

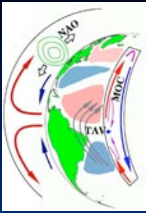
# CLIVAR Atlantic perspective



Martin Visbeck

Wilco Hazeleger

Co-Chairs of the CLIVAR  
Atlantic Implementation Panel



# CLIVAR Atlantic Implementation Panel Terms of reference



To recommend and oversee the implementation of observations in the Atlantic Ocean sector, in order to meet the objectives outlined in CLIVAR's Science and Initial Implementation Plans, particularly with respect to the Principal Research Areas:

- D1 (North Atlantic Oscillation),
- D2 (Tropical Atlantic Variability) and
- D3 (Atlantic Thermohaline Circulation).



# CLIVAR Atlantic Implementation Panel

## Terms of reference



To collaborate with JSC/CLIVAR Working Group on Coupled Modelling (including WGOMD) and CLIVAR Working Group on Seasonal to Interannual Prediction, in order to design appropriate numerical experiments, and to be aware of requirements set by these groups for data sets needed to validate models.

To liaise with the relevant CLIVAR panels, in particular Upper Ocean Panel and PIRATA Steering Group, to ensure that best use is made of resources from the global and equatorial research programs.

To liaise with **Ocean Observation Panel for Climate** and other relevant groups to ensure that CLIVAR benefits from and contributes to observations in GOOS and GCOS.

To report to the CLIVAR SSG.



## CLIVAR Atlantic Implementation Panel

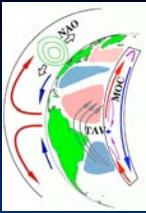


M. Visbeck (co-chair) (2006)	GEOMAR-IfM, Kiel, Germany
W. Hazeleger (co-chair) (2007)	KNMI, The Netherlands
B. Bourles (2007)	IRD, Brest, France
J. Hurrell (2006)	NCAR, Boulder, USA
W. Johns (2006)	RSMAS, Miami, USA
N. Koc (2007)	NPI, Tromso, Norway
D. Marshall (2006)	University of Reading, UK
C. Mauritzen (2006)	NMI, Bergen, Norway
A. Piola (2008)	SHN, Buenos Aires, Argentina
C. Reason (2005)	Univ. of Cape Town, South Africa
D. Stammer (2007)	IfM, Uni. Hamburg, Germany
R. Sutton (2008)	University of Reading, UK
L. Terray (2008)	CERFACS, Toulouse France
I. Wainer (2005)	Univ. of São Paulo, Brazil
D. Wright (2006)	BIO, Halifax, Canada
C. Zhang (2007)	RSMAS, Miami USA

### Ex Officio Member

A. Körtzinger (Carbon)	IfM-GEOMAR, Kiel, Germany
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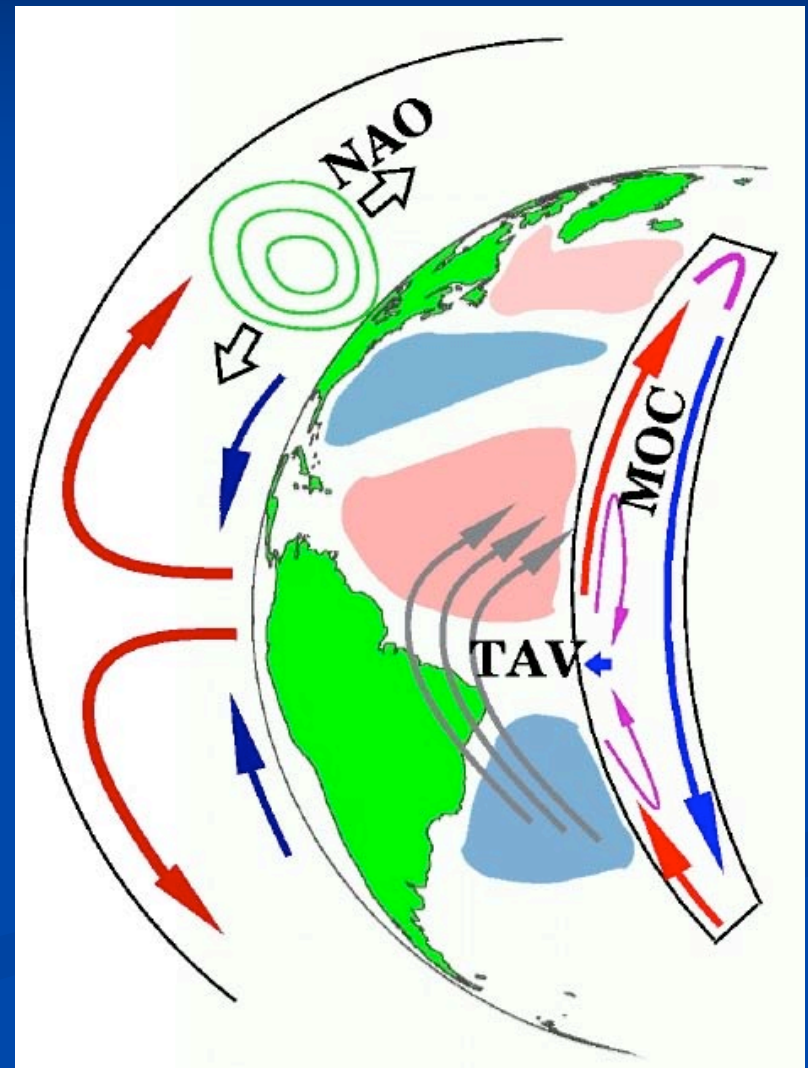
ICPO contact: Dr. Roberta Boscolo

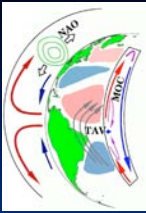


# CLIVAR Atlantic Sector Phenomena



- North Atlantic Oscillation
- Tropical Atlantic Variability
- Meridional Overturning in the Ocean
- With emphasis on interactions with each other and/or other climate forcings including ENSO and ACC





# CLIVAR Atlantic Sector Strategy



Promote a balanced approach to describe, understand and assess predictability of climate phenomena using:

Observations (joined with OOPC and GSOP?):

- sustained observations
- regionally enhanced observations
- process studied

Modeling and Theory (joined with WGCM, WGOMD):

- global and region GCMs
- process models

Synthesis: (joined with GSOP)












