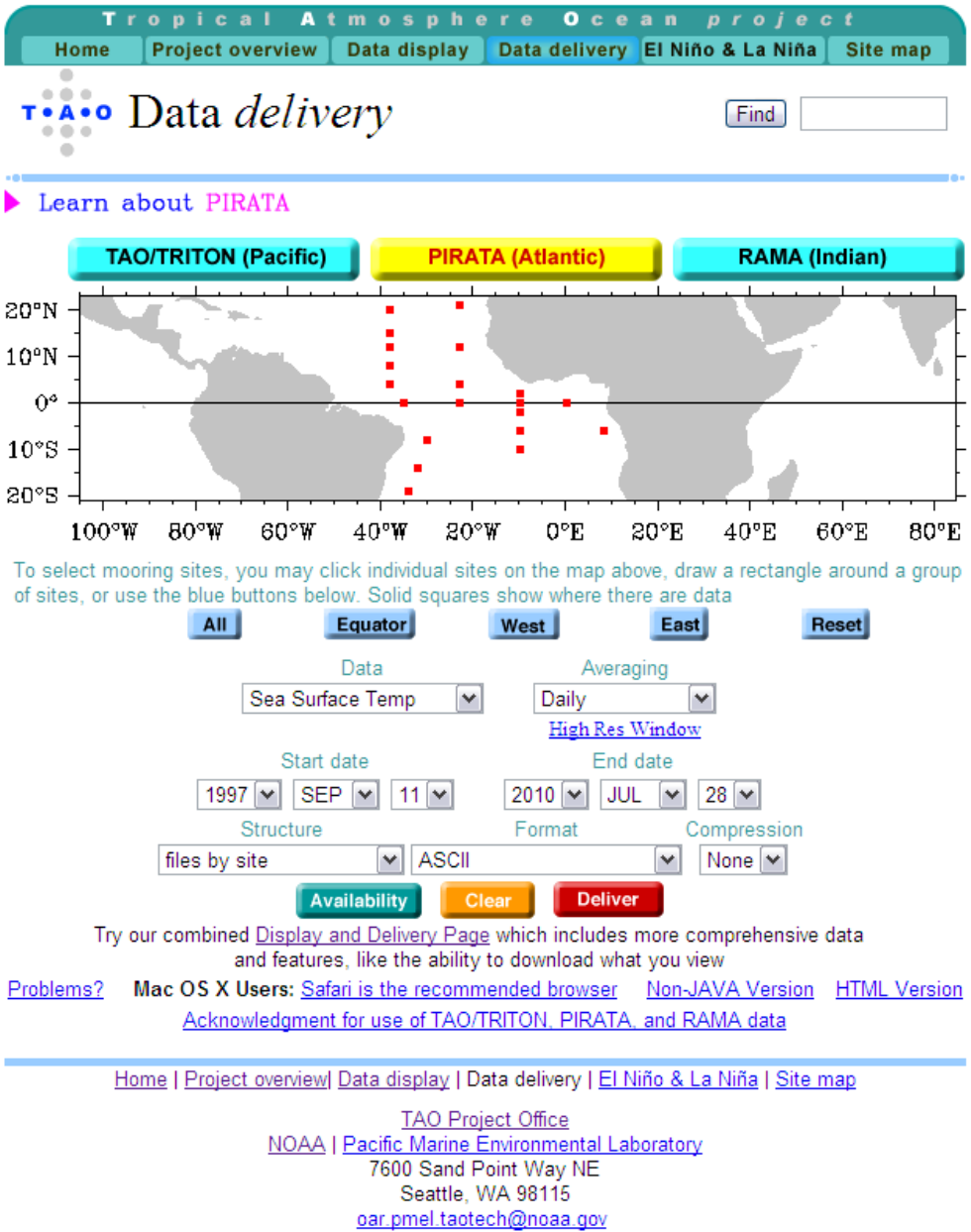
- Dados transmitidos em tempo-real:
  - QC Diário
  - QC Semanal
  - QC Mensal

- Dados armazenados em memória
  - QC após recuperação dos instr. (anual)

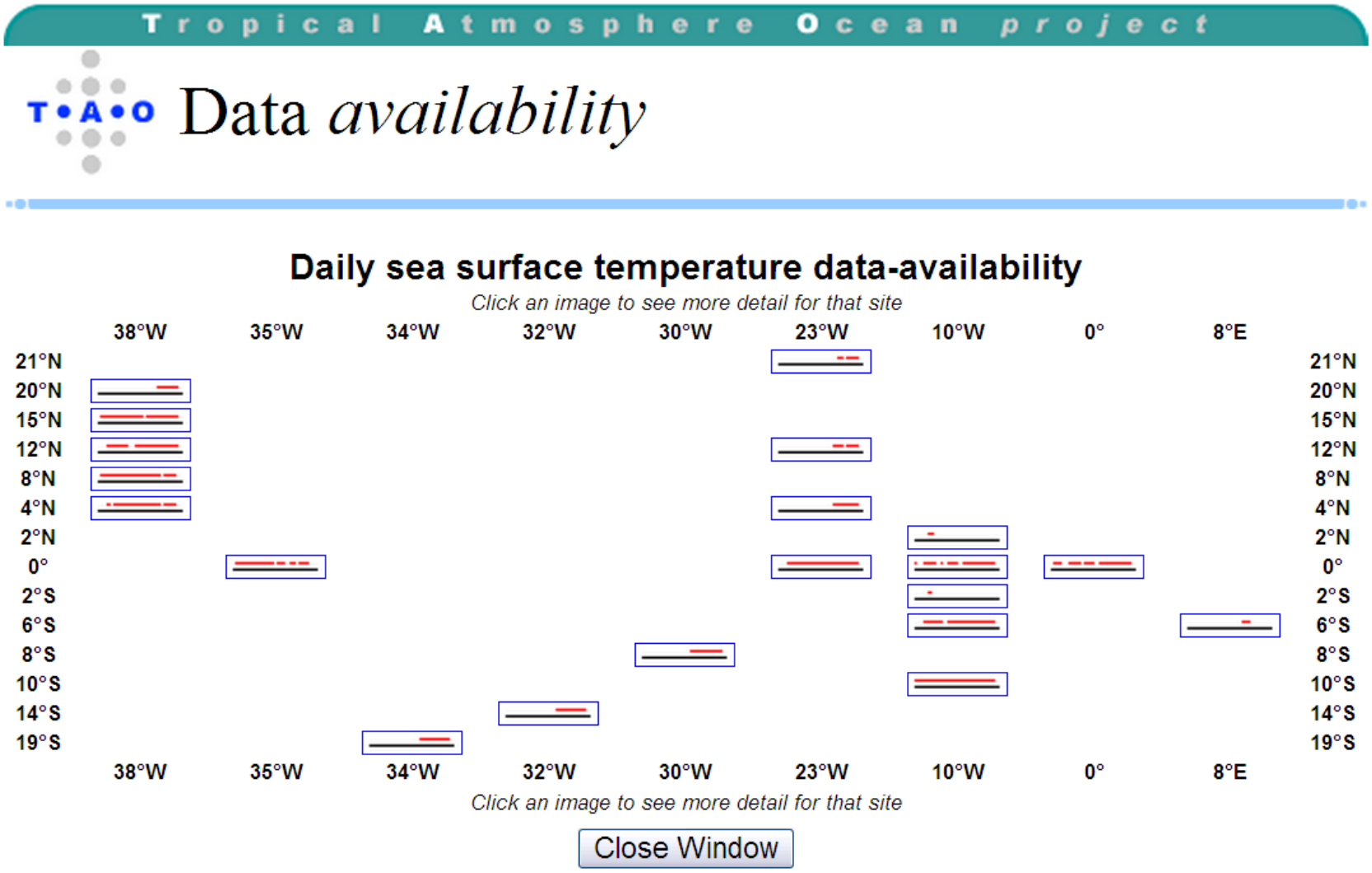
Longo processo estatístico realizado por **analistas treinados**

FUNDEIOS: disponibilidade

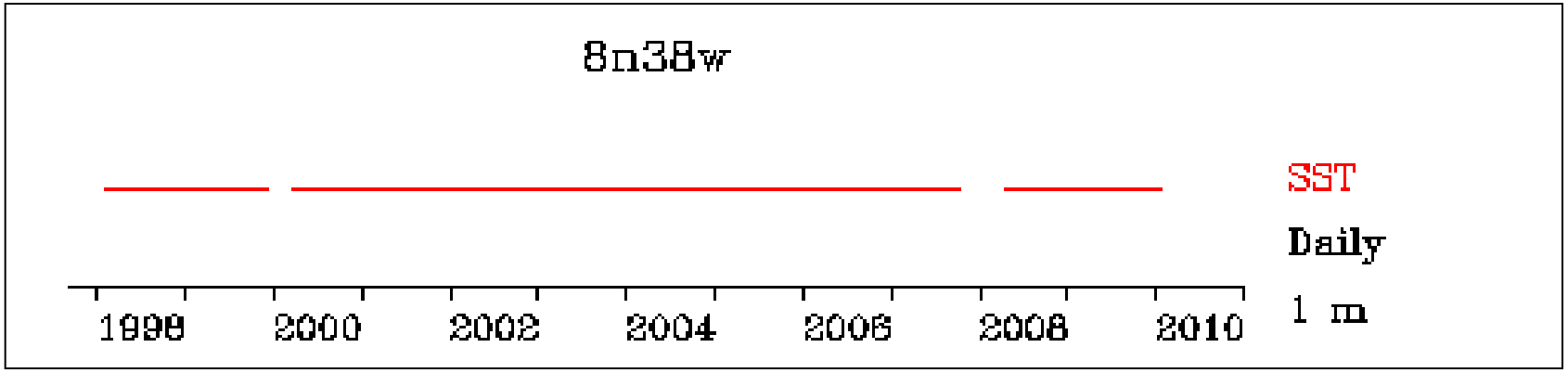
http://www.pmel.noaa.gov/tao/data_deliv/deliv.html



