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## Acoustic resonance and plasma depletion detected above the epicenter of the 2011 Tohoku earthquake

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Two-dimensional structures of the ionospheric variations generated by the acoustic resonance, and plasma depletion were firstly observed above the epicenter after the M9.0 Tohoku earthquake on March 11, 2011. A short period oscillation of total electron content was observed by a GPS receiver array after the earthquake for four hours in the vicinity of the epicenter. The frequency of the dominant mode of the oscillation was 4.5mHz, 222 seconds of period, while there were minor oscillations whose frequency were 3.7mHz and 5.3mHz. These periods are consistent with the periods of the acoustic resonance between the ground surface and the lower thermosphere, predicted by a numerical model. The amplitude of the TEC oscillation showed gradual change of the amplitude. This would be generated by the beat of two modes of the resonance. The two-dimensional distributions of TEC variations generated by this resonance showed wave frontal structures that stretched from northwest to southeast, and traveled to the southwest direction. Besides the oscillation, plasma depletion was observed above the epicenter after the earthquake. The earliest variation was observed about seven minutes after the earthquake. The amplitude of the depletion was several TEC unit, and continued for longer than 60 minutes. The area of this depletion was centered the epicenter but larger than that of the resonant oscillation. The ionospheric variations above the epicenter after the earthquake will be presented.

Keywords: Ionosphere, GPS, TEC, Acoustic wave, Atmospheric gravity wave, Earthquake