- empirical studies
- atmosphere / ocean / (land) reanalysis
- predictability

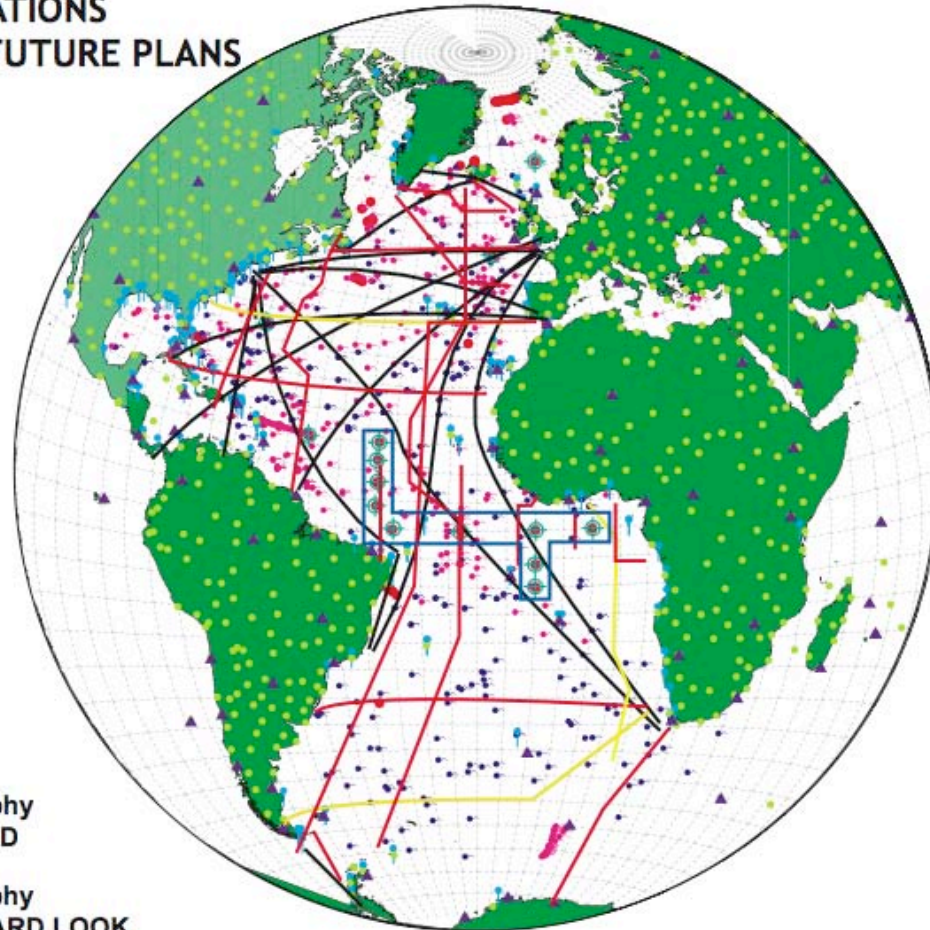


# CLIVAR Atlantic Ocean Observing Network

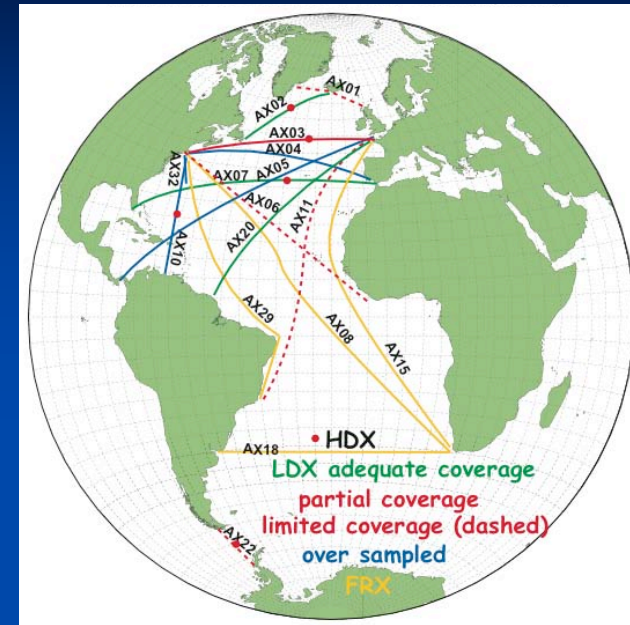
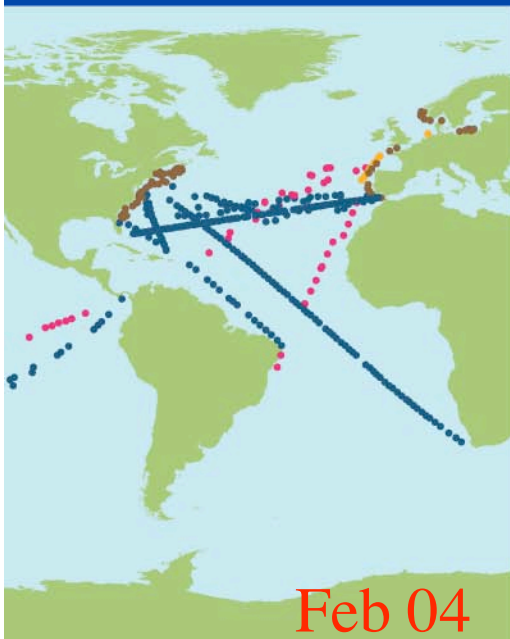
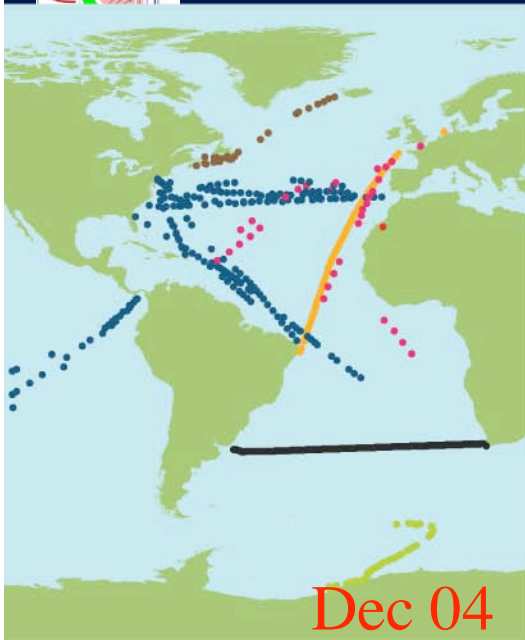
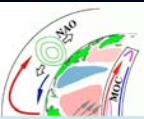


## ATLANTIC OBSERVATIONS PRESENT NETWORK AND FUTURE PLANS

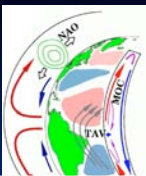
-  PIRATA
-  GUAN
-  GSN
-  SEA LEVEL
-  FLOATS
-  DRIFTERS
-  AIR-SEA FLUX
-  FIXED POINT TIME-SERIES
-  XBT
-  Repeat Hydrography  
PLANNED/FUNDED
-  Repeat Hydrography  
PLANNED/FORWARD LOOK



