We would like to express our cordial thanks to the reviewer for the valuable comments and constructive suggestions. We appreciate the input of the reviewer and hope to make sure that we are incorporating his or her significant inputs to strengthen our analysis. We went through all the comments thoroughly and revised the manuscript accordingly.

This paper as the title describing, presents the first observation of the Transient Luminous Events (TLE) effect on the ionospheric Schumann Resonance (SR), based on the China Seismo-Electromagnetic Satellite. The results are very impressive and novel, which could potentially make significant contribution to the understanding of the electro-coupling between the lower atmosphere and ionosphere. The paper is suitable for ACP and can be published after some revisions and clarifications. The followings are my suggestions of this paper.

1. To further exclude the other possible sources or mechanisms that disturb the power Spectral Density of SR. The author should check if this is the impact of a cosmic gamma flare effect. Also, the authors should consider the possibility of Ionospheric Alfvén Resonator (IAR) illustrated as multi-band Spectral Resonant Structure (SRS) which is associated with tropospheric sprite lightning flashes. Some discussions should be added around this topic to enhance the readability of the paper.

Reply: Thanks for your valuable comment. Regarding other sources or mechanisms of SR Power Spectral Density perturbations, we examined the global SR during the day and determined that the PSD disturbances were regional, short-lived phenomena. In several neighboring orbits, such perturbations occur less frequently. In addition, cosmic rays and solar flares were not significant during the day. After comparing solar activity data such as solar flares and CMEs, it was determined that there was no influence of other extraterrestrial parameters. In order to make the background data more perfect, we excluded the influence of solar flares and cosmic rays, around line 166: ‘In order to exclude the influence of other factors, we examined the possible influence of solar activity and high-energy proton events. The data showed that the solar activity was relatively calm during these days, and there were no high-energy particle events.’

For the ionospheric Alfvén resonator (IAR), we compared the Alfvén resonance observed by the Chibis-M satellite, according to 'Electric field signatures of the IAR and Schumann resonance in the upper ionosphere detected by Chibis-M microsatellite' (Dudkin et al. 2014). The Alfvén resonance has a large overlap range with the SR band, and the Alfvén waves may perturb the SR characteristics. Therefore, we compared the SR and Alfvén wave interference phenomena observed in the Eskdalemuir Observatory in the Scottish Borders of the UK (referred 'Observation of Ionospheric Alfvén Resonances at 1–30 Hz and their superposition with the Schumann Resonances' (Beggan et al., 2018)), and conclude that there is some difference between this interference and the PSD perturbation of SR. Both surface and ionospheric Alfvén waves exhibit fingerprints form (Beggan et al. 2018; Dudkin et al., 2014), but CSES observations do not show this feature.

To complete the background of sprites and SRS research, we have added statements around line 62 as: 'The TLEs are closely related to atmospheric and ionospheric electromagnetic activities (Bösinger et al., 2006; Sátori et al., 2013; Shalimov et al., 2011). For example, the spectral structure of the surface SR has been studied by the sprite Q-burst, the electrical impulses generated during TLEs have been analyzed, and the ionospheric Alfvén wave resonances excited by jets have been monitored (Bösinger et al., 2006; Füllekrug et al., 1998; Guha et al., 2017). The Alfvén waves are considered to be controlled by global lightning activity, which will affect the magnetic field in the ionospheric region (Bösinger et al., 2002; Surkov et al., 2013).'

2. If possible, could author provide more cases like the examples shown in the paper which could be appended in the attached files and add a table in the main article.

Reply: Thanks for your valuable comment. In this research, we have found more cases of TLEs affecting the ionospheric electric field. When we chose the satellite orbit within 500 km from the Luoding ground station, there are two cases on May 3 and 23, 2021 that can meet the conditions of this study. A large number of TLEs occurred in the vicinity of Luoding on the two nights, while the satellite orbit was at a horizontal distance of about 200 km from Luoding. The ionospheric Schumann resonance was significantly perturbed in these two cases, and the signal-to-noise ratio decreased with the increase of the electric field energy in a similar way to the present study case. However, we lacked the lightning data near Luoding station at that time, and could only speculate that the parent lightning was about 200 km away from Luoding based on the shooting angle. And unfortunately, some other cases may have no comparison for the same orbit. Due to the limited length of the article, we did not put all the study cases in the main text. We have added the information on more TLEs in the supplementary material (see below), and we hope the reviewer could possibly re-assess our case studies again.

3. If possible, the authors may provide more information of the background global space environment and make sure that this is a local phenomenon at a given time and place.
Reply: Thanks for your valuable comment. We have statistically analyzed the nighttime electric field data of CSES on 2021. Due to the influence of solar activity, magnetic storms, and surface atmospheric activity, the ionospheric signal in ULF band is greatly perturbed (Balan et al., 2008; Fejer, 1981; Huang et al., 2005; Xiong et al., 2021). In the mid-latitude region of the northern hemisphere in winter, the signal of the Schumann resonance is weak and the frequency is unstable (Ouyang et al., 2015; Sátori et al., 2013; Zhou et al., 2013). This may be due to the concentration of global thunderstorm activity in the southern hemisphere at this time (Hayakawa et al., 2023; Nieckarz et al., 2009). As the center of global thunderstorm activity moves towards the Northern Hemisphere, the Schumann Resonance begins to show enhancement (Hayakawa et al., 2023; Nieckarz et al., 2009). According to our statistical results, there is a higher percentage of cases with more pronounced Schumann resonance (i.e., higher SNR) from May to September. We upload the background image of the PSD for the nighttime ionospheric electric field, i.e., the mean ULF electric field in the Northern Hemisphere for the five months (see the supplementary materials please). The mean ULF appears to have clear first and second modes of SR, representing the ionospheric SR background field.

