How to Download Purple Air Data and Interpret Data

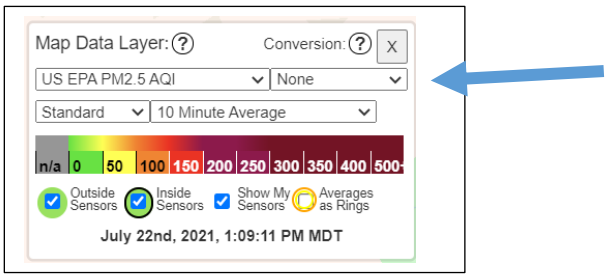
1. Go to the Purple Air website: https://www2.purpleair.com/

Click on View the Map to get to the Purple Air Map. Or you can click on the link below as well.

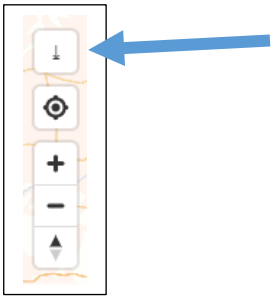
Map: https://www.purpleair.com/map?opt=1/mAQI/a10/cC0#4.58/34.72/-111.09

2. Select a sensor location and click on it.

3. Go to Map Data Layer. The Map Data Layer can be found on the lower left hand side of the map where you will see the color-coded US EPA PM2.5 Air Quality Index as default. Under conversion, be sure to NONE is selected for the conversion factor/correction equation (None should be the default).



4. Next, navigate to the right hand side of the screen and click on the download icon which will take you to the **Sensor Data Download Tool** website.



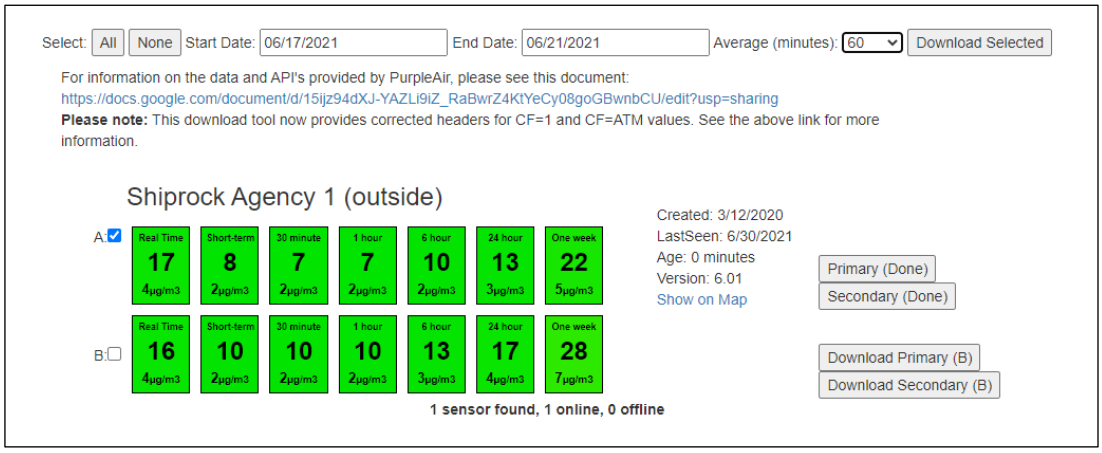
The Sensor Data Download tool will allow you to download data from the sensor's Channel A and Channel B measurements. It will also allow you to view Primary data and Secondary data.

Primary Data is where you will find PM (PM_1, $PM_{2.5}$, PM_{10}) sample values as well as Temperature and Relative Humidity sample values. PM2.5 data is reported as either CF_1 or ATM. If a conversion factor is selected in the Map Data Layer, then a specific correction equation is applied to the ATM sample values to report out atmospheric or outdoor mass measurements in units of micrograms per cubic meter ($\mu g/m^3$) of air. On the other hand, the CF_1 mass measurement ($\mu g/m^3$) values use the outdoor measurements to estimate indoor measurements, which are slightly more elevated than ATM values. EPA suggests using the CF_1 values with no conversion factor selected in the Map Data Layer, instead of the ATM values, to correct outdoor mass concentrations as they provide higher concentrations that are more strongly correlated with FRM/FEM monitors.

Secondary Data is where you will find particle counts in units of microns (micrometer) per deciliter of air as well as outdoor measurements for PM_1 and PM_{10} in units of $\mu g/m^3$.