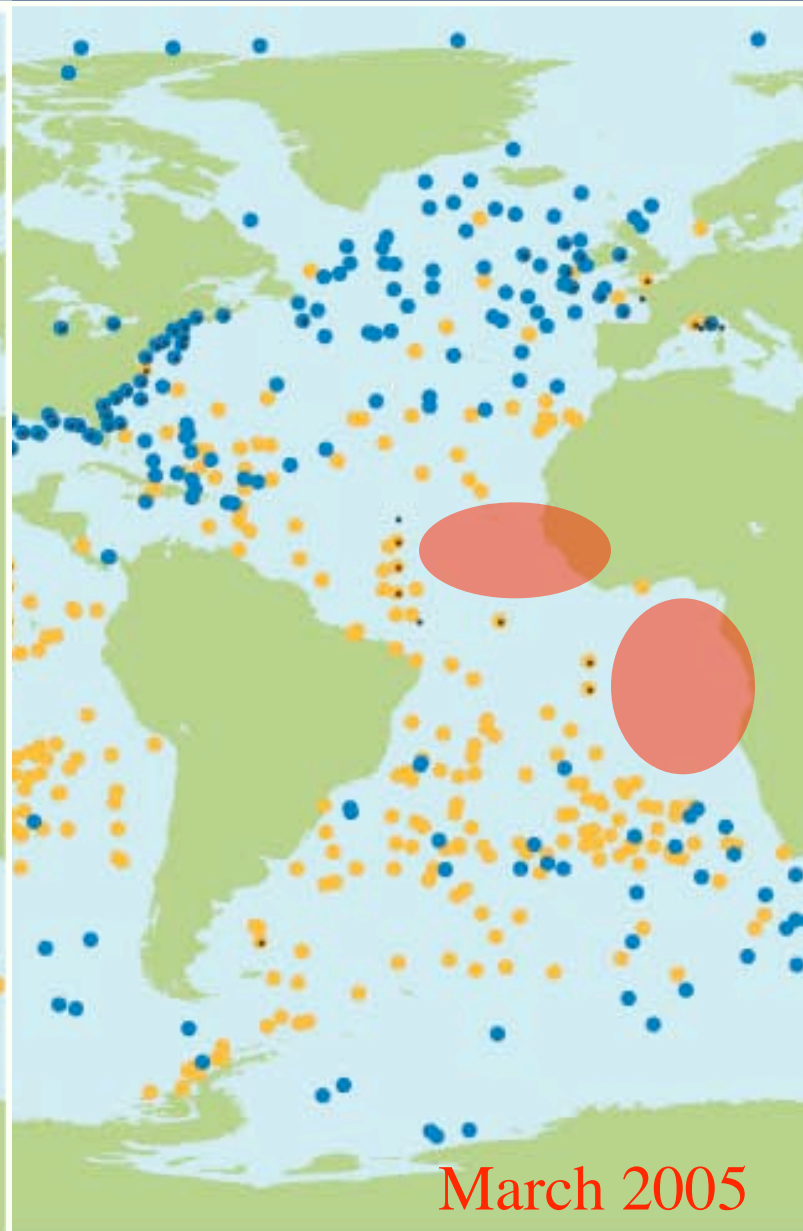
Compiled by R. Boscolo - check CLIVAR [website](#) for details



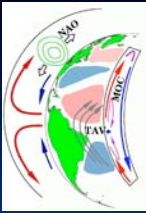
Most lines seem to get covered at about the expected frequency.