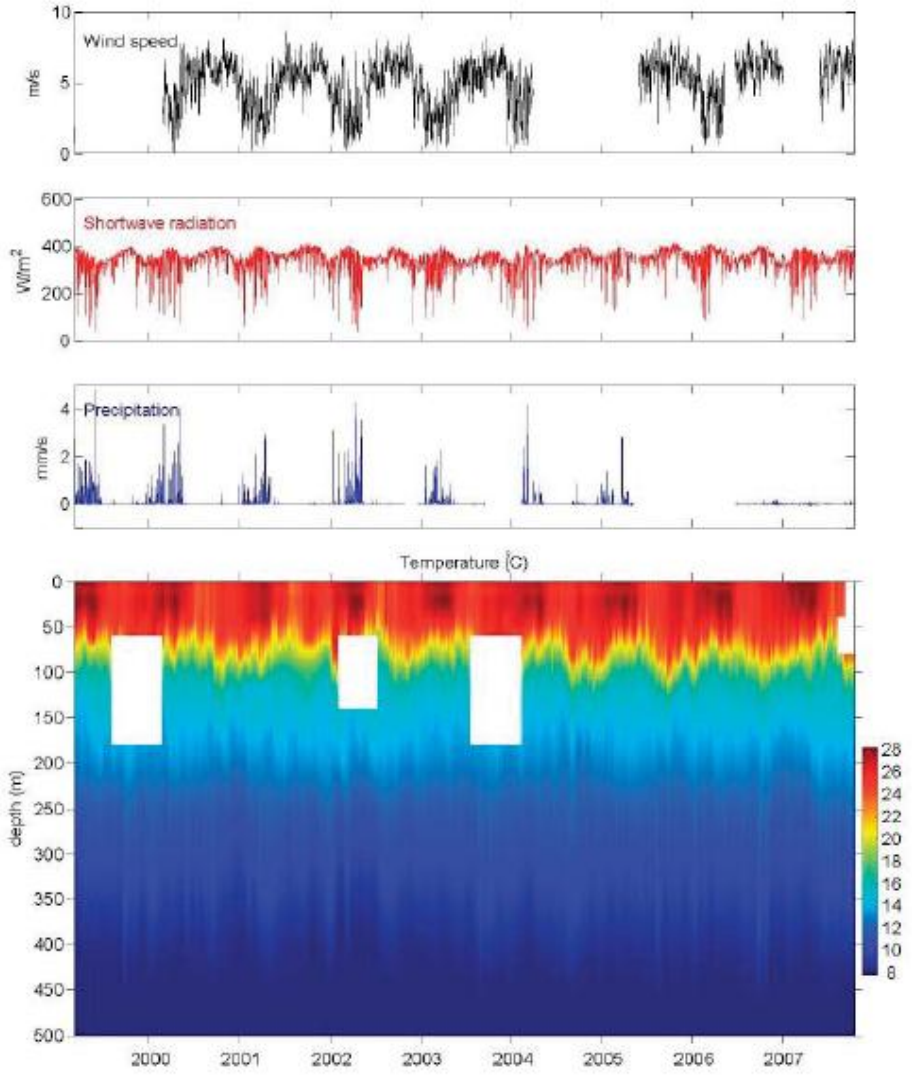
FUNDEIOS: disponibilidade



FUNDEIOS: disponibilidade



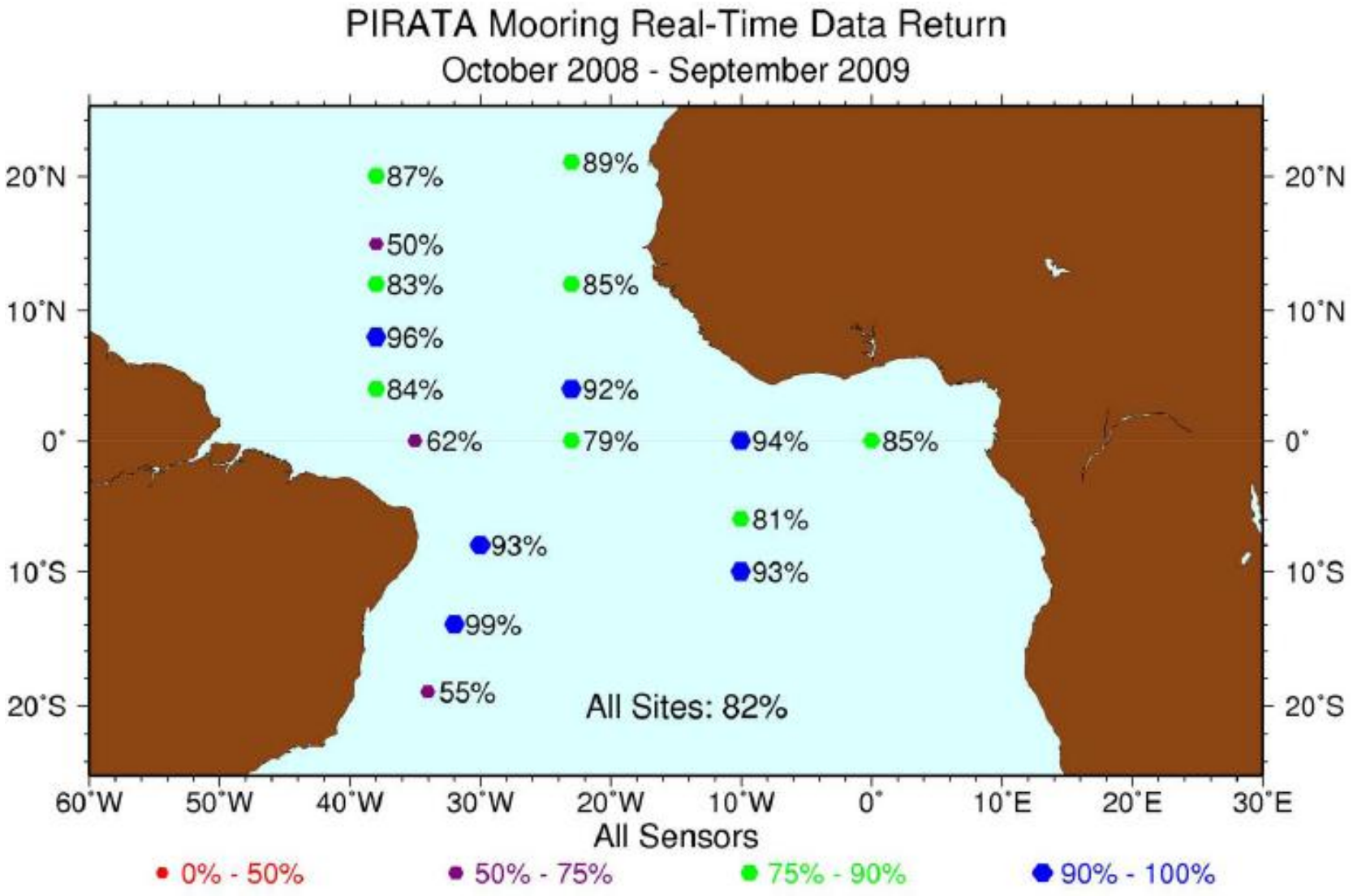
FUNDEIOS: disponibilidade



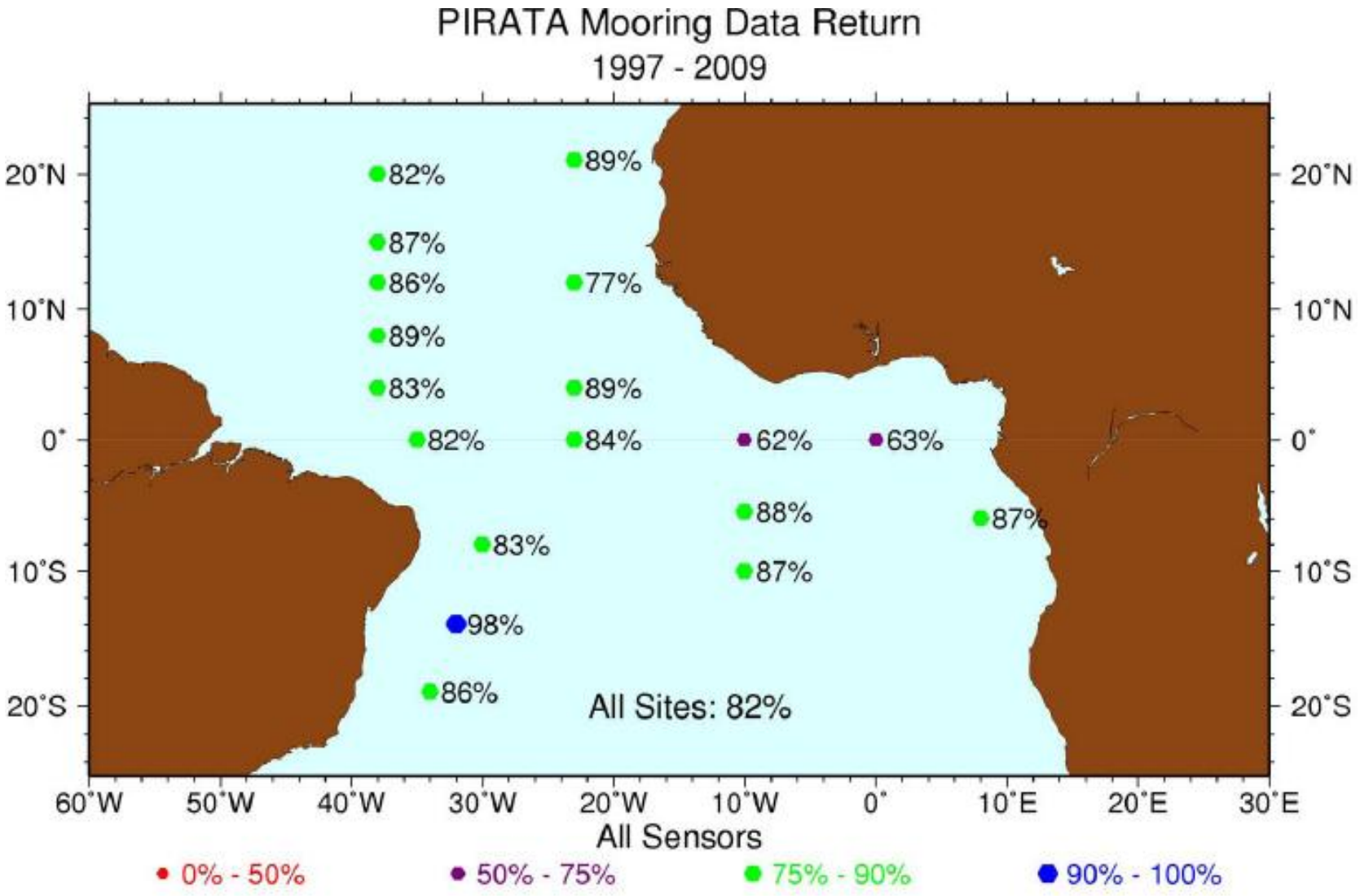
23W-Eq

Gaps p/ evitar: manutenção + frequente e evitar vandalismo.

