Using Weather and Environmental Data in ESSENCE

Syndromic Surveillance

Syndromic surveillance is the near real-time monitoring of key health indicators in emergency department (ED) and urgent care visits. Oregon ESSENCE tracks the number of visits for specific patient symptoms using chief complaints (what the patient says is the reason for their visit) and discharge diagnosis codes. Visit information is collected from EDs and urgent care centers across the state. Currently, all 60 eligible hospitals are sending ED data every day for syndromic surveillance. Some urgent care centers are also currently reporting.

ESSENCE has the ability to categorize visits and produce visualizations of recent visit trends. By incorporating environmental data feeds into a syndromic surveillance system, users can quickly assess the correlation between weather factors or air quality measures and health outcomes of interest in a specific geographic area.

This document is designed to help Oregon ESSENCE users create and interpret time series graphs that overlay health and weather or air quality data from a specific geographic area.

A visualization may be what is needed for situational awareness; however, additional analysis is also possible using ESSENCE data. Users can and should consider relevant information about environmental variables not contained within the system, such as a pollen counts, water quality metrics, or drought conditions, when interpreting health outcome trends. Also, more complex analysis may be undertaken, such as pairing ESSENCE visit counts with environmental data to quantify exposure response functions. **Per the Oregon ESSENCE confidentially policy, reporting, presenting, or publishing ESSENCE data requires a formal project proposal. For more details, please contact the Oregon ESSENCE program.**

Additional guidance on climate-sensitive syndromic surveillance is forthcoming from the Council of State and Territorial Epidemiologists, and guidance on climate-related exposure response functions are available from the Centers for Disease Control and Prevention Climate and Health Program.

For questions, please contact ESSENCE staff at Oregon.Essence@odhsoha.oregon.gov or by phone 971-673-1111, ext. 5.

Weather and Environmental Data

Weather observations from the National Weather Service and air quality observations from AirNow are incorporated into Oregon ESSENCE. Weather and air quality monitors are not always placed in ideal locations for public health surveillance purposes. **In general, users are encouraged to select a monitor that is closest to their population of concern. Values from multiple monitors should not usually be aggregated in ESSENCE. Just like with health data, we are looking for sudden or sustained increases (or decreases) in these weather and environmental parameters.**

Table 1. Weather Factor Summary.

	Category	Factor	Definition (Over the Selected Time Period)	Measure
Weather Factors	Temperature	Maximum	The highest temperature recorded	Degrees Fahrenheit
		Minimum	The lowest temperature recorded	
	Precipitation	Water Equivalent*	Amount of liquid precipitation (includes snowfall conversion)	Inches
		Snowfall	Amount of snow before being converted to water equivalent	
	Wind	Average	Wind speed averaged	Miles per Hour
		Maximum Two Minute	Maximum wind speed sustained for two minutes	
		Peak	Maximum wind speed reached	

* 1ft snow ≈ 1in water (temperature dependent)

Table 2. Air Quality Parameter Summary

	Pollutant	Definition	Contributing Actions and Examples	Measure	Time
Air Quality Parameters	$PM_{2.5}$	Inhalable particles 2.5 microns or less in diameter	Combustion particles, organic compounds, debris from wildfire smoke, metal dust	micrograms per cubic meter ($\mu g/m^3$)	24 hour
	PM_{10}	Inhalable particles 10 microns or less in diameter	Dust (from roads, riverbeds, construction, agriculture, breaks), pollen, mold, and mining debris	micrograms per cubic meter ($\mu g/m^3$)	24 hour
	Ozone	O_3 gas (oxygen molecule with three atoms)	Formed by chemical reactions between nitrogen and organic compounds on hot days and in the presence of sunlight, major sources are electric utilities, gasoline vapors, and chemical solvents	parts per billion by volume (PPB)	1 hour or 8 hour

Air Quality Parameters

The Clean Air Act (1990) of gave the Environmental Protection Agency (EPA) the authority to establish National Ambient Air Quality Standards (NAAQS). States are required to adhere to these standards by monitoring six criteria pollutants: particle pollution (or particulate matter), ground level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. Among those currently available in Oregon ESSENCE, we are often most concerned with $PM_{2.5}$. In the summer, $PM_{2.5}$ is common during wildfire smoke events. In the winter, air inversions can trap particulate matter from wood burning stoves and other sources of pollution. Ozone can be a problem in urban areas such as Portland, particularly when it is sunny and hot. Ambient particulate matter, ozone, carbon monoxide, and sulfur oxide values are available to explore within ESSENCE.

