

Review of

Measurement of turbulent water vapor fluxes using a lightweight unmanned aerial vehicle system

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Recommendation:

Accept subject to minor revisions

Summary:

This article presents results from experiments conducted using a small unmanned aircraft (UA) instrumented to collect observations of turbulent fluxes of water vapor within the planetary boundary layer. Data collected by the UA are compared to flux tower observations in an effort to test the fidelity of the system. Analytical tools were examined for filtering the low-frequency modes that are poorly sampled in the short flight baselines executed. The authors conclude that the data collected by the UA and filtered ex post facto represent the turbulent structures and associated moisture flux for the meteorological conditions encountered.

This is a well-written article documenting a well-executed experiment designed to collect observations of the planetary boundary layer that could be used to answer important questions in the atmospheric sciences. My criticisms of this article are minor and are outlined below.

Comments:

1. The impact of this work on the ultimate objective of reducing “climatic uncertainty” and improving “forecasting of atmospheric rivers” requires more discussion. I doubt that anyone will dispute that climate predictions must be improved and that improved observations of meridional moisture transport via atmospheric rivers could be beneficial to short-term (O(days)) predictions of a host of mesoscale and synoptic scale phenomena. Nevertheless, since this project serves as a proof-of-concept, it is the obligation of the authors to clearly demonstrate the need for the instrumentation and analytical techniques that are tested.
2. On p. 5549 line 19, the authors note that “some γ E variability can be expected due to cloud influences...In gaps between clouds one can expect down-draughts to dominate, with up-draughts dominating beneath clouds”. The cumuliform character of the clouds and progressive vertical growth observed during the experiment (Section 4.2) suggest that the clouds were attributable to boundary layer processes. Thus, the impact of clouds considered here is not independent of the boundary layer eddies, as implied in this paragraph; the updrafts and downdrafts are not caused by the clouds but are a product of the boundary layer circulations that cause them.
3. Although the BAE Manta has been used previously and its description can be found elsewhere, a brief description of its dimensions along with a photo or schematic should be included in Section 2.1.
4. Please define what “UAV test airspace” (p. 5538, line 9) means in terms of FAA regulations.
5. Figure 9 is referenced on p. 5542, prior to references for Figs. 6-8. Please reorder the figures accordingly.

6. Figures 1-3, 7, and 11 are missing panel labels (e.g., “a”, “b”, etc.)
7. The caption of Figure 8 needs to include 1) an explanation of the two colors used, 2) an explanation of the inset, 3) a mention of the FT_B descent profile, and 4) the times of the two flights (for reference to the time of the radiosonde data). The insets on panels a and b need be plotted with their own grid lines or with the grid lines of the background plot “whited-out”.
8. Lines 11-19 on p. 5542 (description of Rogers lake bed) are unnecessary and should be removed.