U.S Environmental Protection Agency
Office of Research and Development
**Center for Environmental Measurement and Modeling**
**Air Methods and Characterization Division**
**Source and Fine Scale Branch**

# STANDARD OPERATING PROCEDURE

SOP Title: Standard Operating Procedure for the Purple Air PA-II-SD PM Sensor

| SOP ID: J-AMCD-SFSB-SOP-3561-3 | Effective Date: Jan 8, 2020 |
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## Revision History

| Version No. | Name | Date of Revision | Description of Change(s) |
|---|---|---|---|
| D-EMMD-SSAB-SOP-3561-0 | Manu Srivastava – Jacobs<br>Andrea Clements – EPA WACOR | 01/03/2018 | Original version |
| D-EMMD-SSAB-SOP-3561-1 | Andrea Clements – EPA<br>Cortina Johnson –Jacobs | 02/12/2019 | SOP amended to include:<br>• Links to a SharePoint site for internal EPA audiences to share informational links, lessons learned, data processing code developed by Daniel Garver, etc.<br>• Links to PurpleAir resources pages.<br>• Field and data file observations that may indicate normal or abnormal sensor operation.<br>• Data file formats for firmware version 3.0 (current as of Feb 2019)<br>• Added procedure to convert the date/time to more standard format.<br>• Updated procedure to include connection to WiFi.<br>• Updated document layout to newly approved EPA format. |
| J-AMCD-SFSB-SOP-3561-2 | Karoline Johnson – ORISE hosted by EPA | 07/18/2019 | SOP amended to include:<br>• Instructions to register the sensor online<br>• Updated sampling interval (firmware version 4.02)<br>• Instructions to download data from PurpleAir website<br>• Instructions to download data from the API<br>• Instructions on how to check on online sensors<br>• Updated Figure 2 with correct inlet outlet labels<br>• Resource: purpleair.com/faq |
| J-AMCD-SFSB-SPO-3561-3 | Ian VonWald – ORISE, hosted by EPA<br>Andrea Clements - EPA | 11/27/2020 | SOP amended to include:<br>• Updated instructions to download online sensor data from the PurpleAir website<br>• Added a note that channel/field labels for data (CF=1 and CF=ATM) are switched in data downloaded from the |

| | | | |
|---|---|---|---|
| | | | PurpleAir website<br>• Updated instructions for obtaining Thingspeak API information for automated data downloads<br>• Updated management/QA after ORD re-organization |

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# *Purple Air PA-II-SD Standard Operating Procedure*

## 1 Scope and Applicability

This standard operating procedure (SOP) describes the procedures for operating and recovering data from the PurpleAir (PurpleAir LLC) PA-II-SD particulate matter (PM) sensor. In this SOP, instructions are provided for deployment, startup, wireless connection, operational verification, data download and data import into Microsoft Excel. Data from the PurpleAir sensors can be compared with collocated reference grade monitors to evaluate accuracy, precision, and bias of the sensor measurements relative to the reference concentrations, as well as variability in the response between the sensors. The Purple Air Sensor can be used for a variety of applications including ambient monitoring and research, indoor air quality investigations, atmospheric and climate research, and health studies.

## 2 Background

The PurpleAir sensor will collect data at an ambient air quality monitoring site. The PurpleAir PA-II-SD uses a PMS5003 laser particle counter to report concentrations of $PM_1$, $PM_{2.5}$, and $PM_{10}$ ($\mu g/m^3$) along with particle counts in several size bins (<0.3µm, <0.5µm, <1µm, <2.5µm, <5µm, and <10µm) as well as temperature (T), relative humidity (RH), and pressure (P). PM is detected via laser scattering with an effective range of 0-500 $\mu g/m^3$, a maximum range of 1000 $\mu g/m^3$, with a counting efficiency of 50% at 0.3 µm and 98% for >=0.5 µm. The operable temperature range is between -20 and 60 ◦C, with a RH range of 0-99% and a pressure of 300-1100 hPa. The PurpleAir records data at a 2-minute (as of firmware versions 4.02 or later, updated across devices on 5/31/19) averaging interval on an internal microSD (Secure Digital) card up to 64 GB. Previous firmware recorded data at 80-second intervals so historic data was logged at this rate and any devices that have not been updated to the current firmware version will as well.

## 3 Definitions/Acronyms

| | |
|---|---|
| µm | micrometer |
| °C | degree(s) Celsius |
| AC | Alternating Current |
| CHP | Chemical Hygiene Plan |
| EPA | U.S. Environmental Protection Agency |
| GFCI | Ground Fault Circuit Interrupter |
| Ghz | Gigahertz |
| hPa | Hectopascals |
| P | pressure |
| PPE | Personal protective equipment |
| PM | Particulate Matter |
| $PM_1$ | particulate matter with diameters < 1 µm |
| $PM_{2.5}$ | particulate matter with diameters < 2.5 µm |
| $PM_{10}$ | particulate matter with diameters < 10 µm |
| PVC | Polyvinyl chloride |

| | |
|---|---|
| RH | Relative Humidity |
| SD Card | Secure Digital Card |
| SSID | Service set identifier |
| T | Temperature |
| UL | Underwriters Laboratories |
| USB | Universal Serial Bus |
| UTC | Coordinated Universal time |
| WACOR | work assignment contracting officer's representative |
| WAL | work assignment leader |
| WiFi | Wireless Fidelity |

# 4 Health and Safety

Standard laboratory PPE should be worn at all times during the operation of the PurpleAir sensors in the lab, in accordance with the U.S. Environmental Protection Agency (EPA) CHP. During outdoor deployment, site-specific safety protocols and procedures should be followed. Additionally, due to the inevitable exposure of the PurpleAir to inclement weather, ensure that all electrical connections are made in a manner that protects all electrical connections from water intrusion.

# 5 Cautions/Interferences

As outlined in sections 8.2-8.5, to mitigate the risk of data loss all directions to power on and power off the unit must be strictly followed. Improper powering procedures could cause data corruption and sensor damage. As with any air monitoring instrumentation, certain precautions should be taken in the installation of the equipment. To achieve the highest data quality, the instrument should be kept upright with the sensor opening facing downward to avoid water and debris accumulation. Do not obstruct the sensor opening, the sensor can operate with a partial obstruction; however, the data quality will be affected.

# 6 Personnel Qualification

Personnel should have basic knowledge and operational experience on the use and functionality of the PurpleAir PA-II-SD PM sensor. If no experience, then personnel will be trained either in the field or lab with this approved standard operating procedure and appropriate instrumentation. Training will be formally documented. In addition, personnel must have knowledge of general workings of laboratory and field site safety practices, including proper handling of instruments in the field. All field training activities will be specified in site specific QAPPs.

# 7 Equipment and Materials

**Equipment:**

- PurpleAir PA-II-SD PM Sensor
- PurpleAir supplied USB/AC Adaptor *(outdoor rated version)*
- PurpleAir supplied microUSB to USB power cord
- Micro to SD card adapter

- Micro SD Card(s)* (*known success with Lexar 300x 16GB microSDHC or SanDisk Ultra Class 10 UHS-I 16GB microSD Memory Card*)
- A pair of tweezers
- Laptop computer, with SD card slot and Microsoft Excel installed
- GFCI power outlet and surge-protected power strip, or weather proof power station/box (able to provide power to the sensor, contains Underwriters Laboratories (UL) listed extension cords and a UL listed surge protector). See the project QAPP or site-specific project plan for details.
- Instrument or research logbook or form

**Only one SD card is necessary for proper sensor function, however it is suggested that at least 2 be available when operating the sensor in the field.*

**Materials (for field use):**

- Safety Glasses
- Safety Shoes
- Work Gloves, *depending on attachment apparatus*
- Sensor attachment materials (*site specific*)

The PurpleAir sensor comes labeled with a unique device ID, an image of the sensor with the outdoor power cable is shown in Figure 1. The underside or base of the sensor (Figure 2) houses the PM inlet, microUSB connection port (for the power cable adapter), and the microSD card slot.


