Response to Reviewer 2 comments:

General comments: This paper demonstrates a nacelle transfer function for "decontaminating" wind measurements mounted on the nacelle of an operating wind turbine. They also explore the impacts of thermal stability and turbulence regimes. The paper is fairly well written, but the Introduction and Data and Methods sections require some clarification, and would benefit from concision.

I am not entirely convinced of the practical application of this technique. Your technique requires contemporaneous measurements from an "upwind" tower, but in practice such measurements often are not available. You even acknowledge this in the introduction: "However, it is not feasible to erect "site calibration" met towers after the turbine has been erected. And, even if "site calibration" is not required because a site is in simple terrain, tower erection is time consuming and unrealistic to complete for every turbine at a given park." Perhaps I am missing important details, but I do not understand how this technique could be applied in the absence of an upwind measurement(s). And those measurements need to be representative of the site. In regions such as Europe, these kind measurements are exceeding rare at operating projects, and it is not clear how applicable this approach is in practice.

As stated in Sect. 1:

"Nacelle measurements could also be used to help improve turbine or park efficiency. For example, power performance verifications for individual turbines can now be based on the nacelle anemometer with suitable nacelle transfer functions (NTFs) (International Electrotechnical Commission [IEC] 61400-12-2 2013). Nacelle measurements can also provide critical input for wind farm production optimization (Fleming et al., 2016). With sufficiently accurate NTFs, these data can provide a valuable, extensive, and continuous source of turbine-specific performance information."

The analysis presented in this work is motivated by the application of power performance testing as stated in the above excerpt. Typically, power performance testing is performed using measurements from some upwind tower or remote sensing instrument, however, IEC standards released in 2013 (IEC 61400-12-2) titled "Power performance of electricity-producing wind turbines based on nacelle anemometry" describe how nacelle anemometer measurements can be used for this application if based on transfer functions. Quantifying these transfer functions require upwind measurements be available at some point post-construction. However, once transfer functions are calculated for a site, the tower can be taken down and the transfer functions used to correct the nacelle measurements for future performance testing. The IEC standards (IEC 61400-12-2, 2013) even allow the use of these transfer functions at other, similar sites as stated within the standard:

"The procedure can be used for power performance evaluation of specific turbines at specific locations, but equally the methodology can be used to make generic comparisons between different turbine models or different turbine settings."

…

“If during an NPC [nacelle power curve] measurement an NTF is used that has previously been measured in another park it may only be applied to turbines with a terrain classification that is the same as the terrain class during the NTF measurements; the terrain must also have the same sign of terrain slope in the measurement sector.”

This work focuses on the effect of atmospheric conditions on these transfer functions, so that when operators perform these calculations for future power performance testing, they will be aware of some of the factors these transfer functions are sensitive to. The manuscript ends with the following:

“Several atmospheric and operational conditions and how they affect the transfer functions should be investigated and perhaps combined to provide an algorithm for manufacturers and wind plant operators to use in power performance validation.”

To further clarify the practicality of the NTF, we will the following to Sect. 1 when introducing NTFs:

“Quantifying these transfer functions require upwind measurements be available at some point post-construction. However, once transfer functions are calculated for a site, the tower can be taken down and the transfer functions used to correct the nacelle measurements for future performance testing.”

Specific comments:

(1) There is insufficient information about the methods and rationale. The reader is frequently referred other papers for these important details. For example, lines 149-151 of the paper state that: "Regimes or classifications for these stability and turbulence parameters are defined in Table 1 and described in detail in St. Martin et al. (2016), along with more detailed descriptions of the data from the lidar, tower and turbine, as well as filtering methods." A scientific paper should be entirely self-contained, and provide enough information for the reader to readily understand what you have done and how you have done it. We should not be forced to locate and dig through other papers for the details of your methods. (2) The classifications in Table 1 seem arbitrary, particularly for the TI and TKE "high", "medium", and "low". Without context and and understanding of how you arrived at these classifications, they seem very subjective.

We understand, and will add equations for each stability metric with definitions of each parameter as well as the following:

“Regimes of TI, TKE, and α are determined by splitting the distributions of each parameter roughly into thirds. Regimes of R_B are similarly determined, as in Aitken et al. (2014) and St. Martin et al. (2016), and uncertainty in the R_B values calculated from propagation of instrument accuracy ensures the regimes are wide enough. Stability regimes based on L are similar to those defined by Muñoz-Esparza (2012).”

