Wind Energ. Sci. Discuss., referee comment RC2
https://doi.org/10.5194/wes-2021-131-RC2, 2022

Comment on wes-2021-131

Vasilis A. Riziotis (Referee)

Referee comment on "High-fidelity aeroelastic analyses of wind turbines in complex terrain: fluid–structure interaction and aerodynamic modeling" by Giorgia Guma et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2021-131-RC2, 2022

The paper assesses the effect of complex terrain on the loads and flow field, in the vicinity of the turbine using high fidelity aeroelastic tools. The results of the complex terrain simulations are compared to flat terrain simulations with turbulent and uniform constant inflow.

Even more important than the simulation results themselves is that the paper demonstrates that high fidelity FSI analysis is doable and it could provide better understanding of the complex physics of the flow in complex terrain.

Therefore in the reviewer opinion deserves publication in WES journal after some revision is performed in the original text.

Detailed comments and corrections can be found in the accompanying pdf. However the most important points are also listed below:

- In my opinion the perspective of the paper in relation to the two structural models employed in the analysis should be changed. It is already important that one can run CFD coupled with a shell type structural model in manageable computer time. Therefore, there is no need for the authors to struggle to point out the advantages of the shell model against the beam model because in this particular configuration and analysis there are no advantages (or at least convincing). The authors first highlight the issue of bend-twist coupling which is well proven that beam models can handle consistently (although the present model does not include this effect), to conclude that the present blade is very stiff in torsion. The same more or less happens with the deformation of the airfoils' shape. It turns out to be negligible. Overall, in the reviewer opinion the shape deformation is far more important difference than bend twist coupling and therefore the assessment study performed is necessary, although it turns out that the effect is negligible for the particular blade. Another point that could be stressed out is that shell models allow for local buckling analyses (identify local buckling modes) while beam models are struggling to provide information about buckling (there are some approximate methods).

- In the same direction the authors struggle to prove that the difference of the beam against shell predictions is notable in the turbulent wind case. What is clear already from the uniform inflow case is that the two models do not predict the same amount of damping in the edgewise direction. Whether the origin of this difference lies in the structural or the aerodynamic model is not investigated (different structural or aerodynamic damping). With a different damping of the critical edgewise mode, it is reasonable that differences in loads will be magnified when the system is excited by a stochastic inflow.
- It should be emphasized that there is still long way to go until load predictions are trustful for design purpose. For example neglecting the controller renders predictions of loads questionable, in particular beyond rated speed.

Some other minor corrections/suggestions to improve the text:

- 1P response of the edgewise loads/deflections is excited by gravitational loads and not by the blade passing in front of the tower. The latter contributes too but definitely much less.
- At low tip speed ratio values induction is low independent of whether the blade is pitched or not.
- PSD plots are much easier to read if some filtering is applied in order to better highlight the harmonic and natural frequency peaks. Please consider doing that in the PSD plots of figure 8 and 9. Furthermore it would be nice to introduce grid lines aligned with the harmonics. Then, harmonic peaks will be easier to see.

Please also note the supplement to this comment:
https://wes.copernicus.org/preprints/wes-2021-131/wes-2021-131-RC2-supplement.pdf