Responses to the Comment and/or Suggestions from Anonymous Referee #1

Manuscript: angeo-2021-71
Title: Study of the equatorial and low-latitude TEC response to plasma bubbles during the solar cycle 24-25 over the Brazilian region using a Disturbance Ionosphere indeX
Authors: Picanço et al.
Reviewer: Anonymous Referee #1

Comments on the manuscript entitled "Study of the equatorial and low-latitude TEC response to plasma bubbles during the solar cycle 24-25 over the Brazilian region using a Disturbance Ionosphere indeX" by Picanço et al. submitted to the Annales Geophysicae journal.

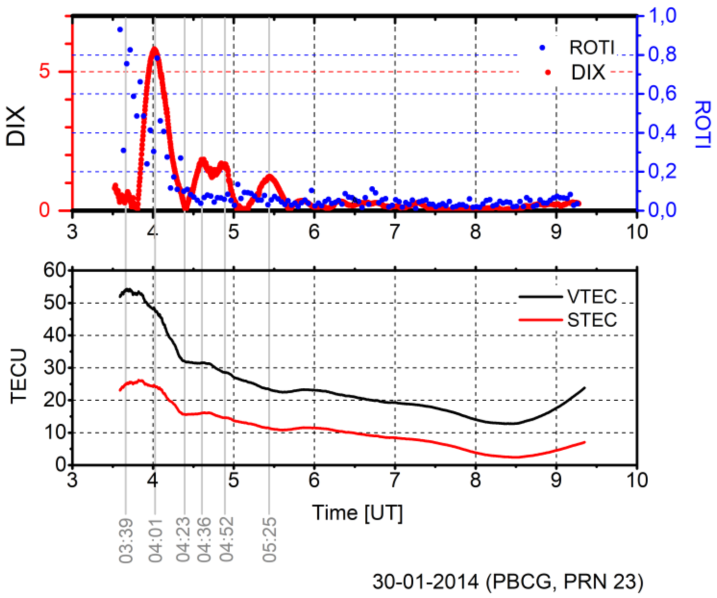
In this manuscript, the authors used the DIX to evaluate the ionospheric responses to EPB events from 2013 to 2020 over the Brazilian equatorial and low latitudes. Their results show that DIX is able to detect EPB-related TEC disturbances. However, the following points should be considered and improved:
Our response:
First, we would like to take this opportunity to thank Reviewer #1 for his/her time spent evaluating our contribution. In the following lines, we provide the specific answers to each specific point risen by the reviewer

1. For ROTI in this work, authors should show detailed calculation method.
Our response:
We agree with the reviewer's suggestion. In this regard, we will now add a full explanation of the methodology used to calculate ROTI in the revised version of the paper.

2. For airglow picture in this work, in order to better compare TEC observation, the authors should map them into the geographical coordinate.
Our response:
We thank Reviewer #1 for his/her suggestion. Indeed, such a modification will facilitate comparing airglow and TEC data. Therefore, such changes will be made in the figures indicated.

3. In the PBCG of Figure 2, the DIX shows a large value 5 at ~ 2 UT. However, the ROTI shows a small value 0.2. Similarly, the DIX of PBJB shows a large value 4 at ~ 3 UT but its ROTI shows a small value 0.1 at the same time. Same result also appears in the PEAF about 3 UT. It shows some inconsistent results between DIX and ROTI in these points. Why? The authors should explain it.
Our response:
We thank the reviewer for raising this important observation. We noticed a mistake in the time format of the DIX values presented in figures 2 and 3, which will be corrected in the revised figures. This caused the EPB-related DIX peaks to appear displaced in relation to the ROTI peaks in both figures. Therefore, we attach as an example a figure with the DIX and ROTI corrected curves for PBCG, along with the vTEC and sTEC curves from which we have derived DIX and ROTI, respectively. Then, we can observe that the first DIX peak is coherent with the time of occurrence of the first ROTI peak. Additionally, we would like to emphasize that the DIX is not an index specifically made to detect small-scale irregularities, such as the ROTI. The DIX is an index that responds to TEC variations in general, whether caused by internal (eg, EPBs) or external (eg, magnetic storms) sources. In this regard, the DIX peaks

after 04:30 UT (figure below) occur probably due to TEC disturbances caused by other ionospheric effects not associated with plasma bubbles.

