

Wind Energ. Sci. Discuss., referee comment RC1
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Comment on wes-2021-94

Anonymous Referee #1

Referee comment on "RANS modeling of a single wind turbine wake in the unstable surface layer" by Mads Baungaard et al., Wind Energ. Sci. Discuss.,
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The article "RANS modelling of a single wind turbine wake in the unstable surface layer" by M. Baungaard et al. proposes new derivation of a k-epsilon RANS model for unstable atmospheric boundary layer applied to a single wind turbine.

After a very clear introduction, the general simulation set-up is given in Section 2 with velocity, k and epsilon inflow profiles, wind turbine modeling and RANS parameters. In the latter, the van der Laan et al. (2017) modified model is described. In Section 3, the derived k-epsilon model is presented with the f_P -limiter parameter. It mainly consists in two modifications: a constant formulation of the buoyant production of Turbulent Kinetic Energy (correcting the van der Laan (2017) unphysical effects) and a new formulation of the f_P parameter (via modifications on f_0 and CR parameters). This model is applied on 5 cases in Section 4 and compared to experimental or LES results, showing a better agreement of the new model compared to the one of van der Laan et al. (2017).

The article is very clear on its objectives, the new methodology proposed and the validation process and is very well written. Some informations may lack of precision or justification (given below) but the overall article is well justified and deserve to be published and addressed to the wind energy community.

Specific comments:

- 1. Introduction, line 19: although precised later in the text, the RANS model can also include complex geometry that analytical models cannot

- 2. Simulation set-up, line 62: the numbers given are from an article of 2015. As the computational resources evolve very quickly, are these numbers still relevant?
- 2., line 66: the comparison in terms of computational resources needed and return time between LES and RANS is well described and objective. Is a comparison with the engineering models would also be relevant here?
- 2.1, line 94: the reason to not take into account more realistic inflow profiles covering the whole ABL is understandable. But what would be the implications or consequences in terms of physics (compatibility of the proposed model for example) or numerics (impact computation time for example)?
- 2.1, line 96: the choice of K and Cu values may be justified
- 2.1, line 116 + Fig. 2: the comments on the eddy viscosity decomposition are poor and may be expanded
- 2.2, line 124: the advantage of the Joukowskt-AD compared to airfoil-AD is not very clear. Is it just interesting because it uses few input parameters?
- 2.3, line 143 + Fig. 3.: the vertical mesh stretching chosen coupled to the large domain should imply a large number of mesh cells out of the wake zone, i.e. the interesting area. This is a classical drawback of stretched structured grids. Can you give the number of cells into the wake region (the one of Fig. 3.) over the total number of elements and comment?
- 2.3, line 163: the Coriolis force and veer effect are not taken into account. Can you briefly justify?
- 3., Fig 4: What is ν_{tref} ? Why the viscosity ratio drops towards zero in the rotor area and in the near wake? This figure may be more discussed.
- 3.1, Fig. 7: the comments on Fig. 7 are poor. More discussions can be added on wake recovery via velocity field, on shear parameters or turbulent time.
- 3.2, Fig. 8 & 9: Same remark
- 4., line 243: the choice of CB and CR values is unclear. As CR depends on CB, how can $CR=4.5$ be fixed ?
- 4., line 248: are 5 applications needed? Some case give the same insights (V80-Abkar and V80-Keck for example).
- 4.3 & 4.4, Fig. 12 & 13: The overprediction of TI of the proposed model is observed, while the 2017 model behaves better in near wake. Can you explain why?

Technical comments:

- line 36: Tubulent --> Turbulent
- Table 1: Cu and K are already given in th text line 96. It shoudn't be repeated here.
- Comma after Equations 9, 13, 14, 15, 16, 17, 18, 20, 22, 23, 24 and point afer Eq. (21). Move the point of Eq. 26 after the parenthesis
- Line 273: comma after "For the SWiFT case"