The Use of CAMD Data for Air Quality Modeling

David J. Long, PE
American Electric Power Service Corporation

Presented At
11th USEPA Triennial Modeling Conference
Research Triangle Park, NC
August 13, 2015

Introduction

- As a result of the passage of the 1990 Clear Air Act Amendments, USEPA developed a program to monitor SO_2 and NO_x Emissions from Electric Generating Units as part of the Title IV Acid Rain Program
  - Data intended for use as an ACCOUNTING PROGRAM to determine consumption of emission allowances
  - Data management is set up to overstate emissions, if there is an error in the measurements.
- Regulations implementing the monitoring requirements are found in 40 CFR Part 75.

Introduction

- The Clean Air Markets Division (CAMD) database includes information for most generating units on an hourly basis
- Parameters typically reported include
  - Unit Gross Load in MW
  - SO_2 emitted in lb/hr and ppm
  - NO_x emitted in lb/hr, lb/MMBtu, and ppm
  - Stack flow rate in scfh
  - CO_2 or O_2 in percent
  - Calculated heat input in MMBtu/hr
- Since the beginning of the monitoring program CAMD has generated a massive database of emissions information from the data reported under Part 75.

Use in Air Quality Modeling

- This data source first came into use by USEPA and other organizations for regional modeling of ozone and $PM_{2.5}$
- Now coming into extensive use for AERMOD under the 1-hour SO_2 program where accurate emissions, temperature, and exit velocities are critical to the proper calculation of ambient impacts
- CAMD data does not include hourly temperature values, even though it is collected by the CEMS Systems for other purposes
- Accurate temperature data is needed to properly calculate plume rise and exit velocity in AERMOD simulations

Reporting Requirements That Are Not Always Accounted for in Data Usage

- Missing data is substituted using various techniques defined in Part 75 prior to the data being reported
- Substituted data is flagged in the submittals, but the flags are not always obtained when data is extracted from the Clean Air Markets Division (CAMD) database for modeling applications
- The measured temperature data used for adjusting the measured flow rates into scfh is NOT reported under Part 75
- Due to the defined calculation methodologies, the high level data typically obtained from CAMD does not clearly identify data that has been generated using substituted data

What Can Impact Data

- Since most modeling applications typically use high level data summaries from CAMD (hourly emissions, flow, and maybe load) one should understand how those values are generated and what can impact the accuracy of the data
- CAMD Data may be adjusted by a bias adjustment factor
  - Bias adjustment factors are never lower than 1.0 and only serve to increase the reported values if the bias test is failed
  - If a monitor is reading high with respect to the reference method and fails the bias test, the bias is noted, but the bias adjustment factor is set at 1.0 so it does not change the measured value

What Can Impact Data

- The lack of concurrent hourly temperature data since it is not reported to CAMD
- Depending on the unit/stack configuration the hourly temperatures may vary widely
  - Wet FGD equipped units have a smaller temperature variation than do non-Wet FGD equipped units.

Temperature Data

- Currently not reported to CAMD, but a required part of the CEMS System for flow calculations
- Temperature data for modeling studies can be sourced from the following:
  - State permit/inventory databases – typically has a single value based on full load conditions that does not offer guidance on how the temperature may change on an hourly basis or with load
  - Obtain the sensor based data from the utility operating the CEMS system
- Can lead to potentially misleading exit velocities and improper dispersion

Flow Calculations

- Hourly Flow is calculated as follows for systems measuring on a wet basis

$$Q_h = \frac{Ts}{Tm}(Qm * BAF)$$

  - Q_h = Hourly flow rate in scfh
  - T_s = Standard Temperature (528 R)
  - T_m = Measured Stack Temperature (R)
  - Q_m = Monitored Flow rate in acfh
  - BAF = Bias adjustment factor >= 1.00
- Remember, missing data substitution occurs at the parameter level, not the emission level

Emission Calculations

- Hourly Emissions are calculated in accordance with Part 75 Appendix F, Sections 2.1 or 2.2

$$E_h = KC_hQ_h * (BAF) \quad \text{(Eq. F.1)}$$

  - E_h = Hourly emissions in lb/hr
  - K = 1.660 x 10^{-7} for SO_2
  - C_h = SO_2 concentration in ppm
  - Q_h = Flow rate in scfh
  - BAF = Bias Adjustment Factor >= 1.00
- Remember, missing data substitution occurs at the parameter level, not the emission level

Data Substitution Issues

- Depending on what the missing data is and how it was substituted will determine the impact on the high level value generated
- If you can obtain the data flags from CAMD, it will offer guidance on how missing data was substituted and a provide means to estimate the potential impact on the high level value
  - Data flags are not normally transmitted with the canned datasets offered by CAMD
- If the substitution is a simple hour before/hour after substitution then the impact on the high level data will normally be relatively minor

Data Substitution Issues

- If data is substituted using the Maximum Potential Concentration value, this can lead to spurious values that can generally be easily identified, but not necessarily easily understood
  - Several examples of this behavior
    - emission rates above a reasonable level, i.e. an emission level that imputes to 2 or 3 lb/MMBtu on a fully scrubbed unit operating normally
    - Exit velocities at two or three times the design value of the stack
- When working with the hourly temperature data, make certain that you select the proper sensor to obtain a reasonable temperature
  - Unrealistically low temperatures can cause excessive concentrations

A Special Data Substitution Case

- Startup of a new stack/CEMS System combination
  - May involve stack test based data for part of the period
  - May have substituted data from the old stack CEMS during periods when stack test data is not being collected
    - Substitution of old stack data gives a complete misrepresentation of emissions and flow during the period for modeling purposes, but meets the accounting based needs of the Acid Rain Program
  - Requires extensive manual effort to set data into a representative operating range for modeling purposes

Recommendations

- OAQPS should become involved with CAMD as they make revisions to the Emissions Data Reporting format (EDR) over the next few months to make certain that CAMD is collecting data that will help improve the usefulness of the CAMD database for air quality modeling analyses
- When developing an hourly inventory for use in a regulatory proceeding, appropriate quality assurance steps need to be applied to find and appropriately fix substituted and unreasonable data for modeling.
  - Remember Acid Rain data was developed as accounting data that is designed to over report emissions to assure reductions in acid rain pollutants