Warm and cold events in the South East Atlantic Ocean.

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Study domain, oceanic and atmospheric conditions.

Data

- Observed Reynolds SST (OISST).

- Aviso SLA

- Simulation TATLT025 (1/4º horizontal resolution, 75 vertical levels).

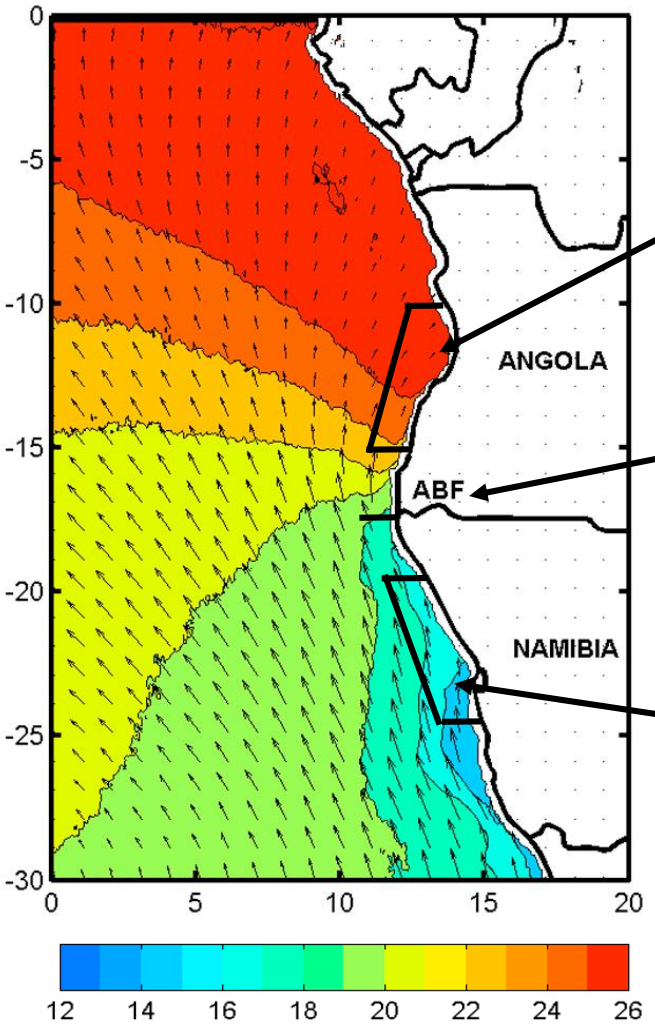


Figure 1: Mean (October to March) austral summer Pathfinder SST (ºC) and Quickscat wind stress (N/M^2) off Southern Africa with position of Angola Benguela Front ABF *(Rouault 2012)*.

Comparison between anomalies of Model SST and Model temperature at 10m .

Good match between anomalies of Model SST and Model temperature at 10m.

