We greatly appreciated Dr. Angelo De Santis for providing the evaluation and valuable suggestions to our manuscript. Here are the point-to-point replies.

1. In general. In this article, specific information about the Mexico EQ is missing (tectonics of the region, fault style, effects of EQs in terms of deaths, economic losses, references, etc.). Also some literature on possible precursors of this EQ is missing.

A: We will add more information about this earthquake in the revised version. The detailed text is as follows:

'The Mexico Mw7.2 earthquake with 10 km depth occurred at 22:40 UT (universal time) on April 4 2010. The epicenter was located at (32.286°N, 115.295°W). It is also called M7.2 Baja California earthquake (Yao et al., 2012; Jie and Guangmeng, 2013; Ulukavak and Yalcinkaya, 2017). The earthquake occurred on the northwest-trending strike-slip fault, which is along the principal plate boundary between the North American and Pacific plates, with a movement rate of 4.6 mm per year (Ulukavak and Yalcinkaya, 2017). Most of the damage caused by this earthquake occurred in the twin cities of Mexicali and Calexico on the Mexico – United States border. At least three people lost their lives and about 100 people were injured in this nature hazard (Hermes, 2010).'

2. Lines 64-65. You missed our recent publication on Scientific Reports (De Santis et al. 2019; https://doi.org/10.1038/s41598-019-56599-1), that proposes a unified and possible standard method.

A: We will cite this article in the revised text in the 'Introduction' section:

'Based on the electron density and magnetic data observed by the Swarm constellation satellites for 4.7 years, statistical studies of 1312 M5.5+ earthquakes were carried out by De Santis et al. (2019). They found that ionosphere anomalies appear from a few days up to 80 days before the earthquakes, and that the occurrence of ionospheric anomaly is related to the earthquake magnitude.'

3. Line 93. Is it the spatial mean at each time within the considered area? It is not clear. Could you please clarify?

A: Yes, it is the spatial mean value for each 5-minute interval in the northern American region (20°N-50°N in latitude, 90°W-140°W in longitude). We will clarify this in the revised text:

‘The Fast Fourier Transform (FFT) algorithm was applied to obtain the spectral distribution of the TEC spatial mean value for each 5-minute interval in the northern American region (20°N-50°N in latitude, 90°W-140°W in longitude) from 2000 to 2017 (Figure 1)’.

4. Figure 2 (line 129). There is a clear spike in TEC data on 03/26. Why? Did you remove it before the analysis? It seems not.

A: In Fig. 2, we show the TEC residual change around the epicenter (in the region of latitude 30°N-34°N and longitude 113°W-117°W). Thank you for your comment. We reprocessed our data and found that there was a small bug in the processing routine. We re-plotted the data in Fig. S1, and the trend of TEC residual is almost the same as Fig. 2 in the text, except the spike on 26 March in the previous figure. So our results are not changed by this correction. In the revised text, we will replace with the new picture.

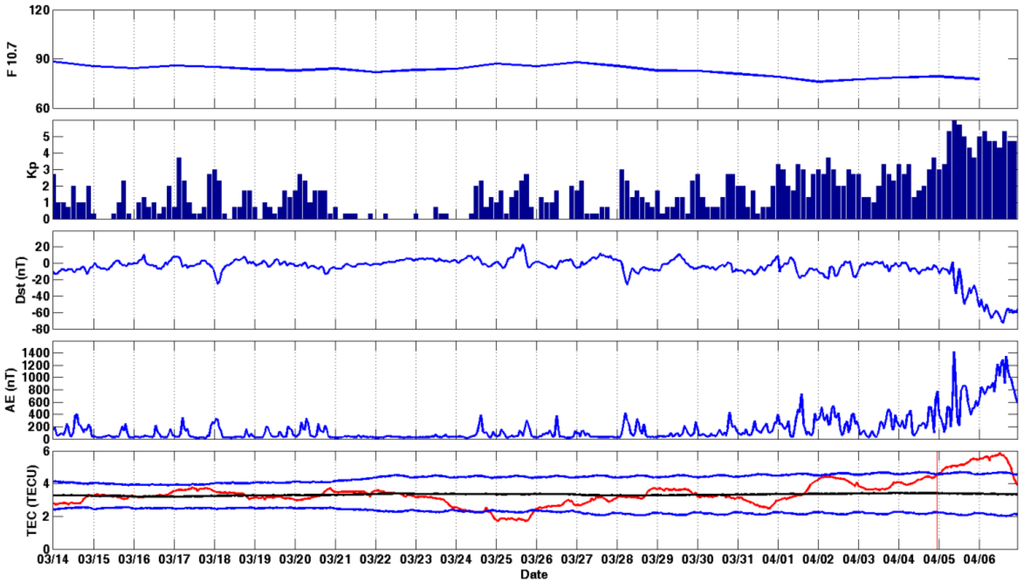

Figure S1: Time series of TEC residual (A(5)) around the epicenter from March 14 to April 6, 2010.

