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Uncertainties due to atmospheric winds in the estimation of event yield from thermospheric pulse lengthening

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The nonlinear stretching of an impulsive, infrasound signal propagating through the upper atmosphere is dependent on the signal source strength. This relationship has been previously used to estimate the associated near-field signal strength of a recorded thermospheric arrival from its pulse duration. This approach, which uses nonlinear ray theory, is presently exploited in order to estimate the yield of an explosion. Uncertainties associated with upper atmospheric wind estimation lead to uncertainties in the associated yield estimation. In this work, the wind profile is modeled as a mean profile plus a random wind perturbation having a Gaussian distribution. We find that the resulting distribution of the predicted yield, calculated using a Monte Carlo-based simulation, can be approximately described by a Weibull distribution for the cases we considered. For these cases, the travel time and return height distributions are found to be both skewed resulting in a non-Gaussian distribution of the predicted yield. The effect of uncertainties in the thermospheric attenuation on the yield has also been investigated. For a sufficiently large near-field pulse duration, the predicted yield is largely insensitive to the uncertainties in the thermospheric attenuation. Comparisons of numerical results with available ground truth data will be presented.