Authors' response to Referee 2

Journal: Ocean Sciences

Title of paper: Impact of intraseasonal wind bursts on SST variability in the far eastern Tropical Atlantic Ocean during boreal spring 2005 and 2006. Focus on the mid-may 2005 event.

Authors: Herbert Gaëlle, Bourlès Bernard.

We thank Reviewer 2 for his comments and suggestions that allowed improvements of our paper. We have made all needed information to make the figures more understandable and conforming with general publications criteria (figures size, labels, etc). We also worked to make the manuscript easier to read and understand, by adding some information and removing others. The abstract has been also modified taking into account the reviewer's comments (the sentence about the NE Brazil has been removed and some words about the West African Monsoon have been added).

Response to specific Comments

1. RC: I wonder for many of the plots, especially when discussing the May 2005 event, if it would be better to plot the difference from the climatological mean (an anomaly). It might make the 2005 event stand out. As the figures are, it is difficult to tell that this event is different from some of the other events in the 1998-2005 range.

AC: Thanks for the suggestion. Indeed, plot the anomalies allow to better identify the particularity of the mid-May 2005 event. We have modified the figure 13, enlarged it and the 30-days low-filtered data averaged over 1998-2008 period has been removed to each total field except for the first panel where the SST is shown. In addition, black thick lines have been added to separate each year.

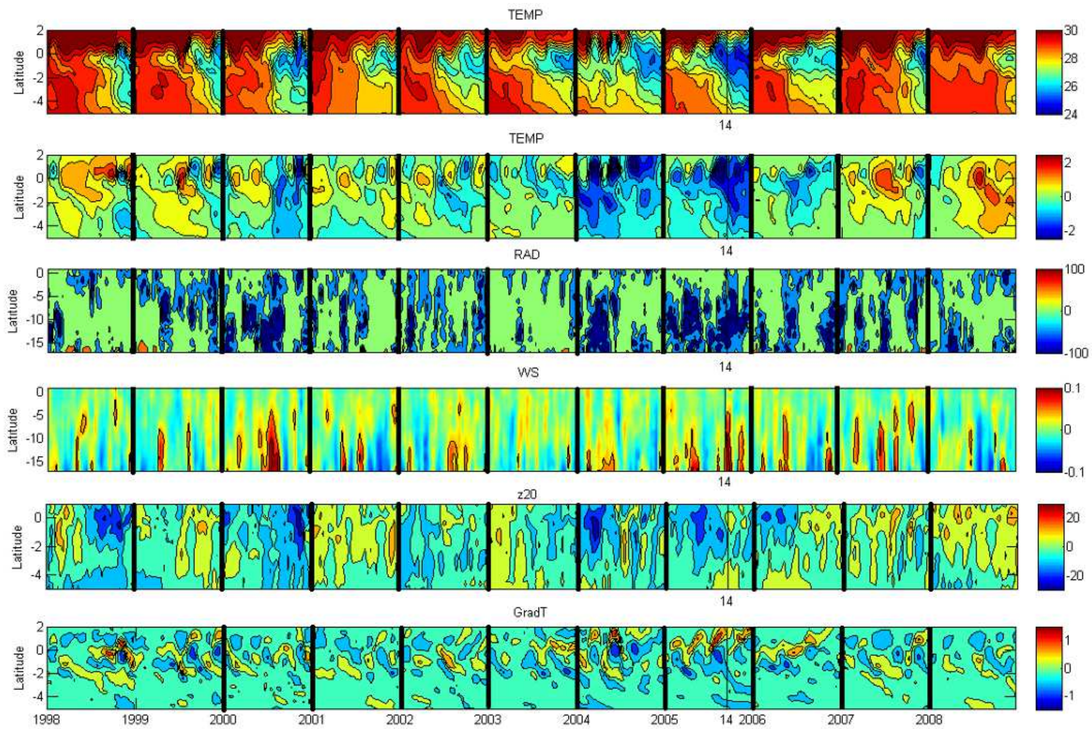

Figure 13: Time-latitude diagrams for April-May along the 1998-2008 period, of 2-days average, from top to bottom i) SST (°C); ii) intraseasonal variations anomalies of SST (°C); , iii) intraseasonal variations anomalies of wind stress magnitude ($N.m^{-2}$) from CFSR fields; iv) intraseasonal variations anomalies of short-wave radiation surface flux ($W.m^{-2}$) from CFSR fields; v) intraseasonal variations anomalies of 20°C-isotherm depth (m) computed from the forced model SST; vi) intraseasonal variations anomalies of meridional SST gradient (every 0.5° of latitude), from the forced model; averaged over 10° W-6° W. For all fields, except for the first SST field, the 30 days low-pass filtered annual field averaged over 1998-2008 period has been removed to the total field. The vertical black thin line indicates the date of 14 May, 2005.

Modifications have also been made on the plot of 20°C-isotherm depths : weaker values of 20°C-isotherm depths indicate shallower thermocline to be consistent with the modifications made on the Fig.1, Fig.3, Fig.5, Fig7 and Fig. 9.

2. RC: For all figures, it would be helpful to increase the fontsize for the x and y-axis labels. The figures are very difficult to read.

AC: Thanks for this suggestion. Modifications have been made.

3. RC: It is unclear in the different sections whether the region being discussed is the Cape Lopez region, the equatorial Gulf of Guinea, or the western part of the basin. One

confusing discussion revolves around the wind bursts. They are sometimes discussed in the Cape Lopez region associated with southerly winds and sometimes in the western basin as westerly wind bursts associated with Kelvin and Rossby waves. The text mostly just says "wind burst" so it's difficult to tell which is being referenced.

AC: Thanks for the remark. Indeed, in the first part of the paper we focused on the Cape-Lopez-region and then extend the analysis at more global scale when we focused on the mid-May wind event. For greater clarity, "wind bursts" has replaced by "southerly wind bursts" when they are discussed in the Cape-Lopez region and by "easterly wind bursts" when they are discussed in the western part of the basin.

4. RC: On line 13, you say "some particular events iii) a decrease of incoming surface shortwave radiation," but in fact, you only described one event this applied to (May 2005). This can be fixed by changing the word "some" to "one."

AC: Thanks for the remark. In fact, another event occurs in spring 2006 (on 2 April). Thus, we included the description of this event in the comments of Figure 4: "A strong net cooling (-30 $W.m^{-2}$) occurred during the 26-28 May 2005 event. It was mainly due to a sudden decrease of incoming surface short wave radiation (drop of about 80 $W.m^{-2}$ in the CLR between 22 and 28 May; not shown) suggesting increased cloud cover. Another strong net cooling occurred on 2 April 2006 with a mean value in the CLR reaching -95$W.m^2$. It is more sudden than the end-May 2005's one, and was almost exclusively restricted to the CLR region with values reaching locally -185$W.m^2$ (not shown). For both events, the net cooling does not concern the equatorial region west of 0°W."

Thus, the sentence in the abstract has not been changed.