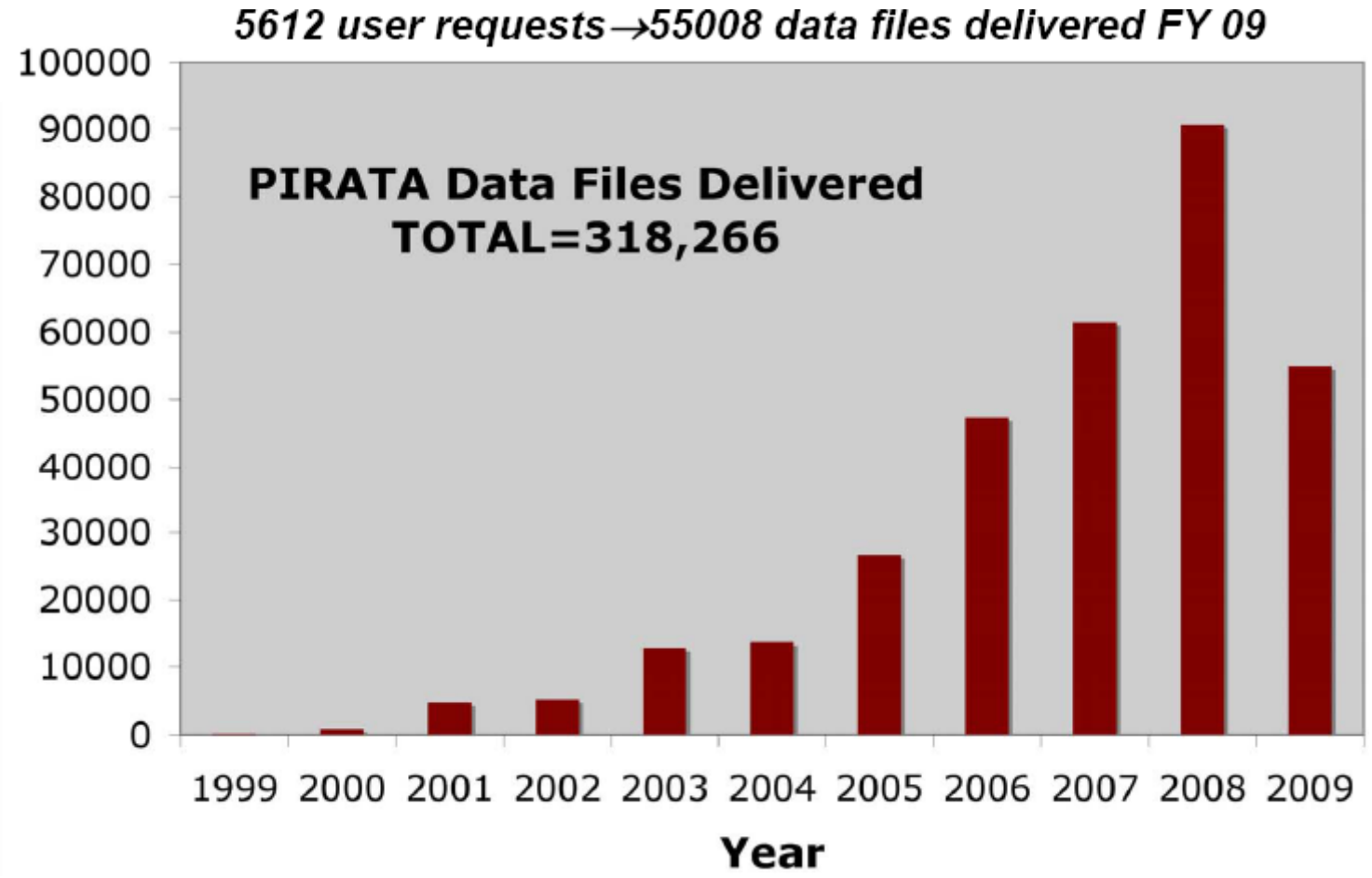
FUNDEIOS: Estatísticas



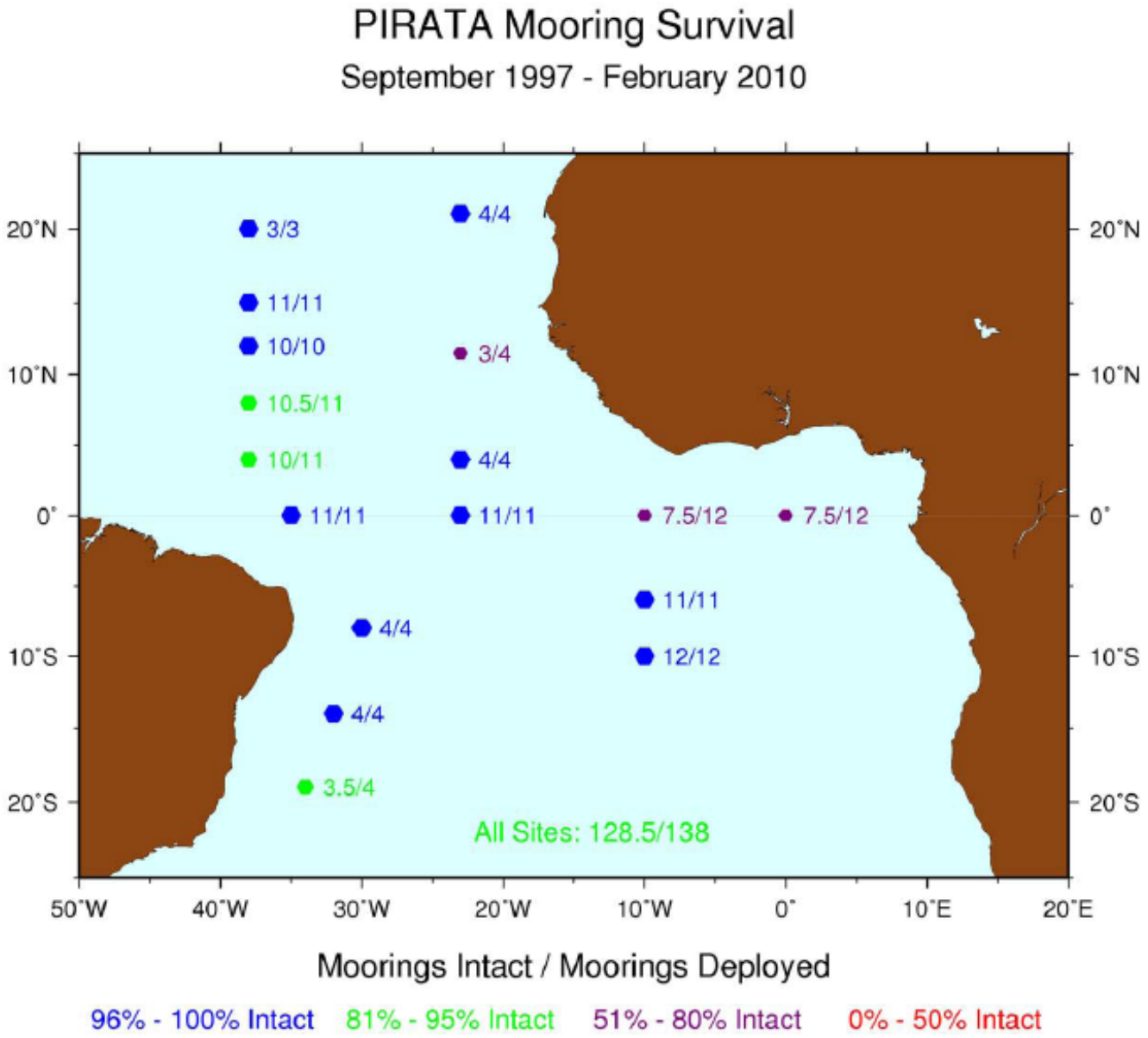
FUNDEIOS: Estatísticas



FUNDEIOS: Estatísticas



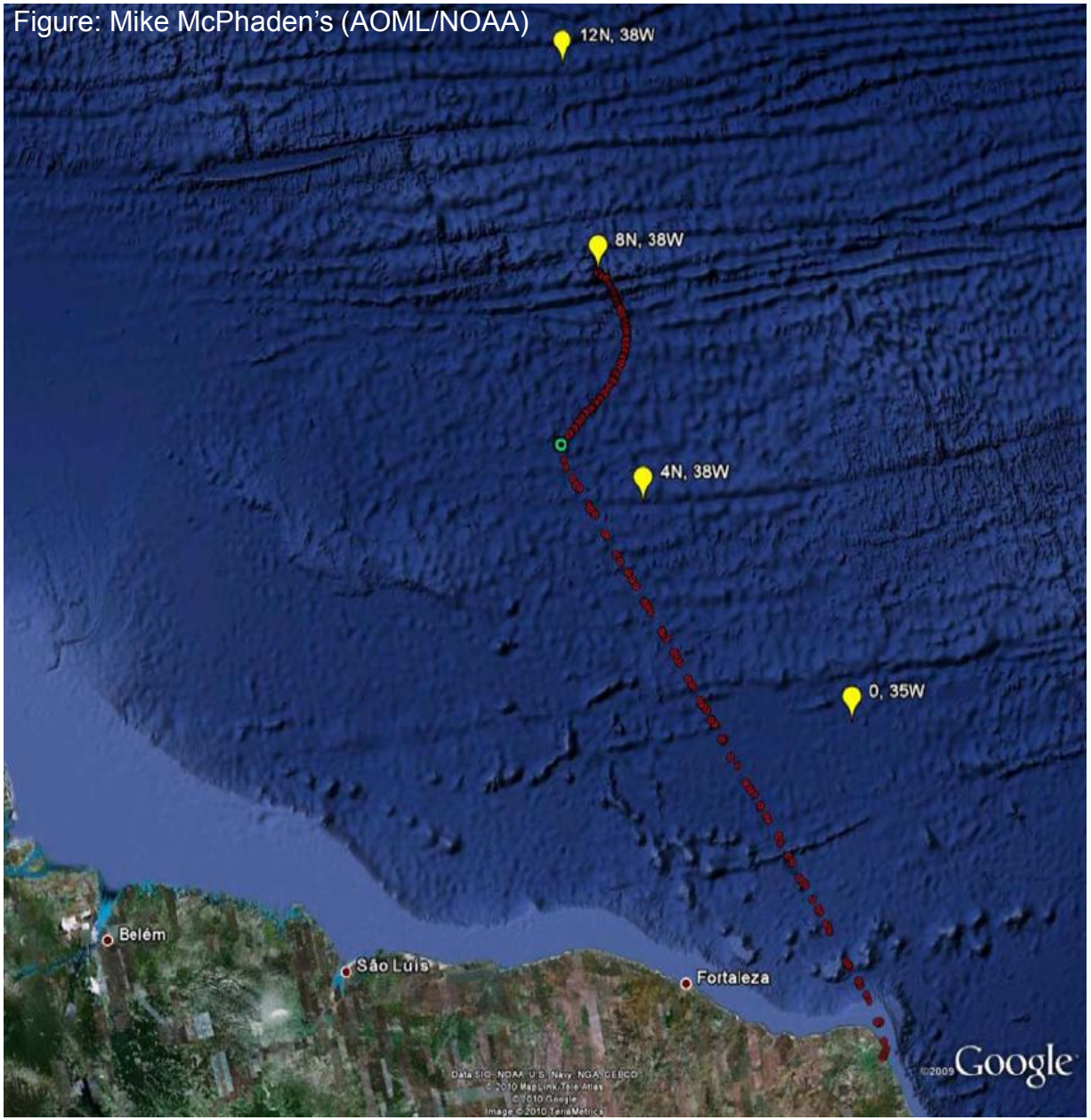
FUNDEIOS: Estatísticas



Vandalismo

Data:
Rec ATM e CO2
Lost hi-underwater

Sensors:
Damage ATM
Lost underwater



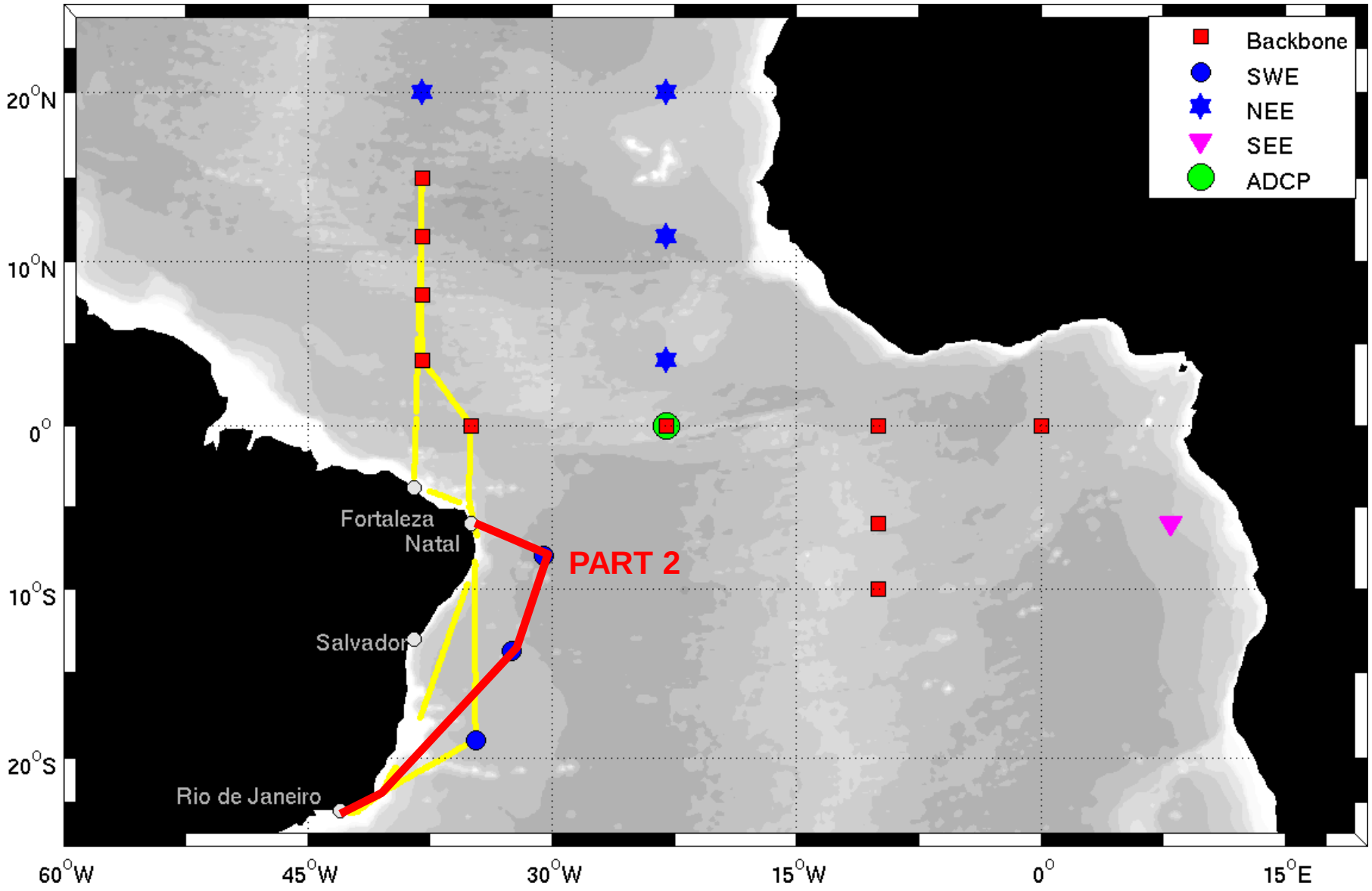
Vandalismo


Certificate of Recognition
for exceptional service
to the
PIRATA Program
presented to
Officers and Crew
of
Brazilian Navy Ship
NB Comandante Manhães
From the TAO Project Office
and
PIRATA Scientific Steering Committee
T·A·O
National Oceanic and Atmospheric Administration
Tropical Atmosphere Ocean Project

Ship data

PBR-XI and SWE-IV

Manutenção das bóias PIRATA
PBR-XI e SWE-IV



PBR-XI e SWE-IV (PARTE 1)

LEG 1: Niterói - Fortaleza

1A: Niterói – 19S34W

1B: 19S34W - Fortaleza

LEG 2: Fortaleza - Natal

2A: Fortaleza – 15N38W

2B: 15N38W - Natal

LEG 3: Natal – Niterói

Period: 09 MAR – 12 APR 2009 (34 days)

Days sailing (DM): 27

ATLAS: 06

CTD: 9

XBT: 37

Radiosondes: 19

SVP: 12

VM-ADCP: 4.040 NM

TERMOSAL: 4.040 NM

pCO2: Fortaleza -15N-Natal (~2240 MN)

RADIOMETER: 07 measurem. of 3 obs.

