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Elegant ABL model for efficient computation of homogeneous inflow conditions

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Referee comment on "A pressure-driven atmospheric boundary layer model satisfying Rossby and Reynolds number similarity" by Maarten Paul van der Laan et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2020-130-RC1, 2021

Elegant formulation of an ABL model with numerical properties to allow efficient computation of wind conditions by dropping dependencies on the wind sheer. The model is motivated by previous papers from the authors grounded on the concept of Re and Ro similarity and provide a practical approach to the parameterization of the model using pre-computed ABL simulations. I have only minor remarks and suggestions that can help in the understanding the derivation of the model. In particular it is important to mention how stability effects are introduced without using a potential temperature equation.

Abstract: “for isolating the effects…” this part does not read well, please reformulate.

P1.19: Please add an example of a reference for RANS dealing with wake and blockage.

P1.22: Please add an example of a reference for RANS switching physics components on and off.

P2.23: avoid using “obviously” when stating any modeling hypothesis. “It ain’t what you don’t know that gets you into trouble. It’s what you know for sure that just ain’t so.” - Mark Twain (one of my favorite quotes that is very applicable to science).

P3.15: The ABL formulation does not include an equation for potential temperature so there is an implicit assumption that the equations are only applicable in neutral conditions. However, later on you show results for stable conditions which, in practice, are dependent on the value of lmax. I think that when you start the description of the model in chapter 2 you should make it clear how you are dealing with stability so that the reader knows that the model is more generally applicable that just neutral conditions. This is particularly confusing when you define lmax based on Blackadar’s equation (2) which was meant to be used in neutral conditions. If I understood correctly, as described in the annex and illustrated in Table 1, lmax and other forcings are derived based on best-fit between the desired reference wind conditions and a pre-simulated library of ABL profiles. This is a practical approach to defining these quantities that are not typically measured in real word campaigns. Instead they become tuning parameters of the model to match the desired profile.

P4.16: “it can be used”

P5.Eq.(8): “If we take the wind veer to be much less than (1/Å□)dÅ□/dz”. It is not straightforward to understand if this assumption holds in general. I guess that the net effect of this assumption is apparent in Figure 1 but you might as well plot the wind veer components vs the wind shear components of eq. (6) to show their relative importance with height and then the approximation will be better substantiated.

P6,8: “This can be seen as an approximation”

P7,26: For completeness, can you specify where this set of constants is coming from?

P8,Figure 2: Please define the symbol "I" of subplot (g) in the text or in the caption.

P9,21: Can you elaborate why z0/lmax is a proxy for normalized ABL depth? Furthermore, why does it "represent a fixed ABL depth or a fixed atmospheric stability?

P12,19: "as an inflow model"

P17,14: "The results are stored as a function"