



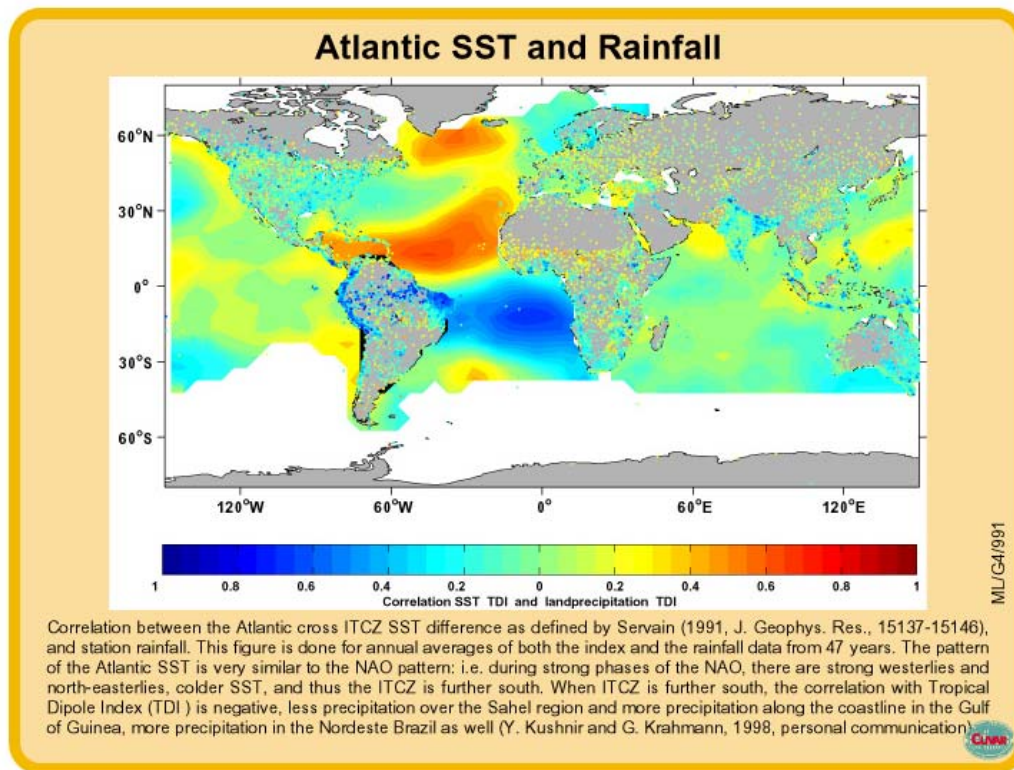
## Prediction and Research Moored Array in the Tropical Atlantic - PIRATA

Ugo<sup>1</sup>, B. Bourlès<sup>2</sup>, E. Campos<sup>3</sup>, H. Giordanni<sup>4</sup>, F. Hernandez<sup>5</sup>,  
R. Lumpkin<sup>6</sup>, M. McPhaden<sup>6</sup>, P. Nobre<sup>7</sup>, R. Saravanan<sup>8</sup>

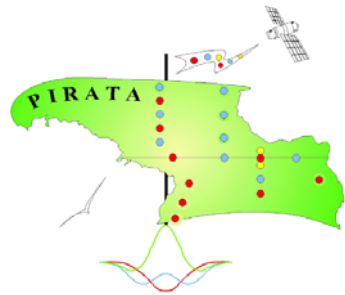
<sup>1</sup>NOAA/CEERMA-UFPE, Brazil; <sup>2</sup>LEGOS, France; <sup>3</sup>IO-USP, Brazil; <sup>4</sup>CNRM-MeteoFrance, France; <sup>5</sup>MERCATOR-Ocean, France; <sup>6</sup>NOAA, USA;  
<sup>7</sup>CPTEC-INPE, Brazil; <sup>8</sup>TAMU, USA.



## → Why tropical Atlantic ?

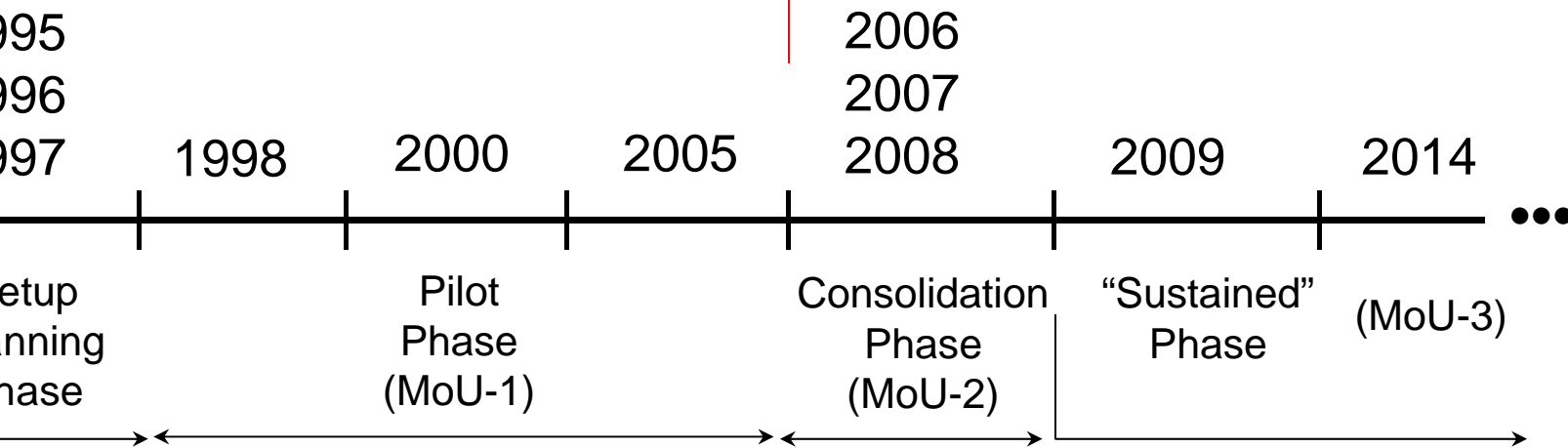


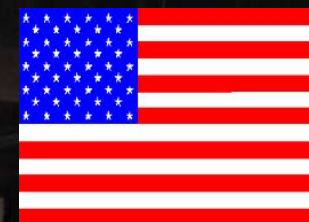
the variability of the ocean–atmosphere system in the tropical Atlantic, from intraseasonal to multidecadal time scales, strongly influences seasonal variations in rainfall, and consequently the economies of the



