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Interactive comment on "Strong influence of solar X-ray flares on low-frequency electromagnetic signals in middle latitudes" *by* Alexandr Rozhnoi et al.

Anonymous Referee #2

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Comments on "Strong inïňĆuence of solar X-ray ïňĆares on low-frequency electromagnetic signals in middle latitudes" by Rozhnoi1 et al.

This paper investigate the fluctuation of VLF/LF signals response to the solar X-ray during two strong solar flares in September 2017. The observations showed that the virtual reflection height of D region, retrieved from the VLF/LF signals, was found to vary 12 km during the X-class 9.3 flare and 9 km during the X-class 8.2 flare. Further, spectral analysis of the X-ray and LF data show that the LF signal spectra are very analogous to X-ray spectra and the maxima interval between X-ray and LF spectra are in 2-16 min.

Generally speaking, it is an interesting paper that would enrich the recognition about lower ionosphere response to the solar flares, and the structure of the paper has been organized in a reasonable way. I have a few comments that need to be addressed, before the manuscript may be acceptable for publication.

Several major comments are suggested as follows: 1. In section abstract. Line 6 in page 1: "It" was found that... 2. In section 1. Line 7 in page 2: Recently, Li et al. (2019) studied the ionospheric response to solar flares based on medium frequency (MF) radar, and found that the electron density (Ne) and effective reflection height (H) had profound responses to solar flares. Liu et al. (2018) investigated the ionospheric D layer height fluctuations, during the solar flares, by analysing the VLF/LF waveforms emitted by lightning. It was found that the short-time fluctuations of D-layer height are linearly correlated to the flux density of solar radiations.

3. In section 2, page 5: What is sampling rate of your VLF receiver? Is the receiver able to continuously record waveforms? The manuscript needs to do a better job of introducing your data.

4. In section 2. Line 8-12 in page 5: "The study of ionosphere...with navigation". This paragraph seems to introduce the importance of investigating the ionospheric, so it is not suitable for the position in this section. It should be moved into the introduction.

5. In section 2, page 6: State the reason why the amplitude anomaly for the path GBZ-BIR is negative shown in Figure 5.

6. In section 2, page 6: Need to briefly mention how the effective reflection heights are calculated by the VLF/LF signals in manuscripts.

7. In section 2.1, page 7: "Maxima for both X-ray and LF spectra are in the interval of 2-16 min". It seems that interval between X-ray flares and LF spectra has correlation with the class of X-ray. Discuss it in this section.

8. In section 2.2, page 8: "Response of the D region of the ionosphere to weak X-ray

ïňĆuctuations during the recovery phase". What is "weak"? Be more specific.

9. In section 2.2, page 8. Need to discuss with previous work.

10. In section 1, page 1. The effective reflection height would be different retrieved by different frequency signals. The Transmitter frequency vary from 19.5 kHz to 45.9 kHz shown in Table 1. It would be useful to compare the reflection height retrieved by different frequency signals.

Li N, Lei J, Luan X, et al. Responses of the D region ionosphere to solar flares revealed by MF radar measurements[J]. Journal of Atmospheric and Solar-Terrestrial Physics, 2019, 182: 211-216.

Liu, F. F., Qin, Z. L., Zhu, B. Y., Ma, M., Chen, M., & Shen, P. (2018). Observations of ionospheric D layer ïňĆuctuations during sunrise and sunset by using time domain waveforms of lightning narrow bipolar events. Chinese Journal of Geophysics, 61 (2), 484 – 493. https:/ /doi.org/10.6038 /cjg2018K0658.

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