Vertical structure of ionosphere perturbed by large earthquake and tsunami

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The FORMOSAT-3/COSMIC (F3/C) radio occultation (RO) technique vertically scans the atmosphere from 0 to 800 km altitude. Here we first show the ionospheric electron density structures which were perturbed by the wavefront of the M_W7.8 Nepal earthquake that occurred on 25 April 2015. Next, we show the acoustic resonance due to the 2008 Mw8.0 Wenchuan earthquake and 2011 Mw9.0 Tohoku earthquake and tsunami. The mean wavelet spectra derived from dozens of atmospheric and ionospheric RO sounding profiles within six hours after the earthquake illustrate that the atmospheric oscillations with the vertical wavelength ranging from 0.5 to 60 km appear at the altitudes from the lower atmosphere to the ionosphere. The vertical wavelength estimated from the atmospheric gravity wave dispersion relation is compared with the observed vertical wavelength. The small-scale gravity waves may not be easy to reach the upper ionosphere. These RO-observed long-lasting atmospheric and ionospheric oscillations may consist of the earthquake/tsunami wavefront and its residual oscillatory tail or acoustic resonance. The results suggest that the RO technique is a powerful tool which is suitable for probing earthquake/tsunami-induced oscillations in the atmosphere, and allow a more comprehensive understanding of the excitation, propagation, and dissipation of earthquake/tsunami-induced gravity waves in the entire atmosphere.

Keywords: coseismic traveling ionospheric disturbance, wavefront, resonance, radio occultation

