RC2:

The paper deal with the detection of sporadic E (Es) layers on a global scale applying the radio occultation (RO) technique. For their study, the authors use data obtained from the Chinese CSES mission. The authors developed a new algorithm to detect sporadic E signatures from RO profiles. The results show that Es appears mainly at heights between 90-110km and preferably in the summer hemisphere in the local daytime hours. The comparison with co-located ionosonde measurements shows a relatively high correlation between both measurements techniques.

The results more or less confirm what we know about sporadic E layer occurrence from former global studies. The paper does not provide new knowledge on the Es phenomenon. Nevertheless, I support the publication of the manuscript after a careful revision since it introduces the valuable and widely unknown RO data set of the CSES satellite to the community. Please find my detailed comments below.

Thank you very much for your positive comments and careful reminding on our manuscript to improve the quality of it.

- It would be informative to add some more details about the CSES satellite. At which altitude and inclination is it flying?

Thank you for your suggestion. We feel sorry that we did not provide enough information about CSES. The CSES is a 3-axes-stabilized satellite, based on the Chinese CAST2000 platform, with a mass of about 730 kg and peak power consumption of about 900 W. Scientific data are transmitted in the X-Band at 120 Mbps. The orbit is circular Sun-synchronous, at an altitude of about 507 km, inclination of about 97.4°, descending node at 14:00 LT. We will include this in the revised manuscript.

- Do the RO profiles cover the whole globe? Are the data equally distributed in local time?

Thank you for your reminding. All payloads of CSES are designed to work in the region within the latitude of ±65°, and the RO profiles range of CSES is mainly between −65° and +65° of geographic latitudes. Overall the GRO occultation can realize global coverage, we can refer to Cheng et al, 2018 (http://doi.org/10.26464/epp2018048). The GOR measurement of CSES from March 1 to December 1 in 2018 are used in the data analysis. With nearly nine months of data from CSES, there are 104531 and 12642 electron density profiles obtained from GPS and BDS-2 data of CSES, respectively. The original data with a sampling rate of 1Hz is from nearly 0:00 to nearly 24:00 every day. When we analyze the distribution of Es incidence with local time and latitude as the section 3.4, although we did not separately provide the distribution of Es incidence with local time, the original data and RO profiles are equally distributed in local time.

- Could you add some information to the "Methods" section about the altitude resolution of your RO profiles? What is the signal tracking frequency?

Thanks for your suggestions. Based on GNSS RINEX format data, we calculate the electron density profile by occultation inversion algorithm (Lei et al, 2007; Yue et al, 2011). The original data processed in this study is the original occultation observation data with a sampling rate of 1Hz. So, the time resolution of our RO profiles is 1Hz. According to occultation inversion algorithm, we can get RO electron density profiles, but we can't easily get the altitude resolution directly. As shown in Figure1-2, the altitude of RO profiles is unequally distributed. So, we feel sorry that we could not provide precise altitude resolution of our RO profiles.

The GOR payload on board CSES can receive the dual frequencies from GPS (L1: 1575.42±10 MHz; L2: 1227.6±10 MHz) and BDS-2 (L1: 1561.98±2 MHz; L2: 1207.14±2 MHz). We will include this in the revised manuscript, thank you.

- Figures 4-6 are my major point of criticism: Due to the relatively low amount of RO profiles, the plots 4-6 are not very informative and deviate distinctly from existing global Es plots. I recommend increasing the grid size slightly (maybe 10° in longitude) or working with sliding windows of a bigger size.

  Thanks for your valuable recommendation. We will increase the grid size of 10° in longitude to analyze the global Es-event distribution and morphology. In order to reduce the impact of accidental errors, we further optimized the statistical method, the Es occurrence rate for the grid is calculated only when the number of occultation events in the grid is greater than 10. We will include these in the revised manuscript.

- line 240-243: There is a contradiction between figure 6 and the text. In the text, you write that the high incidence of Es in the local afternoon is related to high solar radiation. In Fig. 4 (summer plot) the values of Es occurrence are of the same magnitude at 3-6 in the morning where there is definitely no sunshine. Could these high early morning values simply be relicts from data availability? Is an effect from the wind possible? Please comment on it.

