Oceanic Indices to Forecast the Seasonal Rainfall Over the Northern Northeast of Brazil

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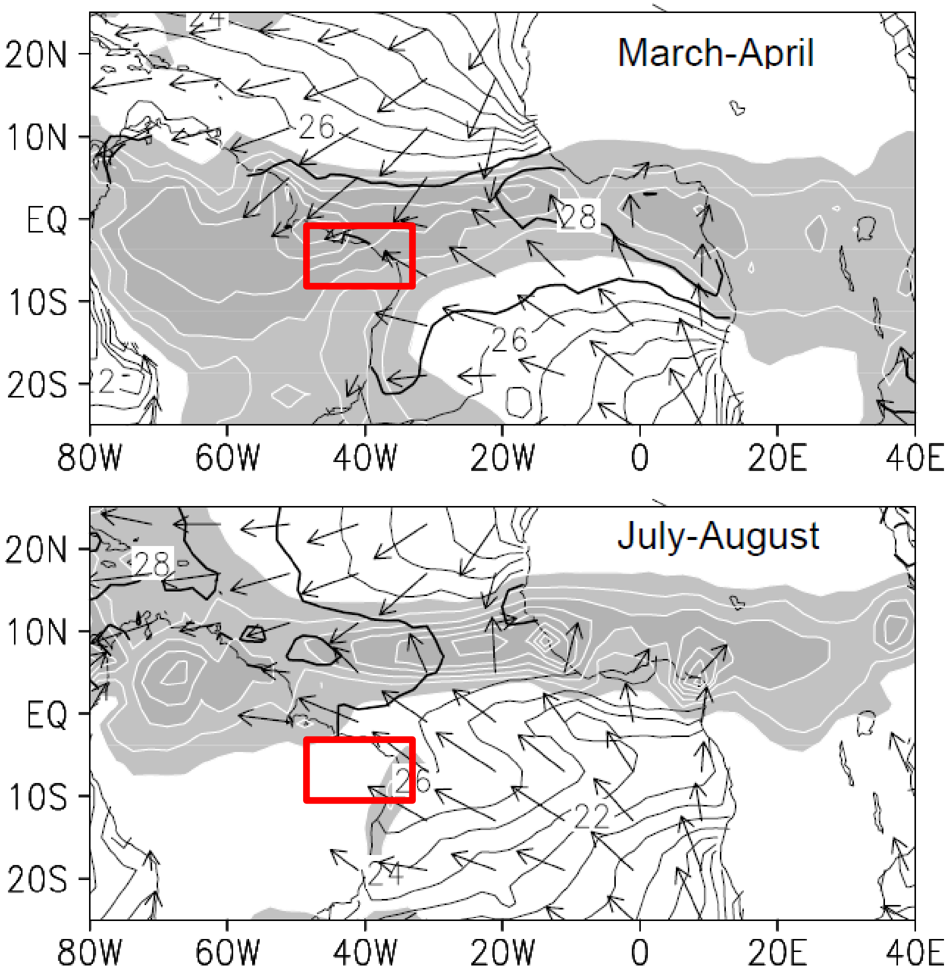
INTRODUCTION



Xie & Carton, 2004

The climate of Northeast Brazil is largely semiarid, with notable variability in seasonal and interannual rainfall.

The seasonal rainfall of the Northern Northeast Brazil (**NNEB**) is strongly influenced by latitudinal excursion of the Intertropical Convergence Zone (ITCZ)

OBJECTIVE

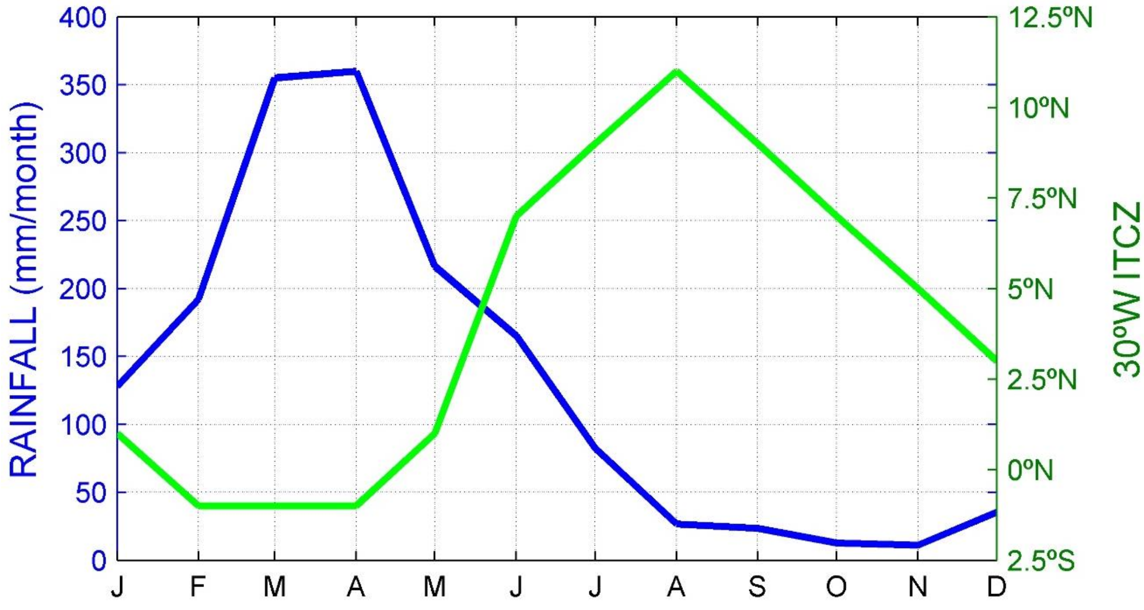
Identify oceanic surface and subsurface variables in the tropical Atlantic that can be used to forecast seasonal rainfall of NNEB focusing on wettest and driest years

