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Review of

Development and comparisons of wind retrieval algorithms for small unmanned aerial systems

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Summary:
The purpose of the research presented in this manuscript is to test 3 algorithms used to derive the 2D wind velocity from GPS positions of unmanned aircraft. Atmospheric science will benefit from accurate calculations of the wind field derived from data collected by UAS. The methods for deriving the wind field need to be compared and this work has the potential to contribute to this need. However, the conclusions reached are not adequately supported by the qualitative analysis conducted. Furthermore, there is no evidence that the UAS deployments executed for this work were in accord with the very specific FAA regulations governing public UAS operation in the NAS. These two principal issues along with 2 other "significant" issues are expanded below, followed by a listing of additional (less significant) suggestions and corrections.

Principal Comments:

1. Given that the aim of this work is to compare the performance of 3 algorithms, the authors are obligated to provide more than just a qualitative comparison. Plots of wind fields derived from each method are included but no substantial analysis is conducted to justify conclusions such as "all of the wind data produced using the SMARTSonde's algorithms agreed with the rawinsonde observation" and "overall, the three algorithms themselves were in good agreement with each other. No algorithm appeared to perform drastically better than any". Error statistics must be included. Their overall conclusions may indeed be correct, but until robust analysis of the results is documented, their conclusions are not supportable.

2. Since the comparison of the 3 algorithms is the purpose of this work, it is unclear why the SODAR section (3.2) and the "Example Application" section (4) completely neglect this comparison.

3. Given the very specific FAA regulations concerning UAS operation in the NAS, the authors are obliged to demonstrate that they were operating in a manner consistent with these regulations. As the authors are undoubtedly aware, the FAA has specifically stated that both civil and public entities "have mistakenly interpreted FAA advisory circular (AC) 91-57, *Model Aircraft Operating Standards*, for permission to operate small UAS for research or compensation or hire purposes" (FAA order 1110.150 pg. 1). According to the Acknowledgments, the development of the SMARTSonde was funded by the University of Oklahoma (OU) Advanced Radar Research Center (ARRC) and through a grant provided by the National Oceanic Atmospheric Administration (NOAA) National Severe Storms Laboratory (NSSL). Thus, the SMARTSonde appears to be a public aircraft and, as such, authorization to fly must be granted via a Certificate of Authorization. The authors need to declare which COA they were using to conduct the flights presented here.

4. The authors do a decent job of describing the "best curve fitting" and "no-flow method" but assert that, because the Paparazzi algorithm is "not well documented", a comprehensive description is not possible. The Paparazzi algorithm is open-source so it's not clear why this algorithm should be treated as a "black box".

Additional suggestions and corrections:

1. Line 37: The authors assert that remote sensing approaches to observing the PBL suffer from the drawback that "one must rely on retrieval algorithms to obtain profiles of meteorological variables." However, this same drawback applies to wind observations collected by UAS using GPS positions alone. As such, this statement needs to be qualified or omitted.

2. Line 54: The assertion that "the onboard instrumentation for the M2AV is relatively expensive" demands a reference or more substantial justification.

3. Line 86: I understand that the purpose of the statement that begins with "the wind speed is found by taking the difference" is to provide a simple summary of the essential principle of the best curve fitting method, but this summary is inadequate since it fails to explain how the ground-relative wind speed is derived. I strongly suggest omitting this entire paragraph and including the essential elements in the following paragraph. After all, the value of the paragraph that begins on line 84 is to provide context for the following paragraph that begins on line 99. Combining the two will improve the flow and obviate the cryptic summary statements like the one addressed in this comment.

4. Line 91: The statement "a Chinese group has experimented with a UAS to obtain soundings of the atmosphere" is awkward and should either be revised or omitted.

5. Line 119: The method is independent of the platform so it is unnecessary to include the statement "from a SMARTSonde flight".

6. Line 148. The authors need to provide a description of the Nelder-Mead optimization scheme, which is referred to multiple times but never explained.

7. Line 170. I may just be missing something obvious here, but why is constant airspeed required?

8. Line 206: "Synoptic weather conditions were fairly weak." How can weather conditions be "weak"? Please revise this statement to accurately reflect the germane synoptic scale meteorological characteristics.

9. Line 238: There appears to be a pretty significant difference between the temporal granularity of the SODAR and UAS data. Was any attempt made to low-pass or average the UAS data to match the averaging of the SODAR data?