# PIRATA

CLIVAR-WCRP  
endorsement



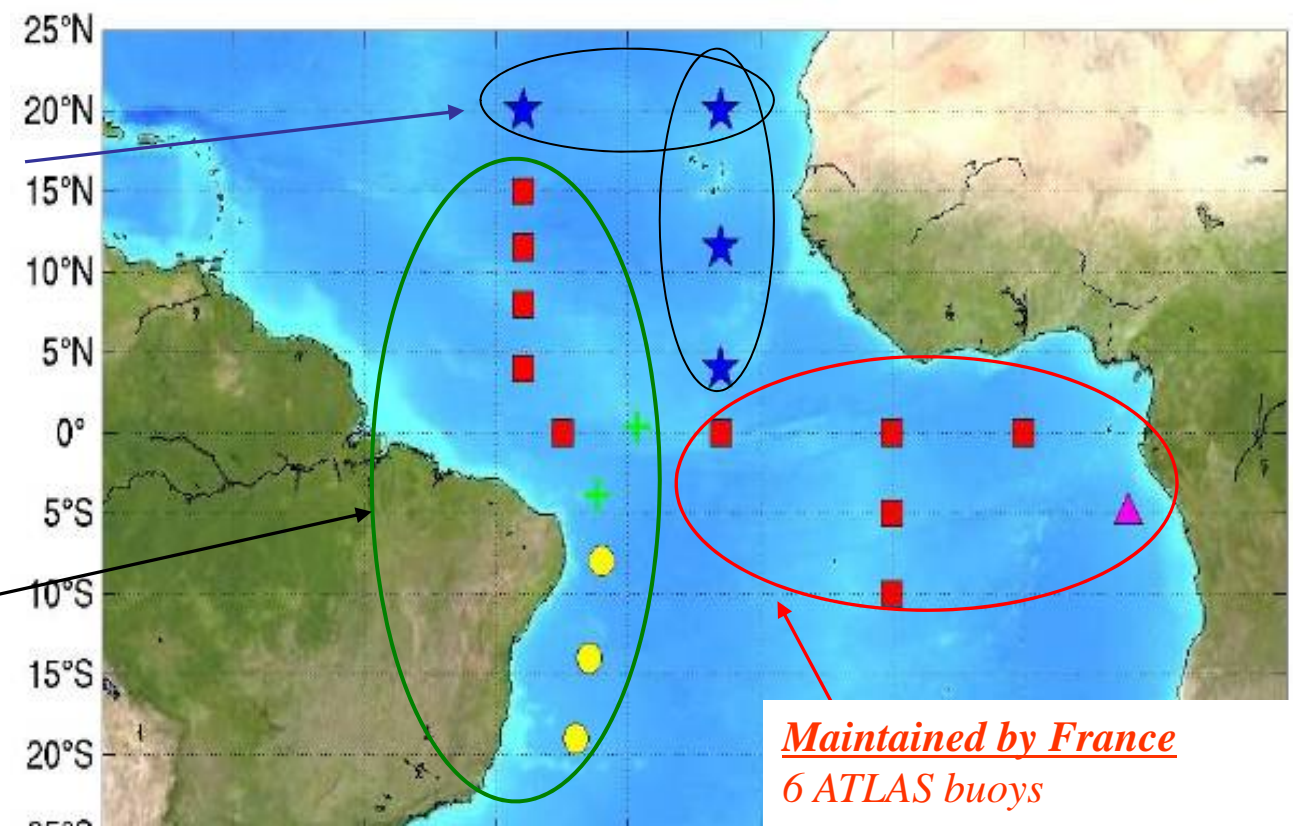




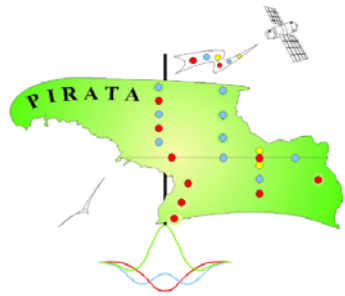


*Maintained by USA:  
ATLAS buoys*

*Maintained by Brazil:  
S buoys*

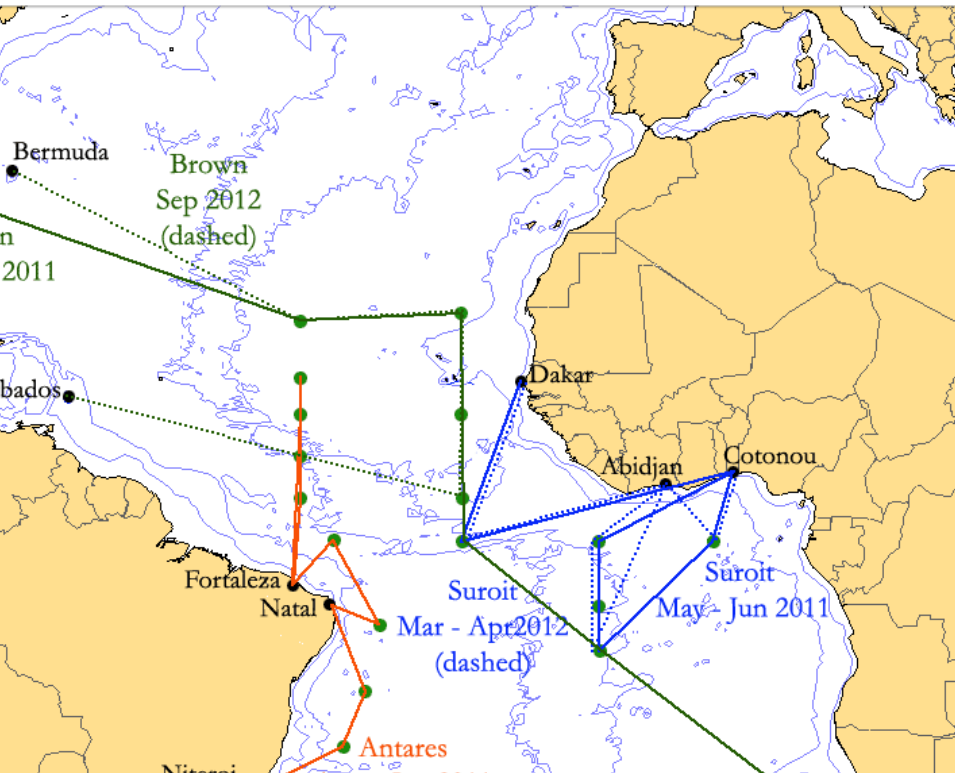


*Maintained by France  
6 ATLAS buoys*



## PIRATA

PIRATA Cruises Mar 2011 - Aug 2012



**Typical sea work year:**

ATLAS moorings deployed: 18

Shiptime: ~ 150 days



## Folie 7

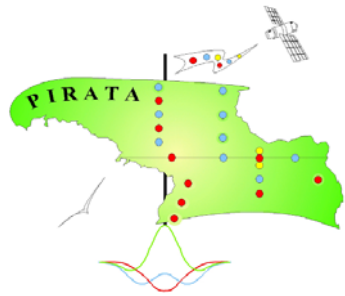
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**I108** 1) The Sea Surface Temperature (SST), which is an indicator of heat build-up of the ocean, plays a significant role in climatic system in the Southwestern Tropical Atlantic

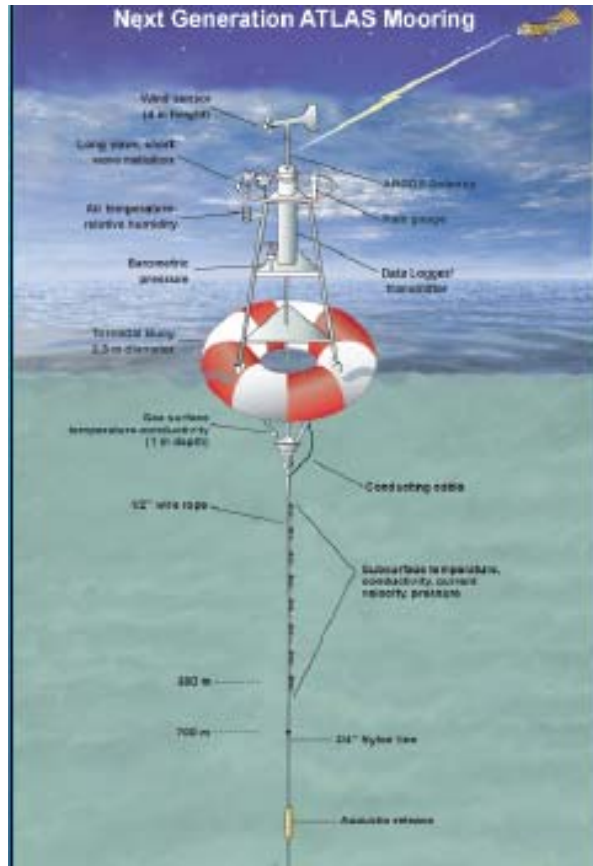
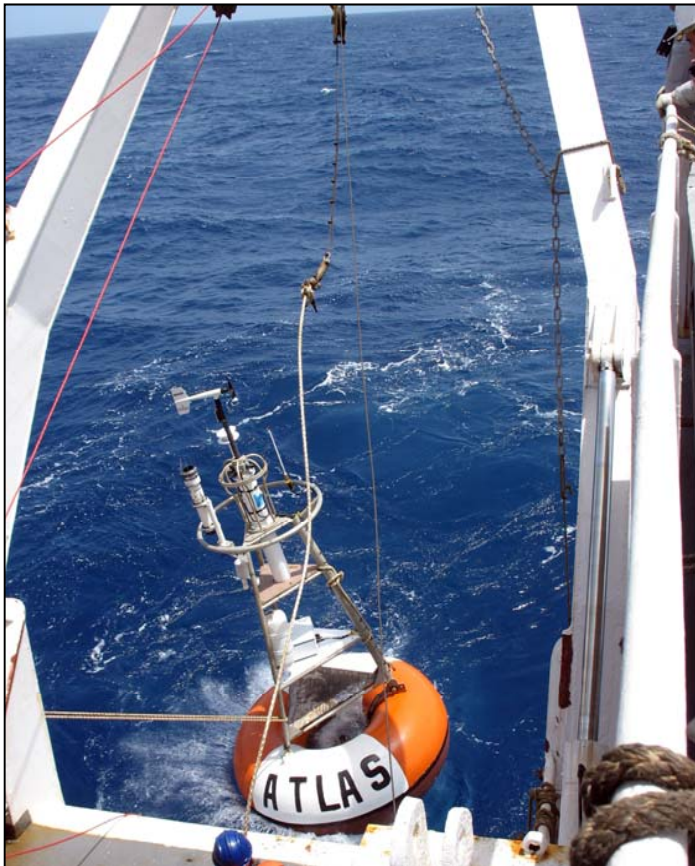
2) and it is usually faced as one of the most important forcing (conditioning factor) of some environmental related events, such as the wind distribution over the ocean