Ceará 2009

Ceará 1983

DATA AND METHODS

Monthly rainfall observations 1974-2008
at **Fortaleza-CE (NNEB)**



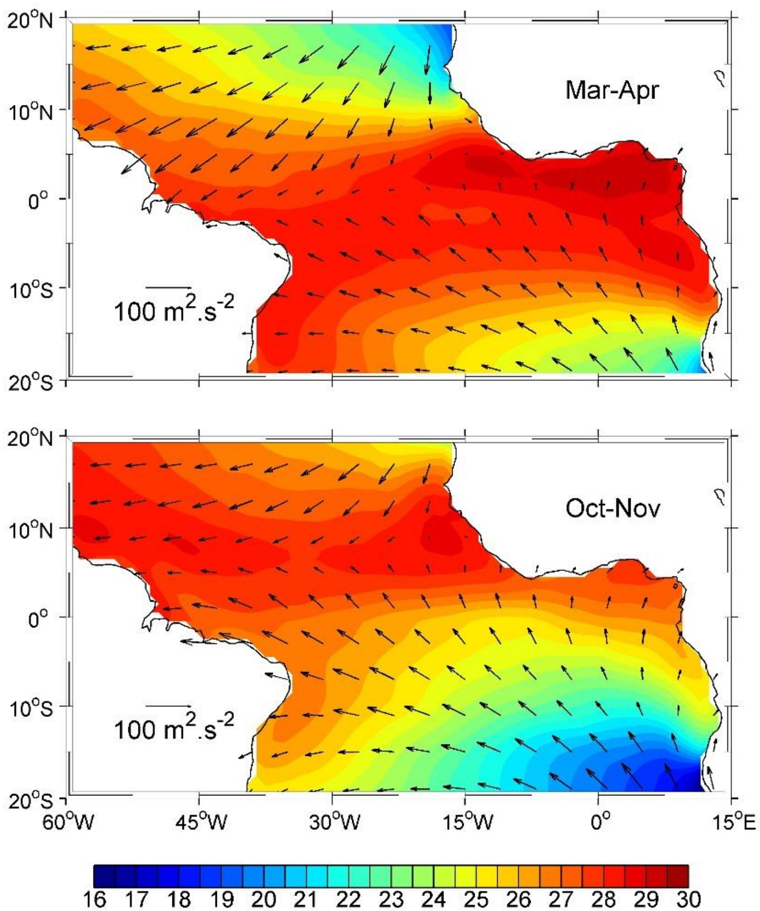
Fortaleza (NNEB):
Rainy season FMAM
Core rainy season **Mar-Apr**
Driest months **Oct-Nov**

ITCZ latitudinal position along 30°W:
- Southernmost in FMA
- Northernmost in JAS

DATA AND METHODS

Monthly pseudo wind-stress (**PWS)** from Servain's data set
SST and Latent Heat Flux (**LHF**) from OAFlux
1974-2008

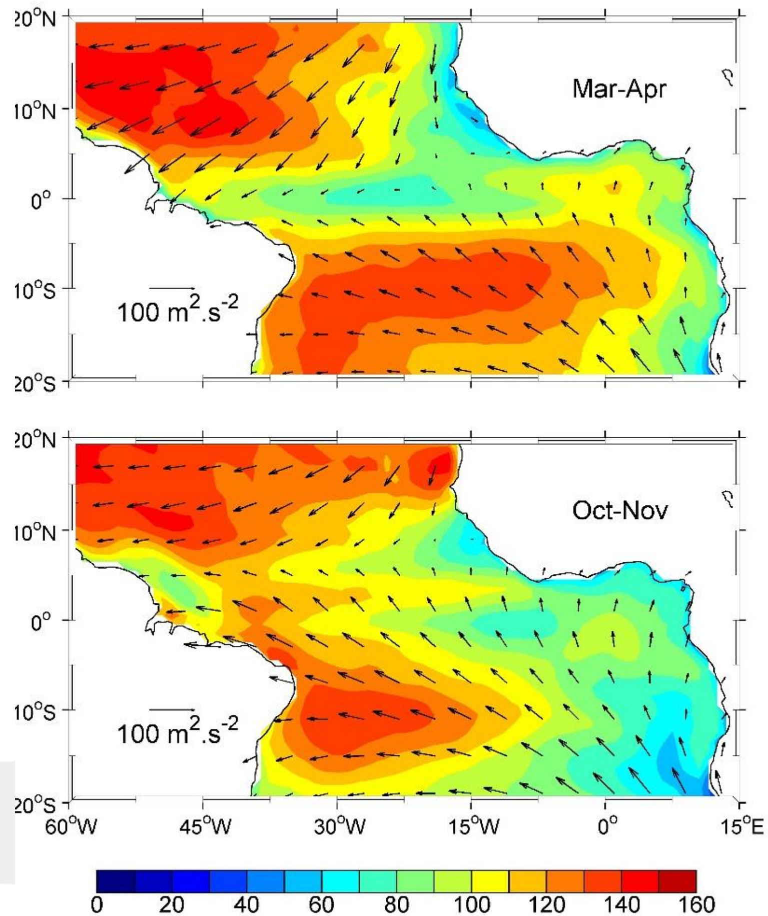
SST (ºC) and PWS (m2/s2)



