Response to Referee's comments:

We would like to thank the Editor and the Referee for the time and efforts handling the reviewing our manuscript. The constructive comments and suggestions were very helpful to improve the manuscript.

The Referee's original comments are formatted in black, while our point-by-point responses are formatted in **blue** font. All the corresponding revisions in the revised manuscript are indicated using the "Track Changes" function.

Reviewer #1

Comments on **Full-scale spectra of 15-year time series of near-surface horizontal wind speed on the north slope of Mt. Everest**

In this article, a 15-year wind time series of near-surface horizontal winds from the National Observation and Research station called QOMS is analyzed. The research station is located on the north slope of Mt. Everest. The authors have also examined horizontal winds' spectral characteristics during different seasons. The wind data comprises 10-min data from 2005 to 2019 at four heights: 1.5, 2, 4, 10, and 20m. High-frequency 10 Hz data from 2015 and 2016 are also studied for information about microscale turbulence.

Overall, the study is quite interesting and provides many insights about wind climatology in the area. I believe the study can be further improved by addressing the following queries:

We would like to thank the review for the helpful comments and suggestions for recognizing the contributions made by this work. Our point-by-point responses are found below.

1. The wind roses in Figures 2 and 3 show higher wind speeds from the south, but no explanation is given for this phenomenon. Do katabatic winds play a role in this speed-up as the cold, dense air flows down from the top and becomes less dense as it heats up in the valley, Especially during the winter season? Please comment on this.

   Thanks for your helpful comments and suggestions. You are right, katabatic winds play an important role in the strong south wind. Many studies have already investigated this topic. The reason is twofold, local-scale katabatic winds (or glacier winds) and large-scale circulations. Following your suggestions, we discussed the reason at the end of second paragraph of section 3.1. Please see lines 208 to 214 in the revised manuscript: "……*Many studies have reported the* *phenomenon that the south wind is stronger than the north wind (Cai et al., 2007; Song et al., 2007; Sun et al., 2007; Sun et al., 2017; Sun et al., 2018). Recently, Sun et al. (2018) revealed that the strong south winds in non-monsoon season are dominated by downward momentum transport for westerly winds aloft, while during the monsoon season, the strong winds are driven by up-valley winds from the Arun Valley east of Mount Everest migrating into the Rongbuk Valley where the QOMS station is located. Moreover, katabatic winds driven by the along-valley temperature gradient between cold temperatures to the south over glacier surfaces and warm temperatures to the north can accelerate the wind speed…...*"

2. In Section 2.3, it is mentioned that "linear detrending is applied to the wind speed data time series". Sometimes, this can significantly reduce the low-frequency part of the power spectrum. It would be interesting to know whether linear detrending the time series affects the results in this article considerably or not.

   We agree that applying linear detrending to wind velocity time series might influence the power spectrum at low frequencies. In Figure 1, we plotted out the frequency-weighted spectra calculated using the 15-year 10-min wind velocity data observed at the height of 10 m. The solid black curve is calculated from the original wind time series without using linear detrending, while the dashed blue one is calculated from the wind velocity data after applying linear detrending. As the reviewer pointed out, differences are observed at the low-frequency part, but only at the first multiple frequencies. Thus, we conclude that applying linear detrending to wind time series would not affect the results in this study.