4. The resolution of the figures can be further enhanced.

Reply: Thanks for your valuable comment. Unfortunately, the sampling frequency of the ULF electric field of CSES is about 0.5Hz, and the sampling distance is about 50Km. Based on the original electric field data, it is difficult to improve the resolution of the image. We appreciate the reviewer's understanding of this shortage of the data.

5. Some papers maybe related to the topic of this paper which I think should be added. Maybe missing some latest paper. The authors had better check that.

Dudkin, V. Pilipenko, V. Korepanov, S. Klimov, R. Holzworth, Electric field signatures of the IAR and Schumann resonance in the upper ionosphere detected by Chibis-M microsatellite, Journal of Atmospheric and Solar-Terrestrial Physics, 10.1016/j.jastp.2014.05.013, 117, (81-87), (2014).

L. Shalimov, T. Bösinger, Sprite-Producing Lightning-Ionosphere Coupling and Associated Low-Frequency Phenomena, Space Science Reviews, 10.1007/s11214-011-9812-x, 168, 1-4, (517-531), (2011).

Gabriella Sátori, Michael Rycroft, Pál Bencze, Ferenc Märcz, József Bór, Veronika Barta, Tamás Nagy, Károly Kovács, An Overview of Thunderstorm-Related Research on the Atmospheric Electric Field, Schumann Resonances, Sprites, and the Ionosphere at Sopron, Hungary, Surveys in Geophysics, 10.1007/s10712-013-9222-6, 34, 3, (255-292), (2013).

Tilmann Bösinger, Ágnes Mika, Sergei L. Shalimov, Christos Haldoupis, Torsten Neubert, Is there a unique signature in the ULF response to sprite-associated lightning flashes?, Journal of Geophysical Research: Space Physics, 10.1029/2006JA011887, 111, A10, (2006).

Reply: Thanks for your valuable comment. We have carefully read these references and corrected the content of the article accordingly. In order to complete the background of the study of ionospheric SR, we have added some references in the introduction and revised parts of the introduction.

We have modified the statements around lines 45-51 as follows:

'This kind of waves with frequencies of 7.8 Hz, 14 Hz, and 20 Hz can resonate with the phase of the initial wave, that is, the Schumann Resonance (SR) (Balser and Wagner, 1962; Sátori et al., 2013; Schumann, 1952). Because of the existence of SR, some bands of the atmospheric electric field energy will show peaks (e.g., the SR frequency) and valleys (e.g., the non-SR frequency) in the spectral graph (Balser and Wagner, 1962; Galejs, 1970; Sátori et al., 2013; Simões et al., 2011). In 1962, the frequencies of SR were deduced to be $\omega_1 = 7.8$ Hz, $\omega_2 = 14.1$ Hz, $\omega_3 = 20.1$ Hz and $\omega_4 = 26.6$ Hz for the first time (Balser and Wagner, 1962). With more and more SR monitoring stations around the world, the global SR distribution has been obtained (Ouyang et al., 2015; Sátori et al., 2013; Zhou et al., 2013). In 2011, observations from the Communication and Navigation Outage Forecast System (CNOFS) satellite showed the electric field energy of ionospheric F layer increased in some bands, rather consistent with the surface SR mode (Simões et al., 2011). Further, theoretical calculations suggested that the SR can penetrate the bottom of the ionosphere (Simões et al., 2011; Surkov et al., 2013). Subsequently, the ionospheric SR phenomenon with an energy of $0.5\mu V/(m * Hz^{1/2})$ was observed by the Chibis-M satellite, and the results proved the existence of the F-layer SR at low and middle latitudes (Dudkin et al., 2014; Simões et al., 2011; Surkov et al., 2013). These results indicated the presence of SR in the ionosphere could also be provided by the energy from the surface atmosphere.'

We have modified the statements around lines 60-64 as follows:

'The mechanism of sprites and elves involves the electromagnetic field heating the particles at the bottom of the ionosphere, which will thus provide a feedback of huge amount of energy through differential potentials (Boccippio et al., 1995; Mende et al., 1995; Sentman et al., 1995). The TLEs are closely related to atmospheric and ionospheric electromagnetic activities (Bösinger et al., 2006; Sátori et al., 2013; Shalimov et al., 2011). For example, the spectral structure of the surface SR has been studied by the sprite Q-burst, the electrical impulses generated during TLEs have been analyzed, and the ionospheric Alfvén wave resonances excited by jets have been monitored (Bösinger et al., 2006; Füllekrug et al., 1998; Guha et al., 2017). The Alfvén waves are considered to be controlled by global lightning activity, which will affect the magnetic field in the ionospheric region (Bösinger et al., 2002; Surkov et al., 2013).'

Since the frequency of the Alfvén wave is close to the ULF band, the Alfvén wave generated by the lightning may also cause a perturbation of the electric field. In order to eliminate the Alfvén wave, we have added statement around line 170 as: 'The lightnings will also produce Alfvén waves, which are close to the two modes of SR, and may interfere with the ionospheric SR (Beggan et al., 2018; Dudkin et al., 2014). Therefore, we analyzed the time-frequency characteristics of the interference patterns between Alfvén wave and the Schumann resonance, comparing with the electric field disturbance. The interference is generally manifested as a fingerprint shape. However, the SR anomaly in Fig.3 is quite different from this interference characteristics. Thus, we still believe that this anomaly is not caused by Alfvén wave.'

6. "… CSES are utilized to the study the disturbance of …" remove "the". Please check every sentence and word to reduce the grammar errors.

Reply: Thanks for your valuable comment. We have corrected the grammatical error at line 184 and checked the whole text. We have modified line 184 to 'In this research, the latest ionospheric electric field data from the CSES are utilized to study the disturbance of ionospheric SR during lightnings and TLEs for the first time.'

References for this response

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Bösinger, T., Mika, A., Shalimov, S. L., Haldoupis, C., and Neubert, T.: Is there a unique signature in the ULF response to sprite-associated lightning flashes? *Journal of Geophysical Research Space Physics*. 111, A10310, https://doi.org/10.1029/2006JA011887, 2006.

