Geophysical Research Abstracts
Vol. 20, EGU2018-12087, 2018
EGU General Assembly 2018

Detecting and monitoring sound from a wind turbine in complex terrain

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A key question for wind turbine noise management is whether prediction of human response to wind turbine noise could be verified by accounting for noise events instead of, or in addition to, energy equivalent or percentile measures of noise exposure. However, there is a critical prior question: how should noise events be measured? Noise events caused by wind turbines is not trivial, and a composition of a broad spectrum and different environmental noise is important. The temporal variation of sound level originates not only from the wind turbine itself at a specific location. Different sound sources (leafs of trees, animals, people, wind etc.) disturb the sound records. This complicates the apportionment of the sound signal from the wind turbine - the focus of our measurements.
The meteorological conditions between source and receiver must be known for correctly assessing the measured sound levels. Therefore, weather conditions close to microphones and in the wider surrounding are considered in detail.
The challenge in describing the sound propagation is to describe both, the local distribution of sound immission as well as the temporal variation at any fixed point in the surrounding of a wind turbine. Therefore a high number of simultaneously measuring microphones was used. Depending on the question that focuses either on weather impacts on sound propagation or spatial distribution of sound immission, the measurement strategies differ.
On measuring sound immission at fixed locations during many days, we proved the variations of the weather influence on the sound generation and propagation. The source receptor conditions remain constant, whereas the environmental conditions change.
The measurements were performed simultaneously with five microphones at different locations to assess the spatial effects on the sound propagation. Due to different distances and angles to the wind turbine we are able to deduce background noise and directivity of sound emission.
The results of our measurements reveal clear signals from the wind turbine at least in several 1/3-octave band (e.g. 80Hz) and shows a variance of up to 30 dB in this band between times, where the turbine was operating and shut down.