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Ground motion emissions due to wind turbines: Results from two wind farms on the Swabian Alb, SW Germany

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Wind turbine (WT) ground motion emissions have a significant influence on sensitive measuring equipment like seismic monitoring networks. WTs permanently excite ground motions at certain constant frequencies due to the eigen modes of the tower and blades as well as the motion of the blades. The emitted waves have frequencies mainly below 10 Hz which are relevant for the observation of, e.g., local tectonic or induced seismicity. Furthermore, frequencies proportional to the blade passing frequency can be observed in ground motion data above 10 Hz, closely linked to acoustic emissions of the turbines. WTs are often perceived negatively by residents living near wind farms, presumably due to low frequency acoustic emissions. Therefore, similarities in ground motion and acoustic data provide constraints on the occurrence of such negatively perceived emissions and possible counter-measures to support the acceptance of WTs.

We study ground motion signals in the vicinity of two wind farms on the Swabian Alb in Southern Germany consisting of three and sixteen WTs, respectively, which are of the same turbine type, accompanied by acoustic measurements and psychological surveys. A part of the measurements is conducted in municipalities near the respective wind farms where residents report that they are affected by emissions. Additional measurements are conducted in the forests surrounding the WTs, and within WT towers. The wind farms are located on the Alb peneplain at 700-800 m height, approximately 300 m elevated compared to the municipalities. Results indicate that WTs are perceived more negatively in the location where the wind farm is closer to the municipality (ca. 1 km) and where other environmental noise sources like traffic occur more frequently. At the location more distant to the WT (ca. 2 km), even though more WTs are installed, residents are affected less. To improve the prediction of ground motion emissions, instruments are set up in profiles to study the amplitude decay over distance, which is linked to the local geology.

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