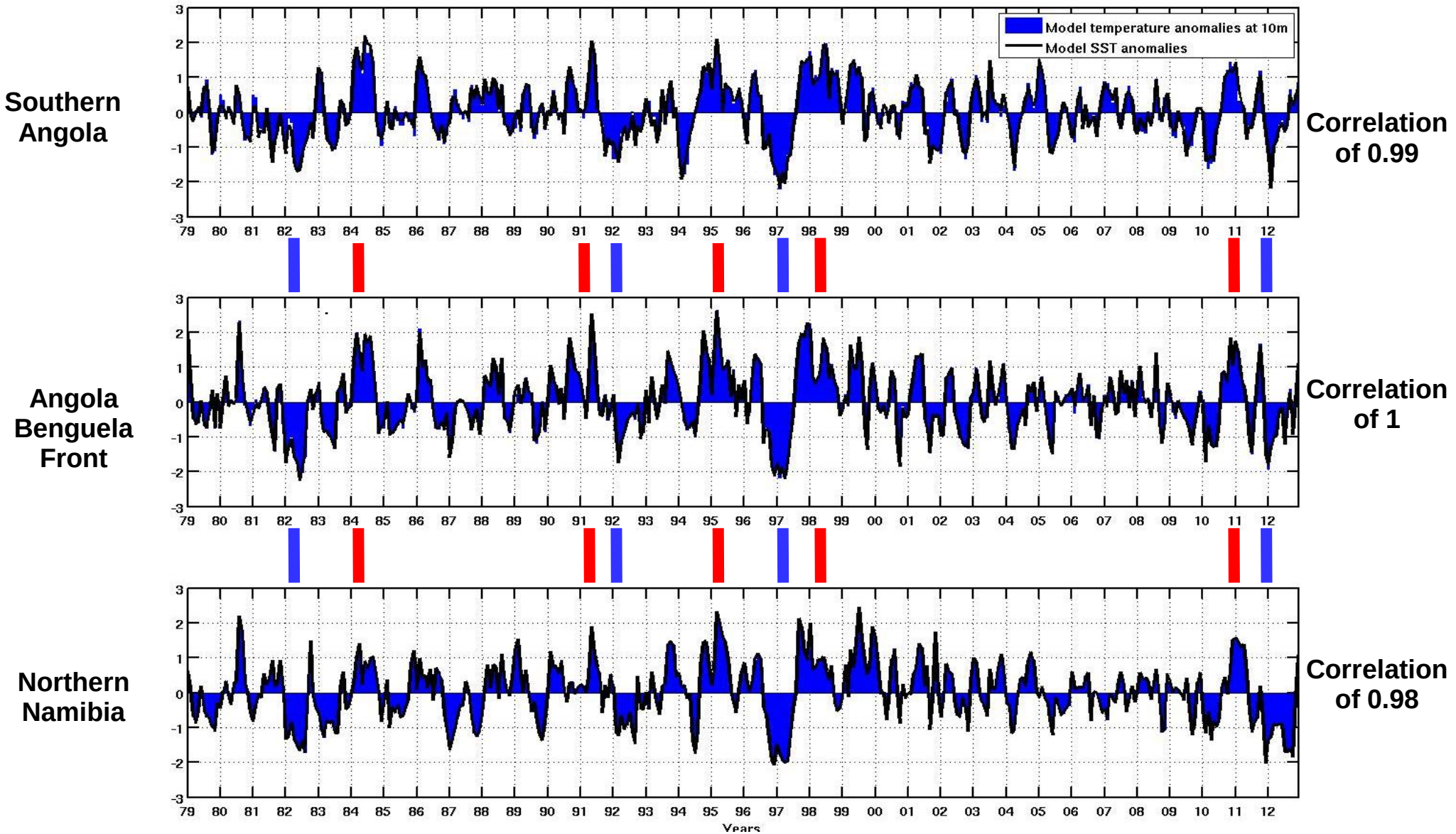
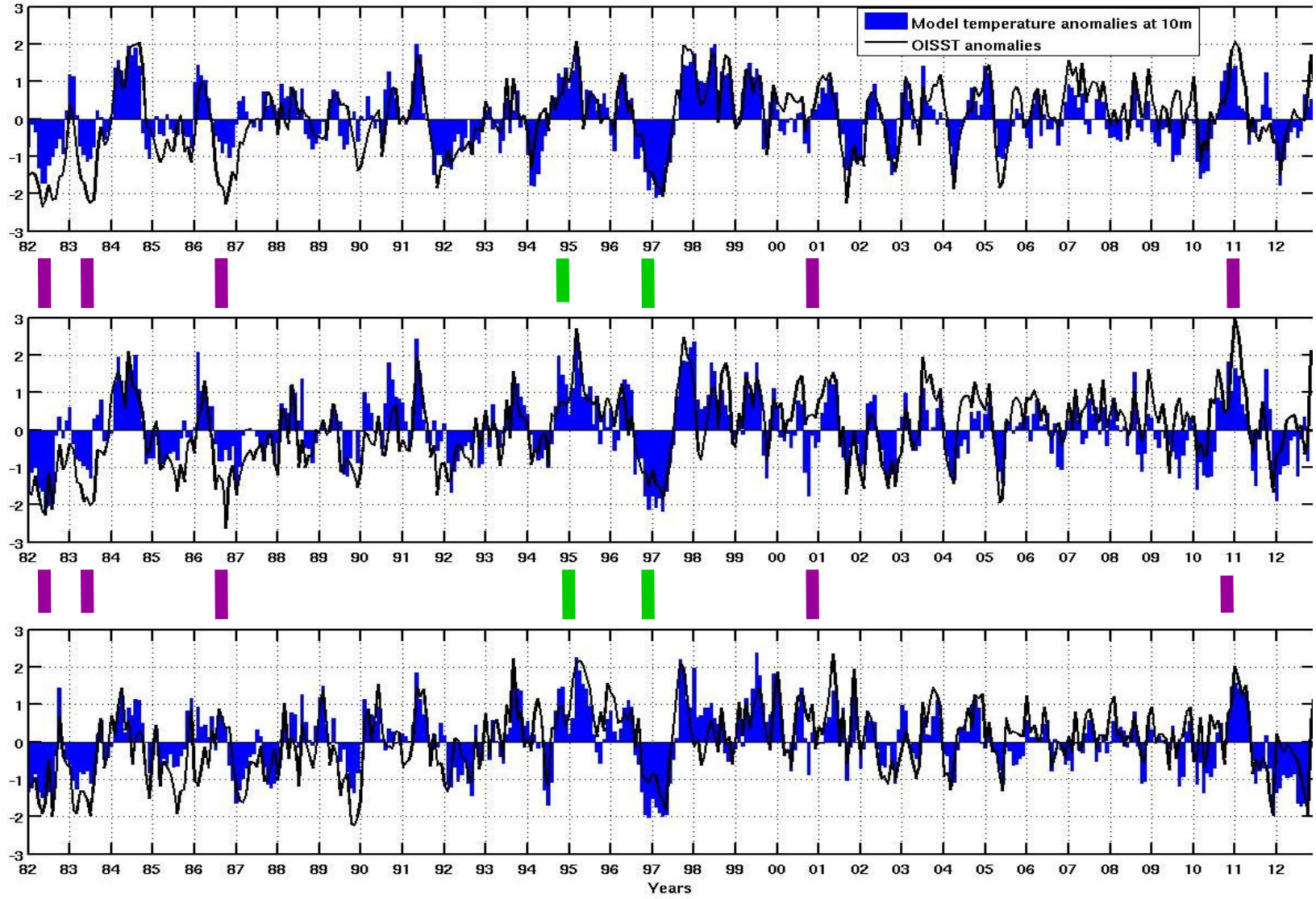


Figure 2: Detrended normalised monthly anomalies of Model SST (Black) and Model temperature at 10m (Blue): (top) Southern Angola over 10ºS to 15ºS and from the coast to 1 degree offshore, (middle) At Angola Benguela Front zone 17ºS from the coast to 1 degree offshore, (bottom) Northern Namibia averaged over 19ºS to 24ºS from the coast to 1 degree offshore from 1979 to 2012 .

Validation of Model temperature anomalies with OI-SST anomalies

Differences observed when comparing Model temperature anomalies at 10m and OI-SST anomalies (black), due to some events which are overestimated and those underestimated by the Model.



Southern Angola — **Correlation of 0.78**

Angola Benguela Front — **Correlation of 0.72**

Northern Namibia — **Correlation of 0.76**

Figure 3: Detrended normalised monthly anomalies of OISST (Black) and Model temperature at 10m (Blue): (top) Southern Angola over 10ºS to 15ºS and from the coast to 1 degree offshore, (middle) At Angola Benguela Front zone 17ºS from the coast to 1 degree offshore, (bottom) Northern Namibia averaged over 19ºS to 24ºS from the coast to 1 degree offshore from 1979 to 2012.

Anomalies of zonal wind averaged over the western part of the equator (50ºW-25ºW, 1ºS-1ºN, blue line) and OI-SST anomalies (black line) along the African coast over the 3 zones.

Detrended normalised anomalies of zonal wind over the western part of the equator and OI-SST averaged in Southern Angola .

Detrended normalised anomalies of zonal wind over the western part of the equator and OI-SST averaged in Angola Benguela Front .

Detrended normalised anomalies of zonal wind over the western part of the equator and OI-SST averaged in Northern Namibia .