PBR-XI e SWE-IV (PARTE 2)

LEG 1: Natal – Niterói

Single Leg

Period: 29 AUG – 06 SEP 2009 (14 days)

Days sailing (DM): 9

ATLAS: 02

CTD: 02

XBT: none

Radiosondes: 04

SVP: 04

VM-ADCP: 1.500 NM

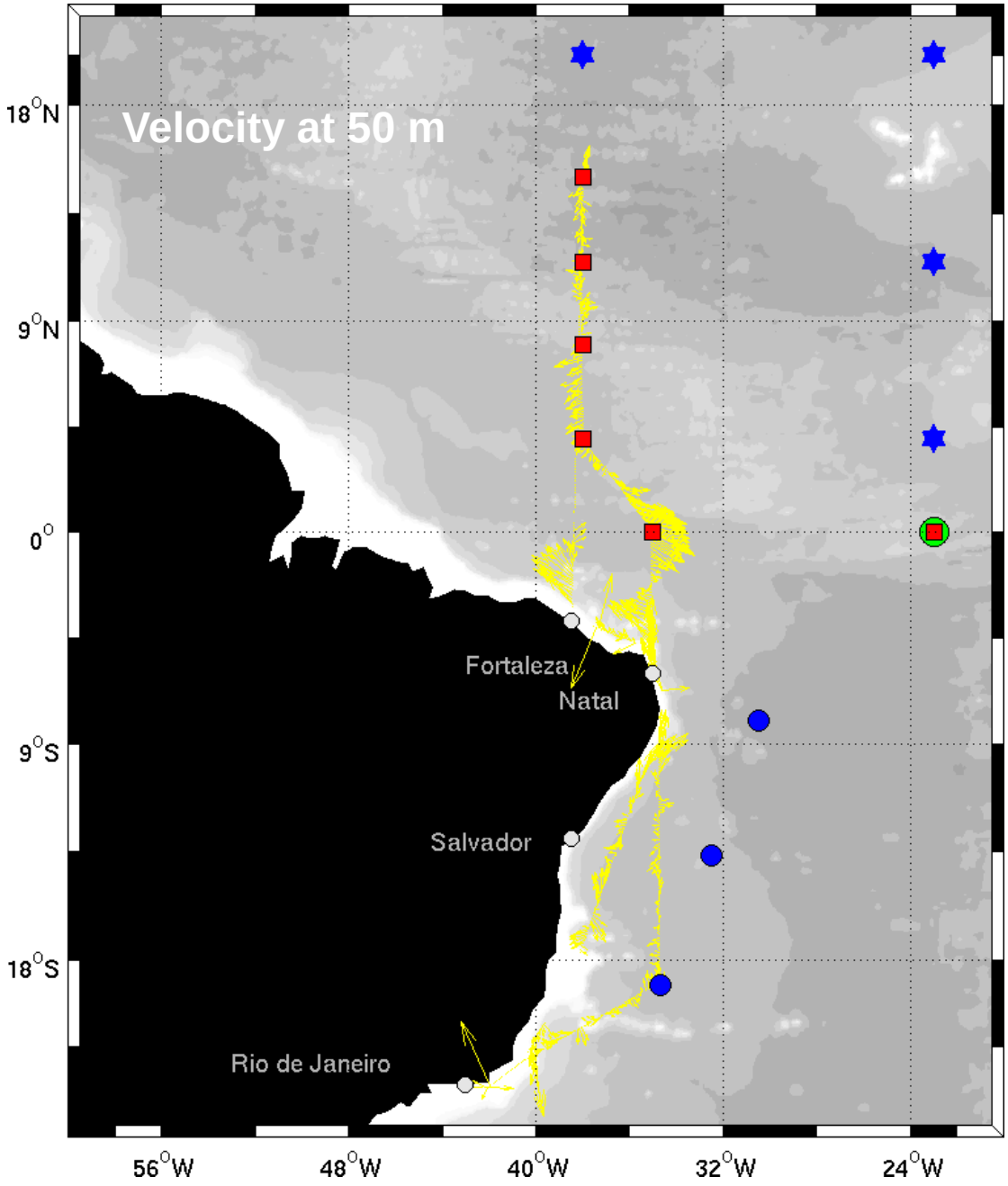
TERMOSAL: 1.500 NM

pCO2: none

RADIOMETER: none

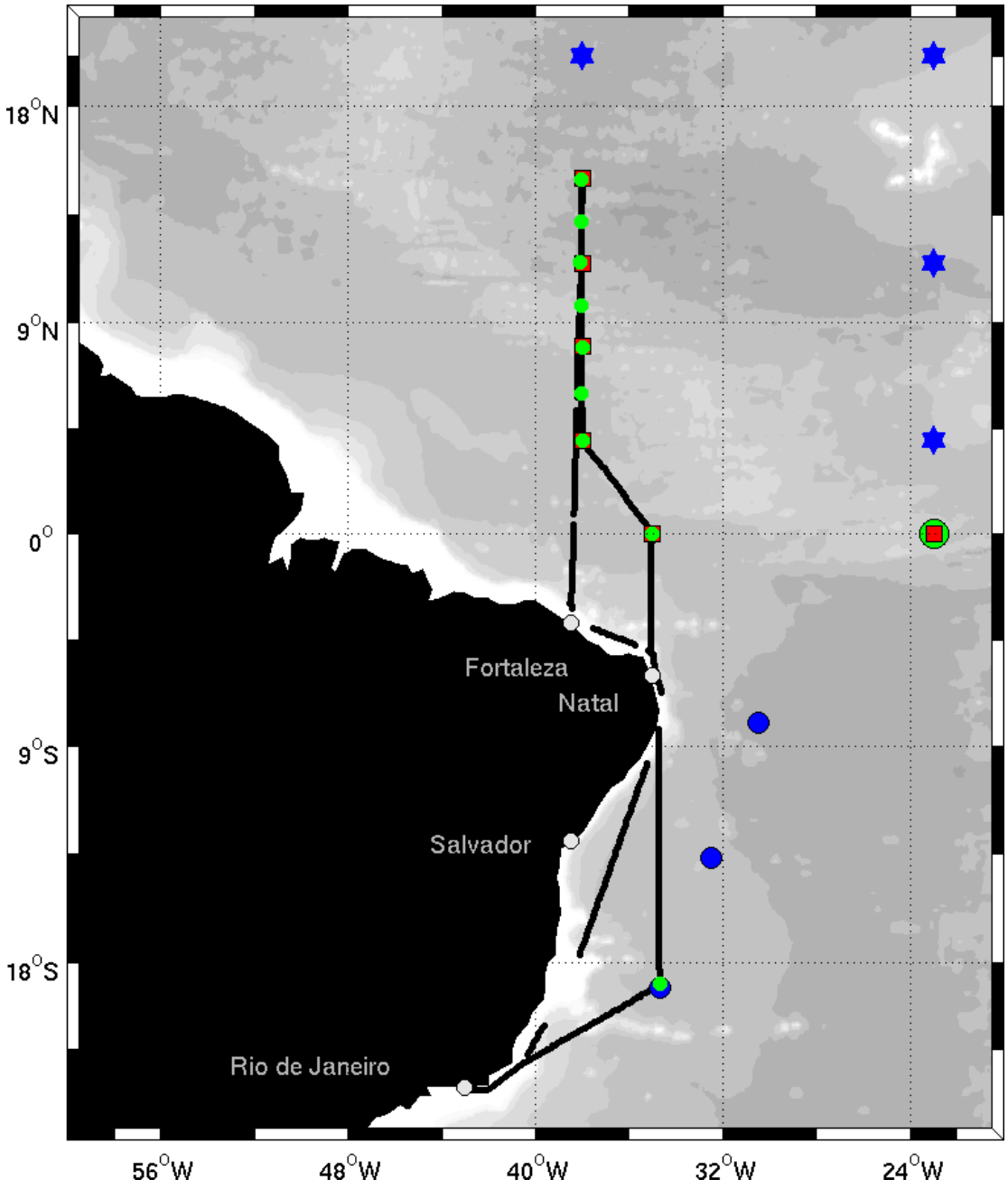
Observações diretas de velocidade

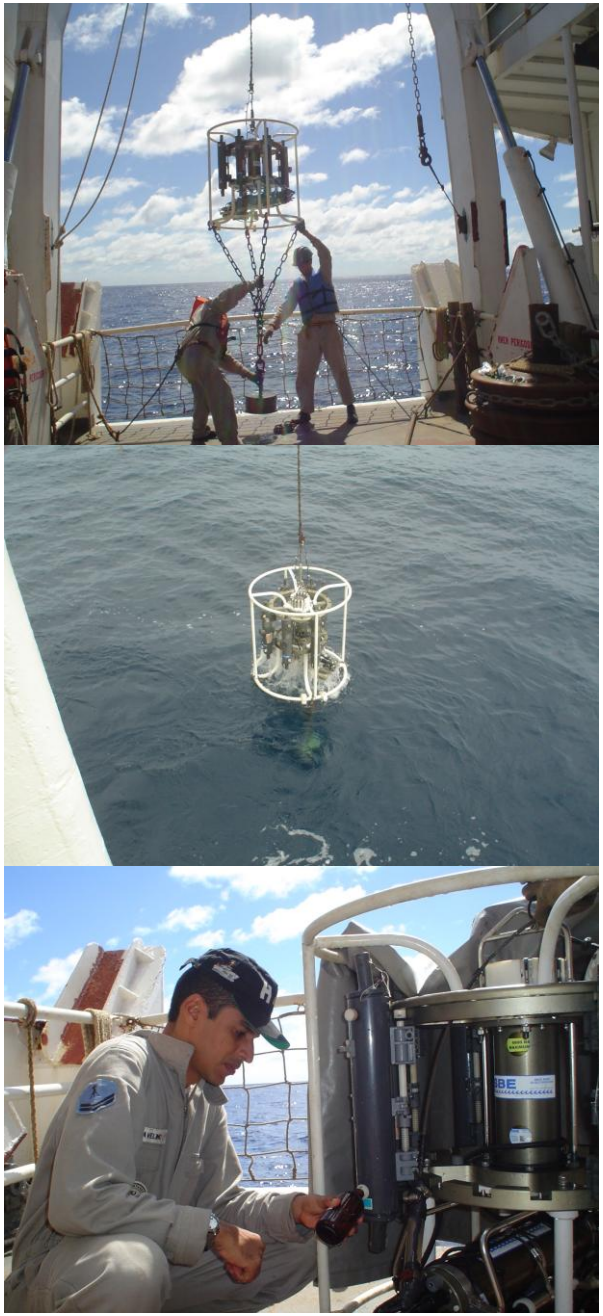
VM-ADCP

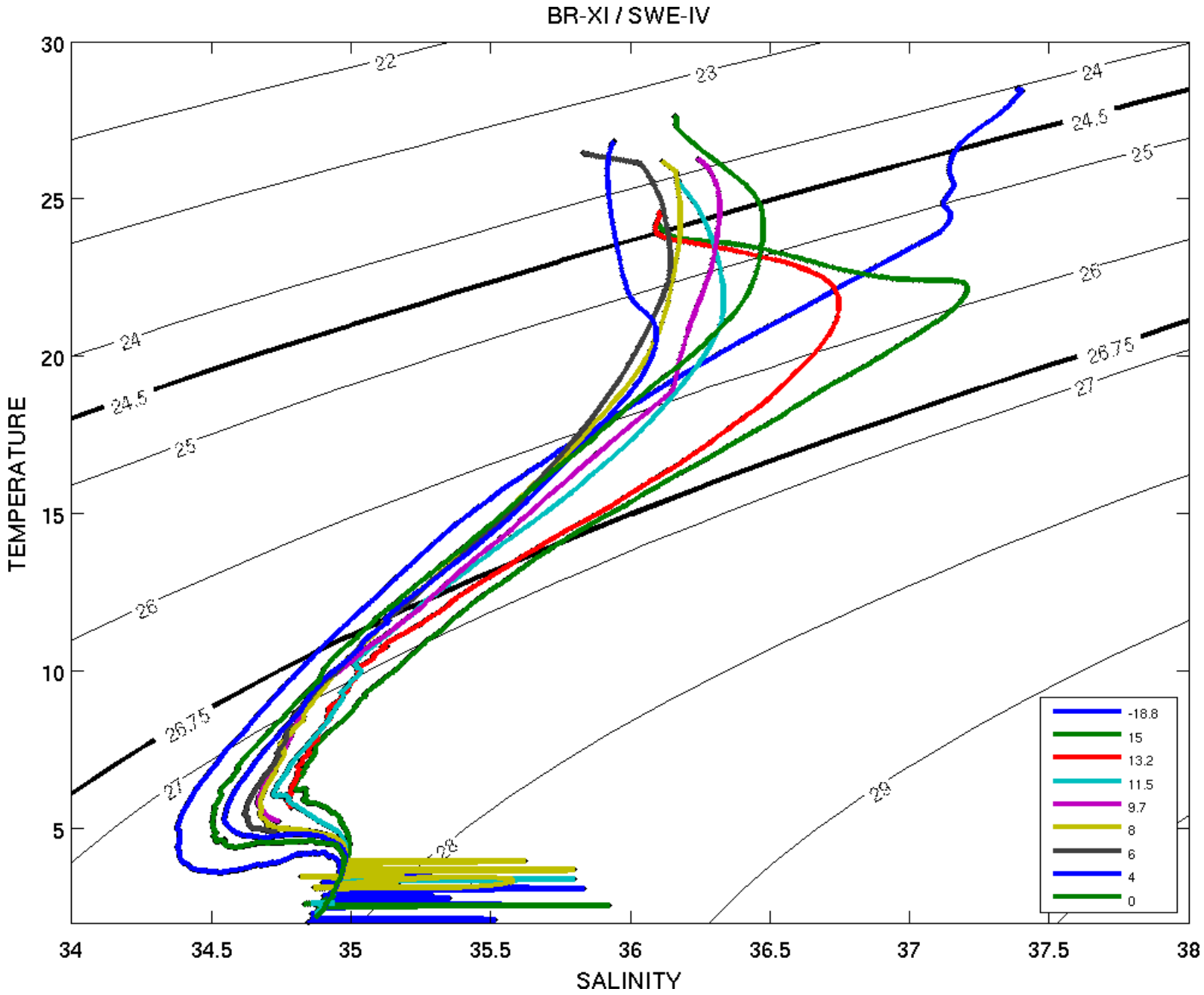

Velocity at 50 m
18°N
9°N
0°
9°S
18°S
56°W
48°W
40°W
32°W
24°W
Fortaleza
Natal
Salvador
Rio de Janeiro