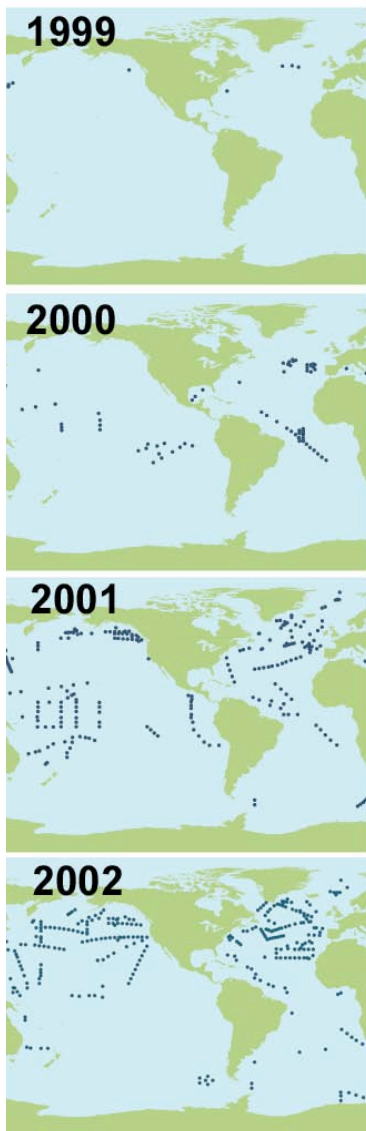
# Surface Drifter Network



ISSUE: Tropical Atlantic reduced coverage



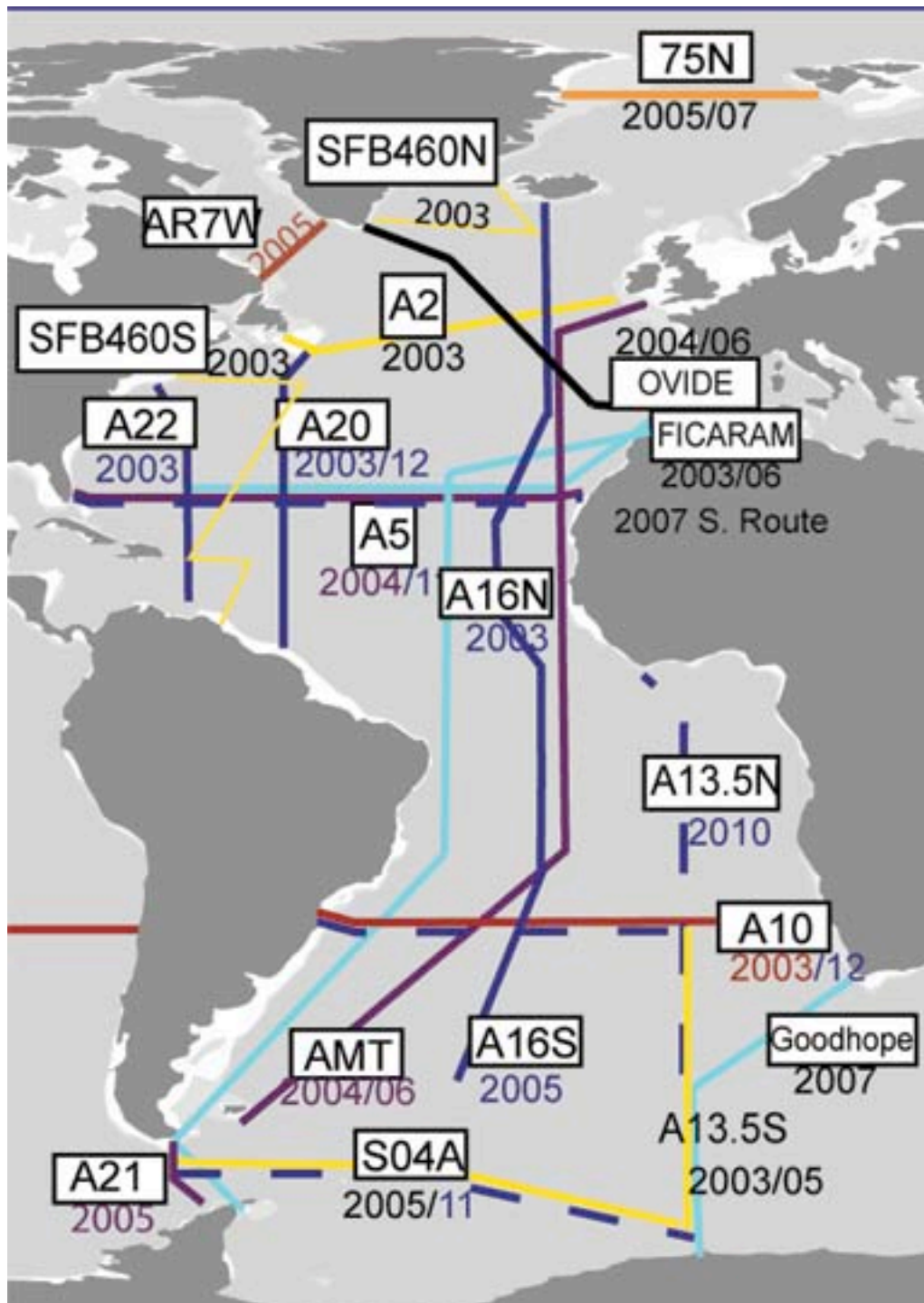
# ARGO profiling float network



rapidly growing,  
a few holes left ...



## Basin scale Repeat Hydrography

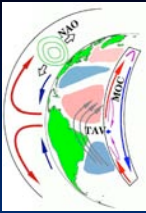


Proceeds in a coordinated fashion between CLIVAR and CARBON needs.

Survey done 2003-05

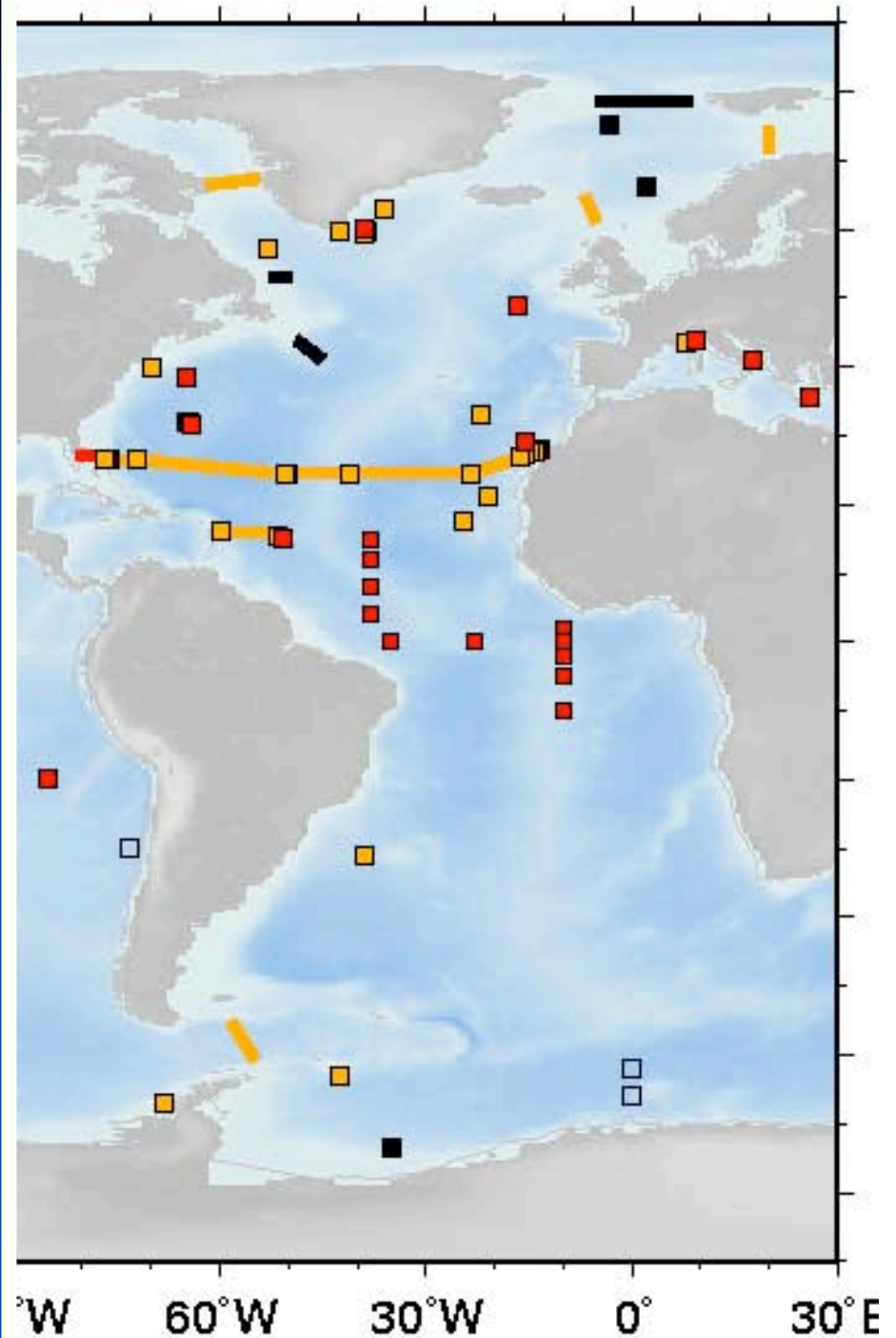
What is the “right” frequency of repeat?

Might there be one more survey 2010-12 during CLIVAR?