March-April

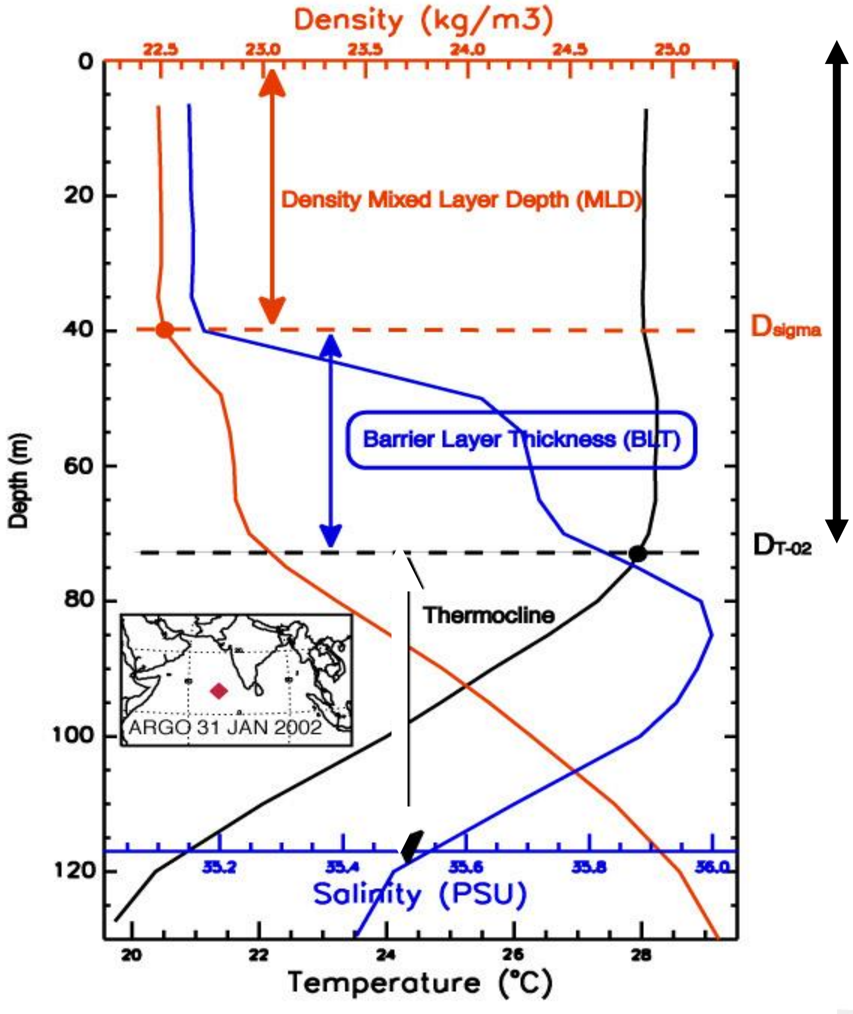
Oct-Nov

LHF (W/m2) and PWS (m2/s2)