Perfilagem Oceânica

CTDO2

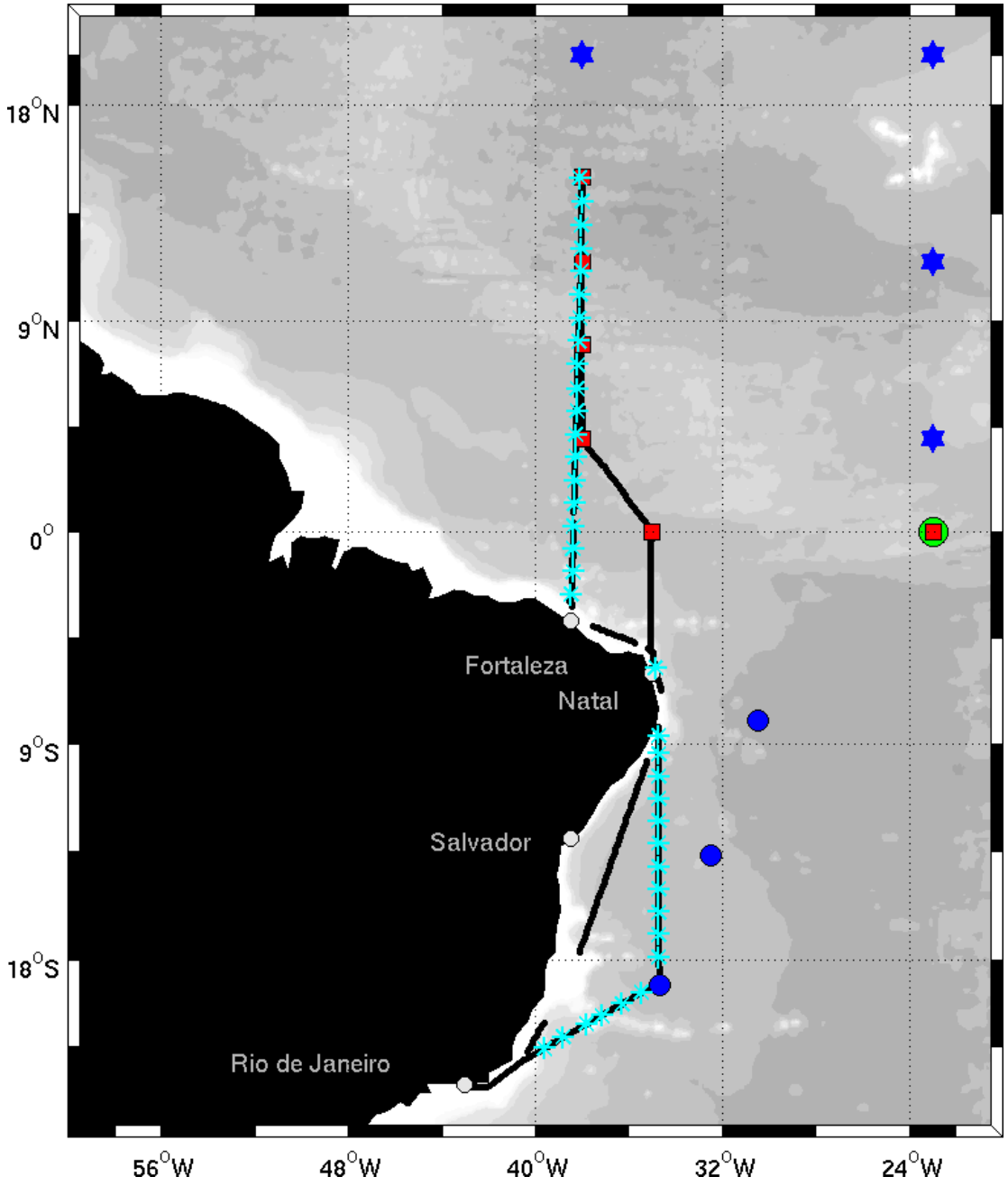

18°N
9°N
0°
9°S
18°S
56°W
48°W
40°W
32°W
24°W
Fortaleza
Natal
Salvador
Rio de Janeiro




BR-XI / SWE-IV
TEMPERATURE
SALINITY
30
25
20
15
10
5
34
34.5
35
35.5
36
36.5
37
37.5
38
22
23
24
24.5
25
26
26.75
27
29
-18.8
15
13.2
11.5
9.7
8
6
4
0

Temperatura Oceânica

eXpendable BathyTermograph
(XBT)

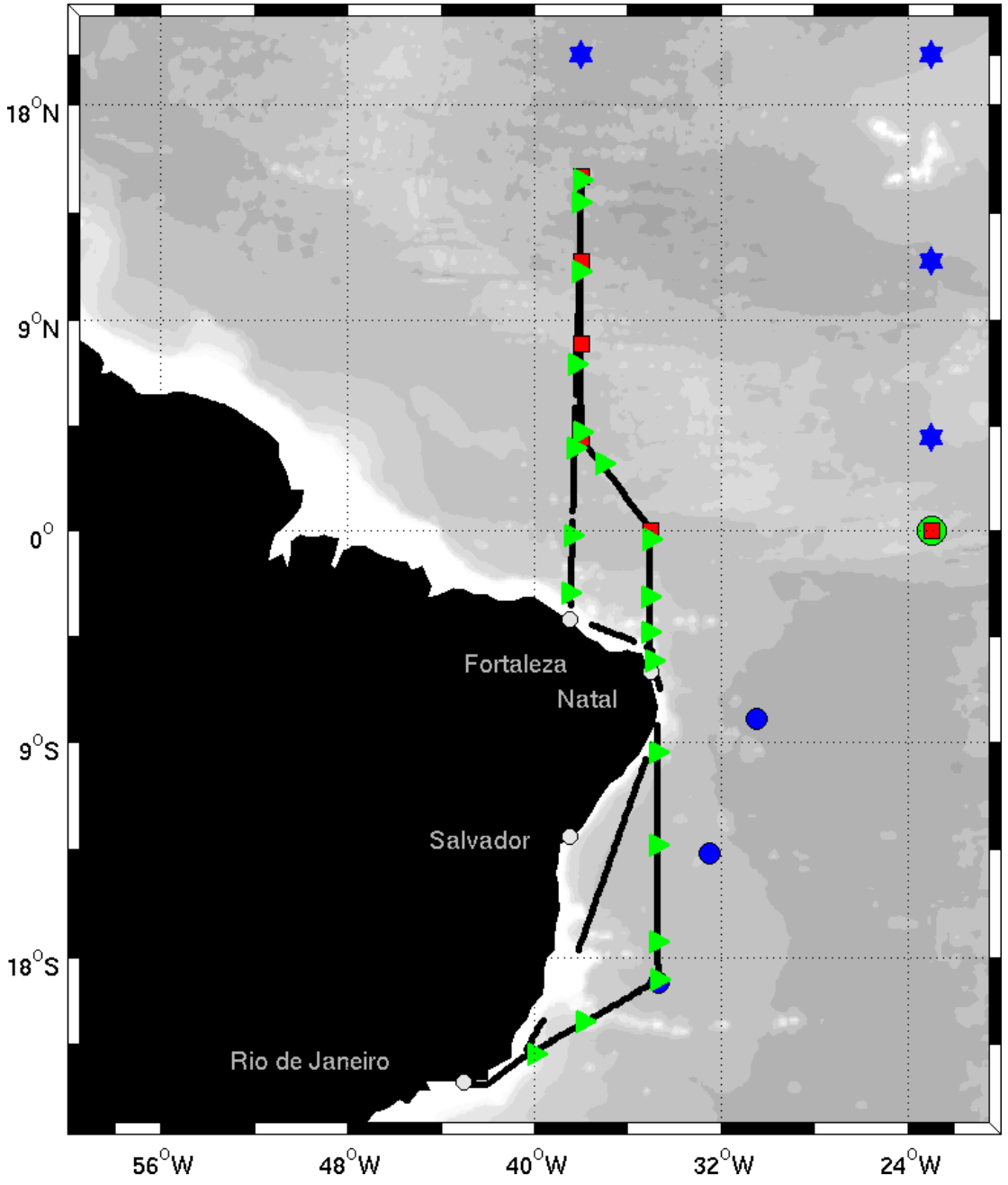

18°N
9°N
0°
9°S
18°S
56°W
48°W
40°W
32°W
24°W
Fortaleza
Natal
Salvador
Rio de Janeiro

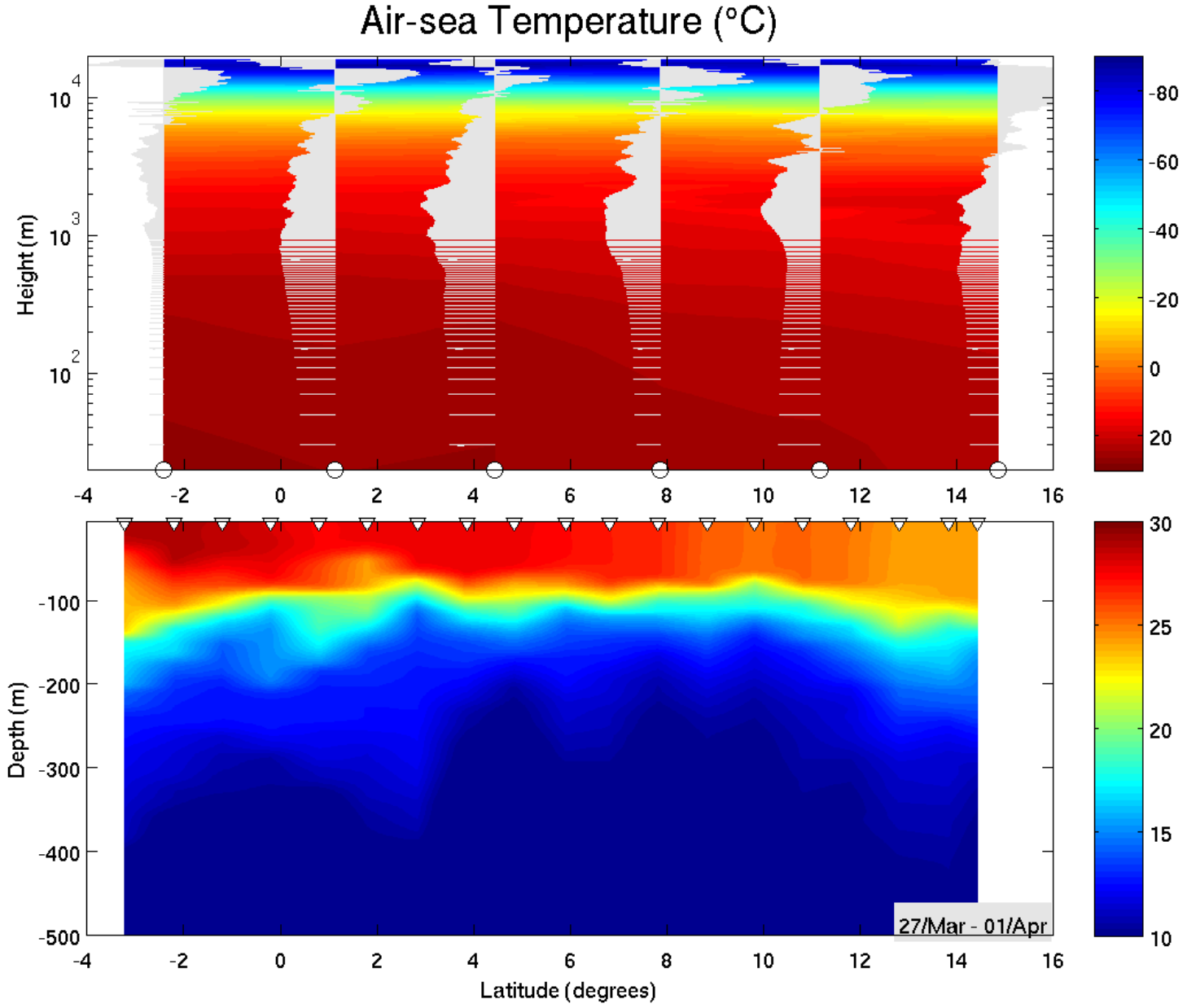

Sippican, Inc.
T5
XBT

Perfilagens Atmosféricas

Radiosondas

(Balão Meteorológico)


