Solar X-ray effects on the D-region ionosphere using tweek atmospherics

Kodai Yamanobe[1]; Hiroyo Ohya[2]; Hiroyuki Nakata[3]; Toshiaki Takano[4]; Kazuo Shiokawa[5]
[1] Chiba University; [2] Engineering, Chiba Univ.; [3] Grad. School of Eng., Chiba Univ.; [4] Chiba Univ.; [5] ISEE, Nagoya Univ.

It has been known that intensity and phase of very low frequency (VLF, 3 - 30 kHz)/low frequency (LF, 30 - 300 kHz) transmitter signals significantly change due to intense ionization by solar flare X-ray [e.g., Mitra, 1974; Thomson et al., 2005]. The duration of the D-region enhancements due to X-ray is easier to be estimated using the VLF/LF waves, because the relaxation time for recombination in the D-region ionosphere is short to be within ˜100 s [e.g., Ohya et al., 2015]. Tweek atmospherics are VLF/Extremely Low Frequency (ELF, 0.3-3 kHz) electromagnetic waves that are originated from lightning discharges and propagate for a long distance with reflecting between the Earth's surface and bottom of the ionosphere. It is possible to estimate the electron density at the reflection height in the lower ionosphere using the tweeks. The D-region electron density in wide area can be estimated by the tweeks compared with limited propagation paths of transmitter signals. In this study, we investigate solar X-ray effects on the D-region ionosphere using tweeks. We analyzed the daytime tweek atmospherics observed at Moshiri (44.37N, 142.27E), Japan. To investigate the X-ray effects on the D-region ionosphere in more detail, the observation time of the tweeks has been improved from four minutes every hour to 59 minutes every hour since 18 June, 2019. In addition, the sampling frequency was changed from 20 kHz to 40 kHz. During 00:00-06:00 UT on 1-5, 29 July and 12-14 September, 2013, the tweek reflection height had a weak negative correlation (the correlation coefficient: -0.42) with X-ray flux observed by the GOES-13/15 satellites, which suggests that electron density in the D-region ionosphere increased with increasing the X-ray flux. In this presentation, we show variations in the tweek reflection height before and after solar flares.