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concurrent microbarom signals to constrain atmospheric infrasound propagation conditions: case study of the 2017 DPRK nuclear test

The 2017 North Korean nuclear test gave rise to seismic and low-frequency acoustic signals, that is, infrasound. The infrasonic signals are due to seismo-acoustic coupling and have been detected on microbarometer array I45RU in the Russian Federation at 401 km from the test site. We analyze the seismo-acoustic coupling by making use of array-processing and backprojection techniques. The backprojections show that infrasound radiation is not confined to the epicentral region. More distant regions are found to be consistent with locations of topography, sedimentary basins, and underwater evanescent sources. The backprojections can be used to estimate the average infrasonic propagation speed through the atmosphere.

During the 2017 North Korean nuclear test, the stratosphere was in a state of transition from summer to winter, and the stratospheric vortex was relatively weak. Because long-range infrasound propagation is largely conditioned by the strength and the direction of the stratospheric vortex, this implies that propagation from the test site to I45RU may have occurred along unexpected paths. The mode of propagation can be difficult to decipher from the seismo-acoustic signals alone.
To supplement our understanding of infrasound-propagation conditions during the test, it can be insightful to analyze concurrent infrasonic signals that were detected at the infrasound array. Indeed, all signals must have propagated through the same atmosphere, albeit from different directions. In particular, continuous signals in the microbarom band (0.1–0.4 Hz) may provide some additional evidence about the mode of propagation, be it stratospheric or thermospheric.

During the 2017 North Korean nuclear test, Typhoon Sanvu was active in the Pacific basin, leading to continuous microbarom observations on array I45RU. The semidiurnal variation in best beam amplitudes suggests that these signals have propagated through the thermospheric waveguide. This independent observation is in line with the weak stratospheric vortex conditions.

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Track Classification: Analysis of Sources and Scientific Applications