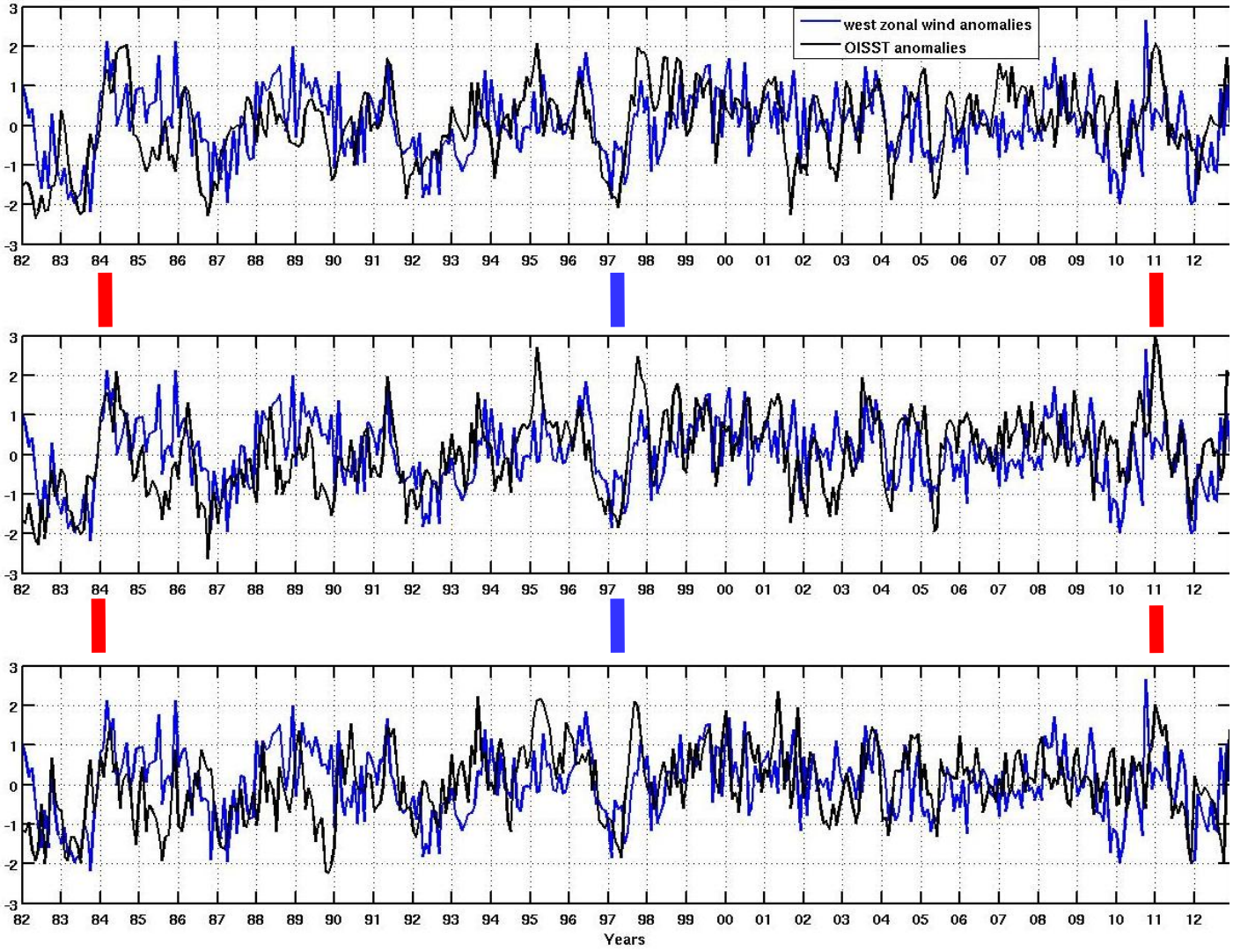
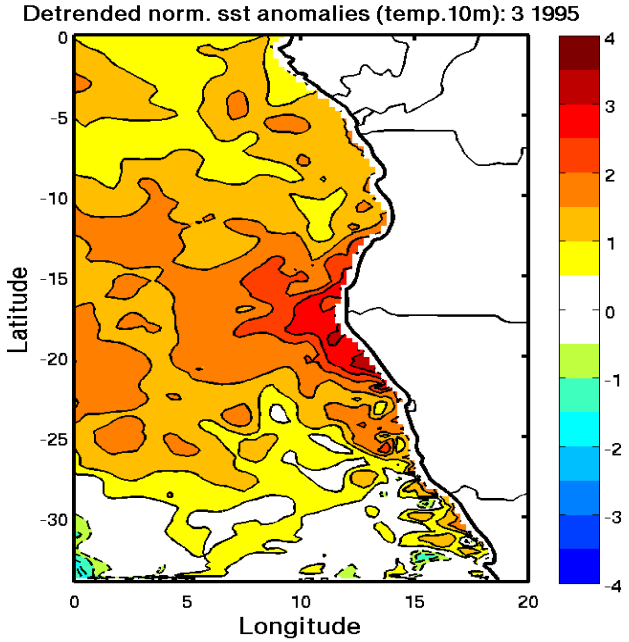


Figure 4: Detrended normalised monthly anomalies of OISST (Black): (top) Southern Angola over 10ºS to 15ºS and from the coast to 1 degree offshore, (middle) At Angola Benguela Front zone 17ºS from the coast to 1 degree offshore, (bottom) Northern Namibia averaged over 19ºS to 24ºS from the coast to 1 degree offshore and Zonal wind (Blue) along the equator averaged over 50ºW-25ºW from 1ºS to 1ºN from 1982 to 2012.

