EQUATORIAL AND COASTAL KELVIN WAVES IN THE TROPICAL ATLANTIC WITH ALTIMETRY

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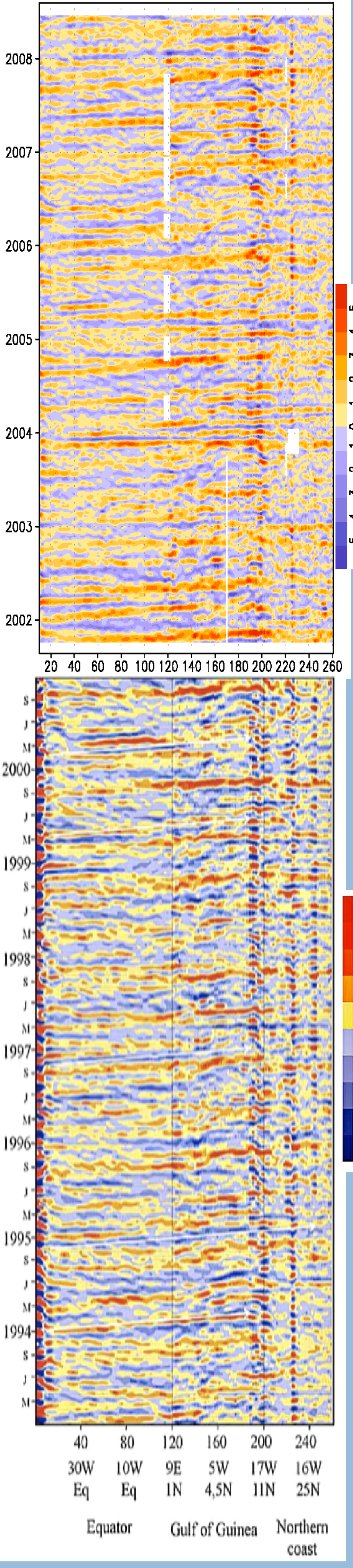

In this work, the intra-seasonal variability of the tropical Atlantic dynamic height is investigated over the TOPEX-Poseidon decade and updated with the Jason period, in the framework of the Kelvin and Rossby waves activity. Based on satellite measurements and an OGCM simulation, we first show the morphology of the equatorial and coastal horizontal propagations observed at intraseasonal period, and then examine the sources and sinks of the signals.

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ANETUS

SEASONAL TO INTERANNUAL VARIABILITY OF THE ATLANTIC NORTH-EASTERN TROPICAL UPWELLING SYSTEM (ANETUS) : LOOKING FOR CAUSES AND BASIN-SCALE CONSEQUENCES