Isis; 07.06.2010





# PIRATA



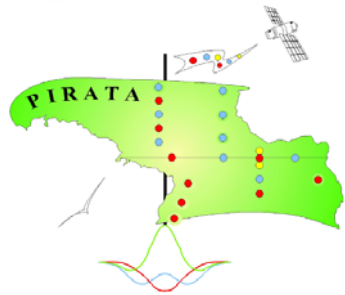
## Folie 8

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I125 1) The Sea Surface Temperature (SST), which is an indicator of heat build-up of the ocean, plays a significant role in climatic system in the Southwestern Tropical Atlantic

2) and it is usually faced as one of the most important forcing (conditioning factor) of some environmental related events, such as the wind distribution over the ocean

Isis; 07.06.2010



## PIRATA

eteorological data:

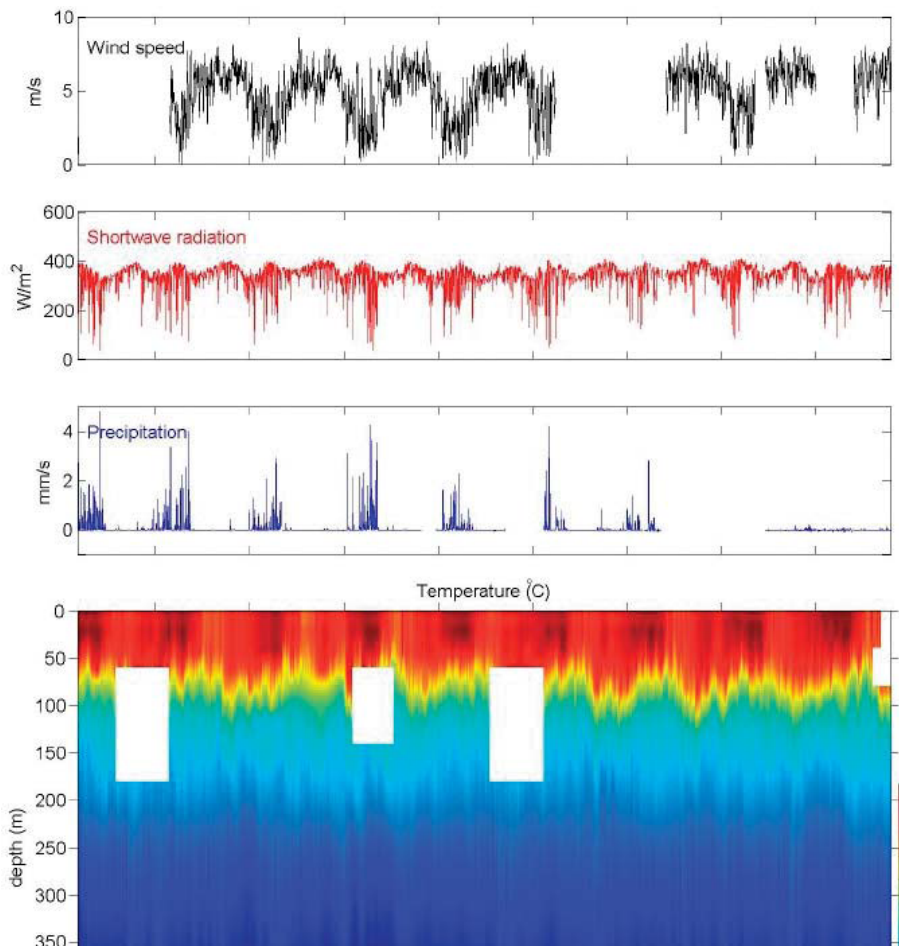
rain, RH, W, SWR, LWR,

Hydrographic data (0-500 m):

11 levels), S(z) (5 levels),

nts

, O<sub>2</sub> (2006 on ...)



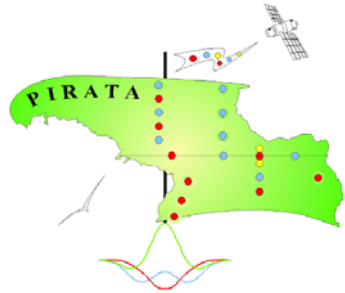
## Folie 9

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I124 1) The Sea Surface Temperature (SST), which is an indicator of heat build-up of the ocean, plays a significant role in climatic system in the Southwestern Tropical Atlantic

2) and it is usually faced as one of the most important forcing (conditioning factor) of some environmental related events, such as the wind distribution over the ocean

Isis; 07.06.2010



## PIRATA

eteorological data:

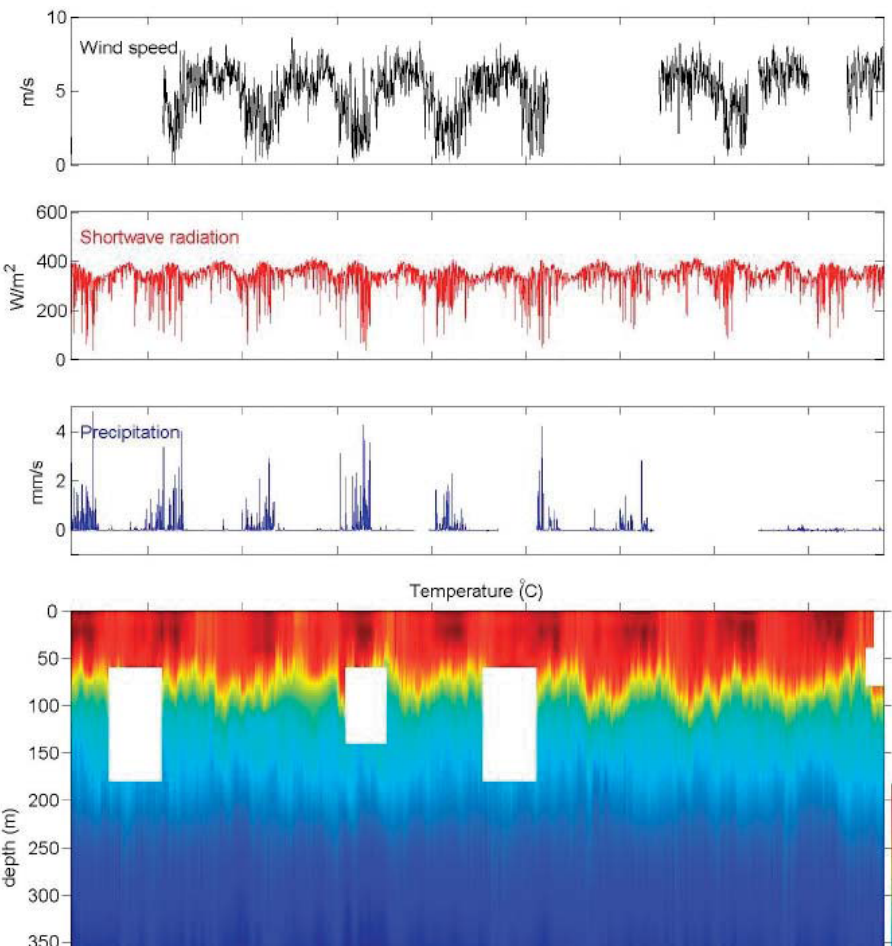
rain, RH, W, SWR, LWR,

Hydrographic data (0-500 m):

11 levels), S(z) (5 levels),  
nts

, O2 (2006 on ...)

n Tracking Network (2014 on ...)