(3) There are a number of confusion passages in the Introduction and Data and Methods sections. For example, the paragraph starting on line 58 is very hard to follow, and could be

greatly shortened without losing the salient information. Here is my humble attempt, which combines the two paragraphs spanning lines 57-77):

"The relationship between UHWS measurements and NAWS measurements used for generating NTFs has been found to depend on a number of factors, including: nacelle height, wind inflow angle, blade pitch angle, yaw misalignment, the position of the anemometer on the nacelle, the anemometer calibration, and the characteristics of the surrounding terrain (References ....). However, the impacts of inflow turbulence and atmospheric stability on NTFs have not yet been explored, even though it has been recognized that they may play an important role (References ....)."

Thank you for the suggestion. To be more concise, we will change the text in the Introduction from:

"In previous work, the relationship between UHWS measurements and NAWS measurements has been found to depend on multiple factors. Antoniou and Pedersen (1997) found that relations between the UHWS and the NAWS were dependent on rotor settings such as blade pitch angle and the use of vortex generators, yaw error, anemometer position, and terrain. They concluded that if these factors were kept constant, the relation could be used for all wind turbines of the same make and type. Frandsen et al. (2009) found a dependence on flow induction caused by the rotor. Dahlberg et al. (1999) discovered that pitch angle affects the relation. Dahlberg et al. (1999), Smith et al. (2002), and Frandsen et al. (2009) also stressed the importance of the correct calibration of the nacelle anemometers and that this calibration has an effect on the error measured in the relation. Zahle and Sørensen (2011) found that the inflow angle to the rotor and yaw misalignment influences the relationship. Smith et al. (2002) concluded the relation may depend on turbine controls, topography, and nacelle height and position. Smaïli and Masson (2004) implemented a numerical model and concluded that a relation should account for rotor-nacelle interactions and hypothesized that wakes, topography, and nacelle misalignment would all have some effect on the relation. To summarize, the factors found to be relevant in NTFs are: rotor settings, yaw error, anemometer position, terrain, flow induction (decrease in wind speed just in front of or just behind the rotor), nacelle anemometer calibration, and inflow angle."

To:

"In previous work, the relationship between UHWS measurements and NAWS measurements has been found to depend on multiple factors, including rotor and turbine control settings such as blade pitch angle and inflow angle, the use of vortex generators, yaw error, terrain, flow induction, calibration of the anemometer, and nacelle height and position (Antoniou and Pedersen, 1997; Dahlberg et al., 1999; Smith et al., 2002; Smaïli and Masson, 2004; Frandsen et al., 2009; Zahle and Sørensen, 2011)."

(4) Lines 95 and 96: Change "(2.7 D upwind)" and "(2.0 D upwind)" to "(2.7 rotor diameters upwind; AND STATE THE PHYSICAL DISTANCE!)" and "(2.0 rotor diameters upwind)".

We agree and will make the following changes in bold:

“Upwind data include 1-Hz measurements of wind speed and direction averaged to 10 min from a Renewable NRG Systems (NRG)/LEOSPHERE WINDCUBE v1 vertically profiling Doppler lidar (2.7 **rotor diameters (D) upwind; 208 m**) and 10- and 30-min averages from a 135-m met tower (2.0 D upwind, **154 m**).”

(5) Lines 100-104: This is really hard to follow, and keep the figures straight. I strongly suggest that you put this into a Table, which will be much easier to digest. This is also one of many places you refer the reader to some other paper for more details–in this case the configuration of met tower. Very frustrating!

We will insert the following table to make it easier for the reader to absorb and retain the information:

Instrument	**Mounting heights (m)**
Cup anemometer	3, 10, 30, 38, 55, 80, 87, 105, 122, 130
Wind vane	3, 10, 38, 87, 122
3-D sonic anemometer	15, 41, 61, 74, 100, 119
Barometric pressure sensor	3
Precipitation sensor	3
Temperature sensor	3, 38, 87
Dew point temperature sensor	3, 38, 87, 122