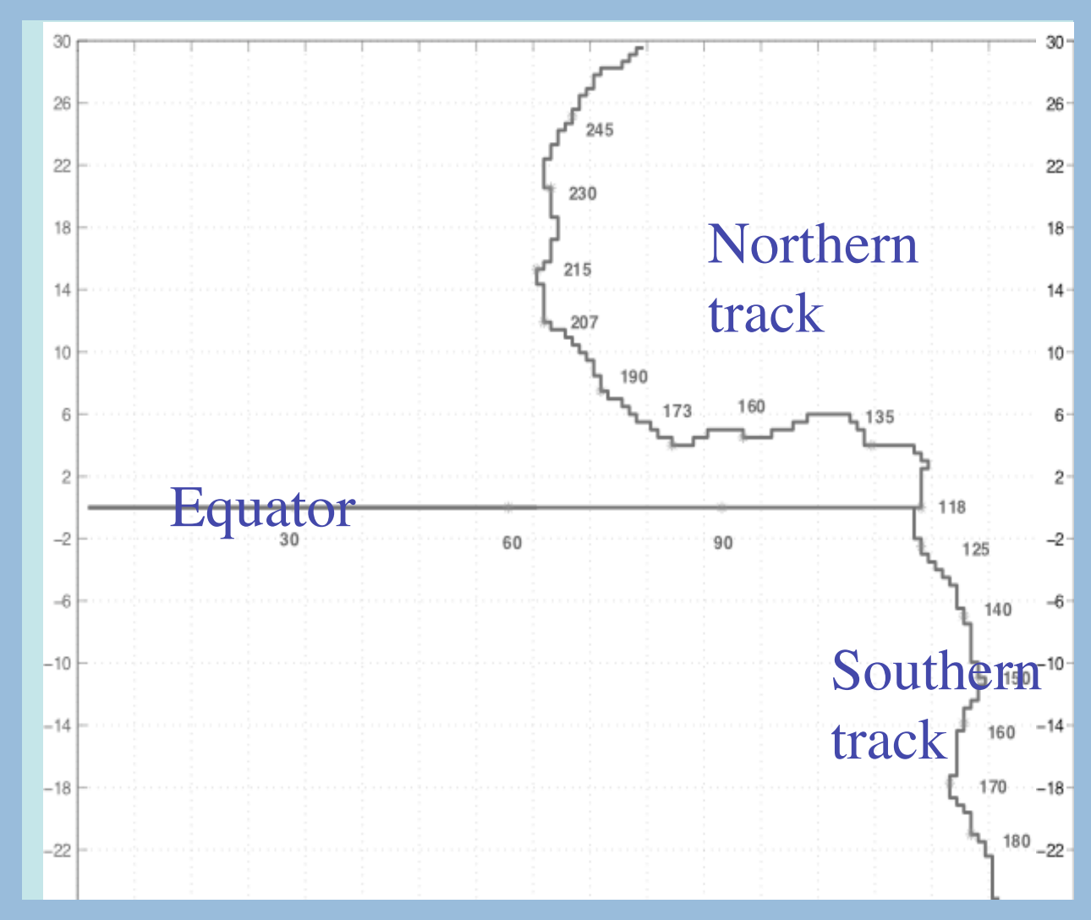
CHARACTERISTICS OF THE EQUATORIAL AND COASTAL PROPAGATIONS

Oceanic Kelvin Waves and Tropical Atlantic intraseasonal Variability. Part I: Kelvin wave characterization.
Irene Polo, A. Lazar, B. Rodriguez-Fonseca, S. Arnault. *J. Geophys. Res* , vol 18 ; 2008.

Table velocity

Reference	Kelvin (m/s) phase speed	Rossby (m/s) phase speed
Illig et al., 2004	Mode 1 : 2.7 Mode 2 : 1.5 Mode 3 : 0.8	Mode 1 : 0.8 Mode 2 : 0.4 Mode 3 : 0.29
Du Penhoat and Treguier, 1985	Mode 1 : 2.17 Mode 2 : 1.26 Mode 3 : 0.91	
Shouten et al., 2005		
Franca et al., 2002	Mode 1 : 1.7	
Katz, 1997	Mode 1 : sounder 2.11 T/P : 1.7	

Table 1 Time-averaged Phase speed values of Kelvin (K) and first Rossby (R1) waves for several first baroclinic modes in the equatorial Atlantic by other authors.



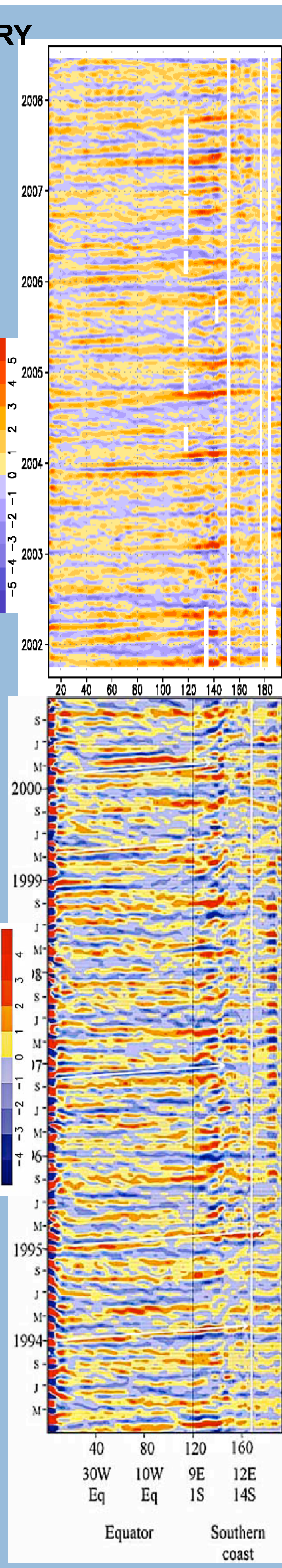
Northern Points	Latitude	Longitude	Phase Speed m/s	Southern Points	Latitude	Longitude	Phase speed m/s
90	0	-4.75	LR: 1.8 RT: 2.4	90	0	-4.75	LR: 1.8 RT: 2.4
140	5.49	2.75	LR: 1.3 RT: 1.9	130	-3.997	10.75	LR: 1.4 RT: 2
190	7.479	-13.25	LR: 1.2 RT: 3	160	-13.25	12.25	LR: 2 RT: 2.6
215	16.28	-17.25	LR: 3 RT: 2	175	-19.60	12.25	LR: 3 LR: 3

Table 2 north and south track points (see figure 1) and phase speed computed as the linear regression slope of the one point lagged correlation plots for each track point (LR) and for the Radon Transform method (RT).

1. <u>20 to 60 days band-pass filter (bpf)</u> TOPEX/Poseidon and Jason SSH (cm) for the northern (left) and southern (right) tracks, Observations as well as model display robust eastward propagating events at the equator, often continuing poleward along the coasts (here along the Equator and the Northern and southern tropical hemisphere coastline).