The UptimeMinutes column tells you how long the sensor has been in operation and the RSSI_dbm corresponds to "Received Signal Strength Indicator." RSSI is a measurement of how well your device can hear a signal from an access point or router. It's a value that is useful for determining if you have enough signal to get a good wireless connection. Since RSSI varies greatly a more standardized, absolute measure of signal strength is measured in decibels, or dBm on a logarithmic scale. There's a lot of math we could get into, but basically, the closer to 0 dBm, the better the signal is.

5. To begin downloading data from the Sensor Data Download Tool, first select your Start and End date. Then you want to select your averaging intervals, the options are 10 minute, 15 minute, 30 minute, 60 minute, up to 1440 minutes which is a 24-hour average. **Select 60 minutes in order to use the time stamp correction spreadsheet we discuss in the next few steps.**

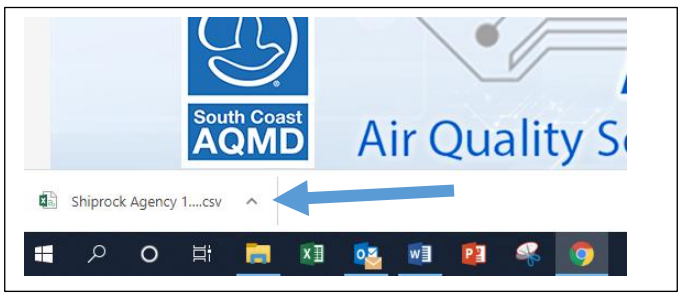


6. In the example above, the date range begins 6/17/21 and ends 6/21/21. The average interval is 60 minutes, which is basically 1-hour averages.

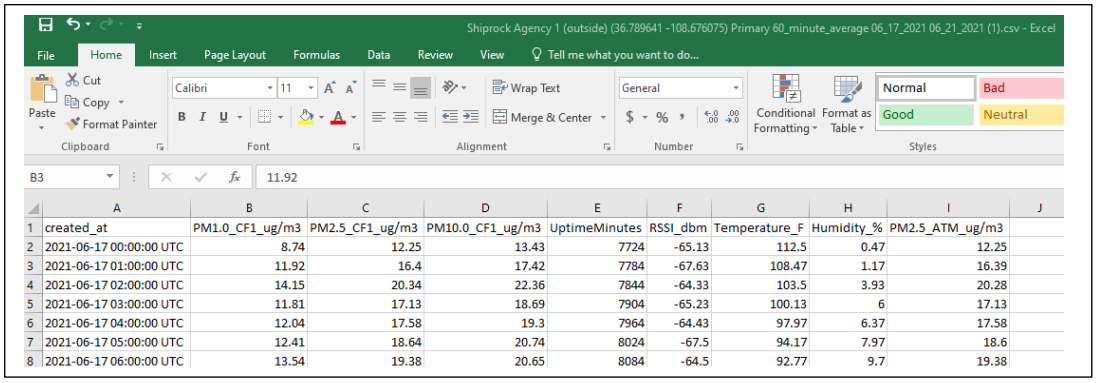
7. Next, you want to select which channel to report data into a .CSV download file. **Select Download Primary (A) in order to use the time stamp correction spreadsheet we discuss in the next few steps.**

Note that you can also download Secondary data from either Channel A or B, but we focus on Primary data from Channel A for use in the spreadsheet discussed in the next few steps. Or you can select All which will give you data from both Channel A and B to include both Primary and Secondary data. As you can see in the picture above, for this example, Channel A is selected to report both Primary and Secondary data.

8. A *.CSV file containing the data will be generated in the lower left hand side of the web browser and you should be able to click on the file and open it.



