Response to the editor

Comments to the author:

Dear Dr Dimoune,

Reviewer#1 is satisfied with the revised version of your manuscript but reviewer#2 still has a number of remarks, that require your attention.

I agree with the reviewers that "current X" is not the right way to refer to a current in an oceanography paper. I would suggest that you consult with specialists of the region (Bernard Bourles and Peter Brandt are examples, but of course you may think of others) to find the best name to describe this current in your manuscript, a name that would seem acceptable to a wide community and be likely to be picked up in future publications.

I wish you a happy new year,

Anne Marie Treguier

Answer:

Happy new year 2023 to you too Dr. Anne Marie Treguier. Thank you for accepting to be the editor of our paper and for your evaluation of this work.

We agree with your suggestion regarding the name of current X. It is important for this current to be more easily discussed by the wide community of oceanographers. After consultations with colleagues, we have decided to use in the new revised manuscript the name Equatorial Surface Current (ESC as an acronym). This name has been adopted by considering the position of the current (the equatorial region), and the fact that it flows in the upper layer of the ocean.

Regarding the reviewer 2, we thank him for his comments and suggestions. We have tried again to respond and clarify some misunderstandings. We hope to have taken into account all the suggestions to improve the manuscript and make it publishable in Ocean Science.

Regards,

Dr. Minto Dimoune

Response to Reviewer 2

Re-Review of "Revisiting the tropical Atlantic western boundary circulation from a 25-year time series of satellite altimetry data" by Djoirka M. Dimoune, Florence Birol, Fabrice Hernandez, Fabien Léger, Moacyr Araujo [Paper # egusphere-2022-402]

Answer: First of all, we want to thank you again for your review and for your comments which were very useful to improve the manuscript. We wish you a happy new year.

The authors have generally corresponded well to most of my comments and suggestions. However, I still have a few concerns, which I think need to be addressed before considering this manuscript for publication.

Answer: We are glad that we were able to give you most of the appropriate responses to your first review. We hope to do the same with your remaining concerns and to provide now a revised version of the paper that is suitable for publication.

First of all, I agree with the other reviewer that the choice of naming a current "X" is rather bad. I agree that the manuscript is already full of acronyms but finding one more for the "new" current does not make the change in my opinion and it would be much better to refer to some sort of … eastward surface current later than to X.

Answer: Thank you for the comment. It has been considered, and after discussions with colleagues we finally adopted the name Eastward Surface Current which acronym is ESC in the new revised manuscript. We have also removed X in the figures and replaced it by ESC (Fig. 3, 4, 5, 6, 7 and 9).

Secondly, while I strongly appreciate that the authors looked for other data sets to validate this product in the equatorial region, I think a bit more work has to be done on the section plots for the ADCP sections as I think they are now shown as part of the Supplementary Material. To my knowledge there are no shipboard ADCPs (sADCPs) which have data at the surface. You write that the first depth varies between 0 and 17m and an sADCP can not have data at 0m. You definitely have some blank bin and then depending on the bin

size you have the first bin roughly I would say between 10-30m. In the plots you show you can also see that when the data is "at 0" it is just vertically pulled to 0m from somewhat like 17m like the others (you have these vertical lines in those plots). So, if your data set has identical values at 0m and 17m I would remove the 0m values as they give a wrong impression. What I also do not understand for your plots is that for the zonal component there is something odd with the colormap I think. How can you still have positive zonal velocities beyond the 0-contour line? For the meridional component it seems to work, but for the zonal plots something is strange.

And then you also have to take care in your formulation about the comparison as you can not really "compare" your velocities. You could maybe plot the surface velocities of your product on top of those sections and then you can "see" how well they fit. Whether an interpolation by eye from the ADCP data to your data seems sensible. I hope it gets clear what I am trying to say. What I envision I found e.g. in this paper:

Kopte, R., Brandt, P., Claus, M., Greatbatch, R. J., & Dengler, M. (2018). Role of Equatorial Basin-Mode Resonance for the Seasonal Variability of the Angola Current at 11°S, Journal of Physical Oceanography, 48(2), 261-281.

In their Fig. 1 geostrophic surface velocities from altimeter seem to be included in the plot of an ADCP. I think this would be a nice way of showing that these data sets somehow fit together.

Answer: Thank you for appreciating our efforts. As you write, there are no ADCP data in the first few meters below the surface because of the removal of the first bins, usually affected by noise. As you say, depending on the SADCP, its configuration and the parameters considered during the data processing, there is no data usually between 10-30 m-depth. It is what is represented on Fig. 2, 4, 5, 8, 9 and 10 of the supplement materials. Only in Fig. 3, 6 and 7 the currents were interpolated up to 0 m-depth but it was done before publishing the data and not by us (as mentioned in the manuscript you can find information about the data on the data center PANGEA website https://doi.pangaea.de/10.1594/PANGAEA.937809 following Tuchen et al, 2022). However, to be consistent with the other figures, and based on the product description we found, we have now hidden the first meters. The new figures are:

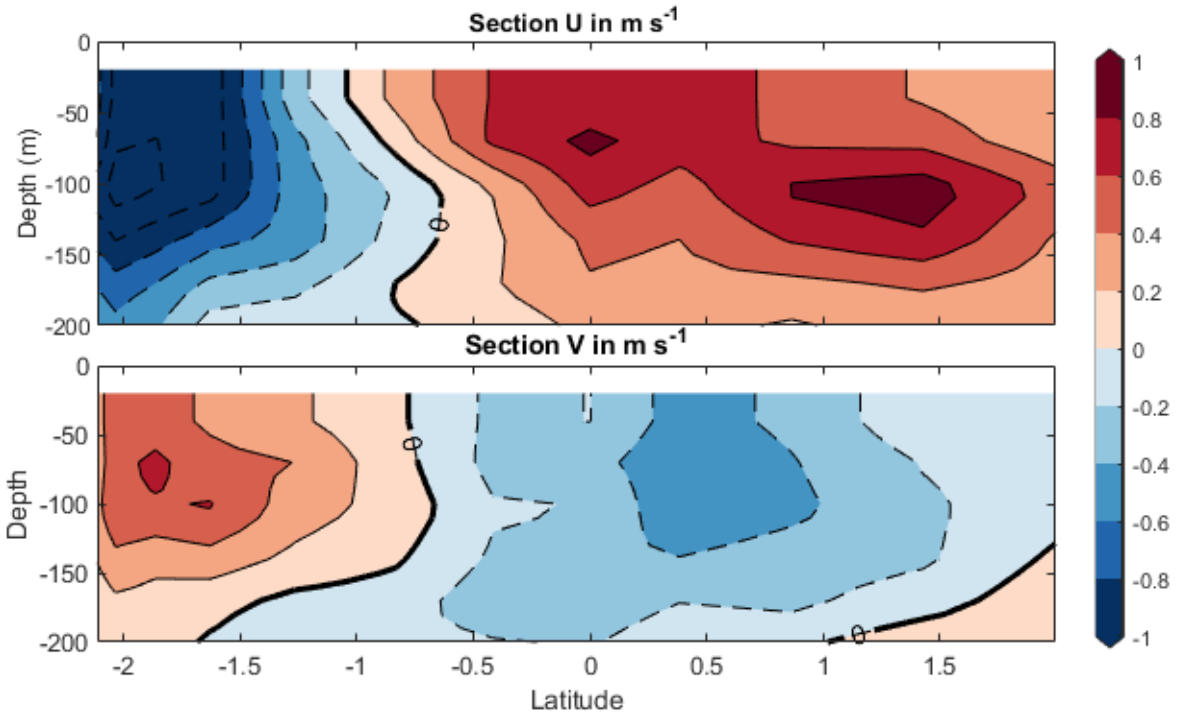


Figure 3: Shipboard ADCP section at 40°W between 2°S-2°N during 03/05/2003 to 05/05/2003 period. The dashed/solid contours represent the westward (northward)/eastward (southward) zonal (meridional) component of the current U (V). The contour intervals are each 0.2 m s^{-1} for both components.