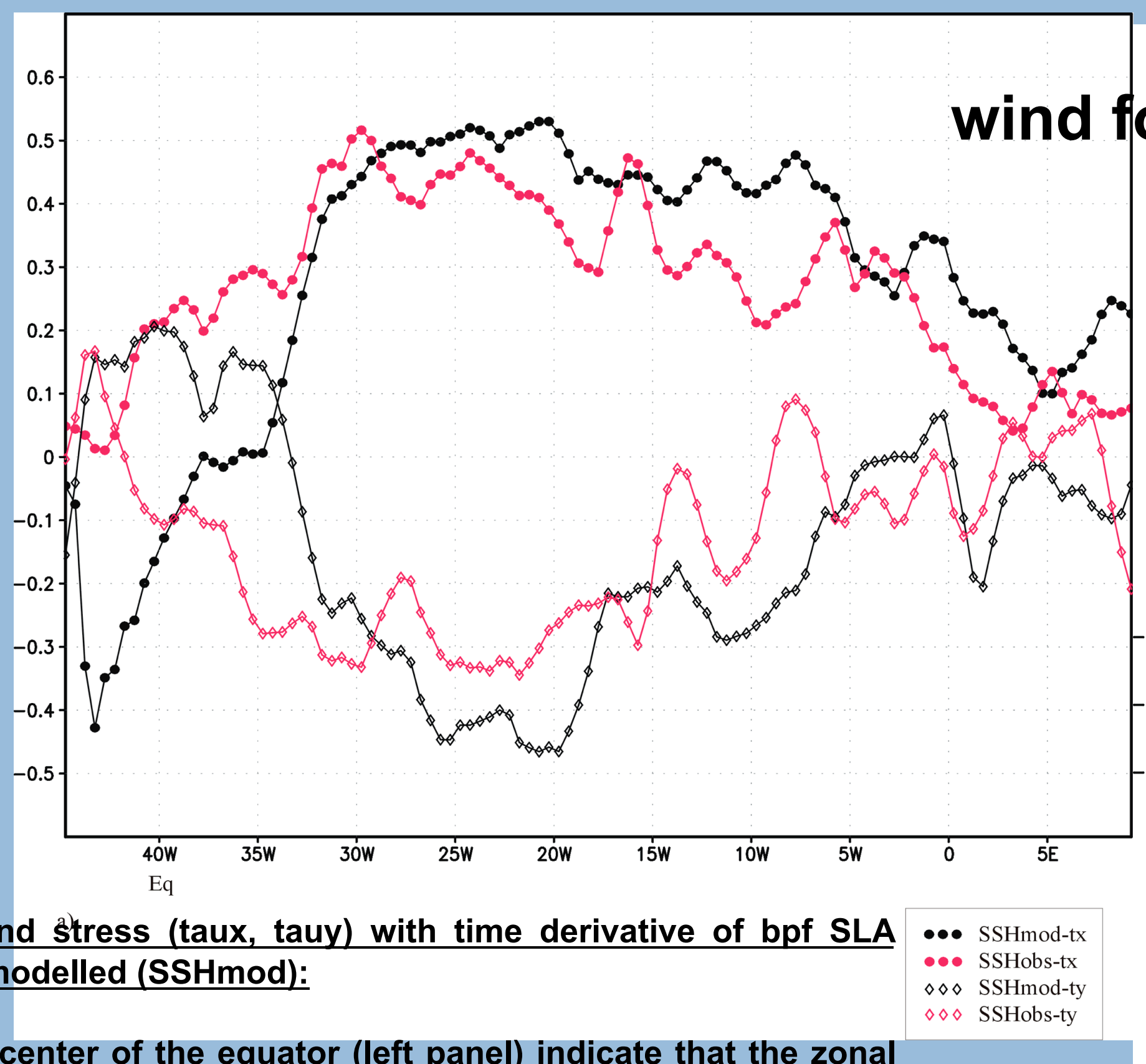
-In boreal Automn-Winter, starting near the brazilian coast, the activity is particularly high and in phase with the seasonal cycle: a November upwelling (blue) wave is followed by a December downelling (red), and a January upwelling. Less recurrent, but frequent, a downwelling wave often leaves the coast in September. A climatology of the bpf was constructed to summarize these events

