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The physics of pulse propagation in the nocturnal atmospheric boundary layer: measurement and theory

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A series of experiments designed to probe the effect of the nocturnal atmosphere on low-frequency (10- 500 Hz) sound propagation will be discussed, and their ramifications explored. These experiments involve detecting arrivals from a propane cannon on a vertical array of microphones 1-3 km from the source, which were collected simultaneously with meteorological experiments designed to measure the vertical temperature and horizontal wind velocity profiles. Chief among the results of these experiments is the observation of a nocturnal model structure that has a significant surface wave component at frequencies below 150 Hz. At higher frequencies and longer propagation distances ($>$ 1.5km), the surface wave is not observed due to attenuation from its interaction with the ground. At higher frequencies, the model structure displays a characteristic "quiet height" first described in Waxler et al. (2006). The potential application of these results for remote sensing the atmospheric boundary layer are discussed, and contrasted with other methods of measurement of the atmospheric profile.