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Permanent seismic monitoring system on a wind-turbine located in Italy: analyses of the structural behaviour under real loads

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In the last years renewable energy sources, especially wind power, have become a focus of energy policies in several countries around the world. Wind turbines have to be located at sites with high wind speeds, this leads to high forces acting upon the tower and the blades, causing vibrations throughout the structure. Some of these can be detrimental to the turbine, whilst others are transferred into the ground and can propagate several kilometres far from a tower. Current technical and scientific literature specifically focusses on vibrations of the wind turbine blades and the effect of earthquakes on the turbines. Additionally, there is considerable research in the field of low frequency noise and infrasound from wind turbines. This study presents the preliminary results retrieved from the analyses performed on real accelerometric time-histories recorded on a wind-turbine located in southern Italy (Faeto (FG), Puglia). The permanent accelerometric monitoring system has been installed in 2016 and it is recording data every day under several climatic conditions. Particularly, both weak- and strong-motion synchronized data are available from one three-directional station installed on the foundation of the tower and another three-directional station installed on the top of the tower. Several velocimetric measurements have been performed on the surrounding ground with the aim to characterize the shear-wave velocity of the site and to analyse the capability of the tower to radiate energy into the ground and contaminate the motion in the surrounding area. In this phase of the study the motion of the monitored tower has been investigated under several wind conditions correlating the dynamic characteristics of the structural eigenfrequencies with others parameters such as wind speed, air temperature, etc. Accelerometric data have been analysed using both stationary and non-stationary tools, particularly, weak-motion data have been analysed using Fourier Transform and Transfer Functions, while, strong-motion data have been analysed using the Stockwell Transform. Preliminary results shown that the complexity of the dynamic behaviour of the monitored tower increases with the wind speed switching from a linear stationary behaviour to a nonlinear elastic behaviour. With regards the capability of the tower to modify the motion of the surrounding area, it has been verified that ground motion is contaminated both in microtremors and strong motion conditions.