## Folie 10

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**I126** 1) The Sea Surface Temperature (SST), which is an indicator of heat build-up of the ocean, plays a significant role in climatic system in the Southwestern Tropical Atlantic

2) and it is usually faced as one of the most important forcing (conditioning factor) of some environmental related events, such as the wind distribution over the ocean

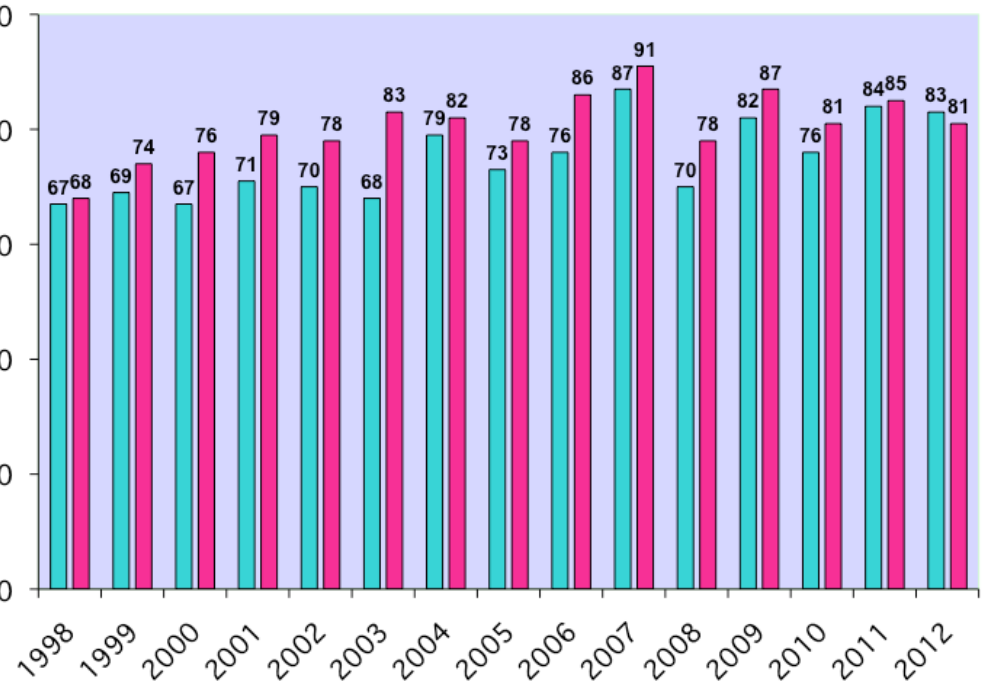
Isis; 07.06.2010



# PIRATA

PIRATA Data Return

Real Time    Delayed Mode



# Open Data Policy



**Real Time:** Daily mean subsurface data and hourly meteorological data at the times of satellite overpasses are placed on the GTS by Service Argo for real-time distribution to operational centers.

## Folie 11

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I127 1) The Sea Surface Temperature (SST), which is an indicator of heat build-up of the ocean, plays a significant role in climatic system in the Southwestern Tropical Atlantic

2) and it is usually faced as one of the most important forcing (conditioning factor) of some environmental related events, such as the wind distribution over the ocean

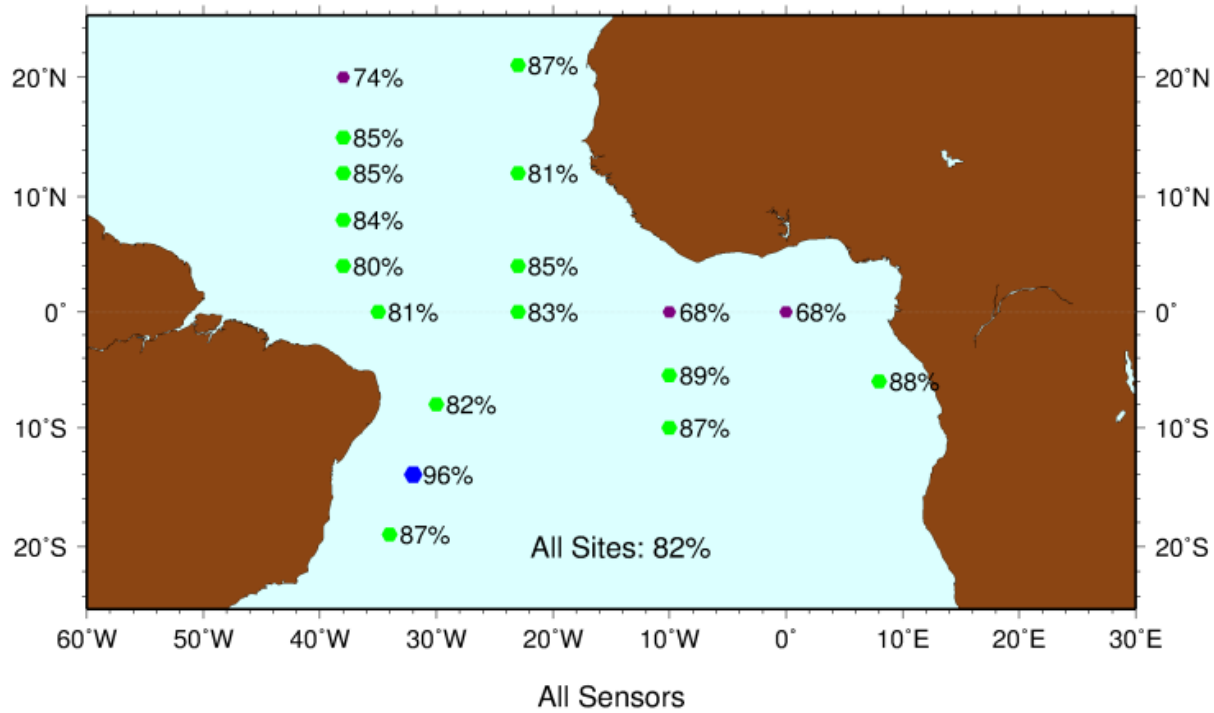
Isis; 07.06.2010





# PIRATA

PIRATA Mooring Data Return  
1997 - 2013



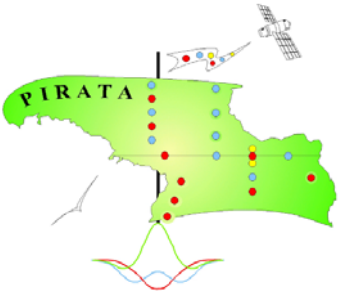
## Folie 12

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I115 1) The Sea Surface Temperature (SST), which is an indicator of heat build-up of the ocean, plays a significant role in climatic system in the Southwestern Tropical Atlantic

2) and it is usually faced as one of the most important forcing (conditioning factor) of some environmental related events, such as the wind distribution over the ocean