5. RC: Many times in the paper, a season (spring, etc.) is discussed. Please indicate boreal or austral.

AC: "spring" has been replaced by "boreal spring".

6. RC: The paper discusses connections between the South Atlantic and the Cape Lopez region, specifically in relation to the St. Helena Anticyclone. A paper by Bates (J. Clim., 2008) discusses an anomalous low pressure originating in the South Atlantic that migrates northeast-ward, influencing the Southern Trade Winds and thus affecting SST in the Cape Lopez region (though she refers to it as coastal Angola). I don't know if

the feature you discuss and the feature she discusses are the same thing. Papers by Bohua Huang and others at the Center for Ocean Land Atmosphere Studies from the 2000s time range also discuss variability in the South Atlantic. You may want to reference these papers if they would add something to your discussion. That is up to the authors to decide.

AC: Thanks for this suggestion. Indeed, Bates et al. (2008) show that the patterns of variability in the coastal Angola region is related to fluctuations in the southeast trade winds trough two mechanisms: i) Bjerknes mechanism and ii) variability in subtropical high in South Atlantic. The phenomenon which is at work during May 2005 event related to anomalous strong St Helena Anticyclone, may correspond to the inverse feature that they describe (anomalous low pressure originating in the South Atlantic that migrates northeast-ward, affecting the SST in coastal Angola region with a peaking SST anomalies by approximately 4 months), but at smaller time scale. We have referenced this paper in the discussion.

7. RC: Because you discuss the NE coast of Brazil and the West African Monsoon, it would be nice to have them documented in the seasonal variability section to show how they fit into the normal seasonal cycle.

AC: Thanks for the suggestion. However, the NE coast of Brazil is only mentioned in Section 5.1.2 when we describe the anomalous precipitation pattern associated with the mid-May event (early SICZ development linked to the anomalous early development of the equatorial cold tongue). We have thus noted that "This convective zone, located between the ITCZ north of the equator and the South Atlantic Convergence Zone (SACZ) in southern tropics, is the Southern Intertropical Convergence Zone (SICZ) (Grodsky and Carton, 2003). This zone forms usually later, by June-August, when the southern branch of the convection separated from the ITCZ which moves north of the equator."

Thus, it appears to us not necessary to add other information about seasonal variability in this area. More detailed information about 'normal' precipitation conditions in this area can be found in Grodsky and Carton (2003).

About the West African Monsoon, the important point for 2005 is the particularly early onset date, as reported by several authors (such as Caniaux et al. (2011)) associated with the particularly early development of the equatorial cold tongue. The role of the mid-May event in this phenomenon is explained in Section 5.2. We think that it is not necessary to describe more in details the seasonal variations of the West African Monsoon. If the reader needs to have more information about the coastal onset phase of the monsoon in the Gulf of Guinea, he can refer to Leduc-Leballeur et al. (2013), as cited in the text (section 5.2). However, we added these sentences as introduction of the section 5.2:

“The mid-May 2005 wind event was found to be involved in the early onset of the ACT development (Marin et al. 2009, Caniaux et al., 2011). The influence of the cold tongue on the WAM onset has been suggested by several authors (Okumura and Xie, 2004; Caniaux et al., 2011; Nguyen et al., 2011; Thorncroft et al., 2011). At the seasonal time-scale, Caniaux et al. (2011) suggest that it comes from strong interactions between the SST cooling and wind pattern in the eastern equatorial Atlantic: the ACT serves to accelerate (decelerate) winds in the northern (southern) hemisphere contributing to the northward migration of humidify and convection, and pushes precipitation to the continent. Thus, due to its impact on ACT developpement, the mid-May wind event is also linked to the onset of the WAM in 2005 which has been the earliest over 1982-2007 period from Caniaux et al. (2011). In this section we aim to better understand how this single wind event may have such impact. For further information on the WAM, the reader can refer to Leduc-Leballeur et al. (2013) and Caniaux et al. (2011).”

8. RC: When discussing the thermocline, do you mean shoaling instead of thinning and deepening instead of thickening? You also mention on line 202 that it is at a minimum, I believe you mean “minimum depth.”

AC: Thanks for pointing this. Indeed, when we say “thinning” we mean “shoaling” and when we say “thickening” we mean “deepening”. “minimum” is indeed used for “minimum depth”. The related sentence on line 202 has been modified as follows:

“The region is also characterized by a shallow thermocline which depicts a strong semi-annual cycle (Fig. 1d). The evolution of z20 reveals a shoaling of the thermocline during May-July and a deepening up to October-November when it exhibits a minimum depth. “

9. RC: Figure 1 has no scale for the wind speed.

AC: In fact, the colorbar at the right of the May-June averaged map indicates the scale for the wind stress magnitude.