**Figure 1: PurpleAir Sensor and Outdoor Power Cord**

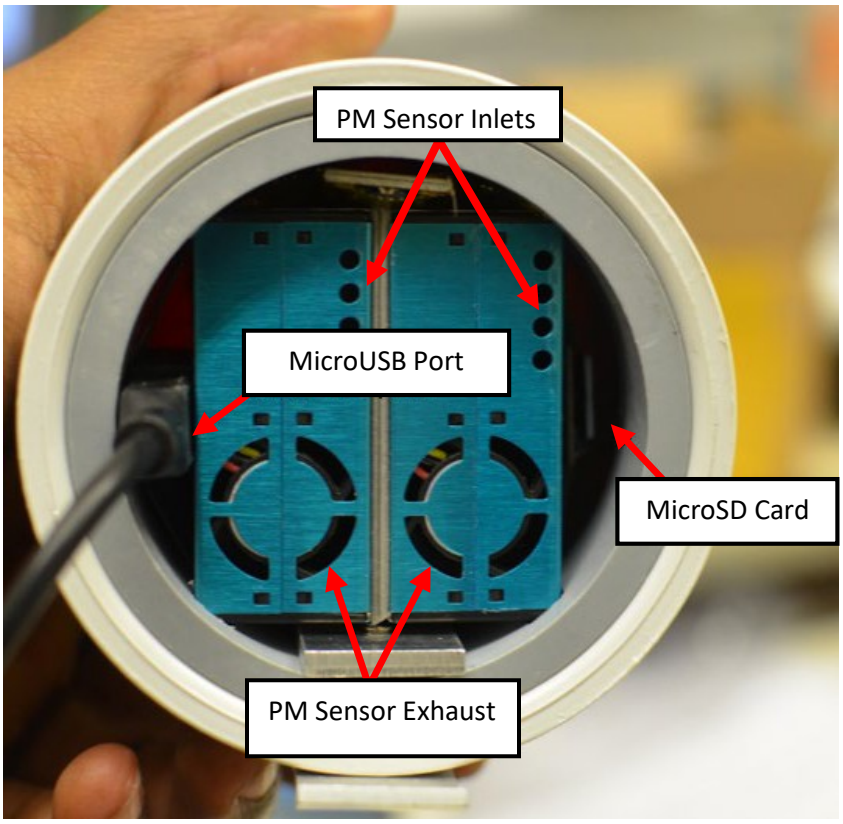


**Figure 2: PurpleAir Ports (Base View)**

# 8 Procedures

The following procedures provide for normal operation of PA-II-SD as part of an evaluation exercise.

## 8.1 Modifying SD Card Placement

If routine access to the microSD card is necessary, the user may wish to mount the sensors to allow for easy removal, so the sensor can be tipped onto its side to facilitate microSD card retrieval. As you can see in Figure 2, the microSD card slot is recessed into the sensor to offer greater protection from the elements. Tweezers will be needed to insert and remove the microSD card from this slot. Alternatively, at the time of ordering, you can request that PurpleAir mount the microSD card holder down toward the base of the sensor to allow easier access and they will customize the device for you. Directions to manually reposition the microSD card holder are provided below.

1. The sensor is held together using one screw on the metal plate. Removing this screw will allow the user to separate the metal plate from the white PVC cap.
2. Remove the grey PVC ring to open the sensor assembly.
3. Un-tape the microSD card holder from the side of the blue sensor, reposition and re-secure it further down.
4. Close the sensor assembly, replace the PVC ring, and reattach the metal plate to the PVC cap.

## 8.2 Registering the PurpleAir sensor on Purpleair.com

1. Go to: https://www.purpleair.com/register and follow the steps to register your device.

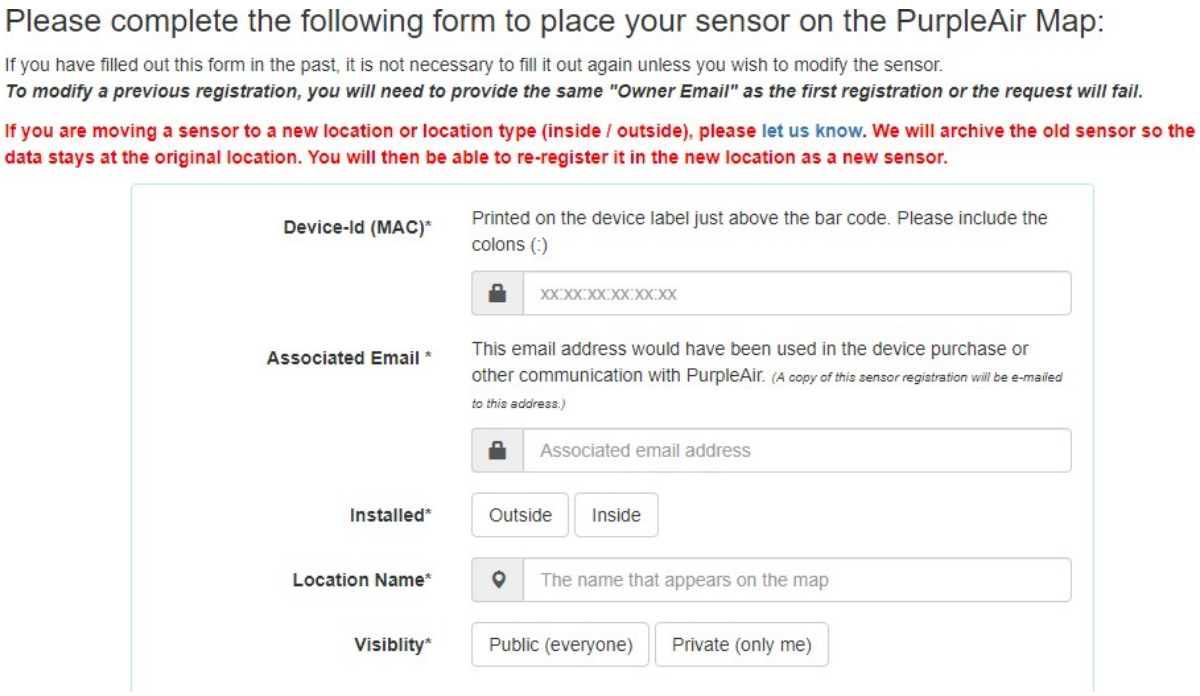


**Figure 3. PurpleAir registration form**

2. The Device-id (MAC) is printed on a sticker on the cap over the PurpleAir sensor (Figure 1).
3. To register the device, you must know the email address associated with the purchase. [redacted]
4. Indicate whether your device is installed outside or inside, give it a name, and decide whether you want it to be publicly available or private. *For EPA projects, the decision to operate sensors connected to the PurpleAir server and in public or private mode will be a project-specific determination specified in the project QAPP.*
5. Select a location on the map, if desired.