18°N
9°N
0°
9°S
18°S
56°W
48°W
40°W
32°W
24°W
Fortaleza
Natal
Salvador
Rio de Janeiro

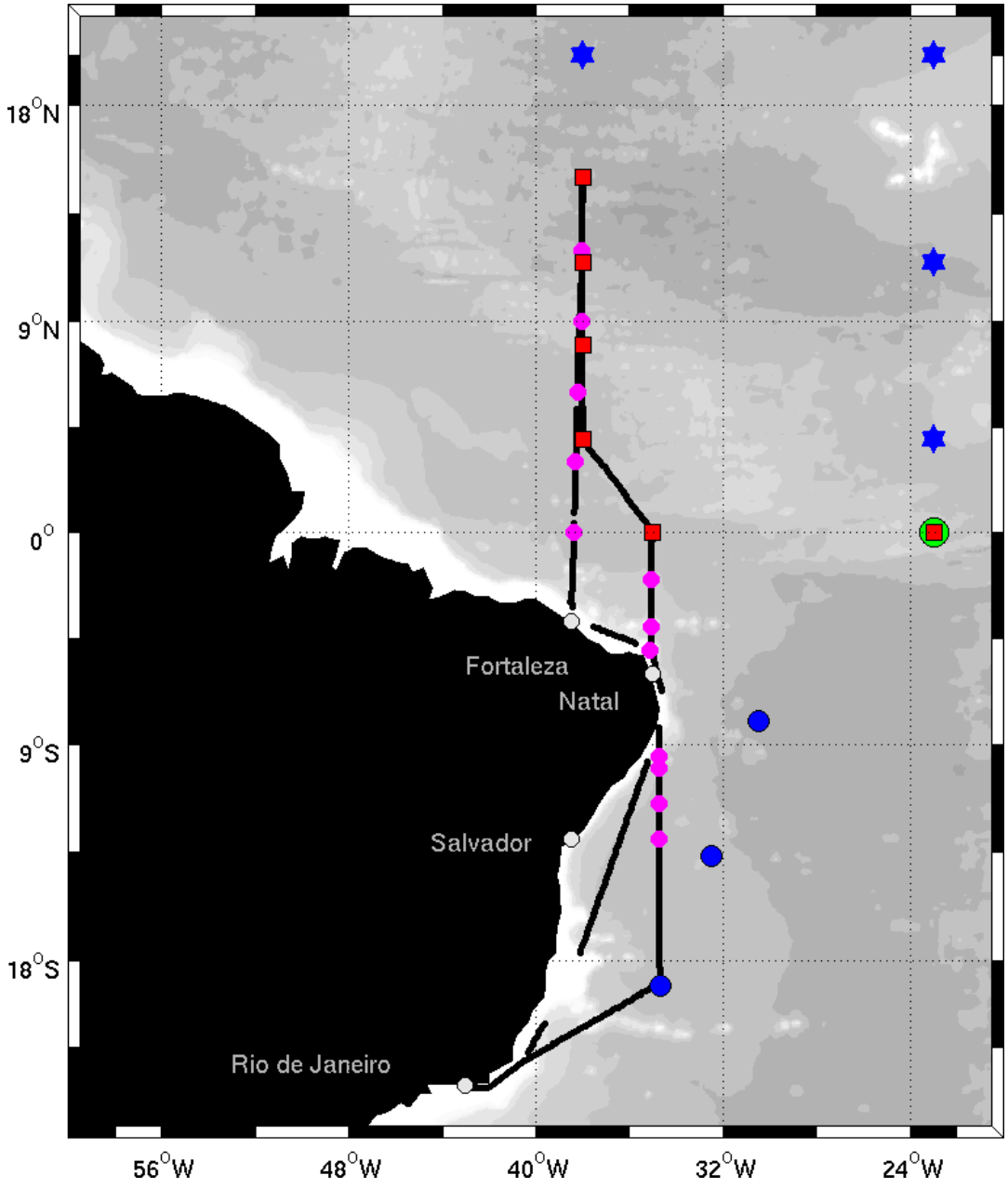

Air-sea Temperature (°C)
Height (m)
10^4
10^3
10^2
-4
-2
0
2
4
6
8
10
12
14
16
-80
-60
-40
-20
0
20
Depth (m)
-100
-200
-300
-400
-500
30
25
20
15
10
27/Mar - 01/Apr
Latitude (degrees)

Derivadores

PNBOIA (GOOS)

Colaboração DHN - AOML/PhOD

(Dr. Rick Lumpkin)

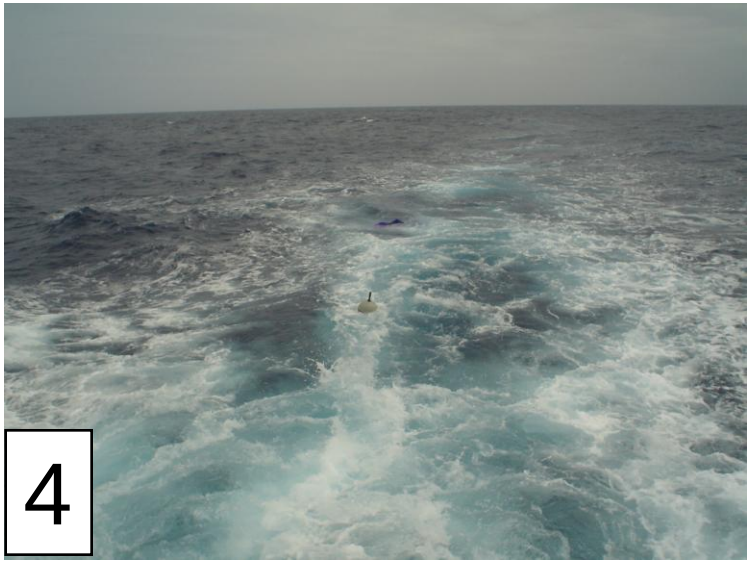

18°N
9°N
0°
9°S
18°S
56°W
48°W
40°W
32°W
24°W
Fortaleza
Natal
Salvador
Rio de Janeiro

12 floats


1

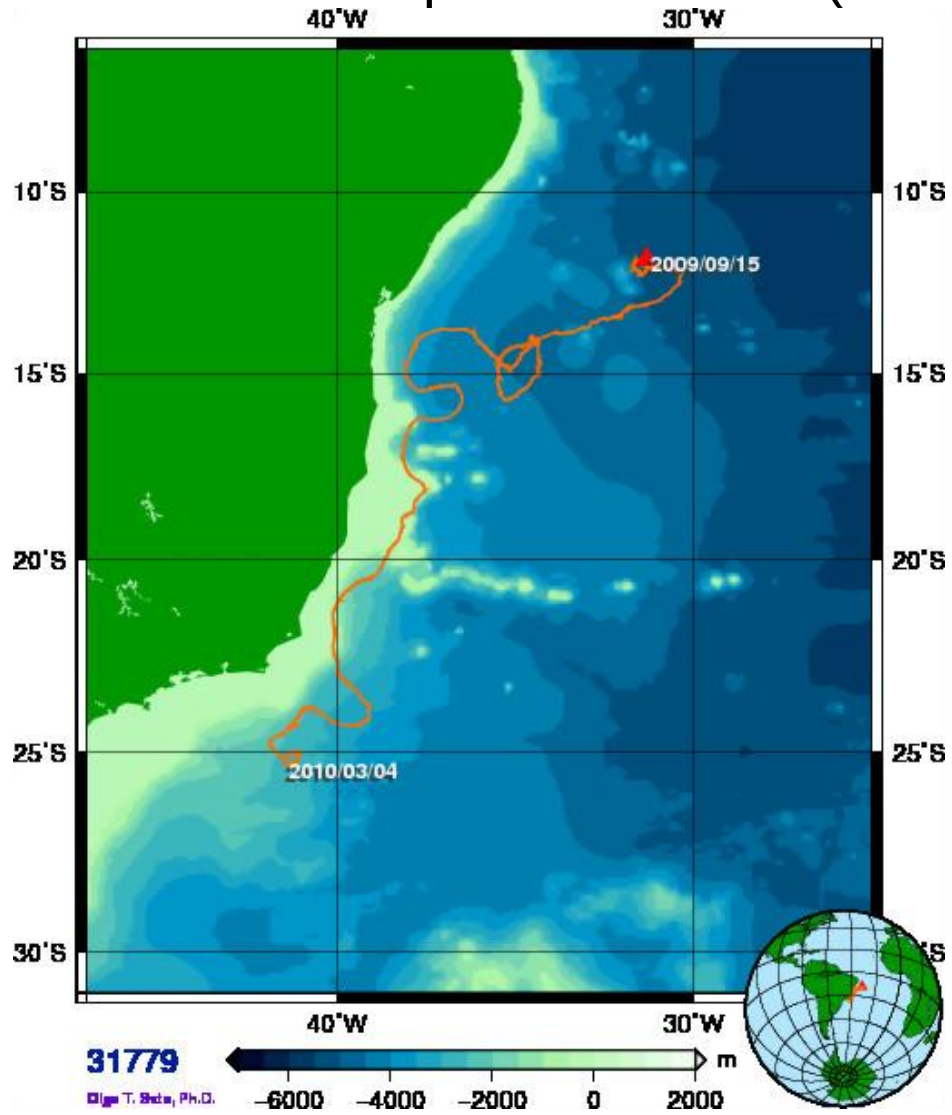

2

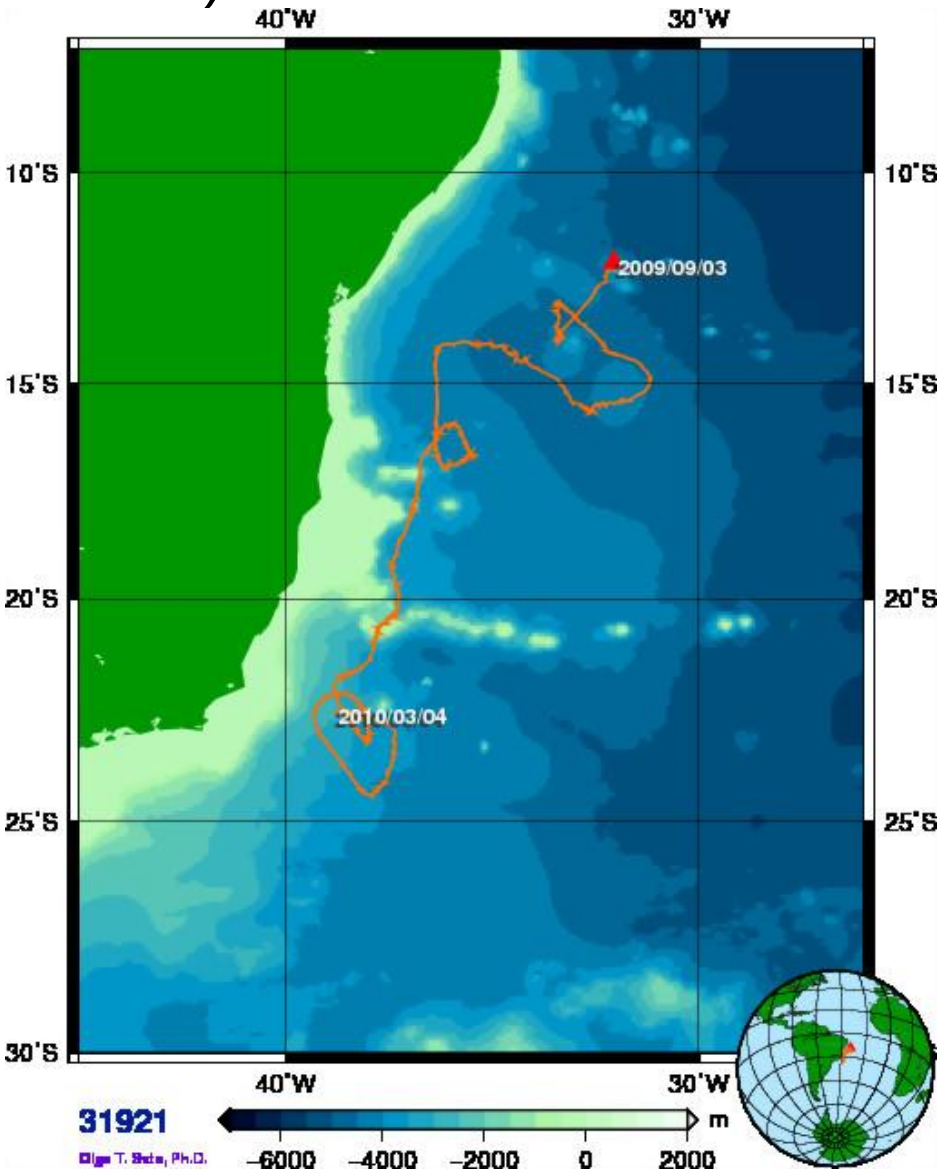

3


4

http://www.goosbrasil.org/produtos/pnboia.html

Sep 2009 / Part 2 (10S and 12S)