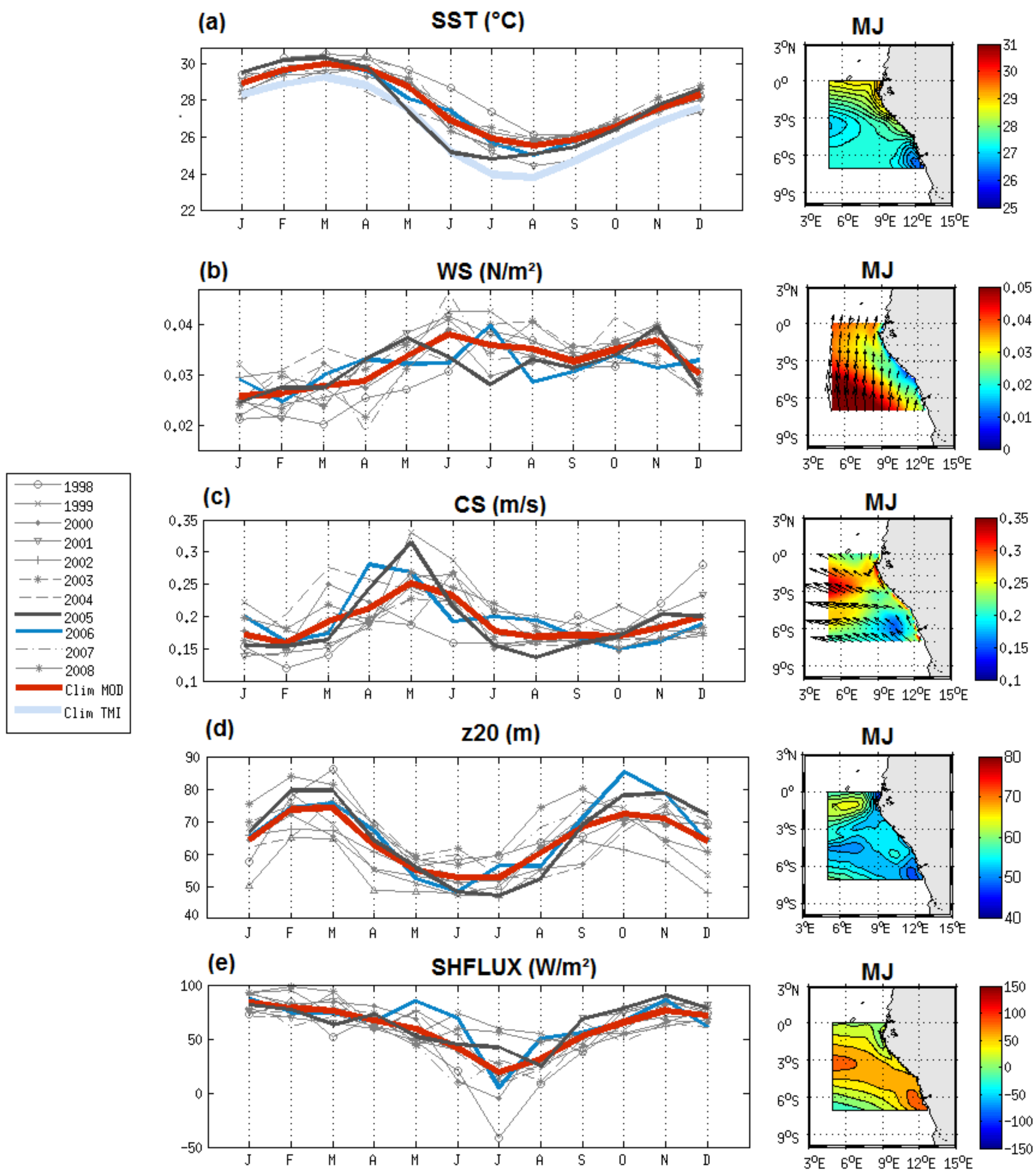

Figure 1: Monthly average of the (a) sea surface temperature (°C); (b) wind stress direction (vectors) and magnitude (color field) ($N.m^{-2}$); (c) horizontal surface current direction (vectors) and speed (color field) ($m.s^{-1}$); (d) 20° C-isotherm depth (m); and (e) surface heat flux ($W.m^{-2}$; positive values indicate downward flux) from January to December from 1998 to 2008 and for the climatology (averaged over 1998-2008) simulated by the model (red curve) and from the observations : monthly average TMI 3-daily SST data (light blue curve in (a)); averaged over 5° E-14° E and 7° S-0° S. Right panel: maps of each variable over May-June.

In addition, modifications have been made on Fig. 1:

- weaker values of 20°C-isotherm depth indicate shallower thermocline to be consistent with the modifications made on Fig.3, Fig.5, Fig.7, Fig. 9, and Fig. 13.

- May-June averaged maps have been enlarged to better locate the CLR.

10. RC: I don't think your discussion of Figure 1d on lines 203-205 reflect what is seen in the plot.

AC: Do you mean "Figure 1e" rather than Figure 1d ? Because the Figure 1d is discussed on lines 200-202 and not on lines 203-205. For the discussion of Figure 1e, the text has been modified as indicated in our response to the question 8.

11. RC: When you discuss the surface heat flux, please designate whether it is positive downward (into the ocean) or upward (out of the ocean).

AC: The sentence "positive values indicate downward flux" has been added in the legend of Fig.1.

12. RC: The individual events mentioned on line 232 are difficult to see. Maybe only plot April-July or change the y-axis.

AC: Thanks for the suggestion. The figures 3 and 4 have been modified in this sense (plot over March-August only). In addition, the intraseasonal variations (removing of the 30 days low-pass filtered field to the total field) of SST/wind stress magnitude/vertical current shear/Ekman pumping are shown on Figure 4 in order to better highlight the intraseasonal events. Modifications have also been made on the plot of 20°C-isotherm depth: weaker values indicate shallower thermocline to be consistent with the modifications made on Fig.1, Fig.5, Fig.7, Fig. 9, and Fig. 13.

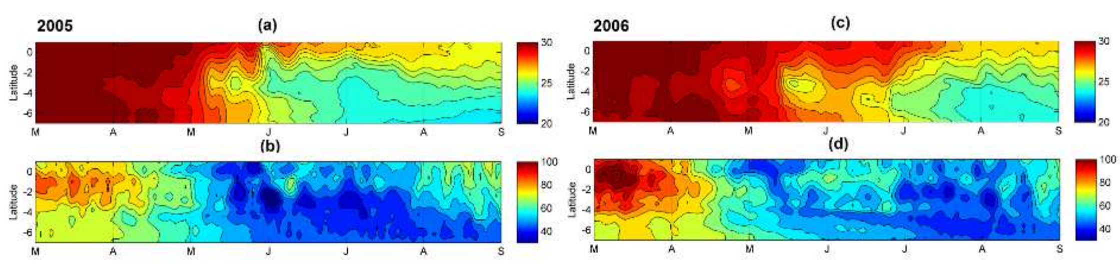

Figure 3: (a & c) Latitude-time diagram of the sea surface temperature (°C) averaged between 5°E and 12°E; (b & d) Latitude-time diagram of the 20° C-isotherm depth (m) averaged between 5° E and 12° E; from 1st March to 31 August 2005 (left panels) and 2006 (right panels).