Illustration from **Model temperature anomalies at 10m** and **Altimetry SSH anomalies**



Benguela niño 1995

Benguela niña 1997

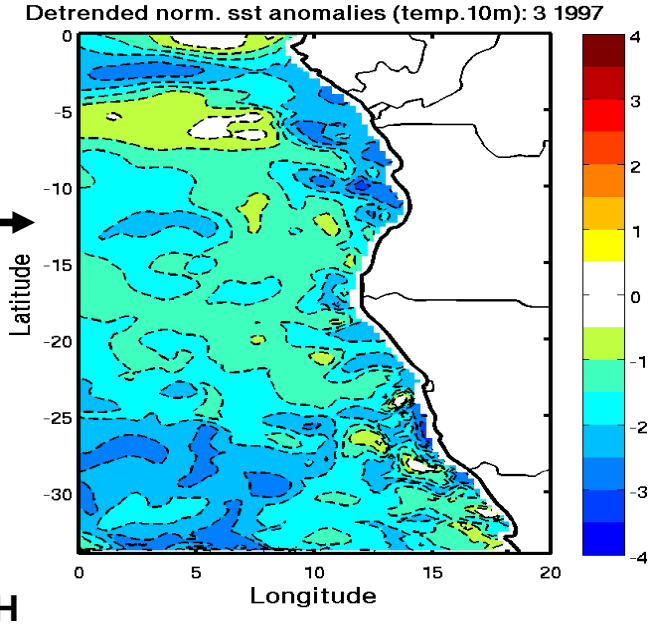
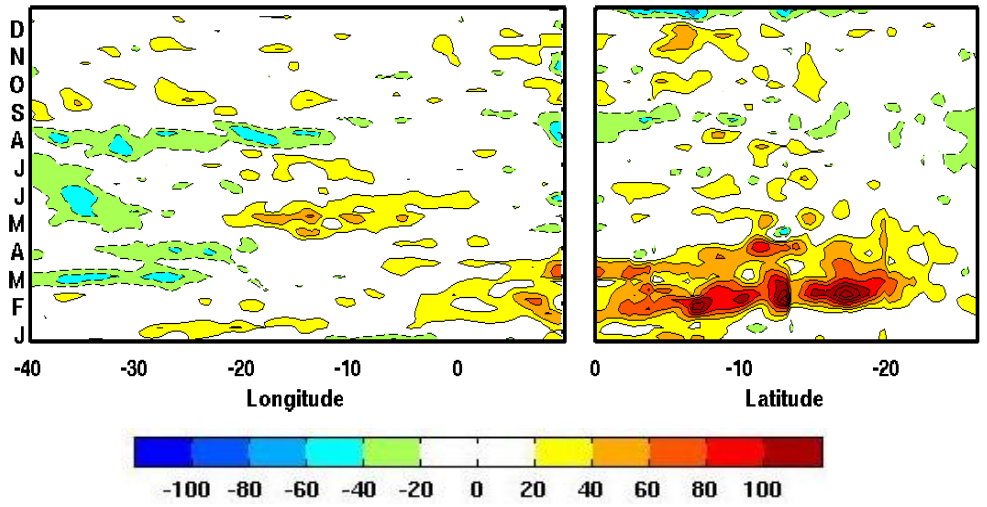


Figure 5: Detrended normalised anomalies of model temperature at 10m (left) for **March** 1995 and 1997 (right).

Altimetry SSH anomalies Benguela niño 1995



Altimetry SSH anomalies Benguela niña 1996/1997

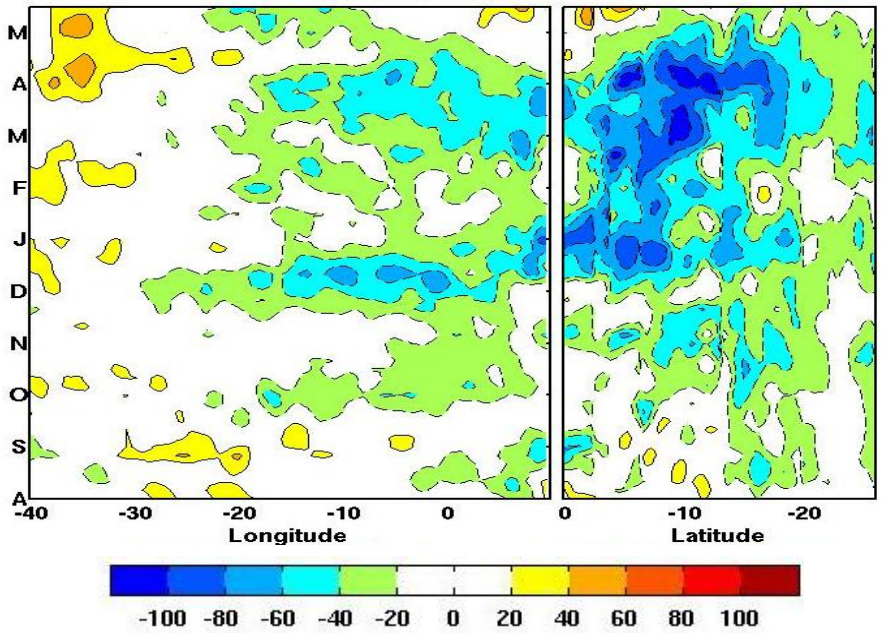


Figure 6: Longitude-time and latitude-time Hovmøller diagram of: weekly SSH anomalies averaged between 1ºS and 1ºN along the equator and from the coast to 1 degree (left) for Benguela niño 1995 and (right) for Benguela niña 1996 /1997.

Major problem, Different velocities from Models leading to different transports at the Angola-Benguela Front 17ºS.

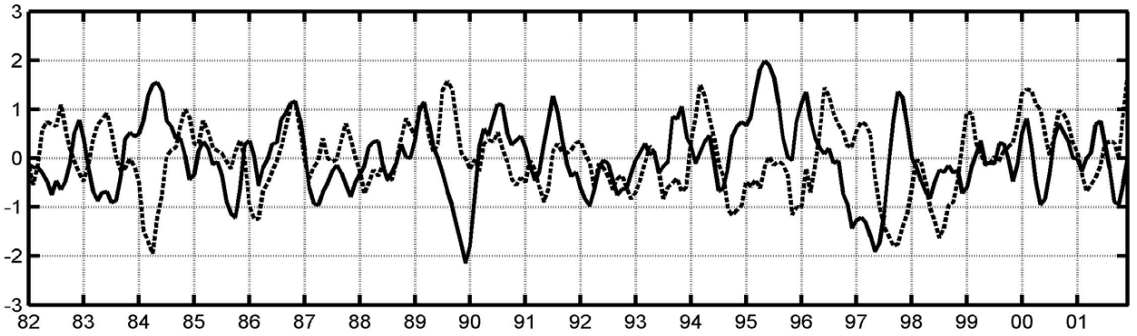


Figure 7: Detrended normalised monthly anomalies of **near surface meridional volume transport** (integrated from 0 to 250m, at 17ºS from the coast to 2.75 degree offshore, dashed line) and OISST in Northern Namibia (averaged over 19ºS to 24ºS from the coast to 1 degree offshore, solid line), *Rouault, 2012.*