Isis; 07.06.2010

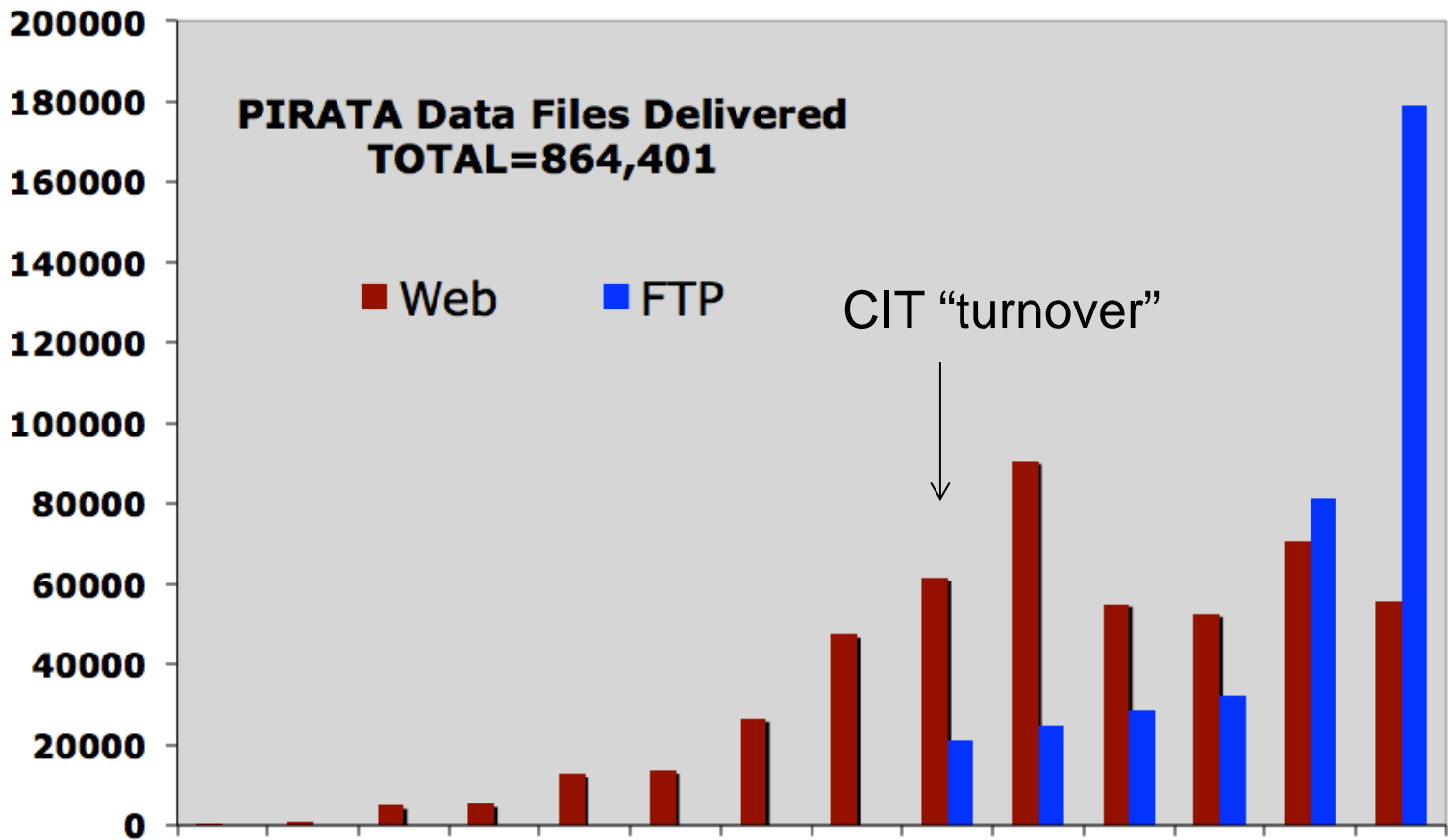


# PIRATA

**PIRATA Data Files Delivered  
TOTAL=864,401**

■ Web    ■ FTP

CIT "turnover"



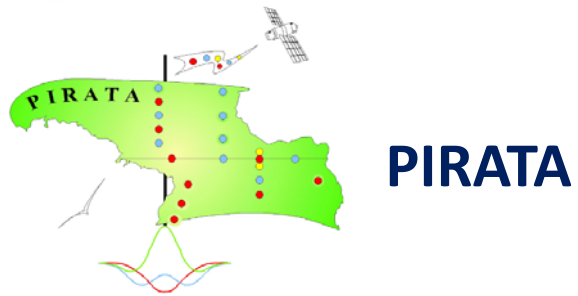
## Folie 13

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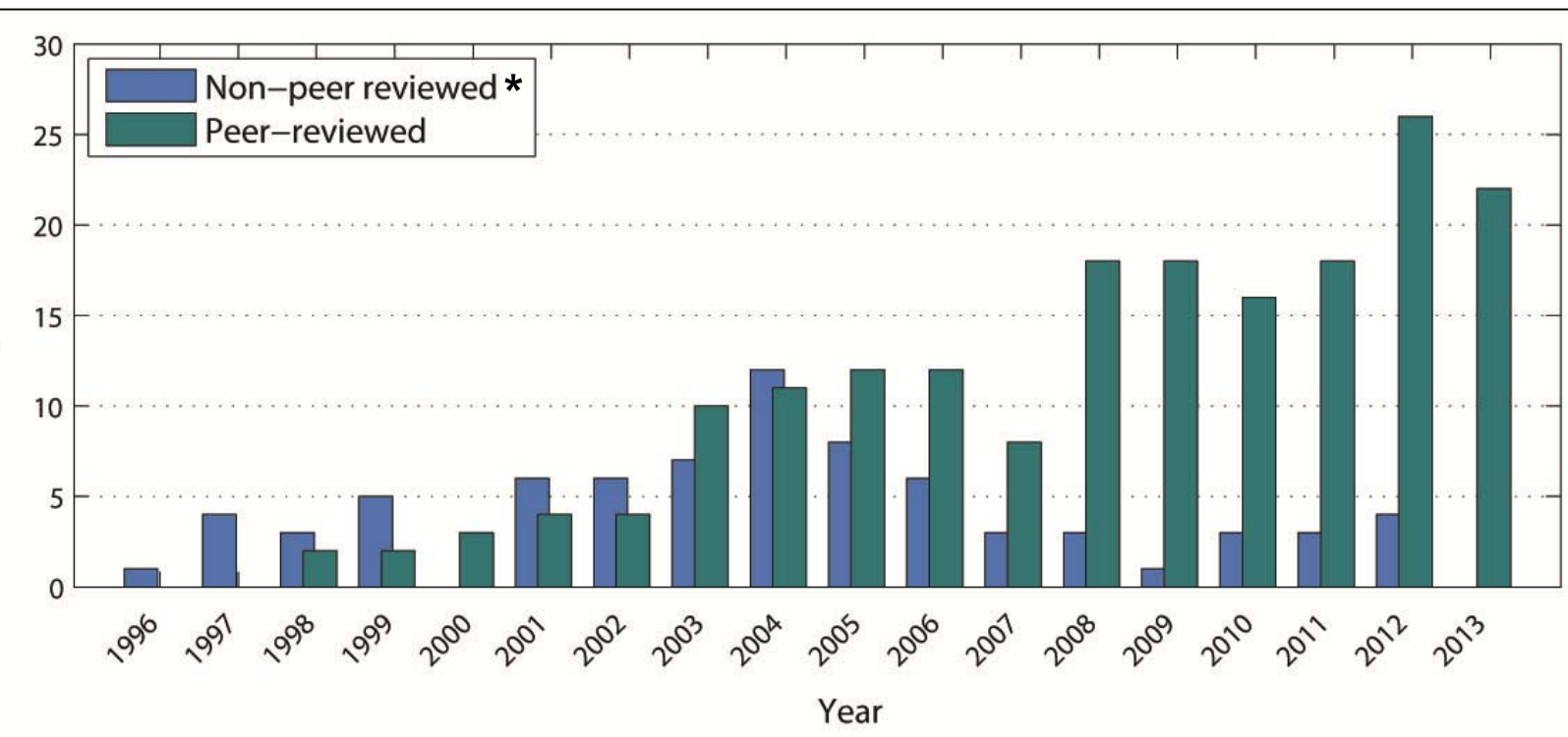
**I123** 1) The Sea Surface Temperature (SST), which is an indicator of heat build-up of the ocean, plays a significant role in climatic system in the Southwestern Tropical Atlantic

2) and it is usually faced as one of the most important forcing (conditioning factor) of some environmental related events, such as the wind distribution over the ocean