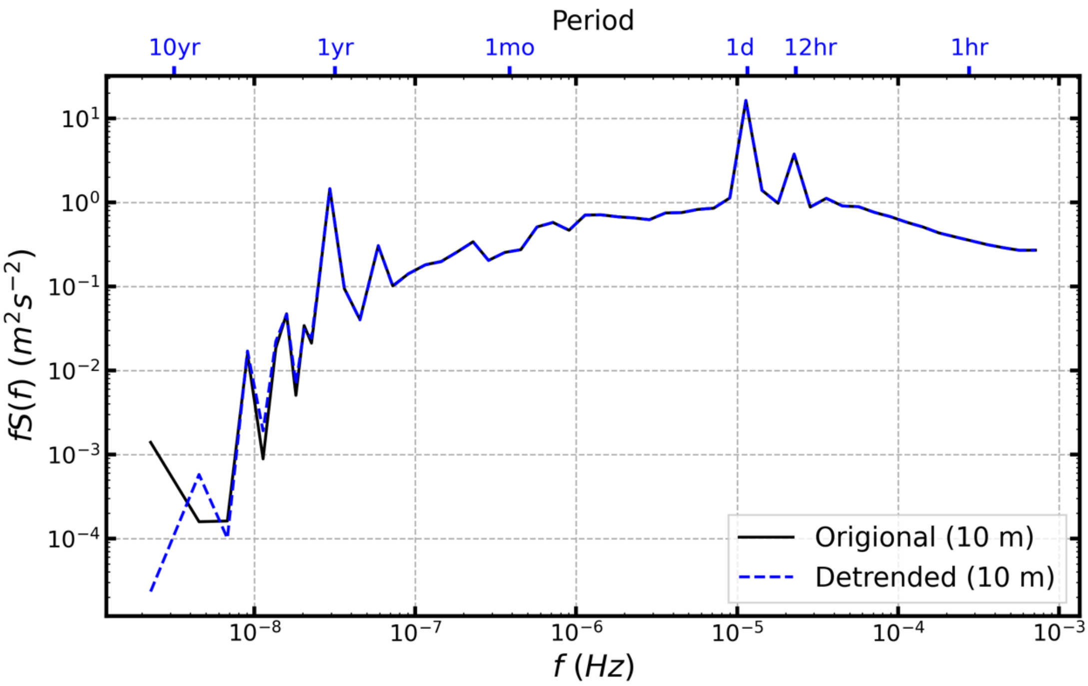

Figure 1: The frequency-weighted spectra $fS(f)$ as a function of frequency f of horizontal wind speed at the height of 10 m at the QOMS station calculated from

the 15-year 10-min wind velocity data. The solid black curve is the spectrum calculated from the original wind velocity data, while the dashed blue curve is the spectrum calculated from the wind velocity data after applying linear detrending.

3. The article focuses on horizontal winds, but it would be interesting to also look at the vertical wind spectrum obtained from sonic anemometer. This would explain the flow circulation in the valley and high-altitude mountains in the south. Plus, you could see the distinction between microscale 3D turbulence and mesoscale 2D turbulence on the frequency scale.

   Thanks very much for your suggestions. Although we focused on the horizontal wind spectrum, we plotted also the vertical wind spectra for winter and summer calculated from the 3D sonic wind data in Figure 6 in the revised manuscript. We discussed the characteristics of vertical wind spectra at the end of last paragraph in section 3.3. Please see lines 315 to 319 in the revised manuscript: "……*Moreover, daily vertical wind spectra calculated from the 10-Hz sonic wind data for summer and winter are also plotted in Figure 6. Rather than decreases in horizontal wind spectra in the frequency range from approximately 2×10-3 Hz to 3×10-1 Hz, the vertical wind spectra increase monotonically. At higher frequencies (f ≥ 1×100 Hz), the shape of the vertical wind spectra is similar to the horizontal wind spectra, and the spectral densities are very close as well*……"

4. In Figures 7 and 8, while the low-frequency part of the spectra follows the $f^{-2/3}$ scaling, the high-frequency part does not follow the same scaling. What could be the reason behind this? According to studies such as Larsén et al., 2016 and Kaimal and Finnigan 1994, you should observe the same scaling in the high-frequency part. Similarly, the Kaimal spectrum (blue dots) can be extended for frequencies higher than $4\text{x}10^{-3}$ Hz.

   The $f^{-2/3}$ scaling refers to the inertial subrange, where energy is neither produced nor dissipated, but cascaded down to smaller scales. Indeed, in this study, we also observed the $f^{-2/3}$ scaling in the high-frequency part (See the figure below, which is the same as Figure 7 in the manuscript but with the reference $f^{-2/3}$ spectrum). Note that there was a smoothing issue in the daily spectra and we fixed the issue and have updated Figures 5~8 in the revised manuscript. The inertial subrange in this study is approximately in the frequency range from 2.0×10^{-1} to 2.0×10^{0} Hz, which is relatively narrow and is slightly different from the ones reported in Larsén et al., (2016) (in a wider frequency range from 3.0×10^{-2} to 1.0×10^{0} Hz). We believe the differences are from the complex topography and complicated local circulations around the QOMS station. Moreover, the daily spectra in this study are highly correlated the four spectral regimes proposed by Högström et al. (2002) in Figure 4 in his paper.