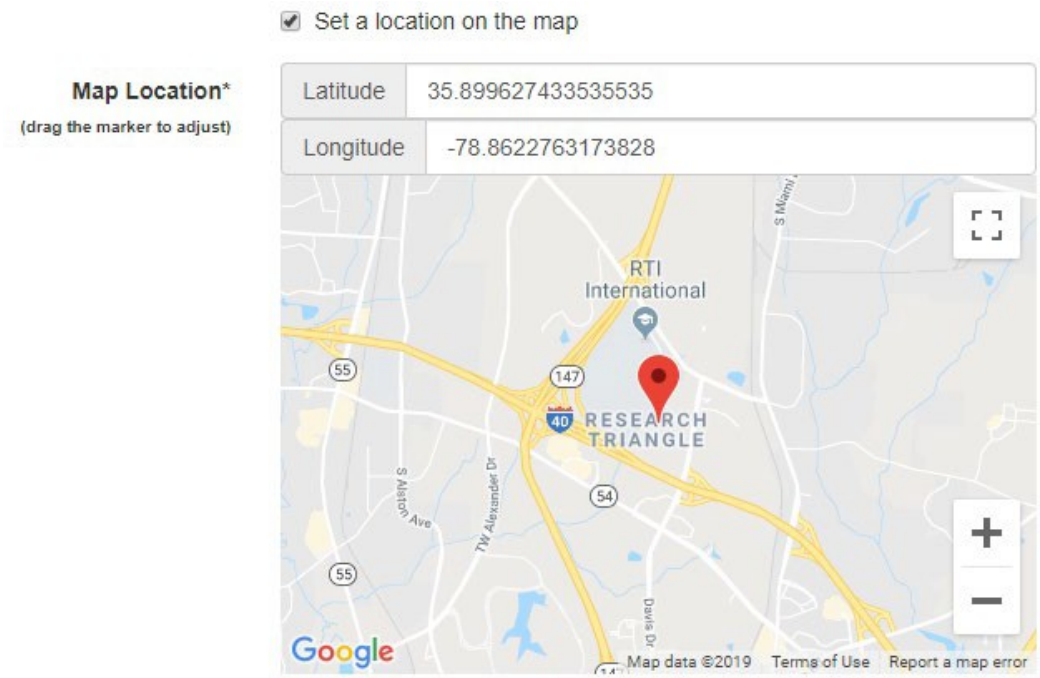


**Figure 4. Setting map location during PurpleAir registration**

6. Provide data to 3rd party services, if you desire.

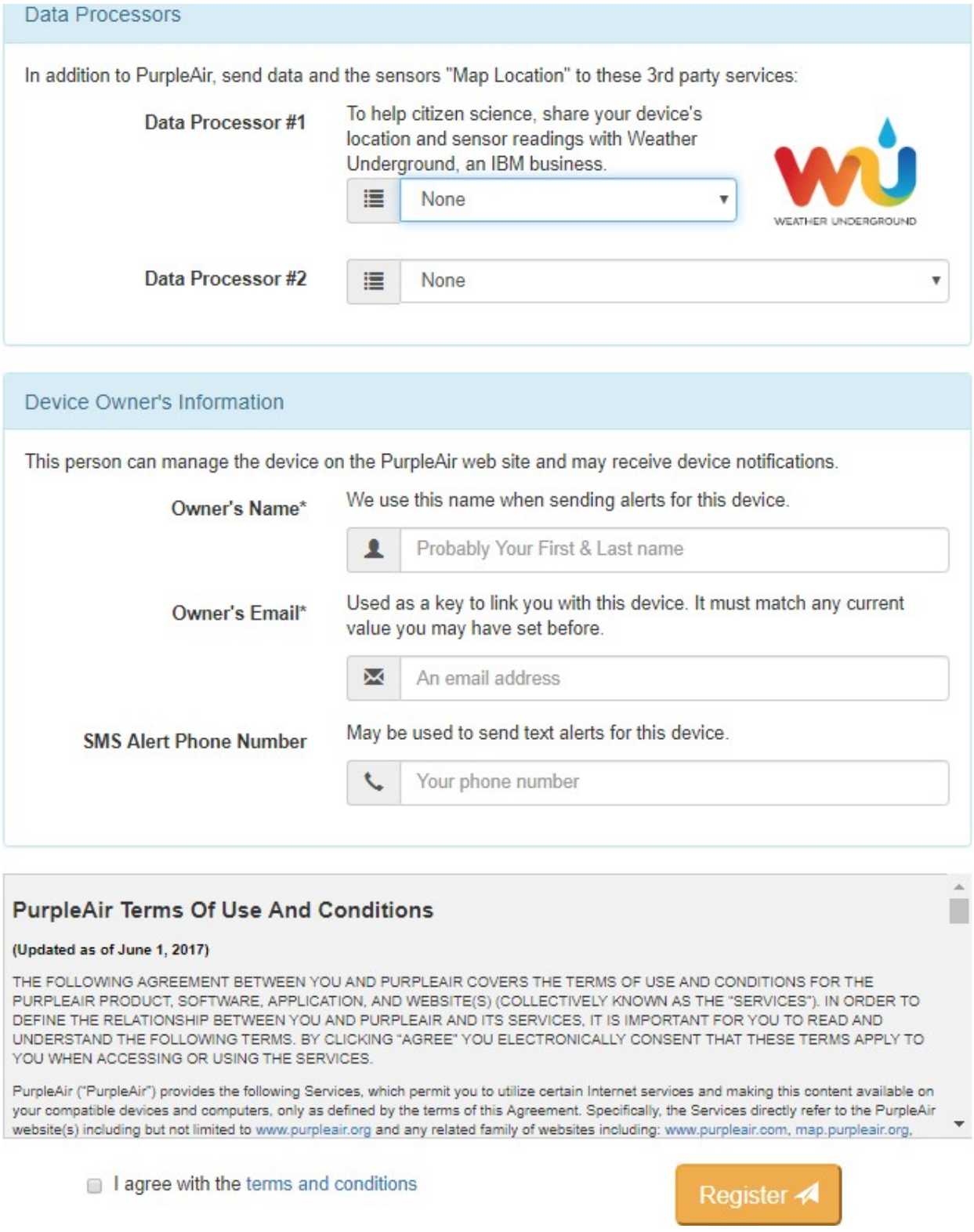


**Figure 5. Final steps of PurpleAir registration form**

7. If you register your device as private, **you must use a Gmail account as the owner's email** to access the data. [redacted]
8. If the device has previously been registered to a different owner's email address, you will have to contact PurpleAir to have them switch the owner email address. They request that you reply to the purchase email or the initial registration email.
9. Finally agree to the terms and conditions and register your device.

## 8.3 Deploying the PurpleAir

The PurpleAir's enclosure is weather proof and can be deployed out in the open or deployed inside a weather shielded shelter. The device must be installed vertically with the dome at the top, as shown in Figure 1. When installed properly, the dome will open downwards, and the sensor inlet and power port will be protected from water and debris accumulation. If sensors are deployed inside a weather shielded shelter, the structure should obstruct rain, even under high winds, but allow ambient air to pass through it for continuous ambient monitoring.

1. Invert the PurpleAir to inspect the inlets and ensure that the microSD card is properly inserted.
2. Secure the sensor to the platform apparatus (platform apparatus will be site specific and should be described in detail via site-specific QAPPs). Inspect setup to verify there aren't any obstructions blocking the sensor inlet.
3. Connect the micro-USB power cord to the outdoor AC adapter.
4. Connect the power cord to the PurpleAir.
5. Plug the AC adapter into a GFCI outlet *(this powers on the unit.)* in a manner that protects all electrical connections from water intrusion (e.g. outlet cover, weather-proof power cord connection box, or mounting inside of a shelter). See the project QAPP or site-specific project plan for details.

## 8.4 Connecting the PurpleAir to a WiFi Network

The PurpleAir has two methods of connection to a WiFi network, general configuration and manual configuration. Manual configuration is only necessary when trying to connect to a network with spaces or special characters in the service set identifier (SSID). At this time the PurpleAir sensors can only connect to WPA/WPA2, 2.4 GHz networks. Both WiFi configuration methods can be performed using a phone, tablet, or PC.

### 8.4.1 General WiFi Configuration

1. Power on the PurpleAir sensor.
2. On your network connected device, open a web browser and navigate to www.purpleair.com/configure, leave this page open for the next step.
3. On the same device, open the list of available WiFi networks and select the PurpleAir sensor signal "AirMonitor_xxxx", where "xxxx" is the last 4 digits of the sensor ID. This will disconnect your device from the WiFi network and connect it to the sensor.

4. Within 5 seconds of connection to the sensor, click “Connect to Sensor” on the configuration page from step 1 (Step 8.4.1.1). (If this connection fails, repeat steps 8.4.1.2 and 8.4.1.3.)
5. If successful, a new page will load with a list of available WiFi networks. Select your network from the list and enter the WiFi password at the bottom of the page, click “Save” to store the configuration settings.
6. Once successfully connected, the “AirMonitor_xxxx” network will disconnect from your device and disappear from the list of available networks.

### 8.4.2 Manual WiFi Configuration

1. Power on the PurpleAir sensor.
2. On your network connected device, open a web browser and navigate to http://192.168.4.1/config?ssid=**somename**&pass=**somepass**, where “*somename”* and “*somepass*” are your network SSID and password, respectively. Press enter to load the page, you should get a message saying that the page cannot load, this is expected. Leave this window open for the next step.
3. On the same device, open the list of available WiFi networks and select the PurpleAir sensor signal “AirMonitor_xxxx”, where “xxxx” is the last 4 digits of the sensor ID. This will disconnect your device from the WiFi network and connect it to the sensor.
4. Once connected to the sensor, **quickly** refresh the browser window from step 8.4.2.2. (If this connection fails, repeat steps 8.4.2.2 and 8.4.2.3)
5. Once successfully connected, the sensor data should appear in the browser window and the “AirMonitor_xxxx” network will disconnect from your device and disappear from the list of available networks.

## 8.5 Starting and Stopping Data Recording

The PurpleAir sensors begin logging data as soon as they are powered on. Be sure to keep detailed notes of the time power was supplied as noted in Section 9. At power on, a green light on one side of the microSD card will blink a few times. Immediately after, the blue light on the opposite side of the microSD card will blink periodically, indicating data is being recorded. If the blue light blinks rapidly, data is likely not being recorded properly and the user should check the data file and microSD card seating. To turn off the sensor and stop data recording, disconnect it from the power strip. The sensor should always be powered off prior to removal of the SD card to prevent data corruption.

## 8.6 Checking the status of an online sensor

If you would like to check on the status of a PurpleAir sensor and it is either publicly available or you have access to the associated email address, you can take the following steps to check on the sensor.