Isis; 07.06.2010



## Science from PIRATA data



## Folie 14

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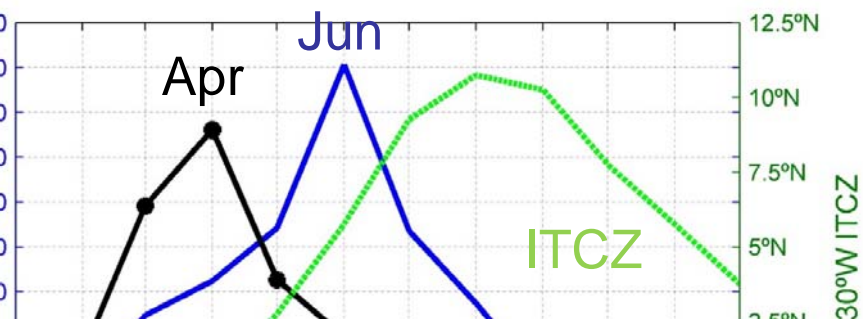
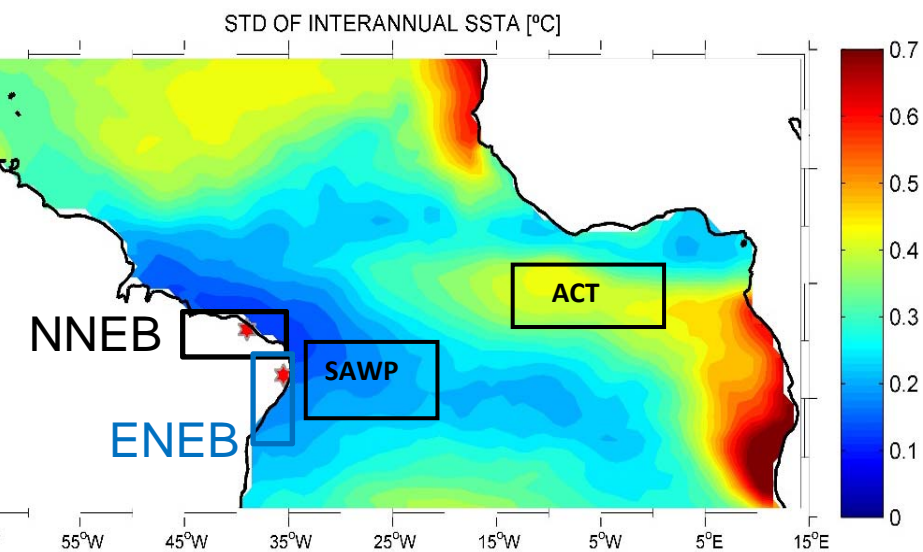
I112 1) The Sea Surface Temperature (SST), which is an indicator of heat build-up of the ocean, plays a significant role in climatic system in the Southwestern Tropical Atlantic

2) and it is usually faced as one of the most important forcing (conditioning factor) of some environmental related events, such as the wind distribution over the ocean

Isis; 07.06.2010

# → Environmental and societal impacts

## 1. Extreme rainfall events



**Fortaleza Rainfall (NNEB)**

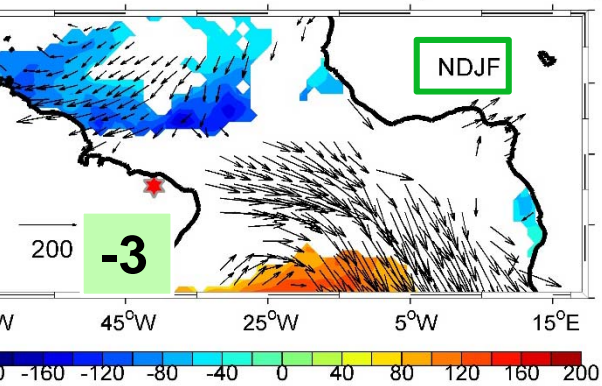
**Recife Rainfall (ENEb)**

# → Environmental and societal impacts

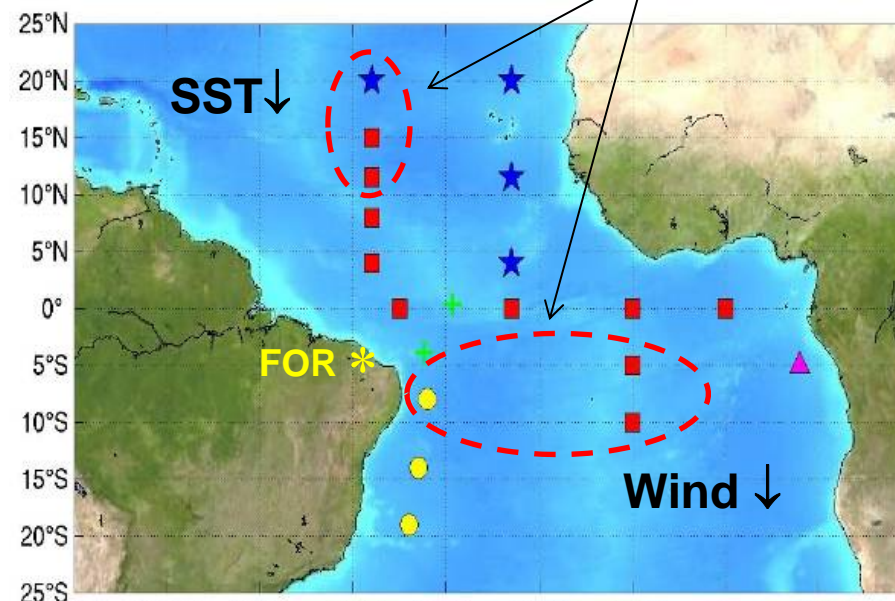
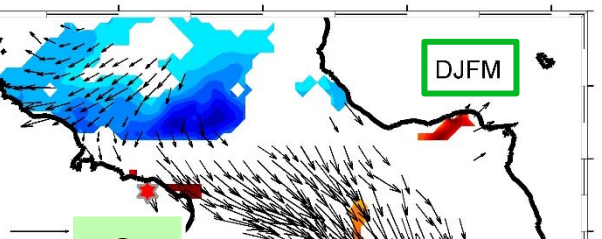
## 1. Extreme rainfall events

### Fortaleza rainfall (NNEB)

REGRES. SSTA X FORTALEZA RAINA [mm.month<sup>-1</sup>/°C]



REGRES. SSTA X FORTALEZA RAINA [mm.month<sup>-1</sup>/°C]

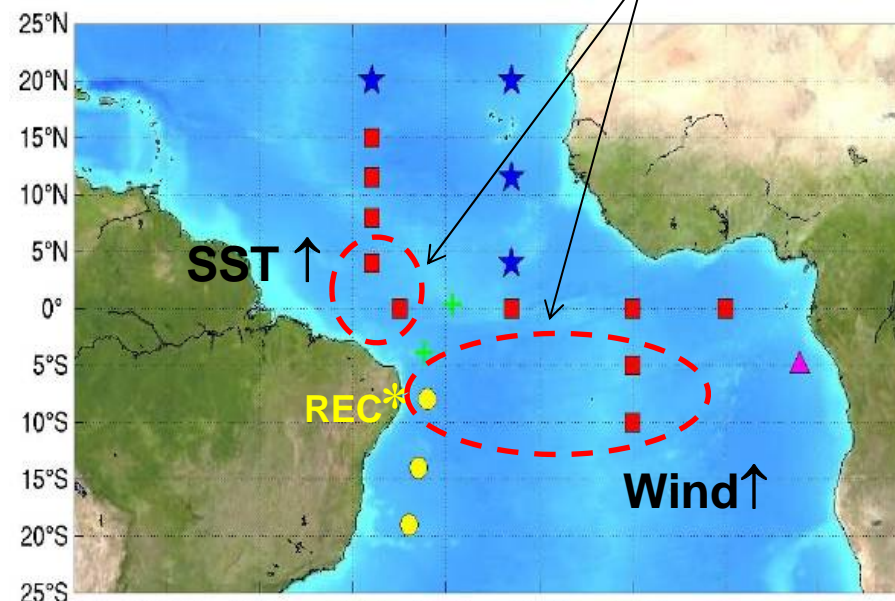
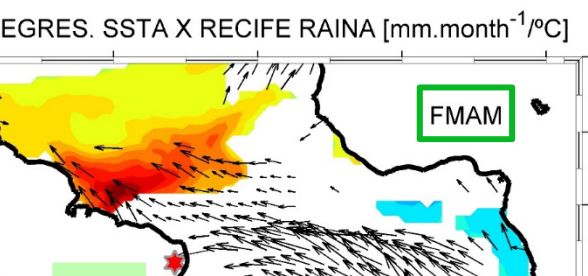
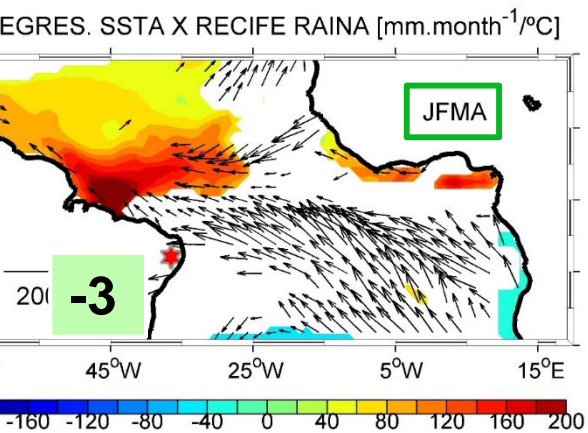