5. Line 137. The reason to use M+/-1.5 sigma is not convincing. I would prefer at least 2 sigma. By the way, why do not you use median and IQR (e.g. 1.5 IQR), because ionosphere is very irregular and it does not have a Gaussian distribution around a mean?

A: Under the assumption of a normal distribution, the probability of data within the range of $\pm\sigma$ and $\pm 2\sigma$ is 68.26% and 95.44%. In order to avoid the probability being too low or too high, we chose M±1.5* σ as the threshold to extract the disturbances that may be related to the earthquake and the probability is 86.64%. There are also some researchers using mean values to identify the ionospheric disturbances associated with earthquakes, such as Pulinets et al. (2005).

According to the reviewer's suggestion, we tried to use the median values and 1.5*IQR as the threshold to re-plot Fig. 2, showing in Fig. S2. The depletion of TEC residual on March 25 is also obvious, almost the same as that in Fig. S1. Therefore, we believe the choice of M+/-1.5 sigma not affecting our analysis results.

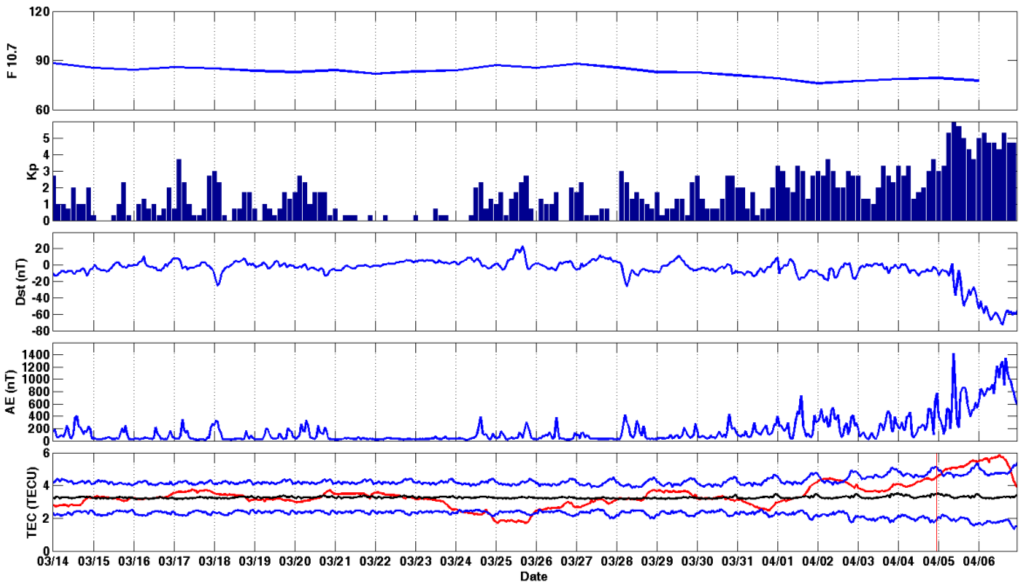

Figure S2: Time series of TEC residual (A(5)) around the epicenter from March 14 to April 6, 2010, using median values and 1.5*IQR as the threshold.

6. Line 181. Why do not you show an analogous figure as Figure 2 also for the other period analysed as confutation period, i.e. December 12 2009 to January 4 2010? By the way, this confutation period is very short. Why do not add at least another period, too, with same quiet magnetic conditions?

A: We also applied the running mean method to analyze the time series changes of TEC residual, showing in Fig. 2. The advantage of this method is that it can reveal the data trend during a continuous time period, with 1 hour time resolution as in Fig. 2. Figure S3 shows the result of the time series analysis during the geomagnetically quiet period from December 12 2009 to January 4 2010. The variation of the observational data is very small so the data spread is much narrower, within 1 TECU. Although there are some data exceeding the thresholds, the maximum relative change is just 6%, whereas the relative change of TEC residual on March 25 for the Mexico earthquake is more 20%. Therefore, considering also the results presented in Figure 6, we do not think that those data outliers are an indication of earthquake related. On the other hand, this also highlights the disadvantage of this method: it does not provide the spatial characters of the data. Therefore, we applied the spatial analysis method to investigate the TEC residual changings in the region, such as in Fig. 3. In all the days shown in Fig. 3, only on March 25 did the TEC residual data show a depletion in the region around the epicenter. In order to compare with the TEC residual character on March 25, the spatial analysis method was also used in other time periods, such as those in Figs. 4, 5, 6, and 7.