1. Visit https://www.purpleair.com/map
2. Search the name of your sensor of interest in the box in the top left.
3. Once the map centers over your sensor, you can click on the sensor for a status update of the current PM levels from that PurpleAir monitor. You can compare the levels of the A and B sensors

and if they do not compare well there may be a problem with the sensor (as shown in the Figure below).

4. You can click on additional sensors and they will be added on the plot in the top left so that you can compare across sensors.

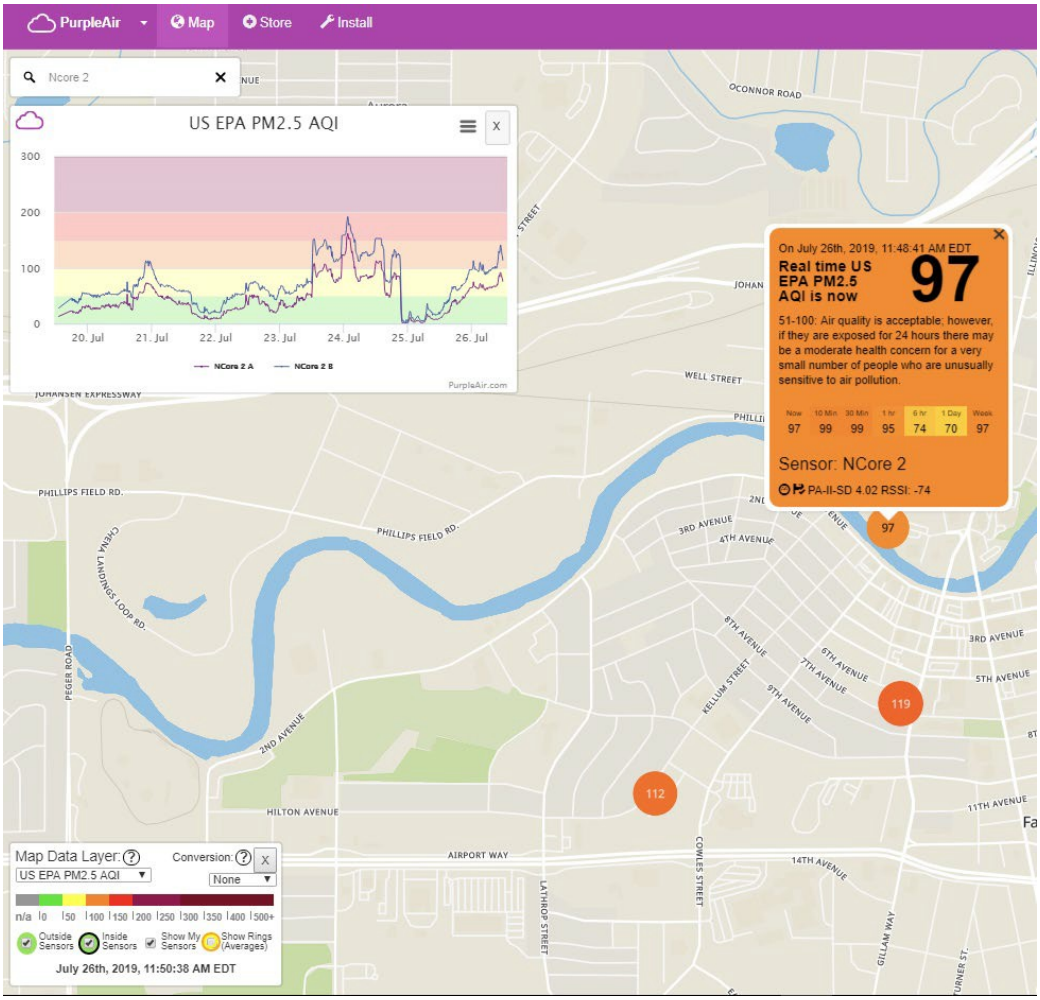


**Figure 6. View from Purpleair.com/map when checking on an individual sensor.**

Note: The view may be slightly different depending on the browser, plugins, and map version you are looking at (this image: from google chrome 7/26/19)

5. If the sensor is not currently reporting, you will see that here. This may indicate the sensor has lost power, WiFi, or has another problem.

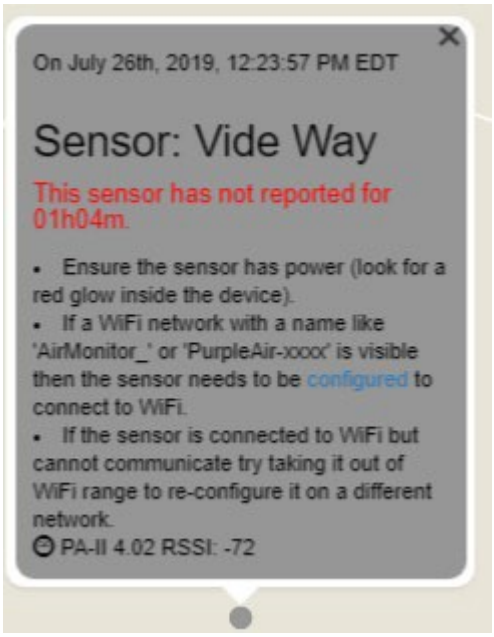


**Figure 7. Example of a sensor that has gone offline.**

6. Now, or next time you visit the site try restarting the sensor, completing the troubleshooting steps in the error message, and/or visiting https://www2.purpleair.com/community/faq for additional solutions.

## 8.7 Data Download

### 8.7.1 Download the data (microSD)

Follow the steps below to stop recording and download data from the device:

1. Turn the sensor off by disconnecting the power.
2. Remove the microSD card from the unit (Figure 2). Using a pair of tweezers, slightly push the microSD card inwards to release it from card docking bay, then pinch the edge of the card and pull gently to remove.
3. Insert the microSD card into an SD card adapter and insert the assembly into the Windows laptop.
4. Select and **Copy** the intended datafile(s). Sensor files are titled 'yyyymmdd.csv' and log files are titled 'yymmdd.log', where 'yyyymmdd' represents the start date. Generally, one data file and one log file will be made each day (dependent on the firmware version).
5. **Paste** the file(s) to the appropriate directory* on the laptop hard drive. *See Section 8.8 for guidelines on erasing the SD card.*
6. It is suggested data collection be verified immediately and before restarting the device. The basic initial check is provided below, further data verification instructions are provided in Section 8.6.

a. Has a data file been created for each day the sensor was deployed? If not, check for power connection issues, improper data card format, or possible improper seating of the SD card into the sensor.

7. Once all files are collected, stop the USB (SD card) device and remove from the laptop.
8. Return the microSD card to the PurpleAir sensor by reinserting the card in the docking bay and gently pressing the card with the tweezers to lock it in place. Be sure to follow the proper card orientation when re-inserting.
9. Power on the device as instructed in Section 8.4. If the blue light flashes repeatedly, the microSD card may not be properly inserted, or the data may not be recording correctly. If this happens, turn off the unit, remove, and re-insert the microSD card and restart.

**Folder directory and file naming structure are site specific determinations and should be identified in the project QAPP. For uses where multiple sensors are collocated, it is suggested that the raw file be updated to include the unit number as a unique identifier.*

### 8.7.2 Download the data (cloud manual)

This is the recommended download method for smaller downloads of data for PurpleAir monitors uploading data to the PurpleAir cloud via a wifi connection (online). If the PurpleAir monitor was registered in private mode, this method of data download requires that you have access to the Gmail account the PurpleAir monitor was registered with. If the monitor was registered in public mode, then the associated Gmail account is not necessary to have.

1. Go to https://www.purpleair.com/map.
2. Log into the Gmail account associated with the sensor(s) of interest if they are operating in private mode.
3. Locate the sensor on the map or by searching for the sensor name in the search bar in the top left and click on the circle representing that sensor.
4. A box describing recent measurements from the sensor will appear. After a few seconds, text will appear at the bottom of the box, including “get this widget” (Figure 8a).
5. Bring the mouse over “get this widget” and click on “download”. This will open a new window to the purpleair.com/sensorlist download tool for that specific sensor.
6. Specify the start and end dates and time average you wish to download.
7. Now you can download the primary and secondary data from the A and B sensors by checking the boxes on the far left of the sensors you are interested in, then clicking “download primary/secondary (A)/(B). Make sure to download both the A and B channels by clicking their respective checkboxes (Figure 8b). Note that the downloaded PurpleAir data has a coordinated universal time (UTC) timestamp and that the time last seen is also in UTC on this page.
8. The channel labels for data downloaded manually from the PurpleAir website are reversed compared to data downloaded using the Thingspeak application programing interface (API) (section 8.7.3). The fields labeled with cf=atm in the manually downloaded data correspond to the fields labeled cf=1 in the data downloaded using API keys, and vice versa (i.e., fields labeled cf=1 in manually downloaded data correspond to fields labeled cf=atm in the API-downloaded data). This is accurate as of 11/27/19.