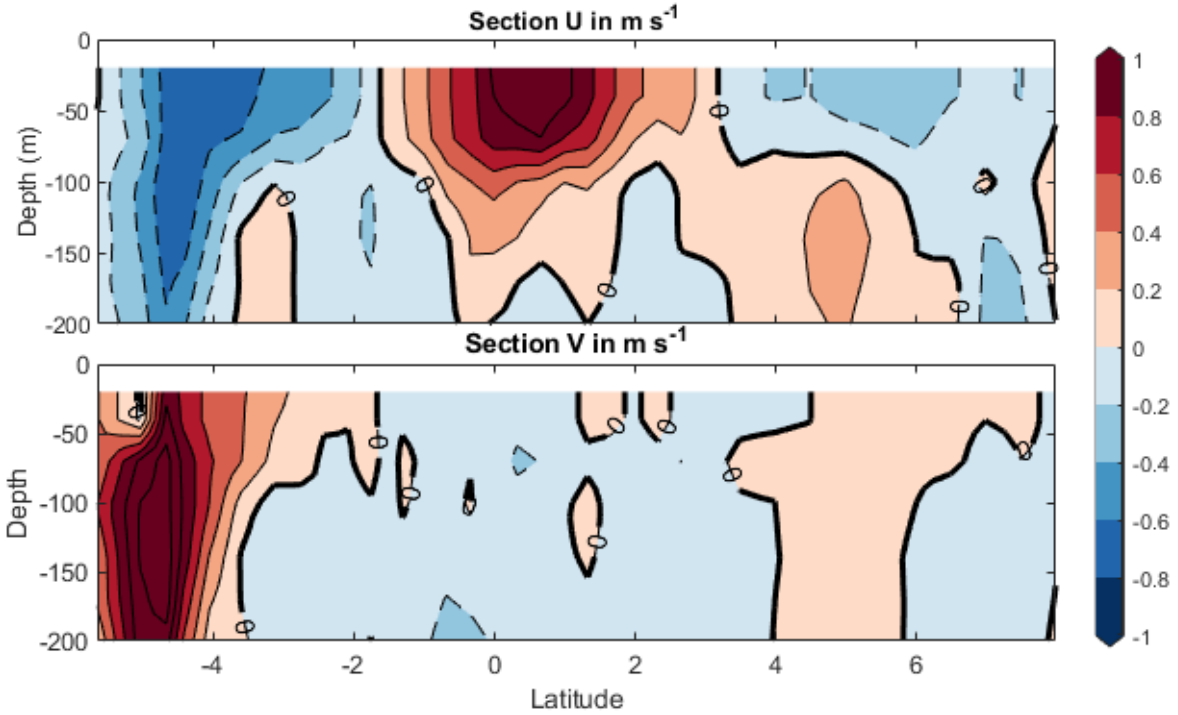


Figure 6: Shipboard ADCP section at 35°W between 6°S-8°N during 09/05/2002 to 16/05/2002 period. The dashed/solid contours represent the westward (northward)/eastward (southward) zonal (meridional) component of the current U (V). The contour intervals are each 0.2 m s^{-1} for both components.

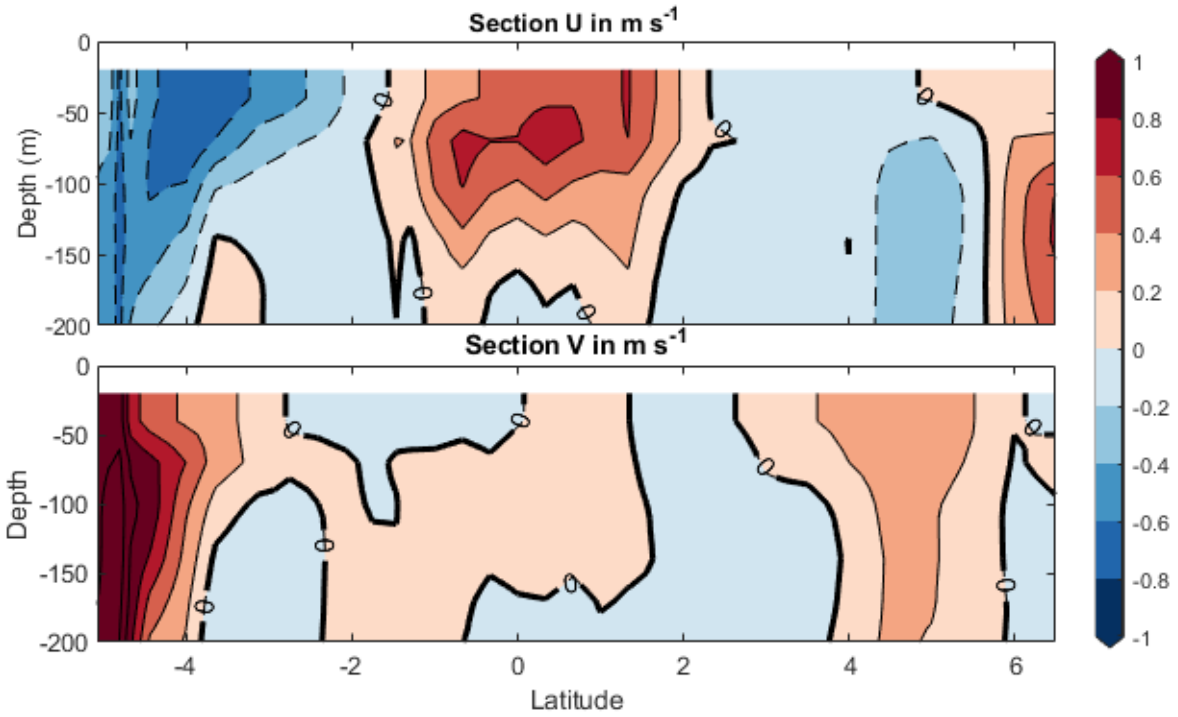


Figure 7: Shipboard ADCP section at 35°W between 5°S-3°N during 26/05/2003 to 01/06/2003 period. The dashed/solid contours represent the westward (northward)/eastward (southward) zonal (meridional) component of the current U (V). The contour intervals are each 0.2 m s^{-1} for both components.

Regarding the 0-17 m-depth mentioned about the values in the first meters, it was a mistake in our response. For all of these sections, the starting depth varies from 17-30 m-depth. This is what should have been written. Thank you for your remark.

Thank you also for the paper (Kopte et al., 2018) you recommended. Regarding Fig. 1 of the authors, it was made by using an ADCP moored at 10°50'S, 13°E. It produced continuous data from August 2013 to October 2016. So, it was possible for the authors to compare the corresponding data with geostrophic currents after specific filtering. In our case, we have individual Shipboard ADCP (SADCP), which measurements are instantaneous at a few dates (then not continuous) and follow given transects. So, the comparison with gridded geostrophic current (resulting from an OI analysis of satellite data which are non colocated in time and space) at these dates is not obvious. However, the SADCP data at different seasons can be used to highlight the presence of the ESC (Equatorial Surface Current). In the different sections, the structure of the currents in the first meters (10-30 m-depth) can give an idea of whether there is an eastward surface current or not. It is clear that a surface current can usually be differentiated from a thermocline layer currents or Undercurrent. So, this was our approach in the manuscript when we mentioned it in the discussion (section 6).