DATA AND METHODS

SODA Reanalysis 1974-2008



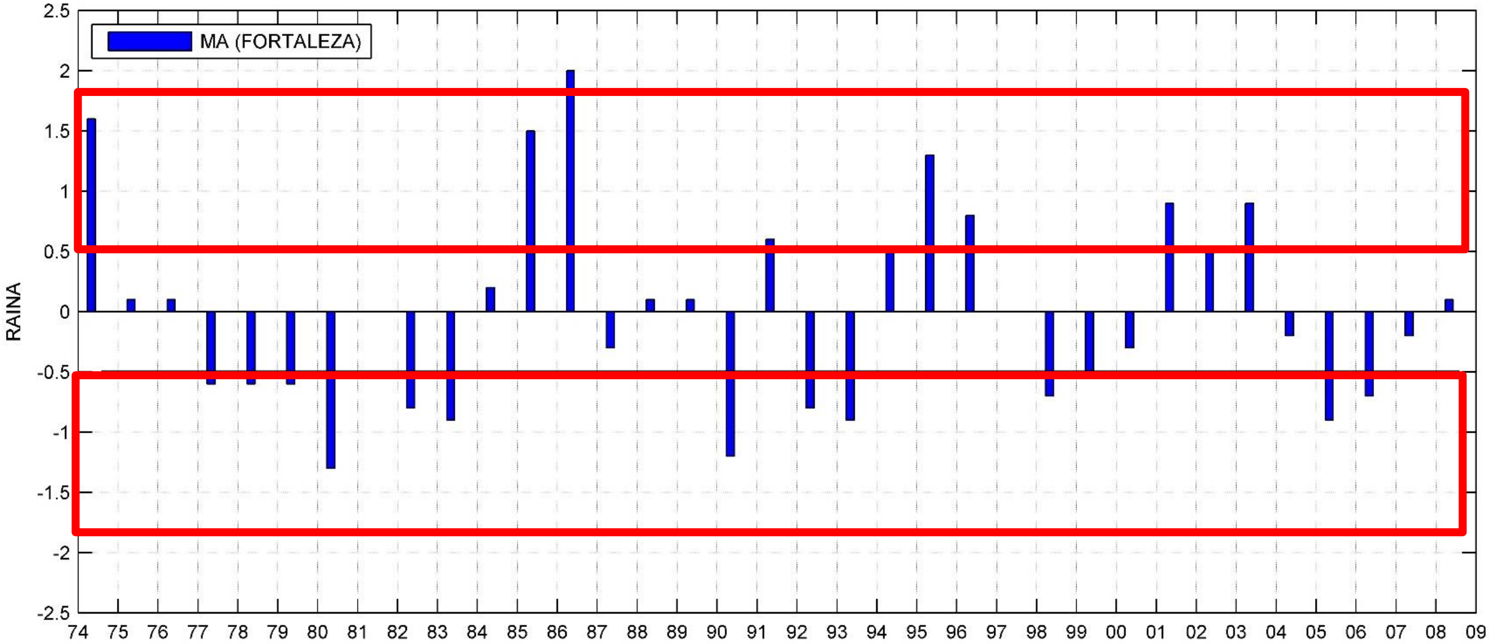
Isothermal layer depth (**ILD**)
Density mixed layer depth (**MLD**)
Barrier layer thickness (**BLT**)
BLT = ILD-MLD

Ocean heat content (**OHC**) integrated within the ILD

(cf. de Boyer Montégut, 2007)

RAINFALL INTERANNUAL VARIABILITY

Fortaleza:
20 years



8 wettest years
(> 0.5 STD)

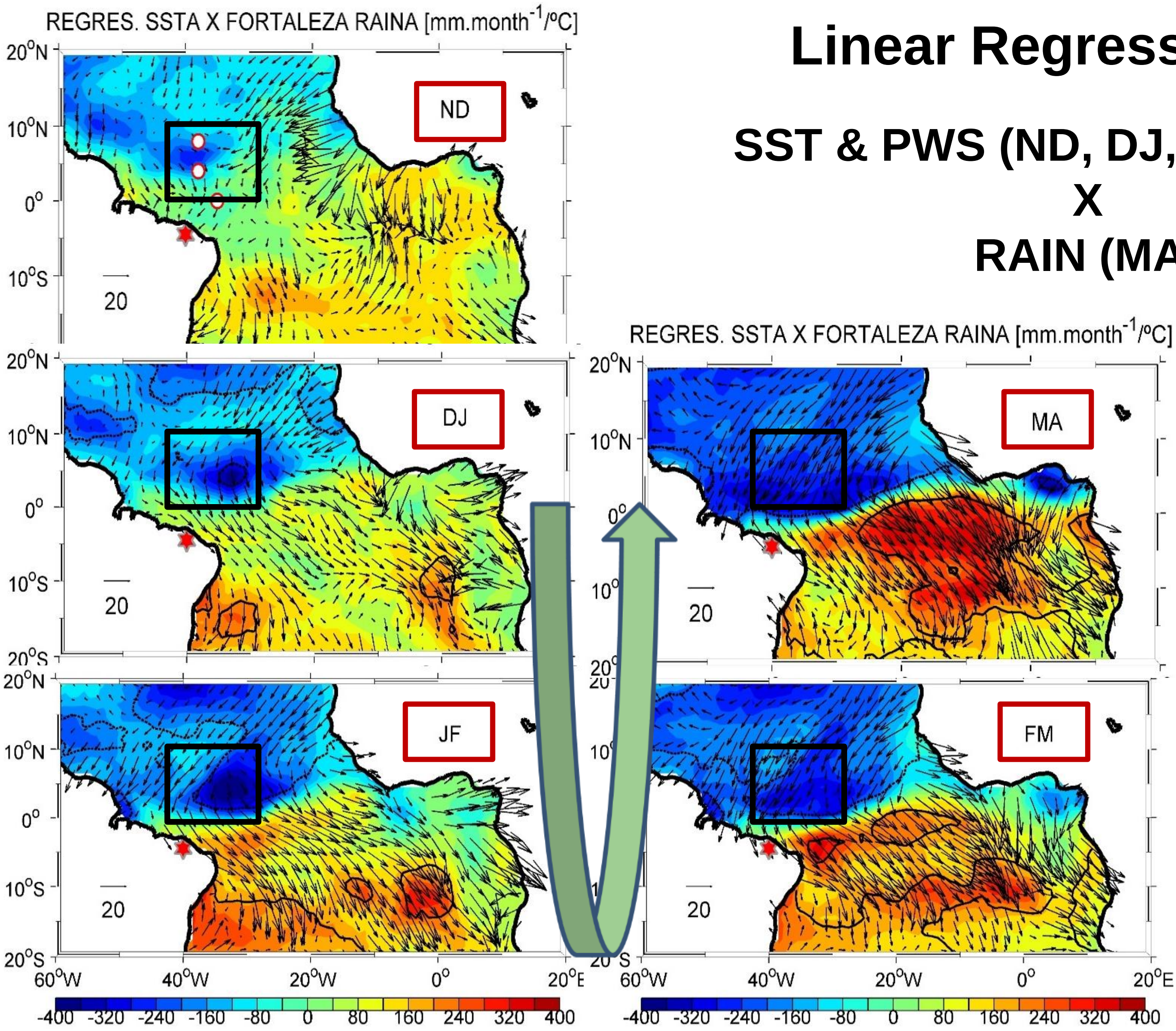
12 driest years
(< -0.5 STD)

