

Interactive comment on “Localized TEC enhancements in the Southern Hemisphere” by Ilya K. Edemskiy

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I thank both reviewers for helpful comments.

1. It is not clear from the text what the author regards as a possible mechanism of LTE generation. A possible mechanism of LTE generation should be one of the main conclusions in section 4. The author is obviously not yet able to indicate the exact mechanism. However, he should single out and discuss possible mechanisms.

Discussion section was almost fully rewritten and now contain some suggestions about the mechanism

2. As I believe (see Comment for Line 163), the author uses the intensity of the interplanetary magnetic field (IMF) to analyze LTE dependence on geomagnetic activity

level. But for this analysis, it is better to use the magnetic activity indices Dst (or SYM-H) and AE, which make it easy to select disturbance periods in Earth's magnetic field variations. In addition to Figures 4 and 5, it would be useful to add a figure to show the time variations of Dst, AE, F10.7 and "temporal position" of each LTE during all the years (2014, 2015, 2018).

Thank you for the recommendation. The figure 4 is replaced by plots showing temporal position of each LTE and the corresponding values of F10.7 and SYM-H indices. Speaking of IMF intensity usage for the comparison, figure 5 is updated and now presents dependencies on AE, Dst and SYM-H as well.

3. Throughout the text, please check the season names in the Southern Hemisphere: in some places March-July are called "autumn-winter" (Lines 143-144, 187-188), and in other places they are referred to as "spring-summer" (Lines 148-149, 227-228).

Thank you. This confusion in the names was corrected.

Thank you for all the comments. They really helped to improve the paper

Comments

Lines 5-6. In Abstract, it is not clear what the author means by "LTE series". Please keep in mind that a lot of people read Abstract only.

I changed the Abstract in accordance with the comment

Lines 7-8. "It is shown that LTE intensity varies in dependence on solar flux and does not directly depend on interplanetary magnetic field orientation." LTE dependence on interplanetary magnetic field orientation is not discussed in the paper.

Line 231. "No clear dependence between orientation of IMF and LTEs' parameters was observed." LTE dependence on interplanetary magnetic field orientation is not discussed in the text. Therefore, this conclusion is not substantiated.

The distributions similar to ones in fig. 5 were calculated but were not presented since

they do not show any trend or dependence of LTE occurrence. The figure was changed to show distributions versus all the main parameters and the corresponding text was added.

Lines 19-25. "The Southern Hemisphere contains at least two large anomalous regions: South Atlantic Magnetic Anomaly and Weddell Sea Anomaly." Since the author mentions two large anomalous regions in the Southern Hemisphere (South Atlantic Magnetic Anomaly and Weddell Sea Anomaly), he should characterize both of them, not one (Weddell Sea Anomaly).

Moreover, I would recommend to pay particular attention to the South Atlantic Magnetic Anomaly (SAMA). The SAMA region is very close to the area where LTEs are detected (Fig. 1A and Fig. 3). Perhaps SAMA (itself or together with some other factors, such as a neutral wind, for example) promotes the LTE formation.

On the other hand, LTE looks like a continuation of the region occupied by the Equatorial Ionization Anomaly (EIA) in Fig. 1A (unfortunately, the boundaries of Fig. 3 cut off the EIA, and nothing can be said here). Maybe sometimes one gets conditions that allow a plume from EIA "fountain" to reach higher latitudes.

The description of the SH anomalies is corrected and now contains more details about each anomaly. Obviously the presented LTEs are connected with configuration of geomagnetic field as well as SAMA anomaly, but it should be noted that the last one is mostly located in Atlantic ocean, when LTE is typically generated and develops in Indian ocean and in geomagnetic latitudes which are usually higher than those of SAMA.

Speaking of continuation of EIA, there are several things to be noted:

- we observe SH LTEs asymmetrically: independent on the season there are no similar structures in NH even during equinox periods, when amount of solar radiation is quite the same in both hemispheres. And it is not clear why we do not have the same continuation in NH.

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- being observed in near-noon area LTE should be formed by solar ionization which impact is maximal in sub-equatorial region.

- It is possible to observe enhancements which are continuation of EIA (e.g. a figure below) and we do not consider them as LTE since they are not localized (do not have clear border)

The figure below shows enhanced values in SH, which do not fulfill the criteria and looks like a continuation of EIA.

Lines 32-33. "However, none of these models predict the occurrence of the LTE phenomenon." Neither the abbreviation "LTE" nor the term "LTE" have been used before. Please, explain what "LTE" is before using it. In a scientific article, one should avoid term/abbreviation explanations after their first use. This makes understanding difficult.

The abbreviation was introduced in abstract, but I agree that it should be introduced in the text as well. A short explanation is added.

Line 48. "Gradients at an LTE edges should be high enough to make LTE borders possible to distinguish." Please, specify the numerical value of the gradient threshold you use.

The formulation of the criteria was changed:

"In this paper a TEC enhancement is considered as LTE if it is:

- located in middle latitudes of sunlit region. Mainly we investigate LTEs, which are clearly observed in Indian and Southern part of Atlantic Oceans and do not take into account enhancements in Northern Hemisphere. At the same time, LTEs in SH are not accompanied by any LTE in NH and such a focusing on SH LTEs is quite reasonable.

- spatially limited by relatively lower TEC values. Normalized difference between squared maximal value in LTE and minimal one at its border ($\Delta=1 - (I_{edge}/I_{max})^2$) should be no less than 20%. Generally that means that there should be a clear trough

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between an enhancement and the equatorial ionization anomaly (EIA).