   Regarding the Kaimal spectrum, we agree that is can be extended for higher frequencies. Kaimal spectra were derived from the Kansas experiment (Kaimal et al., 1972), where is relatively flat and homogeneous. In this study, Kaimal spectrum is not extendible to higher frequencies. We speculate that the main reason is the highly complex topography and underlying surface characteristics around the QOMS site in the Mt. Everest region. Kaimal and Finnigan (1994) also reported that when flow passes over varying terrain and hills, the velocity spectrum in the high-frequency range changes. This is due to the greater contribution to kinetic energy from mechanically (shear) produced turbulence than we expected in a classical convective mixed layer, which leads to the increase in spectral density in the high-frequency range. The wind spectra over complex terrain and heterogeneous surfaces in the Mt. Everest region is a very interesting topic. In this study, we focus on the spectral gap in the transition range between mesoscale and microscale. In the future, we will further study the applicability of the Kaimal spectrum in the microscale spectral range in this region.

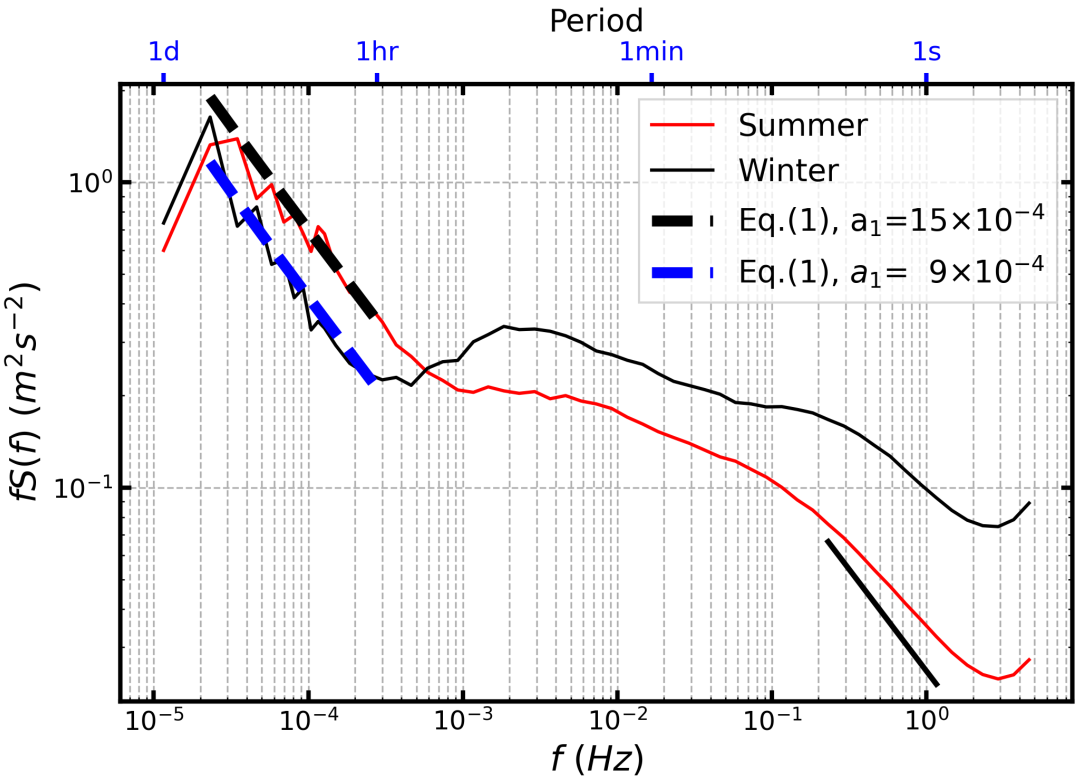

Figure 2: The frequency-weighted summer and winter daily spectra $fS(f)$ as a function of frequency f of horizontal wind speed calculated from the 10-Hz 3D wind data collected in 2015 and 2016. The thick black line indicates the reference $f^{-2/3}$ spectrum.

References:

Högström, U., Hunt, J. C. R., and Smedman, A.-S.: Theory and measurements for turbulence spectra and variances in the atmospheric neutral surface layer, Boundary-Layer Meteorology, 103, 101-124, https://doi.org/10.1023/A:1014579828712, 2002.

Kaimal, J. C., Wyngaard, J. C., Izumi, Y., and Coté, O. R.: Spectral characteristics of surface-layer turbulence, Quarterly Journal of the Royal Meteorological Society, 98, 563-589, https://doi.org/10.1002/qj.49709841707, 1972.

Kaimal, J. C. and Finnigan, J. J.: Atmospheric boundary layer flows: Their structure and measurement, Oxford University Press, New York1994.