Concerning the zonal component of the SADCP sections, we agree that Fig. 2, 3, 4, 8 and 10 of the supplement materials could be improved and it is what we did. Here are the new figures:

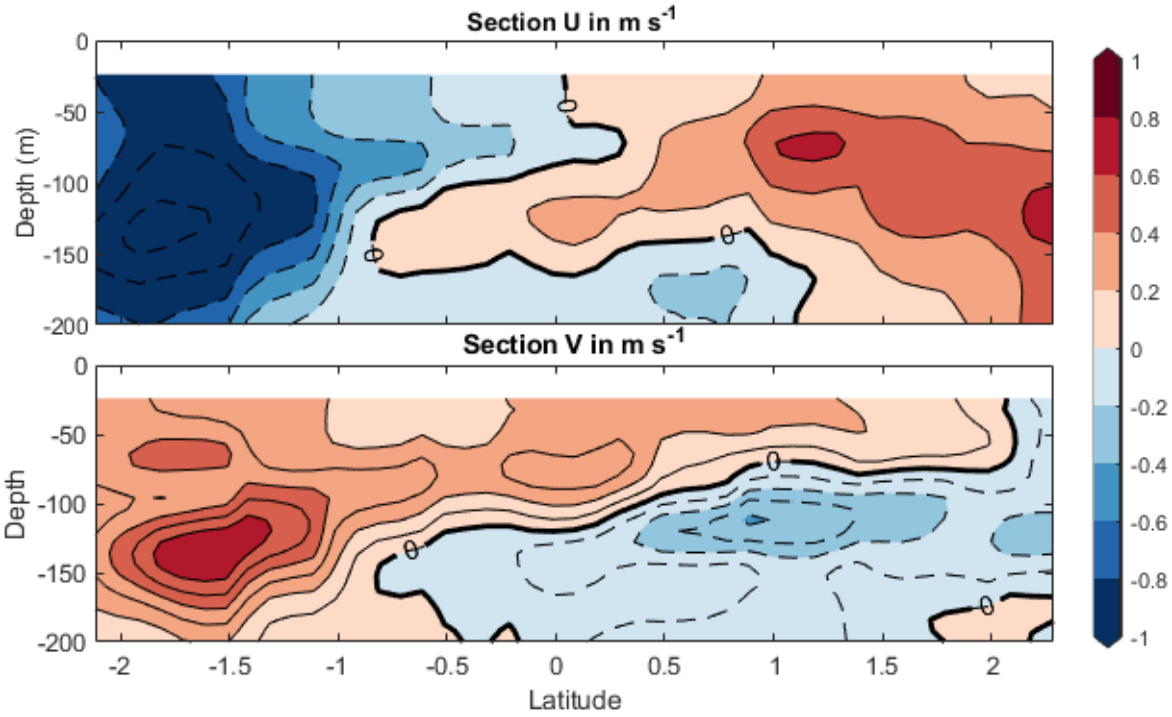


Figure 2: Shipboard ADCP section at 40°W between 2°S-2°N during 07/03/1994 to 10/03/1994 period. The dashed/solid contours represent the westward (northward)/eastward (southward) zonal (meridional) component of the current U (V). The contour intervals are each 0.2 m s^{-1} (0.1 m s^{-1}) for the zonal (meridional) components.

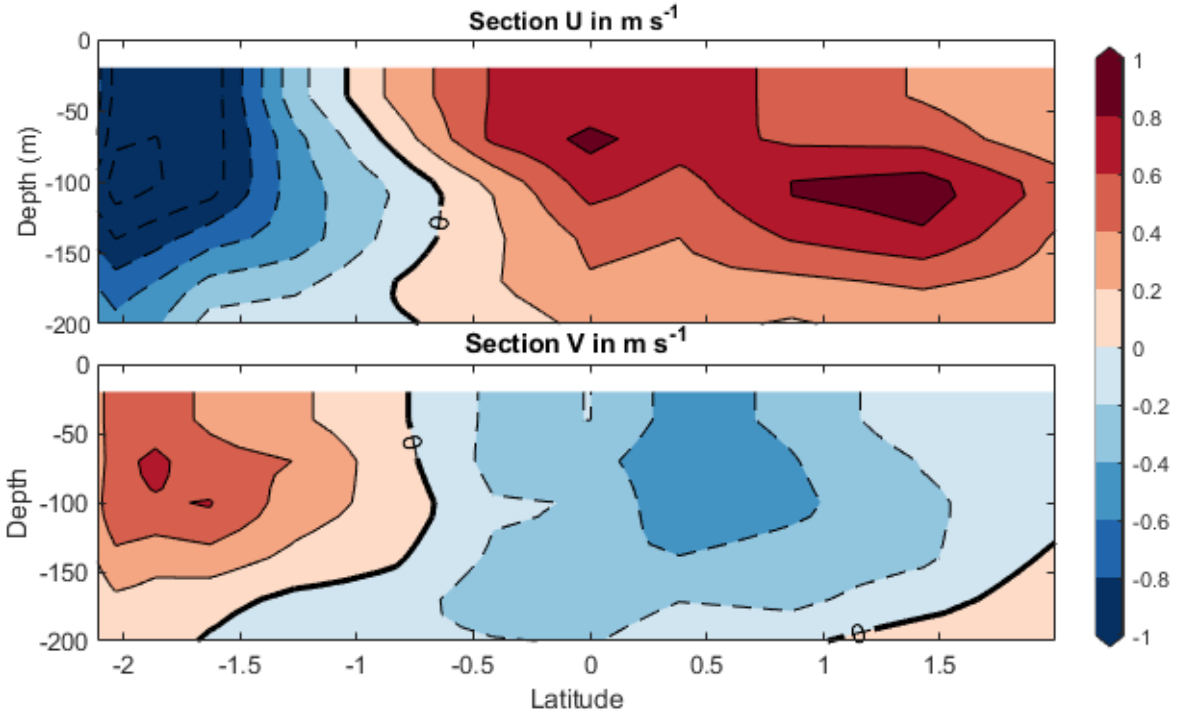


Figure 3: Shipboard ADCP section at 40°W between 2°S-2°N during 03/05/2003 to 05/05/2003 period. The dashed/solid contours represent the westward (northward)/eastward (southward) zonal (meridional) component of the current U (V). The contour intervals are each 0.2 m s^{-1} for both components.

