

Examination of the ionospheric perturbations propagation associated with H-IIA rocket launchings

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It is reported that passage and exhaust plumes associated with rocket launches generate TEC perturbations observed by GEONET data (e.g. Furuya and Heki, 2008; Lin et al, 2014, 2017). On the other hand, there are few studies about ionospheric perturbations associated with rocket launches away from rockets' trajectories. Because the disturbances due to exhaust plumes do not appear in the distance from the trajectories, we can extract the disturbances only affected by the atmospheric wave. Using HF Doppler sounding, therefore, we analyzed ionospheric perturbations associated with H-IIA (Flight.25 and 26) whose trajectories are relatively far from the Japanese Islands. The Doppler sounding system is utilized by the University of Electro-Communications. In this system, the radio waves of 5.006 MHz and 8.006 MHz are transmitted from Chofu campus of University of Electro-Communications and those of 6.055 MHz and 9.595 MHz are from Nagara transmitter Radio NIKKEI. In this study, the Doppler shifts data observed at Sugadaira, Oarai, Kakioka, and Fujisawa were used. In those data, the perturbations of Doppler frequency associated with H-IIA (Flight.25 and 26) were observed about 35 minutes after the launches. It is confirmed that this delay corresponds to the propagation time of the infrasound wave from the rocket to observation points once reflected on the ground. In both events, the periods of the disturbance of Doppler shift were 100~200 s (5~10 mHz). The Doppler frequency perturbations appeared when the infrasound wave reached the observation point after reflection on the ground as compared to the case where the infrasound wave reached the observation point directly. The Doppler frequency perturbation consist of two packets, the first half (packet A) and the second half (packet B). In case of packet A, the arrival time of the perturbations at high altitude were faster than that of at low altitude. Therefore, it denoted that infrasound wave propagated from high altitude to low altitude. In case packet of B, the arrival time of the perturbations at both high and low altitude were simultaneously observed. This result indicates that the infrasound wave propagate almost horizontally.

Keywords: Ionospheric, rocket, HF Doppler Sounding