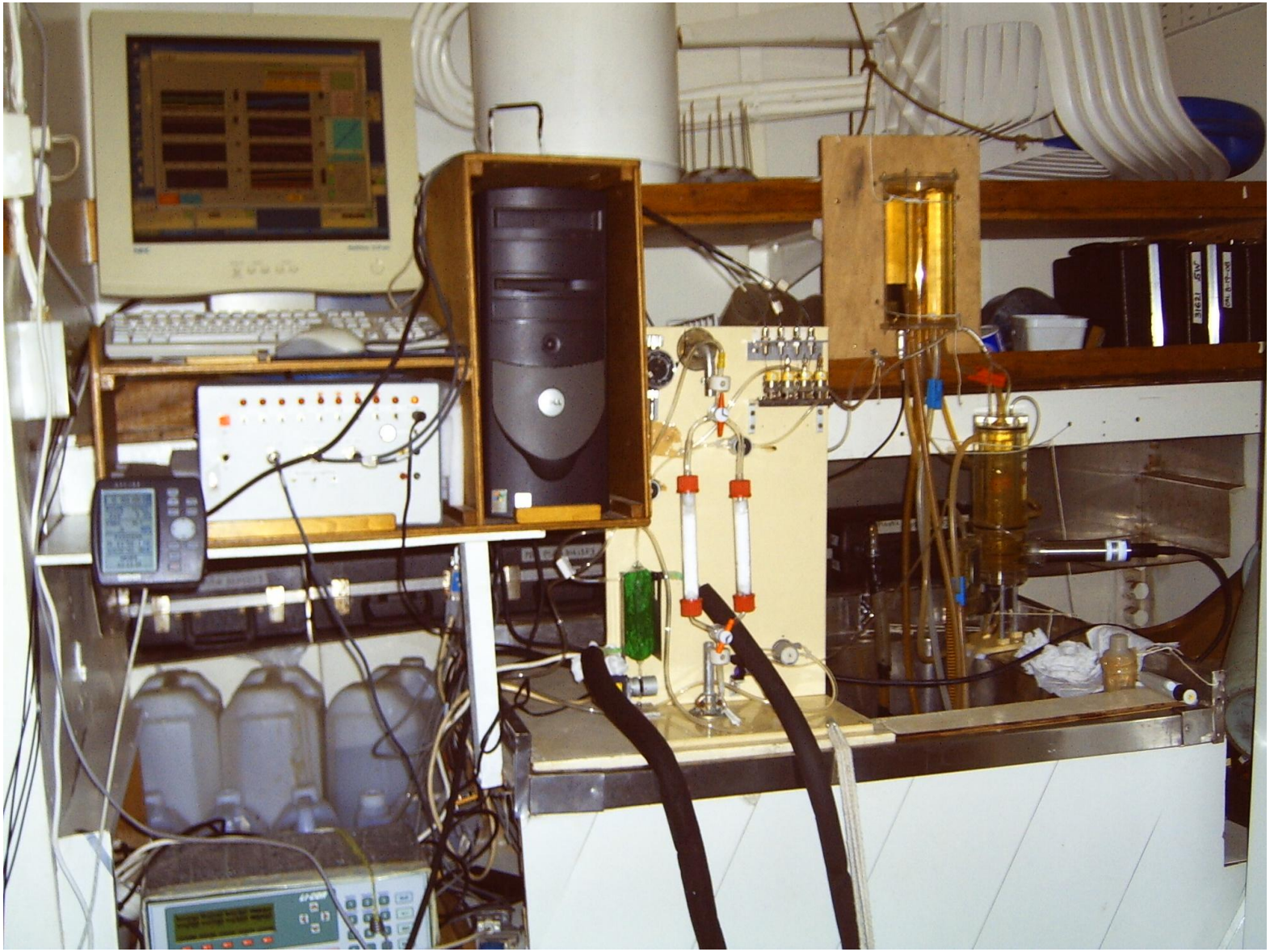


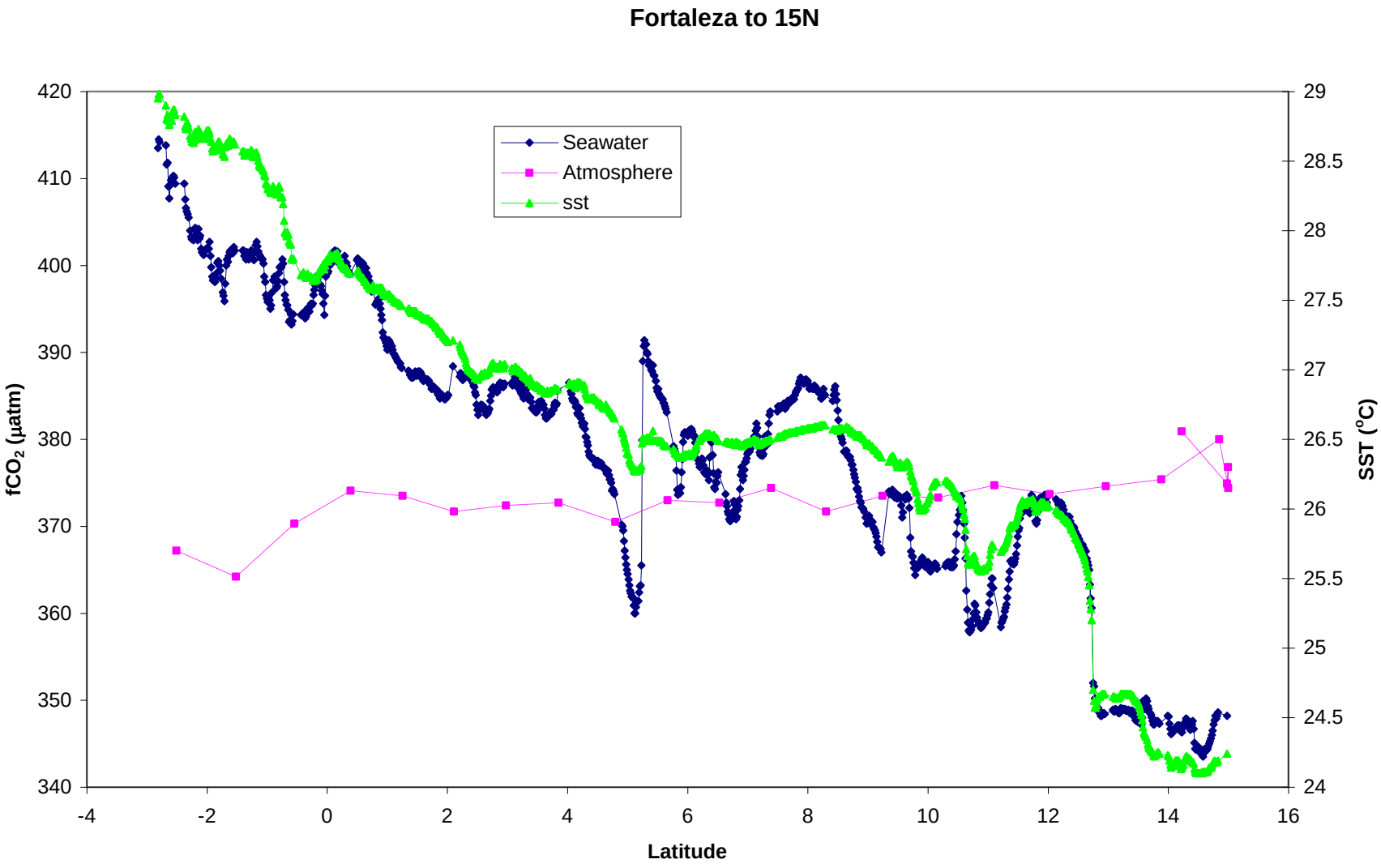


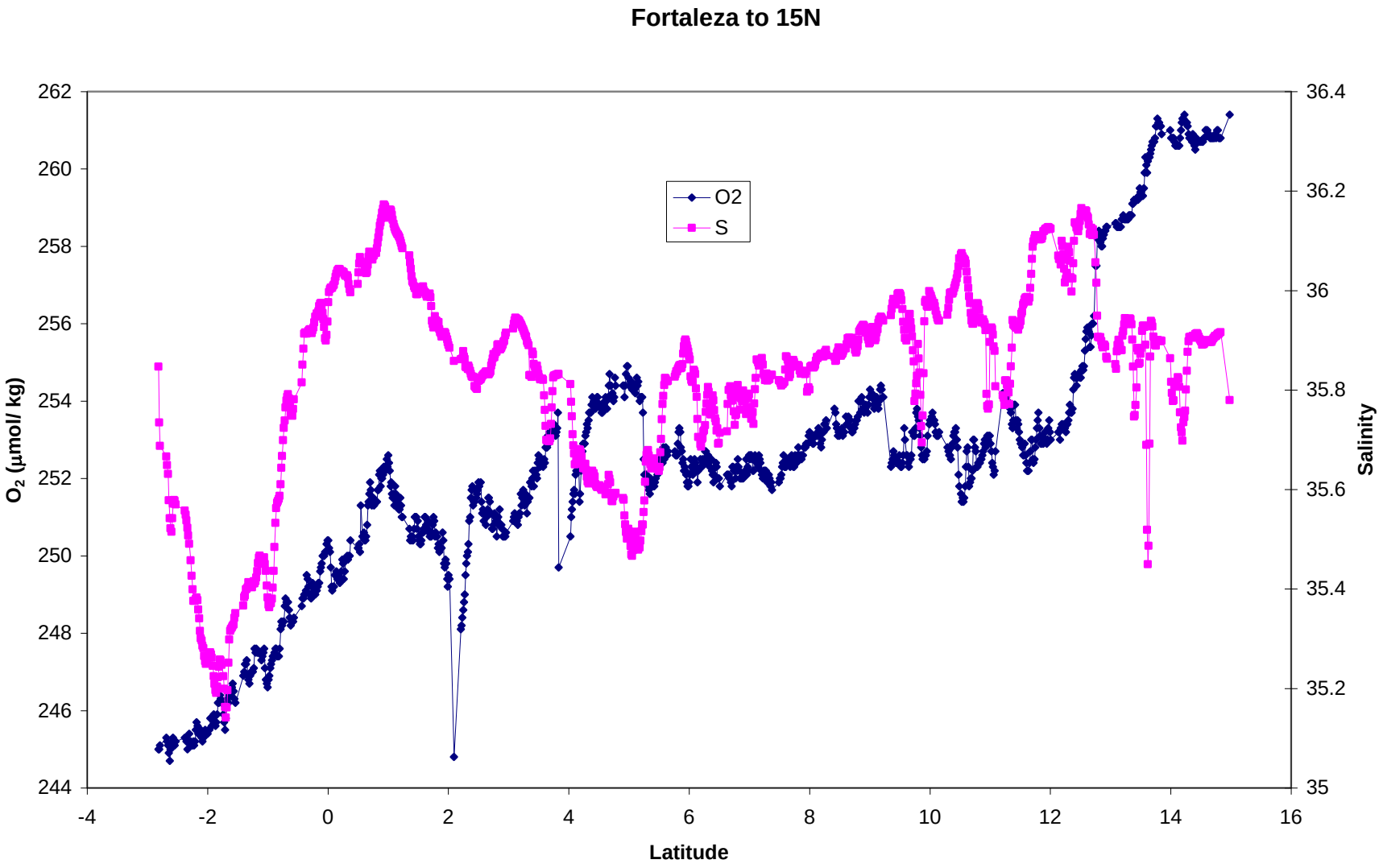
Underway pCO2

Colaboração Brasil-França

(Dr. Nathalie Lefévre)




Fortaleza to 15N
Seawater
Atmosphere
sst
fCO2 (µatm)
SST (°C)
Latitude
420
410
400
390
380
370
360
350
340
29
28.5
28
27.5
27
26.5
26
25.5
25
24.5
24
-4
-2
0
2
4
6
8
10
12
14
16