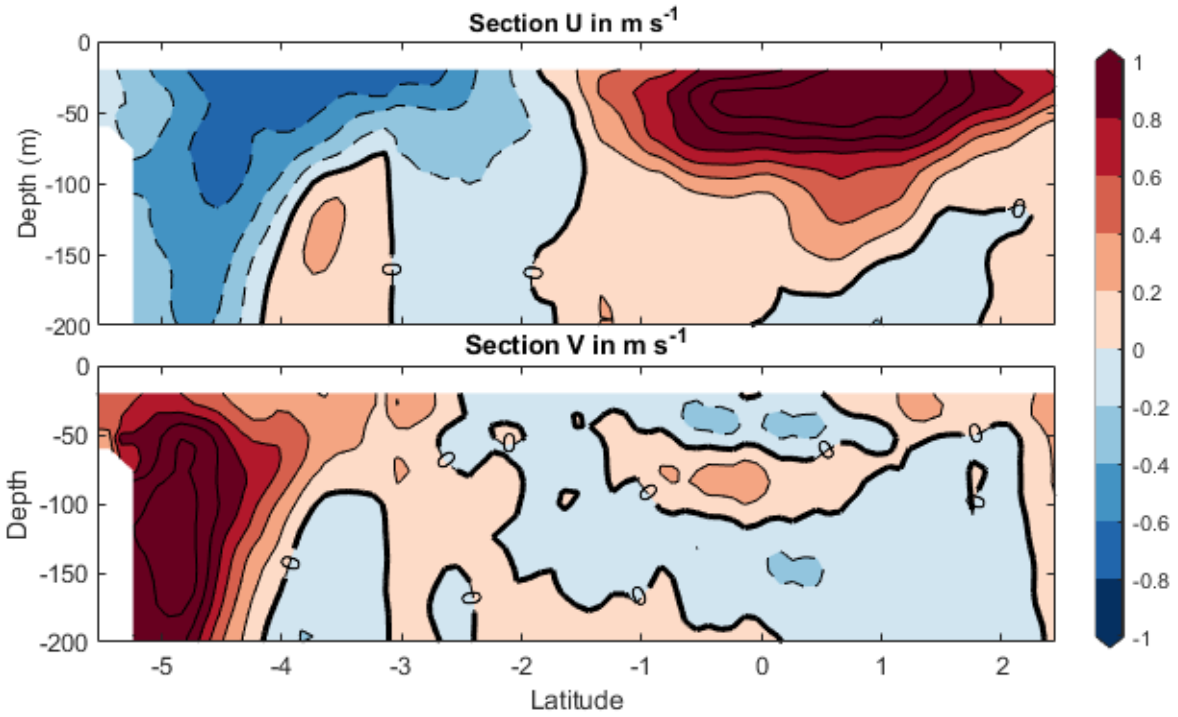


Figure 4: Shipboard ADCP section at 35°W between 6°S-3°N during 30/05/1991 to 05/06/1991 period. The dashed/solid contours represent the westward (northward)/eastward (southward) zonal (meridional) component of the current U (V). The contour intervals are each 0.2 m s^{-1} for both components.

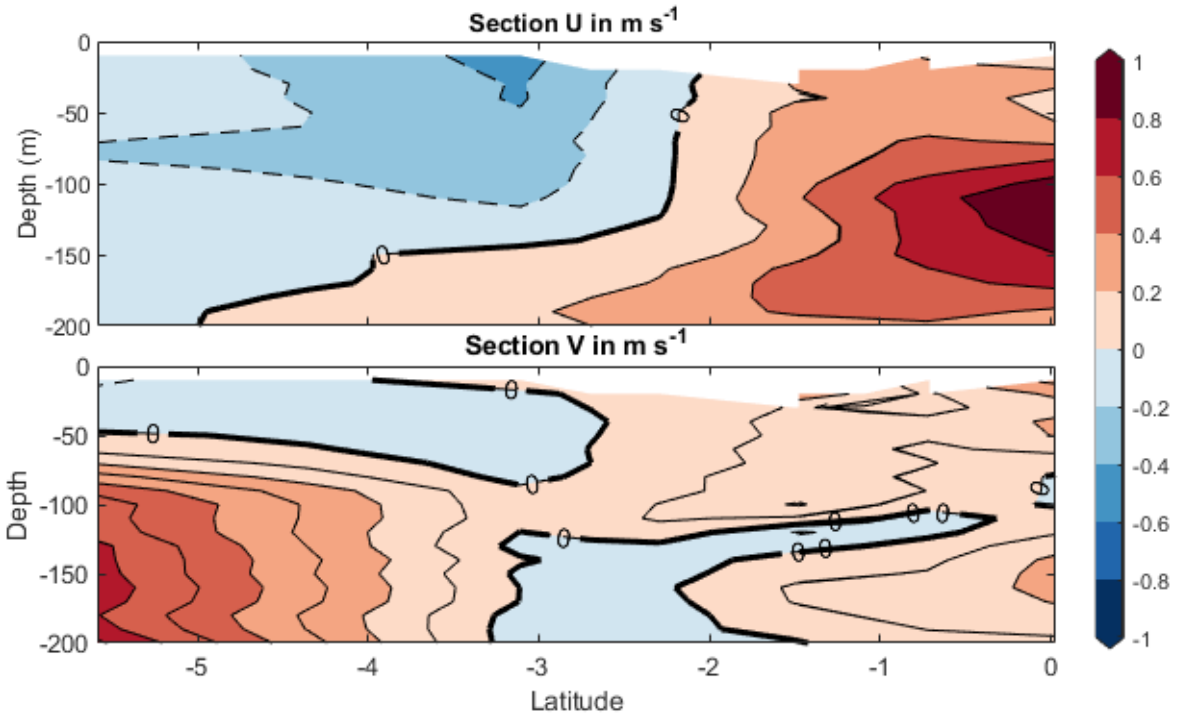


Figure 8: Shipboard ADCP section at 35°W between 6°S-0°N during 17/10/1990 to 22/10/1990 period. The dashed/solid contours represent the westward (northward)/eastward (southward) zonal (meridional) component of the current U (V). The contour intervals are each 0.2 m s^{-1} (0.1 m s^{-1}) for the zonal (meridional) component.

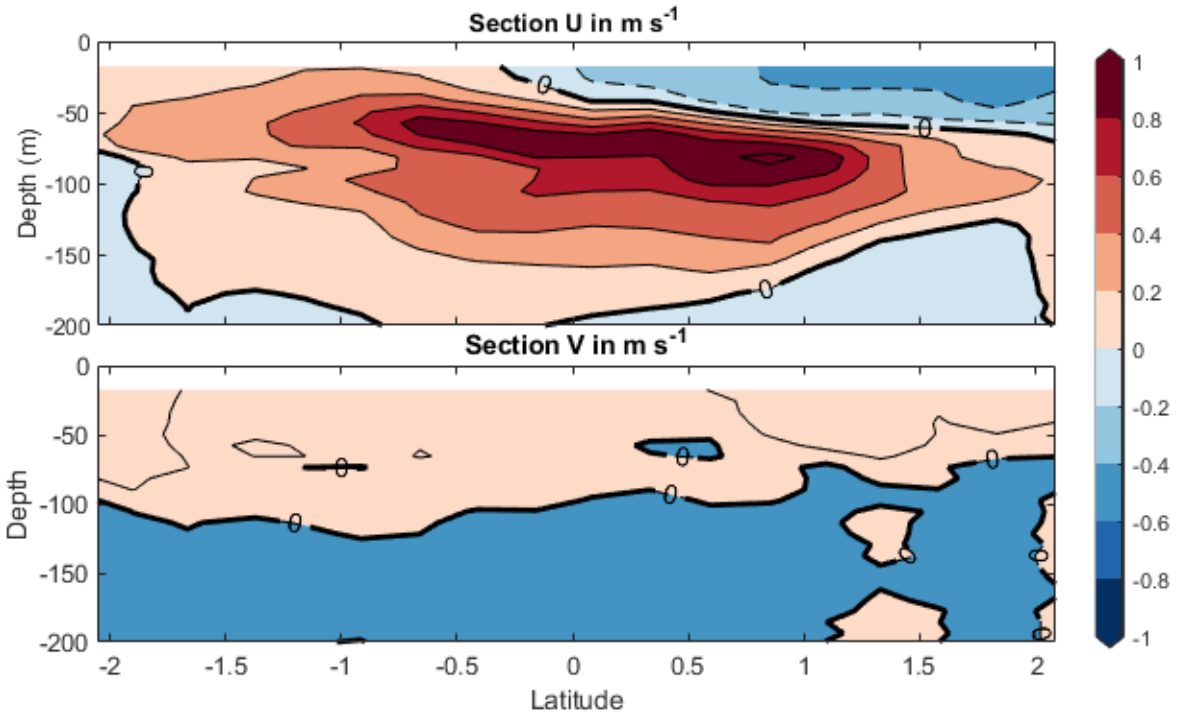


Figure 10: Shipboard ADCP section at 32°W between 2°S-2°N during 12/06/2006 to 13/06/2006 period. The dashed/solid contours represent the westward (northward)/eastward (southward) zonal (meridional) component of the current U (V). The contour intervals are each 0.2 m s^{-1} for both components.

