

PAMS Data Quality Dashboard

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1 Summary

This application provides a Quality Assurance (QA) and data analysis dashboard for the Photochemical Assessment Monitoring Stations (PAMS) network. Monitors at these sites are required to measure volatile organic compounds (*VOCs*), carbonyls (e.g., *formaldehyde*), O_3 , NO , true NO_2 , total reactive nitrogen (NO_y), and meteorology (temperature, wind direction, wind speed, atmospheric pressure, relative humidity, precipitation, mixing-height, solar and ultraviolet radiation). Assessments may be generated for each year when corresponding data are available from the Air Quality System (AQS) application programming interface (API); sample data from years 2016 through the present year are available for review in most tabs. The most recent 2 years of data are updated weekly, and data before are updated every quarter. The visual assessments are intended to assist agencies by providing quick summary access to information at the site or network level for the required pollutants measured at PAMS stations. These assessments are expected to have three major advantages over existing assessments:

- Data are visualized to illustrate large amounts of information in a concise way.

- The site of interest is compared to all other sites, allowing agencies to understand whether their program’s data quality is similar to other agencies or perhaps an outlier.
- The dashboard applications are expected to remain openly available so that users do not have to worry about user authentication IDs and passwords. In this way, users can efficiently use the data dashboard for their program’s monitors.

The PAMS Data Quality Dashboard provides multiple indicators and analysis tools for the key subset of parameters required to be measured at PAMS monitoring stations:

- Site and method summary that provides a tabular summary of key monitors, counts, and method types
- Summary of most recent Technical System Audits at each site
- Yearly summary statistics for required parameters
- Pollution roses for ozone, benzene and propane with options for year and meteorological season subsets
- Time series investigation tool – combines a time series, scatter plot, and pollution rose visualization of any parameter or combination of two parameters
- Sample composition of hourly GC-measured VOCs compared to averaged sample composition profiles at a second site
- Multi-site comparison of hourly parameters at up to 5 sites via boxplot and scatter plot
- Summary of qualifier codes associated with hourly transaction sample data and corresponding statistics including missing data percentage

Additionally, the PAMS Data Quality Dashboard provides three network wide indicators:

- United States site map offers site location and selection
- Trends for key required parameters at a network and site level
- Parameter completeness for required PAMS parameters compared across all stations

2 Tabs Overview

You can view two types of assessments within the data quality dashboard as shown in Figure 1. Tabs colored red indicate *network level assessments* that focus on network wide quality indicators. Tabs colored purple indicate *specific site-level assessments* focused on site-specific quality indicators and analysis tools.



Figure 1: Dashboard tabs, shown for the PAMS dashboard, categorized by color. Red tabs are Network-level Assessments. Purple tabs are Specific Site-level Assessments, and require that a site is selected on the Map Tab.

3 Network-wide Quality Indicator Tabs

Three network wide tabs are available: Map, Trends, and Parameter Completeness.

3.1 Map

The map tab is the default landing page for a data quality dashboard. Figure 2 shows the default map display for the PAMS dashboard. Each circle on the map represents an individual monitoring site. As seen in Figure 2, the PAMS sites are color-coded by urban/suburban (blue) or rural designation (green).

To **select a site**, a user should click a circle on the map. A user must select a site on the map to view metrics on purple *Site Specific Quality Indicator* tabs. To **deselect a site**, a user may click the background of the map (i.e. any non-circle location on the map).

The table below the map provides site details, including location, site code, site name, and the main PQAO listed for the site. The table will update once a site is selected on the map to show information only for the selected site. Deselecting a site will re-populate the table with information for all sites.

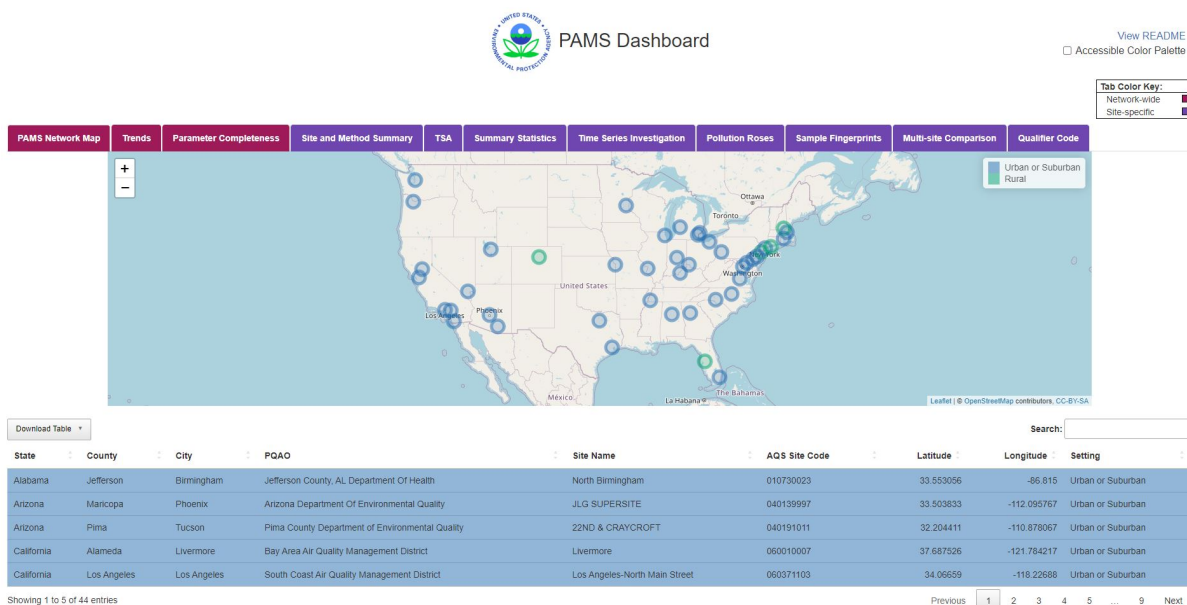


Figure 2: Map tab (default landing page) for the PAMS Dashboard. PAMS sites shown in the map are also listed in the table below.

At the bottom of the Map tab (or any other tab), the user can find the dates for when PAMS data are downloaded from the AQS API. A “Report a Bug” button is also available for the user to report any issue regarding the PAMS dashboard to the supporting technical team.

3.2 Trends

The Trends tab provides figures of annual trends for required monitoring program pollutants. Figure 3 shows the top half of the trends analysis tab of the PAMS Dashboard. The boxplot in Figure 3 shows the distribution of slopes across the network over the past years since 2016 for user-selected pollutants. The percent change in reported annual mean concentrations (normalized by the smallest annual mean concentration) is plotted on the x-axis, and each user-selected pollutant is plotted on the y-axis. A slope is only calculated when a parameter is measured at a site for at least 5 years, and a box is only displayed when at least 5 sites have the calculated slope. A reference line at a slope change of 0% is plotted as a dotted gray line. The drop-down menu on the top left allows the user to add or remove pollutants from the boxplot display. Note that meteorological parameters are excluded from this tab.

Select parameter(s)

Benzene Formaldehyde n-Heptane
n-Hexane Nitric oxide (NO) o-Xylene
Ozone Toluene

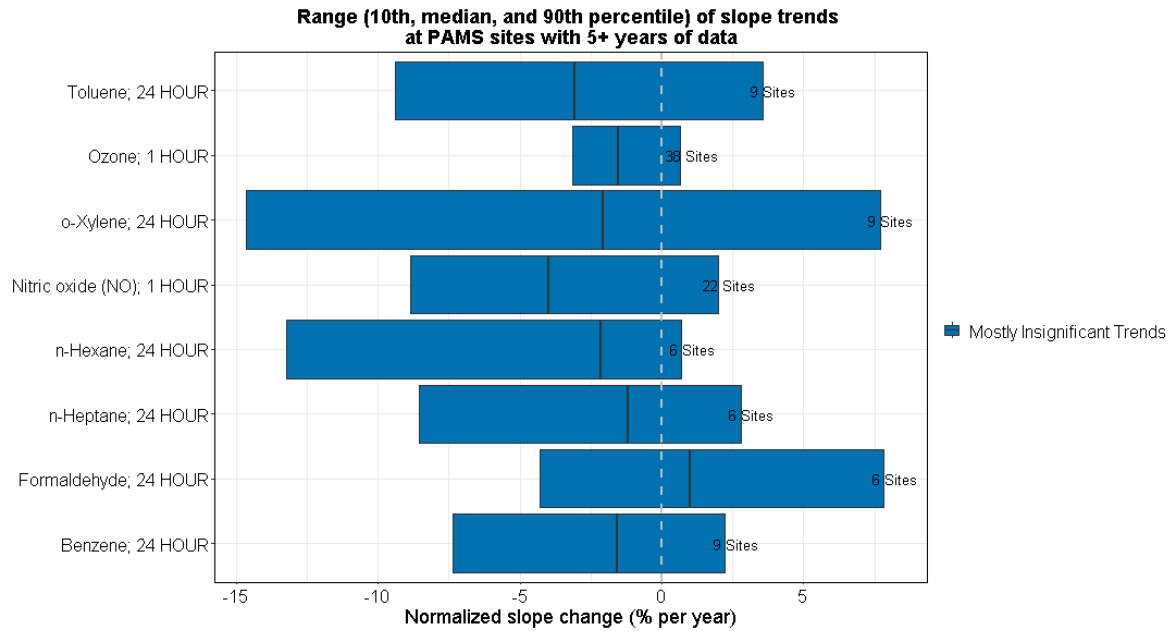


Figure 3: Top half of the Trends tab for the PAMS Dashboard.

Each box in Figure 3 represents the collection of slopes across all sites where the pollutant is measured. The number of sites represented by each box is noted to the right of the box. The left end of the box is drawn at the 10th percentile slope, the right end of the box is drawn at the 90th percentile slope, and the median slope is drawn as a black line within the box. Boxes are color-coded to indicate whether f-test values of individual trends are statistically significant at the 95% confidence level at more than 50% of the available sites; boxes that are blue indicate most site trends are statistically insignificant (i.e., not significantly different from a flat trend) and green boxes indicate that trends are mostly significant. See Figure 4 for reference.

