Responses to Reviewers' Comments for Manuscript

Rotary-wing drone-induced flow – comparison of simulations with lidar measurements.

Addressed Comments for Publication to

Atmospheric Measurement Techniques

by

Liqin Jin, Mauro Ghirardelli, Jakob Mann, Mikael Sjöholm, Stephan T. Kral, and Joachim Reuder

Dear Reviewer,

First of all, we would like to express our gratitude to you for providing your insightful comments on our paper. In this revision, we have carefully incorporated and addressed the two comments that have been raised. This short report summarizes the main modifications we made and a detailed point-by-point response to the comments.

We sincerely appreciate your time and effort in reviewing our manuscript, and we are grateful for the opportunity to address your concerns.

Sincerely,

Liqin Jin, Mauro Ghirardelli, Jakob Mann, Mikael Sjöholm, Stephan T. Kral, and Joachim Reuder

Authors' Response to Reviewer

General Comments. Jin et al. have significantly improved the manuscript with regards to language, clarity and scientific soundness. All reviewer comments have been properly addressed and changes were made wherever possible. The problems with the experimental setup could of course not be changed, but I still think the manuscript is worth publishing in AMT after two more comments are addressed.

Response:

Dear Reviewer, thank you for your contributions to improve the quality of this manuscript. After reading through your comments, we implemented changes to the introduction and conclusion parts in the manuscript. We will now address, one by one, the two comments.

Comment 1

The introduction has been rewritten completely and is in much better shape, but I think a very important part is still missing, which is to describe the state-of-the-art of wind measurements with multicopter UAS in their full extent. The branch of using the avionic information and thus the drone itself as the sensor is not mentioned at all, but is widely used, well validated and shows great potential (Neumann et al. 2015, Segales et al. 2020, Wetz et al. 2021, Wetz and Wildmann 2022, Gonzales-Rocha et al. 2023...). As a direct alternative to the proposed method, this needs to be mentioned in the description of the state-of-the-art. In the discussion, the method with external sonic anemometer should be benchmarked against the uncertainties that are estimated for the wind measurement in those studies.

Response:

Thank you for pointing out this valuable comment. We acknowledge the importance of completing the state-of-the-art wind measurements with multicopter UAVs themselves or with external devices mounted on UAVs. We have expanded our literature review to include the significant contributions of Neumann and Bartholmai [2015b], Segales et al. [2020b], Wetz et al. [2021], Wildmann and Wetz [2022], González-Rocha et al. [2023], which is implemented in the manuscript in **L38** as Since the beginning of the 21st century, uncrewed aerial vehicles (UAVs) with rotary-wings have become more popular for conducting atmospheric measurements [Hemingway et al., 2017, Leuenberger et al., 2020, Tikhomirov et al., 2021], due to their flexibility in orienting, precise hovering capabilities and ease of deployment. Wind velocity and direction can be reconstructed from either the avionic information of UAVs alone [Neumann and Bartholmai, 2015a, Palomaki et al., 2017, Segales et al., 2020a, Wetz et al., 2021, González-Rocha et al., 2023], or from wind sensors mounted on the UAVs. Even though the former indirect approach is well-established and has the advantage of not requiring external measurement devices, it has limitations in resolving three-dimensional wind fields and fine-scale turbulent fluctuations. An exception is found in Wildmann and Wetz [2022], where all three velocity components are measured at a frequency of 1 Hz. However, a sampling frequency of 10 Hz to 20 Hz is typically necessary to resolve the smallest turbulent scales. Therefore, the latter method of using fast-response 3D anemometers, such as sonic anemometers, is inevitable for direct observations of turbulence. This approach extends measurement capabilities, but it may reduce flight performance due to the added weight.

Finally, thank you for your suggestion regarding the benchmark of the proposed method against the uncertainties with the external sonic anemometer. This point will be addressed in the discussion and conclusion part, which is Furthermore, a full-size sonic anemometer could be mounted on the drone in the upstream direction to validate the potentially optimal position defined by CFD simulations and to benchmark wind velocity uncertainties with an external sonic anemometer.

Comment 2

p.22, l.362: "a less stringent threshold": what is the threshold to find the 2-m distance?

Response:

Thank you for this comment. We agree with this point and explain what a less stringent threshold is. The new sentence in **L295** is With a less strict threshold of 5% velocity deviation for both horizontal and vertical winds, this 5-meter distance can be substantially brought down to 2 meters when a background flow of at least 4 ms^{-1} is present, corresponding to a flow distortion of ± 0.2 ms^{-1} (Fig. 8e). This deviation is similar to the accuracy reported by Wetz et al. [2021] as well as Wildmann and Wetz [2022].

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