Dudkin, D., Pilipenko, V., Korepanov, V., Klimov, S., Holzworth, R.: Electric field signatures of the IAR and Schumann resonance in the upper ionosphere detected by Chibis-M microsatellite, *Journal of Atmospheric and Solar-Terrestrial Physics*, 117, 81-87, https://doi.org/10.1016/j.jastp.2014.05.013, 2014.

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Sátori, G., Rycroft, M., Bencze, P., Märcz, F., Bór, J., Barta, V., Nagy, T., and Kovács, K.: An Overview of Thunderstorm-Related Research on the Atmospheric Electric Field, Schumann Resonances, Sprites, and the Ionosphere at Sopron, Hungary, *Surveys in Geophysics*, 34, 255–292, https://doi.org/10.1007/s10712-013-9222-6, 2013.

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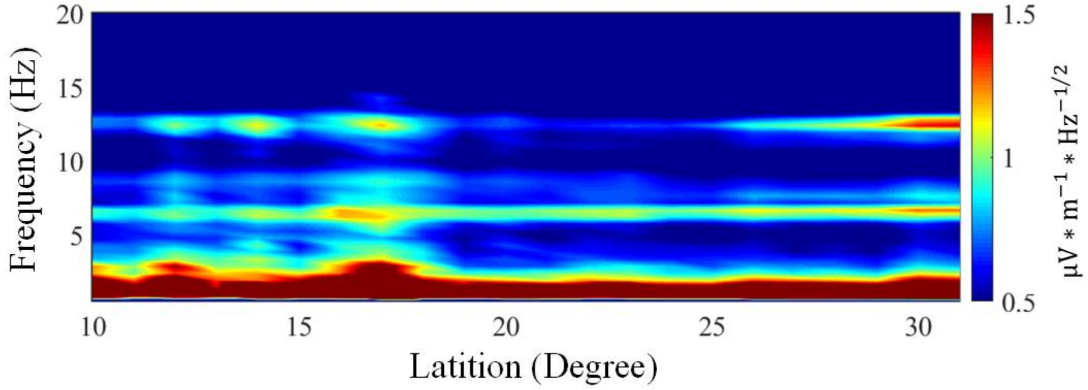
Supplementary materials

1. The background SR of local ionosphere:



Luoding station is located on the northern edge of the thunderstorm's center in South Asia-Southeast Asia region. Thunderstorm activity increases from April to September each year. Ionospheric SR energy enhancement is observed. We selected the background data calculation from April to September. This graph represents the mean of ionospheric SR. From the diagram we can find the SR 1mode and 2mode. We cautiously use it as a background for the SR in 2021. As solar activity intensifies, ionospheric SR appears to be obscured by the strong electric fields (Zhu et al. 2023).

2. Some additional TLEs cases and parameters studied/examined in this research

TLEs are difficult to monitor. Some TLEs occur in clusters, and some TLEs occur sporadically at different times. In 2021, a total of 14 cases of TLEs were monitored at the Luoding Station, including 9 cases in May, 1 case in June, 1 case in August, 2 cases in September, and 1 case in October. The CSES satellite orbit travels and passes overhead around this area twice every day at 6:00 UT and 18:00 UT. In addition to the case on 25 September 2021, we obtained 6 cases of TLEs that occurred near Luoding around the time of 18UT. The 6 cases are shown and summarized in the table below. The time and number of photographed TLEs are documented in the table. 'TLE cases' represents the days when these cases appeared in the Luoding station, 'TLE count' represents the total number of TLEs observed around the station, 'Distance' represents the minimum horizontal distance between Luoding station and CSES's satellite orbit, and 'Anomaly range' represents the approximate range of anomalies in satellite orbits.

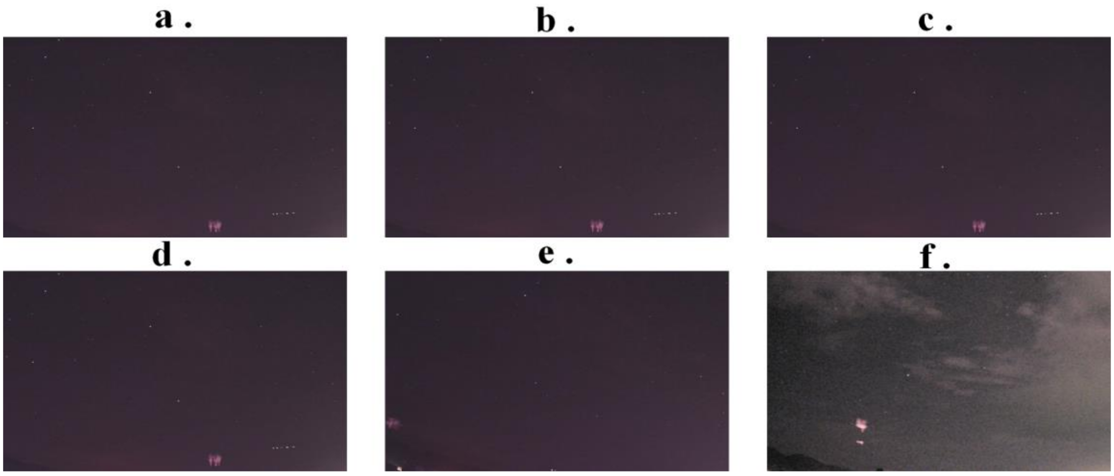
Finally, we attach specific information on all 6 cases of TLEs.