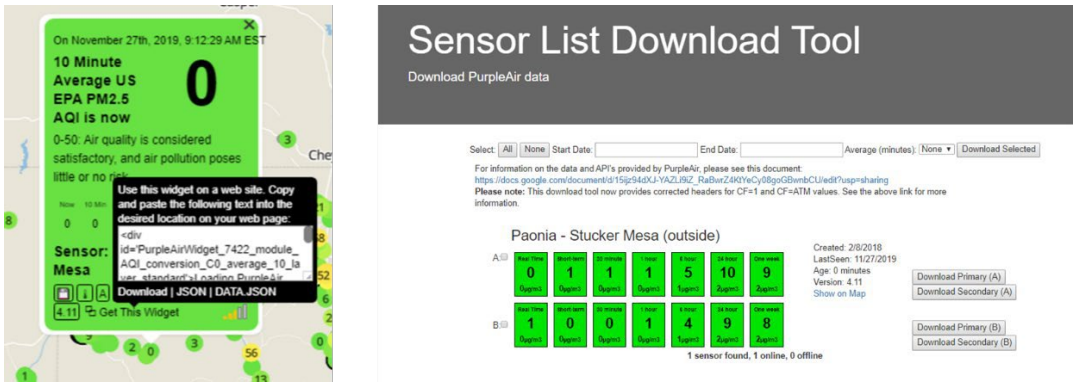


**Figure 8. PurpleAir data download page.**

### 8.7.3 Download the data (cloud automatic-with API key)

This method is preferred for automating larger data downloads or in cases where the data user does not have access to the Gmail account used to register the device.

#### 8.7.3.1 Finding the API key and Channel number

If you do not already know the API keys, follow these steps to identify them.

1. Navigate to https://www.purpleair.com/map
2. If this is a private monitor, log into the owner google account that you used to register the monitor by using the Login button in the top right corner.
3. Locate the sensor on the map or search for the sensor name (if known). Click on the circle representing the sensor of interest.
4. Wait for “get this widget” text to appear at the bottom of the box and bring the mouse over this text. Click on the link labeled “JSON”.
5. You will find 5 fields of interest for both the A and B sensors (10 total – sensor name, 2 - channel IDs, 2 - API keys). In the example below, sensor A is labeled “Paonia-Stucker Mesa” and sensor B is labeled “Paonia-Stucker Mesa B”. The channel IDs are labeled "THINGSPEAK_PRIMARY_ID" and "THINGSPEAK_SECONDARY_ID” and the API keys are labeled, "THINGSPEAK_PRIMARY_ID_READ_KEY”, and "THINGSPEAK_SECONDARY_ID_READ_KEY". Record the values between the quotes for all of these fields. They will be needed to access the data via the API (Section 7.8.3.2). Here’s an example with these values in bold:

{"mapVersion":"0.3","baseVersion":"7","mapVersionString":"","results":[{"ID":
7422,"Label":"**Paonia - Stucker
Mesa**","DEVICE_LOCATIONTYPE":"outside","THINGSPEAK_PRIMARY_ID":"**423102**","THING
SPEAK_PRIMARY_ID_READ_KEY":"**AJC24PSMZ6MYE80Z**","THINGSPEAK_SECONDARY_ID":"**4231
03**","THINGSPEAK_SECONDARY_ID_READ_KEY":"**MRGQDOE6IGAQGNF8**","Lat":38.860887,"Lo
n":-
107.647995,"PM2_5Value":"0.0","LastSeen":1574864174,"Type":"PMS5003+PMS5003+B
ME280","Hidden":"false","DEVICE_BRIGHTNESS":"15","DEVICE_HARDWAREDISCOVERED":
"2.0+OPENLOG+15833 MB+DS3231+BME280+PMSX003-B+PMSX003-
A","Version":"4.11","LastUpdateCheck":1574862731,"Created":1518136411,"Uptime
":"1075021","RSSI":"-
67","Adc":"0.0","p_0_3_um":"108.87","p_0_5_um":"26.84","p_1_0_um":"1.57","p_2

_5_um":"0.93","p_5_0_um":"0.58","p_10_0_um":"0.41","pm1_0_cf_1":"0.0","pm2_5_cf_1":"0.0","pm10_0_cf_1":"0.29","pm1_0_atm":"0.0","pm2_5_atm":"0.0","pm10_0_atm":"0.29","isOwner":0,"humidity":"38","temp_f":"34","pressure":"816.2","AGE":1,"Stats":"{\"v\":0.0,\"v1\":0.1,\"v2\":0.11,\"v3\":0.19,\"v4\":1.15,\"v5\":2.36,\"v6\":2.09,\"pm\":0.0,\"lastModified\":1574864174549,\"timeSinceModified\":119998}"},{"ID":7423,"ParentID":7422,"Label":"**Paonia - Stucker Mesa B**","THINGSPEAK_PRIMARY_ID":"**423104**","THINGSPEAK_PRIMARY_ID_READ_KEY":"**KWJ6KI0WTPIFALI8**","THINGSPEAK_SECONDARY_ID":"**423106**","THINGSPEAK_SECONDARY_ID_READ_KEY":"**SEIBD46YGMUU735V**","Lat":38.860887,"Lon":-107.647995,"PM2_5Value":"0.0","LastSeen":1574864174,"Hidden":"false","Created":1518136411,"Adc":"0.00","p_0_3_um":"104.61","p_0_5_um":"31.06","p_1_0_um":"1.25","p_2_5_um":"0.17","p_5_0_um":"0.0","p_10_0_um":"0.0","pm1_0_cf_1":"0.0","pm2_5_cf_1":"0.0","pm10_0_cf_1":"0.0","pm1_0_atm":"0.0","pm2_5_atm":"0.0","pm10_0_atm":"0.0","isOwner":0,"AGE":1,"Stats":"{\"v\":0.0,\"v1\":0.05,\"v2\":0.06,\"v3\":0.12,\"v4\":0.97,\"v5\":2.12,\"v6\":1.9,\"pm\":0.0,\"lastModified\":1574864174550,\"timeSinceModified\":119998}"}]}

#### 8.7.3.2 Download from the API directly: using PowerShell

You must use a computer that has windows PowerShell to be able to download using this method.

1. Locate and open the windows PowerShell app on your computer.
2. Open a blank text file in notepad
3. Copy and paste the text from section 11.4 (starting below the section title) into the blank text file.
4. You will need to update the location you would like to save data (currently: j:\temp\PA) at both the beginning and end of the document
5. Next you will need to update the table including (Reporting Organization, Channel ID, API key, Start Date). There should be 4 entries for each PurpleAir monitor assuming you want both primary and secondary data from the A and B sensors.
6. Next you will want to update the offset (currently: $offset=9) to the number of hours ahead or behind (negative) UTC is from your local standard time (LST) (e.g. 6 for central standard time (CST), 5 for eastern standard time (EST)). If you set this to zero, you will not get midnight to midnight data from the download as your first hour of data will be at 0:00 UTC.
7. Save this text file so that you can update the start dates and use again if you want to download data from these sites in the future.
8. Copy the text file and paste it into your PowerShell.
9. Press enter to run the script.
10. If this does not generate files, check your keys and try saving to a different location in case you do not have permissions to save in the initial location.

## 8.8 Reviewing the Data

To check data integrity, each file is imported to Microsoft Excel. The steps outlined below may differ based on the version of Excel being used. ***Please remember, raw data files ('yyyymmdd.csv' format) should NOT be altered and should be kept for the duration of any study***.

1. Open a new blank Excel workbook.
2. Under the Data tab, navigate to Get Data → From File → From Text/CSV.
3. Locate the appropriate file, select and click Import.
4. In the import wizard, select Comma and Tab from the Delimiter drop down and click load.