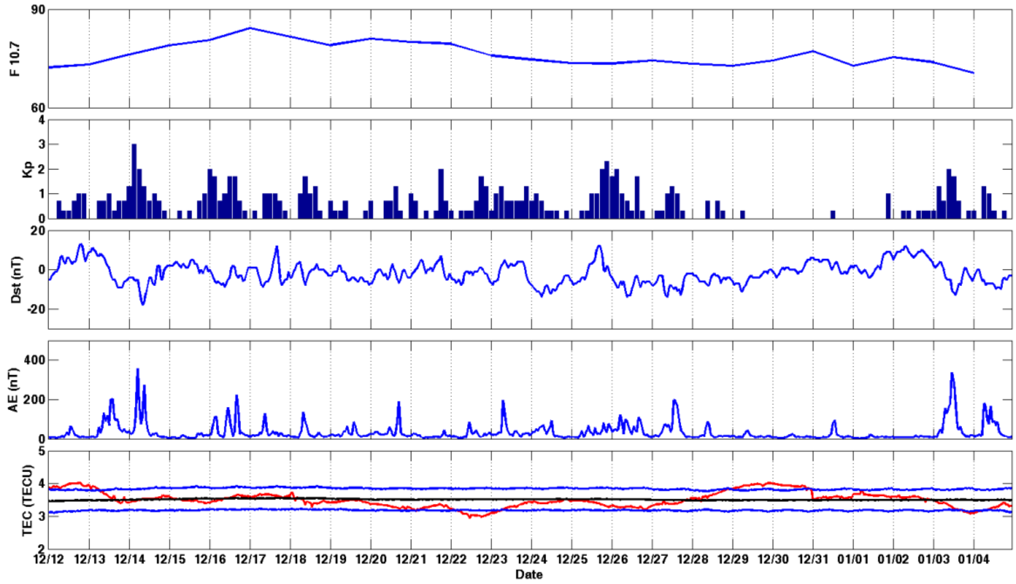

Figure S3: Time series of TEC residual (A(5)) around the epicenter from December 12 2009 to January 4 2010.

In this study, since we use ±15 days data as the background, the time period of the data must cover almost 2 months. Applying the criteria of geomagnetically quiet conditions (-30 nT < *D*st < 20 nT, *K*p < 3, *AE*<500 nT), we survey the magnetic activity data between 2000 and 2017 and found that the time period from November 27 2009 to January 19 2010 was the only time period that satisfied the geomagnetically quiet conditions. Therefore, we showed the analysis results of this period in Fig. 6. We wish to have more geomagnetically quiet periods that could help determine whether the phenomenon on March 25 can be observed in other geomagnetically quiet periods without earthquakes, but constantly changing geophysical conditions makes it very difficult to realize.

7. Since you analyse the data considering 15 days before and 15 days after the day of

concern, for estimating mean and sigma of the anomalous day of 25 March, you also include the day of the earthquake, where a possible co-seismic effect in TEC could have been produced. Have you considered this? Do you think it did not affect your results? By the way, have you looked at it to see if some effect is visible?
A: Thank you for your suggestion. We also considered this issue in our analysis, while we didn't remove the data on the day of the earthquake for the data continuity. In our analysis, the background is moving, hence, if there are some effects, the data before and after the time period should be affected. However, we just found the TEC depletion on March 25, and no anomaly was seen before and after March 25.

8. Finally a remark. You find a single anomaly occurring around 10 days before the Mw7.2 earthquake. Why excluding the possibility of some other anomaly even well before, for instance in February, i.e. a month not analysed in this work? According to Rikitake law (the precursor time scales with earthquake magnitude) we would expect several months before for a such an earthquake.
A: In Figure 3, a large TEC depletion on March 25 was detected. In order to determine whether similar TEC changes occurred in a longer time period, the data of 72 days were also analyzed centered around the earthquake date. Besides the disturbance on March 25, no other significant ionospheric TEC anomalies were identified in the 72-day period around the earthquake, except some TEC disturbances that appeared to be related to the geomagnetic activity. We wish that we could examine the TEC anomaly for a longer period of time, as suggested by the reviewer. However, as the ionosphere changes greatly with geophysical conditions, including season, solar 27-day rotation and geomagnetic activity, to name a few, it is very difficult to extend the period beyond what we showed in this paper.