## Fixed Point measurements

- A significant number of research and sustained fixed point measurements exist
- Continuity for the lifetime of CLIVAR not guaranteed.
- Several arrays will not be continued.





# How to continue?

Florida Transport from  
Cable measurements  
1982 operational, A. Flosadottir



MOC  
at 26.5°N  
Planned  
Funded  
2004-2008  
RAPID/  
MOCA

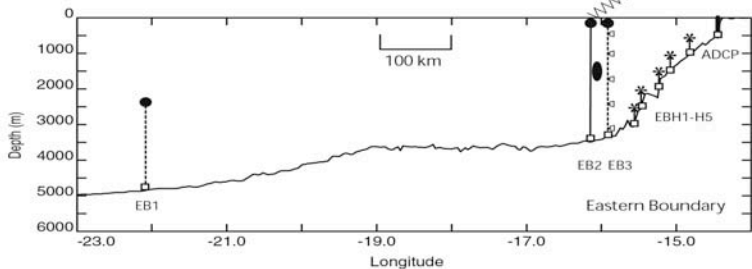
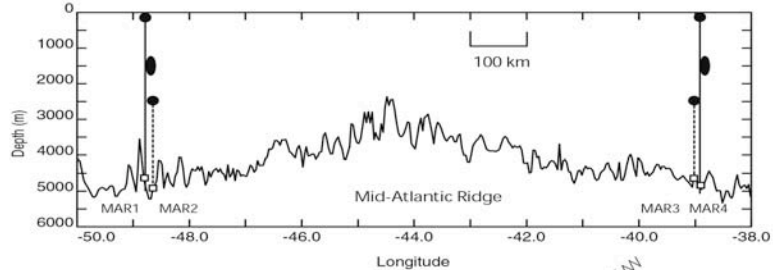
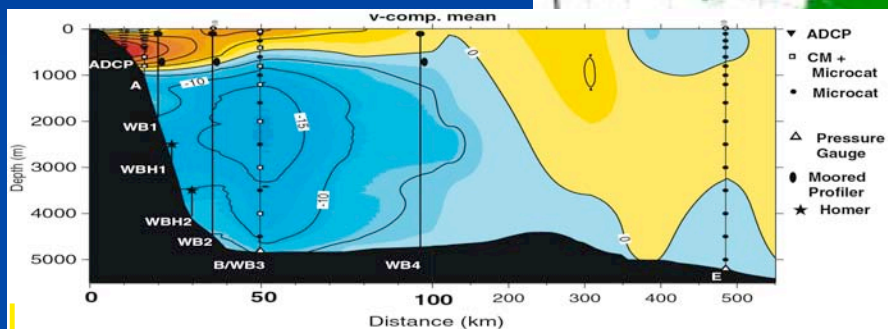
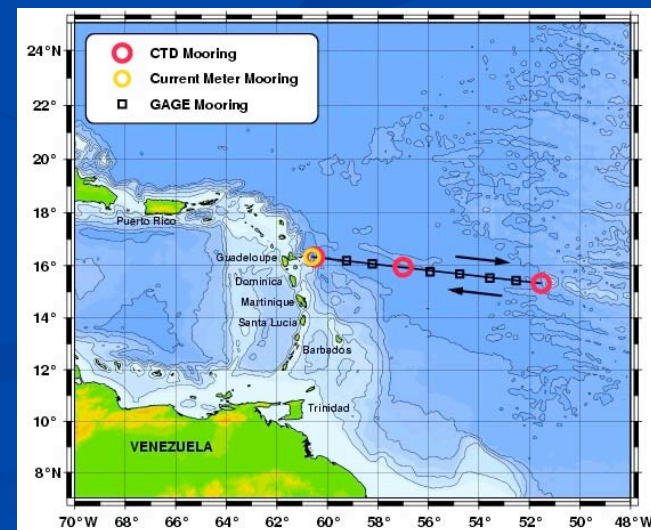
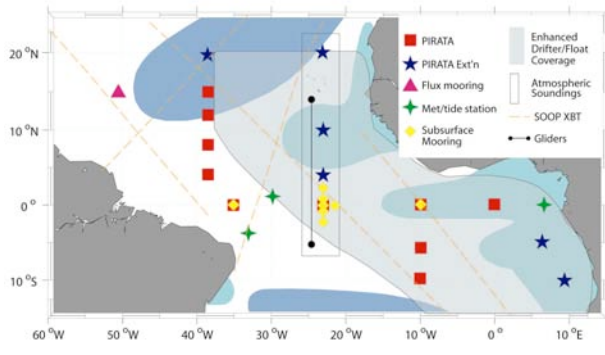


Figure 1: Mooring array for monitoring the Atlantic meridional overturning circulation at 26.5°N. a) Western boundary; b) Mid-Atlantic Ridge; c) Eastern boundary

MOVE  
2000-2007 U. Send





# Tropical Atlantic Climate Experiment TACE

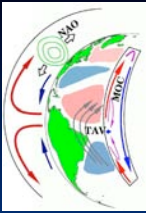
(B. Johns W. Hazeleger)



To advance understanding of coupled ocean-atmosphere processes and improve climate prediction for the Tropical Atlantic region

Specific goals are:

- a) To advance understanding of the key processes that control SST, interactions with the AMI (Atl. Marine ITCZ), and related climate predictability in the eastern tropical Atlantic.
- b) To contribute to the design of an enhanced sustained observing system for the tropical Atlantic region.