March-April normalized rainfall anomalies (blue bar)
at Fortaleza for 1974-2008

Fortaleza (NNEB) - 20 Strong Episodes

Linear Regression

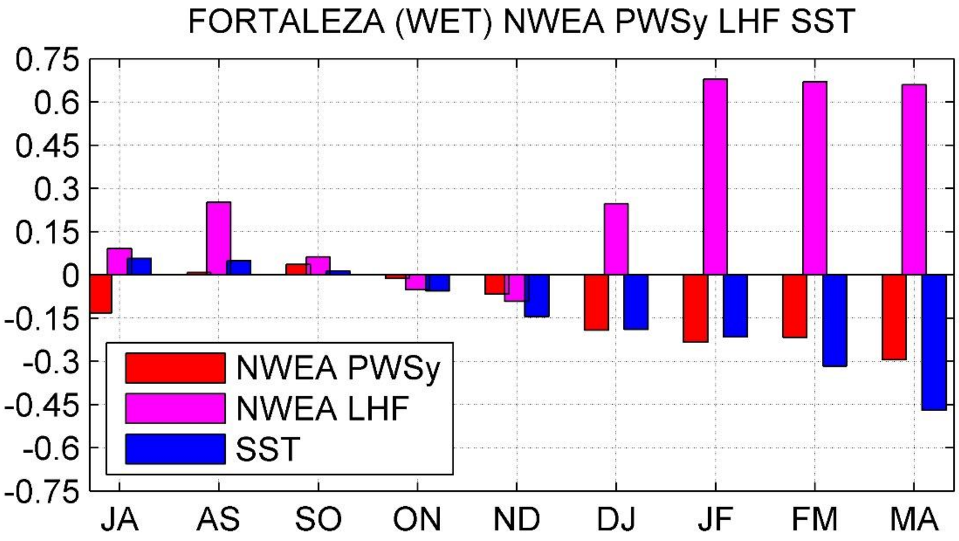
SST & PWS (ND, DJ, JF, FM, MA)
X
RAIN (MA)



SST X RAIN: Significant (95%) negative coefficient in the Northwestern Equatorial Atlantic (**NWEA, black box**) from DJ to MA

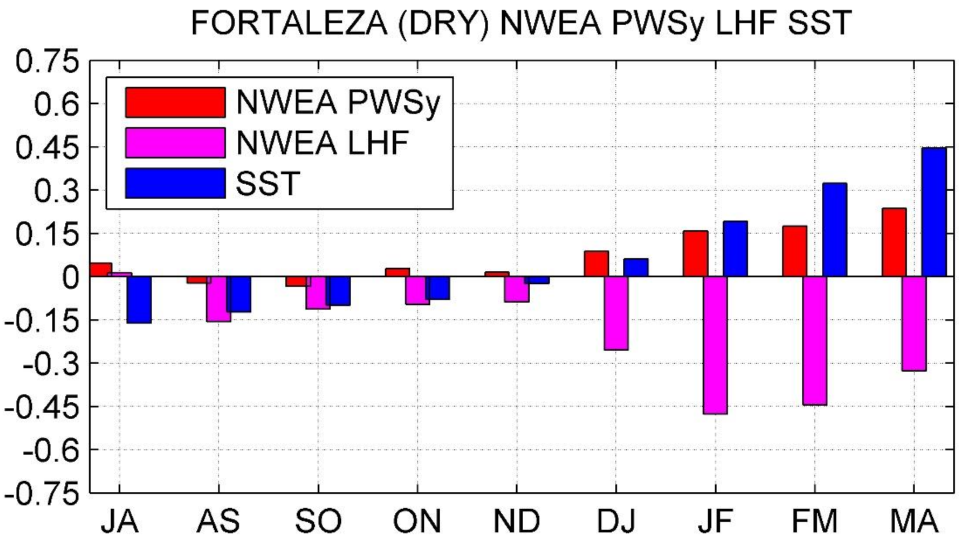
=> Progressively related to the SST and wind interhemispheric mode of variability

Bi-monthly evolution of oceanic surface variables anomalies in NWEA for the 20 selected episodes at Fortaleza



