Atmospheric Radiation Measurement Program Data Quality Office – Real-Time Assessment of Instrument Performance

K. Kehoe, R. Peppler, K. Sonntag, T. Thompson, N. Hiers, and C. Schwarz
ARM Data Quality Office, University of Oklahoma
Norman, Oklahoma

S.T. Moore
ATK Mission Research
Santa Barbara, California

Introduction

The Data Quality Office (DQO), which now resides within the Atmospheric Radiation Measurement (ARM) Program infrastructure, continues to work closely with site operations, data system engineering, instrument mentors, and site scientists to achieve quick instrument-related problem resolution. The DQO is responsible for assessing the quality of ARM data and reporting on problems found affecting both infrastructure and the data user.

Data Quality Processing

The DQO monitors the quality of ARM data through several tools, collectively known as the Data Quality Health and Status (DQ HandS) system. The automated system updates hourly in conjunction with latest data processed at the Data Management Facility. Data quality metrics are produced for primary scientific and diagnostic fields, including comparison metrics with collocated instruments when available (Figure 1). A filtered summary of the metrics results is sent to DQO staff daily, alerting them of new issues. To ensure the DQO system is running properly, the computer system is automatically monitored to check for processing issues, also alerting key staff of any processing problems.

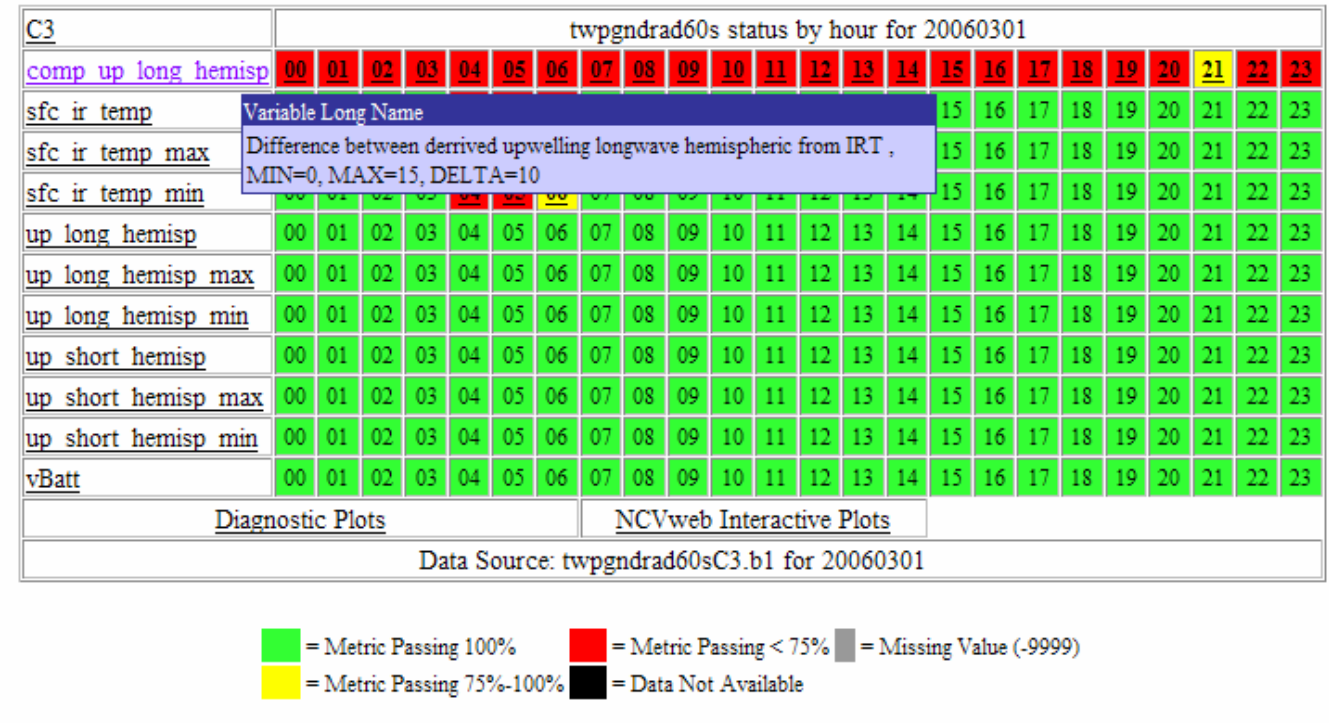

Figure 1. Data quality metrics for twpgndrad60s.b1 datastream on March 1, 2006. The comparison metric between upwelling longwave hemispheric directly measured and derived from infrared thermometer is failing the MAX difference of 15 W/m^2.