9. Click on the up arrow on the file and open the file to view the data. Data should look like this.

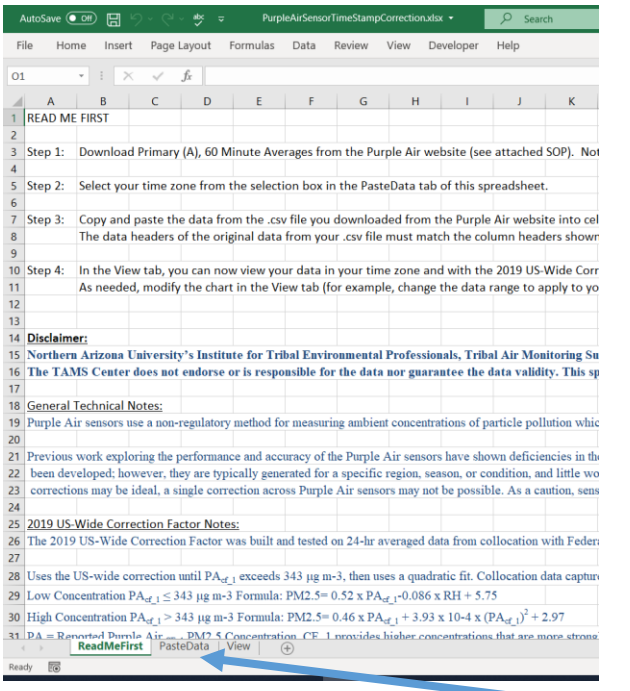


Shiprock Agency 1 (outside) (36.789641 -108.676075) Primary 60_minute_average 06_17_2021 06_21_2021 (1).csv - Excel

B3: 11.92

	A	B	C	D	E	F	G	H	I
1	created_at	PM1.0_CF1_ug/m3	PM2.5_CF1_ug/m3	PM10.0_CF1_ug/m3	UptimeMinutes	RSSI_dbm	Temperature_F	Humidity_%	PM2.5_ATM_ug/m3
2	2021-06-17 00:00:00 UTC	8.74	12.25	13.43	7724	-65.13	112.5	0.47	12.25
3	2021-06-17 01:00:00 UTC	11.92	16.4	17.42	7784	-67.63	108.47	1.17	16.39
4	2021-06-17 02:00:00 UTC	14.15	20.34	22.36	7844	-64.33	103.5	3.93	20.28
5	2021-06-17 03:00:00 UTC	11.81	17.13	18.69	7904	-65.23	100.13	6	17.13
6	2021-06-17 04:00:00 UTC	12.04	17.58	19.3	7964	-64.43	97.97	6.37	17.58
7	2021-06-17 05:00:00 UTC	12.41	18.64	20.74	8024	-67.5	94.17	7.97	18.6
8	2021-06-17 06:00:00 UTC	13.54	19.38	20.65	8084	-64.5	92.77	9.7	19.38

10. As you can see, the time stamp is in Coordinated Universal Time or UTC time. UTC time is the world time standard that regulates clocks and time. It is commonly used by the scientific community in many technical fields. For example, meteorologists, the aviation industry use this time, and it is used to synchronize time across internet networks. The Purple Air Sensor Time Stamp Correction spreadsheet converts the time stamp to the time in your area using formulas in Microsoft Excel. Begin by opening the spreadsheet and reading the ReadMeFirst tab. The Steps shown in the ReadMeFirst tab are a quick summary of this document.

