ARM Program Data Quality Inspection and Assessment Activities: A Streamlined Approach

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Introduction

A primary task of the Atmospheric Radiation Measurement (ARM) Program is to inspect and assess the quality of the data it collects. Cooperation between the Cloud and Radiation Testbed (CART) Site Scientists, ARM Instrument Team, ARM Data Quality Office, CART Site Operators, and ARM Value-Added Product (VAP) Developers has led to the creation of new tools for assessing ARM data quality. Beginning with data for the SGP CART site, a Data Quality Health and Status (DQ HandS) website (http://dq.arm.gov/) has been created (see Figure 1). The DQ HandS system displays near real-time instrument data quality information (including color-coded flag status and diagnostic plots) and provides

Figure 1. The ARM DQ HandS Website.

access to the Operations Management Information System (OMIS). OMIS allows analysts to access metadata regarding maintenance reports, calibration information, and instrument logs. The DQ HandS also contains data quality reporting forms for transmitting results to site operators to initiate corrective measures and to data users so that they may learn more about the data they want to use.

Data Quality Assessment Tools

Data Quality Performance Metrics

Performance metrics are algorithms of varying sophistication used to determine the percentage of data that fall within specified quality tolerances. The quality tolerances include simple measures such as min, max, and delta checks, and may include higher order checks, such as comparing measurements to model output, objective analysis, and cross-instrument comparisons.

Data Quality Diagnostic Plots

DQ diagnostic plots provide a tool for conducting "first line of defense" quality control. These graphical displays aid in identifying problems by plotting key geophysical parameters and cross-instrument comparisons. The plots are a necessary supplement to the performance metrics, allowing the user to identify other problems through visual inspection. Interactive plotting is also available.

Operations Management Information System

The OMIS website (SGP and Northern Slope of Alaska [NSA] only at present) allows users to obtain instrument maintenance information, engineering logs, and calibration information. This information is vital for assessing ARM DQ because it alerts the DQ analyst to activities that have been performed on the instruments that may affect DQ.

Data Quality Reporting Tools

Data Quality Assessment Reports

The first step in documenting DQ is the Data Quality Assessment Report (DQAR). The DQAR is a weekly summary of instrument performance issued by the ARM DQO. These reports provide the first level DQ documentation that is used in subsequent reports. Mentors also issue such reports.

Data Quality Problem Reports

The second step in documenting DQ is to report instrument related problems to ARM Site Operations by submitting a Data Quality Problem Report (at SGP; Quality Assessment Report, QAR, at NSA). The DQPR database in OMIS was developed as a tool to alert Site Operations of instrument problems and to allow the tracking of the status of the problem until it has been resolved. A Problem Identification Form is reserved for large, systemic problems.

Data Quality Reports

The final step in documenting DQ is the Data Quality Report (DQR). The DQR is used to inform the data user about the quality of ARM data ordered from the Archive. All information from DQARs and DQPRs is contained in the DQR, which is delivered to data users with the data.

Data Quality Health and Status (HandS) System

The ARM DQ HandS website (http://dq.arm.gov/) contains numerous DQ assessment tools and reporting forms. The website first shows the HandS Explorer front page. It allows you to select specific DQ information for a site, instrument, facility, and date. A calendar of days for a particular instrument and time period is obtained by selecting a CART site, an instrument, one or more facilities, and a date range. The black cells in a calendar indicate days when no data were collected. The green cells indicate days when all of the available data for a 24-hour period passed the performance metrics. The red cells indicate days when at least one measurement failed a metric. Dark green cells indicate days with a combination of passing and missing values. If you select a particular day, you will see all of the measurements made by the instrument along with their DQ status for each hour of the day. Red cells indicate hours when at least 25% of the available data failed the performance metrics, while yellow cells indicate hours when 1% to 25% of the available data failed the metrics, and the green cells represent hours when all available data passed the performance metrics. Moving a mouse over cells that contain failures provides a pop-up of detailed information regarding the nature of the failures, including which flags were tripped and during what minutes. Diagnostic plots can also be viewed. Failing values are generally plotted as red stars on the time series to highlight the failures discovered by the performance metrics.

By clicking on "Interactive Plot", one can interactively plot data of interest using a tool developed by our team, NCVweb. This allows an analyst to look more in depth at a certain part of the data stream. One can also view instrument log information as compiled by site operators. The instrument log contains information about maintenance performed and can add valuable information to DQ assessments. If a problem needs to be addressed by site operator corrective maintenance, a DQPR can be issued from the website. The DQPR form includes entries for site, instrument, and description of the nature of the problem. When a problem has been resolved, a DQR can be submitted reporting details of the problem to a data user. DQRs are attached to data ordered from the ARM archive.

Summary

The DQ HandS system is providing an efficient way to diagnose and document DQ problems. This method has improved instrument performance and has led to an overall enhancement in ARM DQ. DQ HandS is now available for all three CART sites.