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A unique ground-truth infrasound source with signals observed at IMS station IS26 in Southern Germany

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Infrasound monitoring is one of the technologies used for verification of the Comprehensive Nuclear-Test-Ban Treaty (CTBT), aiming at the detection, location and identification of atmospheric nuclear explosions. The most common sources observed with the IMS infrasound network include meteorites, supersonic aircraft including rocket launches and re-entering spacecraft, volcanic eruptions and non-nuclear explosions, such as mining and quarry blasts, some of them accidental but well recorded. Although these sources may be unambiguously identified, for quantitative monitoring with the infrasound technology, these sources often do not provide accurate source characteristics, in particular ground-truth data. Ground-truth data include precise information on the source time and location, but may include additional information such as source strength.

A real ground-truth source was identified in Southern Germany producing repeated infrasound recordings at the IMS infrasound station IS26, co-located with the seismic GERESS array in the Bavarian Forest. An incidental personal report had suggested that signals from main engine tests of the ARIANE-5 rocket, conducted at the testing facilities of the Space Propulsion Institute of DLR near Heilbronn, could be detectable at IS26. The test facility is at a range of 320 km and at a backazimuth of 280˚ from the station. Based on ground truth information obtained for more than ninety tests conducted since 2000, a subsequent search in the available data archives for IS26 data, both at the IDC and BGR, which is the station operator, for the period since its installation in fall 1999, revealed that some thirty tests showed signals at IS26 above background noise levels. The signals were verified by testing the consistency of different signal parameters: arrival times of about 17-19 minutes after test begin, signal duration, and appropriate signal characteristics such as backazimuth and apparent ve-

locity.

Data analysis revealed a subtle pattern in that signals are only observed for tests conducted between October and April. All about 30 detected signals at IS26 are from about 50 engine tests within these winter months, with no signals found from any summer month test. Therefore a significant change in atmospheric propagation conditions is evident, with significantly better transmission during winter months. Propagation is presumed to be within the stratosphere, based on the measured travel time inconsistent with direct sound propagation along the Earth's surface. This result is further supported by measurement of celerity and apparent velocity from F-K-analysis, with celerity ranging between 270 and 310 m/s and apparent velocity between 310 and 370 m/sec. The backazimuth for the signals scatters between 275˚ and 285˚. Signal-to-noise ratios are generally between 2 and 8, with signal amplitudes reaching up to about 200 mPa for maximum amplitudes, and about a factor of two less for RMS estimates.