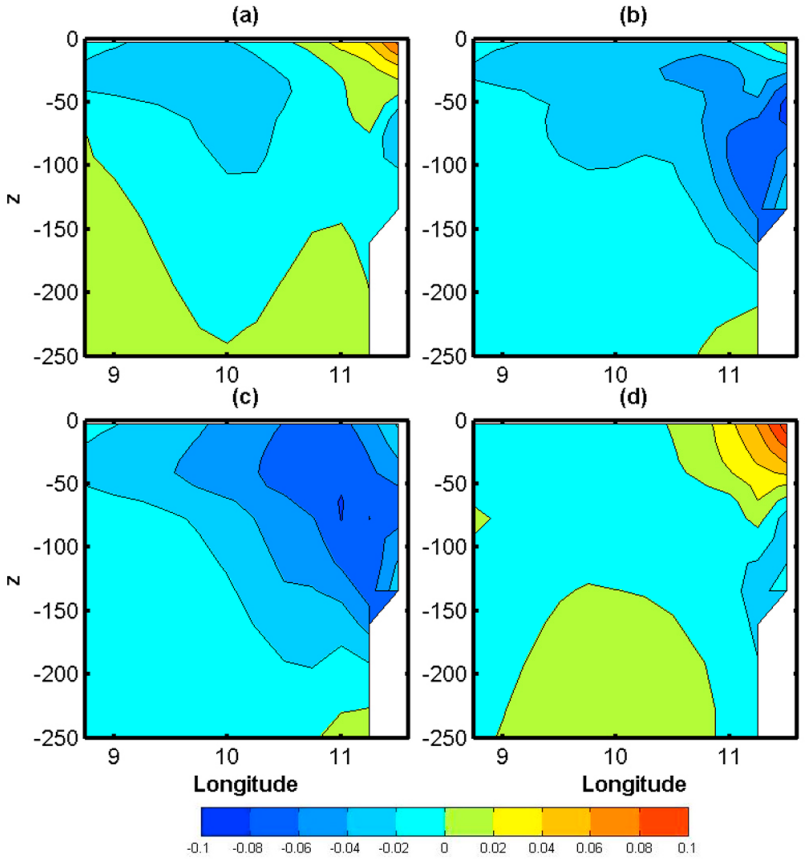


Figure 8: Clockwise from top left: Annual cycle of Modeled meridional velocity in m/s along 17ºS across the ABF in a) December, b) February, d) June, c) October. *Rouault, 2012.*

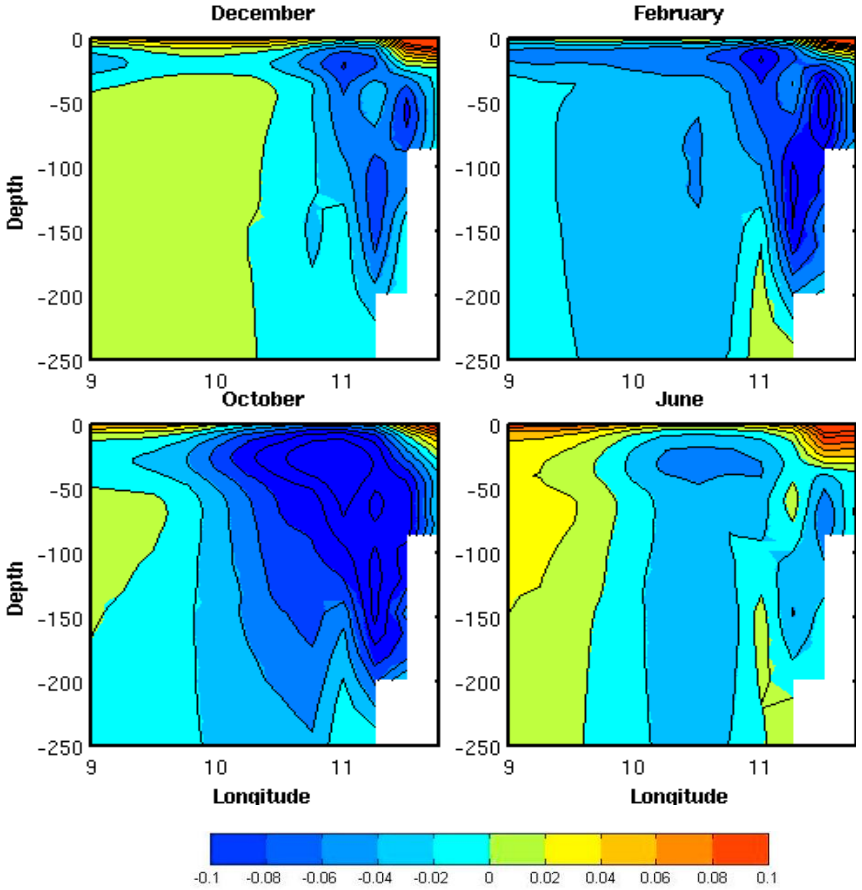
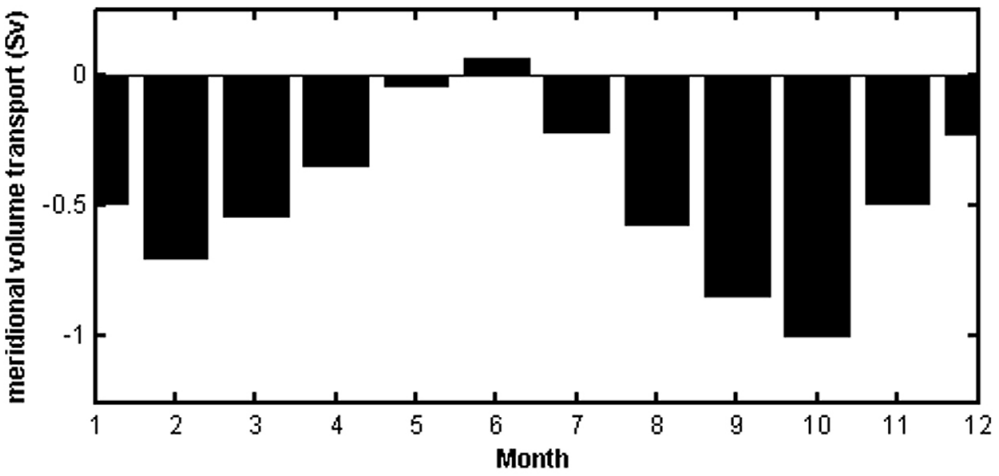
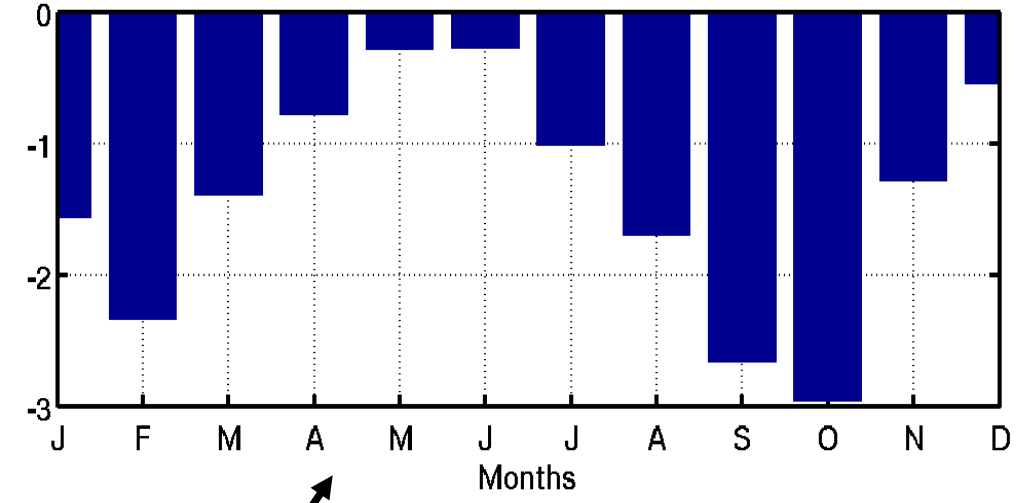