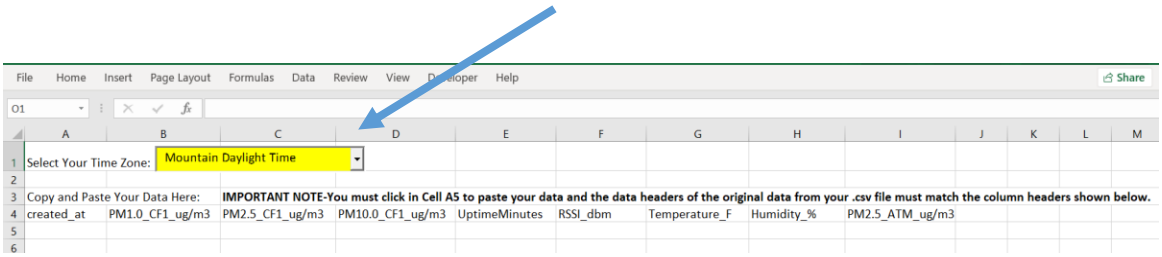


PurpleAirSensorTimeStampCorrection.xlsx

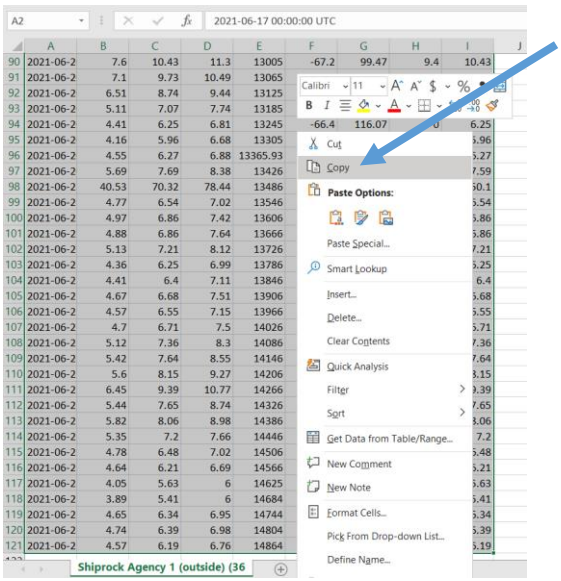
	A
1	READ ME FIRST
3	Step 1: Download Primary (A), 60 Minute Averages from the Purple Air website (see attached SOP). Not
5	Step 2: Select your time zone from the selection box in the PasteData tab of this spreadsheet.
7	Step 3: Copy and paste the data from the .csv file you downloaded from the Purple Air website into cel
8	The data headers of the original data from your .csv file must match the column headers shown
10	Step 4: In the View tab, you can now view your data in your time zone and with the 2019 US-Wide Corr
11	As needed, modify the chart in the View tab (for example, change the data range to apply to yo
14	**Disclaimer:**
15	**Northern Arizona University's Institute for Tribal Environmental Professionals, Tribal Air Monitoring Su**
16	**The TAMS Center does not endorse or is responsible for the data nor guarantee the data validity. This sp**
18	General Technical Notes:
19	Purple Air sensors use a non-regulatory method for measuring ambient concentrations of particle pollution whic
21	Previous work exploring the performance and accuracy of the Purple Air sensors have shown deficiencies in th
22	been developed; however, they are typically generated for a specific region, season, or condition, and little wo
23	corrections may be ideal, a single correction across Purple Air sensors may not be possible. As a caution, sens
25	2019 US-Wide Correction Factor Notes:
26	The 2019 US-Wide Correction Factor was built and tested on 24-hr averaged data from collocation with Feder
28	Uses the US-wide correction until PA_{cf_1} exceeds 343 µg m-3, then uses a quadratic fit. Collocation data captur
29	Low Concentration $PA_{cf_1} \leq 343$ µg m-3 Formula: $PM2.5 = 0.52 \times PA_{cf_1} - 0.086 \times RH + 5.75$
30	High Concentration $PA_{cf_1} > 343$ µg m-3 Formula: $PM2.5 = 0.46 \times PA_{cf_1} + 3.93 \times 10\text{-}4 \times (PA_{cf_1})^2 + 2.97$
31	PA = Reported Purple Air ... PM2.5 Concentration. CF_1 provides higher concentrations that are more strong

ReadMeFirst | PasteData | View

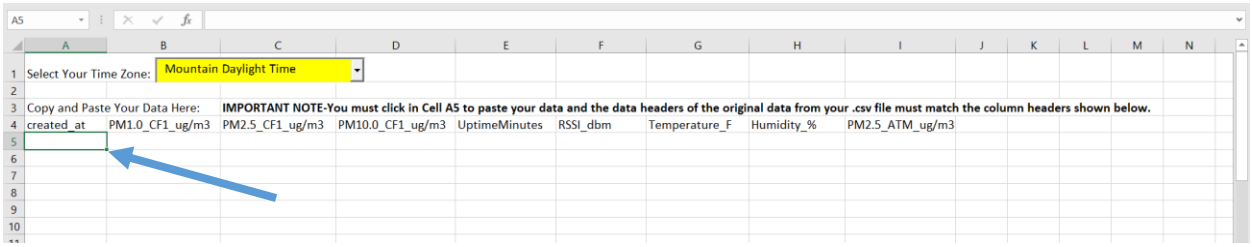
11. After reading the ReadMeFirst tab, click on the PasteData tab. Select the time zone for your area from the selection box at the top of the sheet.



