

R005-23

Zoom meeting C : 11/1 PM2 (15:45-17:30)  
16:45-17:00

## Solar flare effects on the D-region ionosphere using VLF/ LF transmitter signals

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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 flares [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]. In this study, we investigate solar flare effects on the D-region ionosphere using VLF/LF transmitter signals. The transmitters used in this study were NWC (21.817S, 114.167E, 19.8 kHz), JJI (32.05N, 130.82E, 22.2 kHz), JJY40kHz (37.37N, 140.85E), JJY60kHz (33.47N, 130.18E), and BPC (34.63N, 115.83E, 68.5 kHz). The receivers were PTK (Pontianak, Indonesia, 0.003N, 109.367E), SGR (Sasaguri, Japan, 33.632N, 130.505E), RKB (Rikubetsu, Japan, 43.45N, 143.77E), and SRB (Saraburi, Thailand, 14.528N, 100.910E). The analyzed 16 M-class solar flares occurred in 2015. The changes in the VLF/LF phase had a weak correlation with the maximum X-ray flux of solar flares. Based on wave-hop method, there were three kinds of sky waves for each propagation path. By the wave-hop method, the resulting electric field strength of the ground wave (direct wave of LF signals) and sky waves of 1-hop, 2-hop, 3-hop, ..., and 10-hop can be calculated. For the three kinds of propagations, the largest electric field strengths of the sky waves were 1-hop, 2-hop, and equivalent 1- and 2-hop one. If the D-region height uniformly decreased along whole propagation paths during solar flares, the amplitude of the phase variations for the 2-hop sky waves would be larger by two times than that for 1-hop one. We corrected the differences of the phase due to the hop number. In the session, we will show the results in detail and discuss the solar flare effects on the D-region ionosphere.