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Infrasound from the Explosion Sources in the 1-200 km at UTTR

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The propagation of infrasound in the standard atmospheric model is not predicted at the distances less than 250 km, which is called “zone of silence” (Mckenna, 2005). In empirical studies, however, infrasound signals can be recorded in this “shadow zone” (Reed, 1969; Che et al., 2002; Pinsky et al. 2006; Evers et al., 2007) even though the physics of infrasound propagation at this distance range is not well known due to limitations restricted by the quality of ground truth, station distribution and the lack of atmospheric profile.

The experiment in Utah performed in August, 2007 had high quality ground truths (G0) from four rocket motors and a dense deployment of infrasound gauges including six arrays and thirteen single stations at distances from 100 meters over 210 kilometers. The atmospheric profile from the surface to about 25 km at the maximum height gave us an opportunity to access the variations of local atmospheric condition and model the infrasound propagation. To understand the characteristics of propagation path effect on the travel time and waveform of infrasound signals, systematic analysis on group and phase velocities, amplitude variation and atmospheric profile was performed. Based on the analysis, the infrasonic arrivals were classified into two groups: The arrivals at the distance less than 100 km (local arrivals) and those between 150 and 210 km (regional arrivals). The estimates of group velocity at local distances are around 350 m/s while those of regional distances vary from 280 to 300 m/s. The mean phase velocity at local distance range is 359 ± 9.8 m/s which is near to the speed of sound at the surface while that of regional distance is 386 ± 7.6 m/s, which can be expected from the turning rays from the stratosphere or thermosphere. The Utah observations also demonstrate that infrasound amplitude does not decay at local distances around 50 km. The PE modeling explains partially that observed acoustic arrivals and focusing of amplitude at local distances are related to the trapped acoustic energy between the surface and the shallow inverted atmospheric layer.