My third suggestion is to recheck the language again. I found quite some mistakes in the third person with an "s" too much or missing. I am not quite sure whether I found all of them, so please give it a thorough read-through again.

Answer: Thank you for the comment. We have made the necessary changes in the revised manuscript.

Last, but not least I would like to suggest that you work a bit more on Figure 9. I gave some suggestions below how I think it could be improved a bit, because I think it's still quite full, which makes it a bit messy and hard to grasp. As this figure basically summarizes the result I think it should be a bit more easy to access.

Answer: Thank you for your comment and suggestion. We did our best to improve Fig.9 and gave additional information in the text to help understand it. We hope you will find it better.

In addition to these general remarks, I have some detailed remarks throughout the text:

Line 19: I would suggest to write characteristics instead of singularities.

Answer: Thank you for your suggestion. It was made. See line 19 of the revised manuscript.

Line 22-23: I am not sure whether there is a mistake here or maybe the phrasing is misleading : You say the maxima/minima occur within boreal winter/fall, when the ITCZ is at its southernmost/northernmost location.
Instead of using the boreal winter/fall expression which sounds like the ITCZ is at its southernmost/northernmost position directly within the next season, I would use the "months": The maxima/minima occur within February/August, when the ITCZ is at its southernmost/northernmost location.
At least the February/August definition is correct now for the ITCZ migration.

Answer: Thank you for your suggestion. The months have been used in the previous version and it has been suggested to change them into the seasons because all the currents we were referring to don't always have maxima during the same months. However, we agree that the sentence was not well phrased. What we wanted to say is that, the maxima occur during boreal winter when the ITCZ is located equatorward; and the minima occur during boreal fall when the ITCZ is located northward. We rephrased the sentence as follows:
"with maxima/minima during late boreal winter/boreal fall when the Intertropical Convergence Zone is at its southernmost/northern location." (Line 22-23)

Line 80-86: I am still not quite sure about this paragraph. You start the introduction now as we agreed on that the WTA surface boundary circulation is a superposition of AMOC, STC and Sverdrup dynamics. In line 84 you now say the WTA surface circulation is wind-driven and highlight the components which are most important from the vorticity equation meaning Sverdrup. How does this fit together and secondly is this important here?

Answer: Thank you for your comment. It was not clear. We wanted to explain a little bit the dynamics of the region from the intraseasonal to the interannual timescales. But, as our study is focused only on the seasonal and interannual variability, the second sentence is not important here. So, we have removed it. Thank you for your careful review and remark.

Line 90-92: Maybe rephrase this sentence. At least I understand that you want to say: The wind influence, which is related to the seasonal migration of the ITCZ, is reflected in the latitudinal shifts of the currents.

Answer: Thank you for your comment and suggestion. The sentence was not clear. As you understood, we wanted to explain how the wind variability is related to the ITCZ migration and can also been linked to the shift of the currents. We have adopted you sentence and wrote it as follows: "This wind influence, which is related to the seasonal migration of the ITCZ reflects in the latitudinal shifts of the currents." (Lines 88-89)

Line 96: , and also **on ..**

Answer: Thank you for your comment. It has been corrected and formulated as follows: "and also on the seasonal cycle of the local wind forcing (Hisard and Hénin, 1987; Provost et al., 2004; Brandt et al., 2006; Hormann and Brandt, 2007; Brandt et al., 2016)." (Lines 93-95).

Line 112: AZM instead of ACM?

Answer: Of course, it is the AZM. But as the AZM is an Atlantic Climate Mode, we had chosen to say it in general point of view by saying ACM. However, thank you for your comment. We have changed it as follows: "They showed that the EUC transport is affected by the cold and warm events of the AZM (the so called "Atlantic Niño / Niña") and confirmed the previous findings of Goes and Wainer (2003) concerning the link between the interannual variability of the wind and the AZM impacting the strength of the tropical Atlantic circulation." (Lines 107-110).

Line 144-145: , which uses the β-plane approximation as the Coriolis parameter vanishes close/at the equator.

Answer: Thank you for your reformulation. It has been considered and the new idea is as follows: "In the equatorial band, the currents have been calculated using the Lagerloef methodology (Lagerloef et al., 1999) which used the β-plane approximation as the Coriolis parameter vanishes close/at the equator." (Lines 142-144).

Line 149-150: I think I would be a bit more careful here how you phrase the results on the comparison. You say satisfactory … okay maybe, if Lagerloef found similar comparisons and also called them satisfactory. The correlation might be of 0.71 for the zonal component alright, but the amplitude is a factor of 2 off most of the time. The meridional component is completely off showing opposite signs most of the time. So, I think you somehow also have to admit these deficiencies and make that clear in the phrasing of this sentence and then say but its similar to Lagerloef and hence probably okay as he called it satisfactory. By the way why do you show also the current meter data of 2019, if you have nothing to compare it with? Maybe then instead focus the plots on the comparison you have (2017-2018). An additional remark you could also compare the current meter data outside of your study area at e.g. 23°W or 10°W of the PIRATA buoys to check for the "equatorial consistency". Maybe there is more data overlap there.

Answer: Thank you for your comment. The sentence was not well formulated. We wanted to say satisfactory compared to the results of the previous studies in the equatorial Pacific (Picaut et al., 1989; Lagerloef et al., 1999). To avoid any confusion, it has been reformulated as follows: "The results of the comparison with the geostrophic currents interpolated to the same location were in agreement with the results of the previous studies in the equatorial Pacific (Picaut et al., 1989; Lagerloef et al., 1999)." (Lines 165-168).

Concerning the difference of amplitudes, as suggested, we added a sentence to notice that before talking about the correlation. The sentence is as follows: "However, in all these studies the geostrophic currents are underestimated compared to the observations, and this is because the contribution of the ageostrophic velocities has not been considered (e.g. Fig. 1 in the supplement)." (Lines 168-170).

The opposite signs that is shown on the graph of the meridional component sometimes is due to the underestimation of the amplitude of the geostrophic current. This is also the case of the previous studies cited.

Concerning the plots of the currents meter data of 2019, as you noticed in one of your comment below, we have explained it in Lines 159-160 of the previous revised manuscript (now Lines 273-275). Since one of our major result was the presence of the ESC, it is provided to show the surface current at this period.

Concerning the possible comparison with PIRATA buoys located outside our study area, we didn't find it necessary because the data were already validated in the study area. It shows at least that the geostrophic currents can be used to investigate the current variability in this region.

However, the validation of altimetry currents at all PIRATA buoy positions, especially in the equatorial region can be a good subject for another paper.