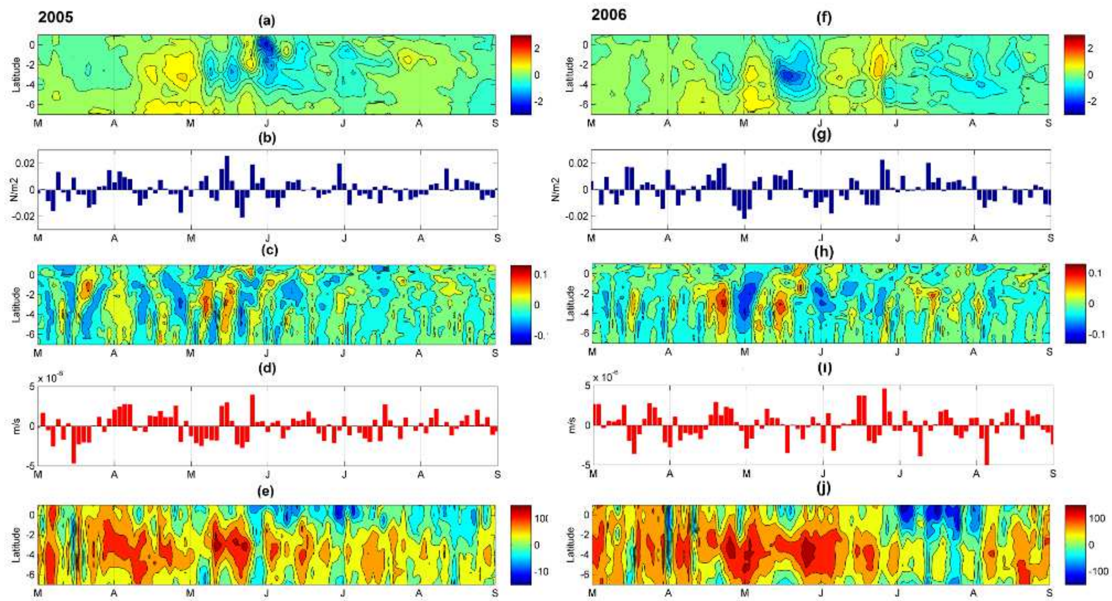

Figure 4: (a & f) Time-latitude diagram, from 7° S to 1° N, of the intraseasonal variations of sea surface temperature (in ° C) averaged between 5° E and 12° E; (b & g) Time evolution of the intraseasonal variations of wind stress amplitude ($N.m^{-2}$) averaged between 5° E and 12° E and between 3° S and 0° S; (c & h) Latitude-time diagram of the intraseasonal variations of the maximum of the current vertical shear magnitude ($m.s^{-1}$) averaged between 5° E and 12°E; (d & i) Longitude-time diagram of the intraseasonal variations of Ekman Pumping ($m.s^{-1}$) averaged over the CLR. Ekman pumping values >0 indicate upwelling; (e & j) Latitude-time diagram of the net heat flux ($W.m^{-2}$) averaged between 5° E and 12° E; from 1st March to 31 August 2005 (left panels) and 2006 (right panels).

13. RC: Lines 275-276: Is the reader supposed to be comparing Fig. 3b with 3d to see the correlation between wind stress and Ekman pumping? If so, it is not clear that this relationship is seen. Also, I don't know how we can see 8degE in this figure. If this correlation is not shown, please say so and let us know what the correlation coefficient is.

AC: The Figures 3 and 4 have been modified. We removed the low-pass filtering (cutoff frequency of 30 days) to the total field. The filtered Ekman pumping velocities have been averaged over the area. Thus, the correlation with wind stress is more clearly visible (see the new Figure 3 and 4 in response to the previous question). The text has been modified.

14. RC: It might be more telling to try to show the SST/heat content changes in the eastern Atlantic due to each of the processes (upwelling, or even split that into wind

stress and vertical mixing, and surface heat fluxes). I'm not sure the best way to suggest this, but perhaps regressions would be suitable. This way, it might be more clear that the May 2005 event was an outlier in terms of short wave cloud radiation.

AC: Thanks for the suggestion. Showing the heat content changes in the eastern Atlantic due to each of the processes would be indeed interesting. However, we consider that showing the Ekman pumping, vertical current shear, and surface heat flux bring the relevant information needed to explain the main processes at play. However, in order to better highlight the particularity of each wind event, we have modified the figure, zoomed from 1st March to 31 August 2005 and 2006 and shown the intraseasonal variations for SST, wind, Ekman pumping, and vertical current shear. The net surface heat flux have been not filtered in order to highlight the events characterized by negative heat flux, such as the end-May 2005 event and the beginning of April 2006 event.

15. RC: Lines 330-332: I do not see the difference between 2005 and 2006 from Fig. 8. It appears that both Kelvin waves reach the east around the same time and originate in the west around the same time. Figure 6 is also unclear. For 2006, I see many episodes of negative SSH (Feb., Mar., May, June), so why are you only picking the one that occurred in Mar-Apr? I do see a negative value in the east starting a tad earlier in 2006, but not by much. I also see a larger anomaly in 2006 in the east in July-Aug. Why is this not discussed…why only the Mar-Apr event? Is it because you are only focused on the boreal spring event?

AC: Do you mean « Fig. 5 » instead of "Fig. 8" ?

On Fig.5 and 6, discussed on lines 330-332, the Kelvin waves in 2005 and 2006 are delayed by about 15 days. Even weak, such a 15 days difference contributes to make the thermocline shallower when the mid-May wind burst occurs in 2005. However, it is true that the difference is not so easy to observe from Figure 5 & 6. Therefore, for more clarity, the sentence on line 330-332 has been modified as follows: "In 2005, negative (positive) SSH (z20) anomalies occurred in the West in early March-early April and in mid-May, whereas they occurred around late-February – mid-March and early May and June in 2006. The first Kelvin wave thus reached the CLR slightly earlier in 2006 than 2005, at the beginning of May." Moreover, the figures have been modified and we have plotted the anomalies only for the period March-August for better clarity. We focus on negative SSH occurred in Mar-Apr in the west because that is this event which induces a shallower thermocline in the east few weeks later, in April-May. Indeed, we focused on the boreal spring events in the east.

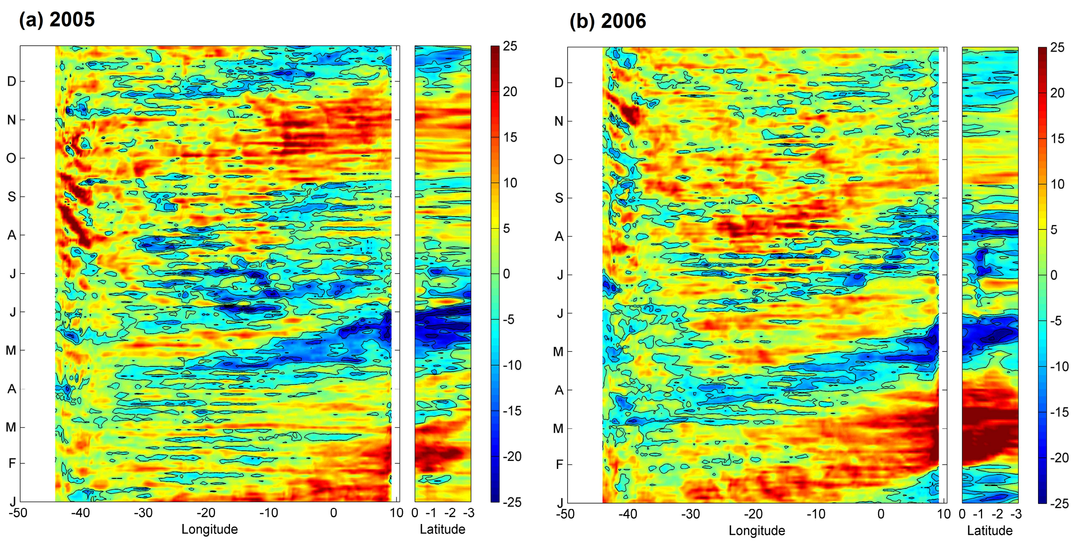

Figure 5: Time evolution of the intraseasonal variations anomalies of 20° C-isotherm depth (m) along the equator (between 54° W and 12° E) and along 9° E (between the equator and 3° S) for 2005 (left) and 2006 (right). Negative values indicate a 20°C isotherm depth closer to the surface.