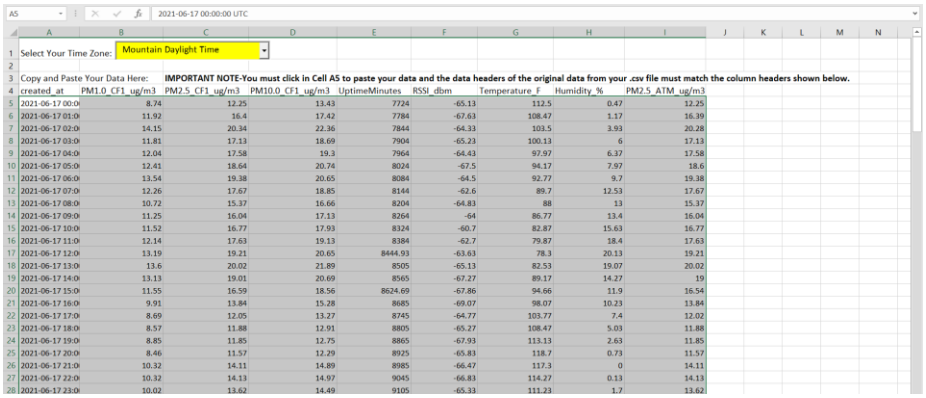
12. Open the .CSV file you downloaded from the Purple Air site. You want to copy the data from this .CSV file into the Purple Air Sensor Time Stamp Correction spreadsheet. Copy only the data and not the data headers. One way to do this is to click on the first cell with data in the .CSV file, Cell A2. Then click on Ctrl+Shift+End on your keyboard. That highlights all of the data without the headers. Then, either press Ctrl+C on your keyboard or right-click on your mouse anywhere within the highlighted data and select Copy.



13. Back in the Purple Air Sensor Time Stamp Correction spreadsheet, click on Cell A5 of the PasteData worksheet. This is the first cell underneath the created_at column header.



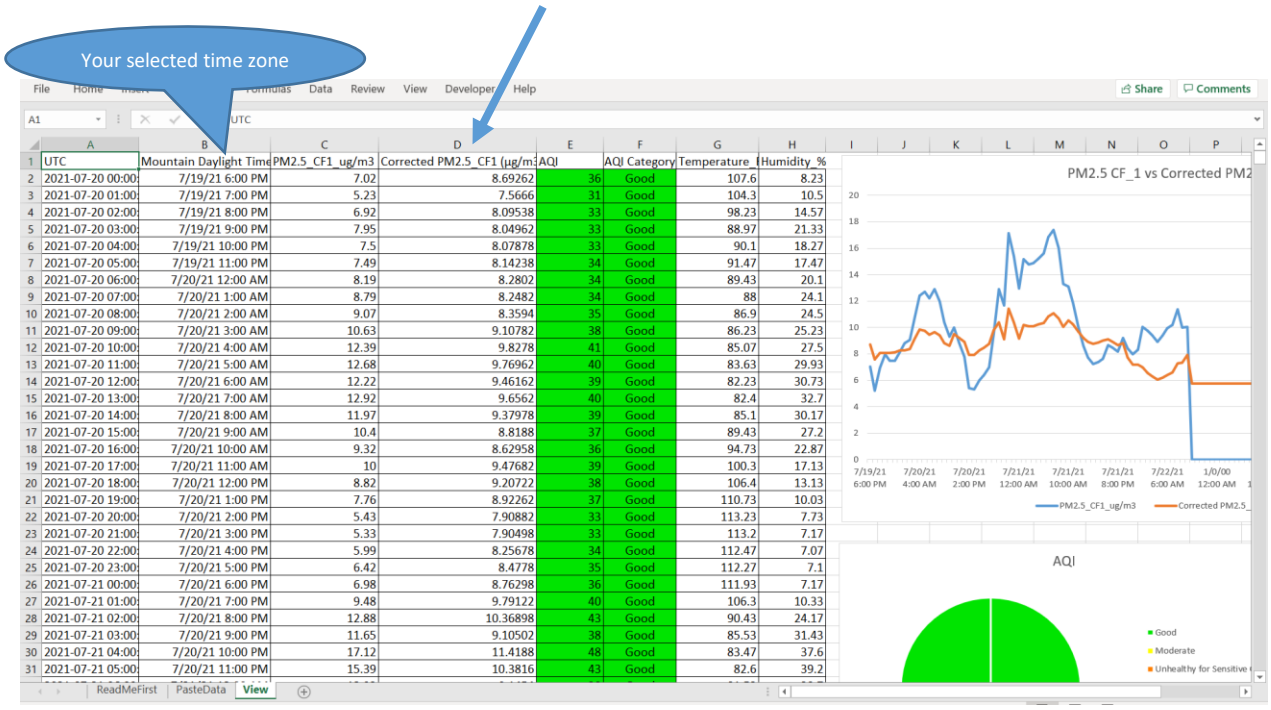
Then, paste the data by either pressing Ctr+V on your keyboard or right-clicking on your mouse and selecting Paste. Your screen should now look similar to this.