Figure 9: Same as **Figure 8,** but with the simulation TATLT025.

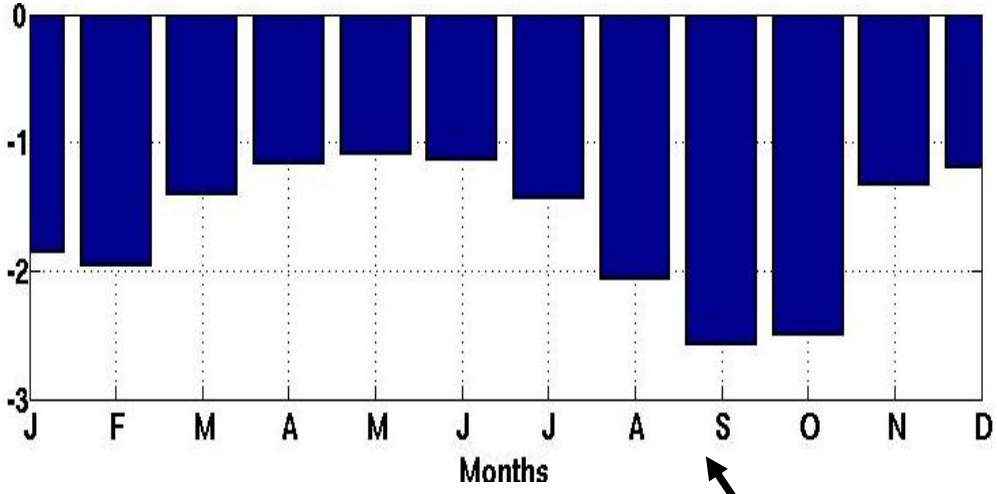
Annual cycle of near surface meridional transport (0-250m, from the coast to 2.75 degree offshore, at 17ºS.)



ORCA025 (*Rouault. 2012*)



TATLT025 from PAGO



ORCA12 from PAGO

Hovmøller diagram of Meridional Heat transport from PAGO.