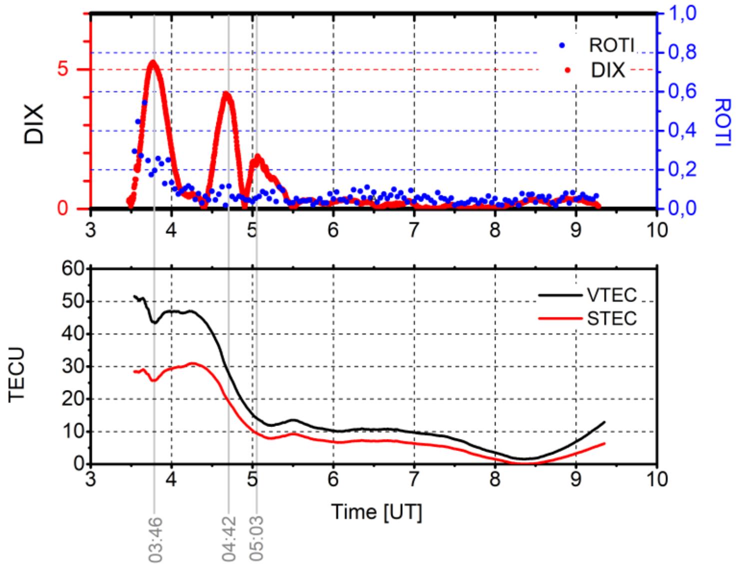


4. In Figure 3, some results are similarly to the results of Figure 2. ROTI is a small value while the DIX shows a large value at some points, such as the value of MGV at ~ 5 UT. The authors should explain it.

Our response:

As it was made in the previous topic, we attach here an example of corrected DIX and ROTI curves for MGV, along with the vTEC and sTEC curves from which we have derived DIX and ROTI, respectively. In this figure, we observe that both EPB-related DIX and ROTI peaks occur around the same time interval (03:30 UT - 03:45 UT). In addition, two peaks appear later only in the DIX, being those possibly associated with the occurrence of TEC variations that are not related to plasma bubbles.

We are grateful for the reviewer's comment, which may avoid misunderstanding in the revised version of the present manuscript.



5. In Figure 4, it is difficult for me to distinguish between the yellow and the orange on my computer screen. I suggest that authors use contrasting colors to replace them.
Our response:
We thank Reviewer #1 for the relevant observation. We will select contrasting colors so that the results are better visualized.

6. In Figure 4 and 5, the authors showed only one picture (airglow and ionogram) in every event. As reader, based on only one airglow and ionogram, I have difficulty understand the texts of manuscript corresponding to these Figures. I suggest the authors to show more detailed airglow and ionogram pictures in each subgraph.
Our response:
We thank the reviewer for the suggestion. We will include more airglow and ionogram images in the results.

7. In Table 3 and Figure 6, the authors did not explain the reason why they used the maximum DIX values to compare the yearly mean total sunspot number. The yearly mean total sunspot number shows the average of solar activity in one year. However, the maximum DIX may be from only one EPB event. There is a large randomness in one EPB event. For example, the maximum DIX just appeared in one EPB event in one year and it may be caused by strong storm or others. If authors use only the maximum DIX to compare the yearly mean total sunspot number, they may get an unreal result.
Our response:
We understand the reviewer's concern in raising this doubt. Perhaps it was unclear, but all periods studied are geomagnetically quiet (kp<=3). Unfortunately, we did not specify this in the text. Therefore, we will include a more detailed description of the methodology for selecting bubble events so that this doubt can be clarified. In short, we intended to compare the intensity of the plasma bubbles (DIX max) with the variation of solar activity (sunspot number). We will include a better explanation in the revised version of the manuscript. Thanks.

8. In Figure 6, 2013 is a higher solar activity year. The mean total sunspot number of 2013 is significantly higher than 2017, 2018 and 2019. However, the DIX of 2013 is significantly lower or equal to that of 2017, 2018 and 2019 at Equatorial stations. Meanwhile, the DIX of

2013 also equals to the value of 2018 at low stations. These results disagree with the year varieties of solar activity. Why? It leads readers into confusion. The authors should explain it in detail.

Our response:

We thank the reviewer for raising this point. Indeed, the magnitude of EPB-related DIX disturbances tends to follow the temporal trend of solar activity in most cases. However, as we have analyzed data from one event per year, the specific disturbances observed during de 2013 EPB event tended to keep the maximum DIX under the scale 2. Specifically, the 2013 plasma bubble event was less intense than the others, so DIX showed smaller-scale disturbances. In this regard, such a weak EPB event caused the 2013 maximum DIX to be smaller than DIX values observed in 2017, 2018, and 2019. This feature can be seen in Figure 4, where the DIX is around the scale of 1 at all GNSS stations. Thus, we will include a better explanation for this question in the revised version of the paper.

Finally, we would like to take this opportunity to thank the reviewer for kindly evaluating our paper helping to greatly improve its quality.