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# Comparison between ionospheric TEC perturbations observed after the earthquake and simulated atmospheric oscillations

Mitsuru Matsumura[1*], Akinori Saito[1], Takuya Tsugawa[2], Hiroyuki Shinagawa[2], Toshihiko Iyemori[1], Yuichi Otsuka[3], Michi Nishioka[3], Chia Hung Chen[1]

[1]Graduate School of Science, Kyoto Univ., [2]NICT, [3]STEL, Nagoya University

Numerical simulations are performed to simulate periodic structures observed at ionospheric heights just after the 2011 off the Pacific coast of Tohoku earthquake. A two and three-dimensional, non-hydrostatic, compressible and neutral numerical model is developed to reproduce the atmospheric oscillations. An impulsive upward surface motion is used as the source. Simulated atmospheric oscillations at 300 km altitude show remarkable agreement with the observed TEC oscillations. In the vicinity of the source, the fast waves with high frequencies are dominant. They have three dominant frequencies for the interval between 20 and 60 min after the impulsive input. The oscillation that has the maximum amplitude is the mode of 4.4 mHz. The others are the two minor modes of 3.6 and 5.4 mHz. These modes correspond to the acoustic resonance modes between the ground-surface and the lower thermosphere. The wave packets with about 0.7mHz frequency are also seen. They are considered as the beat due to the dominant modes. In the distance, the slow waves with low frequencies are dominant. The horizontal phase velocities are about 220 to 450 m/s, and the horizontal wavelengths are about 200 to 600 km. Waves with longer wavelengths have larger phase velocities. These waves correspond to the gravity modes. The good agreement between the simulation and the observations indicates that ionospheric perturbations observed after the earthquake are mainly due to the motion of the neutral atmosphere. In addition, the region where the acoustic waves pass is dependent on the aria of the source. This shows that the area of the uplifted sea surface, the supposed actual source can be estimated from the observed acoustic wave region.

Keywords: acoustic wave, gravity wave, TEC, earthquake