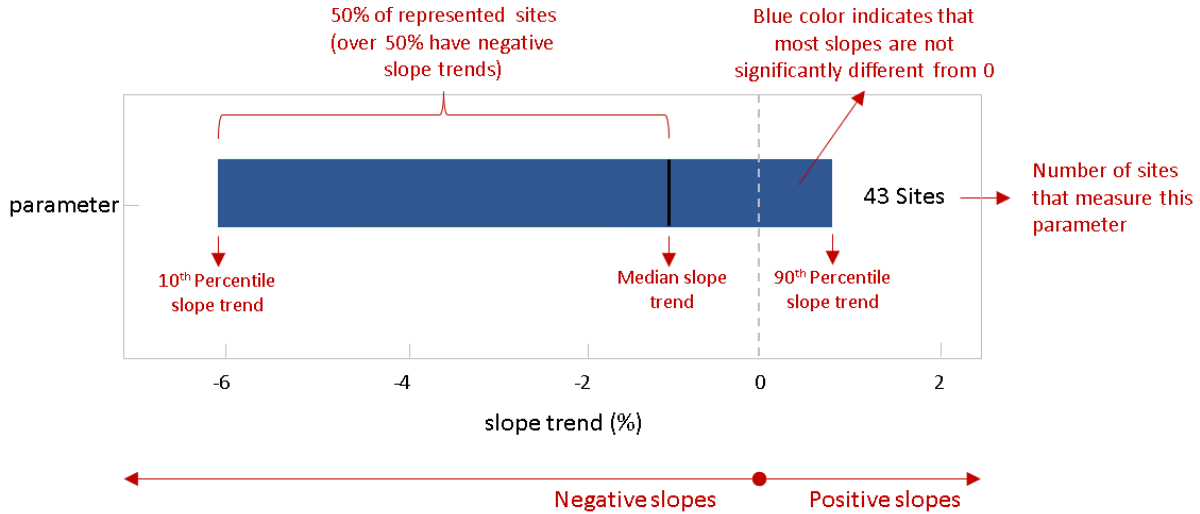


Figure 4: An example box from the slope trends boxplot.

The bottom half of the trends tab allows the user to identify how yearly trend at any measurement site compares to nationwide trends at other sites for the same time period. Figure 5 shows individual site trends for a selected pollutant and sample duration. When a site is selected on the Map tab, it is highlighted as a colored line on this figure. If the site selected does not have a valid trend for the parameter and sample duration, the colored line will not appear in this figure.

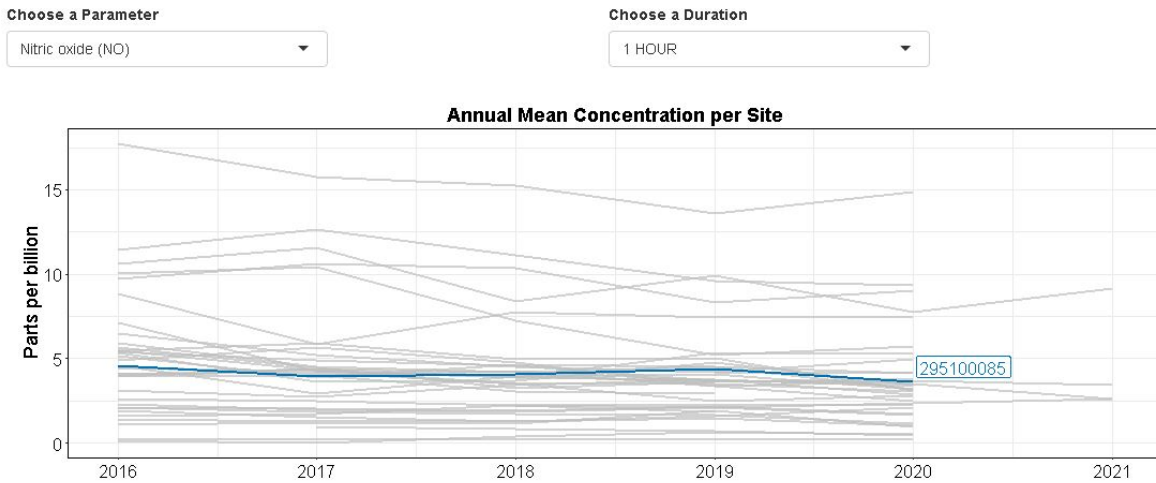


Figure 5: Time series of annual mean concentrations for selected parameter at available sites, with user-selected site highlighted blue.

Annual data from the AQS API are used for the Trends tab, and only data with valid validity indicator are included. For the same parameter measured at the same site with the same method, multiple data streams exist occasionally (due to different metrics or event types for example) and the following criteria are used to select corresponding data stream(s) displayed in this tab:

- nitrogen dioxide and ozone data streams with the metric of daily maximum 1-hour average are used while data streams with “observed values” for metrics are used for the rest of the species;

- data streams with “Concurred Events Excluded” or “No Events” for event type are included.

The arithmetic mean is taken of available data streams if multiple data streams (due to different methods for example) still exist after the above 2 steps.

3.3 Parameter Completeness

Figure 6 shows the default display of the Parameter Completeness tab for the PAMS Dashboard. Completeness of seven required parameters (benzene, propane, ozone, true NO_2 , NO , total reactive nitrogen (NO_y) and formaldehyde) for either the PAMS season or for an entire year can be displayed based on user selections.

Year may be changed using the left drop-down menu at the top left of the figure. The user can add (or remove) one or more parameters (out of the seven described above) of interest via the middle drop-down menu. Lastly, the user may choose between completeness for the PAMS season (i.e., June 1st - August 31st) of the selected year, or the entire year. Yearly completeness statistics are included to accommodate stations that have measurements outside of the PAMS season.

Each monitoring site is represented by a gray line segment according to rank-ordered site completeness, plotted on the x-axis. Parameter completeness (%) is plotted on the y-axis. Each parameter measured at a site is represented by a colored shape and plotted on the gray line segment representing the site. Only sites that have **all** user-selected parameter(s) for the selected time period will be displayed in the figure. Site ranks are dynamically calculated based on the parameter(s) chosen as the average of individual parameter completeness measurements at the site.

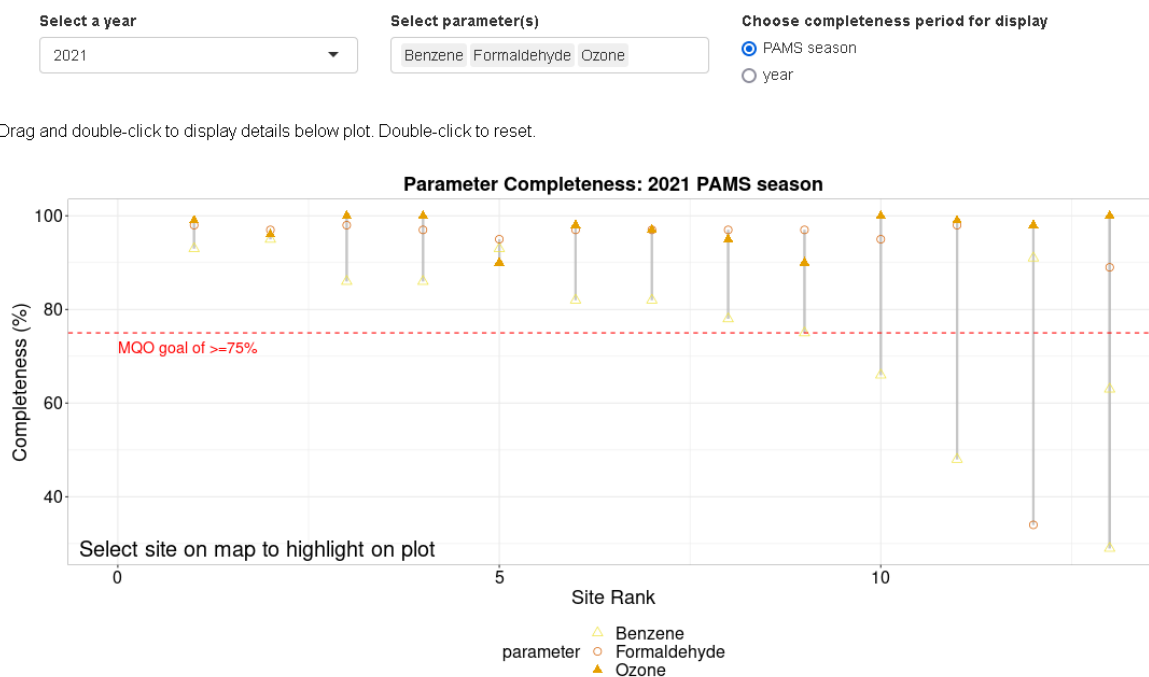
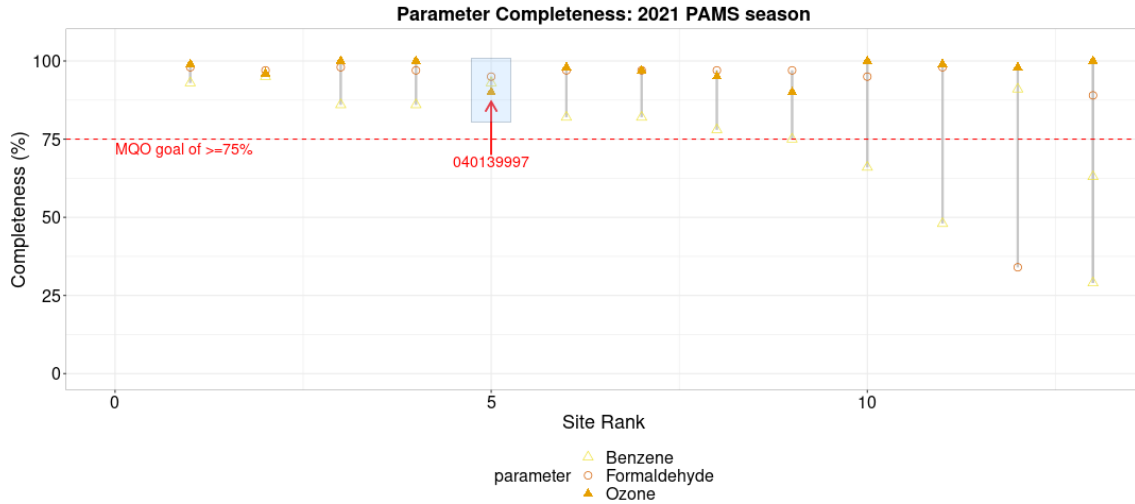


Figure 6: Parameter Completeness tab for the PAMS Dashboard.

If a site is selected on the Map Tab, the segment representing that site on the parameter completeness plot will be highlighted with an arrow and the site AQS number. A user can drag and double-click across a subset of the plot to view detailed information about the enclosed data points, which will appear in a table below (see Figure 7). If a site has co-located measurements for selected parameters, the information of the co-located data stream will also show in the table as an italicized row.

Drag and double-click to display details below plot. Double-click to reset.