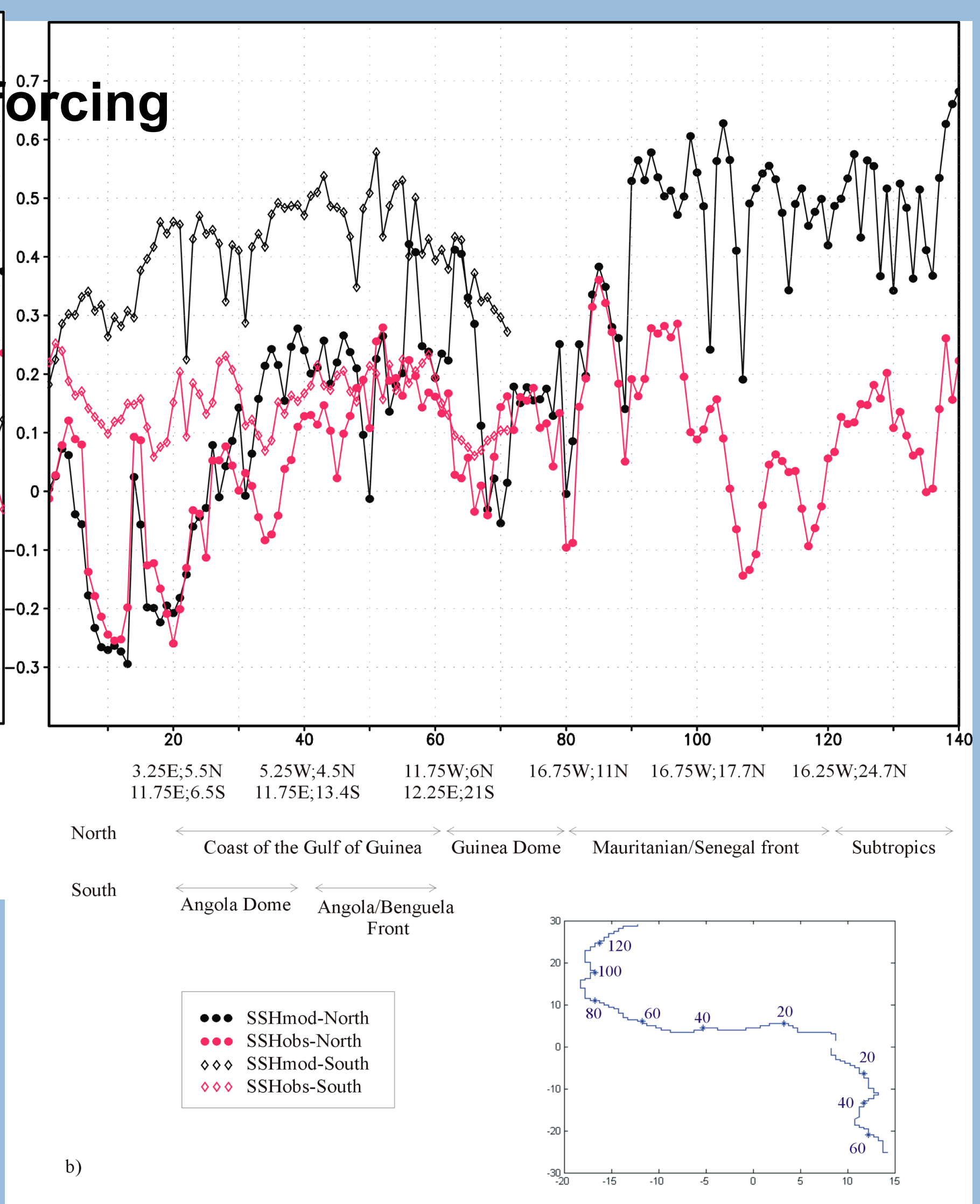
2. <u>Phase speeds</u> in function of location (see geographic correspondence above) along the tracks, support the presence of propagations dominated by first and second baroclinic modes .



MECHANISMS OF EQUATORIAL FORCING AND COASTAL PERTURBATION

Oceanic Kelvin Waves and Tropical Atlantic intraseasonal Variability. Part II: Forcings. Irene Polo, A. Lazar, B. Rodriguez-Fonseca. Submitted to *J. Geophys. Res* , 2008.





4. <u>Correlation of bpf wind stress (taux, tauy) with time derivative of bpf SLA observed (SSHobs) and modelled (SSHmod):</u>

-Large correlation in the center of the equator (left panel) indicate that the zonal wind burst frequently force the wave (it explains about 40% of the variance)