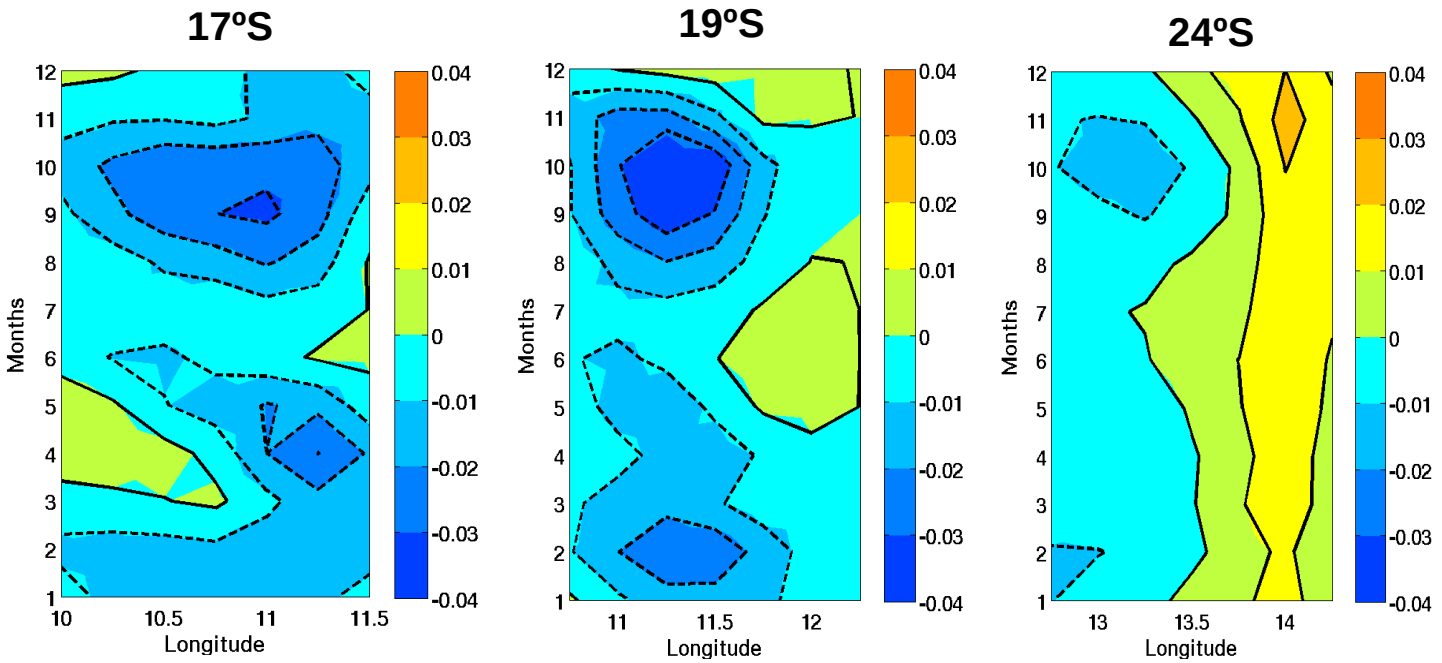


Figure 10 : **Hovmøller diagram of integrated heat transport** (PW/m, 1PW = 10^15 W) from 0 to 150m **from the left to right at 17ºS, 19ºS, and 24ºS** respectively from PAGO.

Poleward heat transport = Negative heat transport

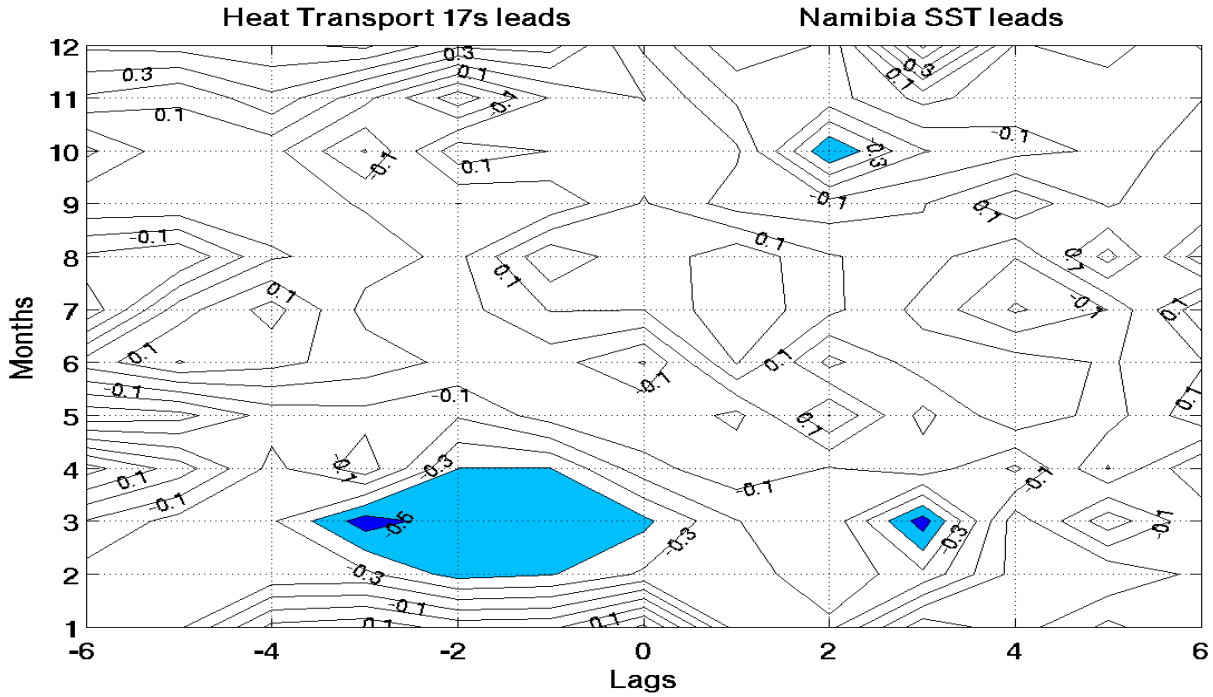


Figure 11 : **Lag correlation** between detrended normalised anomalies of **integrated heat transport at 17ºS (1.5 degree offshore, from 0 to 150m) and OISST in the Northern Namibia** (19-24ºS from the coast to 1 degree offshore).

Correlations statistically significant at 95% are <= - 0.4 .

Summary

1) No difference between anomalies of model temperature at 10m and model SST .

2) The simulation TATLT025 represents quite well the Benguela niños and Benguela niñas events.

3) The positive (negative) than normal SST anomalies from 17ºS to 24ºS seem to be associated with the weaken (strong) than normal easterlies in the west equatorial Atlantic.

4) Kelvin waves activities seem to be observed through the propagation and connection of positive (negative) SSH anomalies along the equator and the West African coast.

5) The poleward heat transport is a key element for the development of Benguela niños (niñas).

Further work: 1st part

Ocean Linear model (Equatorial Waves dynamics) **and** **Observations data from PIRATA**