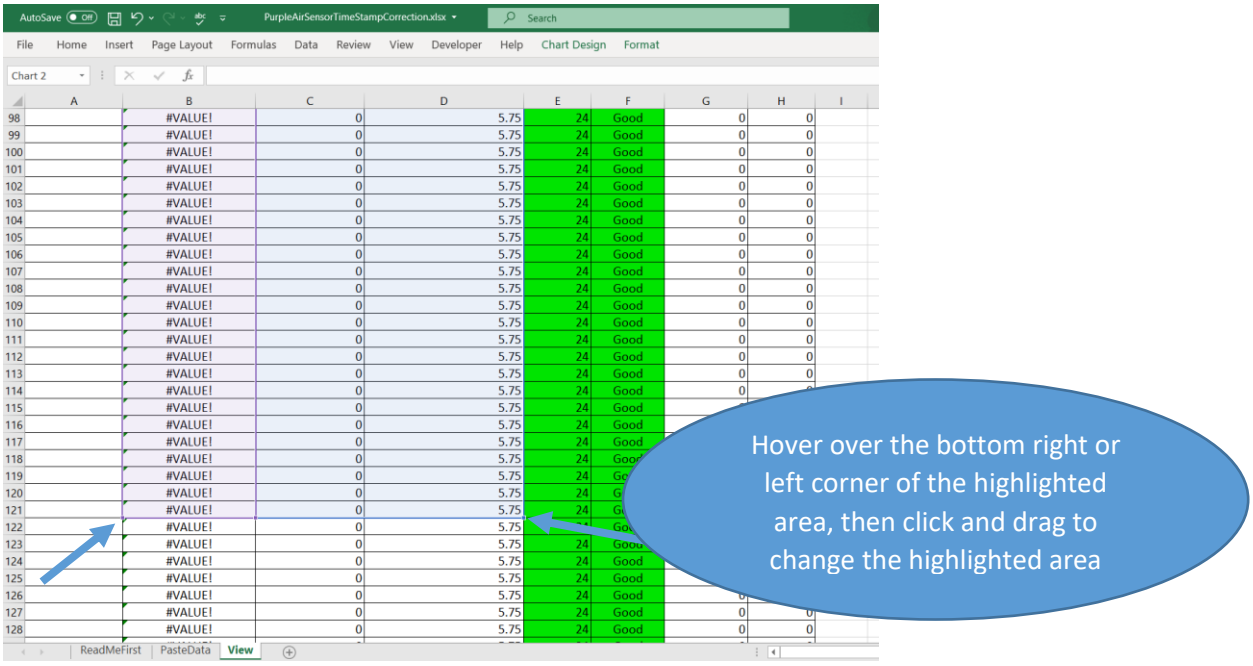
14. Click on the View tab. The data are now shown with the correction applied for the time zone you selected in the PasteData sheet. You can see your time zone in Column B. In this example, the user selected a time zone of Mountain Daylight Time (MDT) in the PasteData sheet. UTC is 6 hours ahead of MDT. The spreadsheet converts the timestamp in UTC to MDT by subtracting 6 hours using a formula.

Purple Air sensors use a non-regulatory method for measuring ambient concentrations of particle pollution which do not meet the designation as Federal Reference Methods (FRMs) or Federal Equivalent Methods (FEMs) in accordance with Title 40, Part 53 of the Code of Federal Regulations (40 CFR Part 53). The spreadsheet applies the 2019 US Wide Correction Factor that makes the sensor PM2.5 data more comparable to PM2.5 data collected using FRMs or FEMs, **however, even with this correction factor applied, sensor data can never be used for regulatory purposes**. You can learn more about the 2019 US Wide Correction Factor here: https://www.epa.gov/air-sensor-toolbox/technical-approaches-sensor-data-airnow-fire-and-smoke-map.