Line 153: What do these numbers stand for? You say mean bias and standard deviation difference. What does that mean that you calculated here?

Answer: As in Lagerloef et al. (1999) cited in our manuscript, the numbers are the differences (currents component and standard deviation) between the two measurements. The mean bias is the mean of the difference between the values of the two measurements while the standard deviation difference is the difference of the standard deviations of the two measurements. The sentence has been reformulated as follows: "The mean biases/differences in standard deviation for both components are respectively, 0.04/0.11 m s^{-1} and 0.14/0.03 m s^{-1}." (Line 172-173)

Line 159: Okay I see the point from above that's why you show the 2018/2019 part of the time series.

Answer: Thank you. We have also mentioned it above.

Line 160-161: Maybe rephrase this a little: "legitimizes our desire to know more about this flow". Somehow this sounds a bit unscientific.

Answer: Thank you for your comment. We have rephrased it as follows: "These findings motivate our investigation of the variability of the surface currents in the equatorial part of our study area. (Lines 275-276)

Line 183: You used tau_x and tau_y in the equations now, but not in the text.

Answer: Thank you for your remark. It has been corrected. See line 186.

Line 256: I would add an introductory phrase to the sentence, something like:" To further investigate the variability of the different current branches, we then … "

Answer: Thank you for your suggestion. We have reformulated as follows: "To further investigate the variability of the different current branches, we then monthly averaged the daily

geostrophic currents and extracted the cross-section geostrophic velocities along the six sections defined above (Fig. 1).” (Lines 257-259)

Line 272: This is the first time that I encounter this “X” current again and I agree with the other reviewer that calling a current “X” is a really bad choice. Please reconsider this. I do understand that this paper is already full of acronyms making it difficult to read, but one more or less does not make the situation worse.

Answer: Thank you for your comment. As we mentioned it at the beginning of the responses, we gave a name to the current X which is now the ESC (Equatorial Surface Current). We have also changed it in all the new revised manuscript.

Fig 3: I appreciate the improvement of the figure. However, I would still rephrase the second sentence in the caption to something like: “On the left side of each panel the time average over the section is shown (thick line) framed by the corresponding standard deviation (thin lines). The color shading shows ….” I think what is written is too complicated.

Answer: Thank you for your comment and suggestion. We have rephrased caption as you suggested. The new caption is as follows: “**Figure 3.** Hovmöller diagrams (1993 to 2017) of the cross-section current components (m s^{-1}) for S1, S2, S3 S4 S5 and S6. On the left of each panel, the time average over the section is shown (thick lines), framed by the corresponding standard deviation (thin lines). The color shading shows the northward/eastward (red) or southward/westward (blue) direction of the cross-current. Acronyms are listed in Table 1. The numbers next to the acronyms represents the number of the section. The green line in S1 indicates the time series of the maximum velocity of the cross-section current (NBC), and is framed by the time series of the maximum velocities divided by 2 (blue lines) over 1993-2017 period.” (Lines 311-317)

Line 305: paths -> path. The sentence starting with “These maxima …” is strange as it is now, please rephrase and make sure the brackets are set well.

Answer: Thank you for your correction and comment. The corrections have been made and the sentences are reformulated as follows: “In order to further investigate the temporal variations

of the current amplitude or strength, the maximum speed values of each current path have been determined for each month. The maximum speed corresponds to the current core velocity and is called Vmax hereafter: (see Fig. 3, green line on S1). The location of the core velocity is also computed." (Lines 318-321)

Line 305 ff: I hope I understand now correctly: V_max = core velocity and location of V_max is core location;
strength/intensity time series is the average over the complete area between Vmax/2 and Vmax for every time step, correct?

Anwser: Yes, it is correct.

Width of the current: Take the mean of the current over the section (left part of Fig.3) and check where it drops to zero. Do you take the average for that or you do that for every time step. I am not quite sure I understand; you come up with one number, so probably you do that for the average curve, but on the other hand you write about the time series for that, so please clarify.

Answer: Yes, we wanted to say the average curve over the period of study. To make ourselves more understandable, we have reformulated as follows: "The width of the currents (Table 2) is determined by the average curve over the whole period of study (1993-2017) (see left boxes of the Hovmöller diagrams of Fig. 3)." (Lines 324-326)

Line 329: On the right side of each subplot …

Answer: Thank you, it has been changed.

Line 336: I do not see a monthly climatology of the current width in Fig. 5. See my comment above I also would not really know how this is obtained. In the end of the line: Our analyses …

Answer: Thank you for your comment. Yes, you are right, it was a mistake. "Current width" does not has its place in this sentence. The sentence is reformulated as follows: "For further analysis, the monthly climatology of Vmax, Vmax location and the relative current intensity has also been derived from the corresponding monthly time series for different current components (Fig. 5)." (Lines 349-351)

The width of the current has been also clarified (see the previous response).
To avoid repetitions, we have removed the last sentence, and the whole paragraph became: "Here we focus on the seasonal cycle of the different current branches observed in the study area. Therefore, a monthly climatology of the velocity estimates shown in Fig. 3 is calculated for each of the six sections (Fig. 4). For further analysis, the monthly climatology of Vmax, Vmax location and the relative current intensity has also been derived from the corresponding monthly time series for different current components (Fig. 5)." (Lines 347-351)

Line 366: the NBC2 *intensifies* one month …

Answer: Thank you, it has been corrected (Line 381).

Line 367: This shows … contribution to the NBC to the north of the equator.

Answer: Thank you, it has been corrected and the sentence has been reformulated as follows: "This shows the importance of the nSEC contribution to the NBC in the northern hemisphere." (Lines 381-382).

Line 374: tends to retroflects …This can justify the phasing of the annual cycle of the …

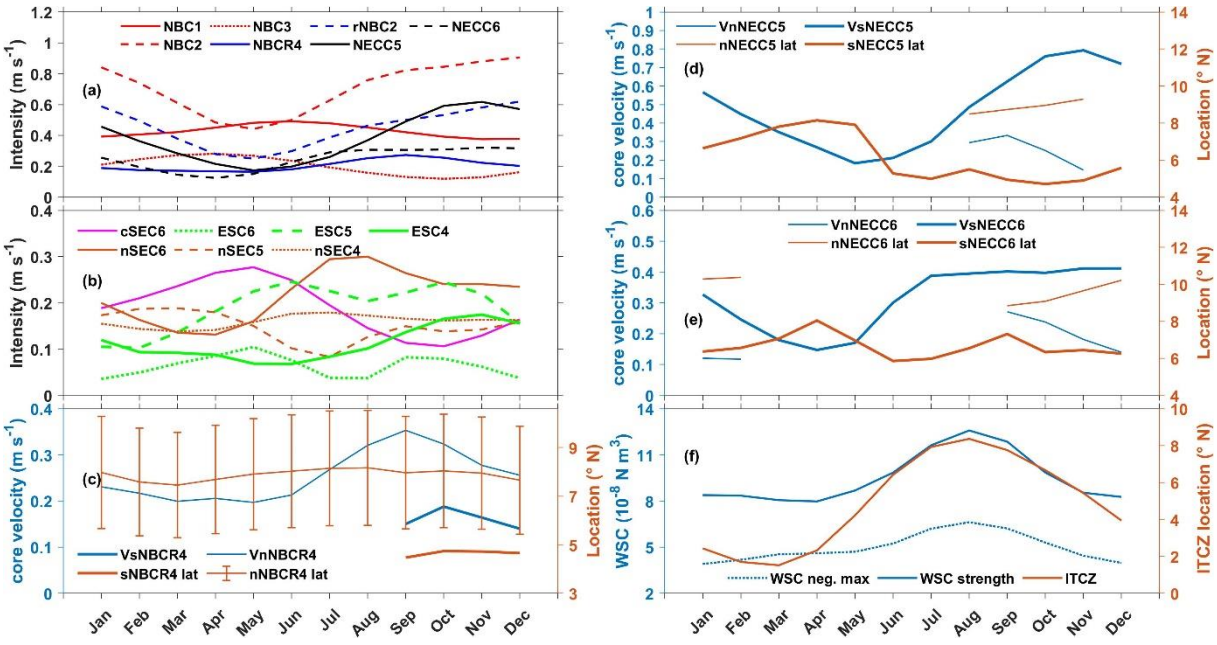
Answer: Thank you, it has been corrected and the sentences have been reformulated as follows: "The latter may generate barotropic and baroclinic instabilities of the NBC which then tends to retroflect eastward. This could explain the phasing of the annual cycle of the NBC2, NBC4 and rNBC2." (Lines 386-388).