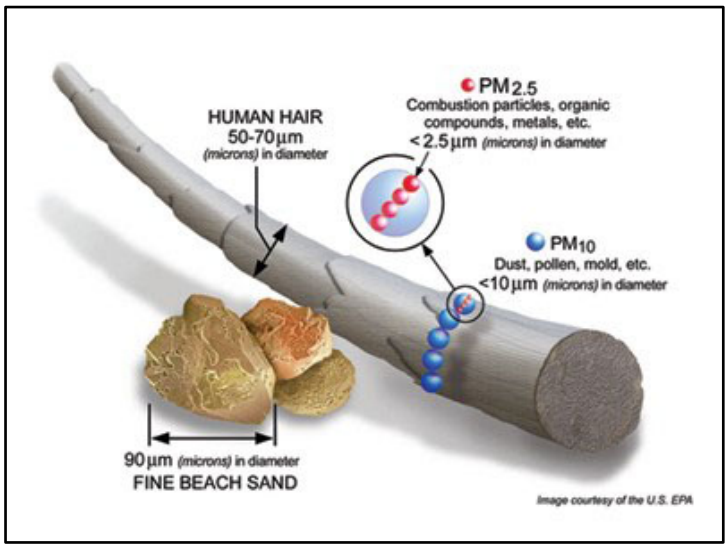


Figure 1. Particle Pollution (PM) size comparison. From the U.S. EPA.

ESSENCE contains air quality observations. These are different than Air Quality Index (AQI) values.

Air Quality Monitor Values Compared to Air Quality Index (AQI)

ESSENCE contains air quality observations from monitors around the state. These measurements are used for regulatory purposes and are verified with quality assurance procedures. See table 2 for more information on the unit of measures, monitoring time period, and pollutant source. **The air quality data in ESSENCE are not the same as Air Quality Index (AQI) values.** When communicating with the public, AQI is often reported. This index quickly categorizes monitored values for the criteria air pollutants into an easily interpretable color-coded message. Agencies use different calculations to determine air quality over the past 24 hours, which is why it's possible to see some variation in the AQI when visiting different sites. None of these calculations are more right or wrong than the other. They are just different. It's important to remember that the AQI is just a tool.

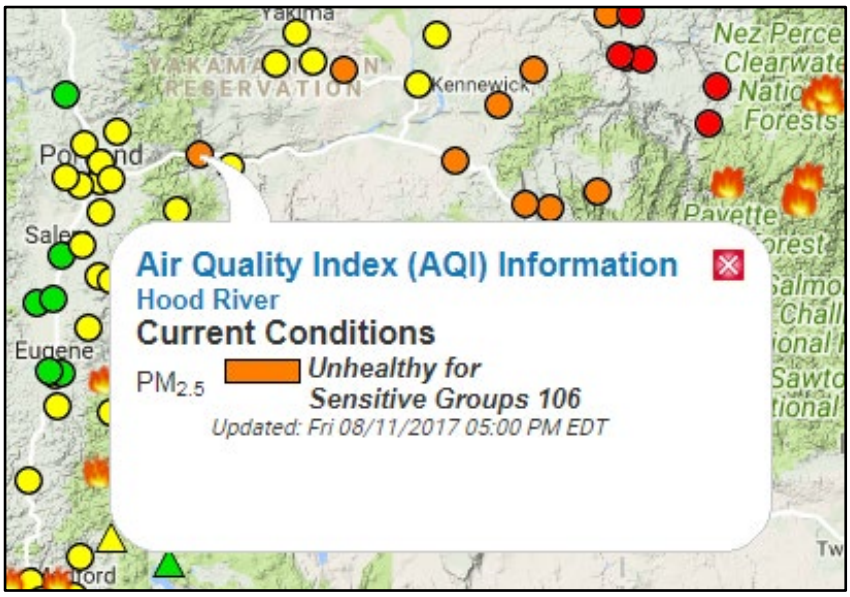


Figure 2. Example of AQI map. An AQI of 106 is approximately equal to an observed 24-hour PM 2.5 concentration of 37.5 µg/m3. These values (both observed and AQI) fall into the "Unhealthy for Sensitive Groups" category. From oregonsmoke.blogspot.com.

Table 3 below shows the categories for PM 2.5 and Ozone. AirNow also has an AQI calculator that may be helpful. For more information on AQI calculations and health messaging, see this EPA documentation.

Category	AQI	PM 2.5 (µg/m3) 24 hour	PM 10 (µg/m3) 24 hour	Ozone (PPB) 8 hour
Good	0-50	0.0-9.0	0-54	0-54
Moderate	51-100	9.1-35.4	55-154	55-70
Unhealthy for Sensitive Groups	101-150	35.5-55.4	155-254	71-85
Unhealthy	151-200	55.5-125.4	255-354	86-105
Very unhealthy	201-300	125.5-225.4	355-424	106-200
Hazardous	301-500	225.5+	425-604	Not calculated

Table 3. AQI Category and Value Compared to Monitored Values.

Health Data

A variety of health outcomes are sensitive to weather and environmental conditions.