8 wettest years

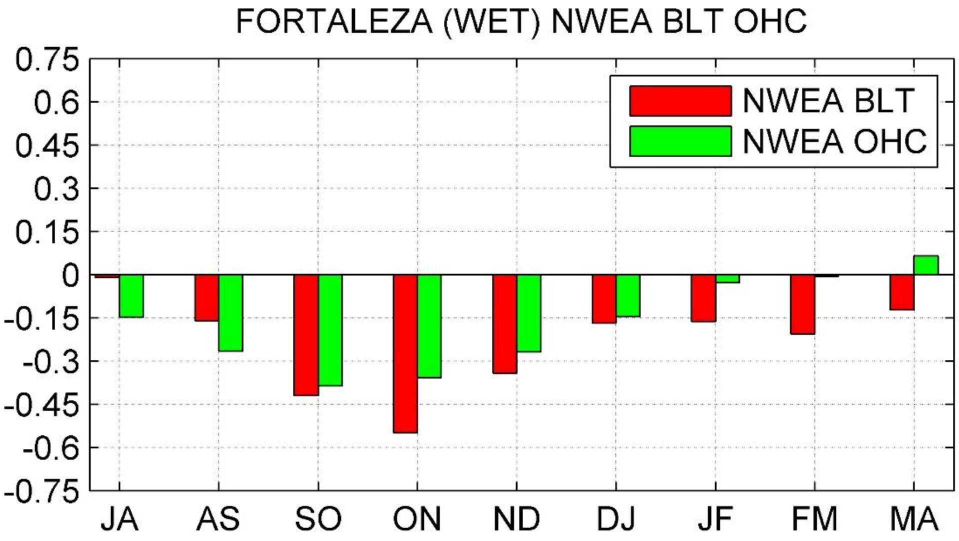
Strengthening of **PWSy** and **LHF** anomalies and negative **SST** anomaly



12 driest years

Weakening of **PWSy** and **LHF** anomalies and positive **SST** anomaly

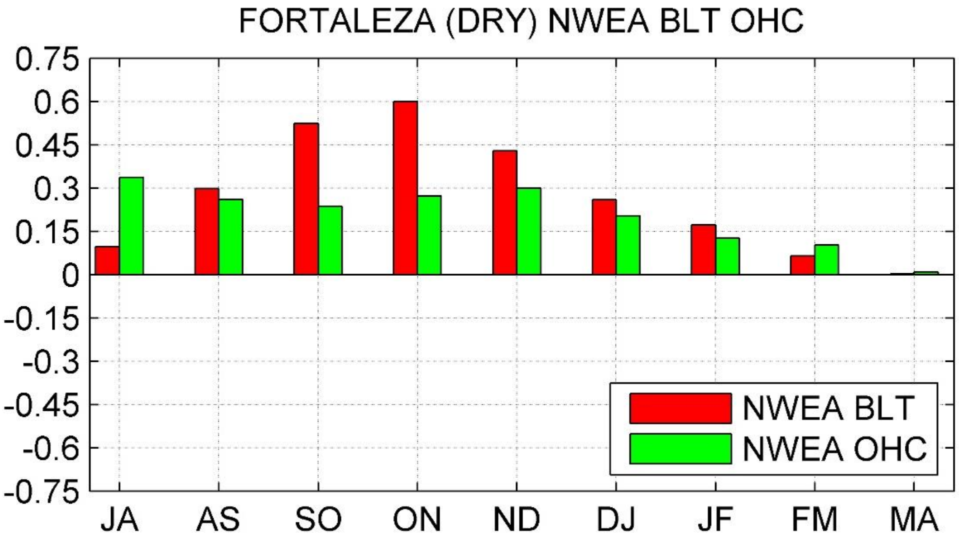
Bi-monthly evolution of oceanic subsurface variables anomalies in NWEA for the 20 selected episodes at Fortaleza



