Referee #2

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

General Comment

This paper presents a systematic assessment results of a UAV-based eddy covariance (EC) system developed by Sun et al. (2021) on the measurement ability in wind and turbulent flux. Overall, the objectives are clearly put forward and well-motivated. The UAV EC system itself is novel and interesting, and the topics are closely related to the current research hotspots.

In the manuscript, the authors provided a comprehensive literature review on the backgrounds of their current study. The authors provided detailed information on methods for wind calculation and system calibration based on airborne platform (in Supplement), and gave evidence that their measured wind vector was insusceptible of lift-induced upwash and leverage effect. From these aspects, I think the authors have solved the difficulties on wind vector measurement from airborne platform very well. My major criticism is in the evaluation of UAV EC turbulent flux measurements. How they calculated the fluxes of sensible heat, latent heat, and CO2 from UAV are not clear stated. Can the results of error analysis results for turbulent fluxes measured by UAV EC system represent the actual situation, or whether the Monte Carlo simulation methods is appropriate for error analysis of EC flux. Therefore, I think this work needs some improvement before it can be published.

Re: Thank you for your insightful comments. In the revised manuscript, we have substantially revised this manuscript in both the methodology for error assessment and the relative contents. In particular, aspects involving the calculation of turbulent fluxes (including the necessary corrections) and the error analysis of wind and flux measurements have been thoroughly revised. Your comments are very helpful to improve the quality of the manuscript.

Specific Comments

Q1. The approach for calculating the sensible heat, latent heat, and CO2 fluxes, as well as the friction velocity from the airborne (or UAV) EC measurements needs to be described in Supplement or manuscript.

Re: In accordance with your comment, in the revised Supplement Part B, we added a detailed explanation to describe the equations to calculate the fluxes of sensible heat, latent heat, carbon dioxide (CO_2), and the methods to quantify the measurement uncertainty in them due to instrument

noise.

Q2. Figs. 1 and 2, the underlying surface should be added in the background of the figures. In the case of low-altitude flight observation, the underlying surface has a direct effect on the EC measurements.

Re: In accordance with your comment, in the revised manuscript, the information of underlying surface over the region for conducting flight campaign was also provided in Figs. 1 and 2. We used Sentinel-2A satellite image to depict the information of underlying surface.

Q3. Line 172, the abbreviations CST should be defined at the first use in the manuscript.

Re: The ambiguous abbreviation "CST" was revised as follow:

Lines 186-187, in Section 2.2.1: "The calibration flight was executed between 7:28-7:48 a.m. (China Standard Time, CST) to coincide with the ebb tide stage."

Q4. Lines 258-264, this sentence is difficult to follow and confused me. Calculated the accurate turbulent flux value is important, but the authors stated that the objective is not to quantify the actual flux value. The authors should reorganize the sentence to clearly state the objective of flux calculation or evaluation in this paper.

Re: In the revised manuscript, the original sentence (Lines 258-264) was rewritten, and the contents about error analysis for measurement of wind and turbulent flux have been substantially revised. The original used of Monte Carlo error simulation method (Lines 273-280 in the original manuscript) to estimate the measurement error of geo-referenced wind and turbulent flux has been totally removed. Then, we used the partial derivatives of the full calculation equation for geo-referenced wind and turbulent flux to estimate the measurement error in wind and fluxes. Accordingly, two main revisions have been made as follow:

First, in the revised manuscript, we used the linearized Taylor series expansions derived by Enriquez and Friehe (1995) (in the revised Supplement Part A) to determine the sensitivities of each of the geo-referenced wind vector components with respect to the relevant variables. Then, combined these sensitivity terms to estimate the overall measurement error (1σ) in the geo-referenced 3D wind vector. The results were provided in Section 3.1 of the revised manuscript.

Second, we added a section (Section 2.4.2) to illustrate the methods for estimating flux measurement error caused by instrumental noise by combining the covariance uncertainty estimated by RS method (Eq. 6 in the revised manuscript) and the propagation of errors in flux correction terms (Eqs. S29-S31 in Supplement Part B). In this study, we mainly focused on the error caused by instrumental noise due to they are related not only to the system performance, but also to the minimum resolvable capability for the flux to be measured. The results were given in Section 3.2 of the revised manuscript.

5) In the discussion, other factors (e.g., variation of the flight height, atmospheric conditions etc.) that were not considered in this study but have an impact on the reliability of the UAV EC measurements should be added or described.

Re: In accordance with your comment, we added the description of other factors which influence the UAV EC measurement in the discussion.

Lines 687-690, in Discussion: "Lastly, it should be noted that the accuracy of the measured geo-referenced wind vector and turbulent flux from the UAV-based EC system is subject to the combination of many factors, mainly including sensor accuracy, UAV powerplant, UAV fluctuation (e.g., variation of the UAV attitude and flight height), and the atmospheric conditions during the measurements, etc."

6) The limitations of airborne (or UAV) EC measurements should be summarized or mentioned.

Re: In accordance with your comment, we added some summary of the limitations of airborne EC measurements in the Section of conclusions and further works (Section 5).

Lines 732-735, in Conclusions and further works: "Although UAV-based EC measurements have many advantages over manned aircraft and tower-based EC measurements, airborne EC measurements themselves have some shortcomings, such as flux measurement results hard to interpret (e.g., influence from surface heterogeneity, flux divergence, etc.), the measurements are restricted to short periods of time, and the interaction between the UAV and turbulence."

7) The manuscript is overall clearly written, except some typos or very complex sentences (e.g. Line 583).

Re: The language of this manuscript has been revised entirely, errors about grammar, spelling, punctuation, and phrasing have been corrected.

References:

Enriquez, A. G. and Friehe, C. A.: Effects of Wind Stress and Wind Stress Curl Variability on Coastal Upwelling, Journal of Physical Oceanography, 25, 1651-1671, https://doi.org/10.1175/1520-0485(1995)025<1651:EOWSAW>2.0.CO;2, 1995.