Italicized rows represent collocated measurements not displayed in the plot.

| Site Rank | Site Code | Year | Parameter | POC | Method | Duration | %Complete (Parameter) | Period |
|-----------|------------------|-------------|---------------------|-----------|---|---------------|-----------------------|--------------------|
| 5 | 040139997 | 2021 | Benzene | 40 | Preconcentrator trap/thermal desorber - no drier - CAS AlrmOzone - benzene response - factor adjusted | 1 HOUR | 93 | PAMS season |
| 5 | 040139997 | 2021 | Formaldehyde | 33 | SILICA-DNPH-CART-KI O3 SCRUB - HPLC ULTRAVIOLET ABSORPTION | 8 HOUR | 95 | PAMS season |
| 5 | 040139997 | 2021 | Ozone | 1 | INSTRUMENTAL - ULTRA VIOLET ABSORPTION | 1 HOUR | 90 | PAMS season |
| 5 | <i>040139997</i> | <i>2021</i> | <i>Formaldehyde</i> | <i>34</i> | <i>SILICA-DNPH-CART-KI O3 SCRUB - HPLC ULTRAVIOLET ABSORPTION</i> | <i>8 HOUR</i> | <i>20</i> | <i>PAMS season</i> |

Figure 7: An example parameter completeness plot with a dragbox over the line and points representing a completeness at a site. The temporary table below shows details about the selected data points within the dragbox.

3.4 Completeness Calculation Methodology

A total of 4 completeness calculation scenarios are considered in the Parameter Completeness tab: **PAMS season completeness for complete years**, **PAMS season completeness for incomplete years**, **yearly completeness for complete years** and **yearly completeness for incomplete years**. Incomplete years are years for which data is not yet required to be submitted to AQS through the end of the year. All completeness statistics are calculated from sample data in the AQS database. For hourly parameters, daily averages are first calculated using completeness threshold of 75%. If fewer than 18 hours of data are available for a day, then this daily average is deemed invalid and not used in the subsequent completeness calculation.

3.4.1 Completeness estimations for complete years

Completeness per complete year is estimated as follows:

$$Completeness(\%) = 100 * \frac{Obs_{recorded}}{Obs_{possible}}$$

Where:

- $Obs_{recorded}$: Number of valid daily averages for hourly parameters, and total number of samples for 8h parameters.
- $Obs_{possible}$: A total of 92 days is used for the PAMS season, and 365 days for the year.

3.4.2 Completeness estimations for incomplete years

Step 1a: Identify incomplete years and “required” date for PAMS season completeness

The deadline for submitting PAMS data to AQS is within 6 months since the end of the PAMS season. As an example, data for the 2021 PAMS season are due on **March 1, 2022**.

Examples:

- On February 6, 2022, incomplete years include 2021 and 2022. The required date is August 31, 2020, the last day of the 2020 PAMS season.
- On August 22, 2022, 2022 is the only incomplete year. The required date is August 31, 2021, the last day of the 2021 PAMS season.

Step 1b: Identify incomplete years and “required” date for yearly completeness

The deadline for submitting data to AQS is two quarters before the most recent complete quarter. E.g. If today is June 6, 2022, the most recent complete quarter is Q1 2022 which ended on March 31, 2022. 2 quarters before this date is the end of Q3 2021, **September 30, 2021**.

Incomplete years include all years greater than or equal to the year of the required date.

Examples:

- On June 6, 2022, the required date is September 30, 2021. **Incomplete years include 2021 and 2022.**
- On July 1, 2022, the required date is December 31, 2021. **Incomplete years include only 2022** because data is required through the end of 2021.

Step 2: Estimate datastream completeness statistics for incomplete years

Completeness per datastream (unique site, poc, parameter, method) for incomplete years is calculated against either the required date, or the maximum date of available data if data extends beyond the required date.

The expected number of observations per data stream is calculated using the sample frequency recorded in sample data from AQS. If more than one sample frequency is available for a datastream across available years, the most recent recorded sample frequency is used.

A complete list of sample frequencies can be found [here](#). The expected number of observations per year is calculated per sample frequency as shown in the list below (e.g. Every 4th day = $365 / 4 = 91.25$ expected days). Seasonal designations are ignored in this list (e.g. PAMS). Sample frequencies without an obvious cadence (seasonal, random, episodic, etc.) are assigned 365. **Decimal days are rounded in subsequent steps.**

- ‘EVERY DAY’ = 365 expected days
- ‘EVERY 24TH DAY’ = 15.208 expected days
- ‘EVERY 30 DAYS’ = 12.167 expected days
- ‘EVERY OTHER DAY’ = 182.5 expected days
- ‘EVERY 3RD DAY’ = 121.6677 expected days
- ‘EVERY 4TH DAY’ = 91.25 expected days
- ‘EVERY 5TH DAY’ = 73 expected days
- ‘EVERY 6TH DAY’ = 60.833 expected days
- ‘EVERY 12TH DAY’ = 30.417 expected days
- ‘STRATIFIED RANDOM’ = 365 expected days
- ‘RANDOM’ = 365 expected days
- ‘EVERY 90 DAYS’ = 4.05555556 expected days
- ‘DAILY: 24 - 1 HR SAMPLES -PAMS’ = 365 expected days

- ‘DAILY: 8 - 3 HR SAMPLES - PAMS’ = 365 expected days
- ‘DAILY: 1 - 3 HR SAMPLE - PAMS’ = 365 expected days
- ‘DAILY: 1 - 24 HR SAMPLE - PAMS’ = 365 expected days
- ‘DAILY: 4 - 6 HR SAMPLES - PAMS’ = 365 expected days
- ‘DAILY: 4 - 3 HR SAMPLES - PAMS’ = 365 expected days
- ‘EVERY 3RD DAY:24-1 HR - PAMS’ = 121.667 expected days
- ‘EVERY 3RD DAY:8-3 HOUR - PAMS’ = 121.667 expected days
- ‘EVERY 3RD DAY:1-3 HR - PAMS’ = 121.667 expected days
- ‘EVERY 3RD DAY:1-24 HR - PAMS’ = 121.667 expected days
- ‘EVERY 3RD DAY:4-6 HR - PAMS’ = 121.667 expected days
- ‘EVERY 3RD DAY:4-3 HR - PAMS’ = 121.667 expected days
- ‘EVERY 6TH DAY:24-1 HR - PAMS’ = 60.833 expected days
- ‘EVERY 6TH DAY:8-3 HR - PAMS’ = 60.833 expected days
- ‘EVERY 6TH DAY:1-3 HR - PAMS’ = 60.833 expected days
- ‘EVERY 6TH DAY:1-24 HR - PAMS’ = 60.833 expected days
- ‘EVERY 6TH DAY:4-3 HR - PAMS’ = 60.833 expected days
- ‘EPISODIC SAMPLING’ = 365 expected days
- ‘SEASONAL’ = 365 expected days
- ‘5 OUT OF 7 DAYS (FOR PSI)’ = 260.7142857 expected days
- ‘EVERY 6TH DAY: 3-3 HR - PAMS’ = 60.83333333 expected days

Completeness per incomplete year is estimated as follows:

$$Completeness(\%) = 100 * \frac{Obs_{recorded}}{Obs_{possible}}$$

Where if calculating **yearly completeness**:

- *IncompleteMaxDate* : The more recent date between the required date, and the date of the most recent observation available in AQS (within the year in question)
- *IncompleteMinDate* : The first day of the incomplete year (e.g. if the required date is 2021-09-30, Incomplete Min Date = 2021-01-01)
- *FracRequiredDays* : Expected yearly observations based on sample frequency (see list above) / 365
- *Obs_{recorded}* : Number of complete daily observations ($\geq 75\%$ completeness in sample data) between *IncompleteMinDate* and *IncompleteMaxDate*
- *Obs_{possible}* : (Number of days between *IncompleteMinDate* and *IncompleteMaximumDate*) * *FracRequiredDays*

Where if calculating **PAMS season completeness**:

- *IncompleteMaxDate* : The more recent date between the required date, and the date of the most recent observation available in AQS (within the PAMS season in question)
- *IncompleteMinDate* : The first day of the PAMS season of the incomplete year (e.g. if the required date is 2021-08-31, Incomplete Min Date = 2021-06-01)
- *FracRequiredDays* : Expected yearly observations based on sample frequency (see list above) / 365
- *Obs_{recorded}* : Number of complete daily observations ($\geq 75\%$ completeness in sample data) between *IncompleteMinDate* and *IncompleteMaxDate*
- *Obs_{possible}* : (Number of days between *IncompleteMinDate* and *IncompleteMaximumDate*) * *FracRequiredDays*

Notes and Assumptions

- Completeness estimates $> 100\%$ are capped at 100% . Estimates greater than 100% could result from inaccurately recorded sample frequencies.
- Leap years are not accounted for in this estimation.
- Decimal days are rounded to the nearest day.

4 Site Specific Quality Indicator Tabs

4.1 Pollution Roses

The Pollution Roses tab shows pollution roses for ozone, benzene and propane at the PAMS monitoring site selected by the user on the Map Tab. Figure 8 shows the top half of the tab. The site metadata table of the selected site is shown at the top followed by two drop-down menus for year (or year range) and meteorological season (or seasons) selections. The seasons are defined as:

- Spring: March, April, and May
- Summer: June, July, and August
- Fall: September, October, and November
- Winter: December, January, and February

Two of the three pollution roses are shown in Figure 8 as an example. Below the pollution roses is an urban-scale (~25 km) map showing the selected site location within its local area (Figure 9).

