Vertical profile of ionospheric disturbances associated with Tohoku Earthquake using GPS occultation observation

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Many studies have reported that ionospheric disturbances occur after giant earthquakes. One of the causes is the infrasound wave excited by ground motions and/or tsunami. The horizontal propagation of the ionospheric disturbances after large earthquake have been examined in detail by using a network of ground-based GPS receivers. On the other hand, the vertical propagation of coseismic ionospheric disturbances especially is rarely reported. In this study, to examine the vertical propagation of the ionospheric disturbances excited by tsunami, we have examined electron density profiles observed by GPS radio occultation measurements of FORMOSAT-3/COSMIC satellites. We analyzed the ionospheric disturbances caused by Tohoku Earthquake (M9.0) occurred at 5:46:18UT on 11 March 2011. Density profiles observed within 3 hours after the passage of tsunami were analyzed. In extracting disturbed components from observed density profiles using Chapman model, short wavelength fluctuations were recognized over altitude 300⁻⁵00 km. Wavelength spectrums of these fluctuations were calculated using wavelet transform. It is confirmed that the spectrum intensity for the wavelength of 10⁻⁶⁴ km were enhanced. Maruyama and Shinagawa (2014) showed that acoustic waves generated by ground motions of seismic wave excite ionospheric disturbances with the wavelength of several tens kilometers. The present results is consistent with these previous studies.

Keywords: Acoustic Wave, Vertical Propagation, Occultation, Tsunami, Tohoku Earthquake