Determining Variabilities of Non-Gaussian Wind Speed Distributions using Different Metrics and Timescales

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Motivation

• Quantifying the uncertainty of winds is critical for the wind resource assessment process. However, wind speed variations differ across averaging temporal scales.
• Standard deviation is a commonly used metric to quantify variability, yet it is not statistically robust or resistant (Wilks 2011).
• Our goal is to contrast the distribution spread and characteristics of wind speed at different averaging timescales, and to explore the value of using a robust and resistant method to assess variability.

Methodology

• We apply the horizontal wind speeds from the National Aeronautics and Space Administration’s Modern-Era Retrospective Analysis for Research and Applications, Version 2 (MERRA-2) reanalysis data set (Gelaro et al. 2017) from 1980 to 2017.
• We derive the wind speeds at 80 m above the surface using the power law and derived shear components. We compute the mean wind speeds at six time resolutions: hourly, daily, weekly, monthly, seasonal, and annual.
• We use a collection of spread metrics and distribution parameters, including:

Results and Discussion

• RCoV effectively contrasts the wind speed variabilities of different regions, especially in monthly and seasonal mean data.
• RCoV indicates mountainous regions with high wind speed variabilities, regardless of the averaging timescales.
• Skewness and kurtosis drastically change with averaging time frames. Nonzero skewness and kurtosis illustrate that the Gaussian assumption is principally inadequate in most of the United States for all averaging time frames of wind speeds.
• Analysts should account for skewness and kurtosis when they use standard deviation to quantify long-term variability.
• Overall, using RCoV to evaluate wind speed variability is advantageous given its statistical robustness and resistance.

References
