

Dear Astrid Lampert and co-authors,

thanks for your detailed replies to the reviewer comments and providing a revised manuscript, which is much improved.

Please find below remarks on your revised manuscript, following up on the reviewers' comments, where I find that further clarification is needed and/or would increase the quality of your manuscript. (page and line numbers refer to the revised manuscript)

Abstract:

Maybe add a sentence that explains your motivation. Why are you conducting this study, why is this comparison important?

Introduction:

p1, l19: Maybe add an example (e.g. "as towers"): " ... and measurements at fixed locations, as towers, providing higher vertical and temporal resolution." (In accordance with reviewer 1 – it's a point measurement - I would omit the part "but representative only for a small area")

p1, l21ff: This small section about the turbulence and fluxes stands a bit out of context here. However, as it talks about essential properties for your study, I suggest better integration it in the text and extension of the content.

p2, l4-6: I feel that your explanation to the reviewer regarding the relevance of cloud chamber studies to your study does a better job than the sentence you write there. Maybe rephrase similar to:

"Since measuring atmospheric water vapour precisely is difficult, the uncertainties of atmospheric water vapour measurements are high. Even with the best systems under well controlled conditions in the laboratory, there are large discrepancies between different measurement systems, e.g. intercomparison measurements of different hygrometers probing the same air simultaneously revealed discrepancies between different measurement systems of around 10 %."

Please also include a reference for your last statement ("discrepancies between different measurement systems of around 10 %").

p2, l16: ..., which is used..." (is instead of are)

p3, l9-11: Maybe better: "However, with the end of the life time of the radiation sources (glow discharge lamps) and difficulties in replacing them, other humidity sensors become more important, and a variety of fast-response sensors is now available."

However, in the following you only mention two more sensors (one not being applied for atmospheric research, the other specific to one research aircraft), this does not sound like a "variety of fast-response sensors"? Please clarify!

Section 1.2/1.3:

I find it somewhat confusing that you refer to molecular absorption (and their deficiencies compared to atomic absorption) in Section 1.2 before introducing molecular absorption in Section 1.3. Either swap these sections or refer to atomic absorption from section 1.3 instead.

p3, l11: "A similar system is the Krypton hygrometer KH20" similar to what? State!

p3, l13: "It is, however, not broadly present in airborne applications." Maybe drag some text of your reply to the reviewer into the manuscript:

"It is, however, mostly used for ground-based measurements. Furthermore, the instrument is very sensitive to path length, and calibration is difficult even for the ground-based applications (Foken and Falke, 2010)."

p3, l19: "...are now easily available..." Do you mean "readily" available?

p4, l8ff: I find this little section deserves more attention, as it points out the importance of your study. I recommend strengthening this part, stating your motivation more clearly (cf your reply to reviewer comment

"I have a concern that the authors and other research groups are using LICOR sensors in an environment that the manufacturer does not recommend.

We understand that the manufacturer does not sell the system for airborne applications, as they are aware that vibrations may hamper the data. For that reason, we consider it even more important to figure out the limitations of the sensor in terms of vibrations.)"

Maybe add something along the line: "...its airborne applications will very likely increase. Therefore, knowing the limitations of the LICOR sensors with respect to vibrations is important, and one of the main aims of this study."

p4, l21: "The spectroscopic sensors are experimental systems and not commercially available yet." Remove "yet", these systems probably remain experimental and will never be commercial.

p4, l25: "... for the typical flight altitude of few 100m and airspeed..." – "of a few 100m"

p5, l12/13: Regarding your reply to reviewer comment about the "delay time":

"How can you carry out successful fast measurements with the closed-path LICOR if there is a 250-millisecond calculated delay? Have you tested the delay? What is the residence time in the sample cell?"

The delay is just a temporal offset, which can be corrected. The residence time in the sample cell depends on the air flow speed, and is taken into account in Sect. 2.2."

also:

"Furthermore, it is unclear from this manuscript whether the LICOR has an actual temporal resolution of 20 Hz (when the sampling delays and internal processing are included).

The delays are constant temporal offsets, which do not influence the capability of the sensor to provide data at 20 Hz resolution.)"

Maybe better say "temporal offset" "or "time shift" instead of "delay time" or "time delay" to avoid confusion here and in other places?

p5, l19/20: "...a slow, but highly accurate Rosemount DB102 temperature sensor..." Please specify slow and highly accurate.

p5, l20: "... and a fast response (100Hz) Rosemount EL102 sensor."

Remove one "a", and add what quantity the Rosemount EL102 sensor is measuring.

p5, l22/23: Regarding the reviewer comment about Humicap: If you do not use data from this instrument, I suggest not mentioning it, or at least say "(not operational in this study)" instead of "(not used for this study)".

p6, l3-9: I agree with the reviewer comment about the time resolution discussion being split up in too many places, but also understand your reasoning. The discussion here in Section 2.2 could be moved into and combined with Section 3.2?!

former p6, l20ff: reply to reviewer comment:

"We added in the text:

"These small sub-legs were chosen with different but homogeneous surface conditions and different but constant flight altitudes to compare if there are systematic differences in the parameters like the vibration level."

"

I could not find the added text in the revised manuscript!

p7, l30: Fig. 9 referenced before Fig. 4. Please number figures in accordance with their mentioning in the text.

p8, l2: "The overall aim of the Helipod measurements was to study greenhouse gas emissions on a scale of up to 100 km..."

What does the scale of up to 100km refer to?

former p10, l12: reply to reviewer comment:

"... covariance of the vertical wind speed and the humidity values from the different sensors..."

We changed as suggested.

The change got lost in the revised manuscript?!

Figures:

General: I recommend using 90° turned y-axis labels in all figures (not all labels turned in figures 3, 5, 9, and 10)

Fig. 5: "For the spectral analysis, the part of the data shaded in grey were used, excluding segments indicated in the last plot." You mean "... lowermost panel" or "...panel e" (not "last plot")?

Also change "...the part of the data... was used..."

Fig. 6: Does it refer to the shaded area in Fig.3? If yes, please state explicitly; if no, please indicate the relevant section in Fig. 3 (e.g. with a bar on top or bottom of the figure if you wish to add no further shadings).

Fig. 9: Some labels and y-axis annotations of the left plot overlap: "180°" phase and "0" coherence, "phase" and "0°" phase.