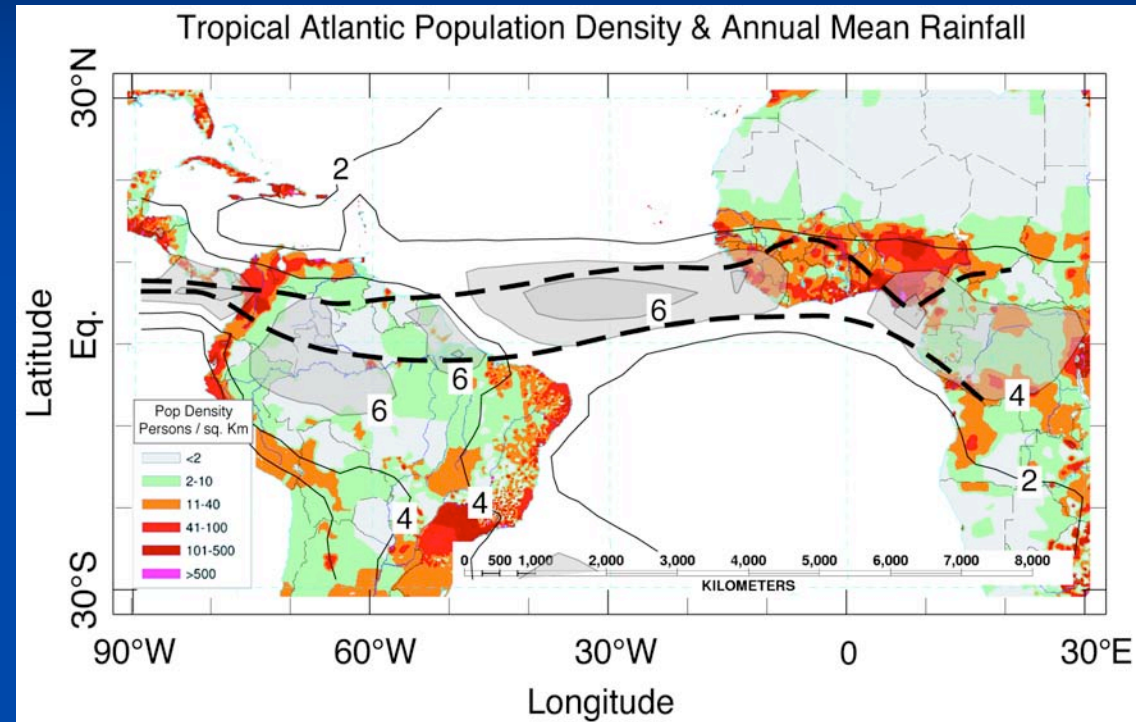


# Influence of the AMI Atlantic Marine ITCZ

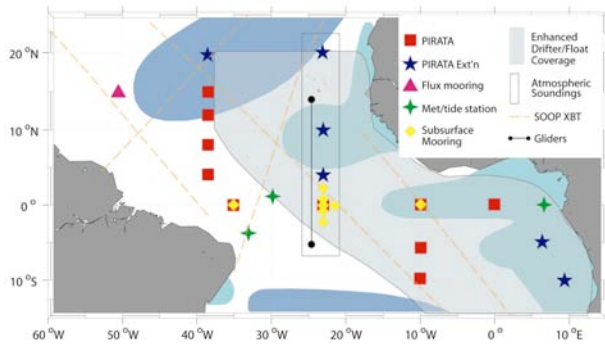


The AMI annual migration determines the seasonal distribution of rainfall in the densely populated regions of West Africa and South America and its interannual variability directly affects water resources, agriculture, and public health conditions there.

The AMI and its variability have the potential to affect circulation in remote regions such as the North and South Atlantic through teleconnection patterns



*Population density (color) and annual mean rainfall in mm/day (contours & grey shading). The heavy dashed lines show extent of climatological ITCZ migration north (July) and south (April). [Figure from Y. Kushnir]*



# Tropical Atlantic Climate Experiment TACE



(B. Johns W. Hazeleger)

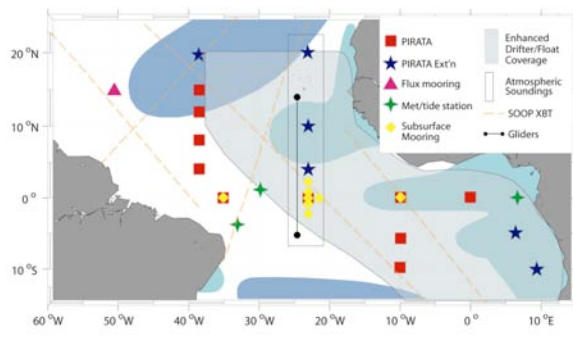
## Objectives:

A) Enhance existing observing system to provide the data needed for research and operations

**Working group proposed (Johns & Brandt)**

B) Improve coupled predictive systems, ocean synthesis, and transfer from science to operations

**Working group proposed (Hazeleger & Böning/Stockdale?)**



# TACE

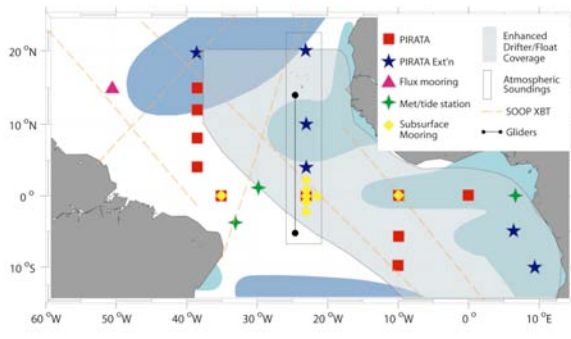
## Observations for seasonal predictions:

(B. Johns W. Hazeleger)

(i) in situ surface and subsurface current, temperature and salinity measurements along the Atlantic equator,

(ii) surface and subsurface temperature and salinity measurements in the eastern off-equatorial portions of the basin between 20°S to 20°N, including the coastal upwelling regions off NW Africa and SW Africa,

(iii) In situ surface measurements of temperature, air temperature, air humidity, radiative fluxes and winds north and south of the equator through the regions of dominant SST variability. Additionally, satellite measurements of SST (including microwave SST), sea surface height, wind stress, cloudiness, precipitation, and ocean color are needed throughout the TA region.



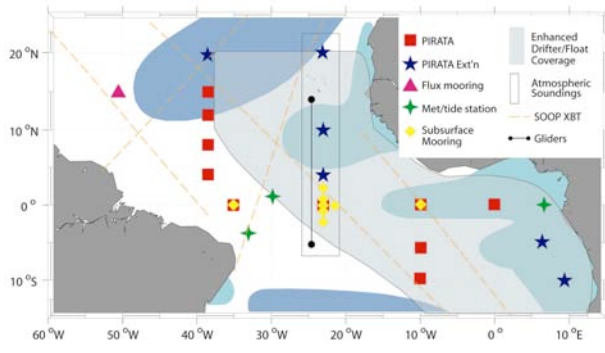
# TACE

## Additional Observations for interannual and longer timescales:

(B. Johns W. Hazeleger)



- (i) upper ocean temperature and salinity throughout the tropical Atlantic,
- (ii) moored time series sections in the central/eastern equatorial band ( $\sim 5^{\circ}\text{S}$  to  $5^{\circ}\text{N}$ ) to monitor the equatorial wave system and the supply of water masses to the eastern equatorial thermocline and the Angola and Guinea domes,
- (iii) surface drifters to monitor the divergence at the equator from upwelling regions to subduction regions,
- (iv) tracer observations to monitor changes in ventilation rates to the equatorial thermocline, and
- (v) atmospheric soundings to study boundary layer and air-sea interaction processes occurring under the varying SST regimes.