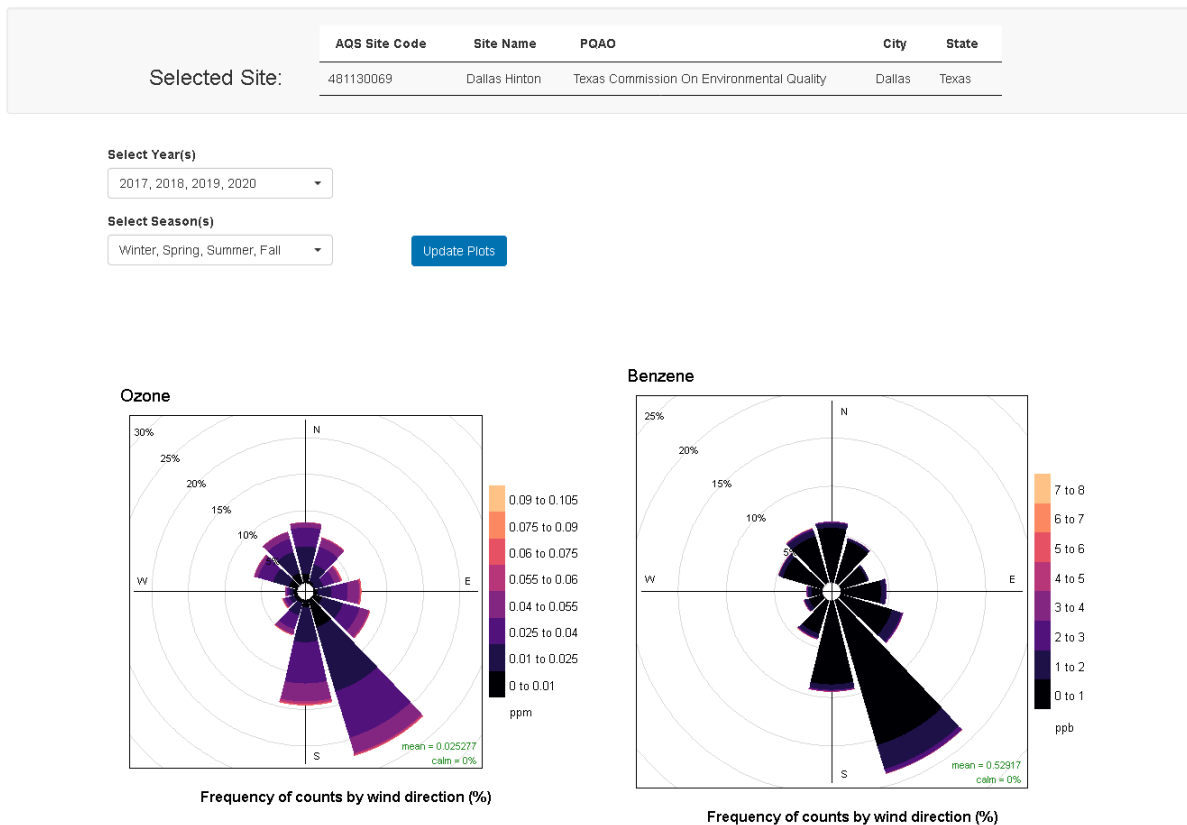


Figure 8: Concentrations of ozone (*ppm*) and benzene (*ppb*) by wind arc displayed in the Pollution Roses Tab.

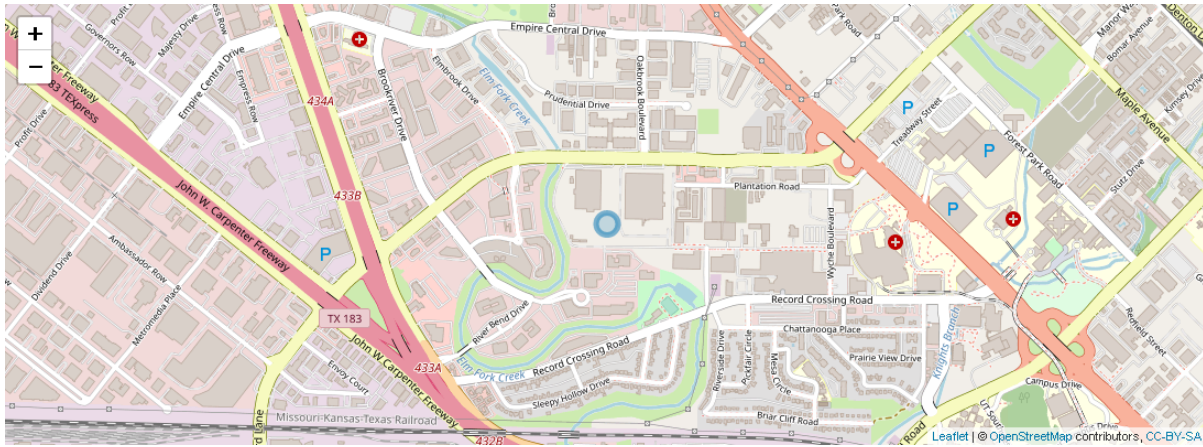



Figure 9: A local map showing the user-selected site as a circle in the Pollution Roses Tab.

4.2 Technical System Audits

PAMS Technical System Audits (TSAs) review an air agency’s compliance with PAMS requirements, QAPP, SOPs, and other practices. The TSA tab provides a summary of the most recent VOCs, Carbonyls (Field), and Carbonyls (Lab) TSAs at each site. If no site is selected in the PAMS Network Map tab, a table with TSA information for all sites will be displayed. This table is for informational purposes only and will be updated after TSAs are completed.


PAMS Dashboard
View README
 Accessible Color Palette

PAMS Network Map
Trends
Parameter Completeness
Site and Method Summary
TSA
Summary Statistics
Time Series Investigation
Pollution Roses
Sample Fingerprints
Multi-site Comparison
Qualifier Code

PAMS Technical System Audits (TSAs) review an air agency’s compliance with PAMS requirements, QAPP, SOPs, and other practices. This table is for informational purposes only and will be updated after TSAs are completed.

Download Table Search:

| State | County | City | Site Name | AQS Site Code | Last VOCs TSA | Last Carbonyls TSA (Field) | Last Carbonyls TSA (Lab) |
|----------------------|----------------------|---------------|--|---------------|---------------|----------------------------|--------------------------|
| Alabama | Jefferson | Birmingham | North Birmingham | 010730023 | Not Available | Not Available | Not Available |
| Arizona | Maricopa | Phoenix | JLG SUPERSITE | 040199997 | May 2023 | May 2023 | December 2022 |
| Arizona | Pima | Tucson | 22ND & CRAYCROFT | 040191011 | Not Available | Not Available | Not Available |
| California | Alameda | Livermore | Livermore | 060010007 | Not Available | Not Available | Not Available |
| California | Los Angeles | Los Angeles | Los Angeles-North Main Street | 060371103 | Not Available | Not Available | May 2023 |
| California | Riverside | Rubidoux | Rubidoux | 060658001 | May 2023 | May 2023 | May 2023 |
| California | Sacramento | Arden-Arcade | Sacramento-Del Paso Manor | 060670006 | Not Available | Not Available | Not Available |
| California | San Diego | El Cajon | El Cajon - Lexington Elementary School | 060731022 | Not Available | Not Available | Not Available |
| Colorado | Jefferson | Not in a City | ROCKY FLATS-N | 080590006 | Not Available | Not Available | Not Available |
| Delaware | New Castle | Wilmington | MLK CORNER OF MLK BLVD AND JUSTISON ST | 100032004 | Not Available | Not Available | Not Available |
| District Of Columbia | District of Columbia | Washington | MC MILLAN NCore-PAMS | 110010043 | Not Available | Not Available | Not Available |

Figure 10: Example of the Technical Systems Audits tab.

4.3 Site and Method Summary

The Site and Method Summary tab provides a set of quality indicators for the required parameters and optional parameters at the PAMS monitoring site selected on the Map Tab. These indicators are calculated and displayed by year. Figure 11 shows a subset of available parameters at an example PAMS monitoring site in 2020. At the top of the page is a description of the selected site and its metadata. A selectable drop-down menu allows the user to select a year of interest – data is acquired via AQS database since 2016. The main

table below shows individual parameters and monitor specific information including POC, method, units, count and method detection limit (MDL). The color-coding of the table indicates the group of parameter being measured. Groups include:

- **Required Gases** : required program parameters that are gas-phase measurements
- **Required VOCs** : a subset of six key required volatile organic compounds (benzene, toluene, ethylene, propane, isoprene and o-xylene)
- **Required Carbonyls** : a subset of key required carbonyls (e.g. formaldehyde)
- **Required Meteorology** : required program parameters that are meteorology measurements
- **Other Required VOCs** : the rest of the required volatile organic compounds as listed in Table 2-2 in [Technical Assistance Document For Sampling and Analysis of Ozone Precursors for the Photochemical Assesment Monitoring Stations Program \(April, 2019\)](#)
- **Other Required Carbonyls** : the rest of the required carbonyls (e.g. acetaldehyde)
- **Optional VOCs** : optional volatile organic compounds as listed in Table 2-2 in [Technical Assistance Document For Sampling and Analysis of Ozone Precursors for the Photochemical Assesment Monitoring Stations Program \(April, 2019\)](#)
- **Optional Carbonyls** : optional carbonyls, (e.g. acetone)
- **Additional Supporting** : additional program parameters that do not fall into any category listed above

When a required parameter is missing in the annual data for the selected year and site, a row with the parameter name, code and group is added to the table. The rest of the columns for that row are left blank to indicate missing data.

| Selected Site: | | AOS Site Code | Site Name | POAO | City | State |
|----------------|--|---------------|---------------|---|--------|-------|
| | | 481130069 | Dallas Hinton | Texas Commission On Environmental Quality | Dallas | Texas |

| Select a Year | |
|---------------|--|
| 2020 | |

Download Table ▾

Search:

Site: 481130069

| Parameter | Parameter Code | POC | Method Code | Method | Method Type | Units | Count Valid | Count > MDL | Avg. MDL | Group |
|-----------------------------------|----------------|-----|-------------|--|-------------|-----------------------------|-------------|-------------|----------|----------------|
| Nitric oxide (NO) | 42601 | 3 | 699 | Instrumental - Chemluminescence Teledyne API 200 EU/501 | | Parts per billion | 8199 | 5707 | 0.0 | Required Gases |
| Ozone | 44201 | 3 | 087 | INSTRUMENTAL - ULTRA VIOLET ABSORPTION | FEM | Parts per million | 8558 | 7744 | 0.005 | Required Gases |
| Reactive oxides of nitrogen (NOy) | 42600 | 3 | 699 | Instrumental - Chemluminescence Teledyne API 200 EU/501 | | Parts per billion | 7428 | 7396 | 0.0 | Required Gases |
| True NO2 | 42602 | 4 | 212 | Teledyne Model T500U - Cavity Attenuated Phase Shift Spectroscopy | FEM | Parts per billion | 7036 | 7035 | 0.0 | Required Gases |
| Benzene | 45201 | 3 | 128 | PRECONCENTRATION TRAP - PE 8700,AUTO GC,SUBAMBIENT-DUAL FID | | Parts per billion Carbon | 7727 | 6412 | 0.0 | Required VOCs |
| Ethylene | 43203 | 3 | 128 | PRECONCENTRATION TRAP - PE 8700,AUTO GC,SUBAMBIENT-DUAL FID | | Parts per billion Carbon | 7585 | 7566 | 0.0 | Required VOCs |
| Isoprene | 43243 | 3 | 128 | PRECONCENTRATION TRAP - PE 8700,AUTO GC,SUBAMBIENT-DUAL FID | | Parts per billion Carbon | 6988 | 5235 | 0.0 | Required VOCs |
| o-Xylene | 45204 | 3 | 128 | PRECONCENTRATION TRAP - PE 8700,AUTO GC,SUBAMBIENT-DUAL FID | | Parts per billion Carbon | 7727 | 7306 | 0.0 | Required VOCs |
| Propane | 43204 | 3 | 128 | PRECONCENTRATION TRAP - PE 8700,AUTO GC,SUBAMBIENT-DUAL FID | | Parts per billion Carbon | 7723 | 7723 | 0.0 | Required VOCs |
| Toluene | 45202 | 3 | 128 | PRECONCENTRATION TRAP - PE 8700,AUTO GC,SUBAMBIENT-DUAL FID | | Parts per billion Carbon | 7727 | 7727 | 0.0 | Required VOCs |

Figure 11: Example of the Site and Method Summary tab.

