Geophysical Research Abstracts
Vol. 13, EGU2011-10441, 2011
EGU General Assembly 2011

On estimating the radiated source energy from remote infrasound recordings

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Currently, estimates of radiated source energy are based on empirical yield-scaling relations, which account for prevailing stratospheric winds. The most commonly used yield-scaling relation is derived from a high explosive dataset (Whitaker & Mutschlecner, 2008). However, limitations of this approach have been found by comparisons with reference events where problems arise either due to a fixed stratospheric wind speed or by an over-estimate of a known yield (e.g., Green et al., 2010). More realistic predictions can be achieved by using improved atmospheric specifications and measured station noise characteristics, as well as attenuation relations derived from operational propagation tools.

Near-real time atmospheric up-dates and background noise calculations at various times of day for each month and local wind speeds provide a realistic description of infrasound propagation and recording conditions covering a broad frequency range. Moreover, an improved yield-scaling relation is considered. This has been derived from massive numerical simulations using wide-angle parabolic equation methods because such methods account for detailed propagation information within reasonable computational time. Finally, a reduced number of parameters have been found describing the source (source altitudes between 0 and 30 km, dominant frequencies between 0.01 and 4.0 Hz) and the atmosphere (including naturally occurring gravity waves, altitude and strength of the stratospheric wind jet); all parameters have a significant impact on infrasound propagation.

We present a first approach for source energy estimates by combining all this information which provides a realistic picture of both station specific recording conditions and infrasound propagation from source to receiver. The spectrum of a full wave-train, whereas the local background noise is removed, can be inverted to a noise-free source spectrum at a certain reference distance, which is in turn related to certain yield based on empirical relations (e.g., Glasstone & Dolan, 1977). The capability of our approach is demonstrated for the two Sayarim explosion data-sets.