5. Once the data is imported it should resemble the data shown in Figures 9-12 depending on how the data was downloaded.

| A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|
| UTCDateTime | mac_address | firmware_ver | hardware | current_temp_f | current_humidity | current_dewpoint_f | pressure |
| 2019/02/08T00:00:47z | 68:c6:3a:cb:e9:b5 | 3 | 2.0+OPENLOG+15931 MB+DS323 | 82 | 36 | 52.42 | 1005.67 |
| 2019/02/08T00:02:07z | 68:c6:3a:cb:e9:b5 | 3 | 2.0+OPENLOG+15931 MB+DS323 | 82 | 36 | 52.42 | 1005.58 |
| 2019/02/08T00:03:27z | 68:c6:3a:cb:e9:b5 | 3 | 2.0+OPENLOG+15931 MB+DS323 | 82 | 36 | 52.42 | 1005.58 |
| 2019/02/08T00:04:47z | 68:c6:3a:cb:e9:b5 | 3 | 2.0+OPENLOG+15931 MB+DS323 | 82 | 36 | 52.42 | 1005.66 |
| 2019/02/08T00:05:18z | 68:c6:3a:cb:e9:b5 | 3 | 2.0+OPENLOG+15931 MB+DS323 | 82 | 36 | 52.42 | 1005.62 |
| 2019/02/08T00:06:38z | 68:c6:3a:cb:e9:b5 | 3 | 2.0+OPENLOG+15931 MB+DS323 | 82 | 36 | 52.42 | 1005.66 |
| 2019/02/08T00:07:58z | 68:c6:3a:cb:e9:b5 | 3 | 2.0+OPENLOG+15931 MB+DS323 | 82 | 36 | 52.42 | 1005.69 |
| 2019/02/08T00:09:18z | 68:c6:3a:cb:e9:b5 | 3 | 2.0+OPENLOG+15931 MB+DS323 | 82 | 36 | 52.42 | 1005.65 |
| 2019/02/08T00:10:38z | 68:c6:3a:cb:e9:b5 | 3 | 2.0+OPENLOG+15931 MB+DS323 | 82 | 36 | 52.42 | 1005.65 |
| 2019/02/08T00:11:58z | 68:c6:3a:cb:e9:b5 | 3 | 2.0+OPENLOG+15931 MB+DS323 | 82 | 36 | 52.42 | 1005.59 |
| 2019/02/08T00:13:18z | 68:c6:3a:cb:e9:b5 | 3 | 2.0+OPENLOG+15931 MB+DS323 | 82 | 36 | 52.42 | 1005.59 |
| 2019/02/08T00:14:38z | 68:c6:3a:cb:e9:b5 | 3 | 2.0+OPENLOG+15931 MB+DS323 | 82 | 36 | 52.42 | 1005.59 |
| 2019/02/08T00:15:58z | 68:c6:3a:cb:e9:b5 | 3 | 2.0+OPENLOG+15931 MB+DS323 | 82 | 36 | 52.42 | 1005.63 |
| 2019/02/08T00:17:18z | 68:c6:3a:cb:e9:b5 | 3 | 2.0+OPENLOG+15931 MB+DS323 | 82 | 36 | 52.42 | 1005.57 |

| I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| adc | mem | rssi | uptime | pm1_0_atm | pm2_5_atm | pm10_0_atm | pm1_0_cf_1 | pm2_5_cf_1 | pm10_0_cf_1 | p_0_3_um | p_0_5_um | p_1_0_um | p_2_5_um | p_5_0_um | p_10_0_um |
| 0 | 30944 | 31 | 510 | 2.26 | 2.85 | 2.85 | 2.26 | 2.85 | 2.85 | 519.72 | 150.93 | 18.52 | 0.61 | 0 | 0 |
| 0 | 30944 | 31 | 590 | 2.61 | 3.02 | 3.02 | 2.61 | 3.02 | 3.02 | 551.54 | 168.07 | 16.17 | 0.61 | 0 | 0 |
| 0 | 30944 | 31 | 670 | 2.04 | 2.57 | 2.57 | 2.04 | 2.57 | 2.57 | 517.24 | 155.93 | 14.33 | 0.35 | 0 | 0 |
| 0 | 30944 | 31 | 750 | 1.67 | 2.02 | 2.02 | 1.67 | 2.02 | 2.02 | 510.2 | 154.46 | 14.54 | 0.39 | 0 | 0 |
| 0 | 30944 | 31 | 30 | 2.73 | 2.73 | 2.73 | 2.73 | 2.73 | 2.73 | 291.8 | 83.87 | 3 | 0 | 0 | 0 |
| 0 | 30944 | 31 | 110 | 1.71 | 2.6 | 2.6 | 1.71 | 2.6 | 2.6 | 486.33 | 146.47 | 13.78 | 0.89 | 0 | 0 |
| 0 | 30944 | 31 | 190 | 1.8 | 2.59 | 2.59 | 1.8 | 2.59 | 2.59 | 512.67 | 157.93 | 16.09 | 0.43 | 0 | 0 |
| 0 | 30944 | 31 | 270 | 1.52 | 2.15 | 2.28 | 1.52 | 2.15 | 2.28 | 543.07 | 160.35 | 16.8 | 0.65 | 0 | 0 |
| 0 | 30944 | 31 | 350 | 1.72 | 2.59 | 2.83 | 1.72 | 2.59 | 2.83 | 558.91 | 168.89 | 18.15 | 1.09 | 0.35 | 0 |
| 0 | 30944 | 31 | 430 | 2.2 | 3.13 | 3.13 | 2.2 | 3.13 | 3.13 | 520.5 | 157.17 | 20.78 | 0.8 | 0.35 | 0 |
| 0 | 30944 | 31 | 510 | 2.48 | 3.39 | 3.39 | 2.48 | 3.39 | 3.39 | 530.8 | 160.09 | 18.35 | 1.65 | 0.35 | 0 |
| 0 | 30944 | 31 | 590 | 1.93 | 2.85 | 3.11 | 1.93 | 2.85 | 3.11 | 493.7 | 147.98 | 18.7 | 1.02 | 0.35 | 0 |
| 0 | 30944 | 31 | 670 | 2.57 | 3.37 | 3.43 | 2.57 | 3.37 | 3.43 | 545.35 | 162.61 | 20.02 | 0.72 | 0.09 | 0 |
| 0 | 30944 | 31 | 750 | 2.04 | 2.74 | 2.81 | 2.04 | 2.74 | 2.81 | 507.19 | 151.7 | 12.38 | 0.21 | 0.21 | 0 |

| Y | Z | AA | AB | AC | AD | AE | AF | AG | AH | AI | AJ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| pm1_0_atm_b | pm2_5_atm_b | pm10_0_atm_b | pm1_0_cf_1_b | pm2_5_cf_1_b | pm10_0_cf_1_b | p_0_3_um_b | p_0_5_um_b | p_1_0_um_b | p_2_5_um_b | p_5_0_um_b | p_10_0_um_b |
| 1.89 | 2.83 | 2.83 | 1.89 | 2.83 | 2.83 | 526.11 | 159.72 | 18.33 | 0.48 | 0 | 0 |
| 2.18 | 3.51 | 3.51 | 2.18 | 3.51 | 3.51 | 542.73 | 160.87 | 25.98 | 1.36 | 0 | 0 |
| 2.07 | 2.67 | 2.83 | 2.07 | 2.67 | 2.83 | 548.74 | 161.57 | 21.52 | 0.3 | 0 | 0 |
| 2.13 | 2.36 | 2.36 | 2.13 | 2.36 | 2.36 | 470.94 | 143.43 | 13.68 | 0.3 | 0 | 0 |
| 2.11 | 2.11 | 2.11 | 2.11 | 2.11 | 2.11 | 346.33 | 100.56 | 4.44 | 0 | 0 | 0 |
| 1.72 | 2.07 | 2.26 | 1.72 | 2.07 | 2.26 | 446.02 | 135.41 | 9.96 | 1.02 | 0.35 | 0 |
| 1.61 | 2.41 | 2.41 | 1.61 | 2.41 | 2.41 | 540.91 | 162.8 | 15.78 | 0.57 | 0.35 | 0 |
| 2.04 | 2.3 | 2.3 | 2.04 | 2.3 | 2.3 | 513.46 | 153.5 | 13.72 | 0.57 | 0.35 | 0 |
| 2.59 | 3.04 | 3.04 | 2.59 | 3.04 | 3.04 | 537 | 159.52 | 13.61 | 0.54 | 0.35 | 0 |
| 2 | 2.83 | 3.09 | 2 | 2.83 | 3.09 | 508.11 | 152.85 | 18.13 | 0.65 | 0.26 | 0.26 |
| 2.46 | 2.8 | 2.89 | 2.46 | 2.8 | 2.89 | 521.35 | 157.04 | 16.8 | 0.41 | 0.09 | 0.09 |
| 1.98 | 2.26 | 2.26 | 1.98 | 2.26 | 2.26 | 485.09 | 142.26 | 10.59 | 0.41 | 0.09 | 0.09 |
| 2.46 | 3.11 | 3.11 | 2.46 | 3.11 | 3.11 | 577.63 | 176.8 | 15.13 | 0.41 | 0.09 | 0.09 |
| 2.6 | 3.15 | 3.45 | 2.6 | 3.15 | 3.45 | 543.13 | 163.21 | 16.7 | 1.53 | 0.3 | 0.3 |

