WIND PARK SITING IN COMPLEX TERRAINS ASSESSED BY WIND TUNNEL SIMULATIONS

Sophia Buckingham, France
Supervisors: Prof. J.P.A.J. van Beeck & B. Conan
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The installation of wind farms requires consistent wind resource assessment over the terrain. However the current reliability deteriorates in more complex topographies, thus the urgent need for an accurate description of the flow in such conditions.

The purpose of this study, within the frame of the European WAUDIT project (Wind Resource Assessment Audit and Standardization), is to simulate the flow past a complex terrain, the Alaiz hill (Navarra, Spain) in the L1 wind tunnel of the von Karman Institute. The modeling of a 15 km x 15 km mountain implies a very large downscaling (several thousands) and therefore requires the implementation and the characterization of a new atmospheric boundary layer (ABL) profile in the wind tunnel.

Preliminary hot-wire boundary layer profile investigation provides a thorough description of the flow and in particular the turbulence characteristics of the ABL. This deep study allows the verification of the flow similarity assumptions and qualifies the test section for the simulation of atmospheric flows. A systematic method for detailed scaling assessment of the modelled ABL is established, based on both fluctuating and mean quantities.

For the first time in the atmospheric test section, the flow around the Alaiz hill is investigated using PIV measurements in addition to hot-wire. The converging results highlight the strong speed-up due to the hill effect, leading to an over-speed at the hill top without flow separation. The visible effect of the flow separation that occurs after the upstream ridge indicates that upstream topography can have a significant influence even after kilometres. The effect of inlet boundary layer characteristics is also underlined. Information extracted from this study is of importance, especially knowing that for wind energy applications, power availability is very sensitive to wind velocity predictions.