Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

PEM36-19 Room:312 Time:April 28 15:15-15:30

Study of ionospheric disturbance characteristics during solar flare events using the SuperDARN Hokkaido radar

WATANABE, Daiki[1] ; NISHITANI, Nozomu[1*]

[1]Solar-Terrestrial Environment Laboratory, Nagoya University

Ionospheric disturbances during solar flare events have been studied by various kinds of observation instrument in the last few decades. Kikuchi et al. (1985) reported on the positive Doppler shift in the HF Doppler system data during solar flare events, and indicated that there are two possible factors of Doppler shift, i.e., (1) apparent ray path decrease by changing refraction index due to increasing electron densities in the D-region ionosphere, and (2) ray path decrease due to descending reflection point associated with increasing electron density in the F-region ionosphere.

In this study, we use the SuperDARN Hokkaido Radar to investigate the detailed characteristics of solar flare effects on ionospheric disturbances. We focus on the positive Doppler shift of ground / sea scatter echoes just before sudden fade-out of echoes. Davies et al. (1962) showed that if the factor (1) is dominant, the Doppler shift should have positive correlation with slant range and negative correlation with elevation angle and frequency. On the other hand, if the factor (2) is dominant, the Doppler shift should have negative correlation with slant range and positive correlation with elevation angle and frequency. While Kikuchi et al. (1985) studied solar flare events and mainly discussed frequency dependence of Doppler shift, we study mainly slant range and elevation angle dependence, for the first time to the best of our knowledge. We found that the factor (1), in other words, increase of electron densities at D-region ionosphere, is dominant during solar flare events. This result is consistent with that of Kikuchi et al. (1985). In order to study characteristics of ionospheric disturbance in more detail, we are studying relationship between timing / amplitude of ionospheric disturbance and that of the solar irradiation changes, by comparing the HF radar data with high wavelength resolution irradiation data for X-ray and EUV from RHESSI and SDO satellites. Generally, X-ray radiation becomes more important for the changes in the D-region during solar flare events. Therefore we investigate relationship between X-ray flux changes and electron density variation in the D-region ionosphere intensively. Furthermore, we estimated electron density changes in the ionsosphere by analyzing elevation angle dependence of Doppler shift in radar echoes quantitatively. We are estimating electron density by considering chemical reaction and photoreaction caused by solar radiation. We will compare the two electron density changes deduced from different two ways and evaluate the amplitude of ionospheric disturbance observed by the HF radar. More detailed analysis result will be reported.

Keywords: SuperDARN, Hokkaido radar, solar flares, ionospheric disturbances, photochemical reaction, range dependence