TLEs cases and parameters:

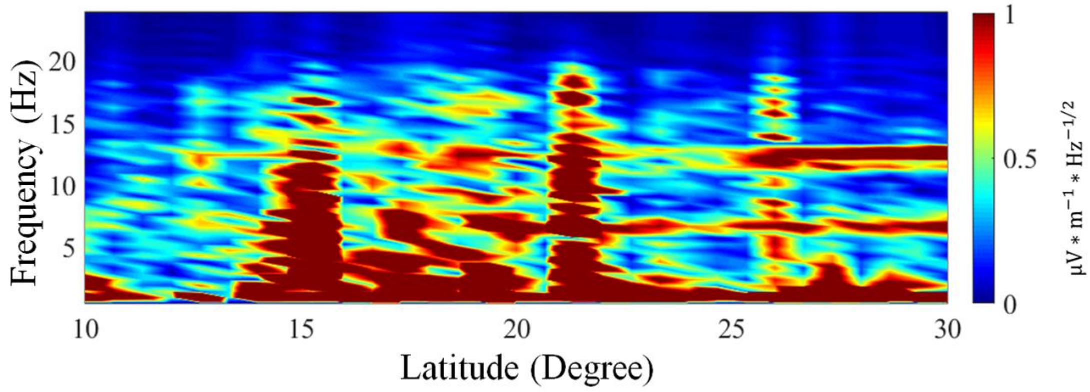
TLE cases	TLE count	Distance (km)	Anomaly range
May 3, 2021	27	300	13°N-20°N
May 10, 2021	90	1800	10°N-25°N
May 11, 2021	65	1300	10°N-30°N
May 12, 2021	26	800	10°N-16°N
May 23, 2021	16	300	17°N-22°N
June 5, 2021	20	1300	17°N-22°N

The details of the TLEs:

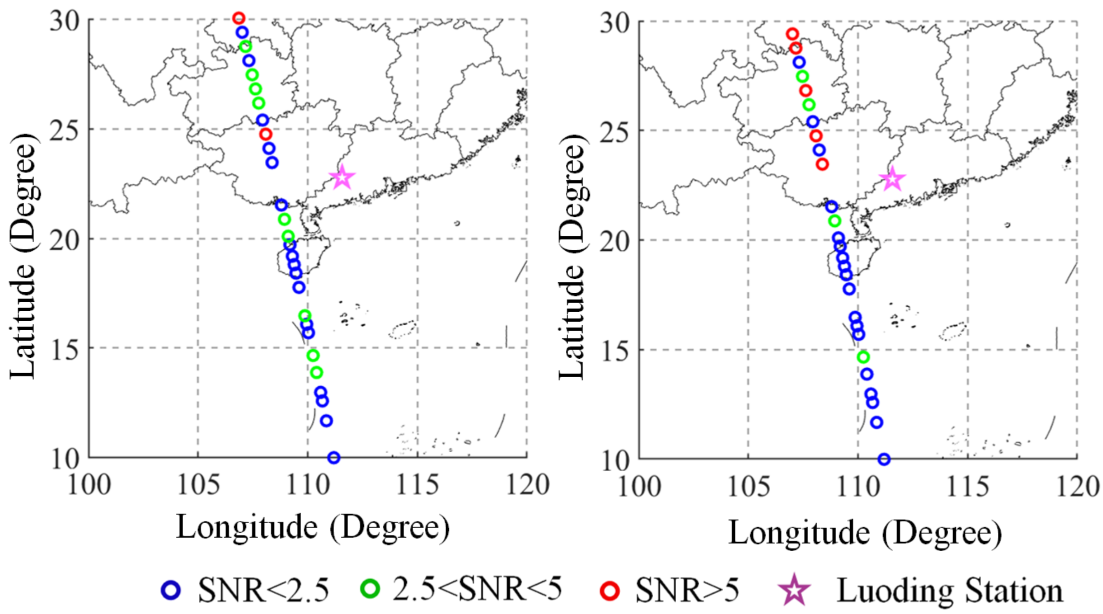
(1). TLEs on May 3, 2021



Some TLE cases photographed on May 3, 2021

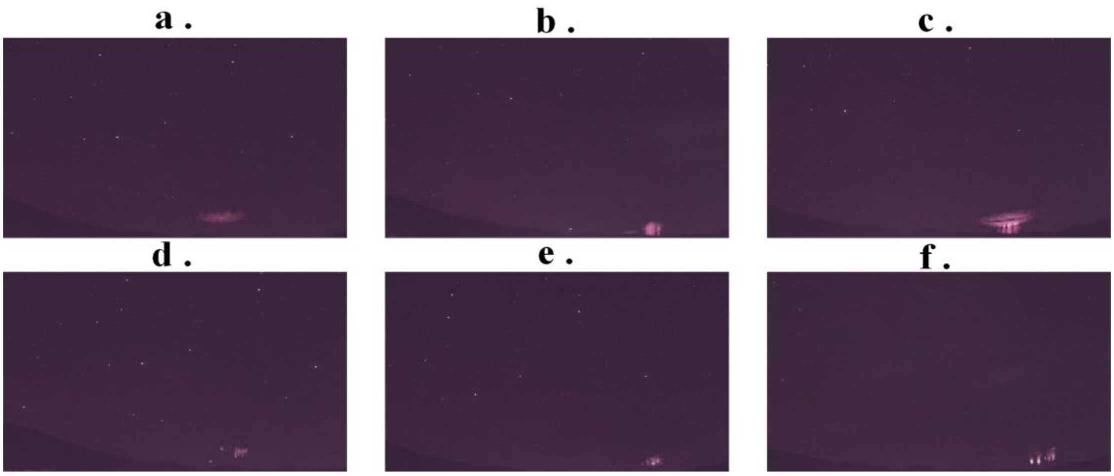


The PSD of ULF electric field

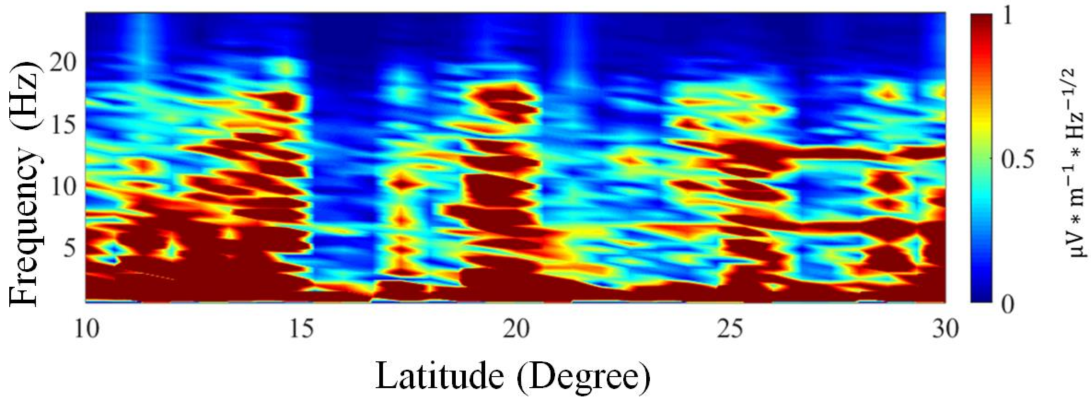


The SNR of SR 1mode (left) and 2mode (right)

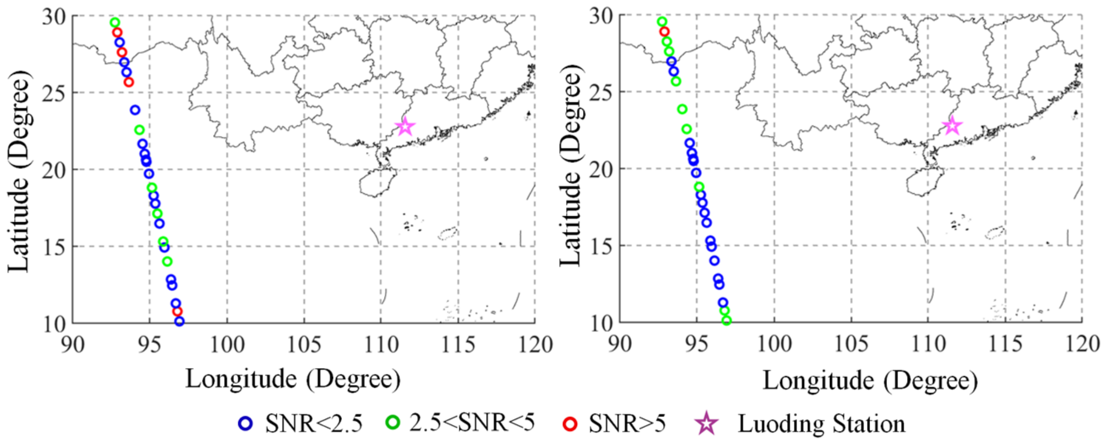
(2). TLEs on May 10, 2021



Some TLE cases photographed on May 10, 2021

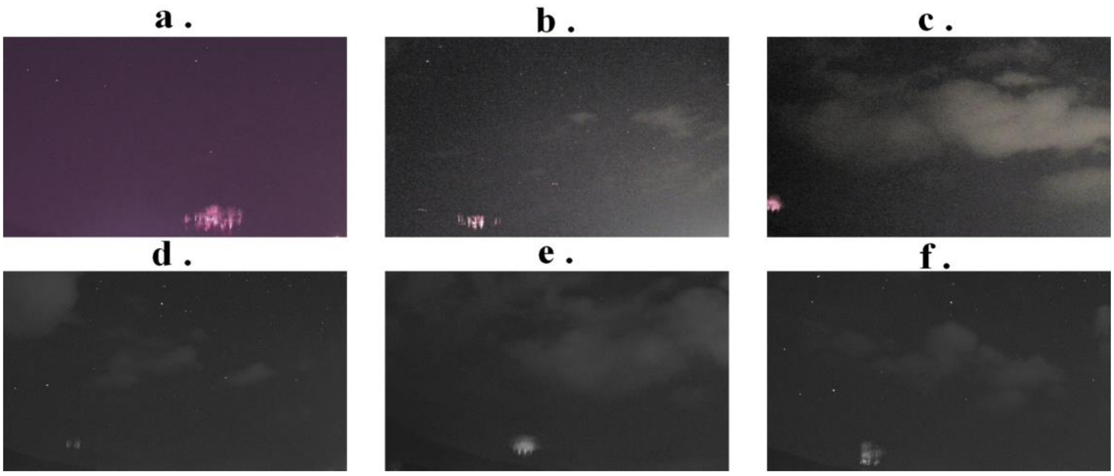


The PSD of ULF electric field

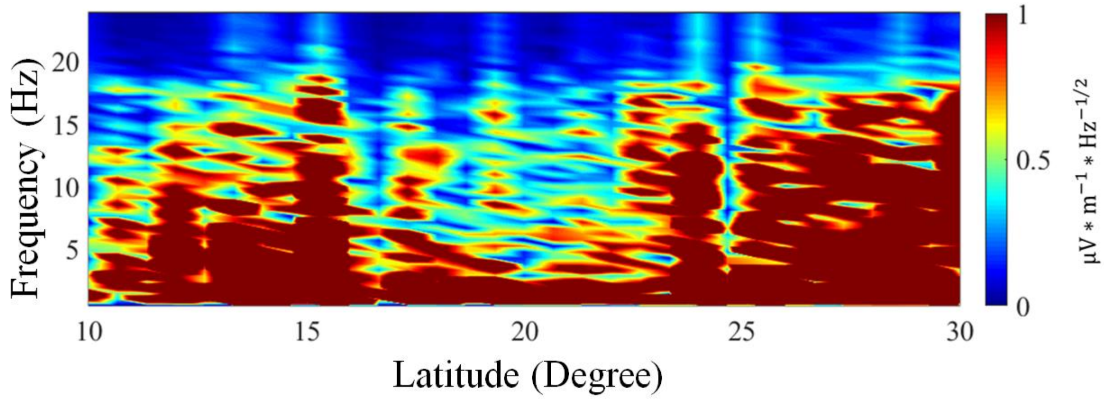


The SNR of SR 1mode (left) and 2mode (right)

