A new method for directly measuring atmospheric turbulence parameters based on coherent Doppler wind LiDAR is proposed in the preprint manuscript. The spatiotemporal distribution map of the power-law exponent of the inertial subrange is published, which indicates the heterogeneity of atmospheric turbulence at different altitudes, and also indicates that the power-law exponent at high altitudes does not fully comply with the −5/3 power law. the detection results under clear sky turbulence and cloudy weather are compared. The detection results were compared under clear and cloudy weather, respectively. I was very interested in this method and the results of the detection, but when I carefully reviewed the manuscript, I found that some issues needed to be resolved before they could be published in the journal. Therefore, my opinion is that major modifications are needed, and the specific suggestions are as follows:

1. In the introduction section, the development process of turbulence detection was introduced, but the differences between these development processes and this manuscript were not discussed. Please carefully refine them. For example, the methods used by Doppler LiDAR to detect turbulence, as described in references 18-22, and their differences and connections with this manuscript.
2. In section 2 of the manuscript, did you mention that your CSAT data is averaged over 30 minutes? Does this exceed the atmospheric turbulence freezing time?
3. In the abstract section, it was explained that you have for the first published a spatiotemporal distribution map of the power law exponent of the inertial subrange, which shows the non-uniformity of atmospheric turbulence at different altitudes. I am not very clear about what I have read in sections 3.1 and 3.2 of your manuscript, because the new method you proposed is not expressed clearly. I can roughly understand it as using spectral analysis for fitting and formulating a system of equations to solve turbulent kinetic energy κ and the power-law exponent n (and n is not fixed -5/3). So it is important for you to carefully explain your new method and its differences from previous research methods.
4. Turbulence has both spatial and temporal scales, and directly measuring the spatiotemporal distribution of turbulence has always been an important issue. And we know that most turbulence spectra are distributed between 0.1Hz and 100Hz. In section 3.2 of the manuscript, the highest frequencies of turbulence spectra that can be monitored by ultrasonic anemometers and wind LiDAR are 5 Hz and 0.1 Hz, respectively. Is this the reason for the significant difference in detection results between the two sensors? What is the contribution to the difference in detection results?
5. From your results, the comparison between LiDAR and CSAT is a single point comparison around 320 meters. How can the comparison of single points be close to prove that the spatial distribution of the results detected by LiDAR is correct? Why didn't you compare a few more points below 320 meters in the vertical direction?
6. In the results and discussion of section 4, we believe that its detection ability will be limited for such a system and sampling frequency. For example, whether the consistency of turbulence is better only in clear skies (Figure 3a-c), and the consistency of results becomes worse in severe convective weather (Figure 7a-c)
7. In Figure 9, we can clearly see that when the turbulent kinetic energy is high, the turbulent kinetic energy and power-law exponent of LiDAR and CSAT3 in the vertical direction are significantly different. Why is this? Does it mean that this method is flawed in cloudy weather conditions?

8. Some normative issues in drawing, such as: the area near the ground pointed by the red arrow in Figure 1a is white, while the area where the LiDAR is placed in the right image is clearly a green lawn. This is very confusing; Can the lines in Figures 3, 5, 7, 9, and 10 be distinguished by dotted lines, dashed lines, etc?
9. At the end of section 3.1, turbulent kinetic energy κ was introduced. However, there is no mathematical relationship between it and the aforementioned formula, which is very confusing.