# → Environmental and societal impacts

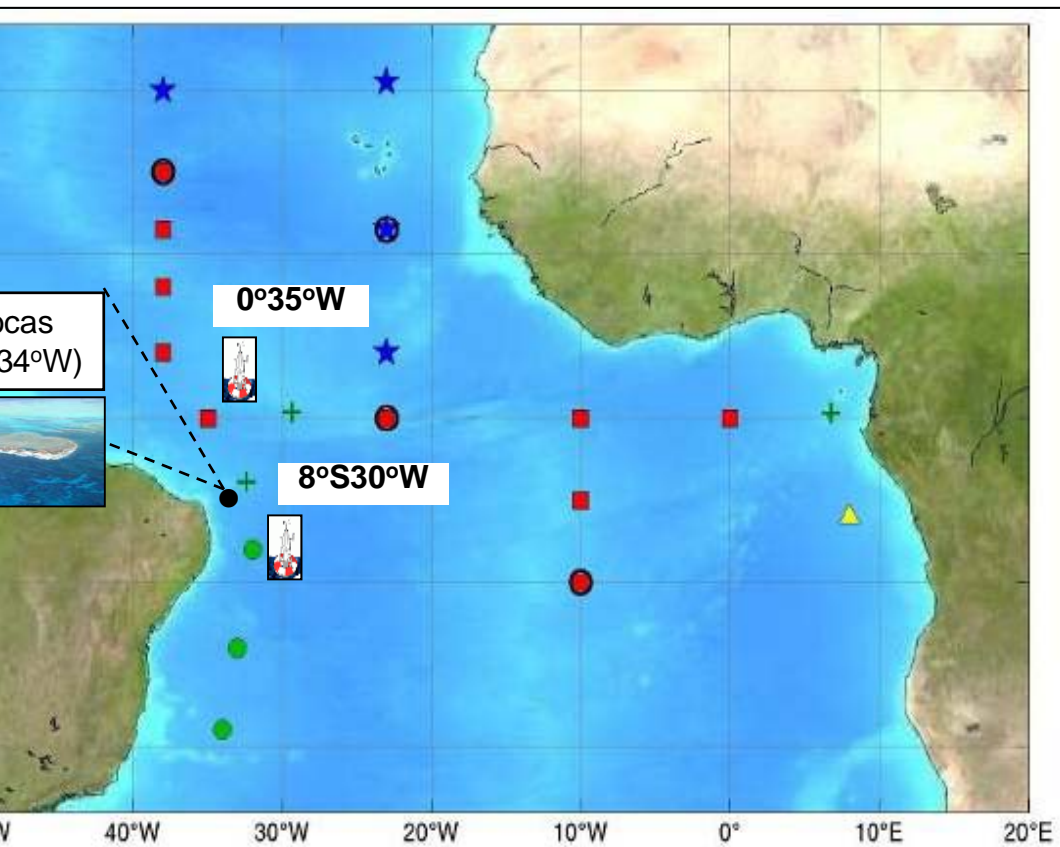
## 1. Extreme rainfall events

### Recife rainfall (ENEB)

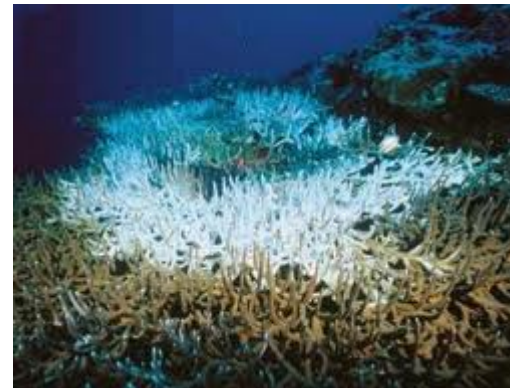


# → Environmental and societal impacts

## 2. Coral reefs bleaching

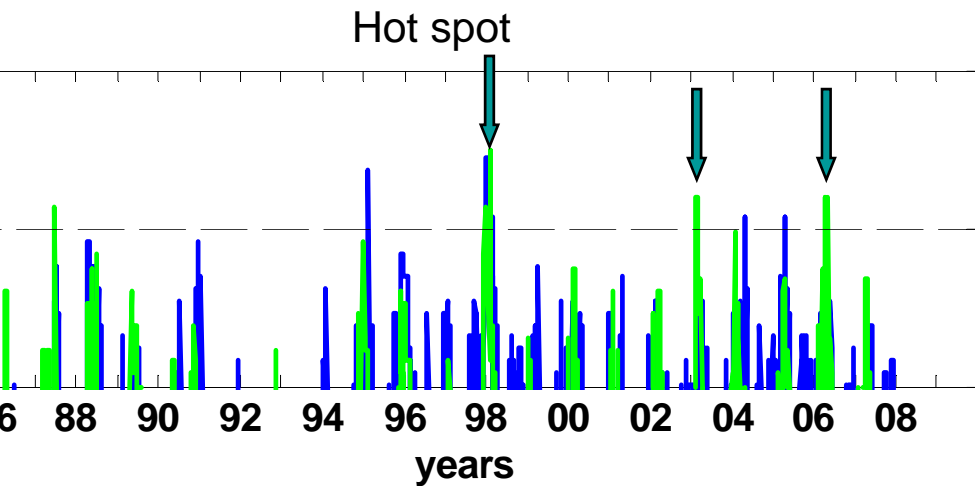


SST ↑



# → Environmental and societal impacts

## 2. Coral reefs bleaching



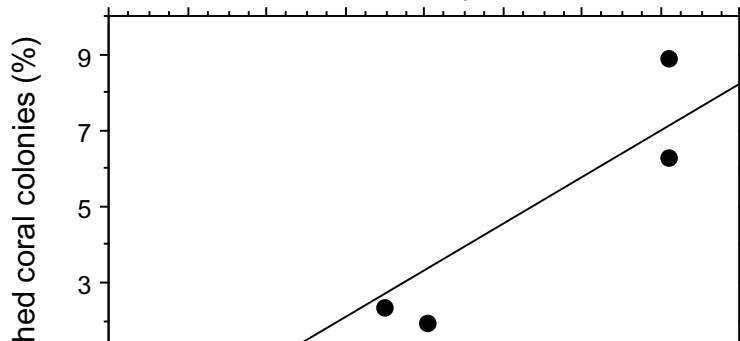
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—