- Extreme heat makes many groups, including people with chronic disease, young children, older adults, and outdoor workers, vulnerable to heat-related illness (HRI). HRI is a variety of conditions resulting from elevated body temperatures such as heat stroke, heat syncope (fainting), heat exhaustion, and heat cramps.

- High temperatures are also correlated with respiratory disease exacerbations, cardiovascular events, injury, and violence.

- Wildfire smoke, air pollution, and pollen can exacerbate cardiovascular and respiratory conditions, such as asthma.

- Extreme cold and winter weather makes many groups, including outdoor workers and persons experiencing homelessness, vulnerable to hypothermia.

- Winter precipitation may create slippery surfaces, leading to slips, trips, or falls.

- Winter weather and windstorms can cause the power to go out. Sometimes BBQ grills or generators are used near or inside the home during outages, leading to carbon monoxide poisoning.

- Prolonged power outages or flooding can lead to increases in stomach illness as food goes unrefrigerated or water sources change.

- Visits by vulnerable age groups, such as children ages 0-4 or adults 65 and older, can also be monitored as the percentages of total visits.

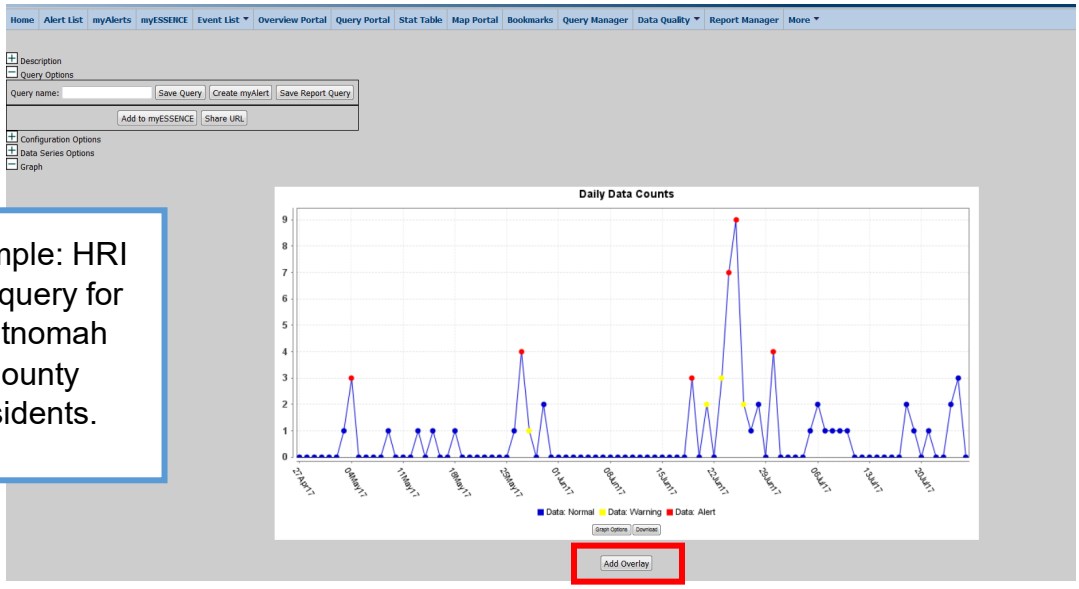
For more on seasonal hazards, subscribe to the ESSENCE Hazard Reports.

ESSENCE Time Series Overlays

Several different types of overlays can be added to a time series graph in ESSENCE. For example, users can overlay visits for specific types of conditions or from different geographic areas. Data sources can be visualized together, including a health outcome and either a weather or air quality measure.