4.4 Summary Statistics

The Summary Statistics Tab (Figure 12) provides a quick glance at the annual summary statistics for the program parameters. The page layout is similar to that of the Site and Method Summary tab, with an identical site metadata table on top, followed by two drop-down menus for year and parameter group selections, and then the table with annual summary statistics by monitor.

The user may choose both year and parameter group(s) displayed in the summary table. The color-coding of each parameter group is the same as the Site and Method Summary tab (see the [Site and Method Summary](#) section for more detail). In addition, the summary table provides annual summary statistics (maximum, average, median, minimum) for each available measurement. When a required parameter is missing in the annual data for the selected year and site, a row with the parameter name, code and group is added to the table. The rest of the columns for that row are left blank to indicate missing data.

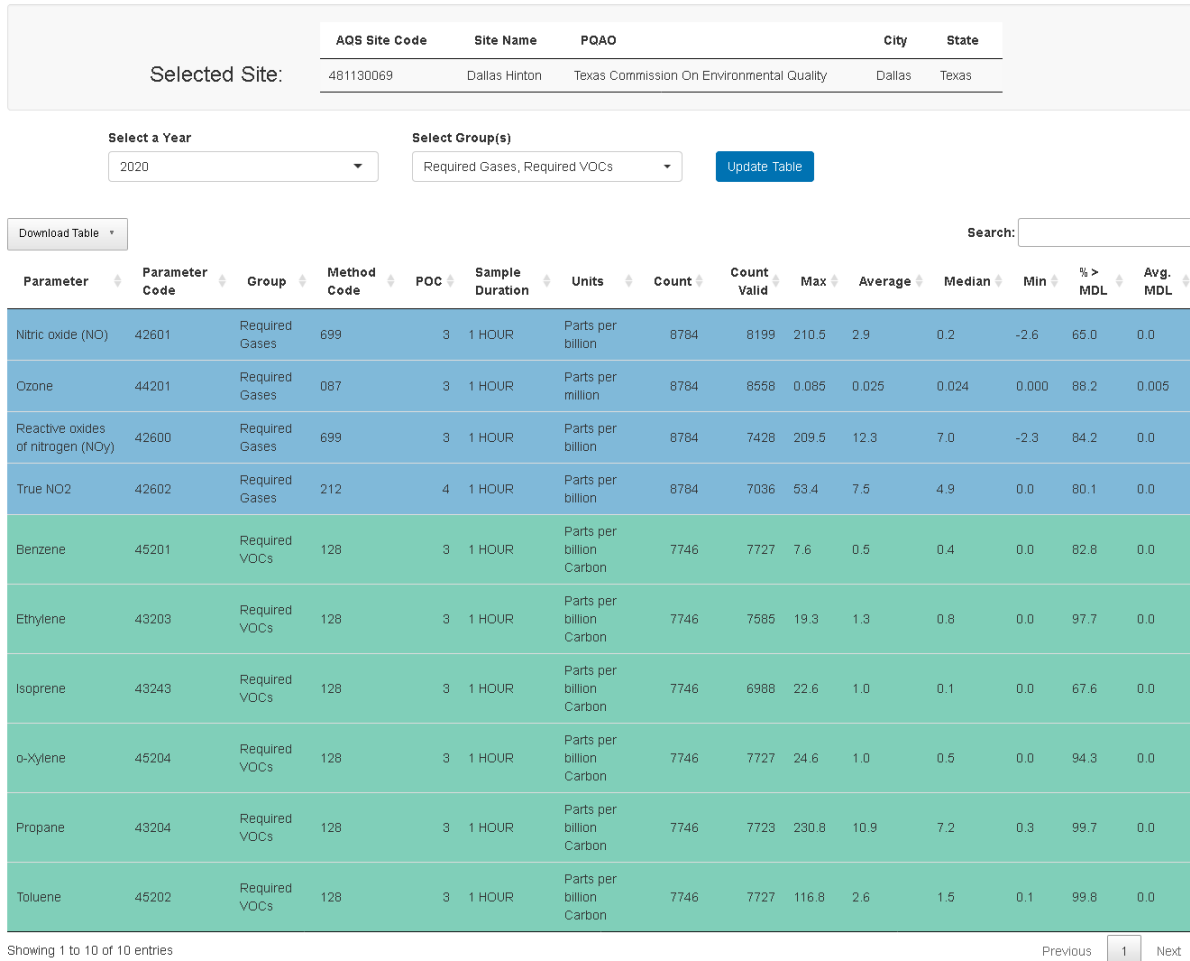


Figure 12: Example of the Summary Statistics tab, shown for PAMS Dashboard.

4.5 Time Series Investigation

The Time Series Investigation tab allows a user to compare two measurements, the first one hourly, and the second with any available sample duration (e.g., 1-hour, 8-hour or 24-hour), via time series, pollution rose, and scatter plots at the user-selected site from the Map tab. **Pollution rose and scatter plot comparisons are only available if both parameters are hourly.**

Drop-down menus above the plots allow the user to select first an hourly parameter and a specific poc to display, and optionally, a second parameter to compare with. Once the radio button for the second parameter other than “None” is selected, additional drop-down menu will appear with available options for the second parameter based on the chosen sample duration.

If one hourly parameter is chosen:

- The timeseries plot will display the parameter concentrations as a solid line.
- A single pollution rose will display for that parameter.
- Scatter plot comparison is unavailable.

If two hourly parameters are chosen:

- The timeseries plot will display the first parameter concentrations as a solid line and the second parameter concentrations as a dashed line. A secondary y-axis (right-hand side) will be included to reference the second parameter values. (Figure 13)
- Two pollution roses will display for both the first and the second parameters, respectively. (Figure 14)
- A scatter plot comparison will display, with the option to overlay a one-to-one line and/or a linear regression line using check-box selections. (Figure 15)

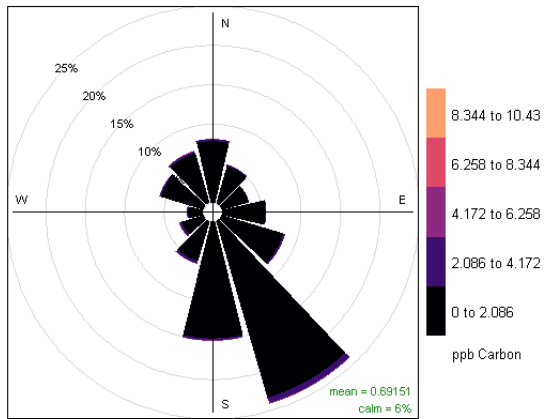
If one hourly parameter and one non-hourly parameter are chosen:

- The timeseries plot will display the first parameter concentrations as a solid line and the second parameter concentrations as points. A secondary y-axis (right-hand side) will be included to reference the second parameter values.
- A single pollution rose will display for the hourly parameter.
- Scatter plot comparison is unavailable.

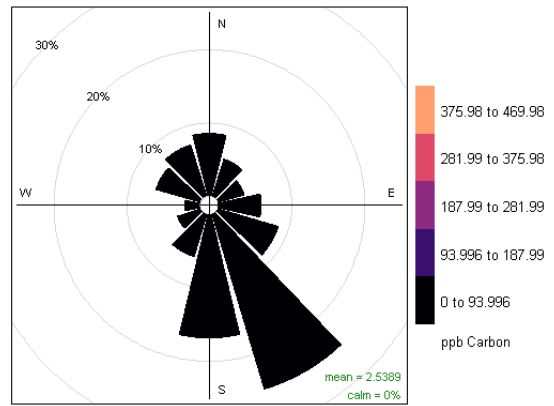


Figure 13: Time series plot of the first (hourly) and the second parameters (hourly). The right-hand y-axis represents the second parameter.

Benzene - 3



Toluene - 3



Note: Displayed 1-hr wind directions are resultant values.

Figure 14: Pollution roses for the first (hourly) and the second parameters (hourly).

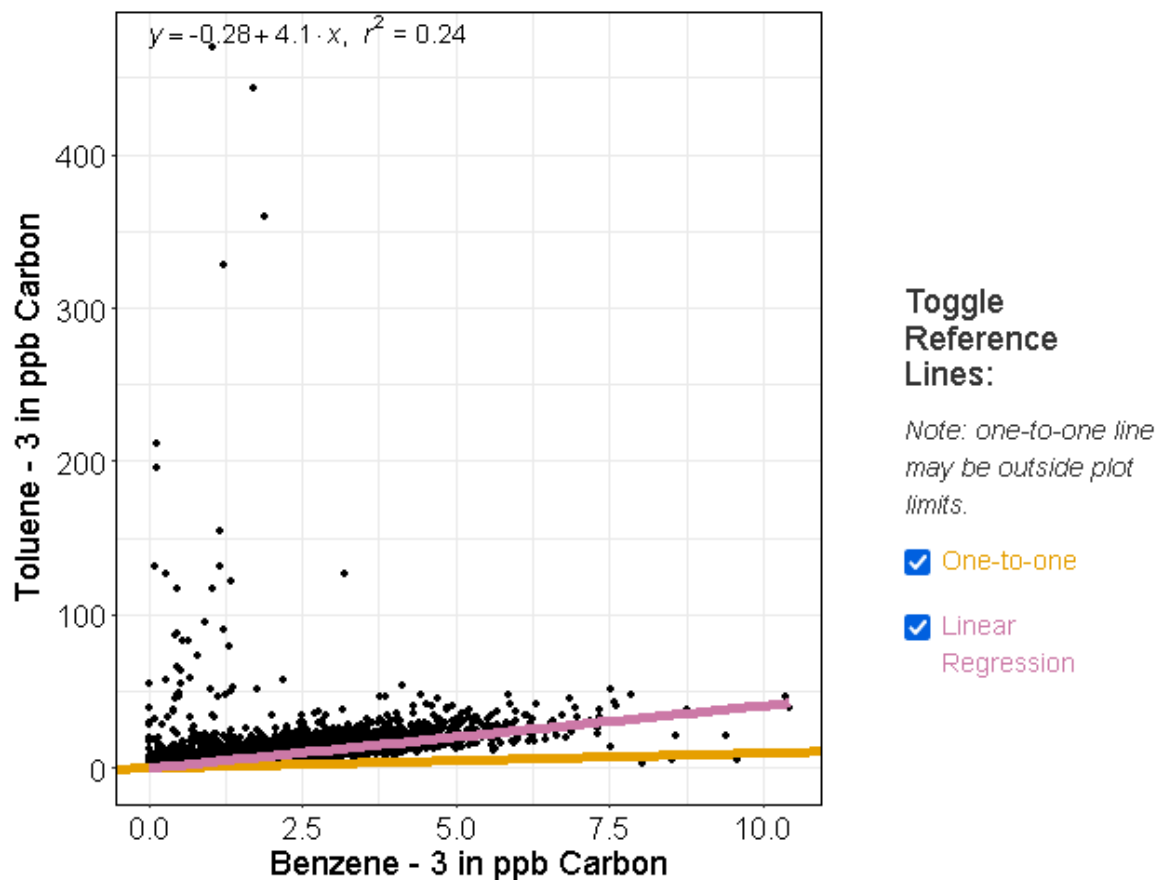


Figure 15: Scatter plot comparing the first (hourly) and the second parameters (hourly), and one-to-one and linear regression lines shown. A scatter plot comparison is only available when two hourly parameters are chosen.