Line 387: .. seems

Answer: Thank you, it has been corrected (Line 401).

Figure 5: the tick for April misses the "r". It only says "Ap"

Answer: Thank you for you remarks. It has been corrected in the new revised version. Please, see also the corrected figure below.



Line 423: .. and starts decreasing …

Answer: Thank you for your correction. It has been corrected (Line 437).

Line 444: In my understanding these winds are called the south east Trades and not the southerlies. In addition, I think this sentence is somehow irritating in the aspect to what is the cause of the changes. The ITCZ position is always north of the equator due to the asymmetric SST distribution. The migration of the ITCZ follows the zenith of the sun, which moves between the turning circles. As the ITCZ is the position, where the trades meet they also show a seasonal variability with latitude. Please somehow clarify these things.

Answer: Thank you for your comment and suggestions. The south east Trades are also called southerlies in some papers (See Okumura and Xie, 2004; Snowden et Molinari, 2003; Marin et al., 2009, Simpson et al., 2018; ….).
However, to avoid any confusion we have considered your suggestion and have reformulated as follows: “This is due to the fact that, in the northern hemisphere, the nSEC can be affected by the Southeast Trades which cross the equator.” (Lines 458-459).

Section 4.4: I very much appreciate that you looked at other data sets trying to verify the eastward surface velocities with other observations giving trust to the geostrophic product.

However, I think for the PIRATA velocities you need to be careful how you formulate the "good" agreement. Here you should really strike that it is probably underestimated in your product, as the amplitude of the eastward velocities in the PIRATA record are much bigger. However, you can also have ageostrophic velocities included in the PIRATA velocities, which are not in your product. This has to be clearly stated.

Answer: Thank you for your comment and suggestion. As you also mentioned it earlier, we have mentioned it in section 2.1 as follows: "However, the geostrophic components are underestimated, and this is because the contribution of ageostrophic velocities has not been considered (e.g. Fig. 1 in the supplement)." (Lines 168-170)
We have added to this paragraph (at the end): "Note that as mentioned in Sect. 2.1, the ESC amplitude captured in the altimetry product here is probably underestimated compared to the observations." (Lines 490-491)

Line 479: Which characteristics do you mean, I think only the intensity and core velocity are considered here?

Answer: Of course, it is the intensity and core velocity/location. You are right. Thank you for your comment. We have rephrased as follows: "The latter is analyzed here, using the time series of the characteristics (intensity and core velocity/location) of the different current branches (see end of Sect. 3) captured along the 6 sections (Fig. 6)." (Lines 494-496).

Line 480: I think its not so great to make the reader go back to end of section 3 to look up how you defined the intensity/core velocity of the currents. If I recall correctly you calculated something like mean over area where (V_max/2 < V < V_max) for the intensity and V_max as the core velocity in the latitudinal part of the section, where the current is located on average. So I would try to simply add something like that here.

Answer: Yes, it is correct. It has been already taking into account in one of the responses above. The sentences have been reformulated as follows: "The maximum speed corresponds to the current core velocity and is called Vmax hereafter: (see Fig. 3, green line on S1). The location of the core velocity is also computed. Then, to estimate the current relative strength/intensity, we have considered the part of the sections of velocities larger than Vmax/2 (see Fig. 3, blue

lines on S1), and we finally computed the values by averaging the velocity values over the area where V_max/2 < V < V_max.". (Lines 319-324)
Thank you again for your suggestion.

Figure 6/7: I was really hoping that some of this could be combined.

Answer: Yes, you are right. As you can imagine, we tried our best but to not create confusion in the head of the reader, we chose to have two figures instead of having one figure with too much information.

Line 517: relationships

Answer: Thank you, we have corrected it.

Section 5: How did you decide which current branches to show in the plots belonging to this section? Probably the ones from the area in Fig. 2 which show most pronounced interannual variability? Although no then you would probably only show the currents from section 6 and maybe section 5. So what drives your choice?

Answer: Thank you for your comment. Of course, we plotted the current branches of the area in Fig. 2 which show most pronounced interannual variability, investigating also the year-to-year variations found in the intensity, the core velocity/location of the current throughout the time period.

Line 525: 1993-2017

Answer: Thank you for your remark. It has been corrected. (Line 539)

Line 532: Isn't it called the Student's t-test?

Answer: Yes, you are right. It has been corrected. (Line 545)

Line 539-540: I am not quite sure I understand. What is the difference between "insignificant" and "none"? Please clarify.

Answer: Thank you for your comment. “insignificant” is for the correlation, and by “none” we wanted to say that no month is related to this correlation. We have clarified it as follows:” Where the correlations are found lower than 0.5, we indicate “insignificant” over the whole time period (“none” for no month is related to this correlation).” (Lines 553-556)

Line 593: Please consider my comments about these plots.

Answer: Thank you. We have considered it and new figures have been made (see the first responses above)

Line 609/610: This is exactly what I am saying about the ADCP observations and why you can not have data at 0m.

Answer: Yes, we agree with you. The explanations have been given in the first responses above, and we have considered your suggestions.

Line 612-616: This paragraph is still not very conclusive to me how it is written. Okay, you say Ekman velocities are westward. So to observe somewhat strong absolute eastward velocities you need quite strong geostrophic eastward velocities as v_abs = v_ekman + v_geo. Maybe that is meant with we conclude that the velocities found here (which are geostrophic) should be underestimated. Okay, but maybe rephrase a little to make it clearer if this is meant. But how is that consistent with the X current found in Fig. 5b? I do not understand what is meant with this.