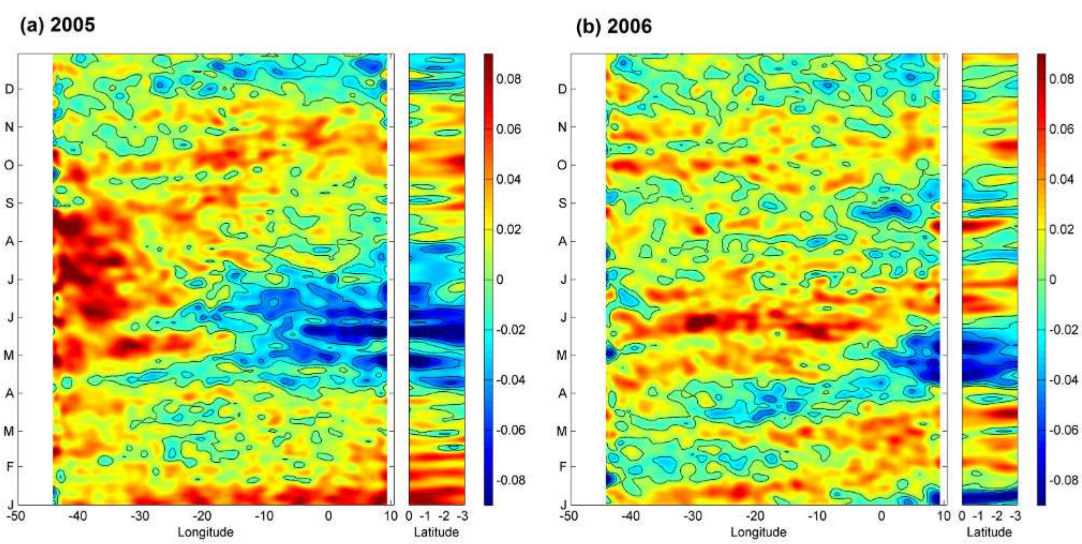

Figure 6: Time evolution of the sea level anomaly (m) along the equator (between 54° W and 12° E) and along 9° E (between the equator and 3° S) for 2005 (left), and 2006 (right) from AVISO data.

16. RC: The text on Fig. 7 is nearly impossible to read.

AC: Sorry for that. Modifications have been made on the figure 7 for more clarity.

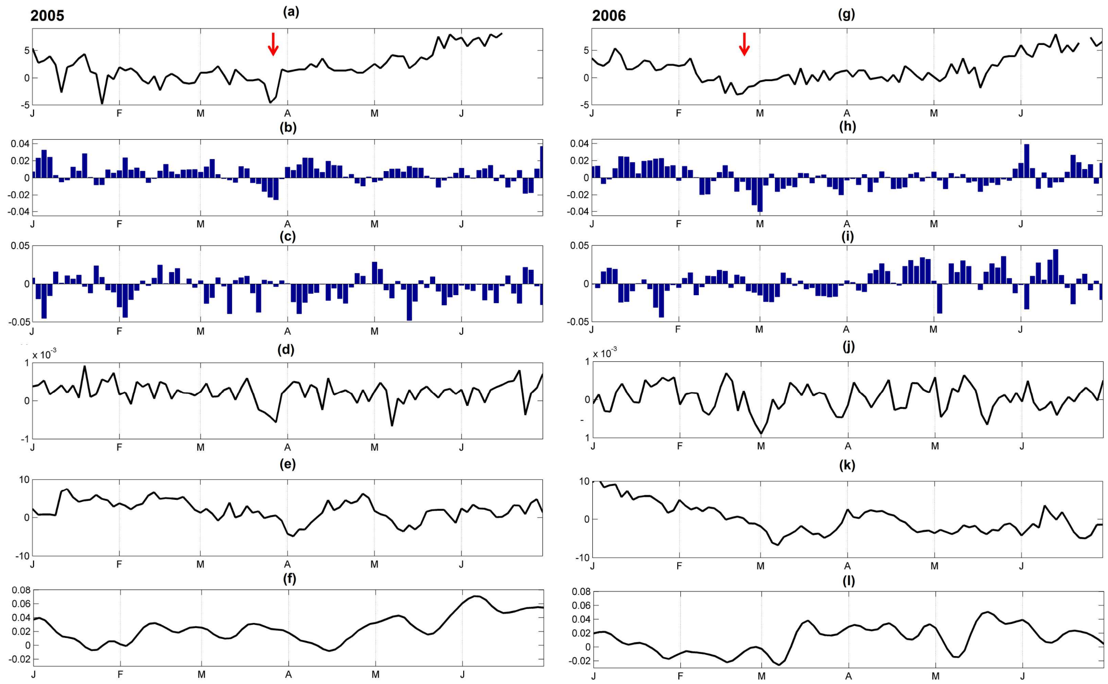

Figure 7: Time evolution, from 2-days averaged model outputs over Jan-June2005 (left) and Jan-June 2006 (right); of (a&g) the position (in latitude, between 5° S and 10° N) where the meridional wind stress value equal zero (indicator of the position of the ITCZ); (b&h) the meridional wind stress (N.m^{-2}) averaged between 50° W and 35° W and between 1° S and 1° N; (c&i) same as (b&h) but for zonal wind stress (N.m^{-2}); (d&j) the wind stress curl (N.m^{-2}) ; (e&k) the 20° C isotherm depth (m); (f&l) the sea level (m). The red arrow in (a&g) indicates the southward shift of the ITCZ before the excitation of the Kevin wave (see text). For each variable, the mean low-pass (> 1 month) filtered signal over 1998-2008 period has been removed to the total field.

17. RC: Lines 409-416: This discussion is about southerly wind bursts in the eastern basin, I assume along the coast, but in Fig. 8, I do not see many arrows in that region, so it is difficult to make this connection from the figure.
This paragraph also suggests a linkage between SST variability in the Cape Lopez region and the equatorial region. You might explain this a bit further by discussing the climatological behavior of this connection (like when it occurs and how it develops). I assume that this is not a feature specific to 2005. I believe that the Bates and Okumura et al. papers might refer to this connection too.

AC: The figure 8 has been modified for better visibility.

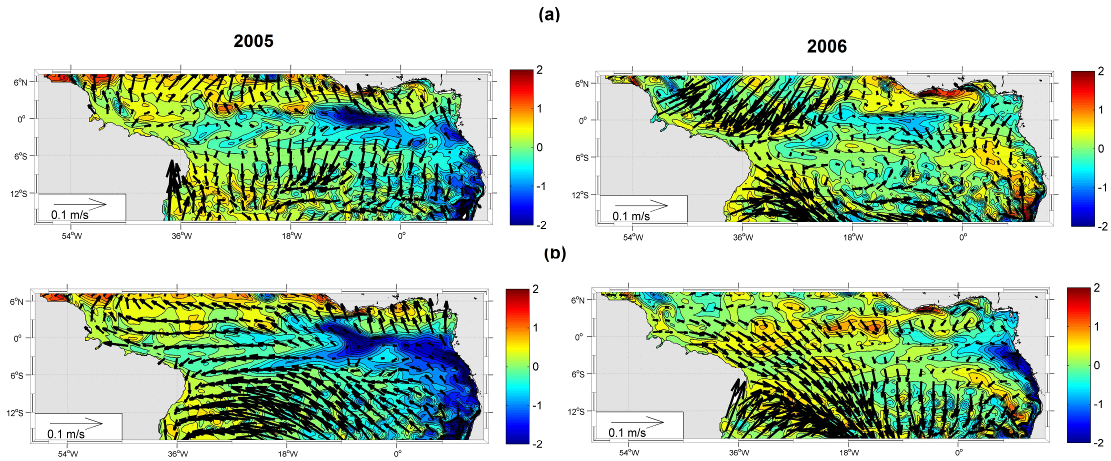

Figure 8: (a) Sea surface temperature (° C; color) superimposed with wind stress intensity (arrows) averaged over 1-12 May 2005 (up panel) and over 14-30May (down panel); (b) same but for 2006. The SST and wind stress fields are obtained after removing the 30 days low-pass filtered field averaged over 1998-2008 period to the total field.

