ASPIRE-2021 Project Manager Report

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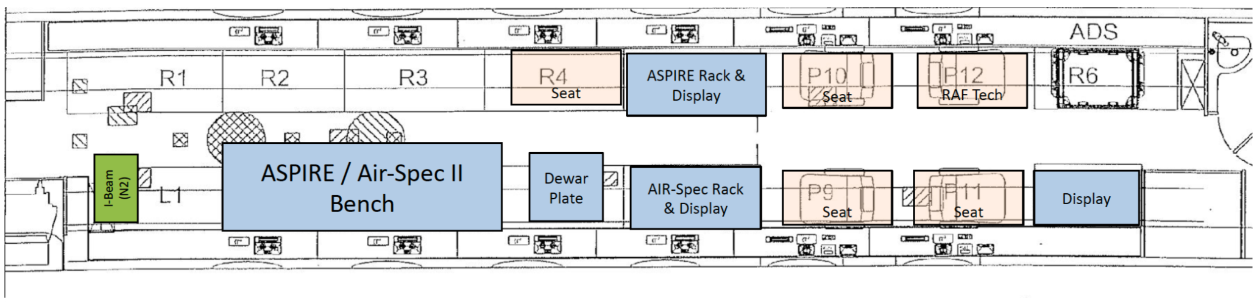
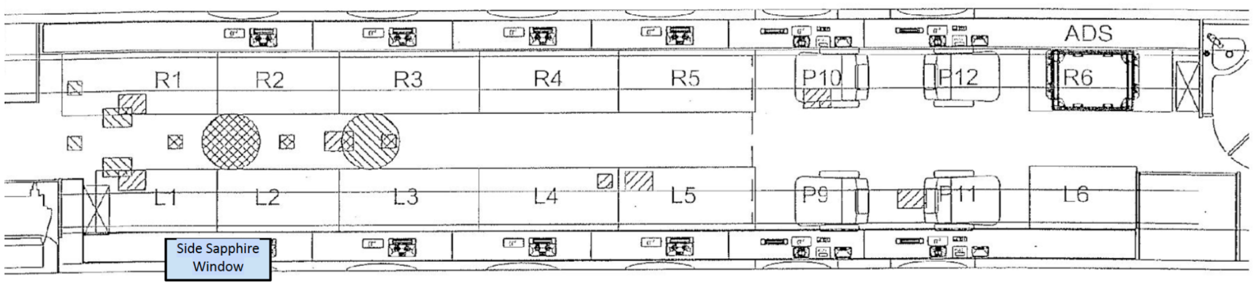
I. Aircraft Payload and Layout





- ASPIRE view windows: L2 front left side window with "lasagna pan" sapphire window
- Wings: clean

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. 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, which is equal to WIC, is the variable for vertical wind during ASPIRE. It uses the same calibration coefficients for all flights. 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 (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. 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.

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. The dewpointer data was bad from 18:33:51 to 18:46:25 and from 22:19:04 to 22:21:29.

RF03

No significant issues with the data. The dewpointer data was bad for the entire flight. As a result, variables dependent on humidity are also not available for the entire flight (THETA*, etc.)

IV. Flight Notes by Flight

RF01

-Software engineering group recently updated DSM drivers. DSM303 and DSM304 inop at startup. Catherine and Josh were able to troubleshoot and recover the ARINC driver & Diamond card driver for DSM304.

-Planned takeoff 1120L. Actual takeoff 1132L.

-IRIG timing driver was not installed prior to takeoff

-1916Z: RTH3 showing strange pattern

-RTH3 and RTH4 experienced random step changes throughout flight

-INMARSAT hand set appear to be inop (does not stay on or charged when removed from dock)

RF02

-Prior to takeoff, DSM304 (MPDB) timing card shows errors: NOSYNC, NOPPS_LOCK, NOCODE, NOSYNC

-RTH3 experienced step changes throughout flight

RF03

-Prior to takeoff, DSM304 (MPDB) timing card shows errors: NOSYNC, NOPPS_LOCK, NOCODE, NOSYNC

-INMARSAT handset at ADS rack still appears to be inop, however, Kurt conducted ground testing and was able to make a call from the cockpit ICS

-1818: After starting ascent to 45,000ft, MIRRTMP Dewpointers stopped working (-32767 value on AEROS but "REBALANCE" light not illuminated)

-RTH3 experienced step changes throughout flight

-ICS Station Display at R4 missing some digits

Additional info regarding dewpointer issue:

Prior to engine start on December 8th, the right and left dew point hygrometers were in the controlled state. They seemed to still be working properly after takeoff but around 1818 UTC, while the plane was at 25,000ft and continuing to climb to 45,000ft, both stopped working for the rest of the flight:

-MIRRTMP_DPL and MIRRTMP_DPR showed "-32767"

-In the Status section of the Controls Tab, dewpointers showed red "0.0" for both DSM303 (ADS) & DSM304 (MPDB)

-There was still power going to the hygrometer panels at the ADS rack and the "Rebalance" light was not illuminated on either one. However, I can't remember if "0.0" or another value was displayed on the panels.

Because the dewpointers were not critical to the ASPIRE mission, we proceeded with the research flight.