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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711
OFFICE OF AIR QUALITY PLANNING AND STANDARDS

Technical Note - PM_{10} Continuous Monitor Comparability Assessment

The PM_{10} continuous monitor comparability assessment tool is available at:
https://www.epa.gov/outdoor-air-quality-data/pm10-continuous-monitor-comparability-assessments

Summary:
This tool provides a one-page technical report that assesses the comparability of a PM_{10} continuous monitor when collocated with an FRM[1] sampler. This report is based extensively on the $PM_{2.5}$ continuous monitor comparability assessment report, which is available on the web at: https://www.epa.gov/outdoor-air-quality-data/pm25-continuous-monitor-comparability-assessments These reports are intended to assist monitoring agencies in understanding if the PM_{10} continuous monitors operated in their network are appropriate for their intended monitoring objective (i.e., comparison to the NAAQS and/or reporting the AQI). Data are summarized by season across years, by year, and for all data.

The most appropriate way to interpret the comparability of the PM_{10} continuous monitors is to look at either the entire data set, designated as "AllData" or "A", or view the last complete year of data. Since the available methods to assess the comparability of $PM_{2.5}$ continuous monitors to collocated FRMs are more detailed and have been used extensively over the last several years, we are using these methods, where applicable, to evaluate the comparability of PM_{10} continuous monitors to collocated FRMs. However, PM_{10} comparability performance criteria, as identified in part 53 are used, where appropriate.

Description of Data and Assessments:

The following information describes the data and assessments in the one-page reports:

Table 1 – Dataset Descriptors

Dataset	Short Descriptor	Color of descriptor or data points	Description
AllData	**A**	**black**	Represents all the data in the assessment
Winter	W	**blue**	Winter is represented by the dates December 21 – March 20.
Spring	R	**green**	Spring is represented by the dates March 21 – June 20.
Summer	S	**red**	Summer is represented by the dates June 21 – September 20.
Fall	F	**brown**	Fall is represented by the dates September 21– December 20.
Year	0-9	**black**	Full calendar year

Note: Seasons are fixed dates regardless of year.

Illustration of Linear Regression Relationship:

On the top left of the page a regression relationship is illustrated and the regression equation is presented along with the correlation of the equation. A 1:1 line is drawn as a solid line to quickly assess if data points are above, below, or straddling the 1:1 line. A dashed line is drawn as the regression relationship. The FRM is presented on the X-axis, while the continuous method is presented on the Y-axis.

[1] Note: specific to PM_{10}, the FRM may be a hi-volume sampler, low-volume sampler, dichotomous sampler, or other approved reference method specifically designated as a filter-based FRM for PM_{10}.

Illustration of Difference Trend:
On the top right of the page a time-series of the daily difference between the continuous and FRM methods is provided. Data are presented in a color-coded manner to determine any seasonal patterns, should they exist.

Part 53 Specifications:
On the middle left side of the one-page assessment an illustration of the seasonal, yearly, and full data set for slope (multiplicative bias) and intercept (additive bias) is provided. This test is based on the specifications for PM_{10} candidate FEMs described in Table C-4 of Part 53. From a linear regression output (y = mx + b), the slope (m) is plotted along the horizontal axis, while the intercept (b) is plotted along the vertical axis. Note: the acceptable additive bias for PM_{10} continuous methods is +/- 5 $\mu g/m^3$, thus the overall acceptance criteria is presented as a rectangle, which is different than what is used for $PM_{2.5}$ continuous methods.

On the middle right side of the one-page assessment, an illustration of the seasonal, yearly, and full data set for correlation coefficient (i.e., r and not r^2) as compared to the concentration coefficient of variation (CCV) is provided. CCV is calculated using equation 22 in Part 53. The CCV is a statistic that describes the spread of the sample population. For example, a location with a concentration range of 0 – 25 $\mu g/m^3$ is expected to have a lower CCV than a location with a concentration range of 0 – 50 $\mu g/m^3$. Datasets at or above the solid line meet the part 53 correlation criteria (r>= 0.97 for PM_{10}) used in approving continuous PM_{10} FEMs. The dashed line (r = 0.90) is provided for historical context on the use of $PM_{2.5}$ methods used for AQI prior to there being a mechanism to approve $PM_{2.5}$ continuous methods as FEMs. Meeting or exceeding an r of 0.9 was intended to help guide decisions on the use of $PM_{2.5}$ continuous methods for AQI reporting.

Mean of PM_{10} Dataset:
On the bottom left of the page, the mean for the FRM and continuous method are presented for all data, seasons, and years used in the assessment. A simple ratio of the continuous method over the FRM is calculated in the right-hand column.