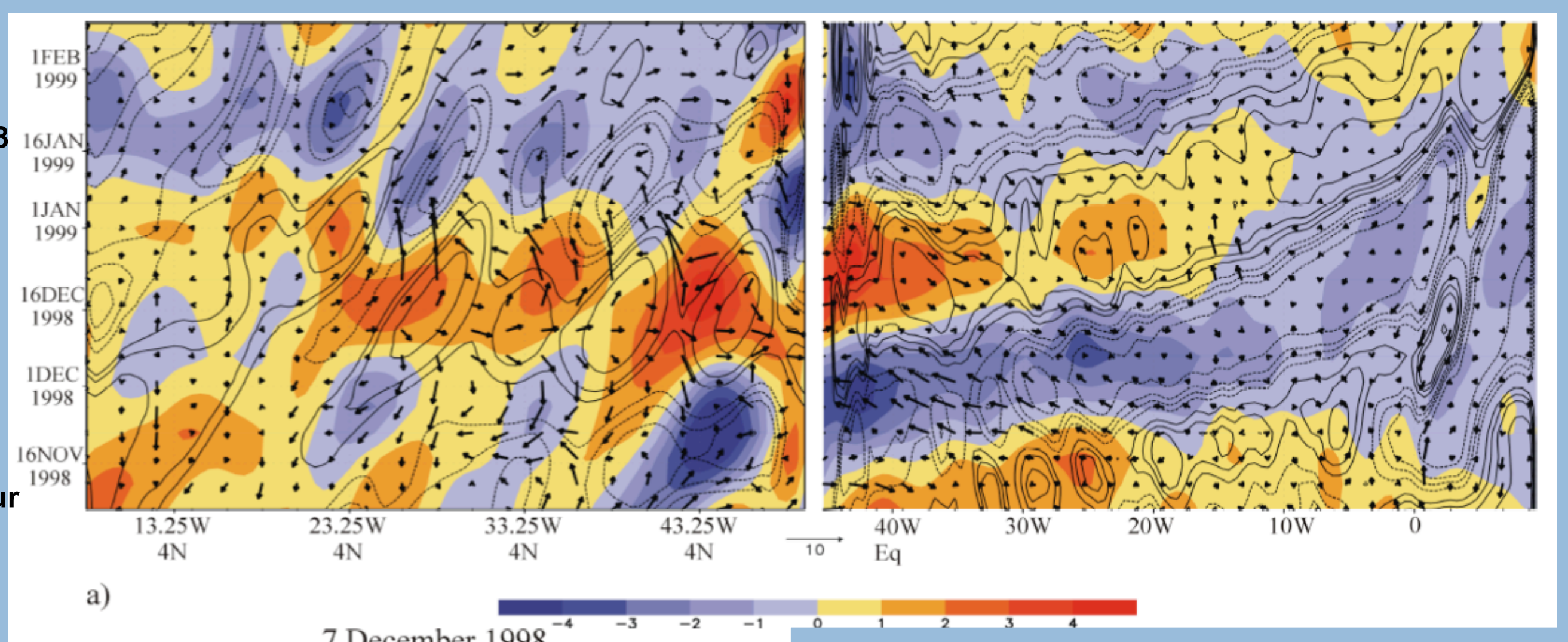
-5. Near the Brazilian coast, the correlation drop, suggesting that the local wind is not the principal forcing of the Kelvin waves!

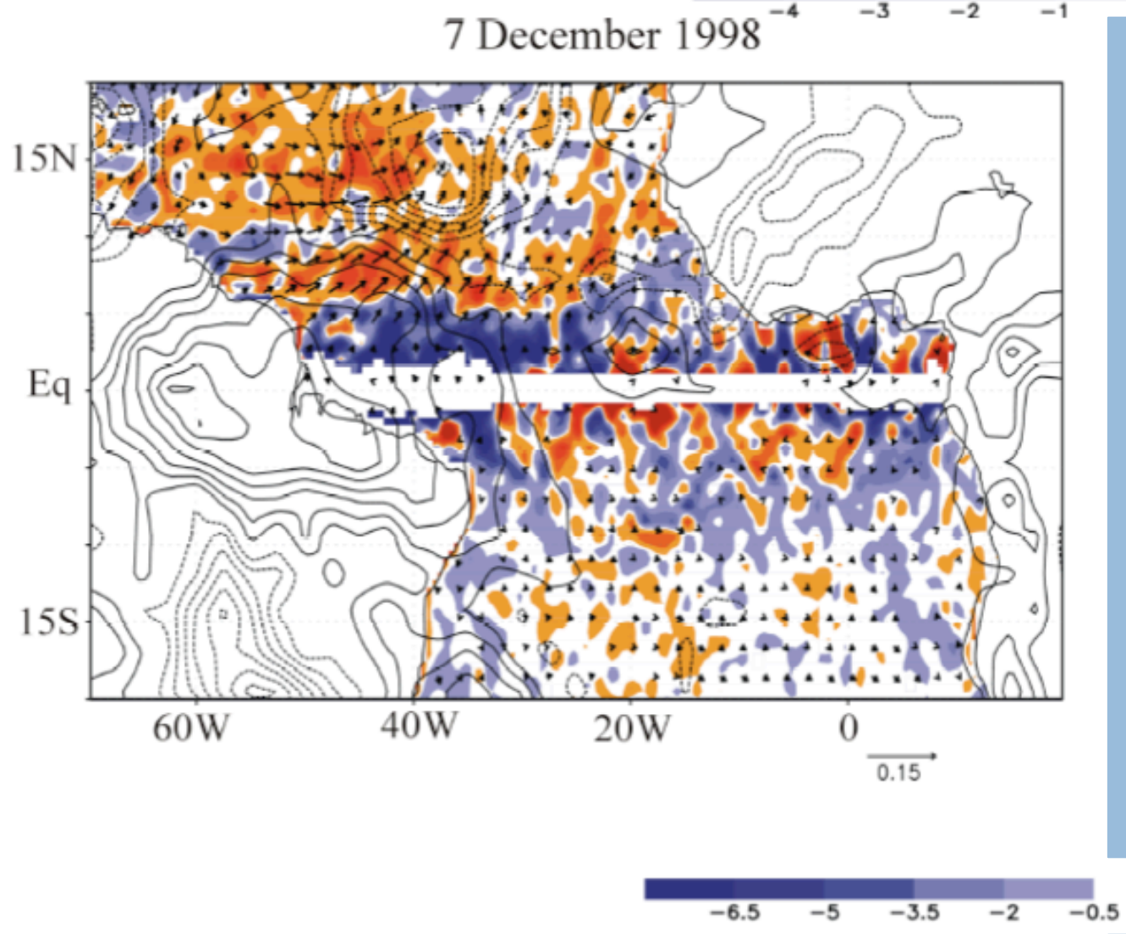
-6. Along coastlines (right panel), the poleward increasing correlation of SLA with alongshore winds suggests that, within the deep tropics, the SSH anomalies are rather dominated by remote forcing, whereas polewards, the local forcing takes over control