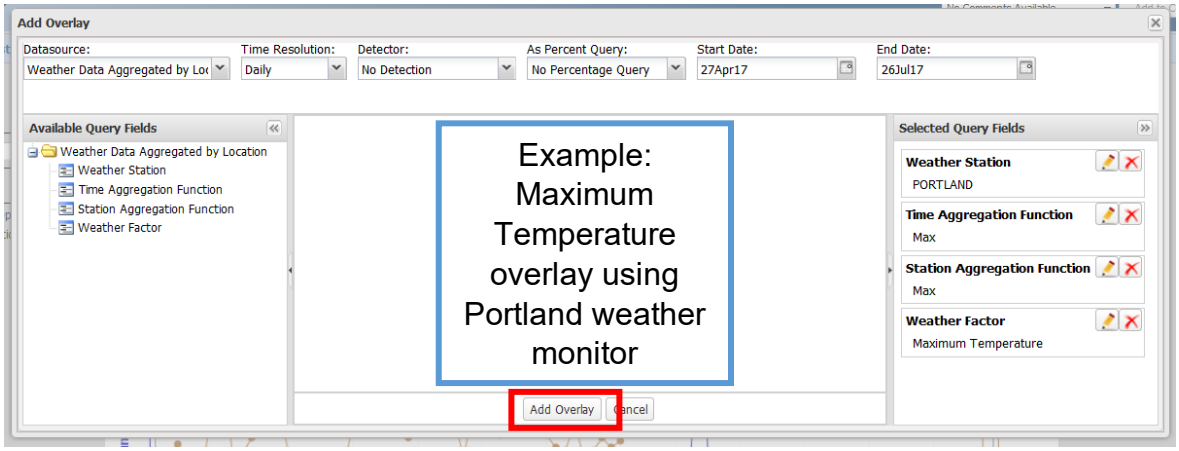
Step by Step: **Weather**

1. Make a **Time Series Graph** for the health outcome of interest in the Query Portal. Note: Guidance on how to make a basic query and the full ESSENCE user guide are available at healthoregon.org/essence.



Example: HRI visit query for Multnomah County residents.

2. Select the **Add Overlay** button below the chart. This will prompt a query wizard to appear.



Example: Maximum Temperature overlay using Portland weather monitor

3. Select **Datasource = Weather Data Aggregated by Location.**

4. Select **Detector = No Detector.**
   - It is recommended that “No Detector” is chosen because none of the available detectors in ESSENCE can display reliable alert information for weather.

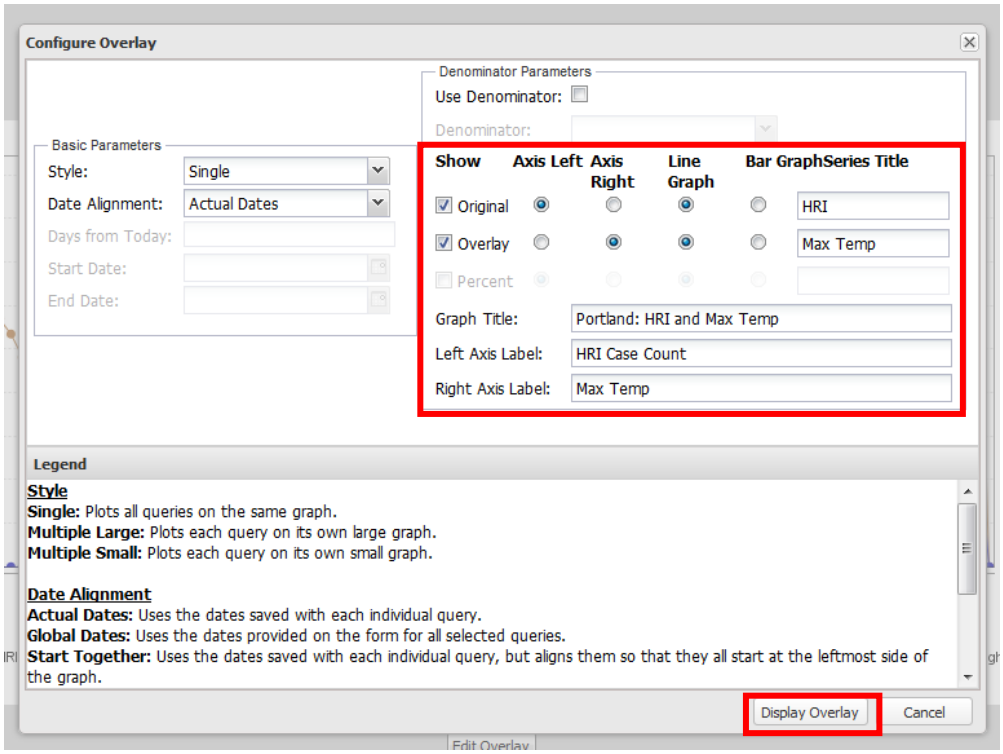
5. Select **Dates**.

- Select the appropriate start and end dates
- If no dates are selected, ESSENCE defaults to the previous 90 days
- It is recommended to match the overlay timeframe with the timeframe used on the initial query.

6. Select **Weather Factor** (See Table 1).

7. Select appropriate **Weather Monitor.**
   - In general, users are encouraged to select a monitor that is closest to their population of concern.
   - Values from multiple monitors should not usually be aggregated in ESSENCE.