Data Quality Analysis

On a weekly basis, DQO analysts will perform a detailed manual analysis of each datastream to identify problems not detected by automated processes. A typical analysis will start by viewing the quality control metrics. This will alert the analysts to obvious issues that require further investigation. In addition to the metrics, key variables of scientific and diagnostic parameters are plotted and inspected. These include direct and simply-derived comparisons with co-located instruments and/or similar measurements from different datastreams (Figure 2). The Oklahoma portion of the ARM Climate Research Facility (ACRF) Southern Great Plains (SGP) site is fortuitously situated within the Oklahoma Mesonet, allowing comparison plots between neighboring Oklahoma Mesonet sites and ARM extended facilities housing surface meteorological observations (Figure 3).

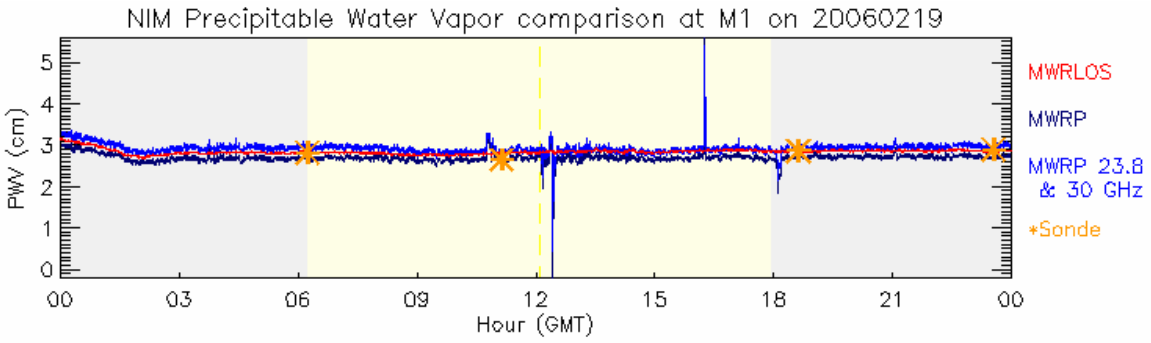

Figure 2. Comparison plot for NIM precipitable water vapor with microwave radiometer, MWRP and derived radiosonde precipitable water vapor.

When an analyst detects suspicious data within a diagnostic plot, they can then "zoom-in" on the problem using NCVweb, our on-line interactive plotting tool. Once the problem has been thoroughly diagnosed, the analysts then starts the process of informing infrastructure by filing out a web-based problem-reporting form (Data Quality Problem Report) that automatically alerts the appropriate site technicians, site scientists, and instrument mentors. This form also ensures that the data user is properly informed by initiating the process for filing a DQR that will accompany the data when ordered through the ARM Data Archive. A data quality summary of each datastream also is e-mailed weekly to appropriate ARM infrastructure personnel: it contains links to any problem tracking that may be taking place.

