Sub-ionospheric effects of volcano eruptions using VLF/LF standard radio waves

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Several studies for the F-region ionosphere associated with volcano eruptions based on GPS-TEC data have been reported so far (e.g., Heki, 2006; Dautermann et al., 2009; Heki et al., 2010). These studies reported that acoustic waves excited by volcano eruptions reach up to the F-region ionosphere, and caused F-region perturbations. After eruption of the Kelud Volcano, Indonesia, in February 2014, acoustic resonance between the Earth’ s surface and lower thermosphere was reported based on TEC data and the seismic wave data (Nakashima et al., 2015). However, little studies on the D-region ionosphere associated with volcano eruptions have been reported. In this study, we investigate the D-region effects of eruptions of Sakurajima volcano (31.59N, 130.66E), Japan, at 04:11 UT on June 6, 2014, using intensity perturbation of VLF/LF transmitter signals. The VLF/LF propagation paths use in this study are JJY (JJY 60 kHz) - Tainan (TNN, Taiwan), and JJI (22.2 kHz) - TNN. Based on wavelet spectra, the perturbation of both transmitter signals had a frequency of 2-6 mHz during 04:12-04:30 UT after the eruptions (04:11 UT).We compared the perturbations with atmospheric pressure data obtained by an infrasonic meter observed by Sakurajima Volcano Research Center, Kyoto University, and seismic waves in the NIED F-net data (FUK, STM, and SBR) located close to the JJY-TNN path. The atmospheric pressure and vertical velocity of the seismic waves had the similar frequencies of 2-10 mHz during 04:12-04:47 UT. These similar frequencies suggest that the perturbations would be caused by acoustic resonance between the Earth's surface and lower thermosphere, or by acoustic and atmospheric gravity waves generated by volcanic eruptions. In the presentation, we will discuss the cause of the VLF/LF perturbations in more detail.