4.5.1 Plot Reactivity

A user may zoom in on a particular time range in the timeseries plot by clicking-and-dragging a box across the desired subset of data on the plot, and double-clicking within the drawn box to zoom in. If displayed, pollution roses and the scatterplot will update to reflect this zoomed time period. To reset the zoom, double-click the timeseries plot.

Two reference lines are available to overlay on a scatter plot comparison: a one-to-one line, and a linear regression line. These may be drawn by selecting one or both checkboxes to the right of the scatter plot. A one-to-one line may not appear within the plot boundaries if the scales of the primary and secondary parameters do not overlap (e.g. ozone and barometric pressure).

4.6 Sample Fingerprints

The Sample Fingerprints tab allows a user to examine the sample composition profile at a specific hour measured by the auto-GC at the primary monitoring site selected in the Map Tab, and compare that to a time-averaged composition profile at a second PAMS site (Figure 16).

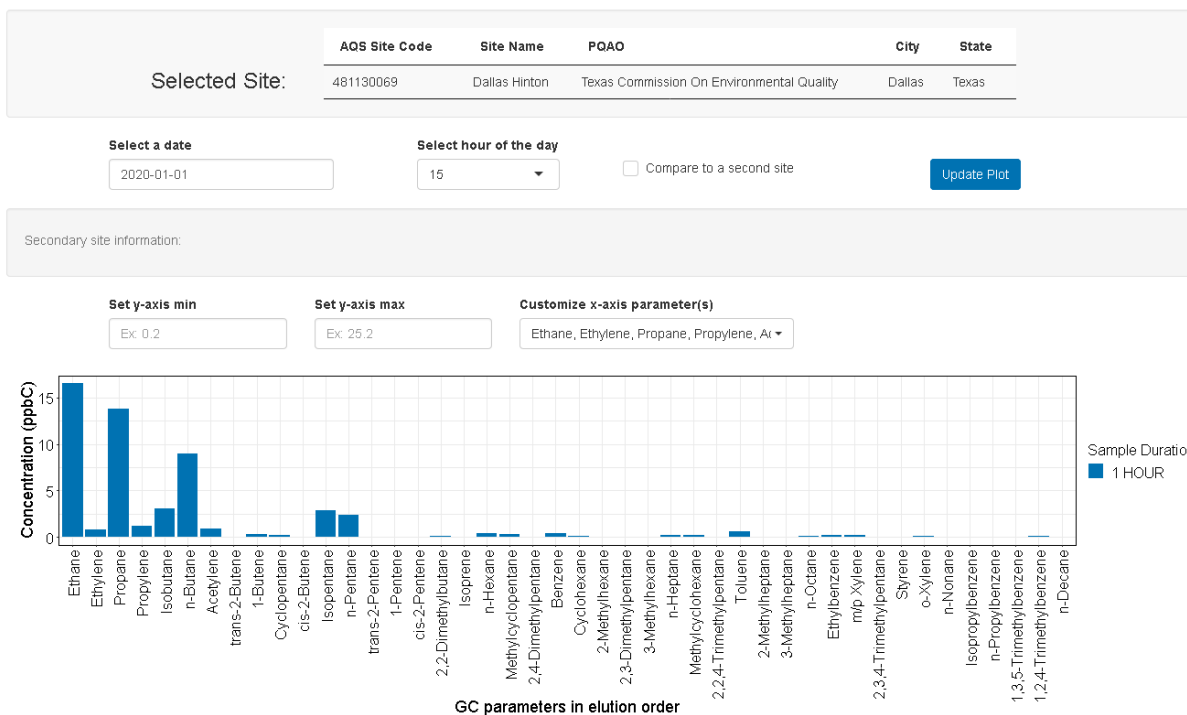


Figure 16: Sample Fingerprints tab layout when sample composition profile is displayed at the user-selected primary site.

Options for the time-averaged composition profile include yearly averages, PAMS season averages and averages of low/high/remaining ozone days of the same year. Low ozone days are defined as days with 8-hour daily maximum ozone (MDA8) concentrations below the 20th percentile. High ozone days are days with MDA8 concentrations either above the lower of either the 95th percentile or 71 ppb. For example, if the 95th percentile MDA8 ozone at a site is 65 ppb, this threshold is used to distinguish high ozone days. If the 95th percentile MDA8 ozone is 75 ppb, a threshold of 71 ppb is used. The remaining ozone days are days with MDA8 ozone concentrations between the thresholds for low and high as defined above.

Under the site metadata table of the primary site, two drop-down menus are available for users to select a specific date and hour. If no second site is selected, the bar plot below will display the auto-GC measured parameter concentrations in its elution order for that specific hour at the primary site after the “Update Plot” button is clicked. If the box for comparing to a second site is checked, a panel with options for the second site will appear below (Figure 17). Users can choose from the 3 drop-down menus in the panel to specify the second site and the comparison period. **Note that if the auto-GC is not the CAS system, then elution order of the Markes system is used.** In addition, three options are built in for custom display of the bar plot, i.e., setting the minimum and the maximum of the y-axis, and filtering parameters displayed on the x-axis.

| AQS Site Code | Site Name | PQAO | City | State |
|---------------|---------------|---|--------|-------|
| 481130069 | Dallas Hinton | Texas Commission On Environmental Quality | Dallas | Texas |

Selected Site:

Select a date:

Select hour of the day:

Compare to a second site

Secondary site information:

1. Select a state:

2. Select a city-site (AQS code):

3. Select a comparison period within the same year:

Figure 17: Additional drop-down menus for second site and averaging period selections.

If no second site is chosen:

- The bar plot will display available hourly GC measurements in elution order at the primary site (Figure 16).

If a second site is chosen, and comparison period is either annual or PAMS season average:

- The bar plot will display hourly GC measurements from the primary site as blue bars and those from the second site as green bars (Figure 18).
- Error bars for either yearly or PAMS season average will display for the green bars.

If a second site is chosen, and comparison period is low/high/remaining ozone days:

- The bar plot will display hourly GC measurements from the first site as blue bars and those from the second site as green bars (Figure 19).
- Error bars of the average for the chosen ozone days will display for the green bars.
- The number of days within the chosen ozone day type will be displayed in red text at the top left corner of the bar plot.

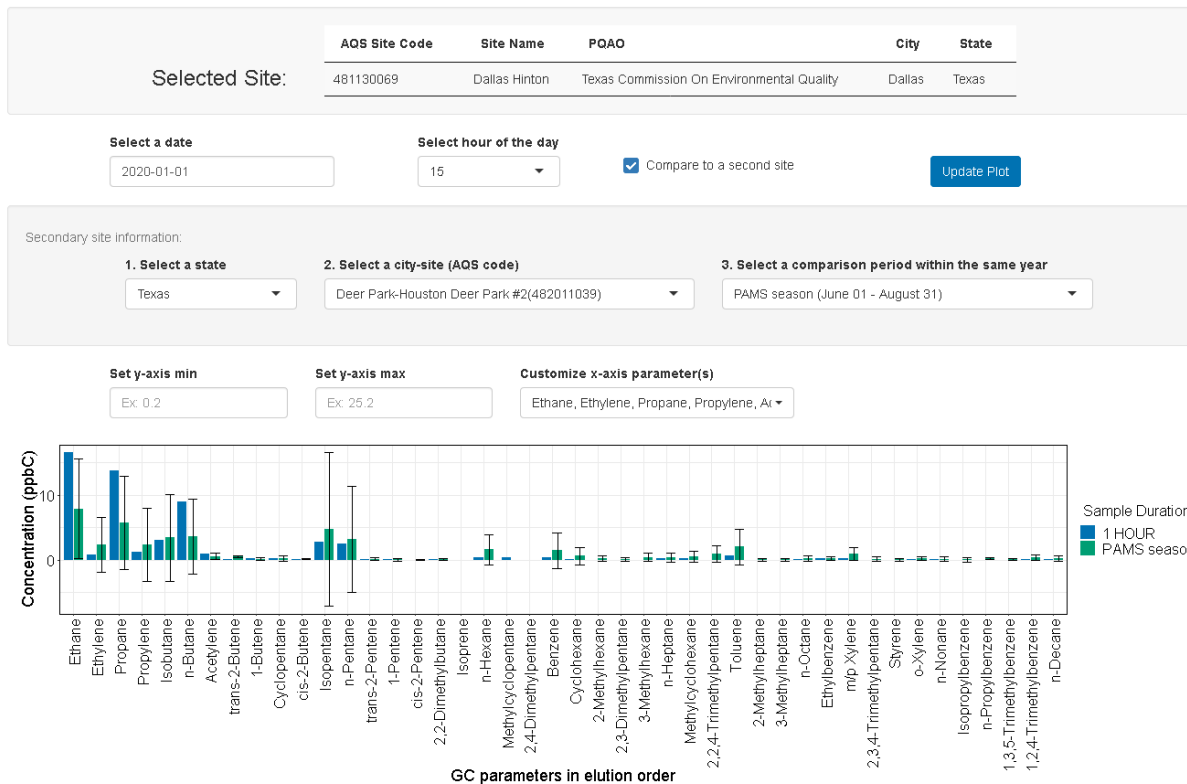


Figure 18: Example bar plot comparing an hourly sample composition profile at the primary site to the PAMS season average composition profile at a second site.

