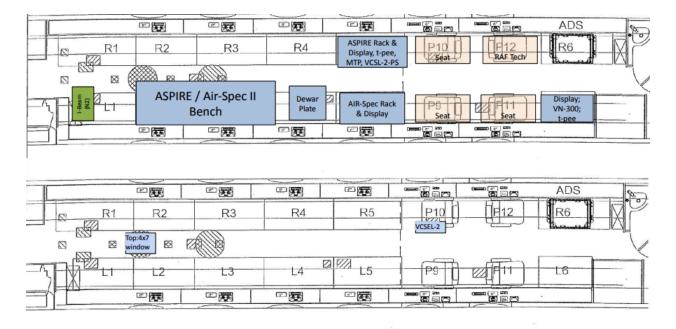# ASPIRE-TEST (2021) Project Manager Report

PIs: Samra, Madsen

I.   Aircraft Payload and Layout

- ASPIRE view windows: L2 front left side window and upper large viewport with "lasagna pan" sapphire window on the left side
- Regular GV window will be used in addition to the zenith optical port
- VCSEL-2: aperture above P10 seat
- Wings: MTP-RWO

This summary has been written to outline basic instrumentation performance affecting the quality of the data set and is not intended to point out every bit of questionable data. It is hoped that this information will facilitate use of the data as the research concentrates on specific flights and times.

This summary covers only the RAF supplied instrumentation on the GV and is organized into the following sections. Section II provides a general overview of the data collected and lists recurring problems, general limitations, and systematic biases in the standard RAF measurements. A discussion of the performance of RAF specialized instrumentation will be provided separately, along with the data. Section III describes issues that occurred on a flight-by-flight basis.

Information on the processing algorithms used to produce the final dataset can be found at:
https://www.eol.ucar.edu/content/raf-bulletins

II.   General Data Notes

RAF staff have reviewed the data set for instrumentation problems. When an instrument has been found to be malfunctioning, specific time intervals are noted. In those instances the bad data intervals have been filled in the netCDF data files with the missing data code of -32767. In some cases a system will be out for an entire flight.

1.   Position and Altitude Data

The GPS operated well during ASPIRE-TEST. Terrastar corrections were active on all flights. Data were collected at 20 Hz. The horizontal standard deviation was typically below 0.1 m. Vertical standard deviation was less than 0.2 m except during and following turns, where loss of GPS data quality is expected. These are represented in the GGxxx variables in the dataset.

2.   Three Dimensional Winds

Vertical wind has been optimized by applying calibration to the angle of attack, with the aim to achieve the mean vertical wind of zero. Angle of attack was calibrated using a linear model based on two predictors: the ratio of the vertical differential pressure (on the radome) to the dynamic pressure and the dynamic pressure alone. The model was fit to near-level legs, in clear sky conditions and with minimal roll. WIX is the variable for vertical wind during ASPIRE-TEST, and had to be calculated slightly differently for subsets of flights for reasons not presently understood. Vertical wind data during climbs and descents may be subject to artifacts and used with caution.

The reference horizontal wind variables are WDC and WSC.

3.   Pressure

Static pressure (PSF) on the GV is measured using a static port on the fuselage and then corrected (PSFC) using the angle of attack and dynamic pressure. This sensor worked well through the entire project and its measurements are the reference for ASPIRE-TEST (PSX, PSXC). There are two measurements for dynamic pressure: a heated pitot tube on the fuselage (QCF) and the forward hole on the radome (QCR), which is unheated. Both are also corrected using the static pressure and angle of attack (QCFC and QCRC). Water can sometimes get into the radome tubing and cause poor measurements. QCF and QCFC are chosen as the reference raw and corrected dynamic pressures (QCX, QCXC), respectively, for ASPIRE-TEST. The corrected measurements from the pitot-static sensor mounted on the nose of the GV (QCTFC and PSTFC) track well with the traditional variables described above but are not used as the reference measurements here; their intent is to reduce the line length and resonance in the lines, which has not been found significant in ASPIRE-TEST.

4.   Ambient Temperature

Temperature measurements were made using heated sensors from Harco (ATH1 & ATH2). The temperature sensors tracked well throughout the project with the greatest differences of ~0.25C seen during high altitude cruise. The published reference temperature, ATX, is equal to ATH1.

5. Humidity

Humidity is measured by two thermoelectric dew point sensors. These chilled mirror dewpointers (_DPL, _DPR) typically perform poorly in the flight profiles of the GV as they become very cold at high altitude and subsequently flood with condensation on descent into more humid lower atmosphere and take a long time to evaporate condensation and re-stabilize. There are also non-physical oscillations that occur occasionally in the chilled mirror sensors. DPL performed best and is used as the reference humidity measurement (DPX and EWX).

III. Individual Flight Summary

All times are UTC.

RF01
No significant issues with the data.

RF02
No significant issues with the data.

RF03
No significant issues with the data.

IV. Flight Notes by Flight

RF01
08 July 21

Pre-flight:

Discussed flt-ops for optical bench & LN2 (pilots, mechs, techs) with users - further discussion needed

Jenna declined N2 window purge

Takeoff 1638

Fwd camera inop - no cameras found, driver issue suspected

VXL2 is not working

1655 QCR iced-up?

Turned on N2 purge after tiny ice particles were noticed between the window panes at 47Kft (on both the top and the side window). It did help to clear the ice somewhat, need to start N2 purge at the beginning of pre-flight on flt days. The Mott frit on the N2 delivers 500 sccm at 30 psi, this is then teed to both windows via 1/8" od teflon tubing, or 250 sccm to each window. The N2 cylinder has about 900 psi remaining.

TCAB may be reading higher than actual ambient cabin temp, maybe by +5 deg C, just a guess.

1934 QCR came back on descent thru 20Kft

Land 1956

RF02

7/12/21

Takeoff: 16:46

Landing: 20:24

Had to select "Connect real-time onboard" in Aeros for L6 display laptop.

DPR and DPL lost dewpoints after coming down from 48000 feet. It's expected.

RF03

7/15/21

Tech: Kyle

Takeoff: 23:17

Landing: 02:15

Lost PSF during preflight. Recycled power and it came back. I think we lost it when I powered up DPL.

"acserver" was red on the status page during initial startup. Catherine got it going.

>>> END