Answer: Thank you for your comment. You are perfectly right. It was not clear. What we wanted to say after plotting the Ekman current in the whole tropical Atlantic (include the area outside of our study area), is that, the Ekman current seems to influence more the ESC in the central basin. But, it can create more confusion in the reader head. We have rephrased all the paragraph, removing this aspect and explaining now as follows: “In the equatorial region (2° S-2° N), Fig. 8 also shows the ESC with lower intensity. It appears to be extended east of 32° W and is stronger during boreal spring and fall. This feature can be related to the near-surface eastward flow mentioned previously by Hisard and Hénin (1987) and Bourlès et al. (1999b) on top of the EUC in the WTA. Hisard and Hénin (1987) explained the poor description of this current in the literature by the difficulty of ADCP measurements to fully capture the upper layer

currents in this area. They showed that this near-surface current, independent from the EUC, can reach amplitudes larger than 0.5 m s^{-1} between 23° W and 28° W. Comparing their currents values to the ESC intensity in our study, we conclude that the weaker values found here (mostly towards 32°W: Fig. 5b) might be explained by the importance of the ageostrophic components of the currents which are not considered here." (Lines 619-628)

Line 619: maximum -> maxima

Answer: Thank you , it has been corrected (Line 631)

Line 631: currents

Answer: Thank you for your remark. We have corrected it (Line 643)

Figure 9: The width of the arrows is proportional to the current amplitude you say. What is meant here? Do you mean V_max or intensity or really their amplitude which then should be something like the difference between max and min? What determines the length of the arrows then as the length also differs?
Why are the acronyms explained here in the caption again? In all the other figures the reader is referred to the acronym table. Why are there sometimes 1 and sometimes 3 arrows for the NEC (blue arrows)?
I still do not understand why in the JAS figure there are three arrows in the NECC region. The nNECC, sNECC and ? In some places there are 2-3 arrows after each other probably all representing the NECC and in other cases like for the NBC there are some arrows which cover quite some length extent. How did you decide about these things? Is there a meaning behind that? I think it would definitely help to have less arrows as it makes the plots quite messy, so maybe consider to reduce them, if there is no specific meaning behind the amount of arrows per current branch.

Answer: Thank you for your comments and suggestions. Indeed, the arrows are proportional to the current intensity. It was a mistake and has been corrected. The arrows are wider when the intensity of the current is maximum (normal arrows) and decrease in the season they reach a minimum (dotted thin arrows). So, we have reformulated the sentences corresponding to the introduction of the figure and in the figure caption (Lines 646-647)

The intensity of the current is only defined here by the width of the arrows (not on the length) and depends on the location.

Since Fig. 9 is a major figure which summarizes the study, we chose to keep the acronyms to allow everyone to have a direct idea about what are they mean.

Also, since we followed the currents from one position to another in our study, we have found it good to put many arrows in order to show the variability of the intensity of the currents along their path. We have now mention it in the introduction to the figure (Lines 647-648).

Concerning the three arrows in the JAS figure, you are right. It had to be only two arrows: one for the sNECC and the other for nNECC. We have made a new figure with a new caption (see below).

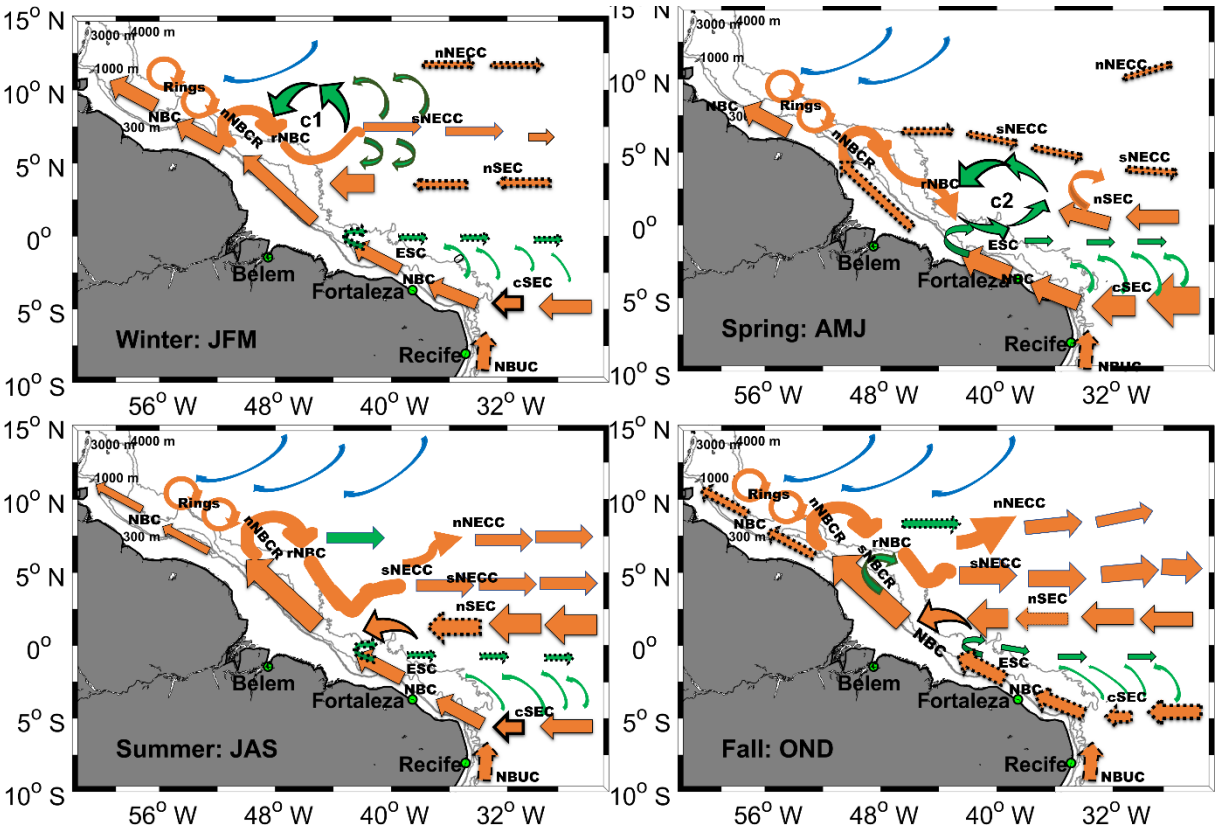


Figure 9. Schematic view of the seasonal maps of the tropical western boundary surface circulation together with the subsurface NBUC signature at the surface. C1 and C2 represent the cyclonic circulations highlighted in this study. The size of the arrows is wider when the intensity of the current is maximum (normal arrows), and decreases with season to reach its minimum (dotted thin line). The NBUC is represented because of its contribution to the NBC transport and is shown by dashed arrows. The current branches which are already known are in orange/blue

(orange/blue for the current fed by southern/northern hemisphere water). The green arrows characterize the new branches observed. NBC is the North Brazil Current; nNBCR and sNBCR are the northern and the southern flows of the North Brazil Current retroflection, respectively; rNBC is the retroflected branch of North Brazil current; nNECC and sNECC are the northern and the southern branches of the North Equatorial Countercurrent (NECC), respectively; cSEC and nSEC are the central and the northern branches of the South Equatorial Current (SEC), respectively; and ESC is the Equatorial Surface Current.

Line 662/663: Please rephrase, somehow the defined in the end sounds odd.

Answer: Thank you for your suggestion. We have rephrased as follows: "To do so, a new approach based on the calculation of the current intensity was adopted, using six defined horizontal sections." (Lines 679-680)

Line 667: on the one hand

Answer: Thank you for your remark. We have corrected it (Line 684)

Line 687: But -> However,

Answer: Thank you for your suggestion. It has been considered and the sentence reformulated as follows: "However, the ageostrophic velocities need also to be considered here to fully understand the surface circulation." (Lines 704-705)

Line 690/691: You probably mean the eastern part of the region you are investigating. Eastern part of the basin could also be in front of Africa.

Answer: Thank you for your remark. You are right. We were meaning the eastern part of the region investigated in our study. It has been reformulated as follows: "The interannual variability is much weaker than the seasonal one. It is more important in the eastern part of our study area and there is no obvious regional pattern of low frequency variations." (Lines 706-708)

Line 693: … opens the way **for** further investigations

Answer: Thank you, it has been corrected. (Line 710)