**Figure 9: Data in Excel from SD Card**

| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | created_at | entry_id | PM1.0_CF | PM2.5_CF | PM10.0_C | UptimeMi | ADC | Temperat | Humidity_ | PM2.5_CF_1_ug/m3 | |
| 2 | 2019-07-03 00:01:51 UTC | 251669 | 3.28 | 6.36 | 6.61 | 9608 | -84 | 93 | 59 | 6.36 | |
| 3 | 2019-07-03 00:03:51 UTC | 251670 | 2.94 | 5.08 | 5.48 | 9610 | -83 | 93 | 59 | 5.08 | |
| 4 | 2019-07-03 00:05:54 UTC | 251671 | 3.09 | 4.96 | 6.49 | 9612 | -87 | 93 | 58 | 4.96 | |
| 5 | 2019-07-03 00:07:51 UTC | 251672 | 2.33 | 5.33 | 5.72 | 9614 | -82 | 93 | 58 | 5.33 | |
| 6 | 2019-07-03 00:09:53 UTC | 251673 | 2.58 | 5.82 | 6.43 | 9616 | -83 | 93 | 58 | 5.82 | |
| 7 | 2019-07-03 00:11:52 UTC | 251674 | 3.03 | 4.87 | 5.49 | 9618 | -82 | 92 | 58 | 4.87 | |
| 8 | 2019-07-03 00:13:51 UTC | 251675 | 3.04 | 5.37 | 6.63 | 9620 | -83 | 93 | 59 | 5.37 | |
| 9 | 2019-07-03 00:15:51 UTC | 251676 | 2.84 | 5 | 5.83 | 9622 | -84 | 92 | 58 | 5 | |
| 10 | 2019-07-03 00:17:51 UTC | 251677 | 2.62 | 5.25 | 5.25 | 9624 | -82 | 93 | 58 | 5.25 | |
| 11 | 2019-07-03 00:19:53 UTC | 251678 | 3.06 | 5.74 | 7.27 | 9626 | -83 | 92 | 59 | 5.74 | |
| 12 | 2019-07-03 00:21:51 UTC | 251679 | 2.97 | 5.17 | 5.72 | 9628 | -83 | 92 | 59 | 5.17 | |

**Figure 10. Primary data file in Excel from sensor list download**

| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | created_at | entry_id | 0.3um/dl | 0.5um/dl | 1.0um/dl | 2.5um/dl | 5.0um/dl | 10.0um/dl | PM1.0_CF | PM10_CF_1_ug/m3 | |
| 2 | 2019-07-03 00:01:52 UTC | 250538 | 840.42 | 225.28 | 49.03 | 5.56 | 0.5 | 0 | 3.28 | 6.61 | |
| 3 | 2019-07-03 00:03:53 UTC | 250539 | 715.41 | 199.58 | 39.19 | 2.81 | 0.38 | 0.38 | 2.94 | 5.48 | |
| 4 | 2019-07-03 00:05:55 UTC | 250540 | 715.15 | 201.21 | 41.06 | 3.56 | 2.09 | 1.24 | 3.09 | 6.49 | |
| 5 | 2019-07-03 00:07:53 UTC | 250541 | 676.22 | 179.61 | 46.41 | 3.97 | 0.44 | 0 | 2.33 | 5.72 | |
| 6 | 2019-07-03 00:09:55 UTC | 250542 | 700.29 | 191.57 | 44.65 | 5.94 | 0.95 | 0.49 | 2.58 | 6.43 | |
| 7 | 2019-07-03 00:11:53 UTC | 250543 | 722.24 | 197.1 | 43.9 | 2.48 | 1.02 | 0.25 | 3.03 | 5.49 | |
| 8 | 2019-07-03 00:13:53 UTC | 250544 | 716.78 | 199.04 | 42.27 | 5.85 | 1.82 | 0.93 | 3.04 | 6.63 | |
| 9 | 2019-07-03 00:15:53 UTC | 250545 | 730.08 | 192.33 | 42.97 | 3.12 | 1.47 | 0.12 | 2.84 | 5.83 | |
| 10 | 2019-07-03 00:17:52 UTC | 250546 | 696.92 | 194.51 | 42.68 | 1.29 | 0 | 0 | 2.62 | 5.25 | |
| 11 | 2019-07-03 00:19:55 UTC | 250547 | 723.68 | 202 | 49.19 | 4.61 | 1.87 | 1.1 | 3.06 | 7.27 | |
| 12 | 2019-07-03 00:21:55 UTC | 250548 | 732.14 | 196.17 | 38.31 | 2.65 | 0.77 | 0.31 | 2.97 | 5.72 | |
| 13 | 2019-07-03 00:23:58 UTC | 250549 | 716.6 | 201.07 | 50.26 | 4.29 | 1.18 | 0 | 2.76 | 6.47 | |

**Figure 11. Secondary data file in Excel from Purpleair.com/sensorlist download**

**Note:** Column A of the example data file (Figures 9-12) is the date/timestamp in UTC. Once the time field has been reformatted (Section 8.7), the time column will need to be adjusted to the local time zone (i.e. eastern standard time (EST) time is UTC-5).

6. If you are unable to open the file properly (i.e. the file is not readable):
    a. Make sure an appropriate program is being used (i.e. Microsoft Excel).
    b. Attempt to download the data again.
7. Once the data has successfully imported to Excel, verify that:
    a. The columns contain the appropriate data for the header *(as displayed in Figures 9-12 )*.
    b. The first data row contains a time of either '00:00:00' representing the start of the new day or is consistent with the logging start time.
    c. The last row contains a time e.g.'23:59:59' representing the last timestamp associated with the day or is consistent with the logging stop time.
    *d.* The volume of data is acceptable for the operating time. While recording data for a period of 24 hours at 80 second intervals, the file should contain about 650 rows and the file size should be approximately 300KB. *Note that if the PurpleAir sensor is not connected to a network, the data stream may be periodically interrupted by several lines of text (depending on firmware version).*
    e. The mac address from the data files (Column B) matches the mac address on the device (from offline data only – see Figure 9).
8. If applicable, open the previously imported data file and ensure the date and time stamp from the last record of the file closely precedes that of the first record from the new file. If not, search for an explanation or missing data file.
9. ***If this device is being used in support of EPA-based research, send a copy of these electronic files to the appropriate EPA research lead via email or using an EPA shared drive (e.g., O:, L:) or FTP site. This can be done by copying the entire folder. The EPA will maintain a central repository of all extracted data.***

## 8.9 Converting the Date/Time in Excel

The following procedure can be used to separate the Date/Time column and remove the extraneous characters.

1. After importing the data to Excel, add two columns to the left of Column A.

2. Remove the “UTCDateTime” header (now Column C), otherwise the next step will not work properly.
3. Select the entire UTCDateTime column.
4. Under the Data tab, select Text to Columns.
5. In the wizard, select Delimited and click next.
6. Select Other, put the letter T in the box and click next.
7. Select General and under Destination highlight cell A1, then click finish. The date and time should now be in two columns (A & B) and the date column should now be in the proper MM/DD/YYYY format.
8. Next, select the new time column.
9. Under the Home tab, select Find & Select→ Replace.
10. Under Find, enter z. Leave the Replace field blank and select Replace All. The time column should now be in the HH:MM:SS format. Steps 11-13 instruct on how to round the time field to the nearest minute, as may be required by some analysis tools.
11. Insert a column to the right of the new time column and add a header (i.e. Adjusted Time).
12. In the first cell under the header insert the equation “=MROUND(CELL#,0:01)”, where cell is the first cell in the time column and “0:01” is the multiple. Copy the formula down the rest of the column.
13. Highlight the adjusted time column. Under the Formats dropdown, select More Formats>Time and select desired time format.

### 8.10 Deleting Existing Data

While it is good practice to remove existing data stored prior to the current data collection activity, it is not required in this case as the files are named sequentially. Typically, the microSD Card can hold several months of 1-minute data before getting filled. Data can be deleted as necessary to complete field measurements.

