The ionospheric variations associated with volcanic eruptions observed by GPS-TEC and HF Doppler

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It is reported that ionospheric disturbances are caused by ground and atmospheric perturbations, e.g. earthquakes and typhoons. Even though it is known that the volcanic eruptions excite the atmospheric waves, there are few observations of ionospheric disturbances caused by volcanic eruptions. In this study, we have examined ionospheric variations associated with volcanic eruptions using GPS-TEC and HF Doppler (HFD).

We analyzed TEC data observed by observed in GPS Earth Observation Network (GEONET) which is maintained by Geospatial Information Authority of Japan. Each pairs of satellites and receivers determines the value of TEC every 30 seconds. In this study, TEC data, in which mask angle is larger than 30 degrees, is used. We calculated the spectral intensity of TEC perturbations by Fast Fourier Transform (FFT). We analyzed 19 volcanic eruptions in Mts. Asama, Ontake and Shinmoedake since 2000. As a result, the variations of TEC by volcanic eruption are detected in 2 events. Both events are the eruptions in Mt. Asama with medium-size explosion. The center of the variations of TEC is located south of the volcano, which the same as the case for the earthquakes. Therefore the generation of the ionospheric perturbation associated with volcanic eruptions is the same process of that for the earthquakes. On the other hand, the variations of TEC at the frequency band of 7 ~ 12 mHz are shown, which is higher frequency than earthquakes.

We also analyzed HFD data transmitted from the Chofu campus of UEC for 4 events in Mt. Asama with medium-size explosion. We used the data observed at Sugadaira which is the nearest observation point from Mt. Asama. As a result, variations of TEC are detected in 3 events. In these events, the spectral intensity has peak a remarkable at 3 ~ 5 mHz and several peaks in 8 ~ 18 mHz. A peak at 3 ~ 5 mHz and 8 ~ 18 mHz are remarkable and there are a few peaks in the later. 3 ~ 5 mHz is due to acoustic resonance modes between the ground surface and the lower thermosphere as in variations of TEC associated with earthquakes. The perturbations around 8 ~ 18 mHz are also observed by GPS-TEC data, this caused that the pressure fluctuation excited by the explosion of the eruption directivity propagates to the upper ionosphere.

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