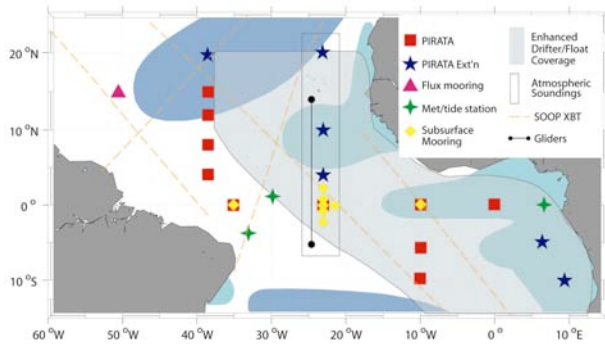


# TACE

## Modeling Strategy

(B. Johns W. Hazeleger)

- 1) Determine oceanic processes important in regulating SST in the tropical Atlantic and associated atmospheric responses
- 2) Improve SST forecasts on seasonal to interannual time scales in the tropical Atlantic
- 3) Provide parameterizations and model improvements to global and regional prediction centers
- 4) Investigate response of tropical Atlantic region to global warming, including teleconnection patterns



# TACE Time Line

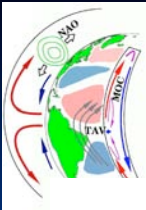
(B. Johns W. Hazeleger)

2003 TACE white paper submitted to CLIVAR (F. Schott)

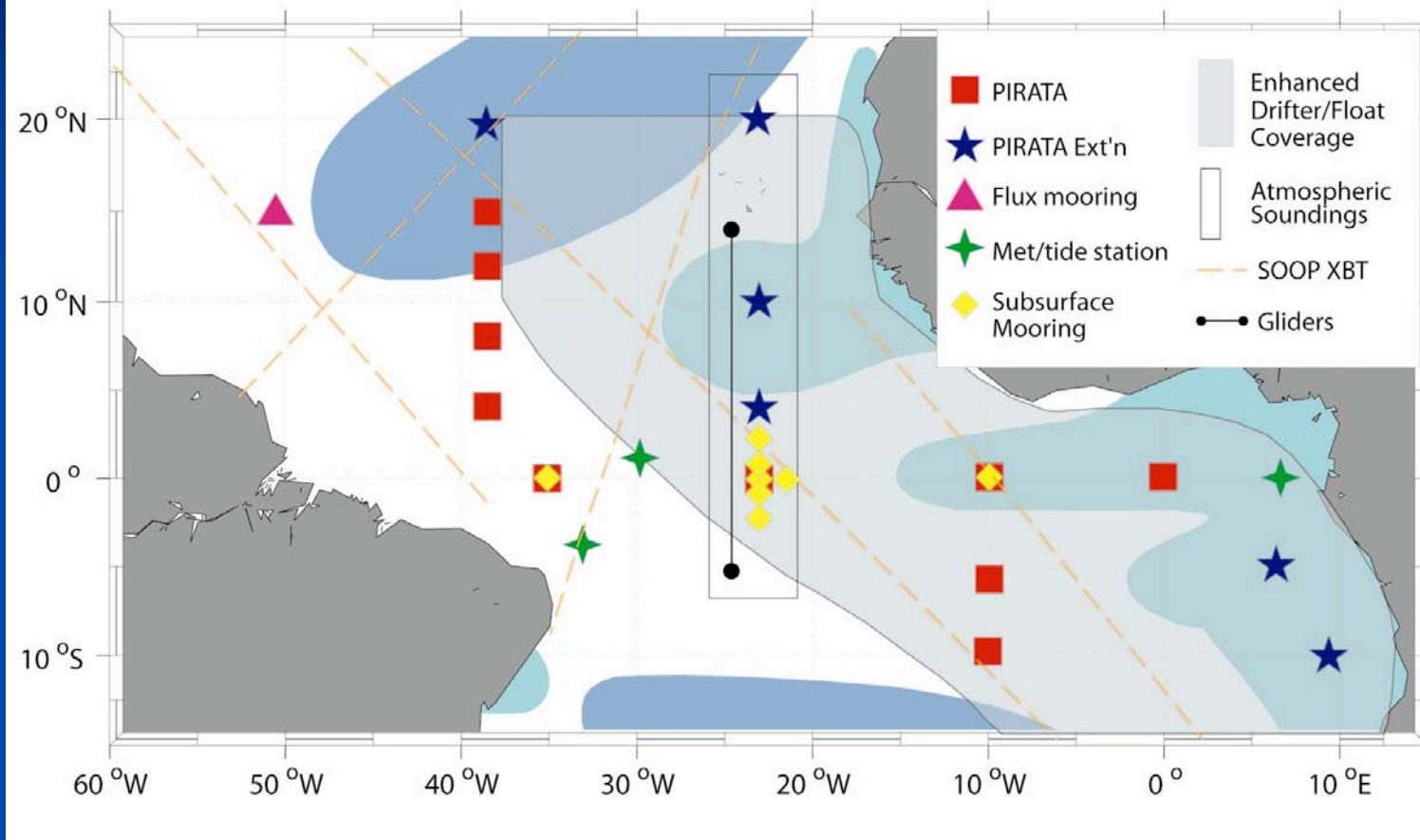
2004 initial TACE review by three CLIVAR panels (Atlantic, WGOMD, WGSIP), positive feedback with some questions.

early 2005 revised TACE executive summary prepared. Currently under review at the Atlantic panel.

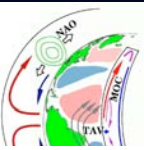
TACE core period six years: 2006/7 - 2011/12