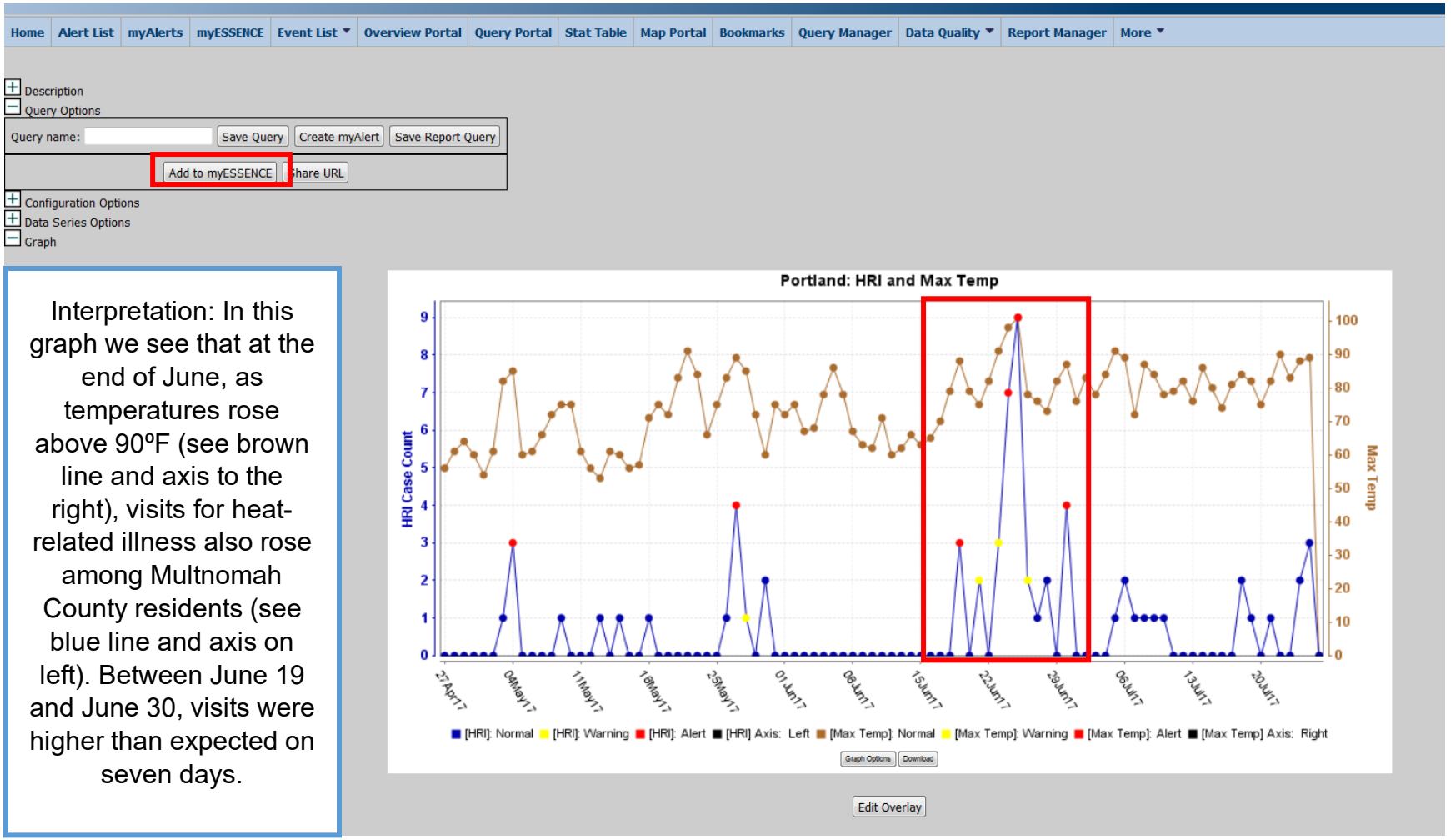
8. Select **Add Overlay.**



9. **Configure Overlay** display.

   - Select **Denominator Parameters**
     - Select the axis display for both the original and overlay.
       - Selecting the same axis will make the y-axis measurement the same for both the original query and the overlay graph. This is not recommended for a weather overlay.
     - Choose a bar graph for one or both axes, if desired.
     - Add labels for time series graph.
   - Select **Date Alignment.** Consult legend to help determine which options are best for an induvial query

