Geophysical Research Abstracts
Vol. 17, EGU2015-7113, 2015
EGU General Assembly 2015


# The vertical propagation of atmospheric disturbances induced by seismic waves of the 11 March 2011 M9.0 Tohoku Earthquake

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Networks and concurrent/co-located measurements of seismometers, infrasonic systems, magnetometers, HF-CW (high frequency-continuous wave) Doppler sounding systems, and GPS receivers are employed to detect disturbances triggered by seismic waves of the 11 March 2011 M9.0 Tohoku earthquake. A theoretical calculation and a simulation are conducted to study the vertical propagation of the triggered disturbances of acoustic and/or gravity waves (AGWs). No time delay between co-located infrasonic (i.e. super long acoustic) waves and seismic waves indicates that the triggered AGWs near the Earth's surface can be immediately activated by vertical motions of the earthquake. The circle method is used to find the origin and compute the horizontal traveling speed of the triggered infrasonic waves. The infrasonic wave origin being coincident with the reported Tohoku epicenter and the speed being about 3.3 km/s suggest that the AGWs are mainly induced by the Rayleigh waves. The agreements in the arrival time at various heights between the observation and theoretical calculation/simulation suggest the AGWs triggered by the Tohoku earthquake vertically traveling from the ground to the ionosphere with speed of the sound in the atmosphere.