Authors' Response to Reviewer 2

***Reviewer's Comment #1*:** The changes and new additions have improved the paper, and the authors have sufficiently addressed my concerns, in general.

There is nevertheless still one aspect that should be improved, in my view. The number of discontinuous random data is quantified on several occasions as "months" or "years" of data, instead as sample size or number of data. This can cause confusions, as "1 month" or "1 year" of random data could be understood as the actual total duration of observation datasets. In reality, "1 month" of random data requires many years of observations in order to get the favorable results shown in the paper.

The clearest way to avoid this confusion would be to remove any mention of "months" or "years" of data when referring to the number of discontinuous random data. At least, a clear explanation of the specific meaning of these time periods should be made, and a wording like "equivalent in size to 1 month" could be used. The use of such time references is particularly misguided in the abstract, as the procedure (random sampling of multi-year datasets) for obtaining the result that "basic parameters, such as mean, standard deviation, and Weibull parameters, can stabilize with ~1 month of hourly data" has not been explained before this statement. Also, in figure 7 the x-axes is written as "Number of data (yrs)", whereas in figures 2 to 6 the actual number of data is used in the x-axes. Using also just "Number of data" in figure 7, as in previous figures, would be clearer. There are several other sentences throughout the text where the use of "months" or "years" should be cancelled or clarified.

***Response to Comment #1*:** We agree that referring to the size of discontinuous random samples as "months" or "years" can be confusing. We carefully revised the manuscript to remove ambiguous uses when referring to discontinuous random samples by doing these revisions:

- Include the original hourly count and use an "years-equivalent" note to denote sample size in time units, for example:

Abstract: "*We apply this method to in-situ station observations and ERA5 reanalysis data at 10 m and 100 m heights. Our results show that basic parameters (mean, standard deviation, and Weibull parameters) stabilize with a sample size equivalent to ~1 month of hourly data (not a contiguous period) drawn across multiple years, while higher-order moments require substantially larger samples (skewness: ~1.6 years equivalent; kurtosis: 88.6 years equivalent). Although ERA5 stabilizes faster, it exhibits systematic biases compared to in-situ measurements. Moreover, random cross-year sampling yields comparable distribution parameters to diurnally or seasonally controlled sampling, while continuous sampling demands far longer records for the same accuracy.*" (*Lines 13-19 in the clean version of the revised manuscript*)

"*The kurtosis bias remained above 10% until sample size exceeded 2 160 hours, and SN50500 required 22 080 observations (~2.5 yrs equivalent) to reduce error to within 10%.*" (*Lines 268-269 in the clean version of the revised manuscript*)

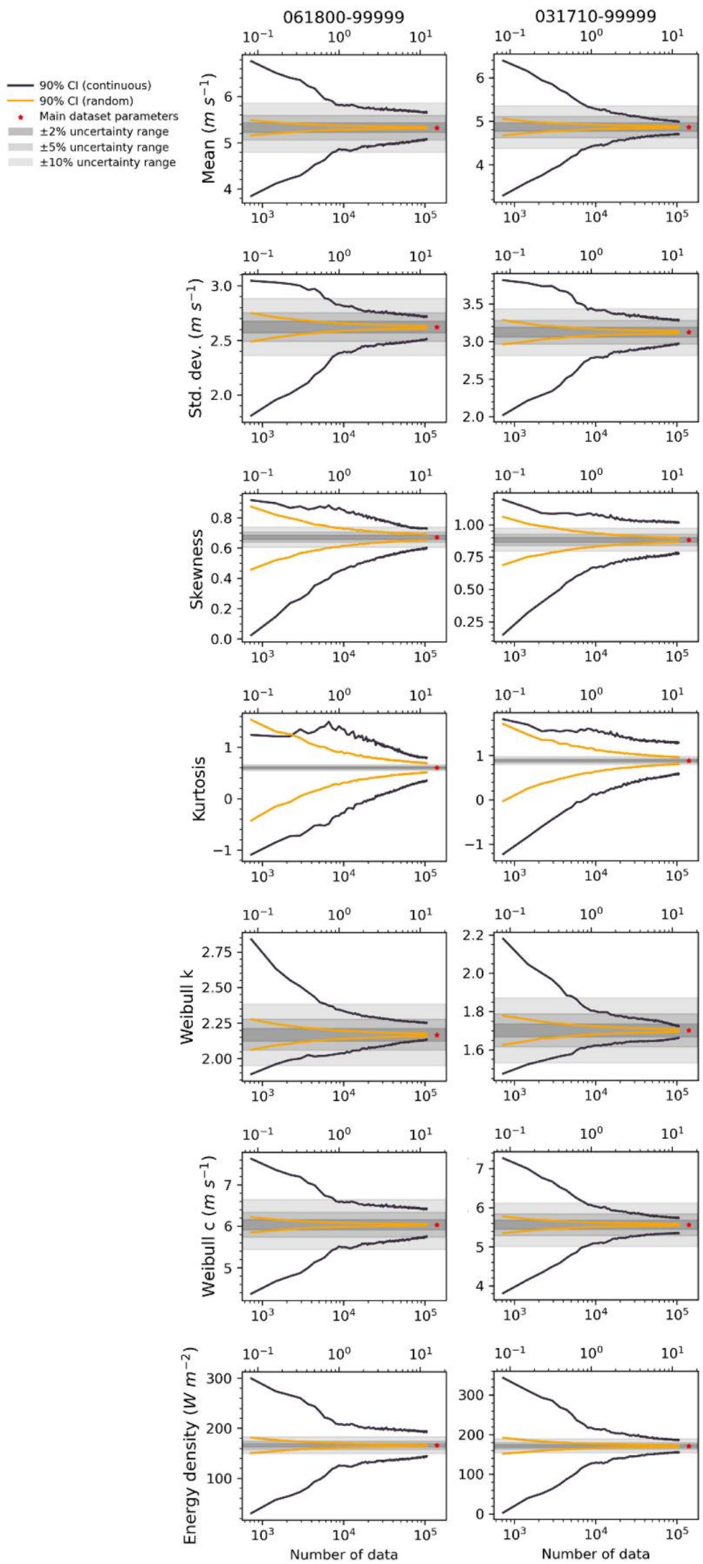
"*For example, ±5% accuracy requires 459 hourly observations for the mean, 470 for the Weibull scale (~20 days equivalent), 796 for standard deviation (~34 days equivalent), and 4 031 for power density. Achieving ±2% and ±1% error requires 6-fold and 24-fold of observations than ±5% case, respectively. Skewness and kurtosis are especially data-intensive due to their sensitivity to distribution tails. For instance, SN38140 needs 177 390 observations (~20 years equivalent) for ±10% error, while SN50500 needs 1 541 437 observations (~176 years equivalent).*" (*Lines 286-291 in the clean version of the revised manuscript*)

