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Observed and predicted performance of the global IMS infrasound network

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The International Monitoring System (IMS) infrasound network is being deployed to monitor compliance with the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Global-scale analyses of data recorded by this network indicate that the detection capability exhibits strong spatio-temporal variations. Previous studies estimated radiated acoustic source energy from remote infrasound observations using empirical yield-scaling relations, which account for the along-path stratospheric winds. Although the empirical wind correction reduces the variance in the explosive energy versus pressure relationship, large error remains in the yield estimates. Numerical modeling techniques are now widely employed to investigate the role of different factors describing atmospheric infrasound sources and propagation. Here we develop a theoretical attenuation relation from a large set of numerical simulations using the Parabolic Equation method. This relation accounts for the effects of the source frequency; geometrical spreading and dissipation; and realistic atmospheric specifications on the pressure wave attenuation. Compared with previous studies, the derived attenuation relation incorporates a more realistic physical description of infrasound propagation. By incorporating real ambient noise information at the receivers, we obtain the minimum detectable source amplitude in the frequency band of interest for detecting explosions. Empirical relations between the source spectrum and explosion yield are used to infer detection thresholds in tons of TNT equivalent. In the context of future verification of the CTBT, the obtained attenuation relation provides a more realistic picture of the spatio-temporal variability of the IMS network performance. The attenuation relation could also be used in the design and maintenance of an arbitrary infrasound monitoring network.