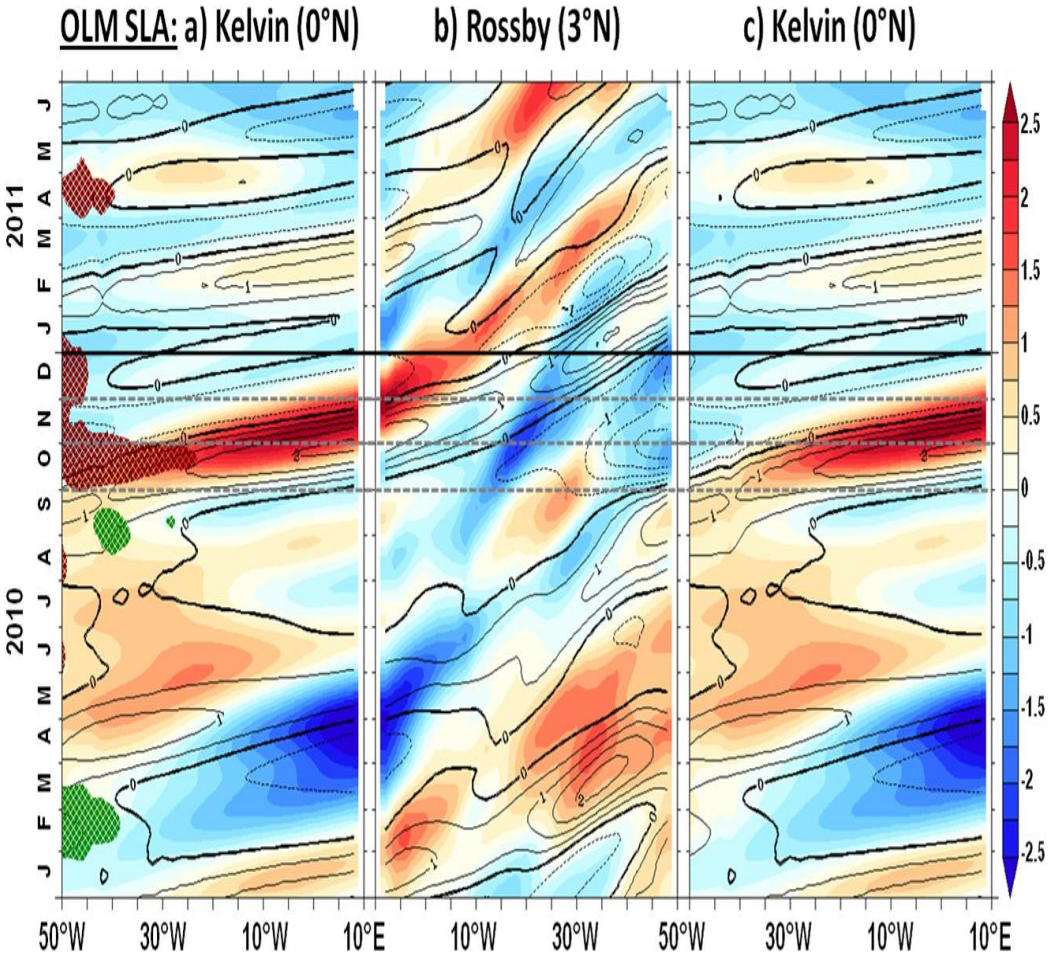


Figure 12: Panel a (b): Longitude-Time Hovmøller diagrams of the eastward (westward) propagating Kelvin (Rossby) wave contribution to the monthly SLA along the equator (at 3ºN) from the OLM from January 2010 to June 2011 ***(Rouault et al,. 2015 in prep)***.

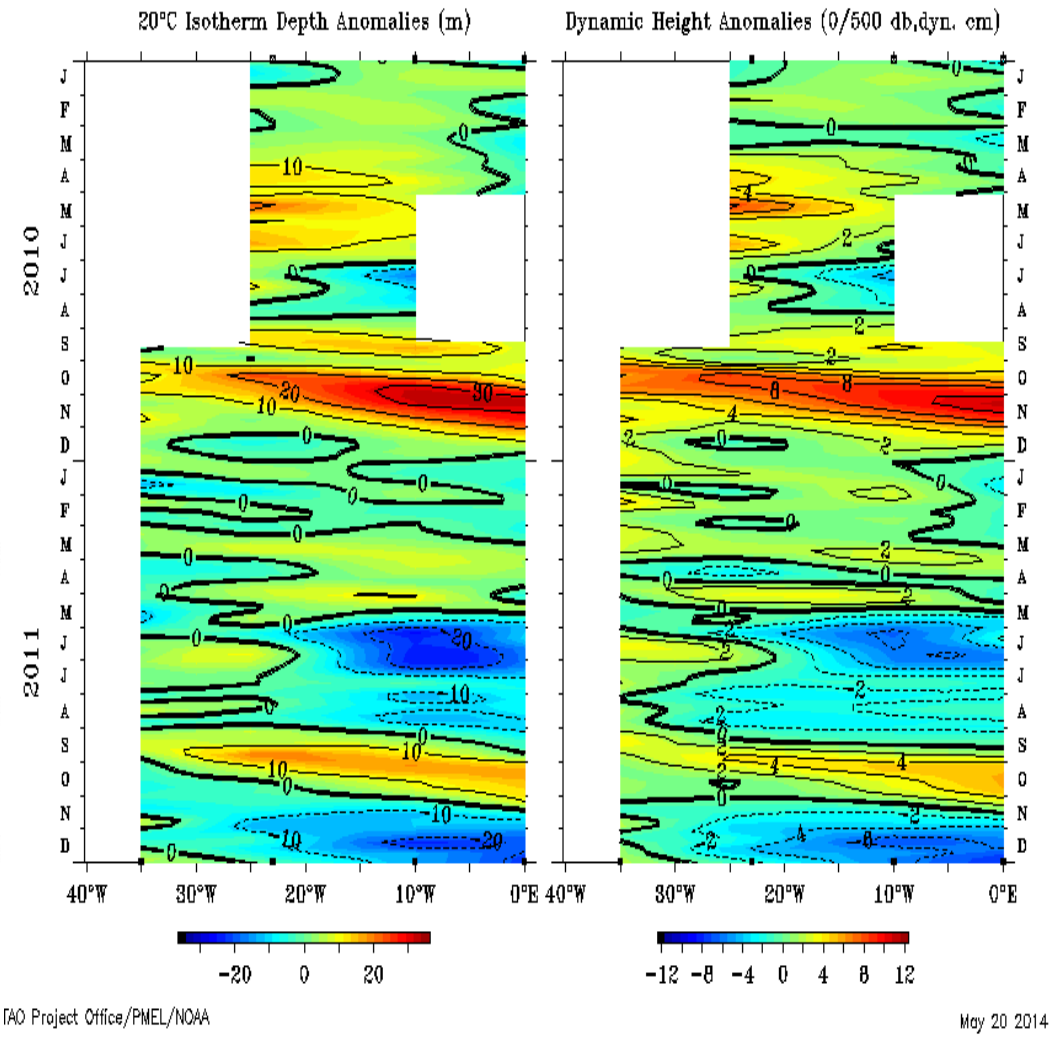


Figure 13: Hovmøller diagram of 20ºC isotherm depth anomaly (m) and dynamic height anomaly from 2010 (top) to 2011(bottom) inferred from PIRATA moorings and interpolated between mooring locations ***(Rouault et al,. 2015 in prep)***.

Further work: 2nd part

1) Study the warm and cold events for the last 30 or 50 years, looking at the impact of the heat content with the model.

2) Combined the Ocean Linear Model, the tropical Atlantic simulation and SST anomalies along the African coast, for looking in detail since 1979 till now.

3) Model comparisons in term of heat transport, volume transport.

THANK YOU FOR YOUR ATTENTION!!!