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Mean vs. event sound-level prediction: obtaining consistency between atmospheric data inputs, propagation models, and the predictand

David Wilson\textsuperscript{a}, Chris Pettit\textsuperscript{b}, Vladimir Ostathev\textsuperscript{c} and Matthew Lewis\textsuperscript{a}

\textsuperscript{a} U.S. Army Engineer Research and Development Center, 72 Lyme Rd., Hanover, NH 03755-1290, USA
\textsuperscript{b} U.S. Naval Academy, Aerospace Engineering Dept., 590 Holloway Rd., MS 11-B, Annapolis, MD 21402, USA
\textsuperscript{c} NOAA/Earth System Research Laboratory, 325 Broadway, Boulder, CO 80305, USA

The following, deceptively challenging, questions are addressed: What are the most suitable atmospheric data resources and propagation models for predicting event (explosion and other short duration) sound-exposure levels? Do these differ from those most suitable for predicting mean sound levels? Atmospheric data typically consist either of single, ”snapshot” samples of the vertical profiles, as from a weather balloon, or average vertical profiles, as from climatology or a numerical weather model. Recent statistical studies, based on high-resolution atmospheric simulation, demonstrate the superiority of mean profiles for prediction of both mean and event sound levels, even when single-sample profiles are synchronized to and collected along the path of the propagation event. Running propagation models ”blind” to the nature of the atmospheric inputs is shown to be hazardous: predictions from mean profiles lack turbulent scattering, thus underestimating sound levels near the ground, whereas predictions from single-sample profiles implicitly assume the turbulence has infinite horizontal extent, thus overestimating sound levels. Some desirable consistency results from numerically solving parabolic equations (PEs) for statistical moments of the sound pressure, rather than conventional deterministic PEs. The moment PEs directly predict mean sound levels or the expected value and variability of event sound-exposure levels.