

Interactive comment on “Characterization of wind power resource in the United States” by U. B. Gunturu and C. A. Schlosser

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We are very grateful to the anonymous reviewer #2 for the constructive comments. The comments have been very helpful in making the manuscript clearer and consistent. We present our responses to the reviewer's comments below in italic text.

1. Definitions for CoV and IQR are missing in the main text, which are needed for general readers with insufficient backgrounds in statistic.

The following description of the two statistics has been added just before their use in the section ‘Results and Discussion’.

Coefficient of variation is defined as the ratio of the standard deviation and the
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mean of a sample. For long-tailed and skewed distributions, the mean and standard deviation are not robust as they are impacted by the extreme values of the distribution. Instead, we use the robust coefficient of variation (RCoV) which is defined as the ratio of median absolute deviation about the median and the median itself.

Since the median is a robust measure of central tendency, this ratio is called robust coefficient of variation.

The difference between the 75th and 25th percentile of a distribution is called the inter-quartile range. As the extreme values render the measures of center and dispersion non-robust, removing the extreme values results in a robust measure of spread. Thus Inter-Quartile Range is a robust measure of statistical dispersion.

2. On P. 7312, Line 20–L21, the similarity theory in boundary layer is used to interpret wind speed at 80m, 100m, and 120m, which is a function of near surface friction velocity, surface heat flux, and surface aerodynamically roughness (P. 7314, L11–L13). This method is based on the assumption that the interoperated wind level is within atmospheric boundary layer, which is typical true for daytime PBL, however it may not be true at nocturnal stable boundary layer when its PBL height sometimes shallow than 80–120m. In the later case, winds near the surface is decoupled from winds aloft at wind turbine height (80m to 120m); therefore turbine winds should not be interpreted as boundary layer winds related to surface heat flux and surface roughness. As a consequence, nighttime wind speeds at various vertical levels may not be well estimated in this paper, which leads to potential problems in estimating WPD variance and intermittent properties in some regions over United States.

Most of the wind power resource estimations including the US wind Atlas (Elliott et al., 1987) assume neutral stability.

It is agreed that atmospheric stability affects the boundary layer parameters and

hence the horizontal wind speed at different heights. The effect is more at nights because a large fraction of useful wind power resource (that the turbine can harvest efficiently) occurs at night. When the wind speeds are large at night, the mechanically generated turbulence adjusts the stability of the atmosphere close to neutral, but is not neutral. When the wind speeds are low, the atmosphere is highly stable. At high wind speeds, which case is of interest for wind power generation, the atmosphere is near neutral. But as the turbine technology advances and they start generating power at lower wind speeds, these instances of higher stability start to become important.

To account for the fact that the estimation is not robust when the atmosphere is far from neutral stability, we mention this as one of the limitations of the present study in the list of limitations.

In a set of further experiments, we are correcting the estimates for atmospheric stability and the effects of local and smaller scale processes. Those results are likely to form a future communication.

3. P7308, L4-7 about shape factor: Original: "The shape factor of the Weibull distribution has a great impact on the fit of wind speeds because as shape factor increases, the tail of the Weibull distribution decreases. Thus, the extreme wind speeds decrease and the distribution transforms towards a normal one. " As shape factor increases, the tail is shorter, which may not lead to decrease of extreme wind speeds, because there is no direct relationship between absolute wind speed and the shape factor. It is suggested to rewrite the sentence to emphasis only the shift of distribution toward a normal one when the tail is shorter.

We rewrite the lines as : 'The shape Thus, **the frequencies of extreme wind speeds decrease and the distribution transforms towards a normal one.**'

4. P7323, L22-25 Original: "Further, it also erroneously characterizes the mountainous regions as high wind resource locations. Thus, wind speed is not a suitable measure for the wind resource. If WPD is used, it is more comprehensive as it covers the variation of air density" The wind resource is not limited to wind power resource but also to extreme wind assessment, surface dust and aerosol transport, surface flux estimation, et al. Wind speed is a suitable measure for the wind resource, but air density variation is also important for accurately estimate wind power resource particularly in non-mountainous regions.

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In the context of the present paper, we use 'wind resource' and 'wind power density' interchangeably to mean the flux of kinetic energy of wind that is available to turn turbines and generate power, as these are also the terms used in the literature.

Further, to be explicit, we also change 'wind resource' in the said lines to 'wind power resource'.

0.0.1 Technical corrections

The following are the changes we made in responses to the technical corrections.

1. Color schemes for Figure 8, 12b, 12c, 13b, 13c, 15b, 15c, 16b, 16c are suggested to be improved for better figure quality;

Since these are difference plots that show the difference of a quantity from that at a different level, we use the most commonly used diverging color scheme - bluewhitered. The purpose of this color scheme is to make the intensities of increases, decreases or no-changes immediately visible and intuitive for spatial comparison. Incidentally, in some of the plots, there is a consistent increase in the quantities from one level to another, and so, it is in red.

2. Study periods are missing in all figure captions.

We added the heights of the levels in all the captions. Further, we mention the study period at the start of the 'Results and Discussion' section since the study period is the same for all the plots.

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