- confined and have a border of lower TEC values ($\Delta \geq 20\%$) no farther than in 40° in longitude from the location of maximal TEC value. Mainly that means that we do not consider longitudinally stretched enhancements assuming different mechanism of their generation."

Line 54. "Edemskiy et al., 2017" Probably, the author meant "Edemskiy et al., 2018"

Yes, that was a misprint

Lines 125-126. "Blue dashed line (Fig. 2, right) presents a profile measured at 10:12 UT at October 19, 2014 when there was no LTE observed in GIM." Please, explain why October 19, 2014 was chosen as a day without LTE. Though April days with LTE are analyzed. Why did not you use a day without LTE closer to April?

The problem consists of two parts: COSMIC should be at a proper position near the local noon to make it possible to observe the given area in Southern Hemisphere; and we did not observe enhanced TEC at this moment. As it could be seen from fig. 4, there was the only day without LTE (Apr 12) and during this day TEC values were enhanced but not fulfilled the LTE criteria. A corresponding short explanation is added to the text:

"Due to the phenomenon of LTE series which will be described later, TEC values over the given region are enhanced almost during the whole month. To demonstrate ionosphere profile without any enhancement in GIM we have chosen October 19, 2014. The profile measured by COSMIC at 10:12UT is shown by dashed blue line in fig. 2."

Lines 133-134. "The intensity and the shape of the presented LTEs vary but at the same time of day all of them occupy the same region." should be replaced with "The intensity and shape of the presented LTEs vary from day to day, but at the same time of day all of the LTEs occupy the same region".

Your text is better, thank you. Your formulation is used in the text.

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Lines 137-138. "In a similar way LTE series were observed during other investigated years of relatively high (2015) and low (2018) solar activity." It is necessary to clarify what the level of solar activity was in 2014 and what index was used for the solar activity characteristic. The author should also indicate numerical values of the solar activity level for each year. Please, explain what "LTE series" is.

Such a definition of LTE series is given in text:

"We define such a continuous sequence of LTEs observed day by day as a series of LTE. At least two consequently observed LTEs are considered as a series."

The following text was added to the section Data and methods.

"The estimation of solar activity level is based on F10.7 index from OMNI database. During the investigated years monthly averaged F10.7 values were varying in ranges 130-160 (2014), 95-135 (2015), 65-75 (2018) sfu corresponding to high, relatively high and low level of solar activity."

Line 163. "distribution of this ratio vs IMF intensity." Please, explain: - what "IMF" is; -what "IMF intensity" is: whether it is B intensity or Bz intensity;

IMF intensity was standing for B intensity. All the mentioned terms "IMF intensity" are replaced by "IMF intensity B".

Line 178. Article [Cherniak et al., 2012] is not included in References.

The missed reference was added

Line 225. "5 Discussion" Probably, the author meant "5 Summary".

The misprint is corrected to "5 Conclusions"

Lines 240-305, References. Articles [Afonin et al., 1995], [Chen et al., 2011], [He et al., 2011], [Krankowski, et al., 2009], [Matyjasik, et al., 2005], [Sun, et al., 2017] are not mentioned in the text.

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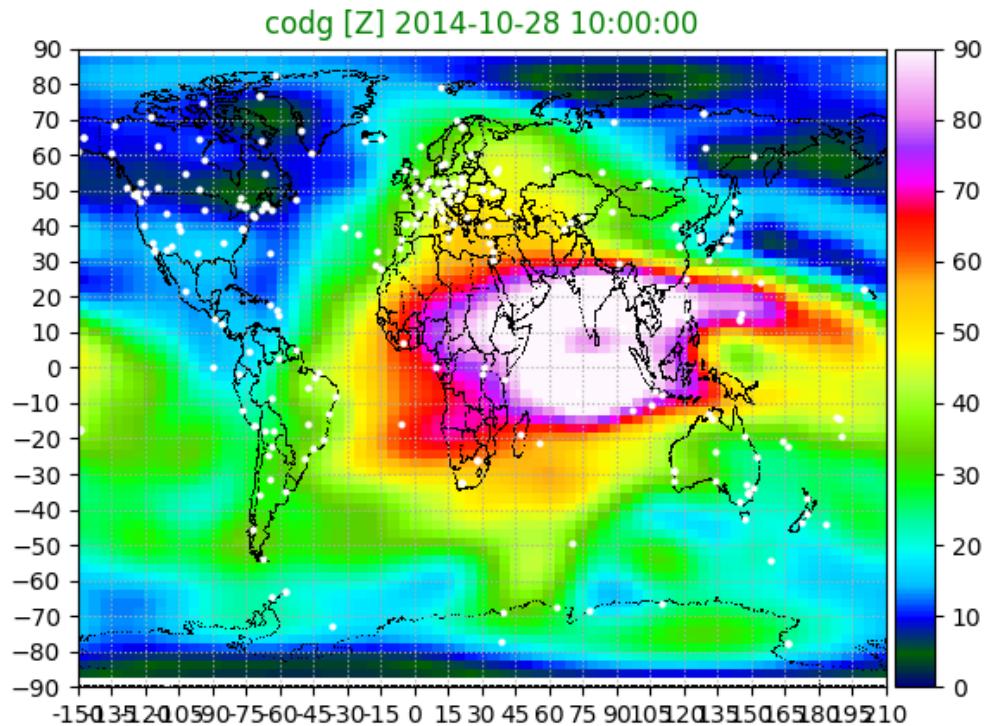
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Interactive comment on Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2019-124>, 2019.

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Fig. 1. Example of EIA continuation