  Thanks for your valuable reminding. We are sorry for our careless mistakes. When we calculate the number of GNSS RO events of each day for CSES GPS, CSES BDS-2, we find the daily RO events number has a certain deviation. Then we checked the RO profiles and the original observations. For the full-day original observations, the RO profiles are uniformly distributed at the local time, but there are some incomplete original observations, especially close to the initial operation period of CSES launch, therefore, the distribution of RO profiles at the local time in those days is not uniform, there is a certain deviation in further obtaining the distribution of the number of Es occurrence at the local time. In the original manuscript, we used the ratio of the number of occultation events with Es events in the grid to the total number of days to calculate the occurrence rate, which caused

a very large error. We will use a new calculation, that is the ratio of the number of occultation events with Es to the total number of occultation observations in the grid, at the same time, the Es occurrence rate for the grid is calculated only when the number of occultation events in the grid is greater than 10 to reduce the impact of accidental errors. After calculation, there is no such abnormal phenomenon at 3-6 in the morning. We will include these in the revised manuscript.
Thank you again for your positive comments and valuable suggestions to improve the quality of our manuscript.

- You show electron density profiles obtained from RO measurements. These profiles are frequently not accurate for smaller-scale ionospheric phenomena since they rely on assumptions like spherical symmetry which is not valid for sporadic E. Could you comment a bit on the assumptions used for calculating the electron density profiles here?

  Thank you for suggestions. Under the assumptions of spherical symmetry (i.e., assuming only vertical electron density gradients), straight-line propagation and an earth's spherical shape, we calculate the electron density profile by occultation inversion algorithm mainly referring to Lei et al. (2007) (https://doi.org/10.1029/2006JA012240).
  Yes, you are right, these assumptions especially the assumptions of spherical symmetry are frequently not fully accurate for smaller-scale ionospheric phenomena, the calculated electron density values are not accurate and can only describe the approximate numerical distribution. Nevertheless, this study does not attempt to retrieve the absolute accurate electron density values of Es, but show the electron density differences at Es peaks compared to those electron density profiles without the Es phenomenon.
  Our new criterion is developed to mainly use the normalized SNR to determine the Es events, the electron density profile is only a reference to illustrate the effect of relatively higher electron density at Es on the normalized SNR variation, it is further verified that variance in SNR can be suggested to identify and sound sporadic E layers.
  We will comment a bit on the assumptions in the revised manuscript.

- Figure 8: I assume the black line is no regression but x=y line, correct? It is a little bit misleading since there is definitely an offset between both parameters simply because virtual heights are always deviating from geometric ones.

  Thank you for your reminding. Yes, the black line is no regression but x=y line. Our original purpose of drawing the line y=x is to facilitate the reader to compare the degree of deviation of radio occultation Es heights and ionosonde derived heights from y=x. We will show the regression line and corresponding statistical coefficients in the revised manuscript.

What is the mean offset between both techniques and can this be explained by different altitude systems?

According to our experimental results, the height offset is mainly concentrated in 100-110km of ionosonde altitude, and the calculation results of different space-time windows are different. The mean offset values in 100-110km are 2.36km, 2.25km, 2.90km, and 3.09km, which correspond to space-time matching windows (10°, 10°, 7.5 min), (5°, 10°, 7.5min), (5°, 5°, 7.5min) and (2°, 5°, 7.5min), respectively. We will include this in the revised manuscript.

In the lower right plot, there should be 5 couples. I only see 4. Is it convincing enough to calculate a correlation coefficient from 4-5 values only?

Thanks for your careful checks. There really be 5 couples, two of the points are very close in height and almost overlap in the figure, we have commented on line 279-280. Yes, it is really not suitable to calculate the correlation coefficient with only 5 values, our original purpose of calculating this space-time matching windows is to draw conclusions that the correlation increased slightly as a stricter space-time matching window involved, but with less pairs or couples. The first three space-time matching window figures have revealed that there is a good agreement between both parameters, which can also be seen from the high correlation larger than 0.7. After discussions with our authors, we decided to remove the results of this window in the revised manuscript, thank you again.

- Please carefully revise the complete references section. There are many typos and different styles in citing existing literature.

  We are really sorry for our careless mistakes. Thank you for your reminding. We will carefully revise the complete references section in the revised manuscript.

small improvements:

line 185-186. I assume there is a detail missing in this sentence. For me, it is hard to follow your intention.

Thanks for your careful checks. We are sorry for our carelessness. We will rewrite them in the revised manuscript.

line 201, 222, and 239: ...results with spring.... "with" is not the correct word here. Please reformulate.

Thanks for your careful checks. We will correct ‘with’ to ‘of’ in the revised manuscript.