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Long range propagation of high speed train noise: Sound level variations before and after the pass-bys

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It has been observed relatively frequently that high speed train (TGV) noise could be heard tens of seconds before or after the actual train pass-bys. This study is aimed at characterizing this phenomenon and the conditions in which it occurs, both experimentally and numerically. Acoustic measurements of TGV pass-bys have been performed under controlled conditions. A relatively strong wind was blowing from the South during the experiment. The measurements show that the TGV noise can be heard before the pass-bys when the TGV was coming from the South (same wind and train directions), and after the pass-bys when the TGV was coming from the North (opposite wind and train directions). This noise is relatively low in frequency (around 400 Hz), and corresponds to propagation distances that can exceed 1 km. Levels associated with this phenomenon can vary significantly over short time intervals (5-10 minutes), which raises the issue of the representativeness of TGV measurements at long ranges. It will be shown using numerical prediction methods (parabolic equation in the frequency domain, linearized Euler equations in the time domain) that these acoustic variations are mostly due to variations in the meteorological conditions between the pass-bys.