Dear Dr. Shen,

We sincerely appreciate your time and effort for your comments on our manuscript, which may help us improve our work. Nevertheless, we would like to point out that three (Q1, Q2, and Q4) out of your four comments have already been extensively addressed in our original manuscript. Please see our point-by-point responses below.

Q1. The critical assumption that ERA5 100-m wind speed data closely aligns with observational data has not been sufficiently validated, especially for areas characterized by complex terrains or significant local environmental variations. The authors need to provide robust evidence supporting the applicability and limitations of this assumption.

Response: In our manuscript, we have addressed this concern by presenting a two-fold justification for our assumption. First, we evaluated ERA5 100-m winds with measurements from 589 wind towers across China, each providing months to years of data spanning different periods between 2004 and 2022. The results show that ERA5 exhibits a smaller mean bias percentage in eastern regions compared to western areas, supporting its higher reliability in eastern regions. This finding led us to focus primarily on weather stations in eastern China and to derive z_0 for 1,805 stations in these built-up regions. Please see this evaluation in Section 3.1. Second, we further validated our assumption through model experiments. The gridded z_0 dataset was tested in WRF simulations and independently evaluated against both unseen station data (10-m winds) and additional tower measurements (100-m winds). Both validation tests confirmed significant improvements in wind speed simulations. Please see the model improvement in Section 3.3.

Regarding the applicability of our assumption in complex terrain areas with significant local environmental variations, we have explicitly addressed this limitation in our study (Lines 281-285). Our analysis shows that the gridded z_0 produced based on station estimates provides only limited improvement for wind speed simulations in topographically complex regions. This suggests two possible explanations: (1) our fundamental assumption may not hold well in such areas, or more likely, (2) z_0 is not the sole determinant of wind speed in these regions. As discussed in our manuscript, wind patterns in complex terrain are governed by multi-scale physical processes including microscale terrain features, turbulent orographic form drag, thermally-driven mountain-valley circulations, and mountain wave dynamics. These processes may make the simple z_0-wind speed relationship invalid in flat terrain.

Q2. The observation dataset without homogenization from CMA has shown large bias in https://journals.ametsoc.org/view/journals/clim/36/11/JCLI-D-22-0445.1.xml. This may significantly affect the generalizability and accuracy of z0 estimations across broader geographic contexts. Direct usage of the CMA wind data would absolutely reduce the robustness of the study. Thus, the homogenization on near-surface wind data is necessary.

Response: We appreciate your reference to Zhang and Wang's study regarding wind speed inhomogeneity in CMA stations. Their work identified significant inhomogeneities with breakpoints concentrated in the late 1970s, mid-1990s, and early 2000s, but they do not affect our results. Our study exclusively uses CMA station data from 2015-2019, when the CMA network had already completed its transition to automated observations with standardized instruments. In addition, we conducted quality control procedures before use, including missing value screening, physical range validation, and temporal consistency checks.

Q3. Although a Random Forest Regression model is employed, the sensitivity analysis of different feature variables lacks depth and clarity. The authors are encouraged to conduct comprehensive sensitivity analyses to clearly illustrate the theoretical rationale and practical implications of feature selection on model accuracy.

Response: In our study, we have conducted comprehensive sensitivity tests at every step of the random forest (RF) methodology to ensure the robustness of our results in Section 2.3 and Figure 3. Specifically, for data partitioning, we evaluated the impact of random seed selection when splitting the dataset into training and test subsets (Figure 3a); for parameter tuning, we systematically adjusted multiple key parameters (e.g., max_depth, n_estimators, min_samples_split, min_samples_leaf and so on) and provided detailed sensitivity analysis on the most influential parameter--the number of decision trees (Figure 3b); for model validation: a five-fold cross-validation approach was used to further verify the stability of our model (Figure 3c); for feature importance, we conducted thorough feature importance analysis to identify the dominant predictors (Figure 3e). These rigorous sensitivity tests confirm the reliability of our RF model. Please refer to Section 2.3 for a complete description of the methodology.

Q4. The validation of the model's performance is restricted to simulations for only one month, limiting the assessment of its robustness across different seasons or under varying long-term climatic conditions. The authors should include additional simulations covering multiple seasons or a full year to demonstrate the general applicability and reliability of their approach.

Given these substantial issues, I recommend rejecting this manuscript in its current form.

Response: We appreciate the reviewer's suggestion regarding the simulation period selection. Our choice to focus on April was motivated by both physical and practical considerations. As shown in Figure S3, April consistently exhibits the highest mean wind speeds across our study domain, making simulated wind speeds particularly sensitive to z_0 effects and thus ideal for evaluating our parameterization. To ensure robust results while managing computational constraints, we employed a carefully designed re-initialization approach where each 36-hour simulation (initialized daily at 12:00 LT (LT=UTC+8)) included a 12-hour spin-up period followed by 24 hours of analysis. This strategy produced 30 independent realizations, capturing diverse meteorological conditions throughout April. The consistent improvement in wind speed simulations across all cases (Section 3.3) strongly supports the reliability of our findings. While the current results are statistically robust, we may extend simulations to other months to further validate the general applicability of our z_0 dataset under varying climatic conditions.

We hope that we have addressed your concerns. We remain open to further feedback and are committed to improving the quality of our work.

Thank you very much!

Sincerely,

Jiamin Wang and Kun Yang

On behalf of all co-authors