

Variations of total electron content in frequency domain accompanied by earthquakes

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Variations of total electron content (TEC) associated with earthquakes have been reported [e.g. Calias and Minster,1995; Afraimovich et al., 2001].The common feature of the variations of TEC is periodic variations with a period of several minutes which is caused by the atmospheric gravity waves. On the other hand, the spacial scales of these variations are not clear. Dense GPS network system, such as GPS Earth Observation Network System (GEONET), is very useful for studying the special scales of the variations. In the 2011 off the Pacific coast of Tohoku Earthquake occurred on 11 March 2011, TEC fluctuations spreading from the epicenter was observed using GPS-TEC data determined by GEONET.[Tsugawa et al., 2011]. This clear variation of TEC is rarely observed.

In this study,spacial scale of the TEC variation is examined by GPS-TEC data in frequency domain. For the earthquakes ($M > 6.5$) occurred in the island and adjaceut area of Japan during 2000. Assuming that the height of the ionosphere is 350 km, ionospheric pierce points are determined. FFT is applied to 32 minutes of TEC data which obtained from GEONET receivers. In two events (the 2011 off the pacific coast of Tohoku earthquake (M8.4) occurred on 11 March 2011, the Tokachi-oki Earthquake in 2003(M8.0) occurred on September 2003), it is observed that the TEC variations whose range is 1.56 mHz~9.38 mHz spread from the epicenters. The frequencies of these variations are consistent with the period of the atmospheric gravity waves or acoustic waves in the ionosphere . In the othe two events (the western Tottori prefecture earthquake in 2000(M7.3) occurred on 6 October 2000, the mid Niigata prefecture earthquake in 2004(M6.8) occurred on 23 October 2004), TEC variations in the high frequencies from 8.33 mHz to 9.38 mHz were observed in the vicinities of the epicenters. Since higher-frequency fluctuations enhance near the epicenter as compared to the fluctuations of the lower frequencies [Matsumura et al., 2011], results of this study is consistent with the numerical study.

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