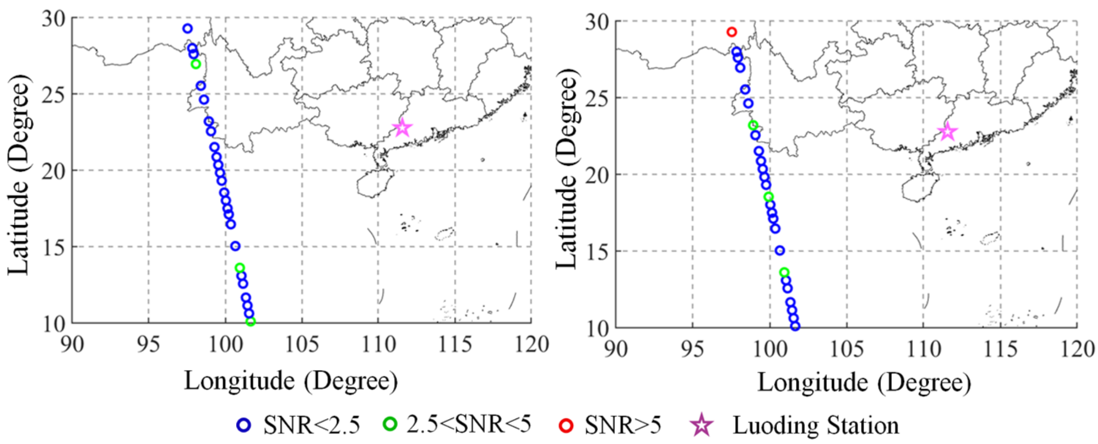
(3). TLEs on May 11, 2021



Some TLE cases photographed on May 11, 2021

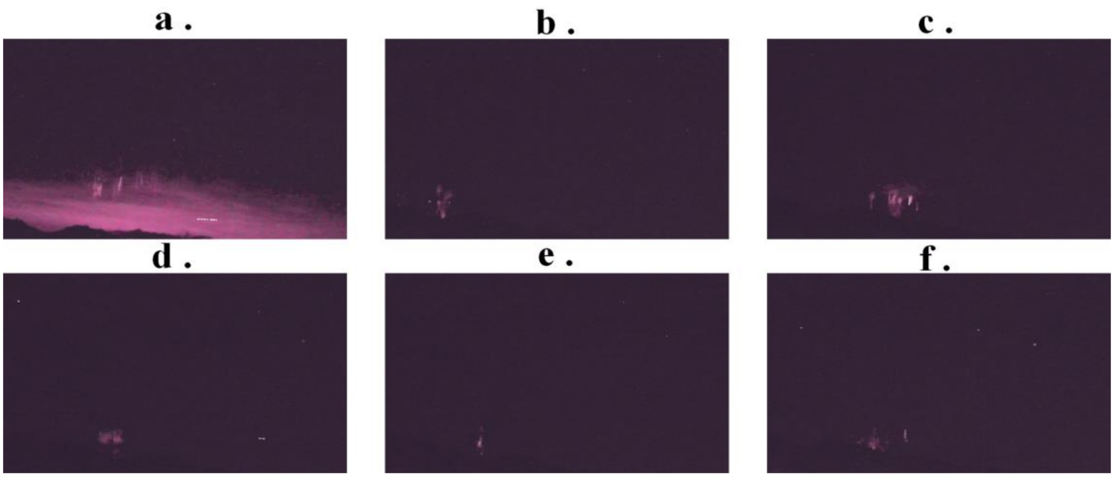


The PSD of ULF electric field

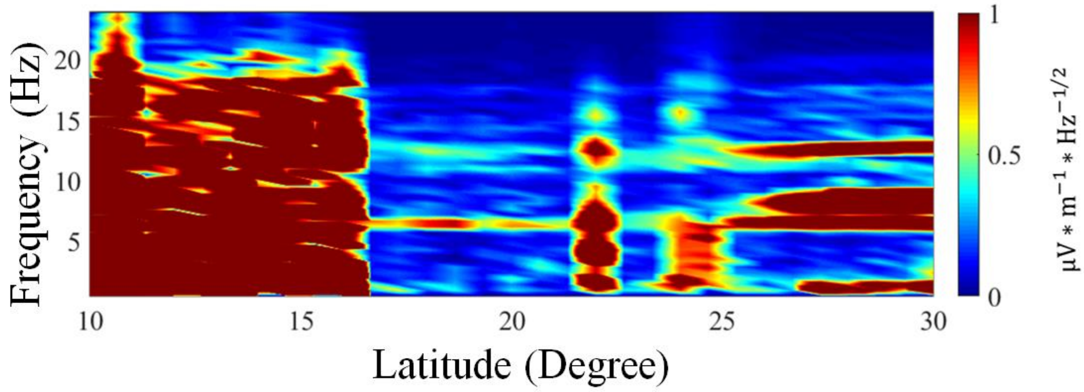


The SNR of SR 1mode (left) and 2mode (right)

