

## ***Interactive comment on “On developing a new ionospheric plasma index for the Brazilian equatorial F region irregularities” by Laysa Cristina Araujo Resende et al.***

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Manuscript ‘On developing a new ionospheric plasma index for the Brazilian equatorial F region irregularities’ by Resende et al. submitted to the Annales Geophysicae.

The paper proposed by Araujo et al. introduces a new ionospheric index for Brazilian equatorial region using the  $V_z$ , calculated from digisonde  $h'F$  values, and tested mainly in summer conditions for the solar cycle 24. They show the relationship of  $V_z$  with the start time occurrence of irregularities, and establishing a  $AV(1-5)$  index. This paper is very interesting from my point of view, and could be published after some technical revision.

C1

We would like to acknowledge the comments given by the referee. We have carried out a revision of the manuscript taking into account all the referee's comments and suggestions.

Comment:

1. What's the difference between  $AV1$  and  $AV2$ ? Since it's not explained in all the paper. Also is not shown the statistics of  $AV1$  and  $AV2$ , probably it could be important for Space Weather issues. Our response: Thanks to the reviewer for this point. To construct our scale, we observe that the irregularities occur after  $V_{zp}$  reaches 40 m/s in general. As for product works of Space Weather have a greater interest in general cases, we consider the values smaller than 40 m/s as conditions of the irregularity will not appear ( $AV1$ ) or will rarely appear ( $AV2$ ). We added this information in page 5, lines 10-13.

2. Also, I couldn't find some relation on the construction of the  $AV$  index with the solar cycle. Probably if you (authors) could add a factor into your equation that could show the solar cycle index. Is properly understood that solar cycle affect the irregularity formation process, as well the season, so, when you are in solar maximum PRE ( $V_z$ ) is well related with irregularities formation (as you mentioned in pag 8), however during solar minimum PRE ( $V_z$ ) is not longer the best factor to initiate the irregularities. Also the time that the irregularities starts is different from solar maximum to solar minimum. Our response: The reviewer is right when he/she emphasizes the relationship between plasma irregularities and solar activity. We observe a relation to the instant in which  $V_{zp}$  increases (using  $V_{zp}$  equation) with the time that the irregularity is identified in  $AV3$ ,  $AV4$ , and  $AV5$  indexes in all solar cycle phase studied. However, we observe some differences according to the phase of the solar cycle. One of them is the time of duration of the irregularity (Figure 3 discussion). Also, we noted the  $AV5$  index seems to have a delay of the irregularity occurrence time. We added this part on page 15 (lines 5-10). More detailed studies using this index and the irregularity observations regarding the phase of the solar cycle intended to be analysed in the future.

C2

3. Why the statistics of other seasons are not shown in the paper? Do they show same behavior as Figure 6? I found very interesting Figure 6 since it shows the relation of irregularities with time along 6 years data (from minimum to ascending phase of solar cycle). I believe that in order to develop an index you have to show the same statistic for the other 3 seasons (spring Equinox, fall equinox, and Winter solstice). This AV index seems to be working properly for summer solstice, however is not possible to conclude, from the paper, that it is effective for other seasons. Our response: As mentioned on page 12, we observed only a few cases of spread-F in winter and equinoxes. Also, as pointed out by reviewer 1, it is already well known that the irregularities related to plasma bubbles are more frequent in summer. Therefore, we opted to show only the summer season in order not to be a very long article. For exemplify, we show the winter statistics here. In fact, we observe that the probability to observe the time that the irregularity starts to appear in ionogram after the Vzp intensification is equal to or higher than 30 minutes to AV3 and AV4 indexes. Thus, notice that in the few cases that the irregularity occurred, the index has the same behaviour than summer.

4. What happens if start of irregularities are observed at midnight and/or post-midnight hours? This AV index does not represent them. Our response: Thank you to the reviewer for this important question. The irregularities that happen at this time (midnight and/or post-midnight hours) are counted in an hour or more in our statistics (>60 minutes). We added this information (page 8, lines 5-10; page13 and 14).

Minor comments:

1. Pag. 1, Abstract, Line 22: "ionogramas" to "ionograms". Our response: We correct it accordingly. Thank you.

2. Pag. 4, 3.1 AV Index Scale, Line 16: "plasma bubbles is more probab..." to "... are more pro...". Our response: We correct it accordingly.

3. Pag 5, Line 10: Since Vz<sub>p</sub> = 53 so AV4 and not AV3/ Table 2: Below Vz<sub>p</sub> shouldn't be 53? Our response: Sorry, the Vz<sub>p</sub> was 43 m/s. We correct it accordingly. 4. Pag

C3

9, Line 4: "... in Figure 2, where..." change for Figure 3. Our response: We correct it accordingly. 5. Pag 10, Lines 20 and 21: Please check the percentage numbers. For example: "Among those, 15% had..." change to "... 10%...". I believe that is related to the Figure 4, AV4, 2001. Our response: We correct it accordingly. 6. Pag 12, Line 16: complete the paragraph "... of days that...". Our response: We correct it accordingly.

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

Please also note the supplement to this comment:

<https://www.ann-geophys-discuss.net/angeo-2019-42/angeo-2019-42-AC4-supplement.pdf>

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