## 9 Data and Records Management

Records should be made during sensor deployment, start-up, shut-down and data transfer. Field notes including observations about nearby or transient pollution sources, weather, and/or instrument operation may be useful in interpreting the sensor data. All such records should be kept using an EPA research or field notebook or form in archival quality black ink and should be marked with the project QAPP ID, location, device ID, date and time or visit and/or data transfer, and observer’s name and signature. Any co-observers should also be recorded. A hard-copy of these notes should be maintained for the lifetime of the project, and if collected in support of an EPA research project, must be provided to the EPA research lead. An electronic research notebook may also be used in addition to or in place of a paper research notebook.

Raw data files will not contain any edits performed by Staff. Any files that contain any analysis will be saved onto the EPA shared drive using a different name and all analysis will be recorded into the research notebook (hard-copy or approved electronic format). The analysis consists of, but not limited to: graphs, statistical tests, notes, conclusions, etc. Any non-handwritten notes will be attached to the lab notebook page and the author will sign and date the edge. Notebook record entries will be reviewed by other members of the team and then an employee outside of the team.

Quality control and assurance work, file concatenation, and data evaluation will all start with the raw data collected by the sensor. ***If this device is being used in support of EPA-based research, a copy of the complete and verified data file for each sensor and the research notebook should be provided to the EPA research lead.***

# 10 Quality Assurance/Quality Control

This SOP is intended ONLY to explain the basic operating procedures of the device such as instrument power-on and power-off procedures, data collection, and data recovery. Project specific QC and QA procedures for the data produced should be developed independently and followed. At a minimum, the recovered data files will be reviewed to look for data gaps and deviations from the expected data files structure (missing lines, columns, or cells within the data file). Unexplained data gaps and deviations will be investigated and troubleshooting procedures implemented, where possible. All efforts should be recorded in the research notebook (see Section 9). As necessary, this SOP will be updated to try to eliminate future data loss.

# 11 Resources

The following resources may be helpful. Some resources may be restricted to EPA personnel or project partners.

[redacted]

[redacted]

[redacted]

## 11.2 PurpleAir documents

Using PurpleAir Data Page:
https://docs.google.com/document/d/15ijz94dXJYAZLi9iZ_RaBwrZ4KtYeCy08goGBwnbCU/edit#

## 11.3 PurpleAir FAQs website:

https://www2.purpleair.com/community/faq

## 11.4 PowerShell script for API data download

```
#This code was written by Sean Fitzsimmons, Iowa Department of Natural Resources
#Modified by Karoline Johnson 7/12/19

# create PA directory if it doesn't already exist
#You may need to change the directory you write to depending on the security settings on your computer
#External devices (flash drive) may be easier
#This example assumes you are writing to a drive j but update for the drive of your flash drive or other
        desired location.
#Here's an additional example if you have access to your c drive:
#md -Force c:\temp\PA | Out-Null

md -Force j:\temp\PA | Out-Null
<#
Uncomment the next line to delete all files in the home directory to clean up between runs;
all the old files must be closed, or the script will hang
#>

#ENTER API KEYS, ETC. HERE!
# You will need to update all these below with your sensor names, channel IDs, API key, and start dates.
# The format used in the rows below is: (Sensor name, Channel ID, API key, Start Date)
#See the example below for open source data from Alaska
$IowaPA=@(
("Ncore","599388","ZQ08WBD0RP32MSHP","7/12/2019"),
("Ncore","599389","7FYHQD0VW1N59PTH","7/12/2019"),
("Ncore B","599390","E81YTMI867007UN8","7/12/2019"),
("Ncore B","599391","VI8KUWBWT3IEL6V6","7/12/2019"),
("NCore 2","583465","DVES8U6IXYSV2SG0","7/12/2019"),
("NCore 2","583466","CUXEI571Q1EXR2WW","7/12/2019"),
("Ncore 2 B","583467","HP1Y8XE12UPBFGBS","7/12/2019"),
("Ncore 2 B","583468","KZS7G5IOTWDP8FJZ","7/12/2019"),
("Ncore 3","666006","H6JBLR24DNECCR5L","7/12/2019"),
("Ncore 3","666007","YUCUSAG739TI7BID","7/12/2019"),
("Ncore 3 B","666008","HTSVHH26TSR8NUX2","7/12/2019"),
("Ncore 3 B","666009","QLE7S8Y2FHTGYMKL","7/12/2019"))

$NumberOfChannels=$IowaPA.Count
```

```
For ($i=0; $i -lt $NumberOfChannels; $i++) {

$channels=$IowaPA[$i][1]
$api_key=$IowaPA[$i][2]
$startdate=$IowaPA[$i][3]

$mylabel=$IowaPA[$i][0] +"-"+ $IowaPA[$i][1]

#create output file that includes the time the script was run

$outfile="J:\temp\PA"+ $mylabel + "_" + $(get-date -f MM_dd_yy_hh_mm_ss) + ".csv"

#write the identifying information for the channel to the screen

echo($mylabel)

#build strings for api query

$url="https://api.thingspeak.com"

# Create variables for start and end dates for query loop

<#
Purple air stores data with a UTC timestamp. EPA monitors have an LST timestamp,
So to compare data sets we will ultimately want to convert the PA timestamps to LST in a spreadsheet.
In this script we download the UTC PA data corresponding to LST days.
Examples:
UTC is six hours ahead of LST(Central Standard Time) in Iowa.
UTC is 9 hours ahead of LST(Alaska Standard Time) in Alaska
Note if you miss this step it won't impact your data quality
you will just be missing a few hours of your daily average
#>
#EDIT THIS OFFSET FOR YOUR TIME ZONE!
$offset=9

# Use the channel's start date (coverted to UTC) for the first day to query

$startloopLST=Get-Date $startdate
$startloop=$startloopLST.AddHours($offset)

#use current date-time (converted to UTC) as the last day to query
```

```
$now=Get-Date
$nowUTC=$now.ToUniversalTime()
$endloop=$nowUTC

# Make start and end dates for the query of the first day's data and make strings

$start=$startloop
$end=$start.AddDays(0).AddHours(23).AddMinutes(59).AddSeconds(59)
$startstring= $start.tostring("yyyy-MM-dd"+"T"+"HH:mm:ss"+"Z")
$endstring=$end.tostring("yyyy-MM-dd"+"T"+"HH:mm:ss"+"Z")

#Create query for header; we dont need any data, so the start and end dates are the same.

$query=$url+"/channels/"+$channels+"/"+"feed.xml?"+"api_key="+$api_key+"&start="+$startstring+"&en
        d="+$startstring

# run api query, store results in variable $xml

$xml = Invoke-RestMethod -Uri $query -Method Get -TimeoutSec 300;

# make the header from the xml

$header=('monitor-id','channel-id', 'created-at', 'entry-id', $xml.channel.field1, $xml.channel.field2,
        $xml.channel.field3,
        $xml.channel.field4,$xml.channel.field5,$xml.channel.field6,$xml.channel.field7,$xml.channel.field
        8)

# write header to outfile; we will append each days data to this file.

$header-join ", "> $outfile

# Loop, querying one day at a time and appending to outfile until final day for the query is reached

Do
{

$query=$url+"/channels/"+$channels+"/"+"feed.xml?"+"api_key="+$api_key+"&start="+$startstring+"&en
        d="+$endstring

echo( $start.tostring("MM-dd-yy"))

$xml = Invoke-RestMethod -Uri $query -Method Get -TimeoutSec 300;
```

```
$nodes=$xml.channel.feeds.feed

#extract each row of data in the days data from the array "nodes" and put it in "array".

foreach ($node in $nodes){

# Extract the first row of data from the xml and append to the channel output file

$array= ($xml.channel.name, $xml.channel.ID.'#text', $node.'created-at'.'#text',$node.'entry-
        id'.'#text',$node.field1,$node.field2,$node.field3,$node.field4,$node.field5,$node.field6,$node.fiel
        d7,$node.field8)
$array-join '', ''>> $outfile
}

# create start and end dates for next days query

$start=$start.AddDays(1)
$end=$start.AddDays(0).AddHours(23).AddMinutes(59).AddSeconds(59)
$startstring= $start.tostring("yyyy-MM-dd"+"T"+"HH:mm:ss"+"Z")
$endstring=$end.tostring("yyyy-MM-dd"+"T"+"HH:mm:ss"+"Z")

# loop while the next day to query day is less than last day of the query.

}While ($start-lt $endloop)
}
```