8 wettest years

Thin **BL** within the ILD →mean Low **OHC**

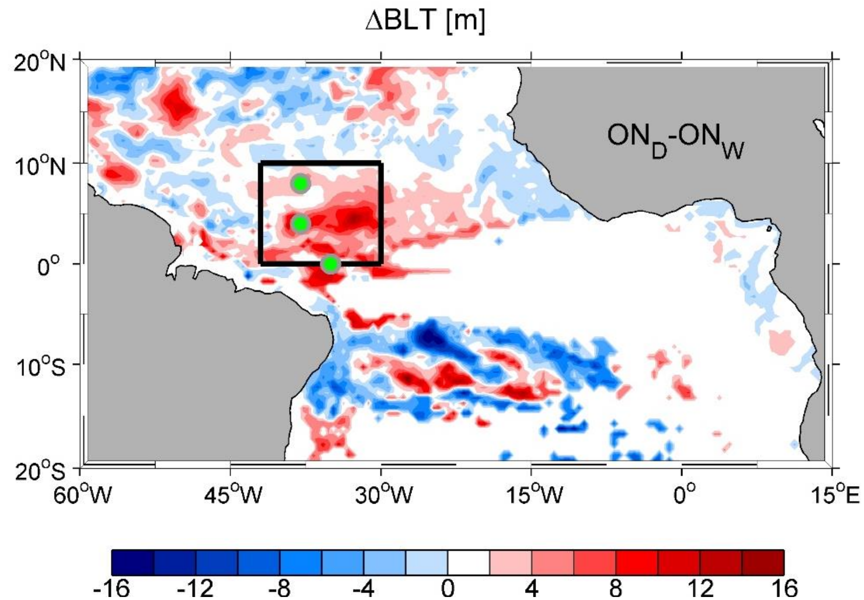
ILD = MLD+BLT

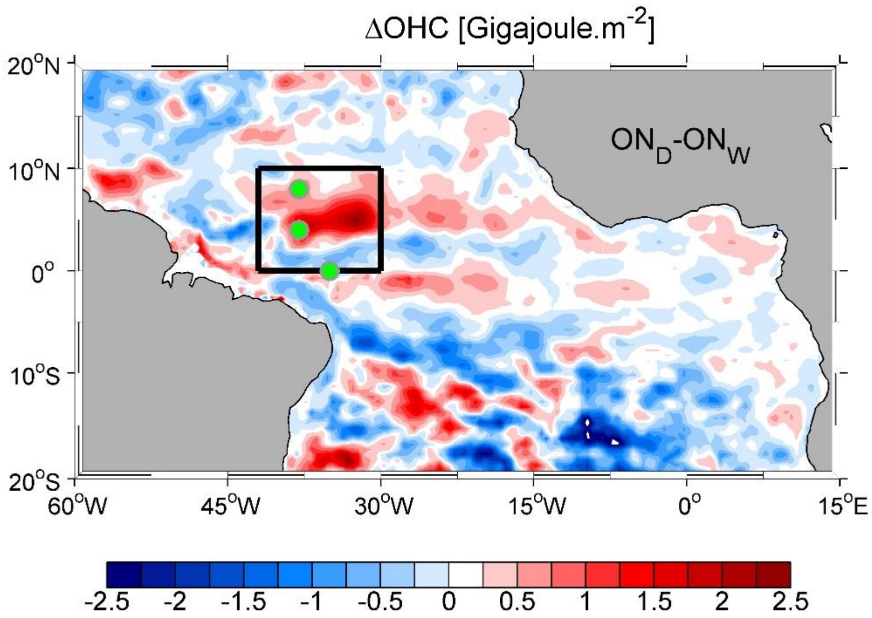


12 driest years

Thick **BL** within the ILD →mean High **OHC**

Spatial distribution of the difference between the composites of 12 driest and 8 wettest years

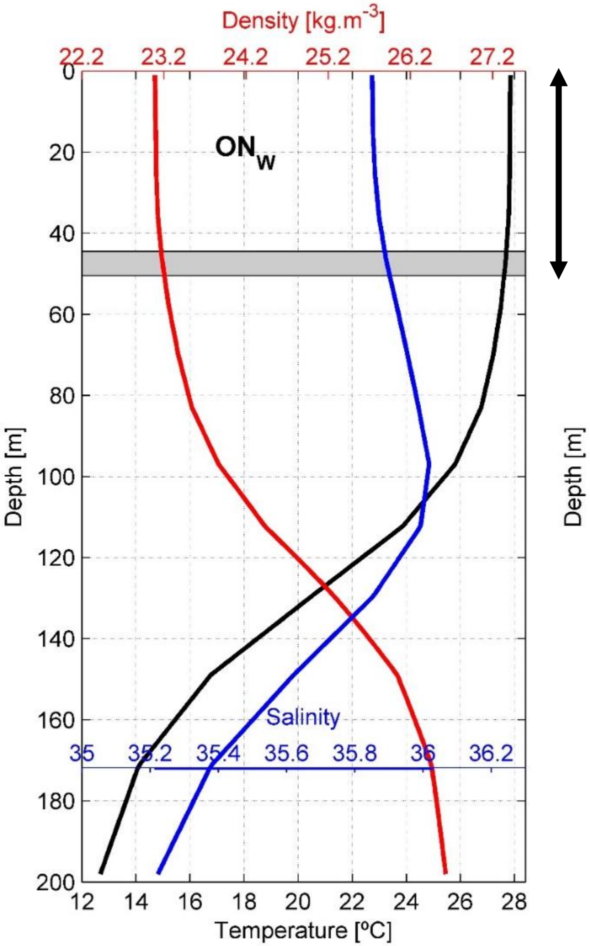




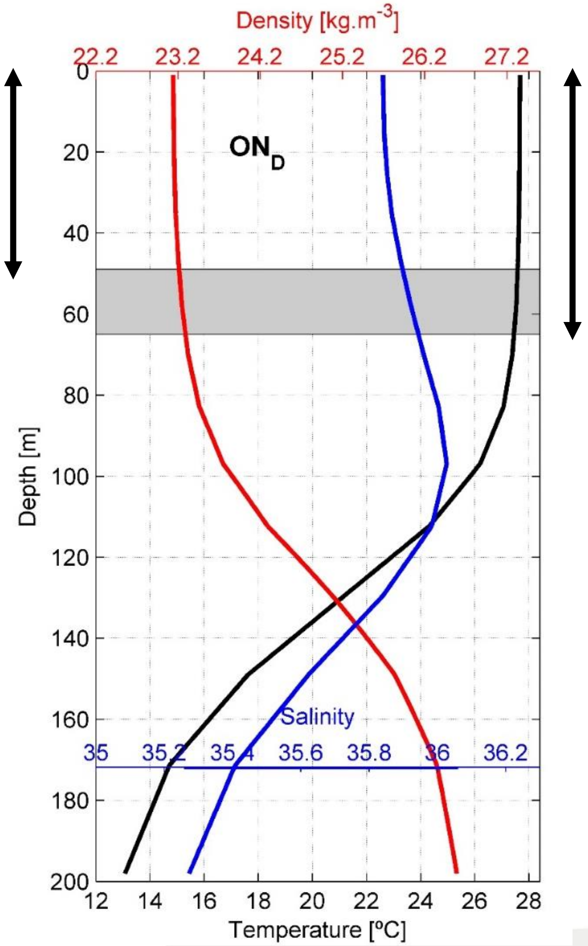
ON$_D$: Oct-Nov corresponding to the **12 driest years**
ON$_W$: Oct-Nov corresponding to the **8 wettest years**

