Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Propagation of meteor infrasound in layered atmospheres

CHRISTOPHE MILLET, CHRISTOPHE P. HAYNES, CEA — In the present work, we provide a theoretical model of the shock wave generated by the atmospheric entry of meteors. Such a shock wave propagates from a strong blast wave region out to the far-field acoustic limit. The matching of the two regions is possible through a shape factor K, which is considered to be a random variable. The amplitude and period of the N-wave signal are obtained using Whitham's nonlinearization method for cylindrical waves. The method has been used to re-examine the crater-forming meteorite fall near Carancas, Peru (2007). As the specific trajectory of the meteor is unknown, all outcomes of the signal have been statistically analyzed. This includes finding the probability of a given signal and how the factor K affects this probability. Even though there is a good agreement between the period of the N-wave signal and the recorded signal, it is shown that a homogeneous isothermal atmospheric assumption leads to large errors in the ballistic overpressure relative to the observed values. Despite this, we demonstrate that inclusion of atmospheric absorption and meteoritic ablation within the model leads to the correct ground acoustic impulse. Future work involves a similar study for randomly layered atmospheres and will focus on the role of small-scale inhomogeneities.

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Date submitted: 04 Aug 2011 Electronic form version 1.4