Response to RC2 of wes-2016-21, "Wind turbine power production and annual energy production depend on atmospheric stability and turbulence" by C. M. St. Martin, J. K. Lundquist, A. Clifton, G. S. Poulos, and S. J. Schreck.

This manuscript is trying to give the guidance of using a multi-criteria approach of evaluating power performance of a wind turbine. The concept of using of stability and turbulence filters in segregating power curves is not new, but the case study done in this manuscript and the associated evidence shown are of great value as a reference for the future work under this topic. The effort of collecting and quality controlling of the measured data from three sources: nacelle, tower and lidar are very noticeable. In the following years I hope I will continue my work in turbulent wind inflow study and would love to cite this paper when published and will try using numerical weather forecasting model/ large simulation model interacting with wind turbine models to reproduce the results found in this manuscript. I find the paper to be very well written.

There is just one general comment: This manuscript spreads out the observed relations between power curves/annual energy production (AEP) and turbulence intensity (TI)/ turbulence kinetic energy (TKE)/Bulk Richardson number(RB), however, the physics behind the phenomenons have not been discussed. For example, what are the authors' perspectives and explanations on the causes of "increased TI and TKE undermined power production at wind speeds near rated, but increased power production at lower wind speeds" ? The illustrative examples look appealing and it may be published if this lack of information is added.

We thank the reviewer for this comment, and we agree. We have added the following passage to Section 4.1 (Results – Power curves) to explain the physics behind the phenomena discussed in the results of this work:

> "The large variability reported in the literature (and herein) regarding power production can be understood by recognizing the interactions between a pitch-controlled turbine and the atmosphere, as well as recognizing that the control algorithms generally operate differently in different wind speed regimes. Depending on the ambient turbulence, this effect can be different.
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> At low wind speeds, around and above cut-in wind speed, the turbine generator speed or revolutions per minute (RPM) increases as well as the generator torque, the blades will often pitch backward to generate more thrust, and the power produced ramps up. At low wind speeds and higher turbulence, the turbine is reacting to the higher variation in wind speed. The turbine is able to capitalize on the variation seen in the wind flow because of the thrust resulting from the blade pitch. At low wind speeds and lower turbulence, and therefore the variation in wind speed is lower, the turbine sees a more consistent wind than in highly turbulent conditions and therefore produces less power.
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> At higher wind speeds, closer or just below rated speed, the turbine needs to maintain rated generator speed rather than continuing to increase its generator speed, and the blades will pitch forward to essentially be feathered, allowing the power production to flatten out to rated power. This process effectively decreases

the amount of thrust generated by a non-feathered blade. At these wind speeds during periods of high TI, a turbine reacts to the high variation in wind speed with subtle changes in blade pitch. For example, if the turbine detects a drop in wind speed, the blades may pitch back to generate more thrust, but then if the wind speed increases quickly after, the blades will pitch forward again. If the blade pitch is not consistent when the average wind speed is higher, then power losses occur, in contrast to a case when the blade pitch is consistent. At these higher wind speeds, lower turbulence allows the turbine to capture more power: the lower the turbulence, the longer the wind speed and blade pitch stays consistent and the more energy the turbine can capture.

It is also important to mention the strong connection between turbulence and shear: high shear will eventually erode turbulence (Wharton and Lundquist 2012). Periods of high shear generally coincide with periods of low turbulence and vice versa. With low shear, the mean wind speed is more consistent over the height of the rotor disk. However, since we did not see significant differences in power curves for different shear regimes here, we cannot speculate further on this in this analysis. Finally, if veer occurs in the wind profile (as in Vanderwende and Lundquist 2012 and Dörenkamper et al. 2015), which usually occurs only in stable or low turbulence atmospheric conditions, that veer will generally undermine power production as the turbine blades are not oriented perpendicular to the flow at all vertical levels."