In the View sheet, the corrected data are shown in the "Corrected PM2.5_CF1 (µg/m3)" column (Column D).

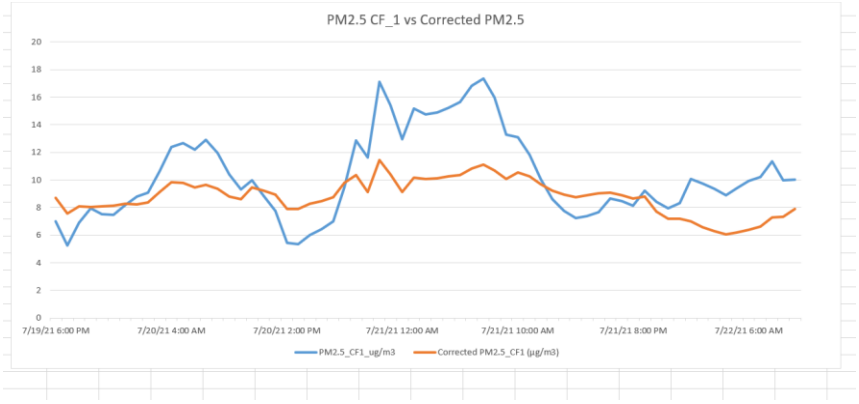


15. There is also a line chart included in the View sheet that plots the corrected versus the uncorrected PM2.5 data. By default, this chart shows the first 5 days of data and the data range likely needs to be adjusted to accommodate your data. In the above example, you can see that there are only a few days of data and after that the chart shows straight lines. To adjust the data range of the chart, click on the line chart. Then, the cells that are included in the chart are highlighted. In this example, you would scroll down in the sheet until you get to the end of the highlighting.



Then, hover over the bottom right corner or the bottom left corner of the highlighted area (there is a little box shown there) and your cursor changes to a double-sided arrow. Click and drag up to where there is actual data to change the highlighted area to include only your data. If you had more data to add to the chart, you would click and drag down to change the highlighted area to where your data ends.

Here is how the chart looks after clicking and dragging to change the highlighted area.



16. You can add more charts to the spreadsheet if you would like to do that.

Notes:

Formulas used to convert UTC to other time zones:

Eastern Daylight Time: =UTC-(4/24)
Central Daylight Time: =UTC-(5/24)
Mountain Daylight Time: =UTC-(6/24)
Pacific Daylight Time: =UTC-(7/24)
Alaska Daylight Time: =UTC-(8/24)

Eastern Standard Time: =UTC-(5/24)
Central Standard Time: =UTC-(6/24)
Mountain Standard Time: =UTC-(7/24)
Pacific Standard Time: =UTC-(8/24)
Alaska Standard Time: =UTC-(9/24)

Formulas subtract N hours (where N/24) from the UTC timestamp to reflect the time zone the sensor is actually located in.

To find what your time zone is in UTC and vice versa, here is a link to a UTC converter: https://savvytime.com/converter/utc-to-pdt

To convert 24 hour time to standard time and vice versa, see link below: https://www.calculatehours.com/Military_Time_Converter.html

Formulas used for the 2019 US Wide Correction Factor:

Formulas use the US-wide correction until PA_{cf_1} exceeds 343 µg m-3, then use a quadratic fit.

Low Concentration $PA_{cf_1} \leq 343$ µg m-3 Formula: $PM2.5 = 0.52 \times PA_{cf_1} - 0.086 \times RH + 5.75$

High Concentration $PA_{cf_1} > 343$ µg m-3 Formula: $PM2.5 = 0.46 \times PA_{cf_1} + 3.93 \times 10\text{-}4 \times (PA_{cf_1})^2 + 2.97$

PA = Reported Purple Air $_{CF_1}$ PM2.5 Concentration. CF_1 provides higher concentrations that are more strongly correlated with FRM/FEM over the full concentration range.

RH = Reported Purple Air relative humidity. Considers relative humidity (RH) influence since monitors measure dry PM2.5 and RH can increase light scattering per mass.

Reference: EPA Tools and Resources Webinar AirNow Fire and Smoke Map: Extension of the US-Wide Correction for Purple PM2.5 Sensors slides, May 19, 2021 (https://www.epa.gov/sites/default/files/2021-05/documents/toolsresourceswebinar_purpleairsmoke_210519b.pdf)