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Interactive comment

Interactive comment on "Simulation of transient gusts on the NREL5 MW wind turbine using CFD" *by* Annika Länger-Möller

Anonymous Referee #2

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Simulation of transient gusts on the NREL5 MW wind turbine using CFD

By Annika Länger-Möller

The article describes a CFD approach to gust modeling for wind turbines, presenting some interesting results.

As the CFD model is incompressible, any change in velocity in the domain is instantaneously influencing the full domain. As a consequence, the gust is not traveling through the domain, but the velocity is basically increasing everywhere in the domain instantaneously. The consequence of this with respect to the wake development should be discussed.

Additionally, the assumption of infinite mass and inertia along with a non-elastic model might also have quite large effects, and should be discussed.

Finally, the ABL is neglected along with any turbulence, which is also indicated by other reviewers could be much larger than the cosines gust.

Figures:

Generally the figures are very small, and Figure 1 about the grid set-up is basically of no use and should be replaced. The Cp and Cf plots, Fig. 7,8,9,10, 11 and 12 are very small and not providing that much information. They could be exchanged with plots of radial force distributions at [0,90,180,270] degrees azimuth. Eventually, a blow-up of the Cf distribution could be included to assist the discussion about separation versus no separation.

In Figure 13, the choice of blue and black color is not optimal, red would be easier to distinguish from the black.

Flow Solver:

The description of the flow solver setup is very sparse and should be extended.

What time integration is used for the present work, and what size of time step is used.

It is stated that a second order central scheme is used, but it seems highly unrealistic that this can be done without generating wiggles for this high a Reynolds number without some artificial damping. Please explain.

The present reviewer is well aware of the no-slip wall conditions used, but I do not understand how it differs from the viscous wall condition prescribed at the earth surface. Should it be an inviscid wall or slip conditions at the earth surface?

Grid Characteristics

The description is not accurate and do not even include any description of the gridding of the tower component.

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Additionally, some more details about the issues related to including the nacelle in the grid should be given.

The chord-wise resolution is on the coarse side; normally more than 250 cells are needed for an accurate resolution of the flow development. Are the results at all close to grid independent?

More illustrative figures showing the chord-wise and span-wise resolution should be included, along with a cut through the full grid topology.

Results:

Generally, the pressure distributions add very little information to the discussion, and should be replaced by span-wise force distributions.

Figure 13 on the tip vortex movement is very hard to interpret, as we do not know if the rotor is at identical azimuth positions for the different snap-shots.

I would maybe be more interesting to show the axial and radial location of the tip-vortex as function of vortex age at the three instances in time.

References:

The major references to CFD for wind turbines are very recent; CFD for wind turbines track back to the late nineties which I believe should be reflected.

Additionally, the author chose to refer to secondary references eg. Kessler and Lôwe 2012, where the reference to Zhang et al from my point of view should be preferred.

P3, L15 moving grid blocks (Zhang et al. 2007) as implemented by (Kessler and Lôwe 2012).

Another example is the reference for the usage of k-omega model for wind turbines which has been pioneered by others in the late nineties, e.g.

Rotor performance prediction using a Navier-Stokes Method, Sørensen and Hansen,

AIAA-98-0025.

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