



Wind tunnel study of a vertical axis wind turbine in a turbulent boundary layer flow

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Vertical axis wind turbines (VAWTs) are in a relatively infant state of development when compared to their cousins the horizontal axis wind turbines. Very few studies have been carried out to characterize the wake flow behind VAWTs, and virtually none to observe the influence of the atmospheric boundary layer. Here we present results from an experiment carried out at the EPFL-WIRE boundary-layer wind tunnel and designed to study the interaction between a turbulent boundary layer flow and a VAWT. Specifically we use stereoscopic particle image velocimetry to observe and quantify the influence of the boundary layer flow on the wake generated by a VAWT, as well as the effect the VAWT has on the boundary layer flow profile downstream. We find that the wake behind the VAWT is strongly asymmetric, due to the varying aerodynamic forces on the blades as they change their position around the rotor. We also find that the wake adds strong turbulence levels to the flow, particularly on the periphery of the wake where vortices and strong velocity gradients are present. The boundary layer is also shown to cause greater momentum to be entrained downwards rather than upwards into the wake.