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Interactive comment on "Wind turbine power production and annual energy production depend on atmospheric stability and turbulence" *by* C. M. St. Martin et al.

Anonymous Referee #1

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General comments:

This manuscript uses nacelle-based and upwind met tower measured data to calculate power curves (PC) and annual energy production for a specific wind turbine. This work thoroughly investigates the sensitivity of the PC and AEP to atmospheric parameters such as turbulence intensity (TI), Turbulence Kinetic Energy (TKE) and Bulk Richardson Number (RB) which would be of value to manufacturers in power performance testing. As indicated by the authors, the existing literature do not agree on the effects that these atmospheric parameters have on the PC and AEP. Although the present work provides significant observations about the effect of TI, TKE and RB on power performance, it does not elaborate on the underlying physics of the obtained results.

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Discussion paper

Also, this work does not provide any insights towards the factors that can contribute to the variability in the results reported in the existing literature.

Specific comments:

- Power curve measurements using hub height winds result in high uncertainties and are not a good representative of the energy contents of the flow. How does this known fact play role in the current study?

- P5: Did you perform any data quality control on the 3D sonic measured values? If yes, what is the total number of data points remained for 3D sonic and why resulted in less number of data points for this instrument compared to the other met tower instruments?

- P8: It is not clear how the authors came up with a different classification for RB. This needs to be explained in more detail.

- P9: It appears that L values are calculated using 80m measurement data. Since at 80m only cup anemometers are installed, how is w' obtained?

- P12: Observations are made regarding the differences between nacelle power curves and tower curves and their dependency on the wind speed range (Lines266-276). However, no discussion is provided as to what are the possible explanations for such observations/ behavior.

- P13: Authors have used power curves calculated using upwind tower data to obtain AEP. Given the variability observed between the tower data and the nacelle data, it would be interesting to look at the AEP values calculated using power curves obtained using nacelle measurements.

- P14: Given the lack of statistically significant impact of wind shear on the power curves and the AEP values provided in Table 5 for shear filter, one cannot make a conclusive statement about the effect of shear on AEP.

- P15: the authors suggest calculating different power curves for different conditions.

Now the questions is with the practicality of this approach.

Technical corrections:

- Fig 1: this figure is not providing the required information. I suggest that you replace this with a schematic drawing which marks and labels the turbine, the lidar and the met tower. Also include prevailing wind direction.

- Fig 6: “Grey line represents..” It should read “black line. . .”

- Fig 17: mark rated wind speed on the graphs

- The vertical axis on all distribution plots is not representing frequency but rather the number of points. This needs to be corrected.

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