ANALYSIS OF SEISMIC AND IONOSPHERIC DISTURBANCES GENERATED BY THE EXPLOSION IN NORTH KOREA ON SEPTEMBER 3, 2017

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Data from networks of seismic stations and ground-based GPS/GLONASS receivers was used to explore the seismic and ionospheric disturbances caused by the underground nuclear test (UNT) in North Korea on 3 September 2017. We analyzed the frequency composition of the longitudinal and surface waves detected by more than 40 seismic stations. It was found that low frequencies (~0.45±0.21 Hz) predominated in the longitudinal wave spectrum. For both types of waves, the frequencies decreased with distance in accordance with the power law. Analysis revealed two trends in the spatial distribution of peak frequencies. First, the continental landmass was characterized by high and medium frequencies (0.14–0.50 Hz), and regions adjacent to fringe seas (transitional lithosphere zone between oceanic and continental crust) showed low frequencies of surface waves (0.13 Hz and lower). Second, there was an uneven frequency variation for different azimuths relative to the UNT epicenter: the frequencies subsided rapidly in the east, southeast and southwest directions from the epicenter, while towards the inner parts of the continental landmass, the frequency variation was much slower. From the records of longitudinal waves detected at different distances from the epicenter, we estimated the size of the epicenter area (R=0.98 km). Analysis of data from GPS/GLONASS receivers near the Korean Peninsula revealed ionospheric disturbances that were most likely caused by the underground nuclear test. Disturbances in the ionosphere appeared approximately 8 minutes after the UNT and were observed for about 5 hours. During the first 1.5–2 hours, traveling ionospheric disturbances (TIDs) were recorded. They propagated from the epicenter at speeds of approximately 600, 250 and 133 m/s. These TIDs had periods of 1–10.5 min and could be associated with acoustic waves induced in the Earth's atmosphere by UNT. After the TID passage, a long-lived (more than 3.5 hours) region with non-traveling (a velocity of about 7 m/s) ionospheric disturbances formed above the UNT site. The non-traveling ionospheric disturbances were extended from the southwest to the northeast. The reason for the formation of this region requires further study and modeling. In our view, the occurrence of this region may be due to the formation of standing waves in the atmosphere or the development of plasma instabilities.