R005-37
B 会場 ：9/25　PM2 （15:45-18:15）
17:00〜17:15

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Periodic Oscillations of Doppler Frequency Excited by the Traveling Ionospheric Disturbances Associated with the Tonga Eruption

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The enormous eruption of the Hanga Tonga-Hunga Ha'apai volcano on January 15, 2022 caused atmospheric waves with propagating the Earth, inducing ionospheric disturbances across diverse temporal and spatial scales. A High-Frequency Doppler (HFD) sounding system in Japan identified distinctive ionospheric disturbances exhibiting periodic oscillations in the Doppler frequency with an approximate period of 4 minutes. This study investigated these periodic oscillations by comparing them with the observed Total Electron Content (TEC) data from the Global Navigation Satellite System (GNSS). The observed periodic oscillations in Doppler frequency showed distinct S-letter shaped variations, indicating the passage of Traveling Ionospheric Disturbances (TIDs) around the reflection point of the HFD sounding system. These periodic oscillations were prior to the arrival of tropospheric Lamb waves triggered by the Tonga eruption. Analysis of the GNSS TEC data made clear that the TID responsible for the periodic oscillations was stimulated by tropospheric Lamb waves at the conjugate point in the southern hemisphere. Specifically, the electric field perturbations generated by Lamb waves in the southern hemisphere are projected along magnetic field lines to the sensing area of the HFD system in the northern hemisphere. The periodic oscillations were observed only in the path between the Chofu transmitter and the Sarobetsu receiver. This observational results suggests an elongated meridional structure for the TID. The Doppler frequency variations were estimated using a simplified model of TID propagation and the resulting motion of the reflection points. The vertical motion of the reflection point associated with the periodic oscillations was estimated to be approximately 1 km. Periodic fluctuations with a duration of approximately 4 minutes are occasionally observed in conjunction with earthquakes, known to be attributed to the resonance of acoustic mode waves propagating between the ground and the lower ionosphere. Thus, a comparable resonance structure in the southern hemisphere, induced by the passage of tropospheric Lamb waves triggered by the Tonga eruption, emerges as a plausible source of the TID detected in the northern hemisphere.