NOREASTER (2015) Project Manager Report

Rauber

I. Aircraft Payload and Layout

This report is written to provide documentation on data quality and instrumentation issues during the experiment. The goal is to provide sufficient background information to assist data users when analyzing the project data set.

The report 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 any other specialized instrumentation (e.g. HCR) 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 NOREASTER. Terrastar corrections were active on all flights. Data was 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. WIC is the variable for vertical wind during NOREASTER. The values are reasonable between 14:44Z and 19:34Z but likely affected by similar wetting

issues as QCR (see below) prior to 14:44Z. Vertical wind data during climbs and descents may be subject to artifacts and should be 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 NOREASTER (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, which was the case with QCR on this flight. QCF and QCFC are chosen as the reference raw and corrected dynamic pressures (QCX, QCXC). For NOREASTER, the static pressure spectrum was not optimal. The cause is unknown.

4. Ambient Temperature

Temperature measurements were made using heated sensors from Harco (ATH3 & ATH4). The temperature sensors tracked well throughout the project with the greatest differences seen during high altitude cruise. The published reference temperature, ATX, is equal to ATH3.

5. Humidity

Humidity is measured by two thermoelectric dew point sensors. These chilled mirror dew pointers (_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. DPR performed best and is used as the reference humidity measurement (DPX and EWX).

6. Liquid Water Content

LWC is measured by the King probe (PLWCC). PLWCC also often shows non-zero values on descent after high-altitude ferry and sometimes during descents in dry air while profiling. At times these values reach up to 0.05 g m^{-3}. For NOREASTER, the King probe had power at the beginning and end of the flight, but it doesn't show any data (even housekeeping) for the vast majority of the flight. The cause is unknown.

7. Supercooled Liquid Water Indicator

RICE should be used only as a qualitative indicator of the presence of icing.

III. Individual Flight Summary

All times are UTC.

RF01 (02/02/2015 12:52 - 20:34)
The research flight took off just before 8 am local time. The aircraft flew up and down the eastern seaboard, up to the Canadian border. A total of three transects between Philadelphia and the Canadian border were executed. The GV landed in Raleigh at the end of the research flight. PLWC worked at the very beginning of flight and then encountered issues. Several power cycles and DSM reboots were attempted to bring the instrument back. The QCR froze on take off (moderate rain lasted 30 minutes on ground and for take off), but came back after a couple of hours. The Forward Camera iced over and took a while to come back (melt). The flight profile was consistently high altitude the entire time except takeoff and landing. The dew pointers data have two blankout periods: 13:03 - 20:20 (DPL) and 13:15 - 20:19 (DPR) during this flight.