Wind Energ. Sci. Discuss., referee comment RC1
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Comment on wes-2022-43

Anonymous Referee #1

Referee comment on "Numerical simulations of ice accretion on wind turbine blades: are performance losses due to ice shape or surface roughness?" by Francesco Caccia and Alberto Guardone, Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2022-43-RC1, 2022

General comments:

The authors investigate the ice accretion on a wind turbine. The article seems original because it allows to quantify the effect of the ice surface roughness on the performance losses of the wind turbine. For this, the authors use numerical simulations. Being well aware of the strong uncertainties on the roughness input data, they performed an interesting parameterization. Moreover, they have performed quite fine simulations of the ice accretion on each studied section by a time-efficient multi-step approach.

Specific comments:
- Introduction : line 101, "The icing event was long enough for ice horns to form, to combine the effects". The author are supposed to address rime-ice conditions from an earlier comment. The term "horn" is more often used for glaze-ice shapes.
- Methodology :
  * line 129, what is the "wind shear exponent"?
  * line 131, what does the OpenFAST simulation imply for the ice accretion simulation? For instance, do the wind turbine operation data account for the retroaction of the ice shape growth? (rotational velocity, etc.)
  * line 146, it seems to me a good idea to define an average power value. But why use the Weibull distribution rather than another one?
  * line 206, this is not clear to me how and why this extrapolation is performed. If it is common practices, is there any reference available?
  * line 209, "the average flow field is resolved down to the Kolmogorov length scale." This seems misleading to me. This looks more like the definition of DNS simulations. The low-Re approach is related to the description of the turbulent boundary layer structure and requires y+=1 to capture the region of the viscous sublayer.
  * line 236, is there any reference for uhMesh? what kind of mesh generation technique is used?
  * line 247, "the output had a 1P component". What does that mean?
- Validation:
  * line 273, since the description of the setup is diluted over several sections, it is not fully

clear to me what experimental conditions are simulated in section 3.1.
 * line 298, since the residual seems to be of importance for the methodology, it would be worth describing exactly how it is computed.
- Results and discussion:
 * line 327, does the roughness always cover the whole ice surface (in the std and ext case)? On the contrary, can it cover the blade surface further than the ice?
 * line 338, "the ice shape was mainly responsible for the aerodynamic penalty". It would be interesting to know the polar for the smooth-wall simulation of the iced shape to support this assertion.
 * line 343, "due to the supposed early transition", I do not understand this early transition. Is the transition modeled for the rough-wall simulations? If not, wouldn't it be fairer to compare against the clean simulations without transition?
 * line 356, "This effect is peculiar since roughness should have little effect on the aerodynamic coefficients when ie horns are well developed." Is there an explanation?
 * line 399, "Once more, our results agree with those by Etemaddar et al.", in which sense do the results agree? They may be consistent with each other but they are not in agreement (except if the figures in the table are wrong).

Technical corrections:
- Lines 62 and 66: 20 microns, 25 microns
- Figure 10, page 14: why are there systematically 2 curves for "Clean" (and the slope is not recovered)?
- Line 370, define what TSR and Cp are
- Reference Lavoie et al (line 494): The journal article https://doi.org/10.2514/1.C036492 is probably more accessible to most readers
- Reference McClain et al (line 498): The journal article https://doi.org/10.4271/2019-01-1993 may also be more accessible to most readers than the conference article referenced. However, this is not exactly the same topic (although the main information that roughness evolves both in space and time is also given).