Conclusion: "*While the mean and standard deviation stabilize with a few hundred hourly samples, skewness requires at least 14 084 hours and kurtosis at least 777 573 hours to meet a ±5% error margin (1.6 years and 88.6 years-equivalent, respectively). Here, "years-equivalent" denotes the number of hourly observations equal to the hours in that duration and does not imply a contiguous period (samples are randomly drawn across years). These results emphasize that the required sample size is strongly dependent on the shape of the underlying distribution, with regional differences becoming more pronounced as accuracy demands increase, particularly for higher-order statistical moments like skewness and kurtosis*." (*Lines 497-503 in the clean version of the revised manuscript*)

- We revised the captions for Figures 4-5 and for the corresponding SI figures. We also updated Figure 7 to adopt the same x-axis convention as Figures 2-6 and added a secondary top axis showing the equivalent years.

"**Figure 4: The relationship between the percent error (Y) and sample size (n) (number of hourly observations) across five stations.** Curves are fitted for n = 720 ~ 140 160, with n = 720 is equivalent in size to 30 days of hourly data and 140 160 equivalent to 16 years. The equations of fits here are shown in Table 3. Grey circles indicate the values used to fit the 90% confidence intervals for the percent error shown." (*Lines 307-310 in the clean version of the revised manuscript*)

"**Figure 5: Same as Fig. 4, but the hourly observations ranging from n = 24 ~ 720 across five stations.** These intervals are calculated using the same fits as shown in Fig. 4." (*Lines 312-314 in the clean version of the revised manuscript*)



061800-99999
031710-99999
90% CI (continuous)
90% CI (random)
Main dataset parameters
±2% uncertainty range
±5% uncertainty range
±10% uncertainty range
Mean ($m\ s^{-1}$)
Std. dev. ($m\ s^{-1}$)
Skewness
Kurtosis
Weibull k
Weibull c ($m\ s^{-1}$)
Energy density ($W\ m^{-2}$)
Number of data

Figure 7: Distribution parameters and Weibull power density derived from random sampling (orange lines) and continuous sampling (black lines), based on in-situ measurements from weather stations. The x-axis shows the number of hourly observations; a secondary top axis indicates the equivalent number of years (1 year = 8760 h). Asterisks indicate values computed from the full 46-year dataset. Details of the experimental setup and sampling procedures are provided in the Methods section. (*Lines 381-386 in the clean version of the revised manuscript*)

Reviewer's Comment #2**:** On the other hand, I suggest that the authors include an additional application field of the results: the analysis of long-term high-resolution climate simulations for wind energy assessments. The fact that a relatively small number of random data from long-period wind series can reproduce relevant characteristics of the wind distributions could be very helpful for managing the huge amount of data from long-term high-resolution climate simulations.

Response to Comment #2**:** We thank the reviewer for this valuable suggestion. It highlights an important additional application for our results and further underscores their relevance. In the Conclusion, we have added the following concise statement to make this use case explicit (we did not modify the Abstract due to word limits):

"*An additional application of this result is to long-term high-resolution climate simulations: rather than processing the full, continuous multi-decadal time series, a relatively small, randomly sampled set of hourly outputs spanning multiple years can recover the key wind-distribution characteristics. The required sample size can be determined from our sample-size-uncertainty relationships to meet a prescribed accuracy bound, while model biases and non-stationarity should be addressed separately.* " (*Lines 515-519 in the clean version of the revised manuscript*)

Reviewer's Comment #3**:** Typos: L55: change "if we must REPLY on short-term dataset" to "if we must RELY on short-term datasets"

Response to Comment #3**:** We have revised L55 accordingly: "*if we must rely on short-term datasets*" (*Line 51 in the clean version of the revised manuscript*)