Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Non-linear and linear wave propagation in booming sand dunes
NATHALIE VRIEND, MELANY HUNT, ROB CLAYTON, California Institute of Technology, Pasadena, USA — For centuries booming sand dunes have intrigued travelers and scientists alike. These dunes emit a persistent, low-frequency sound during a slumping event or natural avalanche on the leeward face of the dune. This sound can last for several minutes and be audible for miles. The acoustic emission is characterized by a dominant audible frequency (70 - 105 Hz) and several higher harmonics. In the work of Vriend et al. (2007), seismic refraction experiments show the existence of a multi-layer internal structure in the dune, which acts as a waveguide for the acoustic energy. The waveguide channel, within the subsurface structure of the dune, amplifies the sound and determines the booming frequency. The recorded booming frequency depends directly on the spatial dimension of the natural waveguide. The current study presents additional insight in the wave propagation characteristics. The source of the acoustic emission is burping sand - sand with a narrow particle size distribution that emits short broadband squeaks (50 - 100 Hz) upon direct shearing of the grains. The burping emission displays non-linear and dispersive effects in its wave propagation characteristics during field experiments. The emission cannot develop into the loud, sustained booming without the proper subsurface structure.

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Date submitted: 04 Aug 2008 Electronic form version 1.4