10. Click **Display Overlay.**

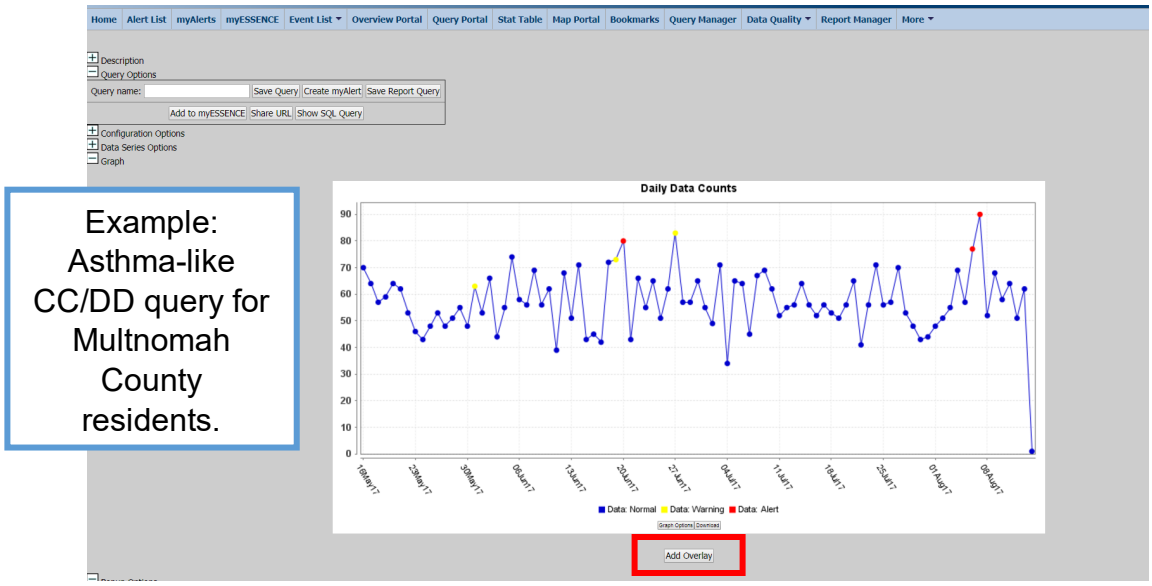


Interpretation: In this graph we see that at the end of June, as temperatures rose above 90ºF (see brown line and axis to the right), visits for heat-related illness also rose among Multnomah County residents (see blue line and axis on left). Between June 19 and June 30, visits were higher than expected on seven days.

11. **Save Visualization**. Images can be saved as PNG files by right clicking on the graph. Or you can save the graph to myESSENCE.

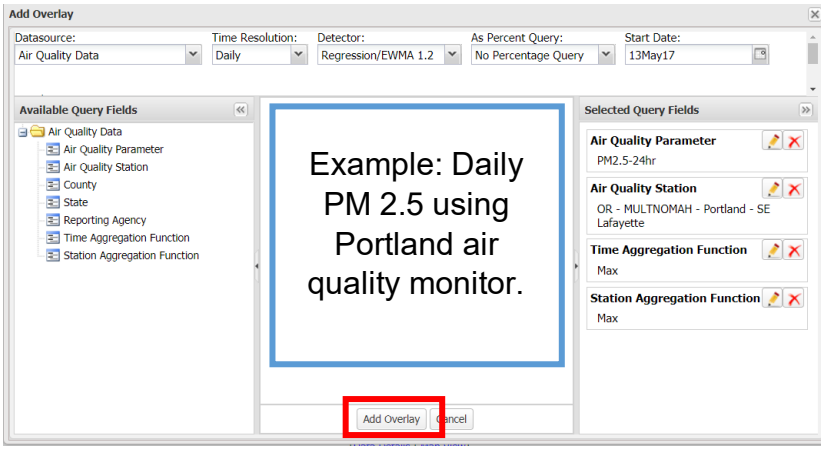
Step by Step: **Air Quality**

1. Make a **Time Series Graph** for the health outcome of interest in the Query Portal. Note: Guidance on how to make a basic query and the full ESSENCE user guide are available at healthoregon.org/essence.



Example: Asthma-like CC/DD query for Multnomah County residents.

2. Select the **Add Overlay** button below the chart. This will prompt a query wizard to appear.



Example: Daily PM 2.5 using Portland air quality monitor.

3. Select **Datasource = Air Quality Data**.

4. **Select Detector = No Detector.**
   - It is recommended that "No Detector" is chosen because none of the available detectors in ESSENCE can display reliable alert information for air quality.

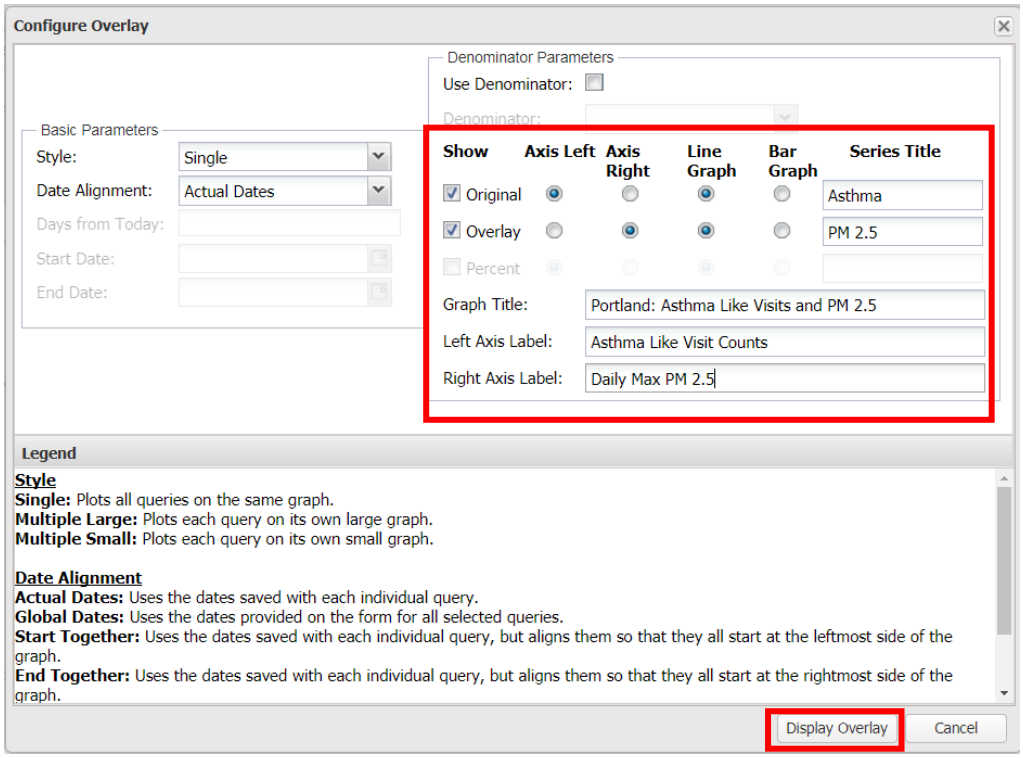
5. Select **Dates**.