5. <u>Western off-equatorial Ekman pumping forcing: demo in winter 1998-1999</u>

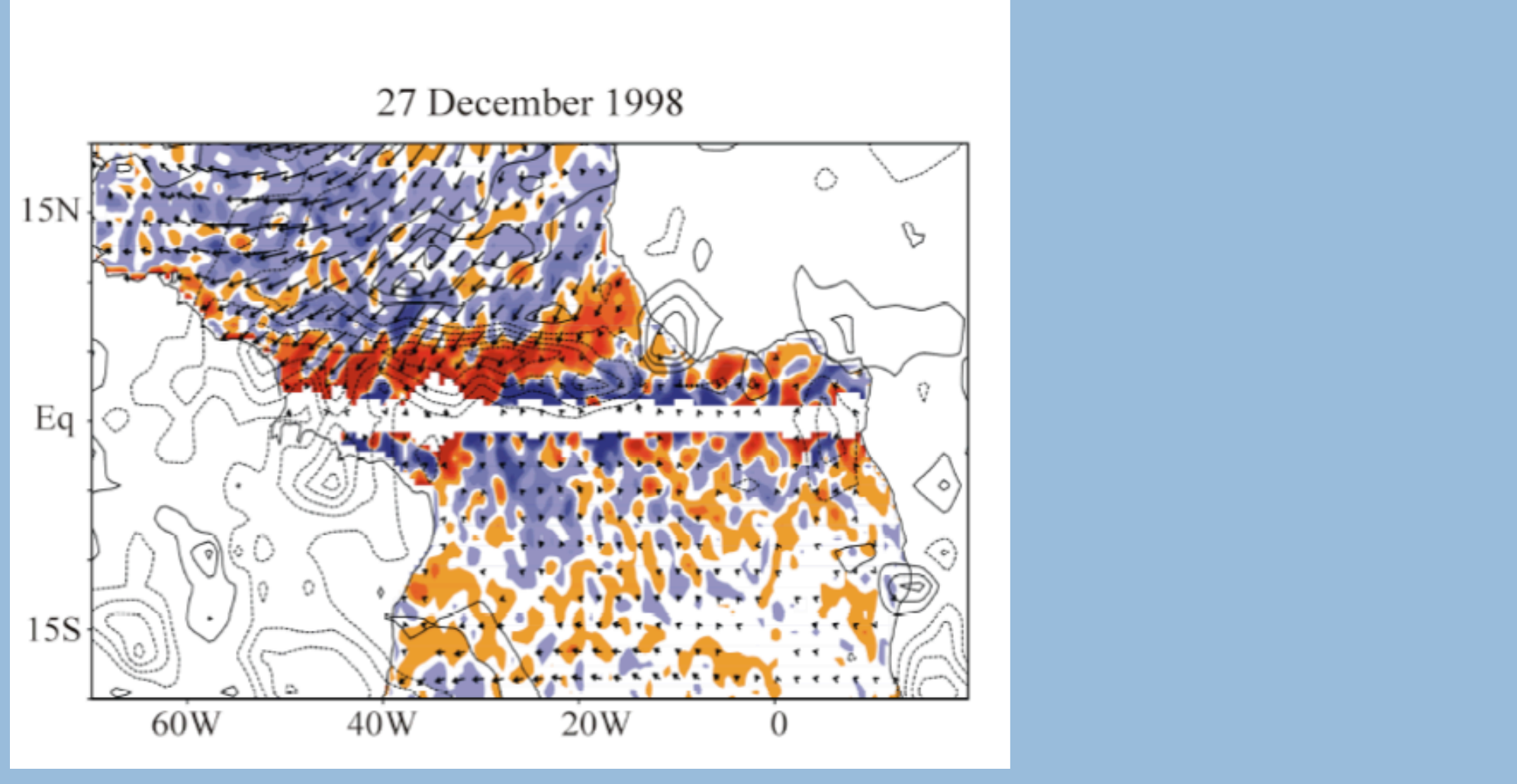
Left panel: observed SLA (shaded areas, in cm), z18 (contour lines, levels ±1, 2, 3, 5 m) and the vector consisiting in the zonal wind stress (0.5 10^{-2} N/m^2 positive rightward) and the Ekman pumping (m/5days positive upward) for the northern Rossby wave-track