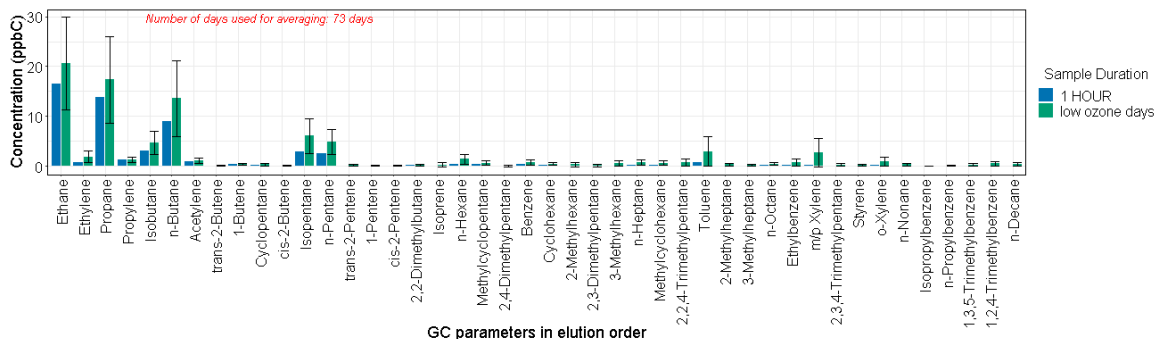


Figure 19: Example bar plot comparing an hourly sample composition profile at the primary site to the low-ozone-days average composition profile at a second site.

Sample data from the AQS API are used to calculate averages at the second site, and MDA8 ozone concentrations in this tab. Daily averages are first calculated using completeness threshold of 75%. If fewer than 18 hours of data are available for a day, then this daily average is deemed invalid. For yearly (or PAMS season) average, more than 274 (or 69) valid daily averages are required. An error message of “Not enough hourly GC data at the selected secondary site for the selected period” will display if the requirement is not met.

4.7 Multi-site Comparison

The multi-site Comparison tab allows a user to compare measurements at up to 5 sites, including the primary user-selected site (via the Map tab). The user can compare one parameter across selected sites in the box plot, and explore correlations between 2 parameters (with the same sample duration) across selected sites in the scatter plot.

(Figure 20) shows the top half of the tab, including the primary site metadata and a panel with selections on the left. As the users make their choices through the list of selections (Item 1 through Item 4b), the text on the right will dynamically update to reflect the users' choices.

| AQS Site Code | Site Name | POAO | City | State |
|---------------|---------------|---|--------|-------|
| 481130069 | Dallas Hinton | Texas Commission On Environmental Quality | Dallas | Texas |

Selected Site:

1. Select a parameter at primary site
Benzene

2. Select sample duration
1 HOUR

3. Select up to 5 sites and available pocs
New Hampshire-Londonderry-MOOSEHILL SCHOOL(330150018) POC

4a (optional). Scatter plot: select a second parameter (hourly):
Toluene

4b (optional). Scatter plot: select available poc(s) for second parameter
Texas-Dallas-Dallas Hinton(481130069) POC 3

Update Plots

You have selected:

Primary parameter:
Benzene
1 HOUR

Site(s) and primary parameter poc:
New Hampshire-Londonderry-MOOSEHILL SCHOOL(330150018) POC 1
New York-New York-PFIZER LAB SITE(360050133) POC 1
Rhode Island-East Providence- FRANCIS SCHOOL East Providence(440071010) POC 4
Texas-Dallas-Dallas Hinton(481130069) POC 3
Texas-Deer Park-Houston Deer Park #2(482011039) POC 1

Secondary parameter (hourly only):
Toluene

Site(s) and secondary parameter poc:
Texas-Dallas-Dallas Hinton(481130069) POC 3

Figure 20: Top half of the Multi-site Comparison tab for the PAMS Dashboard.

Selections made through Item 1 to Item 3 are used as inputs for the boxplot, as shown in (Figure 21). The users will first choose a primary parameter among available parameters at the primary site, its duration, and then up to 5 sites with available POCs listed. The default setting for the x-axis increment is by month, and the y-axis values will be logarithmically spaced. (The user can change these 2 settings.) The box plot will display as long as the chosen measurements are available at at least one site. If none of the selected sites has the chosen measurements, then an error message will be returned instead of the box plot.

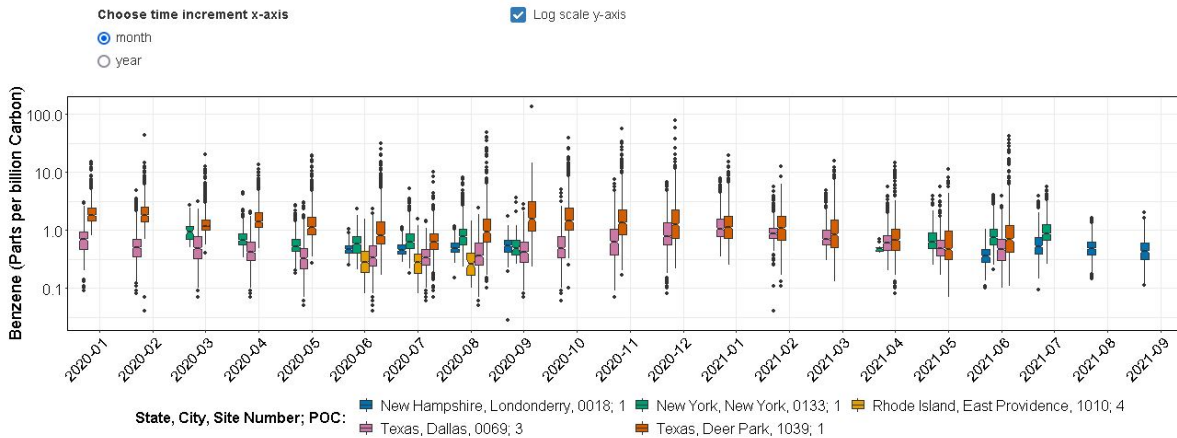


Figure 21: An example boxplot in the Multi-site Comparison tab.

How to interpret a box plot:

- IQR = interquartile range
- lower whisker = smallest observation greater than or equal to lower hinge - 1.5 * IQR
- lower hinge = 25% quantile
- lower edge of notch = median - 1.58 * IQR / sqrt(n)
- middle line = 50% quantile
- upper edge of notch = median + 1.58 * IQR / sqrt(n)
- upper hinge = 75% quantile
- upper whisker = largest observation less than or equal to upper hinge + 1.5 * IQR

The optional scatter plot displayed at the bottom of the tab is shown in (Figure 22). The inputs are determined from Item 4a and Item 4b on the panel of selections. The scatter plot allows a user to select a second parameter and investigate its relation to the primary parameter at selected site(s). The scatter plot will display with both x- and y- axes in logarithmically spaced by default. The user can change this by un-checking the corresponding boxes in the panel. A user can zoom in on a specific region of the plot by clicking-and-dragging to create a box around the region of interest and then double-clicking within this box.

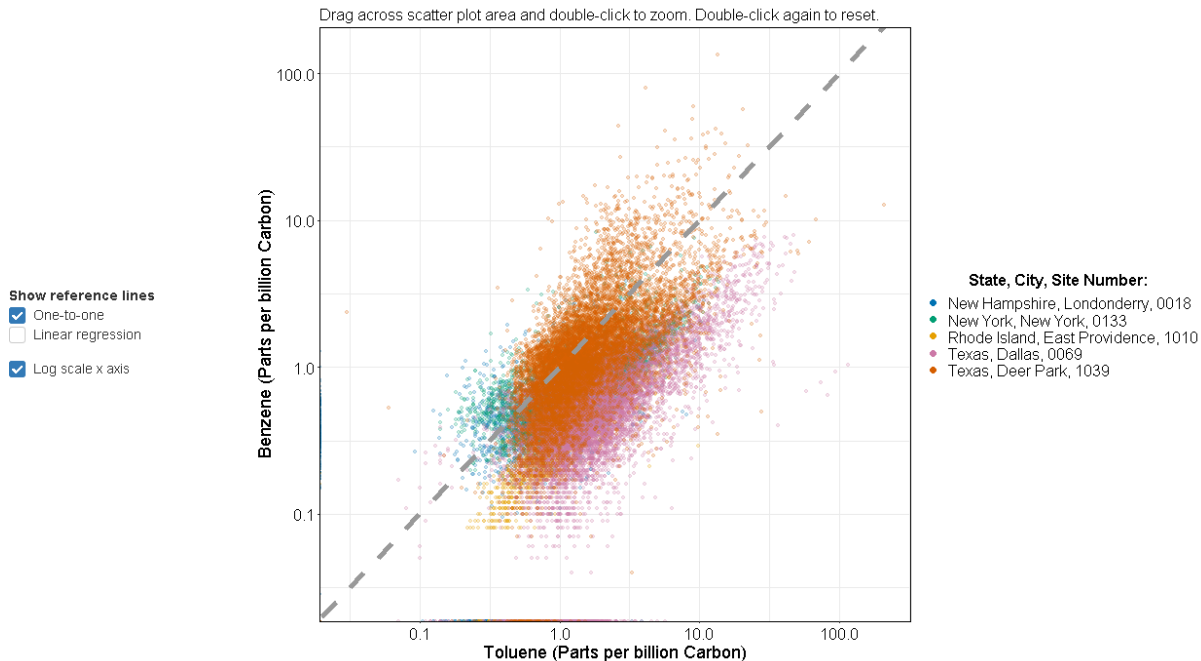


Figure 22: An example scatter plot comparing the first (hourly) and the second parameters (hourly) at selected sites. The one-to-one line is shown as a gray dotted line. A scatter plot comparison is only available when two hourly parameters are chosen.

4.8 Qualifier Code

The Qualifier Code tab of the the PAMS Dashboard provides information on qualifier codes associated with hourly transaction data from AQS. Figure 23 shows the default display of the Qualifier Code tab, consisting of the selected site metadata and four selectors with an update button. Upon selection, information on all available qualifier codes, including a null code and up to ten QA codes, will be presented to a user via a tile plot, two bar plots and a summary table. All displays on this tab are downloadable.

The four selectors allow a user to choose a time period and an hourly parameter + poc of interest at the selected site. The default time period is June of the past year. A user may extend the time period to a maximum of 3 months, e.g., the PAMS season. The minimum allowed time period is 3 days. Once the selections are made, the plots and table will update to show information of the selected period.

| AQS Site Code | Site Name | PQAO | City | State |
|---------------|---------------|---|---------|---------|
| 040139997 | JLG SUPERSITE | Arizona Department Of Environmental Quality | Phoenix | Arizona |

Selected Site:

1. Select start date

2. Select end date

3. Select an hourly parameter

4. Select a POC

Figure 23: Default display of the Qualifier Code tab for the PAMS Dashboard when a site is selected, e.g., the JLG supersite in Phoenix, AZ.

The tile plot, shown in Figure 24, provides a user with a visual summary of the number of hourly data points with either a NULL code or QA code(s) assigned. Each tile represents an hourly data point, with the color

of the tile indicating the category that the data point belongs to out of the five possible categories. These include “No Qualifier Codes” (green), “REQEXC or NULL QC Code Assigned” (orange), “QA or INFORM Code Assigned” (yellow), “Null Code Assigned” (grey) and “No Data Reported” (red). A user may also hover their mouse over each tile for details on the hourly data, including all possible QA codes.

