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Interactive comment on "Evaluation of Possible Corrosion Enhacement Due to Telluric Currents: Case Study for Brazilian Pipeline" *by* Joyrles Fernandes de Moraes et al.

Anonymous Referee #2

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General comments:

The article estimates the possible corrosion rate in a pipeline in South America due to GICs and compares the results for geomagnetic storms of different intensities. The topic is quite interesting and presents a methodology where is used both models and experimental data. The content of the article is relevant and collaborates to increase the knowledge about the GICs influence in this sector. The final results are compared to values published in other locations of the globe. Although the corrosion rate estimated in the GASBOL pipeline was smaller than compared to these locations, it shows a great variation during different geomagnetic storms intensities. That result enhances the

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importance of space weather condition monitoring and its influence in ground systems. Before the manuscript is accepted it should be considered major revisions.

Specific comments:

Page 1, line 18: Is there a specific reason why the PSP is maintained at negative potential? Why at least -850 mV?

Page 2, line 13: I suggest include at this point some parameters about the 17th March 2015 Geomagnetic Storm, e.g. DST index, Kp, and others just as a reference about the event.

Page 2, line 19: The only experimental data are from the magnetometer at the São José dos Campos station. Is that correct?

Page 3, equation (1): Emphasise that the equation for the general case is vectorial, so z is actually a 2x2 tensor. The horizontal components of Electric Field (Ex and Ey) and Magnetic Filed (Hx and Hy) at the surface should relate as follows: Ex=Zxx.Hx + Zxy.Hy ; Ey=Zyx.Hx + Zyy.Hy. In the case where is assumed a stratified homogeneous model (1D model), as proposed in Table 1, the Zxx=Zyy=0 and impedance z can be treated as a scalar, relating the orthogonal components of the fields: Ex=z.Hy and Ey=z.Hx; or as shown in equation (1) E_surface=z.H_surface. Whats was the value used for "z"? Was it consider a scalar or a tensor? Was that obtained by the model in Table 1 and consider constant for the whole pipeline? If that is the case it should be considered that the geological resistivity may vary a lot, even locally. For a structure with more than 1000 km the z should change completely.

Page 4, line 6: in equation (2) I recommend specifying what represents Ep and Vp. Is Ep the Electric field estimated using the surface impedance z and the magnetic data at São José dos Campos?

Page 4, line 13: I suggest to describe what the termination impedances represents in the pipeline.

Page 4, Table 2: Were the values in Tabel 2 used to estimate the Ap, Bp and other constants in equation (2)? How do you estimate Ap and Bp?

Page 5, line 10: I suggest to explain how the electric field was estimated. The electric field was obtained using the magnetic data and equation (1)? If yes, take into consideration the previous comment about the impedance z and the relation between orthogonal components of H and E.

Page 5, line 10: figure 2 shows the electric field that I presume was estimated using equation (1), a given z and the magnetic data, correct? I suggest discussing a little bit more the methodology to estimate the eastward and northward electric field and make it clear that it is obtained from the magnetic horizontal data of the São José dos Campos magnetometer. It may be worth to include in the figure the magnetic field horizontal component for the period.

Page 5, line 22: what does it mean "cathodically protected"? Is it related to the -850mV maintained PSP?

Page5, line 23: figures 3 and 4 shows the PSP for 0.1 and 1000 ohm terminating impedances at different sites. What exactly are these different sites of the pipeline? Are they different locations along the pipeline? If yes, these locations should be included in figure 1. Another concern about this topic is the value of the estimated electric field. Although the surface magnetic field can be approximately the same at a given latitude for a large regional area, the electric field in the surface may vary completely due to changes in Earth's resistivity and therefore in the surface impedance z. The model of Table 1 can not be considered for the whole extension of the pipeline. So, if the electric field is been estimated to São José dos Campos (SJC) site it should not be taken as equal to the rest of the pipeline. Another possibility is that the DSLT theory needs the electric field at only one point and then it can estimate de Vp, in equation (2), for the different points of the pipeline. If that is the case it should be made clear in the text and described with more detail in the methodology. Anyway, I think it is worth to discuss

more how the PSP is been estimated as well as if the electric field is been calculated only at SJC or for the whole pipeline.

Page 5, line 30: How can I identify the ends of the pipe in figures 3 and 4?

Page 6, line 2: What does it mean exactly "Durgin one half electric field"?

Page 6, line 4: data in Figures 6 and 7 are calculated using equation (3)? Just to be clear.

Page 7, figure 3: What does it represent exactely the numbers in km at the top right of each subfigure? If it is the position in the pipeline what is the reference or origin point? Same to figure 4.

Page 9, figure 5: What are the locations represented at 0 and about 1750 km distance? There should be a reference position.

Page10, figure 6: the legend shows "Metal loss estimation". For "metal loss" it seems it should be represented by the loss of volume (mm3) or the loss of mass (kg) of the material. However, the graphics show mm/year. I understand that the corrosion rate in equation (3), page 5, is represented in mm/year through a hole of 1 cm diameter. The hole has an equivalent area so the corrosion rate will represent at last a loss of volume per year (mm3/year). Is that correct? I suggest mentioning that again when explaining figures 6 and 7 as well.

Technical corrections:

Page 1, line 17: "...which can take to a corrosion process".

Page 5, line 18: The sentence "can affect the GIC amplitudes" seems to be out of order in the phrase. Please review the sentence.

Page 6, figure 2: I suggest to include the time markers for the top subfigure.

Page 7, figure 3: Again I suggest to include the time markers for all the subfigures.

Make it clear what means the value in km in the top right of each subfigure. Include in the legend that it is for 0.1 ohms terminating impedance.

Page 8, figure 4: Same as to figure 3. Include in the legend that it is for 1000 ohms terminating impedance.

Page 9, line 1: it seems there is a unit missing in "... of 10 in 14 years".

Page 9, line 5: change "more resistive media" to "more resistive medium".

Page 10, figure 6: in the legend, it says that the dashed line represents the limit of CR. However, I don't see any dashed line.

Page 11, figure 7: in the unit of corrosion rate for the bottom subfigure (b) I think there is an extra "mm".

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