Right panel: SLA (shaded areas, in cm), z18 (contour lines, levels ±1, 2, 3, 5 m) and the wind stress (vectors, 0.5 10^{-2} N/m^2) along the equator

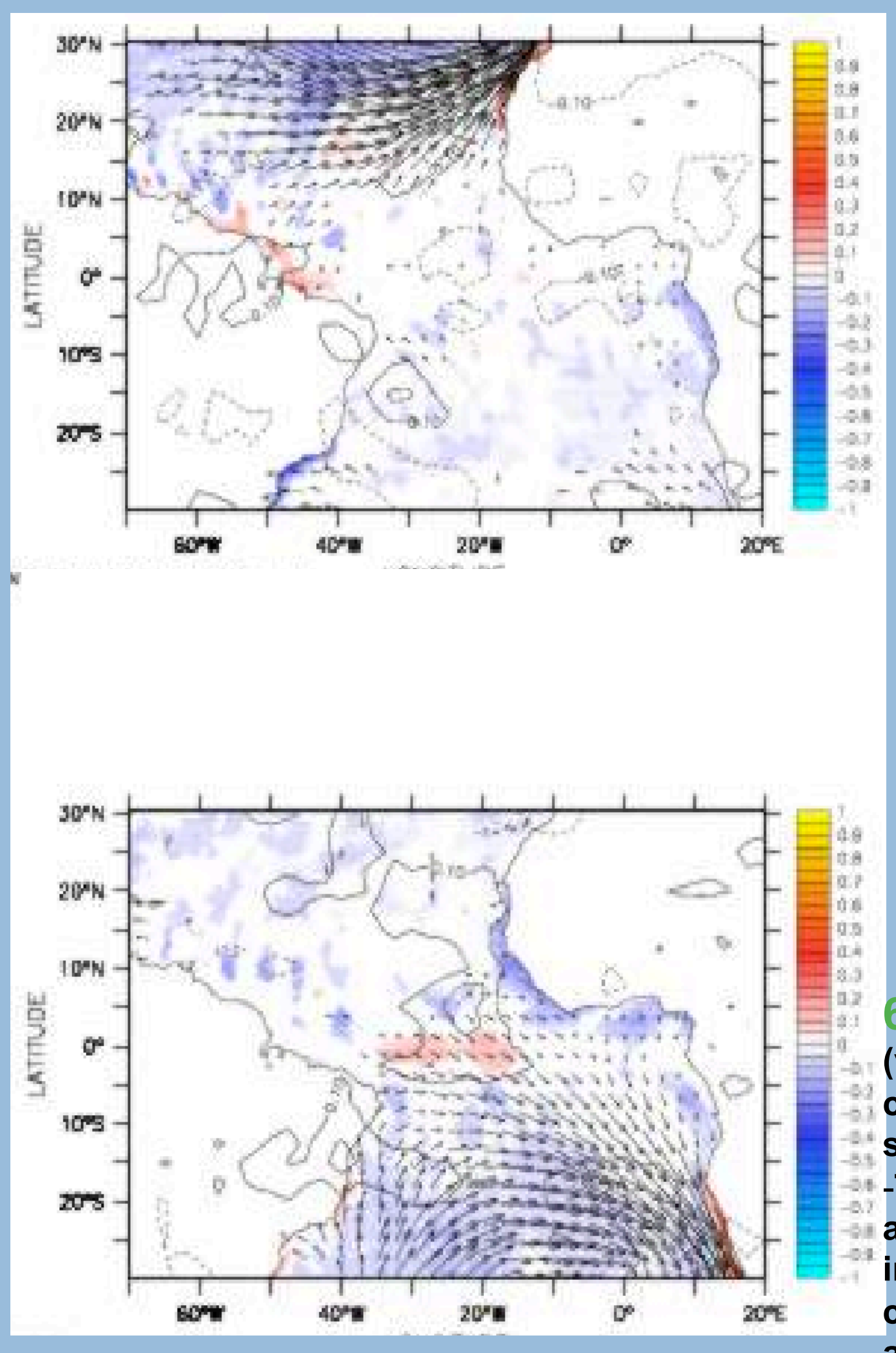


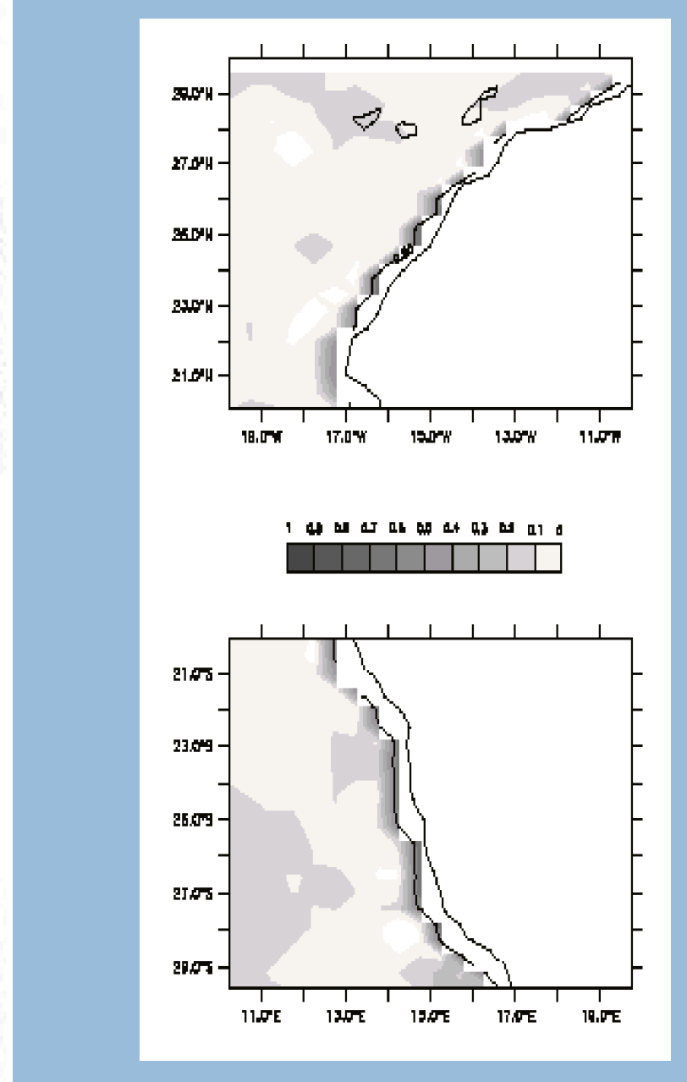


Wind stress anomalies (vectors, 10^{-2} N/m^2), Ekman pumping anomalies (shaded areas, 10^{-6} N/m^3 positive upward), OLR anomalies (contour lines, CI=5 W/m^2, the zero line has been removed) :7 December (27 December), the beginning of the downwelling (upwelling) Kelvin wave event.



6. <u>Dominance of the local wind control for lat> 12-15°N/S</u>





6. Linear regression (color) of the bpf wind field (vectors) and the bpf ssh onto the PC of the first EOF of coastal bpf ssh along the northern track (upper) and southern track (lower).
-The interruption and slope change of the propagations at 15°N/S seen in xt plots is explained by the strong intra-seasonal variability of the trade winds along the coast poleward of 15°N. There, the local winds prevail as evidenced by high correlations of Ekman pumping and ssh (right panel)
-The large scale and position of the regressed wind pattern indicates that this corresponds to oscillations of the subtropical highs at intra-seasonal scales.

CONCLUSIONS AND PERSPECTIVES

-Coastal T/Poseidon and Jason sea level intra-seasonal anomalies along the Western Africa, equatorward of 15° of latitude, were shown to be related to the western and central equator through first and second baroclinic mode Kelvin wave dynamics.

-The forcing of these equatorial Kelvin waves is complex, and the various hypotheses found in the litterature seem to all play a role. Zonal wind burst are dominant in the middle of the wave guide, whereas equatorial Rossby wave reflection (not shown) and off-equatorial wind burst trigger Kelvin waves at the Brazilian coast.

-Poleward of 15° of latitude, the variability of the subtropical highs generates a large local Ekman pumping which dominates the ssh to the expense of the remote forcing.

-We are currently investigating the effect of the intra-seasonal waves on the SST (A.C. Peter & A. Lazar) as well as their SST impact at interannual scale (I; Polo et al.).