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Wind turbines and their emissions - an interdisciplinary approach to validate the induced seismic and acoustic wavefields

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The public acceptance of wind energy, which is important to achieve climate objectives of countries all over the world, could be enhanced by a better understanding of the emitted seismic and acoustic signals of wind turbines (WTs) and their interaction with humans. This is the goal of the ongoing project "TremAc", where we identify the main parameters of the emitted seismic and acoustic wavefields and develop simulation models by taking into account the turbine design, the topography, the geological underground and the place of immission.
Combined acoustic and seismic wavefield measurements at a single Enercon E-82 WT were performed, analyzed and compared with measurements at a wind park containing the same type of turbine. During the field measurements, several shut-down experiments at different daytimes were conducted to separate the induced signals from the overall background noise. By starting the WTs of a wind park one by one during a period of high wind speeds we are able to estimate an increase of the seismic noise level with the number of the operating WTs.
Results of these measurements are used to validate prognosis models for the seismic and acoustic wavefield propagation based on numerical simulations. It is found that the numerical models are highly capable to map the complex process of emission. We are able to allocate spectral peaks in real data to different eigenfrequencies and multiples of the blade-passing frequency (three times the rotation rate) of the WT and to validate their behavior regarding the propagation through different subsurface conditions. These results are not just important for the understanding of how WT-induced signals interact with humans but also for finding methods to reduce troublesome signals. The latter may help to increase the acceptance of WTs.

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