Appendix A to Part 58 Statistics:
On the bottom right of the one-page assessment, equation 1 from Appendix A to Part 58 is used to calculate bias. In the bias calculation we first calculate individual paired biases as % difference = [[continuous – FRM]/FRM]*100. Then we take the average of all the paired biases. These are described in detail in section 4.2.5 of Appendix A. Statistical output for the Appendix A bias calculation is presented in the left column for all observations and on the right for those cases where both the FRM and continuous PM_{10} monitor are greater than 3 $\mu g/m^3$. Appendix A calls for only using data when the both observations are greater than 3 $\mu g/m^3$; however, we calculate both options for users to see how low concentration data affects this statistic[2].

Interpreting the Comparability Assessment:
The one-page PM_{10} continuous monitor comparability assessment is intended to provide a concise description and illustration of the comparability of each operating PM_{10} continuous monitor that is collocated with an FRM. The assessment assumes that the operating FRM at the site represents a true value when compared to the PM_{10} continuous monitor, even though the FRM will have its own uncertainty. Changes in the set-up or operating procedures of the PM_{10} continuous monitor (e.g., upgrading the firmware) during the period of the assessment may result in changes to the outputs. If changes have occurred, the time series difference assessment at the top right-hand side of the one-page output may provide a useful tool to differentiate before and after the change.

[2] We note that section 4 (c) of Appendix A to Part 58 identifies to only use measurement pairs in precision and bias calculations for cases where both measurements are equal to or above 3 $\mu g/m^3$ for lo-volume methods and 15 $\mu g/m^3$ for hi-volume methods. However, to limit datasets with hi-volume methods to only those cases with >= 15 $\mu g/m^3$ would substantially decrease the number of data pairs available for an assessment and thus in many cases not produce an assessment at all. Therefore, for convenience we include two options. One with all data and the other with data where both the FRM and continuous methods are both above 3 $\mu g/m^3$.

Total precision is not readily available from the PM_{10} continuous monitor comparability assessment since this statistic requires collocated data from the same make and model. However, bias is illustrated and calculated a few different ways (i.e., the illustration of additive and multiplicative bias, the ratio of the datasets, the Appendix A bias calculation for all data and for only those cases with data above 3 µg/m^3). As described in the summary, the most appropriate way to interpret the comparability of the PM_{10} continuous monitors is to look at either the entire data set, designated as "AllData" or "A", or view the last complete year of data. Monitoring agencies can also use this tool to identify outliers or to investigate seasonal patterns.

Parameter Codes:

At the top of the PM_{10} continuous monitor comparability assessment there are notes on the FRM and continuous PM_{10} methods and parameter codes used in the assessment. The tool will provide an output for any case when a PM_{10} continuous method is reported and there is a collocated PM_{10} FRM reported to the same parameter code (i.e., 81102 or 85101). A comparability assessment is not produced if the FRM data is in one parameter code and the PM_{10} continuous monitor data is in the other. For convenience the PM_{10} parameter codes are explained here:

Table 2 – Parameter codes available for use with PM_{10} continuous monitors.

Parameter Name	Parameter Code	Purpose	Notes
PM10 Total 0-10um STP	81102	Appropriate code for all FRM and FEM used for comparison the PM10 NAAQS and AQI	Measurement flow is reported at standard temperature and pressure.
PM10 - LC	85101	Although not used in NAAQS, PM10 – LC data is often reported so that it can be compared to $PM_{2.5}$ measurements which are also taken at LC or so that $PM_{10-2.5}$ calculations can be readily calculated. Also, PM10 – LC is often used for methods that are not approved as FRM or FEM.	Measurement flow is reported at local conditions

Additional Notes:

- The data source is the EPA AQS Data Mart, which is updated each week night from AQS.
- A 24-hour average for the PM_{10} continuous method is produced for each day with at least 18 valid hours.
- Data are only presented in cases with at least 23 valid daily sample pairs.
- The processing of an assessment may take less than a minute to several minutes.
- The assessment will provide an output of the last three years of data.
- Data used in the mean for both the FRM and continuous monitor have been rounded to one decimal place, while the ratios are carried to two decimal places.
- The mean PM_{10} concentrations will likely **not** represent exactly the overall mean of the site. On one hand, we only use days where both a valid FRM and continuous monitor data point are available; on the other hand, we use all the available data, even where identified as an exceptional event. However, it's still likely that these mean values will be very close to a mean annual average for a given site.