Reply on RC2
Thomas Potentier et al.

Author comment on "High-Reynolds-number wind turbine blade equipped with root spoilers. Part I: Unsteady aerodynamic analysis using URANS simulations" by Thomas Potentier et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2021-140-AC2, 2022

We thank the reviewer for the quality of the feedback. Below are the answers to the several points noted.

1. It is noted that ISIS-CFD code has not been properly cited in the current state of the paper. Therefore we have updated the section 3.1:

ISIS-CFD, developed by Centrale Nantes and CNRS and available as a part of the FINE\texttrademark/Marine computing suite, is used in the present study to solve the incompressible Unsteady Reynolds-Averaged Navier-Stokes (URANS) equations. It is based on the finite volume method to build the spatial discretization of the transport equations. The unstructured discretization is face-based, which means that cells with an arbitrary number of arbitrarily shaped faces are accepted (unstructured mesh). A second order backward difference scheme is used to discretize time. The solver can simulate both steady and unsteady flows. In the case of turbulent flows, transport equations for the variables in the turbulence model are added to the discretization. \\

All flow variables are stored at the geometric cent of arbitrary shaped cells. Volume and surface integrals are evaluated with second-order accurate approximations. The method is face-based, which means that the net fluxes in the cells are computed face by face. Thus, the cells with an arbitrary number of arbitrarily shaped faces are accepted. Numerical fluxes are reconstructed on the mesh faces by linear extrapolation of the integrand from the neighbouring cell centres. A centred scheme is used for the diffusion terms, whereas for the convective fluxes, a blended scheme with 80\% central and 20\% upwind is used.\\

The velocity field is obtained from the momentum conservation equations and the pressure field is extracted from the mass equation constraint, or continuity equation, transformed into a pressure equation. The pressure equation is obtained by the Rhie and Chow interpolation \cite{rhie_chow_83}. The momentum and pressure equations are solved in an segregated manner as in the SIMPLE coupling procedure \cite{issa_85}. A detailed description of the discretisation is given by \cite{queutey_visonneau_07}.\\
The turbulence model used is SST k-$\omega$ (see \cite{menterZonalTwoEquation1993}). The flow characteristics are representing the air at sea level at a temperature of $15\degree{}C$, i.e.: $\nu = 1.81\times10^{-5}\unit{}{kg m^{-1} s^{-1}}$ (dynamic viscosity) and $\rho = 1.225\unit{}{kg m^{-3}}$ (air density). A uniform inflow of $45\unit{}{m/s}$ is set, which induces a chord Reynolds number of: $Re_c = 3\times 10^6$ for the presented section of $\frac{r}{R}=13\%$.

2. ISIS-CFD has been validated many times over regarding 3D cases for hydrodynamics and automotive cases (see \cite{4, 5, 6, 7, 8}). However, the 2D cases validation were not explicitly cited or showed in the present paper. As part of \cite{10}, a comparison between the existing DANAERO literature both experimental and numerical and ISIS-CFD was performed. The following figures illustrates the good agreement between the 2D The following lines will be added to the introduction of the section 3.2:

“A comparison between the existing DANAERO literature both experimental and numerical and ISIS-CFD was performed (see \cite{potentier_cfd_2020}). The outcome showed the good agreement between the 2D wind tunnel experiment and the 2D URANS ISIS CFD simulations, thus validating the use of ISIS-CFD for 2D external applications. The domain size study has also been performed and the recommended square domain of 80 chords in length was used.”


\cite{8} E. Guilmineau, G. B. Deng, A. Leroyer, P. Queutey, M. Visonneau, and J. Wackers, 'Assessment of hybrid RANS-LES formulations for flow simulation around the Ahmed
3. This is indeed an interesting question that can be answered only by comparing 2D URANS simulations and LES simulations. However, LES simulations of this present configuration do not exist in the literature and is therefore a full work by itself. We believe that the present URANS simulations have a sufficient representation of the wake dynamics (until $x/c = 5.0$) to perform a first analysis of the spoiler impact. Ongoing RANS-DES simulations of the present configuration will be used in the future as a comparison with the present URANS simulations, which is out of the scope of the present paper.

You will find in attachment a difference file between the the original and the revised manuscript. I have also attached a plot showing the good agreement between ISIS-CFD (FINE/Marine) against the DANAERO database (from comment 2) and a plot of the PSD at several position in the wake (comment 3).

Please also note the supplement to this comment:  
https://wes.copernicus.org/preprints/wes-2021-140/wes-2021-140-AC2-supplement.zip