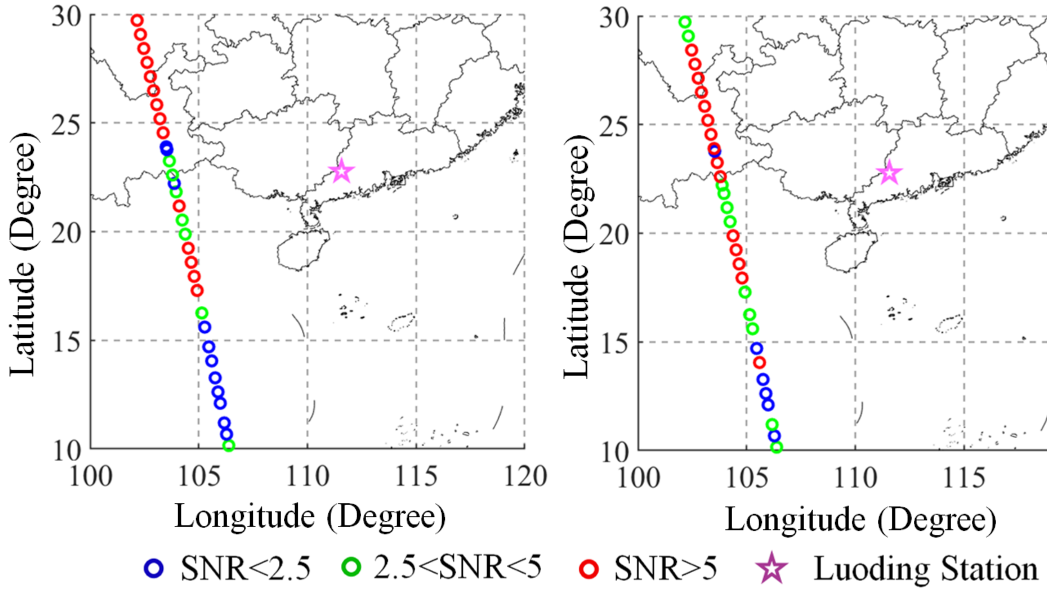
(4). TLEs on May 12, 2021



Some TLE cases photographed on May 12, 2021

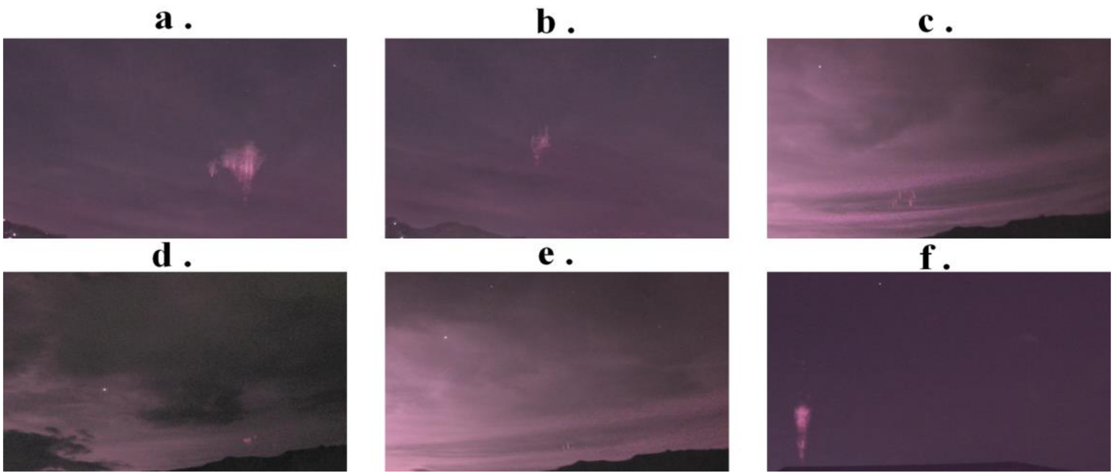


The PSD of ULF electric field

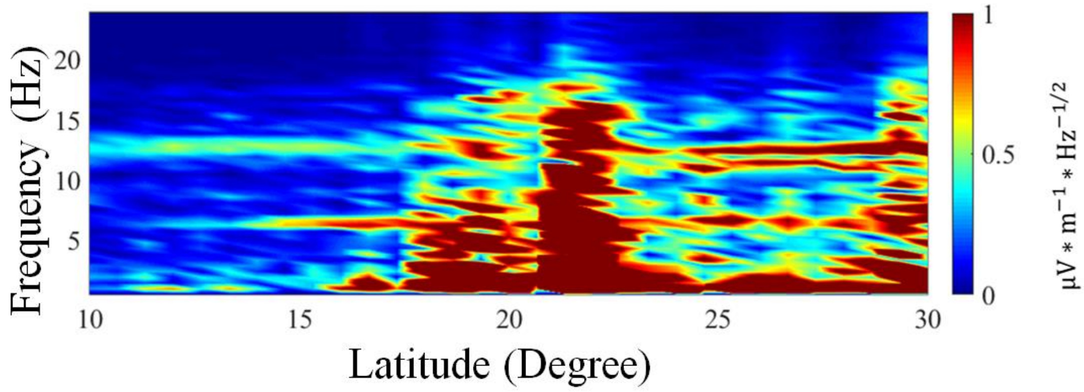


The SNR of SR 1mode (left) and 2mode (right)

