General Comments

The authors describe a novel method of determining aircraft static and dynamic pressures corrections based on independent and simultaneous measurements of true airspeed ahead of the aircraft from a new airborne laser air-motion sensor (LAMS). Both static and dynamic pressures are very important parameters for any aircraft air data system. In particular, for research aircraft, they need to be measured very accurately as they intervene in the expressions of the air state and thermodynamics variables, and ultimately of those of the wind components. The authors take further these corrections and combine them with high-resolution measurements of geometric altitude from the GPS to determine air temperature correction via the integrations of the hydrostatic equation. The development parameterized fits for of the pressure corrections for the two NSF/NCAR aircraft (C-130 and GV) is particularly useful as they can be implemented when the LAMS is not flown and potentially in the reprocessing of flight data from past projects. My understanding is that the LAMS is still under development with the goal of having a system that measures a full 3-D airstream vector. The authors should be commended for finding a useful application for this 1-D version of the system.

Except for appendix A where some errors have been noted (see specific comments) and that I find redundant with long available work in the literature, the manuscript is well written, well organized and easy to follow. It is very relevant and a useful contribution for improving the techniques of airborne measurements in general and air motion measurements in particular.

I recommend the paper for publication after the authors address the specific comments listed below.

Specific Comments

Page 2587, line 16: "A tube," suggested modification: "a stainless steel tube".

Page 2587, line 19: "and the sensor"; suggested modification: "and the tube".

Page 2589, line 12, "of normal temperature sensors" may be conventional would be a better word choice here than "normal".

Page 2590, line 2: "A small inertial system (Systron Donner C-MIGITS INS/GPS) mounted in the wing pod with the LAMS measured deviations caused by wing flex or other vibration of the pod relative to the aircraft centre axis" Question: If the purpose of the LAMS was only to make correction to the static pressure , and hence dynamic pressure, (I know this is not the case), wouldn't be more cost effective to use the more direct trailing cone method that uses only tubing (reinforced with an internal cable) and a differential pressure transducer without the need for INS/GPS expensive sensors in addition to the laser itself?

Page 2592, Discussion of Fig 2: The data of uncorrected and LAMS-corrected dynamic pressure are shown and discussed. I would be interesting to show also the how the "traditionally" corrected q on the G5 and C130 compare with LAMS q from Eq 2.

Page 2592, line 13: "The normal measurement of total pressure $p_t = p+q$ is obtained on the GV and C-130 and most other research aircraft by measuring the pressure delivered by a pitot tube aligned approximately along the airflow. This measurement is made by adding two measurements, one of ambient pressure p (measured by a Parascientific Model 1000 absolute pressure transducer with measurement uncertainty 0.1 hPa, connected in parallel to static ports on each side of the fuselage of the aircraft) and a second of dynamic pressure q (measured by a Honeywell PPT (0–5 PSI) differential sensor with measurement uncertainty 0.02 hPa, connected between the static ports and the pressure delivered by a pitot tube)."
Comment: On a number of research aircraft p_t is measured directly by plumbing the total pressure line directly to an absolute pressure transducers.

Page 2593, line 5: "For example, on the NSF/NCAR C-130, there are two independent sets of static ports and pitot tubes..." This is a repeat from the previous page on line 21.

Page 2595, line 10: "at a level of about 0.1 hPa," suggested modification: "within 0.1 hPa,"

Page 2595, line 25: Both attack and sideslip angles are function of the dynamic pressure q and are used here to calculate v_l that will be used to correct q. Are the calculations done iteratively?

Page 2596, line 12: "an uncertainty of 0.3° C contributes typically a larger fractional contribution"; suggested modification: "an uncertainty of 0.3° C results in a typically larger fractional contribution"

Page 2596, line 18, Eq 7: Should it be v^2 i.e., $v_l^2/\cos^2\theta$ instead of v_l^2? It would be v_l^2 only if the temperature probe measuring T_r was perfectly aligned with laser beam which is unlikely.

Page 2597, "Fits to the corrections" section: Since the LAMS velocity measurements were made at a distance d=16 m ahead of the radome system on the GV and a bit more than that with respect to the pitot tubes (and some other distance on the C-130) were the high rate (100 Hz) data from the LAMS shifted in time by v/d (so that they are in phase with the radome data) before making the 1-Hz data used in the fits? This may results in even better fits and also improve the corrections determined using the LAMS-measured airspeed throughout the paper.

Page 2600, Eq 10: Obviously the two aircraft are different but is there any more informed explanation on why the ambient pressure correction is affected by the sideslip differential pressure on the C-130 but not that of the GV?

Page 2600, line 5: How does the 0.3 hPa correction to ambient pressure compare with corrections determined for C-130 with the trailing cone in previous projects (e.g., GOTEX)?