- Select the appropriate start and end dates
- If no dates are selected, ESSENCE defaults to the previous 90 days
- It is recommended to match the overlay timeframe with the timeframe used on the initial query.

6. Select **Air Quality Parameter** (See Table 2).

7. Select appropriate **Air Quality Monitor.**
   - In general, users are encouraged to select a monitor that is closest to their population of concern.
   - Values from multiple monitors should not usually be aggregated in ESSENCE.

8. Select **Add Overlay.**



9. **Configure Overlay** display.
   - Select **Denominator Parameters**
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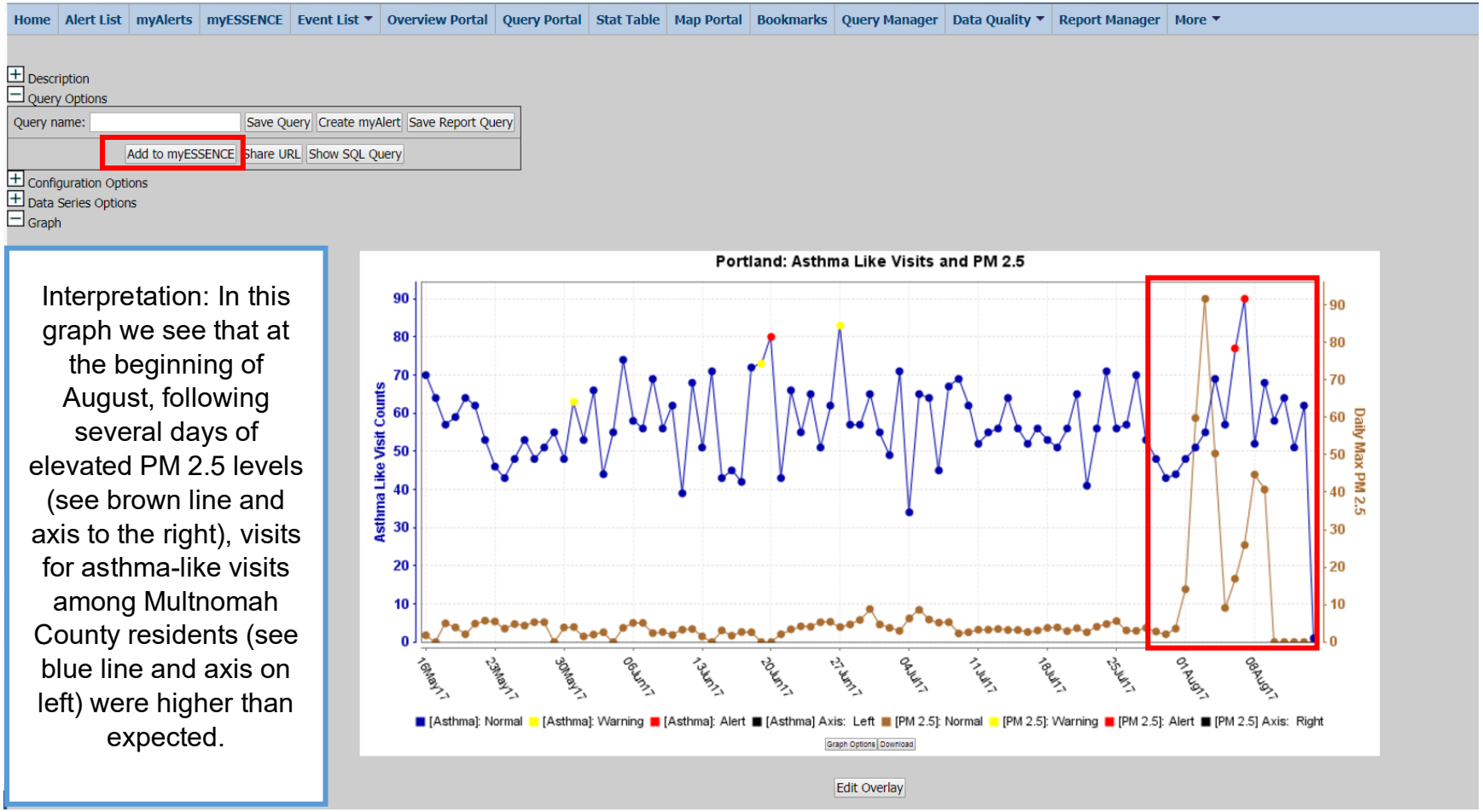
10. Click **Display Overlay.**