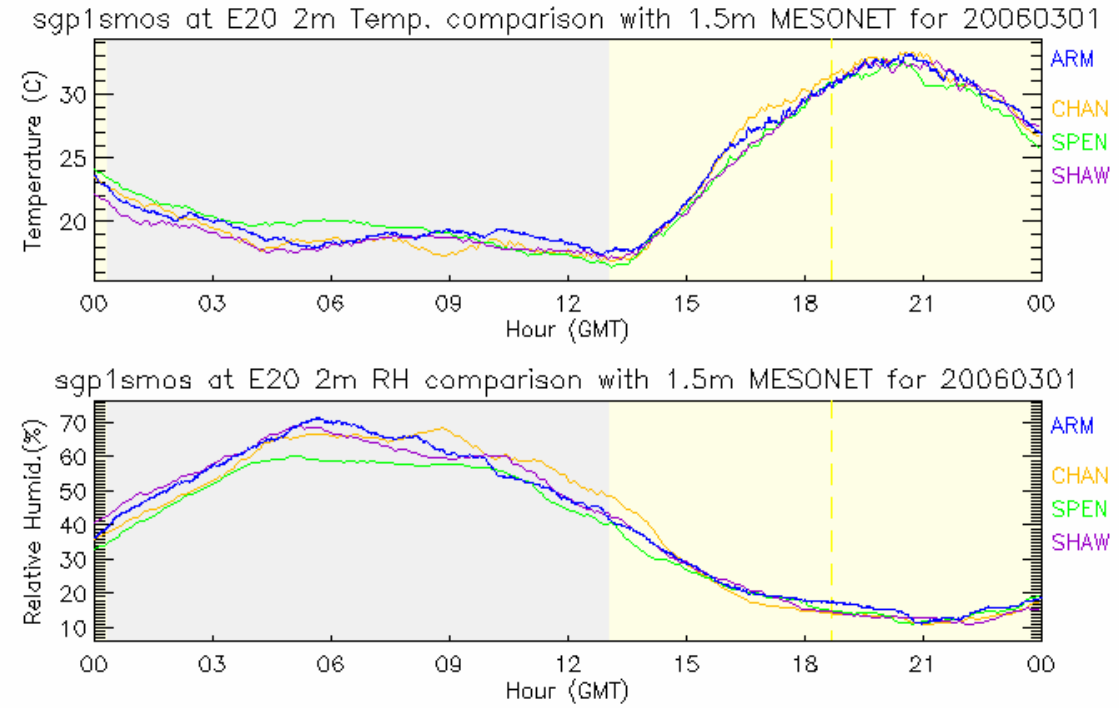

Figure 3. Comparison plot of surface temperature and relative humidity of ARM Meeker, Oklahoma, facility with the three nearest Oklahoma Mesonet sites.

Example of Data Quality Process

Beginning January 3, 2006, the SGP Surface Meteorological Observation System barometric pressure sensor at Ringwood, Oklahoma, started to fail. The analyst was first alerted to the problem by failing metrics. The diagnostic plot (Figure 4) confirmed the problem and the analyst started a Data Quality Problem Report to notify site operations and the instrument mentor of a problem.

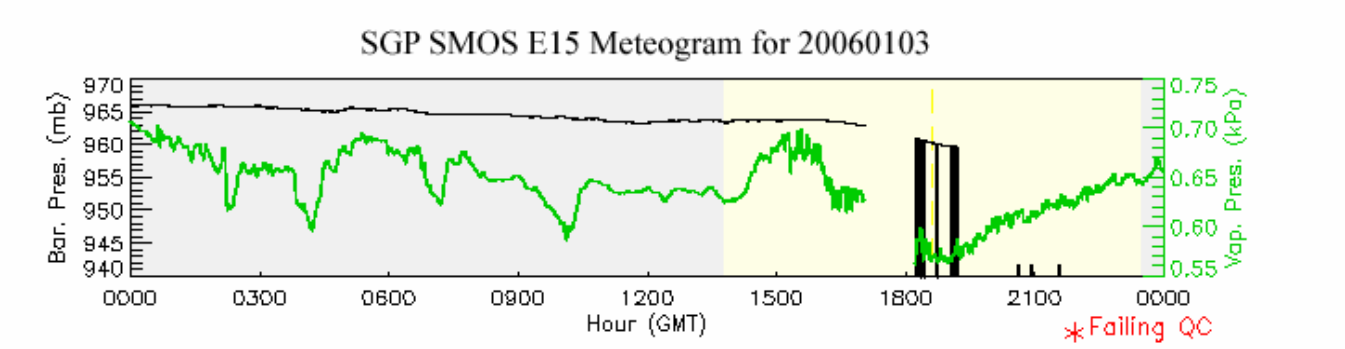

Figure 4. Barometric pressure plot of SGP Surface Meteorological Observation System at Ringwood, Oklahoma, indicating problem with failing/missing data.

Further investigation into the instrument maintenance logs revealed a data logger system upgrade coincident with start of the problem. The problem was resolved by replacing the data logger, and a Data Quality Report was written to inform the data user (Figure 5).

DQRID : D060110.1

Start Date	Start Time	End Date	End Time
01/03/2006	175	01/31/2006	184

Subject:	SGP/SMOS/E15 - Barometer data missing or incorrect
DataStreams:	sgp1smosE15.b1, sgp30smosE15.b1, sgp1440smosE15.b1
Description:	After the data logger operating system upgrade on 01/03 barometric pressure was missing or reporting very low values.
Measurements:	**sgp1440smosE15.b1**: • Maximum Barometric Pressure(max_bar_pres) • Time of Minimum Barometric Pressure(time_min_bar_pres) • Time of Maximum Barometric Pressure(time_max_bar_pres) • Minimum Barometric Pressure(min_bar_pres)
	sgp1smosE15.b1: • barometric pressure(bar_pres)
	sgp30smosE15.b1: • Standard deviation of Barometric Pressure(sd_bar_pres) • barometric pressure(bar_pres)

Figure 5. Data Quality Report indicating problem with barometric pressure.

Work in Progress

We continually develop new tools to assist the process of inspecting and assessing data quality. Recent work to improve our metrics through analysis and application of the historical ARM data set is showing great potential for fine-tuning data quality analysis (see Sean Moore's extended abstract from this meeting). Future plans include the addition of Value Added Product and Quality Measurement Experiment output within DQ HandS.