Difference well marked in NWEA for both BLT and OHC. Interestingly, the PIRATA buoy at 4ºN-38ºW is located in the region of strongest values.

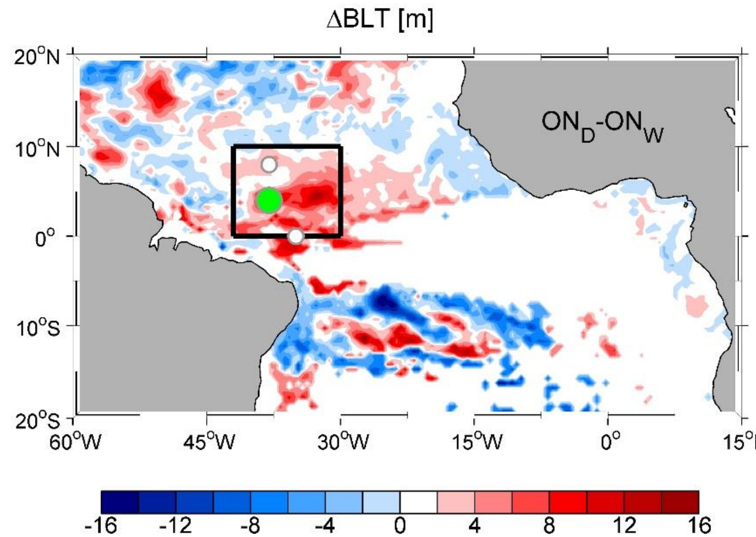
The composite of 12 driest and 8 wettest years at 4ºN-38ºW PIRATA buoy location



8 wettest years



12 driest years

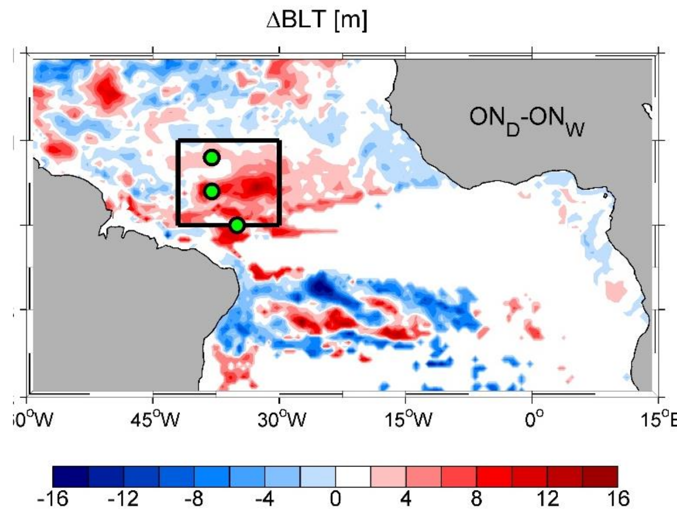


Shallow ILD (50m) in ONw and **deep ILD (65m)** in ONd

Thin BLT (6m) in ONw and **thick BLT (16m)** in ONd at 4ºN-38ºW PIRATA buoy location

SODA This Study	PIRATA At Present	PIRATA At Present	PIRATA Proposed	PIRATA Investment
T/C	**T**	**T/C**	**T/C**	**T/C**
		1	1	
5				
			10	**10**
15				
		20	20	
25				
			30	**30**
35				
		40	40	
46				
			50	**50**
57				
	60		60	**60**
70			70	**70**
82	80		80	**80**
			90	**90**
96				
	100		100	**100**
112				
		120	120	
129				
	140		140	**140**
148				

In order to get access to the necessary oceanic observations in real time



Proposed Investment:

9 T/C x 3 Buoys = 27 T/C

Spare: 27 T/C

Total T/C: 54 T/C

Conclusion

NNEB strong variability (March-April Rainfall)

- Strong influence of the Wind-Evaporation-SST (WES) Mechanism (cf. meridional SST and wind dipoles)
- Progressive predictive effect of anomalies of PWSy, LHF and SST in the NWEA from Nov-Dec up to Mar-Apr
- BLT and OHC perturbations during the last months of the year can be used as a valuable indicator in forecasting especially wet or dry events over the NNEB.
- Proposal for implementing new T/C sensors on three PIRATA buoys within the NWEA

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