Pulinets and Boyarchuk (2004) summarized that the plasma density disturbances that are possibly related to earthquakes occur from about several days to a few hours prior to the earthquakes. Therefore, the time range of seismo-ionospheric anomaly analysis should be long enough to extract the possible anomaly. Our approach is similar to previous studies. Liu et al. (2004; 2009; 2010) analyzed GPS TEC data ±15 days of the earthquakes to detect the seismo-ionospheric disturbances. Li and Parrot (2013) also paid attention to ±15 days of the earthquakes to analyze the ion density observed by the DEMETER satellite. Liu et al. (2011) used GPS TEC data 30 days before and 4 days after the 12 January 2010 M7 Haiti earthquake to study the seismo-ionospheric anomalies. Iwata and Umeno (2016) analyzed GPS TEC data 40 days before the 2011 Tohoku-Oki earthquake to check the pre-seismic TEC anomalies. The time range of our analysis covered 72 days (45 days before and 26 days after), for almost two and half months. Besides that, the TEC changes in other geomagnetically quiet days are also analyzed, which includes another 24 days of data. Therefore, we consider that the time range of our data analysis is long enough, as allowed by the required geomagnetically quiet conditions, for the purpose of study seimo-ionospheric connections.

9. Line 42. Please insert "2003" before "Colima Mexico earthquake".
A: We will insert it in the revised text.

10. Line 57. Please change "Statistics" with "Statistical".
A: We will modify it in the revised text.

11. Line 60. Please insert ""an original" before "software".
A: We will modify it in the revised text.

12. Line 91. This is the portal. Which is the precise site? At which date did you download the data? Please indicate better punctual information. Thanks.
A: The website is http://millstonehill.haystack.mit.edu/. We used the Matlab Madrigal remote data access programs provided by the website to download the data. You can press the 'APIs' on the website to see the detailed tutorial, and several popular programming languages (Matlab, python, and IDL) are available. You can also contact brideout@mit.edu, if there are any questions about the appropriate use and download of these data.

Reference

Hermes, O.: 2010 Baja California earthquake, Alphascript Publishing, 2010.

Iwata, T., and Umeno, K.: Correlation analysis for preseismic total electron content anomalies around the 2011 Tohoku-Oki earthquake, J. Geophys. Res.Space Physics, 121, 8969-8984, doi:10.1002/2016JA023036, 2016.

Jie, Y., Guangmeng, G.: Preliminary analysis of thermal anomalies before the 2010 Baja California M7.2 earthquake, Atmósfera, 26, 473-477,

doi:10.1016/S0187-6236(13)71089, 2013.
Li, M., and M. Parrot: Statistical analysis of an ionospheric parameter as a base for earthquake prediction, J. Geophys. Res. Space Physics, 118, 3731-3739, doi:10.1002/jgra.50313, 2013.
Liu, J. Y., Chen, Y. I., Jhuang, H. K., Lin, Y. H.: Ionospheric foF2 and TEC anomalous days associated with M ⩾ 5.0 earthquakes in Taiwan during 1997-1999, Terr., Atm. Ocean Sci, 15, 371-383, 2004.
Liu, J. Y., Chen, Y. I., Chen, C. H., Liu, C. Y., Chen, C. Y.: Nishihashi, M., Li, J. Z., Xia, Y. Q., Oyama, K. I., Hattori, K., Seismoionospheric GPS total electron content anomalies observed before the 12 May 2008 Mw7.9 Wenchuan earthquake, Journal of Geophysical Research Atmospheres, 114(114), 231-261, 2009.
Liu, J., Chen, Y., Chen, C., Hattori, K.: Temporal and spatial precursors in the ionospheric global positioning system (GPS) total electron content observed before the 26 December 2004 M9. 3 Sumatra-a-Andaman Earthquake, J. Geophys. Res, 115, A09312, 2010.
Liu, J., Le, H., Chen, Y., Chen, C., Liu, L., Wan, W., Su, Y., Sun, Y., Lin, C., Chen, M.: Observations and simulations of seismoionospheric GPS total electron content anomalies before the 12 January 2010 M7 Haiti earthquake, J. Geophys. Res, 116, A04302, 2011.
Pulinets, S. and Boyarchuk, K.: Ionospheric precursors of earthquakes, Springer Berlin Heidelberg, New York, 2004.
Pulinets, S. A., Contreras, A. L., Bisiacchi-Giraldi, G., Ciraolo, L.: Total electron content variations in the ionosphere before the Colima, Mexico, earthquake of 21 January 2003, Geofisica Internacional-Mexico, 44, 369-377, 2005.
Santis, A. D., Marchetti, D., Pavón-Carrasco, F. J., Cianchini, G.and Haagmans, R.: Precursory worldwide signatures of earthquake occurrences on Swarm satellite data, Scientific Reports, 9(1), 20287, https://doi.org/10.1038/s41598-019-56599-1.
Ulukavak, M., Yalcinkaya, M.: Precursor analysis of ionospheric GPS-TEC variations before the 2010 7.2 Baja California earthquake, Geomatics Natural Hazards & Risk, 1-14, 2016.
Yao, Y. B, Chen, P., Zhang, S., Chen, J. J., Yan, F., Peng, W. F.: Analysis of pre-earthquake ionospheric anomalies before the global M=7.0+ earthquakes in 2010, Nat Hazards Earth Syst Sci., 12, 575-585, 2012.