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Interactive comment on "Measurement of turbulent water vapor fluxes using a lightweight unmanned aerial vehicle system" *by* R. M. Thomas et al.

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Response to reviewer's comments

Subject: Author response Many thanks to the reviewer for their helpful comments, the response to each comment is detailed below:

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 bene-

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ficial 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."

Response: First paragraph changed to:

Vertical water vapor transport in the planetary boundary layer is an important component of the Earth's energy systems, particularly in the marine environment. This moisture supply is a key contributor to boundary layer cloud liquid water content (LWC), which in turn impacts the cloud albedo, lifetime and radiative effects – a large source of climatic uncertainty. Recent work has shown the assumption of a constant LWC with aerosol perturbations is not apparent in cloud systems inherent to the boundary layer and its dynamics, e.g. (Xue and Feingold 2006; Roberts, Ramana et al. 2008; Sandu, Brenguier et al. 2009). Stevens and Feingold (2009) describe a number of linkages between water content, cloud morphology and microphysics, aerosol properties, radiative forcing and boundary layer dynamics, which act to buffer cloud responses to perturbations of these elements. Observations of water vapor fluxes (as well as cloud, aerosol, and boundary layer properties) on local spatial scales with a high temporal resolution will help constrain the water budget and aid understanding of such mechanisms, facilitating their inclusion into more complete cloud-resolving models.

Studies of Atmospheric Rivers (AR, ribbon-like structures extending thousands of kilometers contained within the lowest 3 km of the troposphere) also benefit from water vapor flux observations. ARs are a critical pathway for meridional moisture transport (Zhu and Newell 1998) and play a key role in Californian flooding events (Ralph, Neiman et al. 2006). Regular water vapor flux observations on local scales in AR development regions would improve understanding of their formation, maturation and ultimately help to improve forecasting algorithms.

2. "On p. 5549 line 19, the authors note that "some γE 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."

Response: We agree that the boundary layer circulations are the dominant mechanism in this situation regarding cloud formation. The purpose of this sentence was to imply that some of the large-scale eddies could be being re-enforced by cloud processes. To avoid misinterpretation the words "Additionally, some λE variability can be expected due to cloud influences" were removed.

3. "Although the BAE Manta has been used previously and its description can be found elsewhere, a brief description of it dimensions along with a photo or schematic should be included in Section 2.1."

Response: Figure 4 has been enhanced to show close ups of the aircraft and renamed Figure 1. The beginning of section 2.1 has been modified to: The platform used is BAE's Manta UAV offering a compact, durable and aerodynamic platform with extended flight endurance (Fig. 1). The aircraft has a wingspan of 2.6m, a fuselage length of 1.9m and a maximum take-off weight of 27.7 kg, of which up to 5 kg is designated for scientific payloads. With only slight modifications, it can carry both internal and external instrumentation and sensors.

4. "Please define what "UAV test airspace" (p. 5538, line 9) means in terms of FAA regulations."

Response: Altered line to read: EAFB has designated a 112 km2 UAV test airspace area (within the FAA restricted airspace zone R-2515) above the smooth surface of Rogers lake bed, which thus offers a multi-directional runway(Fig. 1).

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5. "Figure 9 is referenced on p. 5542, prior to references for Figs. 6-8. Please reorder the figures accordingly."

Response: Correction has been made

6. "Figures 1-3, 7, and 11 are missing panel labels (e.g., “a”, “b”, etc.) "

Response: Correction has been made

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 FTB 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”."

Response: Correction has been made

8."Lines 11-19 on p. 5542 (description of Rogers lake bed) are unnecessary and should be removed." Response: Correction has been made

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Interactive comment on Atmos. Meas. Tech. Discuss., 4, 5529, 2011.