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# Comment on wes-2021-112

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Referee comment on "Computational-fluid-dynamics analysis of a Darrieus vertical-axis wind turbine installation on the rooftop of buildings under turbulent-inflow conditions" by Pradip Zamre and Thorsten Lutz, Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2021-112-RC1, 2021

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**Content and approach**

The paper deals with numerical simulations of the performance of an H shaped Vertical Axis Wind Turbine in an urban environment.

The aerodynamic design of the VAWT is taken from a paper published in 2016 in Renewable Energy, Volume 90, but for the current simulations the rotor is scaled up with a factor 3.5 to a 7x 4.2 m size.

A high-resolution scale resolving DDES CFD simulation and higher order numerical scheme is used to perform the simulations. First the rotor is simulated in uniform inflow conditions to generate the normal forces, tangential forces and moments as a function of azimuth angle for several tip speed ratio’s.
For the next simulations a grid model of the "Morgenstelle" campus of the University of Tübingen in Germany is made. And on this grid the turbulent flow field for an urban environment including two schematized buildings and a forest area is simulated, and finally the two VAWT’s are added on top of the two buildings and the complete simulations are performed for three different heights above the rooftops. Starting point for the last round of simulations is the fully developed flow field of the urban environment without the wind turbines. The introduction of the two wind turbines in the urban wind field grid is done by applying overlapping grid technique.
Simulation results are presented for the normal, tangential forces on the rotor as well as moments as a function of azimuth angle, for both the uniform inflow conditions and for the rooftop locations.
Also some insight is given in the local flow conditions for the three positions on top of both buildings where the wind turbines are placed.

**Validity of the conclusions**

A first conclusion is that turbines a significant reduction in the computation cost is realised through the initial simulation of the urban wind field without the wind turbines until a converged solution is obtained followed by the subsequent introduction of the wind turbines using this overlapping grid technique. Though this conclusion may be plausible, it is not demonstrated since there is no information presented about computational time, nor a comparison is made with the computation time for a more classical approach. This information needs to be added to the manuscript.

A second conclusion drawn is that the performance of wind turbine is significantly increased in rooftop positions. Especially the lower altitudes (10 and 12 m above the rooftop) are identified as having a “significant improvement of the performance”. But I strongly doubt the validity of this conclusion. That is to say it is the result of the comparative calculations performed for the manuscript, but I am afraid it does not at all say something for a practical situation.
The reason is the assumption about the operational condition of the rooftop wind turbines in the simulations. In line 330 the authors state: “… the rotational speeds are deduced depending on the wind speed and the operating point of $\lambda = 2.75$.” This means that the rotational speed of the wind turbine is always instantaneously following the (highly) fluctuating incoming wind speed in the case of roof top application. And this is of course totally unrealistic. There is a lot of inertia in the system and the wind turbine control also has a role in the response of the rotational speed of the wind turbine on fluctuations in the incoming wind. The result is that the wind turbine will, most of the time, NOT run on its optimal tip speed ratio, and hence it results in power loss. And this is not modelled at all in the current simulations.

And evidently the same doubts hold for the third conclusion: “Therefore, it can be concluded that turbulence has a positive impact on performance”, because again the assumption that here is an instantaneous adaptation of rotational speed to wind speed fluctuations is not realistic.

A annotation version of the manuscript is added with a number of detailed comments, recommendations and issues that need to be adressed in order to improve the manuscript.

Please also note the supplement to this comment:
https://wes.copernicus.org/preprints/wes-2021-112/wes-2021-112-RC1-supplement.pdf