Page 2601, line 15, Eq. 11: Shouldn't the last term be $-v_t \cos\alpha \cos\beta$, ($\alpha$ and β being the angles of attack and sideslip, respectively), instead of just – vt?

Page 2601 and Table 1 on page 2621:
When calculating the mean of the v_x differences from all reciprocal legs pairs it seems that the summation of the values of the last column in Table 1 was made algebraically. This leads to differences of opposite signs cancelling each other and a systematic decrease of the absolute value of the calculated mean. This summation will be appropriate only if all the differences had the same sign (like in the calculation of the mean $T_p - T_m$ from the values of Table 2.) Therefore, it would make sense to do the summation on the absolute values of the differences instead. When done so, the mean absolute value of the v_x differences is 0.644 m s^{-1} for the 12 reverse-heading maneuvers and 0.423 m s^{-1} when the 2 maneuvers with largest v_x differences are excluded.

Page 2602, line 26: "should not introduce perturbations into the measured pressure fields." Suggested modification: "should not introduce perturbations into the measured pressure."

Page 2605, line 20:
Were the climbs between 12 000 and 16 000 ft repeated over the same track or they flown as sawtooth pattern along a given track?

Page 2606, line 15: "After this result was obtained, an investigation discovered an error of about this magnitude in the calibration of the temperature sensor…"
What was the nature of the error? The method developed is very valuable to correct data from past projects. Will that be done?

Page 2615, line 13: "For air the specific heats…" should be "For dry air the specific heats…"

Page 2615, line 14: "while for water the values…" should be "while for water vapor the values…"

Page 2615, Eqs. A3 and A4:
I have trouble following the formulation of Eq. A3. In the first term of the LHS, R_u/M_d and Rd should cancel each other and in the second term of the LHS, R_u/M_w and R_w should also cancel each other. I could not replicate the resulting expression on the RHS. Same remarks apply for Eq A4.

If one would use the expressions of c_v and c_p given in Eqs. A3 and A4 to derive $R_a = c_p - c_v$, one would arrive at this equation:
$1 = 1 + e/p\ (-1+1/\varepsilon)$ which is true only if there is no moisture in the air (i.e., e=0). This confirms that Eqs. A3 and A4 are incorrect.

Page 2616, Eq. A5:
Because of errors in A3 and A4, A5 is also incorrect. The correct expression of gamma is: $\gamma = \gamma_d\ (1+e/7p) / (1+e/5p)$

Page 2616: "These adjustments do not differ significantly from the approximate formulas of Khelif et al. (1999)"

Actually, the expressions of moist air properties given by Khelif et al. (1999) in Eqs. A8, A9, A10 and A11 are not approximate formulas or at least they were obtained with no more approximations than used in the manuscript under review. That paper gives the expression of the moist air c_p, c_v, R and specific heats ratio, γ as a function of the dry air properties and the specific humidity, q, or mixing ratio, r, which are calculated from the measured water vapor pressure and ambient pressure. Also, since it is moist air and not pure water, enhancements factors were used to correct the measured water vapor pressures as was done by Buck (19881).

To get these properties expressions as function of e/p instead of q (or r), substituting q for $\varepsilon\ e / [p + (\varepsilon -1)\ e]$ in Eqs. A8, A9 and A10 and r for $\varepsilon\ e/(p - e)$ in Eq. A11 results in:

$c_p = c_{pd}\ (1 + e/7p) / [1 + (\varepsilon -1)\ e/p]$, (different from Eq. A4 in this manuscript)

$c_v = c_{vd}\ (1 + e/5p) / [1 + (\varepsilon -1)\ e/p]$, (different from Eq. A3 in this manuscript)

$R_a = c_p - c_v = R_d / [1 + (\varepsilon -1)\ e/p]$, (same as Eq. A2 in this manuscript)

$\gamma = \gamma_d (1 + e/7p) / (1 + e/5p)$, or $\gamma = \gamma_d (1 + 0.14285\ e/p) / (1 + 0.2\ e/p)$
(this is different from Eq. A5 in this manuscript.)

It thus appears that the expressions of c_v, c_p and γ given in in Eqs A3, A4 and A5 in this manuscript are incorrect. Incorrect values of c_p for example affects the calculated true airspeed $U_a = [2\ c_p (T_t - T_a)]^{1/2}$ where T_t and T_a are the air total and ambient temperatures, respectively.

References

Buck, A. L., 1981: New equations for computing vapor pressure and enhancement factor. *J. Appl. Meteor.,* **20,** 1527–1532.

Khelif, D., Burns, S. P., and Friehe, C. A.: Improved wind measurements on research aircraft, J. Atmos. Ocean. Tech., 16, 860–875, doi:10.1175/1520-0426(1999)016<0860:IWMORA>2.0.CO;2, 1999. 2616