Response to the comments about the submitted paper to Earth System Science Data :

High frequency observation during the sand and dust storms in the Qingtu Lake Observatory

We thank the reviewer for the appreciative comments. We have addressed all of them and modified the paper accordingly. Please note that reviewers' comments are in blue while our answers are not. Our detailed answers follow:

Answers to Reviewer 2

Dear reviewer,

Thanks for your comments on this manuscript. We appreciate the time and effort that you dedicated to providing feedback on our manuscript and are grateful for the insightful comments on and valuable improvements to our paper. All page and line numbers refer to the revised manuscript file with tracked changes.

General comments: The authors show the high frequency observation weather variables and PM10 during the sand and dust storms. This topic is very interesting and valuable. It would be great to show or discuss the difference between the variables during SDS days and those during normal days. Such comparison would make the study more complete. Validations of the observations before and after the SDS are required, because the SDS may damage the equipment. The paper is generally clear despite of some gramma mistakes.

Thanks for your suggestions! It is indeed valuable for these datasets obtained from the atmospheric surface layer with extreme weather conditions while sand and dust storms occurred. Actually, we did some works (e.g., Wang et al., 2020) where the comparison is between the variables during SDS days and those during normal days in our research group. For example, statistics of the mean flow, turbulent kinetic energy, structure inclination angles, energy peak from the pre-multiplied energy spectrum, etc, have been compared for the large-scale structures of turbulent flows with and without sand. We have added some descriptions in the manuscript, which can be seen in lines 203–208: "*Notably, Wang et al. (2020) explored the comparison of large–scale structures of turbulent flows in the atmospheric surface layer with and without sand. According to the research, the streamwise turbulent kinetic energy is enhanced at all scales in the sand-laden flows, and the inclination angles of large–scale structures are shown to increase with sand concentration, owing to the decreased velocity gradient. However, the streamwise length scale of large–scale structures and the size of the most energetic turbulent structures are found to be unaltered compared to clean-air flows. The abundant mechanisms during the SDS are still unknown, especially the difference between the variables during SDS days and those during normal days, which is necessary to be explored in detail in the future.*" In addition, the instruments of the observations are daily checked by us even though the SDS events had occurred, that is, the validations of the observations can be guaranteed.

Comment R2.1 Line 7: Make the unit m and meter consistent, and throughout the paper as well.
Answer to R2.1 Thanks for the suggestion. We have replaced all the spots 'meter' to 'm' throughout the work, which can be seen in Line 7 and the caption of figure 1.

Comment R2.2 Lines 51-52: How did you overcome the observation difficulty in this work?
Answer to R2.2 Thanks for the concerns. There are many obstacles during our observation, e.g., mainly as follows:

- Selection of observation site: The Qingtu Lake Observation Array (QLOA) is located on the flat

dry lake bed of the Qingtu Lake between the Badain Jaran Desert and the Tenger Desert in western China. This area skirts the pathway of the strong northwest monsoons and sandstorms, which move southward from the Badain Jaran Desert during spring. Requirements are guaranteed that the location can be regarded as a canonical turbulent boundary layer (to explore the characteristics of the large-scale structures without sand) as well as the SDS could be observed in spring (to explore the characteristics of SDS). Such demands take us huge challenges.

- Instrument installation and data collection: Sonic anemometers and Dust monitor ((in total 11, used in this work) were installed on the tower (30m height) to synchronously measure the wind velocity and the air temperature (at a sampling frequency of 50 Hz) as well particle matter 10 (at a sampling frequency of 1 Hz). And the location is far away from the nearest city 30 km. The data were necessary to collect daily.

- Extreme Events: Extreme events (such as intense SDS) gave the possibility to damage the instruments that required us to check and maintain after even when the process occurred. Imagine that the hazard of the SDS offered visibility less than 1 meter and we had to maintain the instrument's proper functioning.

Comment R2.3 Lines 115-116: The sentence is too long and too confusing.
Answer to R2.3 Thanks for the suggestion. The original sentence "*Generally, the raw data collected from the instrument can not directly be used to analyze instead of processing methods that have been carried out, leading to being considered 'trustworthy'.*" has been replaced by "*Generally, the raw data collected from the instrument were necessary to be carried out by the pre-processing methods, otherwise, they could be misunderstood as 'trustworthy'.*".

Comment R2.4 Line 132: Remove "current".
Answer to R2.4 Thanks for the suggestion. "*In the current study*" has been replaced by "*In this study*".

Comment R2.5 Line 235: Put (Fig. 9) at the end of the sentence and remove "see".
Answer to R2.5 Thanks for the suggestion. The original sentence "*It is interesting to note that the power-law relation, see Fig.9, is evident for the current dataset since the Reynolds number of the current data is up to* $\mathcal{O}(10^7)$." has been replaced by "*It is interesting to note that the power-law relation is evident for the current dataset since the Reynolds number of the current data is up to* $\mathcal{O}(10^7)$ *(Fig.9).*"

References

Wang, G., Gu, H., and Zheng, X. (2020). Large scale structures of turbulent flows in the atmospheric surface layer with and without sand. *Physics of Fluids*, 32(10):106604.