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## Variability of Wind Turbine Noise over a Diurnal Cycle

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### Abstract

The diurnal variation of atmospheric conditions over land has a significant effect on the wind and temperature distributions which greatly influence the generation and propagation of wind turbine aerodynamic sound. In this paper, a fully consistent unsteady approach is used to study wind turbine noise such that large eddy simulation with a rotational actuator disk wind turbine model is used to model the wind and temperature around a mega-watt scale wind turbine over a diurnal cycle, and time dependent flow and temperature fields are used as input to the coupled wind turbine noise generation-propagation model. Computations are carried out for four different 10 minutes datasets selected at certain periods of a day for a same hub height wind speed. It is observed that the time dependent as well as the time averaged sound pressure levels in near field do not show large variations during the day. However, as we move away from the turbine, the propagation effects take over and downwind of the turbine the night time levels exceed the day time levels (at 3600 m the averaged difference reaches 6.5 dBA).

*Keywords:* wind turbine noise, diurnal cycle, variability, large eddy simulation, parabolic wave equation

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