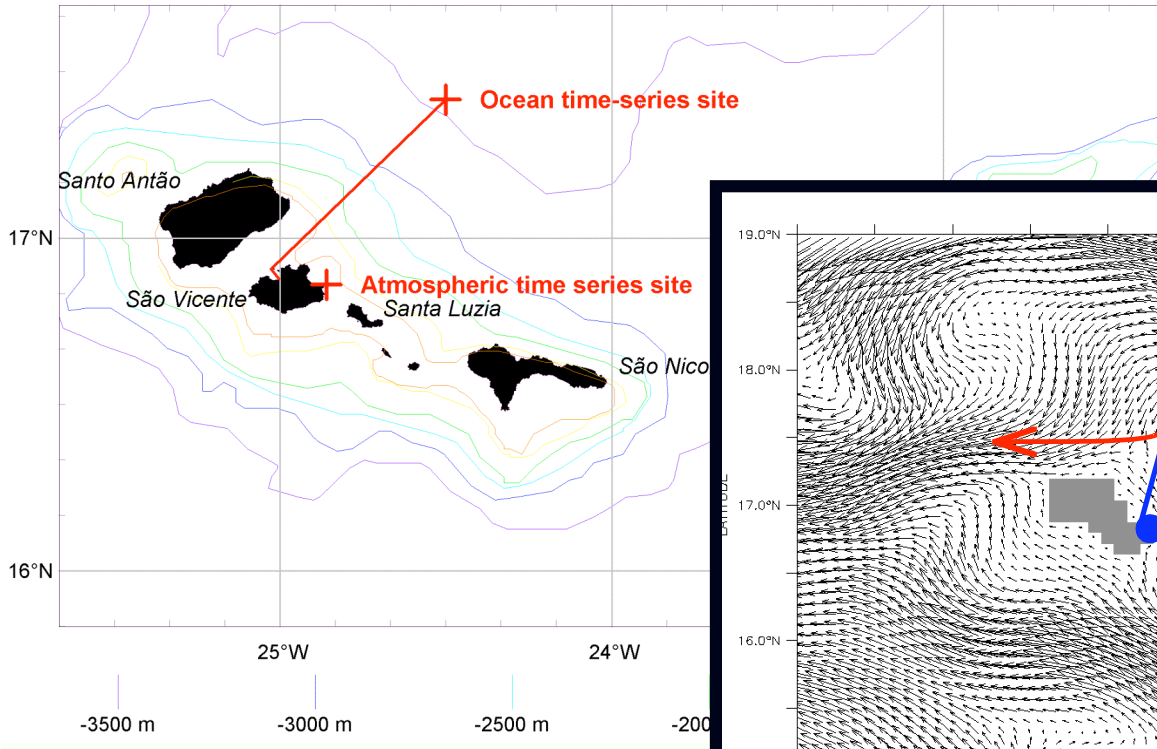
# Tropical Atlantic Observations



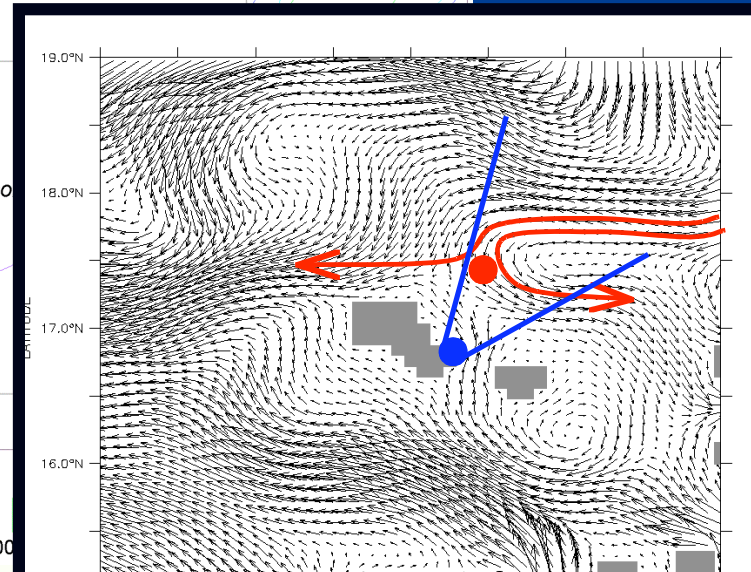
**TACE: Tropical Atlantic Climate Experiment**  
plans under review, but very positive feedback so far.  
23°W Moorings, Glider Section



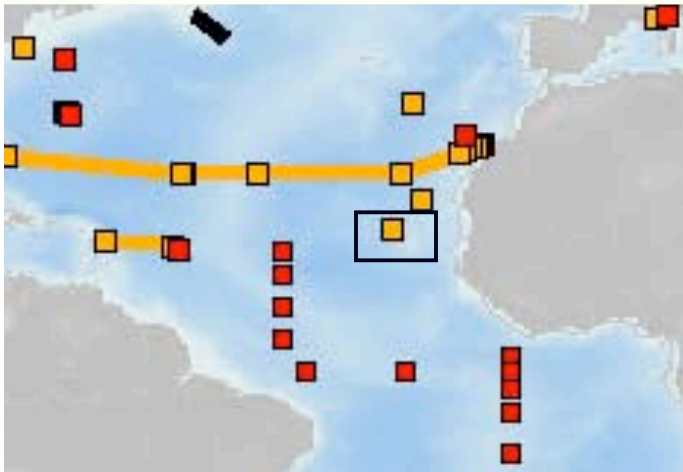
# Cape Verde Observatory

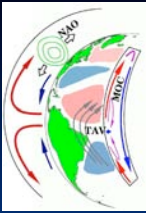


Atmosphere: UK-SOLAS  
MPI-Jena-Germany



Ocean:  
IFM-GEOMAR  
D-SOLAS  
SOC UK  
possibly part of  
MOVE2





# CLIVAR - OOPC Issues



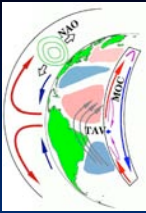
- **How to maintain existing networks?**
  - CLIVAR is one of the scientific users of the existing networks. But all the users should speak with one voice when it comes to defend observing systems. Will OOPC be the voice with input from CLIVAR when needed? | **GUESS YES, progress made**
  - How to evaluate the overall usefulness of a particular array in the context of other data and a variety of users?
- **How to transition pilot efforts to sustained?**
  - CLIVAR has pilot projects in the water that, if proven useful, should be sustained. How will we accomplish that? (list to come).  
**Still an open issue, operational centres no safe haven!**
- **Rich mixture of data types (state, flux) (shallow/deep)**
  - How to come to global/regional synthesis
  - How to manage data



# CLIVAR Atlantic Implementation Panel Issues



- **Synthesis**
  - panel supports strongly CLIVAR wide strategy for model based synthesis
  - Feedback on observing system optimisation
  - Data should also be available for other more empirical studies
- **Data Management**
  - CLIVAR strategy is piecemeal at best
  - needs some “new” ideas
  - Can we build upon emerging data centre in support of “operational” oceanography and “operational” meteorology?



# CLIVAR Atlantic Implementation Panel OOPC actions



- Sustained Observations in support of decadal (ocean) signals not operational but could be.
  - MOC:
    - Overflow measurements (Denmark Strait, FS Channel)
    - Boundary currents (transport, water masses)
      - Labrador Sea outflow
      - 26N RAPID/MOCA & cable
      - NADW deep eddies (design research) ?
      - 20-30S (design research) ?
    - Potential Energy time series
      - Labrador Sea
      - Bermuda
      - Irminger Sea (research)
      - Porcupine Bank (research)
      - Cape Verde (research)
  - Tropical Atlantic Variability:
    - PIRATA + Extensions/replacements (research)
    - TACE (enhanced surface drifter & ARGO & PIRATA)