Title: Air Data Use (Final)

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Data Set Description:

AirdataUse files were made for the ten HIWC-2022 flights to provide a source for air data parameters that have been corrected for various anomalies that occurred in the real time recordings of the pressure altitude, static pressure, static air temperature, true airspeed, and total air temperature. These anomalies are described in each bullet below.

- During the HIWC 2022 flight campaign, there were six time periods when the DC-8 pitot probes associated with either Air Data Computer ADC1 and/or ADC2 experienced anomalies due to probe icing. These pitot anomalies affected the measured Mach number which affected the recorded Total Air Temp (TAT) and Static Air Temp (SAT) associated with ADC1 and ADC2.
- During the flight on 2022-07-10, there was a brief period where static pressure associated with ADC2 dropped to zero.
- TAT and SAT data from the Exp_NonDeIced TAT probe had multiple issues throughout the flight campaign and was considered unusable.
- TAT and SAT data from the ADC1 and ADC2 were rounded to the nearest 0.25 deg C in the final MetNav data files which affects RH and ice saturation calculations.

A correction process (described in the data processing section below) was developed and applied to the ten flights. The ten data file names are:

AirdataUse_20220708v1.csv
AirdataUse_20220710v1.csv
AirdataUse_20220714v1.csv
AirdataUse_20220716v1.csv
AirdataUse_20220718v1.csv
AirdataUse_20220722v1.csv
AirdataUse_20220724v1.csv
AirdataUse_20220726v1a.csv
AirdataUse_20220727v1.csv
AirdataUse_20220730v1a.csv

Instrument Description:
The primary source of the pressure altitude (Palt), static pressure (Ps) and true airspeed (TAS) is from the ADC2 parameter values as found in HIWC-MetNav_DC8_R1 datasets. These values were corrected only during the anomalous time periods. The instrument used for the total air temperature (TAT) and static air temperature (SAT) is a Goodrich 102LJ2AG TAT probe that was mounted on the nose of the fuselage near the ADC pitot probes. This TAT was originally from Boeing, so it is referred to as Boeing SAT or Boeing TAT.

Data Collection and Processing:

The correction process for the Palt and Ps was to identify the time period when the ADC2 values went to zero (only occurred during 2022-07-10) and then apply the Palt and Ps from ADC1 with a small bias correction to account for the normal differences between ADC1 and ADC2 values.

The correction process for the TAS during ADC2 pitot anomalies (2 time periods during 2022-07-10 and 1 time period during 2022-07-27), a recalculation of the TASExp was substituted into that time period. The TASExp in the M300 record was affected by the SATADC static temp miscalculation due to the pitot anomaly, so the recalculation of TASExp used interpolated values of the sqrt density ratio applied to the IASExp (which is not affected by the static temp) for the anomaly period. Plots of airspeed were made for these time periods to evaluate the result and we concluded that this approach seemed to capture the dynamic variation in the airspeed better than using the recalculation of true airspeed based on ground track/ground speed and estimation of winds.

The Goodrich 102LJ2AG TAT probe data was processed using calibration data to derive the recovery temperature, Tr, then applying correction for deice heating error (DHE) recommended by Goodrich. TAT and SAT were then calculated using air density and Mach number relations. The Mach number was originally recorded to two decimal places which caused some jumpiness in the SAT calculation. The final TAT and SAT data used the Mach number in the HIWC-MetNav_DC8_R1 datasets which had Mach resolved to 0.001 and this enabled smoother SAT time histories.

Flights from 2022-07-26 and 2022-07-30 had several brief time periods (2-4 seconds) when the M300 data system did not update. The data files for these two dates were subsequently corrected to synchronize the data from the MetNaV and M300 sources. These files are designated as version (v1a).

The data sets start about 1 minute after takeoff and end during approach to landing when the Mach number reaches about 0.2.

Data Format:

The data are in comma-delimited text format. At the beginning each file and there is a 2-line header, such as the following:

M300 Time Palt use Ps use SAT use TAS use TAT use
UTC   ft   mb   deg C   m/s   deg C

The legend for each column (parameter) in the files is given in Table 1.

Table 1. Summary of parameters provided in AirdataUse data set distribution, version 1.

Parameter	Units	Description

M300time	UTC	IRIG-B time recorded on M300 data system in hh:mm:ss
Palt use	Ft	Official campaign Pressure Altitude, from post-campaign MetNav dataset, or as fixed by NASA GRC for anomalies
Ps use	Mb	Official campaign Static Pressure chosen to circumvent anomalies (usually MetNav ADC2)
SAT use	C	Official campaign Static Air Temperature, calculated post-campaign by NASA GRC from Boeing probe measurements. Free from anomalies
TAS use	m/s	Official campaign True airspeed (usually ADC2), with special treatment by NASA GRC during anomalies
TAT use	C	Official campaign Total Air Temperature, calculated post-campaign by NASA GRC from Boeing probe measurements. Free from anomalies

Data Remarks: This is intended as the final Airdata Usedataset.

References:
- Collins Aerospace Total Temperature Sensors, Technical Report 5755, Rev D (draft), 2021
- Goodrich Total Temperature Sensors, Technical Report 5755, Rev C, 1994

Appendix: None