Indeed, the connection between the Cape-Lopez region around 3°S and the southern edge of the equatorial cold tongue is not specific to 2005 and 2006. The westward extension of the cold SST takes place every year over 1998-2008 period (our period of study) but starts at different time. It occurs generally from June-July, when the cooling events usually occur in the east at this location, and is thus closely linked with the shoaling of the thermocline due to the arrival of the Kelvin upwelling wave at the coast. In 2005, the strongest cooling events induced by strong southerly winds occur earlier, in May, combined with anomalous shallower thermocline due to early arrival of Kelvin upwelling wave. The cooling in the CLR also reaches more coastal area due to anomalous strong wind events in the east part of the basin while it does not reach the coast at this location (3°S) in boreal spring for the most years over 1998-2008 period. In addition, the westward surface currents are usually maximum in boreal spring (as visible on the seasonal cycle shown on Fig.1) and extend over the most coastal area in the east during southerly wind events. They can thus even more contribute to the westward extension of cold coastal waters in May 2005.

In 2006, the westward extension of cold waters established from the beginning of July. Yet, coastal cooling occurred at the end of May but no westward extension of the cold waters is observed at this period. In 2005, the two upwelling Kelvin wave followed each other closely while in 2006, the first Kelvin upwelling wave reaches the coast in May and the second in July. In addition, the wind event responsible of the cooling at the end of May 2006 is rather isolated and less strong than the one in mid-May 2005 (which is preceded and followed by another wind bursts few days before and after). In order to clarify these points in the paper, we added a figure for the year 2006 and modified the comments in the text as follows:

"To better understand the oceanic processes implied in this cooling extension, we compared the z20, SLA and zonal velocities along 3° S from March to September 2005 (Fig. 9 b-d) and 2006 (Fig.9 e-h). In 2005, the cooling westward extension was associated with a westward propagation of a steeper thermocline and negative SLA from the African coast up to 5°-10° W combined with enhanced surface westward current fluctuations at the dates of the successive events from April-June. The fluctuations of the westward surface current occurring off Gabon with periods of ~8-10 days were related to the strengthening of southerly winds during the wind bursts at the same periods (Fig. 3b & 4b). The surface current in this area is part of the westward SEC which is known to intensify during the cold season (Okumura and Xie, 2006). Our study implies shorter time scales than seasonal scale but the intensification of the SEC during wind bursts through Ekman transport processes might contribute to the westward extension of the cooling by advection of cold eastern upwelled water. This is in agreement with DeCoëtlogon et al. (2010) who found from model results that at short time scale (a few days), more than half of the cold SST anomaly around the equatorial cooling could be explained by horizontal oceanic advection controlled by the wind with a lag of a few days. In addition, minimum z20 and SLA values propagating westward at 3° S (Fig. 9), initiated from the coast with a propagating speed of around 10 $cm.s^{-1}$, which is very close to the phase speed of Rossby waves. Indeed, the generation of the westward waves at the coast coincided with the arrival of Kelvin waves (see Fig. 5) suggesting the possibility of Kelvin wave's reflection processes into symmetrical westward propagating Rossby waves. A westward propagation of z20 and SLA, although less obvious, was presently also identified at 3° N (not shown).

In 2005, the locally wind-forced component of the wave might reinforce the remote part of the reflected wave signal at the coast by the sea level slope which balanced the strengthening of alongshore winds blowing during the mid-May and late-May events. The quantitative and respective contributions of local and remote wind forcing to this wave is out of the scope of this study and would require further analysis. This phenomenon is supported in 2005 by anomalous eastward expanded southerly wind bursts observed in May 2005. The month of May is besides a period when westward surface currents are usually maximum (as visible on the mean seasonal cycle shown on Fig.1c). Thus, the combined effects of westward surface currents (via advection and vertical mixing through horizontal current vertical shear), local wind influences (via vertical mixing) and wave westward propagation, resulted in the extension of cold upwelled water from the eastern coast to near 20° W.

In 2006, the westward extension of cold waters established later, from the beginning of July. A coastal cooling occurred on 18-26 May but no westward extension of the cold waters is observed at this period (Fig. 9e). In 2005, the two upwelling Kelvin waves followed each other closely while in 2006, the first Kelvin upwelling wave reached the coast in May and the second in July (Fig.5&6 and Fig.9f). In addition, the wind strengthening responsible of the coastal cooling on 18-26 May 2006 is less intense (wind stress mean in CLR ~0.04$N.m^2$) than the one in mid-May 2005 (~0.06$N.m^2$; which is preceded and followed by another wind bursts few days before and after; Fig. 3b&4b).

The analysis over 1998-2008 period shows that the westward extension of the cold SST takes place every year but begins at different times of the year (not shown). It occurs generally from June-July, when the cooling events usually occur in the east at this location, and is thus closely linked with the shoaling of the thermocline due to the arrival of a Kelvin upwelling wave at the eastern coast."

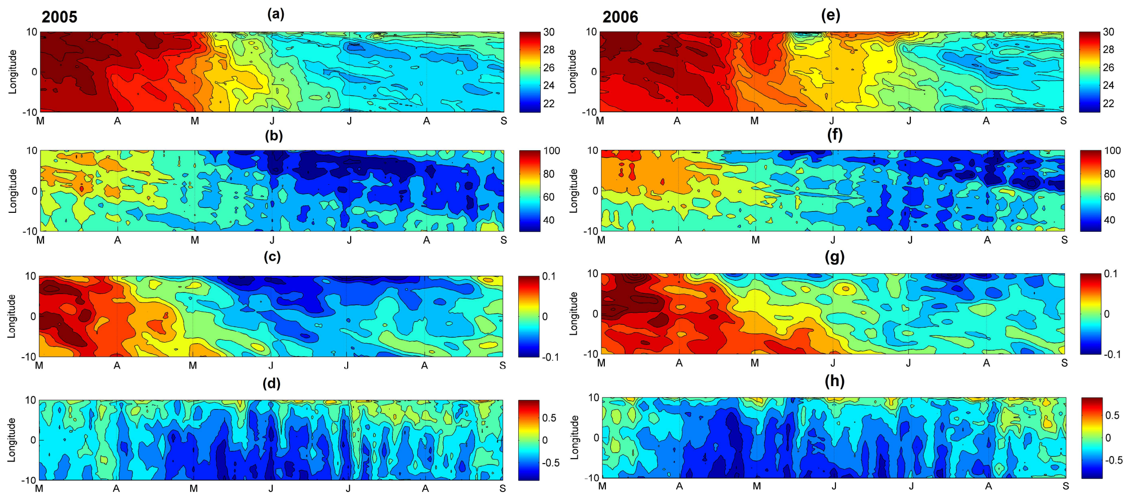

Figure 9: Time-longitude diagrams at 3° S between 10° W and 10° E, and from 2-days averaged model outputs from 1st March to 31 August 2005 and 2006, of (a & e) the sea surface temperature (° C); (b & f) the 20° C isotherm-depth (m); (c & g) the sea level anomalies from AVISO data (m); and (d & h) the zonal component of surface velocity (m.s^{-1}).