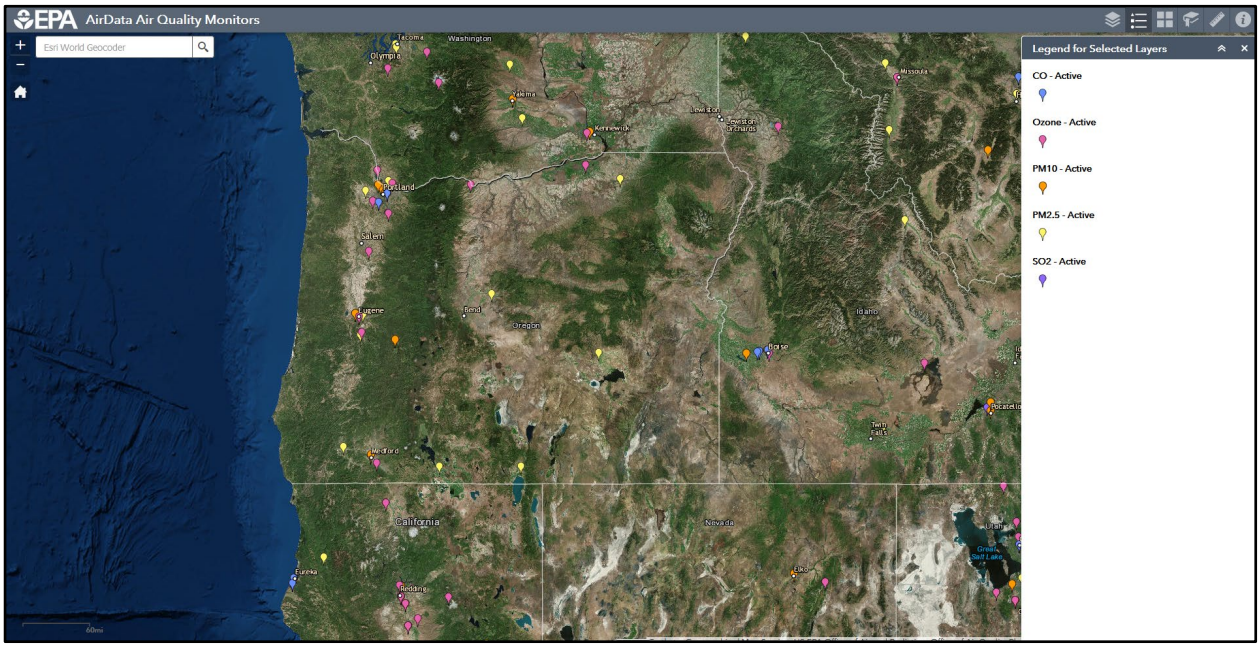


11. **Save Visualization.** Images can be saved as PNG files by right clicking on the graph. Or you can save the graph to myESSENCE.

Additional References

Weather Monitors can be located on the National Centers for Environmental Information data portal.

Air Quality Monitors can be located on the Environmental Protection Agency mapping portal.



The Oregon Climate and Health Program is working with partners to study, prevent, and plan for the health effects of climate change.

The Centers for Disease Control and Prevention Climate and Health Program has guidance on a variety of topics, including climate-related exposure response functions.

The Council of State and Territorial Epidemiologists Climate Change Workgroup has produced guidance documents on climate-sensitive syndromic surveillance, including a Heat-related Illness Syndrome Query Definition.

ESSENCE Technical Assistance

Oregon ESSENCE staff can be contacted via email (Oregon.Essence@odhsoha.oregon.gov) or phone (971-673-1111, ext. 5). More information on Oregon ESSENCE can be found here.

Revision History

Revision History Ver/Rel #	Issue Date	Summary of Changes
V1.0	August 2017	First version based upon ESSENCE version 1.20
V2.0	February 2025	Second version includes new (2024) standards for PM2.5 AQI values. Updated contact information for Oregon ESSENCE.