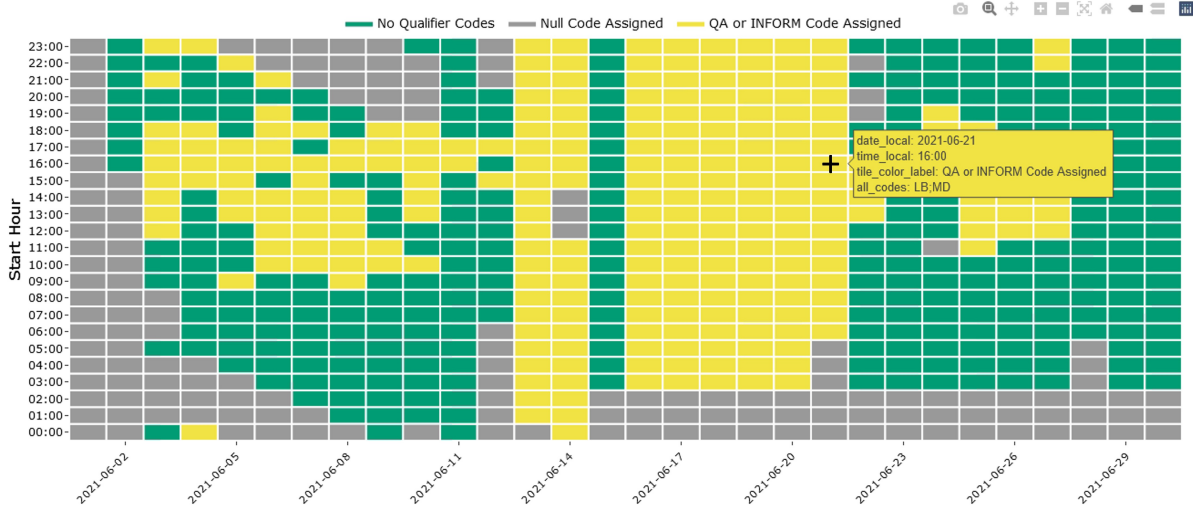


Figure 24: An example tile plot with the tooltip window showing additional information when a user hovers over a tile with the mouse.

The two stacked bar plots in Figure 25, one for QA or INFORM code information (left) and the other NULL code (right), show the number of points for each QA, INFORM or NULL code assigned. Note that the transaction data in AQS allows for up to ten qualifier codes for each data point, and thus a single data point may be counted multiple times. A pdf version of the bar plots will be downloaded if the user click the “Download barplot” button below either graph. When a user select more than 30 days at a time, the two bar plots will update to show count by month instead of by day. Figure 26 is an example when a user selects June, July and August of 2021. Note that each month may not include all days within the month depending on the user selections.

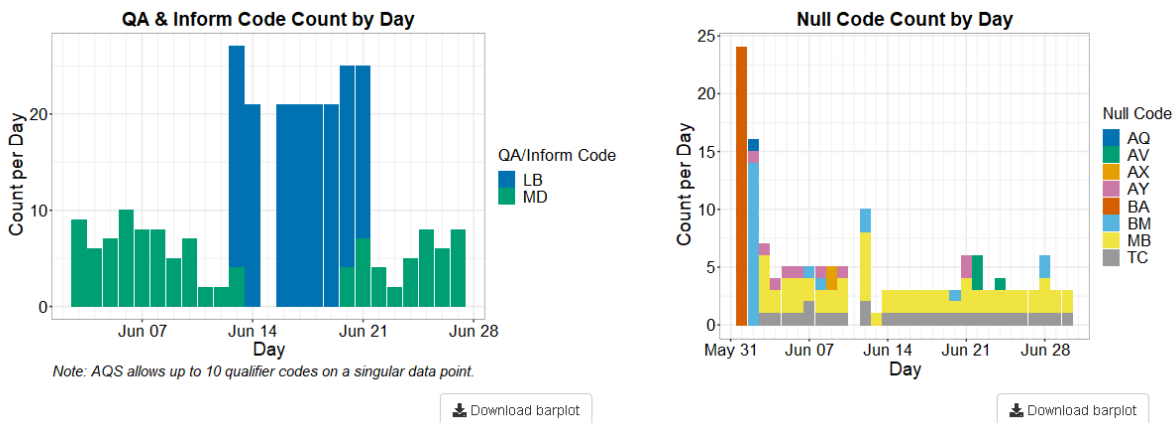
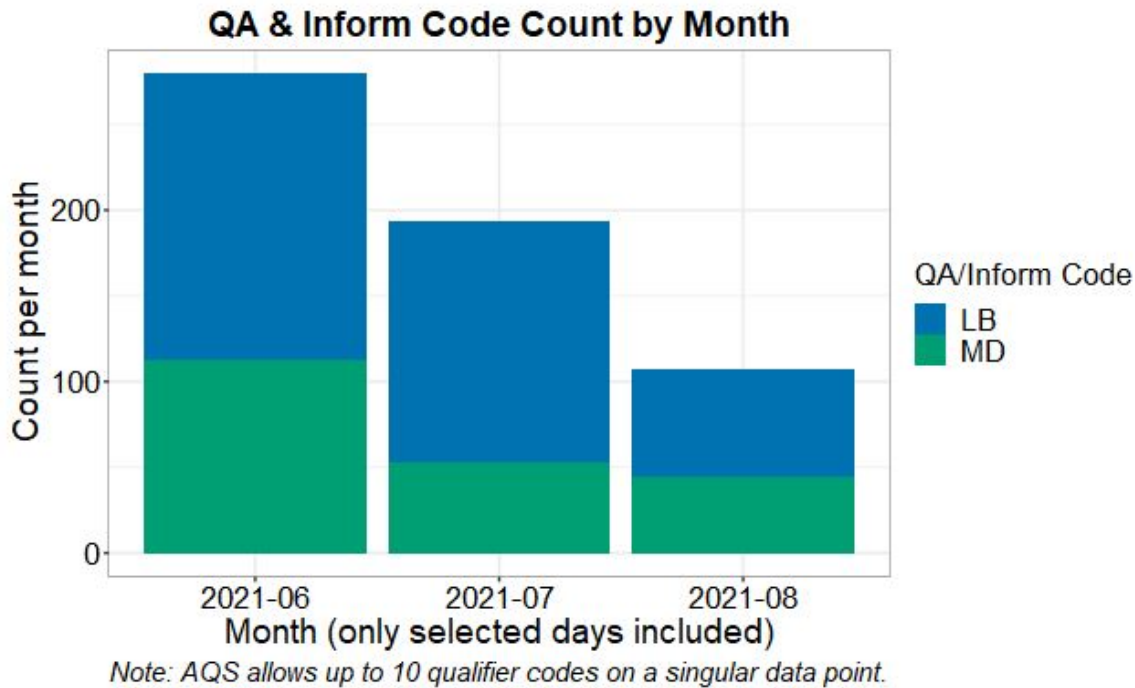


Figure 25: Example stacked bar plots with the left one showing daily counts of OA/INFORM code and the right one showing that of NULL code.



[Download barplot](#)

Figure 26: Example stacked bar plot showing monthly counts of QA/INFORM codes when the user-selected period is longer than 30 days.

The table at the bottom of the tab 27 summarizes the count and percentage for each **Qualifier Category** and for each possible qualifier code during the user-selected period. The ten possible Qualifier Categories include:

- “**No Data Reported**”, no record of this data point exists in the transaction data in AQS;
- “**No Qualifier Codes**”, no qualifier code is associated with this data point;
- “**PAMS Null Code (NULL)**”, a qualifier code of type NULL is assigned to this data point, and this NULL code is listed in the current PAMS TAD;
- “**Other Null Code (NULL)**”, a qualifier code of type NULL is assigned to this data point, and this NULL code is not listed in the current PAMS TAD;
- “**PAMS Qualifier Code (QA)**”, a qualifier code of type QA is assigned to this data point, and this QA code is listed in the current PAMS TAD;
- “**Other Qualifier Code (QA)**”, a qualifier code of type QA is assigned to this data point, and this QA code is not listed in the current PAMS TAD;
- “**PAMS Inform Code (INFORM)**”, a qualifier code of type INFORM is assigned to this data point, and this INFORM code is listed in the current PAMS TAD;
- “**Other Inform Code (INFORM)**”, a qualifier code of type INFORM is assigned to this data point, and this INFORM code is not listed in the current PAMS TAD;
- “**Other Category (REQEXC)**”, a qualifier code of type REQEXC is assigned to this data point;
- “**Other Category (NULL QC)**”, a qualifier code of type NULL QC is assigned to this data point;

Each row in the table is colored by Qualifier Category, and the color scheme matches that shown in the tile plot. Note that the transaction data in AQS allows for up to ten qualifier codes for each data point, and thus the percentage for each row in the table may not add up to 100%. A user may download the contents

of this table by clicking the “Download Table” button on the top left of the table. Available formats include csv, Excel and pdf.

Download Table Search:

Site: 040139997

| Parameter | Parameter Code | POC | Qualifier Category | Qualifier Code | Qualifier Description | Count During Selected Period | % During Selected Period |
|-----------|----------------|-----|--------------------------|----------------|--|------------------------------|--------------------------|
| Propane | 43204 | 40 | No Qualifier Codes | | No Qualifier Codes Assigned | 303 | 42.1 |
| Propane | 43204 | 40 | Other Null Code (NULL) | BM | Accuracy check. | 21 | 2.9 |
| Propane | 43204 | 40 | Other Null Code (NULL) | MB | Method Blank (Analytical). | 64 | 8.9 |
| Propane | 43204 | 40 | PAMS Null Code (NULL) | AQ | Collection Error. | 1 | 0.1 |
| Propane | 43204 | 40 | PAMS Null Code (NULL) | AV | Power Failure. | 4 | 0.6 |
| Propane | 43204 | 40 | PAMS Null Code (NULL) | AX | Precision Check. | 2 | 0.3 |
| Propane | 43204 | 40 | PAMS Null Code (NULL) | AY | Q C Control Points (zero/span). | 9 | 1.2 |
| Propane | 43204 | 40 | PAMS Null Code (NULL) | BA | Maintenance/Routine Repairs. | 24 | 3.3 |
| Propane | 43204 | 40 | PAMS Null Code (NULL) | TC | Component Check & Retention Time Standard. | 28 | 3.9 |
| Propane | 43204 | 40 | PAMS Qualifier Code (QA) | LB | Lab blank value above acceptable limit. | 167 | 23.2 |
| Propane | 43204 | 40 | PAMS Qualifier Code (QA) | MD | Value less than MDL. | 112 | 15.6 |

Showing 1 to 11 of 11 entries Previous **1** Next

Figure 27: Summary table in the Qualifier Code tab with example statistics.