18. RC: Figure 10 is impossible to read, and the features difficult to pick out, especially for the top row and bottom two rows. It would be helpful to mask out the land in all panels and make each panel larger. The text describes a precipitation pattern consistent with a wave train, but I cannot see it because the plot is too small and the arrows seem to be covering the precip pattern.

AC: The figure 10 has been modified. The precipitation and wind patterns have been separated and the plots enlarged.

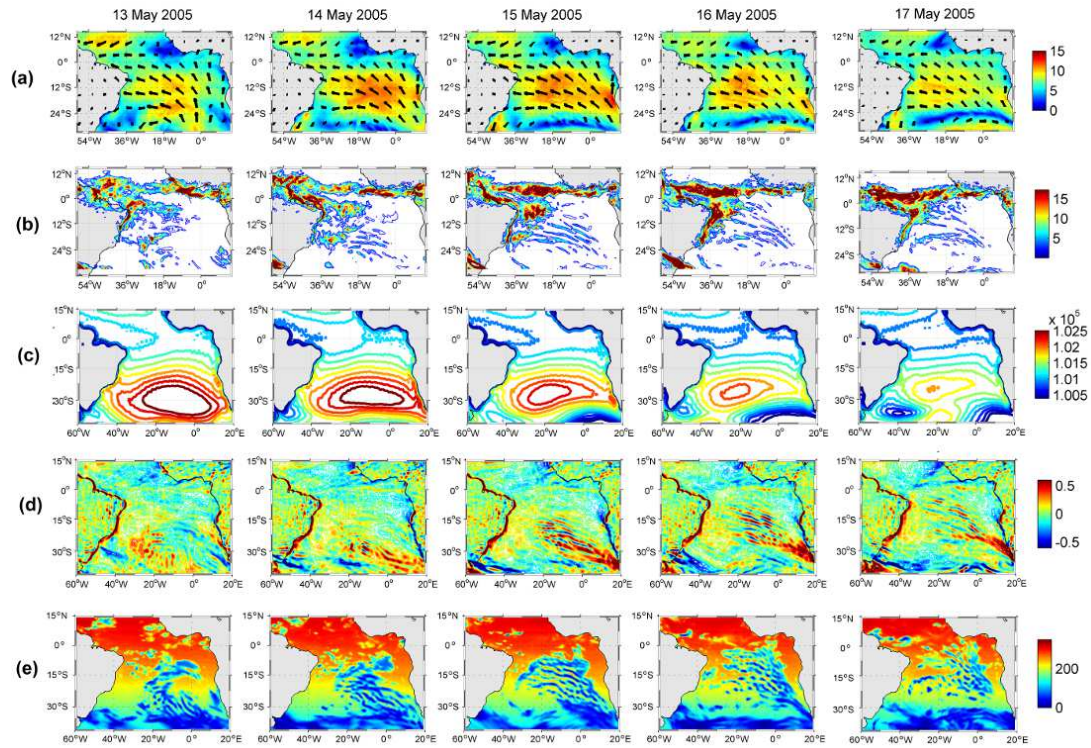

Figure 10: Daily-averaged, from 13 May to 17 May 2005 (left to right panels), of (a) wind magnitude (color field) ($m.s^{-1}$) superimposed with wind vectors from CFSR fields; (b) precipitation rate ($kg.m^{-2}/day)^{-1}$) from CFSR fields; (b) surface pressure (hPa) from ERA-20C reanalysis; (c) wind speed curl ($m.s^{-1}$) computed from CFSR wind speed fields; and (d) downward short-wave radiation ($W.m^{-2}$) from CFSR fields.

19. RC: Figure 11: It doesn't seem that you have referred to this figure in the text, though I believe the discussion is on page 21. I do not see what the authors describe in the figure. Perhaps you could be more specific as to the pattern the reader should notice in the plots.

AC: We decided to remove the figure 11. The text has thus been modified as follows:

"The precipitation fields during the mid-May event (Fig. 10a) also evidence rainfall pattern typical of atmospheric gravity wave train characterized by a horizontal wave length ~500 km and initiated by a front system (forming the northern boundary of a low pressure system) which developed around 17° S on 14 May and traveled northeastward until 17 May. The rainfall train was associated with oscillatory wind stress curl train alternating between positive and negative anomalies (Fig. 10c) as well as alternating downward shortwave radiation minimum (Fig. 10d) associated with the wave clouds. Gravity waves are known to play an important role in transporting the momentum and energy through long distances (Fritts, 1984). Here, they would be a way to carry momentum and energy from South Atlantic to the equator during the strong event."

20. RC: Figure 13: It is very difficult to decipher anything from these plots because they are so small and the contour lines are so close together. It is impossible to tell if an event is stronger or not than others. The text says that the 2005 event "appears to be" one of the strongest over the period, but I cannot tell that from this plot. The authors could confirm this by giving the reader a value of wind stress from this period and state that it is confirmed that this is the strongest.

AC: The figure 13 has been modified for more clarity: vertical black lines have been added to separate the years and the value of wind stress anomaly during the 2005 event has been added in the text (up to 0.13N.m² around 15°S and 0.05N.m² in equatorial region). In addition, we decided to show the fields after removing the 30 days-low pass filtered field averaged over 1998-2008 period, except for the first panel which shows the SST total field.

