Geophysical Research Abstracts
Vol. 20, EGU2018-4321-1, 2018
EGU General Assembly 2018
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Wind Turbines and their Emitted Seismic Wavefields: Results from Different Locations

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Within the ongoing project “TremAc”, we study wind turbine (WT) induced seismic signals at different locations with their specific wave properties. The main goal of this project, which is funded by the German Federal Ministry for Economic Affairs and Energy, is the detection of influences from WTs on human health and buildings in an interdisciplinary way. The interaction between WTs, humans, and infrastructure (incl. seismic stations) becomes more and more an important role with the increase of installed WTs. A comparison of long-term seismic recordings at different locations mostly in the southwestern part of Germany is discussed in detail. We present averaged one hour long PSD-spectra in a frequency range from 0.5 Hz to 10 Hz depending on the wind speed resp. rotation rate before and after the installation of characteristic WTs during one month measurements. These PSD-spectra contain discrete amplitude peaks which can be attributed to vibrations induced by the rotating blade and the swinging tower. The resulting effect of an increasing seismic noise level can influence the detection threshold of a local seismic station, especially for local seismicity with small magnitudes. The increased noise occurs even up to distances of several kilometers to the WTs. We also bring to attention that undisturbed long-term measurements are necessary before the installation of a WT for a subsequent clear identification and interpretation of WT-related seismic signals. Using short-term measurements close to WTs during few hours, we are able to determine the maximum of the PSD values for different discrete frequency peaks as function of distance to the next WT. Afterwards we fit a power-law decay curve proportional to $1/r^b$ to the data. Typical b values range between 0.7 and 1.6. In this way we can differentiate between near- and far-field effects of the seismic wave propagation. A clear frequency dependent decay can be observed, for which high frequencies are more attenuated than lower frequencies, probably due to scattering processes. Our results will help for a better understanding of WTs as a seismic noise source and their interaction with nearby seismic stations and other infrastructure.