Fortaleza to 15N
O2
S
O2 (µmol/ kg)
Salinity
Latitude
262
260
258
256
254
252
250
248
246
244
36.4
36.2
36
35.8
35.6
35.4
35.2
35
-4
-2
0
2
4
6
8
10
12
14
16

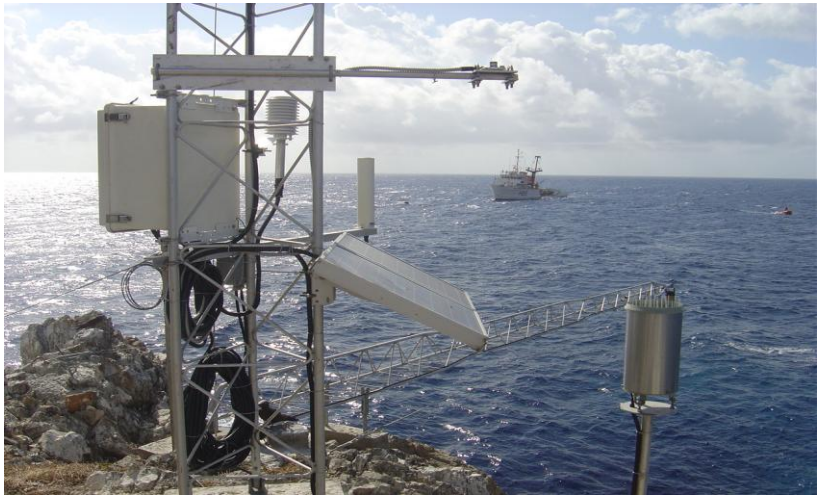
DADOS – PARTE 3

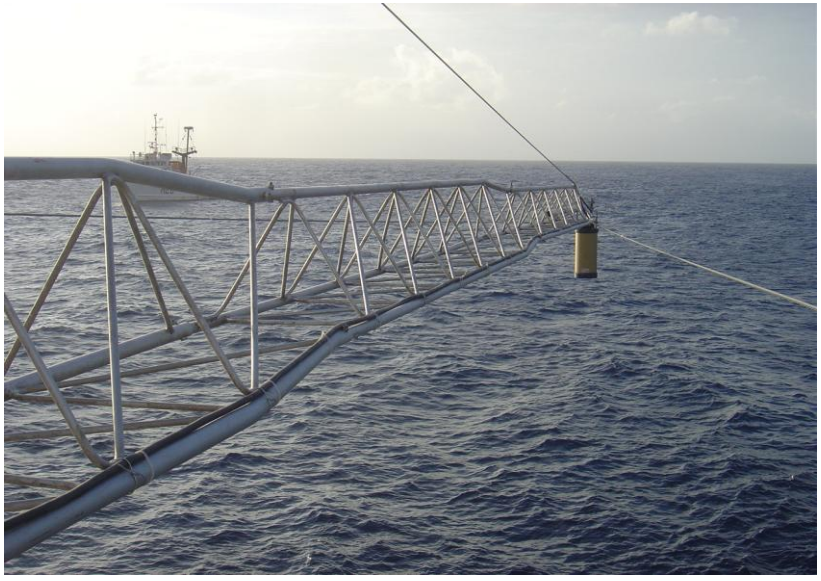
Ilhas Oceânicas

INPE-DHN SCD/ARGOS

Estação Automática Meteo-maregráfica do Arquip. de SPSP

(5 estações sendo adquiridas: 2 em SPSP e 2 Trindade)





FUTURO

novos instrumentos

ATLAS Update Project

Short term: Adapt new electronics to existing mooring hardware

- Eppley PSP (short wave) and PIR (long wave)
- RM Young Capacitance rain gauge
- Paroscientific barometer
- *Gill Windsonic (integrated with Sparton compass)*
- *Rotronic Hygroclip 2 (air temperature and relative humidity)*
- *Optional Met: Vaisala WXT520 (Wind, AT, RH, Rain, BP)*
- *Seabird SB37 (T, pumped C) and Seabird 39 (T, P) with SBE Inductive Modem*
- *Nortek Aquadopp or RDI DVS (Doppler current meters) w/SBE IM*
- *Iridium Telemetry (~ $2/day. GTS submission an issue)*

Updated sensors and features

Sampling, Averaging and Telemetry

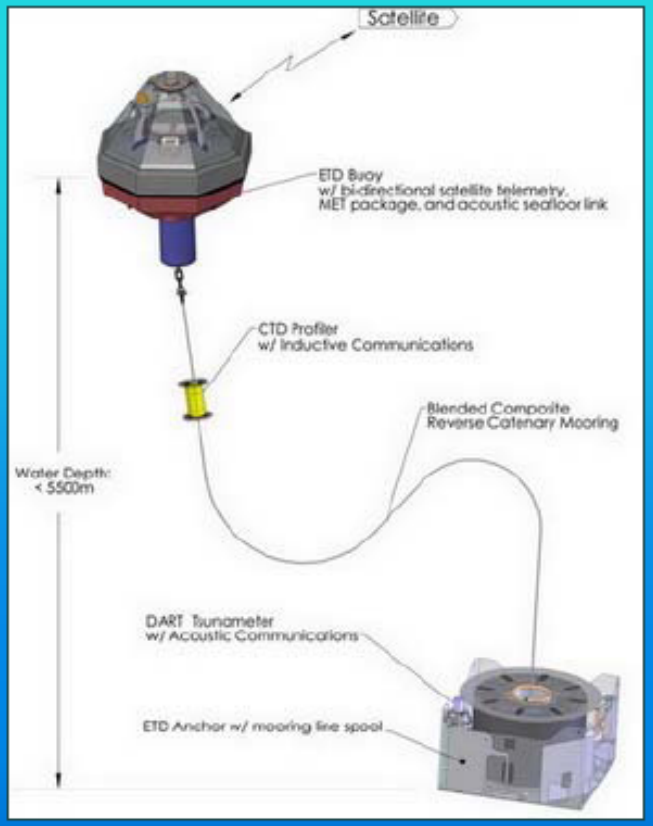
Measurement	Sample Rate	Average	Recorded Resolution	Telemetered Resolution	Call Frequency
Wind Speed, Direction, Air Temperature, Relative Humidity	1 sec	2 min	10 min	hourly	6 hours
Rain and Radiation	1 sec	1 min	1 min		
Barometric Pressure	1	2 min	hourly		
Water Temperature, Conductivity, Pressure	1 sample	1 sample	10 min		
Current	1 sec	2 min	20 min		

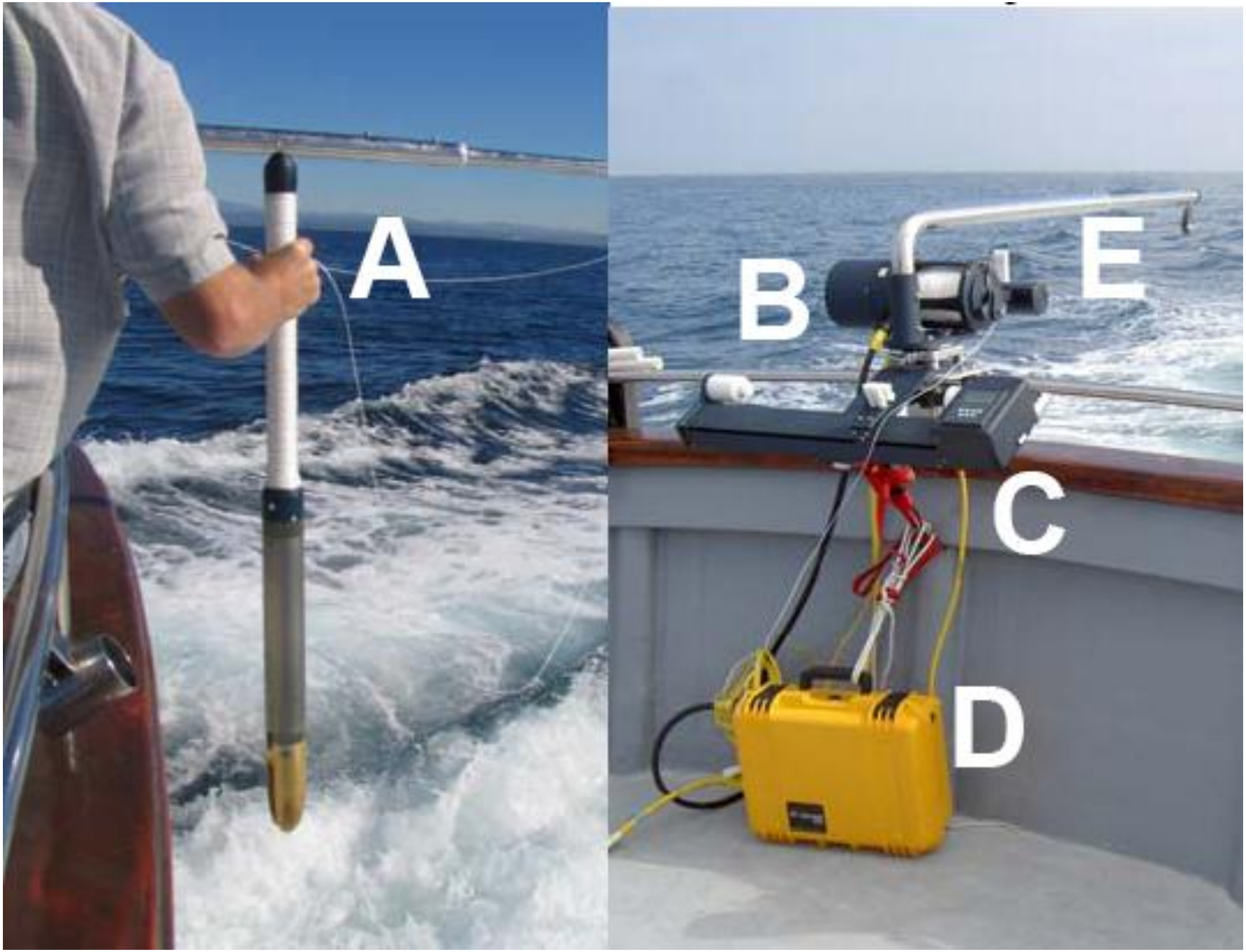
First deployment:
~Fall 2010

ATLAS Replacement Project

Longer term: Smaller moorings

- Safer and significantly simplified operations compared to traditional moorings
- Palletized design eliminates the need for large vessels and skilled deployment personnel
- Mass producible design
- Multi-sensor, vandal resistant features
- Capable in high latitudes, up to 5500 m water depths
- 2-3 year design life




A
B
C
D
E

AQUATEC SUBSEA LTD

Innovation . . . in Depth

The AQUAmark 300 Pinger

The AQUAmark 300 is an acoustic pinger designed to reduce the unintentional catch of harbor porpoises in commercial gillnet and driftnet fisheries.

Large scale trials in the Bay of Fundy and in Denmark in 1996 and 1997 showed a highly significant reduction in bycatch on nets fitted with acoustic deterrents. In Europe, the AQUAmark 100 and 200 models, which transmit a variety of complex ultrasonic signals, have been in commercial use for over three years with several thousand devices in service.

The AQUAmark technology has been adapted to meet the NOAA Fisheries Take Reduction Plan pinger regulations, resulting in the AQUAmark 300 product.

Features

- **Fit and forget !** No battery change with a sealed-for-life design. Typically lasts 2 to 4 years with seasonal use.
- **No noise on deck!** Wet switch means that it only operates when immersed, to save battery life.
- **No leaks!** Fully moulded construction means there are no seals to get damaged.
- **No battery waste!** Return spent units to us or our appointed agents for a discount on replacement devices.

Outline Specification

Frequency	10kHz ± 2kHz
Duration	300ms ± 10ms
Repeat Interval	4s ± 0.2s
Sound Level	132dB re 1 µPa at 1 metre ±4dB
Dimensions	164mm (6.5") long x 58mm (2.3") diameter at widest point
Weight	410 g (15 oz) in air; 135 g (5 oz) in water
Attachment	Dual point attachment through 11mm (0.4") holes 19mm (0.75") from ends, or by placement in bait bags
Maximum depth	200 m (110 fathoms)
Shelf life	Up to 4 years
Battery life	Up to 1 year with continuous immersion, dependent on temperature. 2 - 4 years in typical fishery with seasonal or discontinuous deployment, as devices switch off when not in water.

Meets NMFS Regulations

Aquatec Subsea Limited High Street, Hartley Wintney, Hants, RG27 8NY, UK
Telephone: +(44) (0)1252 843072 Facsimile: +(44) (0)1252 843074 email: info@AquatecSubsea.com www.AquatecSubsea.com

Obrigado pela atenção!

Dúvidas/ Informações:

domingos.urbano@cptec.inpe.br