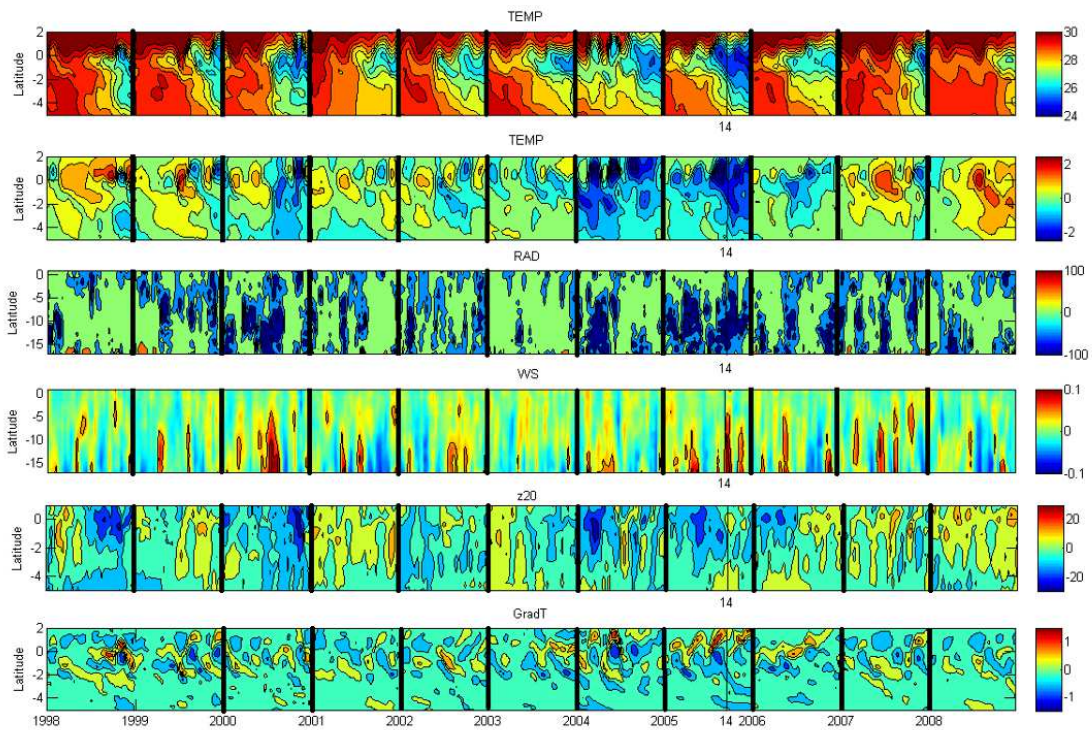

Figure 13: Time-latitude diagrams for April-May along the 1998-2008 period, of 2-days average, from top to bottom i) SST (°C); ii) intraseasonal variations anomalies of SST (°C); , iii) intraseasonal variations anomalies of wind stress magnitude ($N.m^{-2}$) from CFSR fields; iv) intraseasonal variations anomalies of short-wave radiation surface flux ($W.m^{-2}$) from CFSR fields; v) intraseasonal variations anomalies of 20°C-isotherm depth (m) computed from the forced model SST; vi) intraseasonal variations anomalies of meridional SST gradient

(every 0.5° of latitude), from the forced model; averaged over 10° W-6° W. For all fields, except for the first SST field, the 30 days low-pass filtered annual field averaged over 1998-2008 period has been removed to the total field. The vertical black thin line indicates the date of 14 May, 2005.

Modifications have also been made on the plot of 20°C-isotherm depths : weaker values of 20°C-isotherm depths indicate shallower thermocline to be consistent with the modifications made on the Fig.1, Fig.3, Fig.5, Fig. 9, and Fig. 7.

21. RC: Lines 575-577: Is the statement about winds north of the equator relevant to this study? If so, how is this piece of information important?

AC: The wind-strengthening events north of the Equator during boreal spring in the Gulf of Guinea is implied in the rainfall coastal onset and is linked to the intraseasonal southerly wind burst. Indeed, from Leduc Leballeur et al. (2013), the enhancement and maintenance of southerly winds north of the equator in the Gulf of Guinea is linked to a coincident installation of a deep circulation and a northward shift of the low atmospheric local circulation. This wind strengthening on the northern side of the Equator contributes to the northward migration of humidity and convection, and pushes precipitation to the continent. It is an indication of the “rainfall coastal onset” of the monsoon.

In section 4.2, we show that as of date of the mid-May 2005 event, the wind north of the equator becomes and remains strong indicating that the mid-May 2005 event is the trigger event of the rainfall coastal onset. The strengthening of winds north of the equator is due to the meridional SST gradient created at the equator during the event. The figure 13 shows that the meridional SST gradient during May 2005 is indeed anomalous strong compared to April-May usual conditions. That what we noted by the sentence on line 575-477:

“This meridional SST gradient was responsible for the wind surface intensification north of the equator (Fig. 12 and 13a) through air-sea interaction mechanisms as described by Leduc-Leballeur et al. (2011).”

22. RC: Lines 585-593: Is this relevant to the monsoon discussion? Does the deep convection in the Gulf of Guinea lead to rain and a surface cooling? Is that the impact we should take from this paragraph?

AC: The wind strengthening results in equatorial surface cooling, which in turns intensifies the southerlies north of the Equator through air-sea interaction. This increases convection in the northern Gulf of Guinea, accompanied with a northward shift of the precipitation.

Generally, in May the low atmospheric local circulation (LALC) appears briefly due to southeastern wind burst and collapses within a few days. The establishment of the LALC at a self-sustaining level appears usually at the end of May-beginning of June, triggered by a significantly stronger southeasterly wind burst. We show that in 2005, the mid-May event is this significantly stronger southeastern wind burst. It is especially particular because it appears 15 days before the averaged reference date computed by Leduc-Leballeur et al. (2011) over the 2000-2009 period.

The paragraph on lines 585-593 and the figure 14 have been deleted, and the anomalous high pressure in St Helena anticyclone region and the low pressures in Gulf of Guinea are now shown on figure 10, section 5.1.1. Moreover, we have modified the comments about the pressure gradient in section 5.3.

23. RC: Lines 599-602: This paragraph was particularly confusing as to where the wind stress and wind bursts mentioned were located.

AC: The wind burst mentioned lines 599-602 is the one evidenced on figure 13 during the year 2000, over 10°W-6°W region. The sentence on line 599-600 has been modified as follows: "Another southerly wind burst of comparable intensity occurred at the beginning of May 2000 (Fig. 13) while the thermocline was shallow, causing SST cooling at the equator (Fig. 13)."

24. RC: Lines 716-171: Why exactly does this region need more attention? Because of the effect on the African Monsoon? Please elaborate here to make your conclusion points better known.

AC: The South Atlantic region, and in particular the St. Helena Anticyclone variability, need more attention because of the impact of its fluctuations on the SST variability in the tropical Atlantic and in particular on the equatorial cold tongue development, as showed in the paper. The energy from South Atlantic is indeed carried toward lower latitudes by different ways : i) direct effect of the southerly winds in the east, ii) energy transport via atmospheric gravity waves, iii) excitation of Kelvin wave in the West by southeasterly winds.

In our paper, we show that intraseasonal wind bursts, related to St Helena Anticyclone fluctuations have an impact on SST variability in the CLR generating cold events in boreal spring/summer. Other studies, as the one realized by Marin et al. (2009) showed that they also impact the SST variability in the cold tongue region. In addition, the influence of the cold tongue on West African monsoon onset has been suggested by many authors (e.g. Okumura and Xie, 2004; Caniaux et al., 2011; Nguyen et al., 2011; Thorncroft et al., 2011). In 2005, we show that a particularly strong wind burst is responsible for a particularly early coastal monsoon onset. Thus, a better understanding of the variability of St. Helena Anticylone at intraseasonal time scales would allow to bring further information about these processes.

In addition to modifications listed above, many English/grammar corrections have been made in the text.