

Response to comments from Referees

We are truly grateful to reviewers' critical comments and thoughtful suggestions. In accordance with the comments from the reviewers, the manuscript has been thoroughly revised in content; the revisions have been marked in tracked changes. All references to figure(s), table(s), section(s), page(s), and line(s) refer to the revised manuscript unless otherwise stated.

First, in order to improve the readability, the whole manuscript has been moderately revised. There are four main revisions in the revised manuscript.

- 1) The title of the manuscript has been revised to “**Quality Evaluation for Measurements of Wind Field and Turbulent Flux from a UAV-based Eddy Covariance System**” for more clearly express the study purpose of this manuscript to readers.
- 2) The language of Introduction section was optimized to further clarify the scientific problems to be solved in this manuscript and the latest advances in related studies.
- 3) For logical consideration, there were some structural adjustments (e.g., lines 152-157) in the revised manuscript.
- 4) We also invited a native English speaker to improve the language and check the grammar, spelling, punctuation, and phrasing of the manuscript.

Second, in order to further highlight the objectives of this study, summarizing sentences of the developed UAV-based EC system have been added and some redundant sentences have been deleted in the revised manuscript.

- 1) In the Conclusions and further works section, summary of the advantages and disadvantage of this UAV-based EC system were added (lines 685-689).
- 2) To avoid ambiguity for the readers, some redundant sentences (e.g., lines 656-664 in the original manuscript) were deleted in the revised manuscript.

Third, the supplement material was also thoroughly revised carefully for easy understanding and reading to readers.

At last, the English grammars, acronyms, and various reference errors have been corrected. The reviewers gave a very detailed reviewing on this paper and these have really improved the paper's quality and readability. And the formats of the picture, table, and reference have been revised.

For each specific comment, we have made the detailed reply as follows.

General Comments:

The aircraft-based EC flux method has been developed for turbulence measurements at regional scale, which bridging the scale gap between ground tower-based EC flux measurements and model-derived measurements. The manuscript develops an UAV-based EC flux system, and evaluated its precision performance and calibration methods. I think the work is valid and in general useful and appropriate for Atmospheric Measurement Techniques. I recommend that the

authors are required to do a moderate modification of the manuscript and figures before acceptance. They should ensure that manuscript and figures tell the same story and that more effort is put into making certain that dates and terminology are correct and consistent.

Re: We are very grateful to your comments and efforts to improve the quality of this manuscript. In accordance with the comments from the reviewers, the manuscript has been thoroughly revised in contents and language. The title of this manuscript has been revised to “Quality Evaluation for Measurements of Wind Field and Turbulent Flux from a UAV-based Eddy Covariance System” for allowing the readers clearly get the main purpose of this study. The figures, tables, dates, and terminology in the manuscript were checked in detail. We also invited a native English speaker to improve the language and check the grammar, spelling, punctuation, and phrasing of the manuscript. The revisions have been marked in tracked changes. Thanks again for your kind work.

Specific Comments

Q1. The knowledge gap of your scientific problems on the UAV-based EC flux methods to be solved in this study should further be clarified, and showed the state of the art of your scientific problems based on the literature review.

Re: In order to clearly express the main objective to be solved in this manuscript, two improvements have been made in the revised manuscript:

1) The title of this manuscript is revised to “**Quality Evaluation for Measurements of Wind Field and Turbulent Flux from a UAV-based Eddy Covariance System**” for more clearly express the study purpose of this manuscript to readers.

2) The Introduction section of the of the manuscript has been moderately revised for further clarifying the scientific problems to be solved in this study, and the state of the art of scientific problems to be solved in this study have been updated as well.

Q2. The components and configuration of the UAV-based EC flux system should be summarized and further show us the advantage and disadvantage of this UAV-based EC flux developed in this study.

Re: The components and configuration of the developed UAV-based EC flux system were introduced and summarized in Section 2.1 of the revised manuscript. Detailed information on this UAV-based EC system was given by Sun et al. (2021). The advantages and disadvantage of this UAV-based EC system were summarized in the last section (Section 5 Conclusions and further works) in the revised manuscript, the text was modified as follow:

Lines 685-689, in Section 5 of the revised manuscript: “**The UAV-based EC system has several advantages over manned aircraft, including less turbulence disturbance in wind measurement, lower measurement altitude (above the ground level), simpler operation, and lower operating costs, etc.**”

However, there are still some shortcomings need to be overcome, such as resonance noise, how large the difference compared to the tower-based EC under the same conditions, and how to interpret the instantaneous flux results for the flight scenario (e.g., influence from surface heterogeneity, flux divergence, etc.).”

Then based on the disadvantages of the current system, further improvements works are introduced (Lines 689-696).

Sun, Y., Ma, J., Sude, B., Lin, X., Shang, H., Geng, B., Diao, Z., Du, J., and Quan, Z.: A UAV-Based Eddy Covariance System for Measurement of Mass and Energy Exchange of the Ecosystem: Preliminary Results, *Sensors*, 21, 10.3390/s21020403, 2021.

Q3. The writing logic and result representation should be further optimized, and all materials should be centered on your scientific problems to be solved.

Re: The whole manuscript has been thoroughly revised in language, logic, and expression for easy understanding and reading to readers. For example, lines 167-172 in the original manuscript have been reorganized in the revised manuscript (lines 152-157) for better understanding. Some redundant and ambiguous sentences (e.g., lines 102-104, 656-664, etc. in the original manuscript) were deleted in the revised manuscript for emphasizing the focus of the scientific problems to be solved.

Q4. The methodology of the UAV-based EC flux methods should be further clarified on how to achieve the three-dimensional velocity and direction, trace gas concentrations and turbulent fluxes.

Re: The detailed methodology on how to calculating the 3D wind vector, turbulent fluxes, and their uncertainties were provided in the Supplement material. The gas concentrations of CO₂ and water vapor were directly measured by an open path infrared gas analyzer (IRGA) mounted on the UAV, which was also clarified in the revised manuscript (lines 149-150).

The supplement material of this manuscript was also improved in language and expression for providing the readers with a clearly understanding of the methodology used in this manuscript.