Here we provide statistical low-order characterization of noise propagation from a single wind turbine, as affected by mutually interacting turbine wake and environmental conditions. This is accomplished via a probabilistic model, applied to an ensemble of atmospheric conditions based upon atmospheric stability; the latter follows from the basic form for stability distributions established by Kelly and Gryning [Boundary-Layer Meteorol. 136, 377–390 (2010)]. For each condition, a parabolic-equation acoustic propagation model is driven by an atmospheric boundary-layer ("ABL") flow model; the latter solves Reynolds-Averaged Navier-Stokes equations of momentum and temperature, including the effects of stability and the ABL depth, along with the drag due to the wind turbine. Sound levels are found to be highest downwind for modestly stable conditions not atypical of mid-latitude climates, and noise levels are less elevated for very stable conditions, depending on ABL depth. The probabilistic modelling gives both the long-term (ensemble-mean) noise level and the variability as a function of distance, per site-specific atmospheric stability statistics. The variability increases with the distance; for distances beyond 3 km downwind, this variability is the highest for stability distributions that are modestly dominated by stable conditions. However, mean noise levels depend on the widths of the stable and unstable parts of the stability distribution, with more stably-dominated climates leading to higher mean levels.

General information
State: Published
Organisations: Department of Wind Energy, Resource Assessment Modelling
Authors: Kelly, M. C. (Intern), Barlas, E. (Intern), Sogachev, A. (Intern)
Number of pages: 17
Publication date: 2018
Main Research Area: Technical/natural sciences

Publication information
Journal: Journal of Renewable and Sustainable Energy
Volume: 10
Issue number: 1
Article number: 013302
ISSN (Print): 1941-7012
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.41 SJR 0.44 SNIP 0.588
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.2 SJR 0.416 SNIP 0.55
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.369 SNIP 0.534 CiteScore 1.02
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.407 SNIP 0.712 CiteScore 1.05
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.451 SNIP 0.886 CiteScore 1.26
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Scopus rating (2012): SJR 0.578 SNIP 1.285 CiteScore 1.77
ISI indexed (2012): ISI indexed yes
Scopus rating (2011): SJR 0.344 SNIP 1.036 CiteScore 1.3
ISI indexed (2011): ISI indexed no
Web of Science (2011): Indexed yes
Web of Science (2010): Indexed yes
Original language: English
DOIs:
10.1063/1.5012899