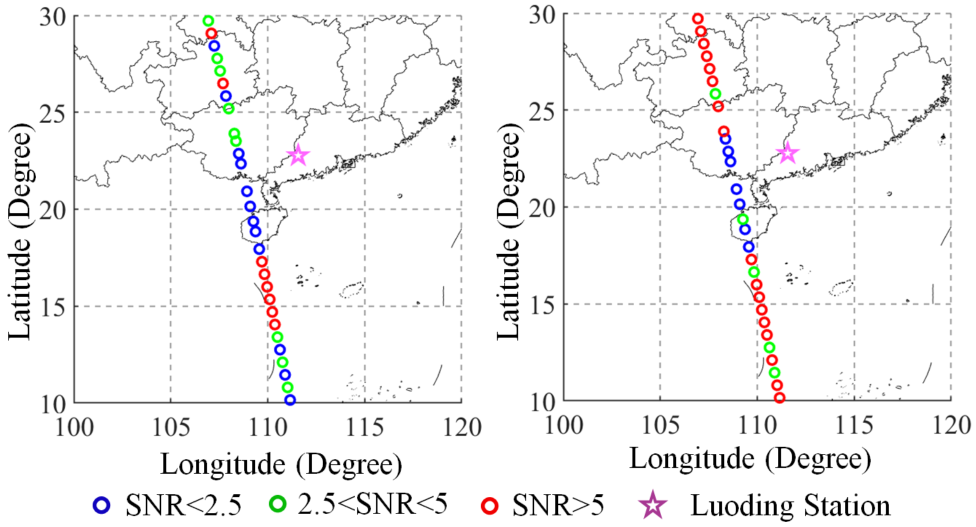
(5). TLEs on May 23, 2021



Some TLE cases photographed on May 23, 2021

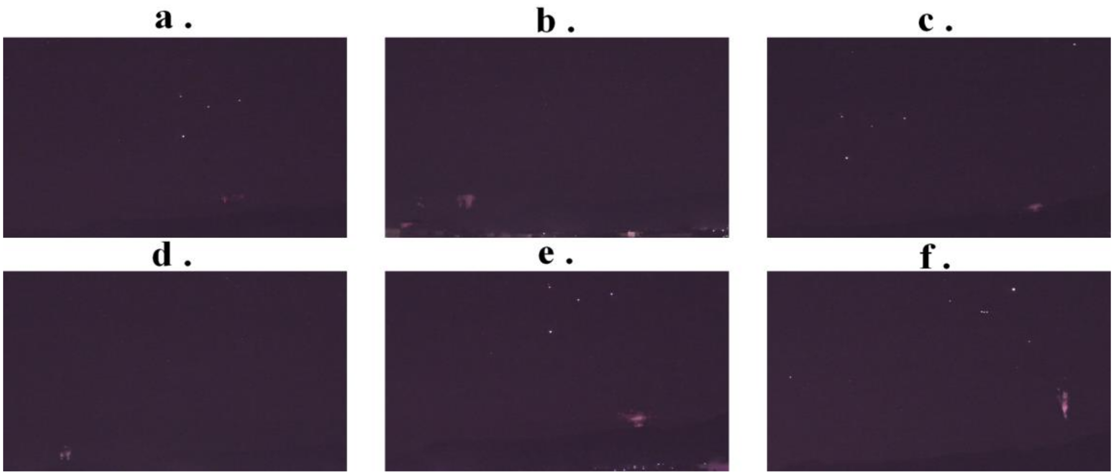


The PSD of ULF electric field

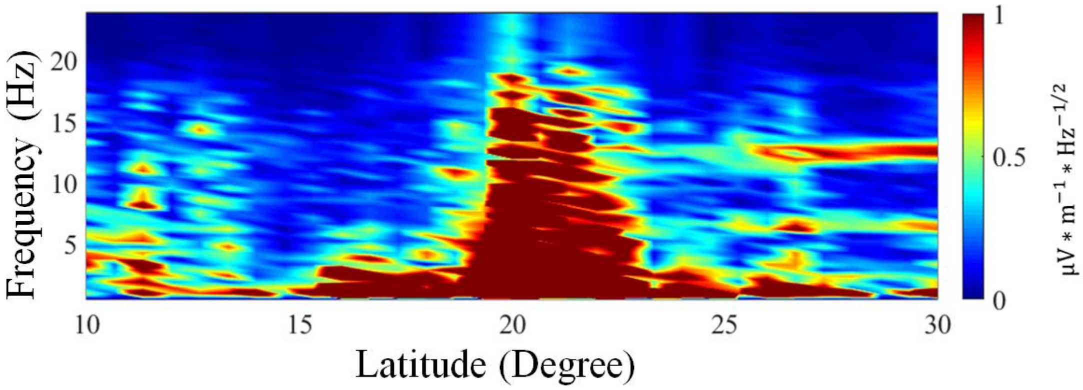


The SNR of SR 1mode (left) and 2mode (right)

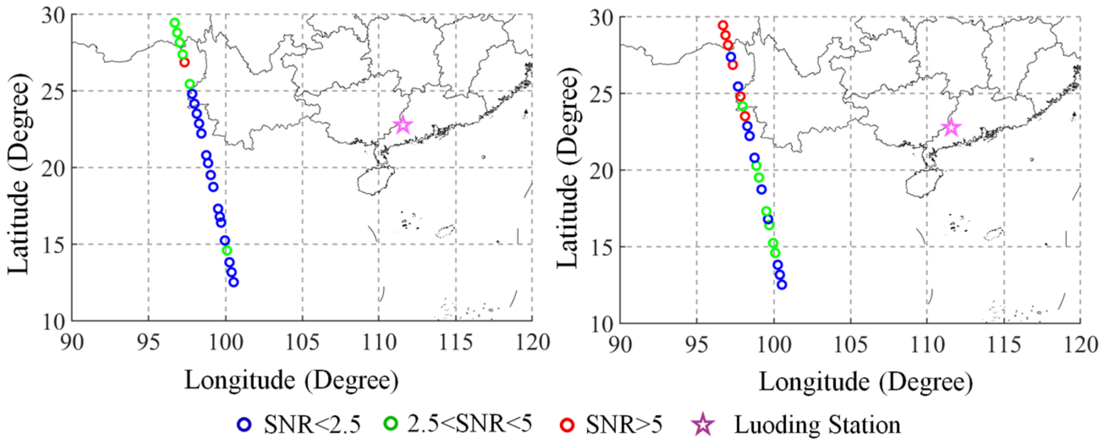
(6). TLEs on June 5, 2021



Some TLE cases photographed on June 5, 2021



The PSD of ULF electric field



The SNR of SR 1mode (left) and 2mode (right)

Reference of this supplementary materials:

Zhu, K., Yan, R., Xiong, C., Zheng, L., Zeren, Z., Shen, X., Liu, D., Guan, Y., Liu, C., Xu, S., Lv, F., Guo, F., Zhou, N.: Annual and semi-annual variations of electron density in the topside ionosphere observed by CSES. *Frontiers in Earth Science*, 11, https://doi.org/10.3389/feart.2023.1098483, 2023.