Joint Seismic-Infrasonic Processing of Recordings from a Repeating Source of Atmospheric Explosions

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A site in northern Lapland is used by the Finnish military for the destruction of old ammunition, and numerous explosions occur every year at this location. The site is approximately 175 km from the IMS primary seismic array ARCES and seismic signals generated by the events are well recorded by this station.

In addition to the regional P and S seismic phases and coda, clear arrivals from the same direction but with air-sound velocities are usually observed several minutes later on the array's seismic sensors. The recorded seismic signals are essentially identical and indicate that the variation in source location and magnitude is negligible. This has been further confirmed by on-site measurements of shot locations and size of the explosives conducted during the summer of 2007 by scientists from the University of Helsinki.

In contrast, the infrasonic arrivals exhibit significant variation both with regard to the number of detected phases, phase travel times, and phase amplitudes, which would be attributable to atmospheric factors. The sources are well constrained by the seismic signals and the data set therefore provides an excellent database for studies in sound propagation, infrasound array detection, and direction estimation.

The amplitude of the ground motion resulting from the infrasound arrivals can often be large and even in excess of the amplitudes resulting from the seismic arrivals. On other occasions, the infrasound signals are well below the noise level. However, the arithmetic mean of the time-aligned cross-correlation coefficients for all sensor pair combinations of the array provides a very sensitive detection statistic for confirming the presence of marginal signals.