$$Y = -5.203 + 6.099X; R^2 = .869; p\text{-value} = 0.021$$



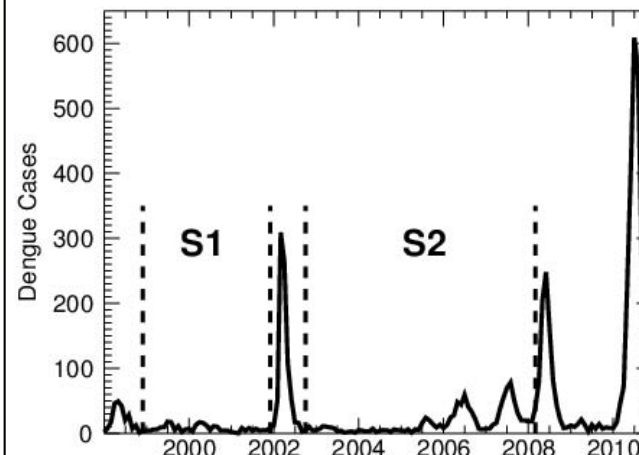
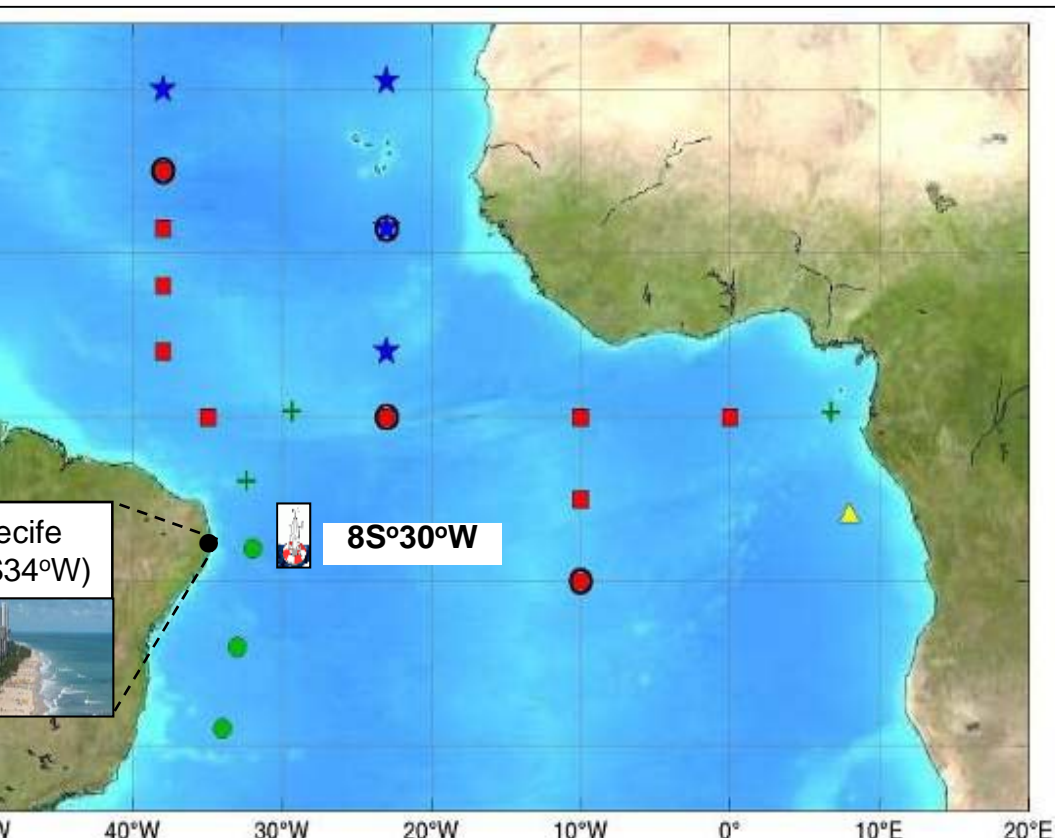
### Observed bleaching events:



- 1998 - Strong
- 2003 - Observed
- 2007 - Observed
- 2009 - Strong

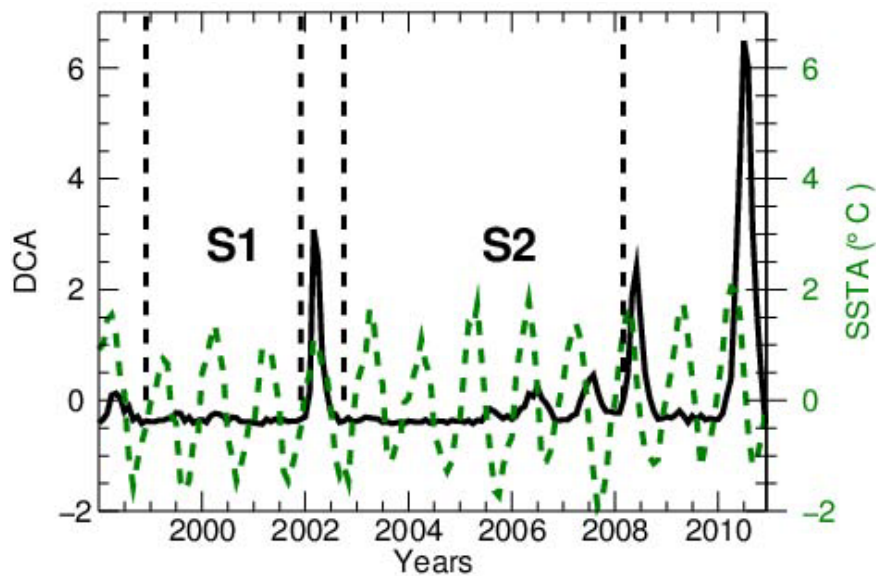
## → Environmental and societal impacts

### 3. Tropical diseases (dengue)

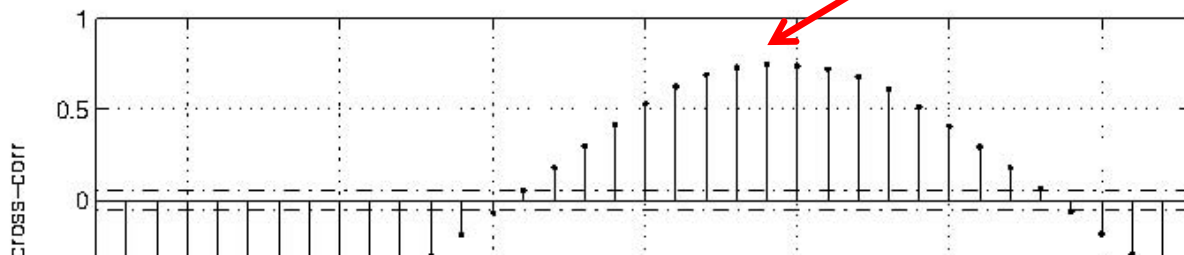


## → Environmental and societal impacts

### 3. Tropical diseases (dengue)



The cross-correlation of series exhibits a high correlation of 0.7 with a lag of 40 days.



## **Concluding remarks**

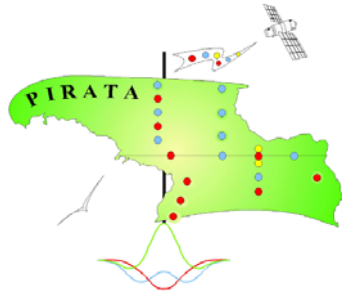
***PIRATA Program is an important component of the climate observing system in the tropical Atlantic. It is very useful for ocean/climate science development and for enhancing the performance of climate forecast modeling.***

***PIRATA Program is a successful example of multi-lateral cooperation in Atlantic ocean research.***

***Main “PIRATA treasures”:***

- High level of multi-lateral commitments***
- Science oriented decisions***

***Open data policy***



# PIRATA

PIRATA 17 – 2012 Kiel, Germany



TAV PIRATA 16 – 2011 F. Noronha, Brazil



PIRATA 18 – 2013 Venice, Italy





**PIRATA**

**Tropical Atlantic Variability (TAV)  
Prediction and Research Moored Array in the Tropical Atlantic (PIRATA)  
OceanSITES  
Brazil - EU Dialogues in Marine Research**

**NOVEMBER 3 TO 7, 2014**  
Hotel Armação, Porto de Galinhas | Brazil







## Prediction and Research Moored Array in the Tropical Atlantic - PIRATA

Lujo<sup>1</sup>, B. Bourlès<sup>2</sup>, E. Campos<sup>3</sup>, H. Giordanni<sup>4</sup>, F. Hernandez<sup>5</sup>,  
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<sup>1</sup>NOAA/CEERMA-UFPE, Brazil; <sup>2</sup>LEGOS, France; <sup>3</sup>IO-USP, Brazil; <sup>4</sup>CNRM-MeteoFrance, France; <sup>5</sup>MERCATOR-Ocean, France; <sup>6</sup>NOAA, USA;  
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