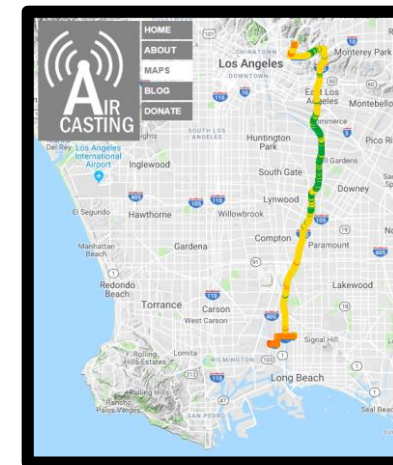




# Participatory Community Air Monitoring

*Using AirBeams &  
Viewing Data on AirCasting.org*

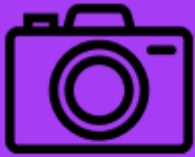


Environmental Health Centers  
Community Engagement Program on  
Health and the Environment

[ehc.usc.edu](http://ehc.usc.edu)



# Contents



## Background

- Community Driven Air Monitoring
- Understanding the measurements

## AirBeams

- Brief overview of AirBeam & AirBeam2
- Start AirCasting: AirBeam
- Start Air Casting: AirBeam2
- During AirCasting session
- Start session
- Stop and Save Session
- Connecting to WiFi & Sync Sessions
- Viewing sessions on Phone
- Viewing sessions on Website

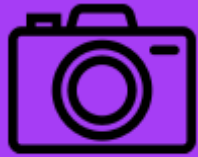
## Setup info + troubleshooting

- Settings for Phone
- Settings for AirCasting app
- Screens that might pop-up

## Technical Notes

### Draft Sensor Scale





# Community driven air monitoring

Air pollution across Los Angeles does not affect communities equally. The presence of freeways and industry can influence concentrations of particulate matter (PM).

In response to community requests to understand and document air quality information in cumulatively burdened neighborhoods, the USC Community Engagement Program on Health and Environment (CEPHE) along with environmental justice organizations in the Los Angeles area, collaborated to decentralize and democratize air quality measurements.

**The Goals:** To increase environmental health literacy, collect community-owned data, and promote awareness about exposures to pollution at the neighborhood level in environmental justice communities in and around Los Angeles.

**The Approach:** Based on data-driven questions, collect, visualize and contextualize air pollution data, across space and time. Use portable low cost air pollution sensors to characterize and map air quality indicators at the individual- and neighborhood- scale. Pollution monitors used include the AirBeam (PM<sub>2.5</sub>) and the P-trak (ultrafine particles).

**Results:** To document our air monitoring work with community groups, we developed [this interactive Story Map](#), showcasing the community-driven air monitoring activities implemented by the Community Engagement Program on Health and the Environment of USC Environmental Health Centers. These activities are meant to be a snapshot of pollution levels recorded and mapped on a single day.



# Understanding the measurements

**Why Particulate Matter (PM):** Human exposure to particulate matter ( $PM_{2.5}$ ,  $PM_{10}$ , and Ultrafine Particulate Matter) are known to impact health across the lifespan. The USC Environmental Health Centers had worked for many years to understand and communicate risks regarding PM and health.

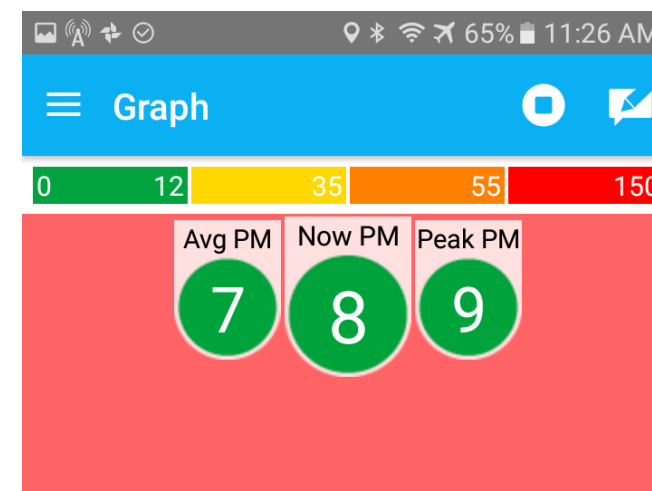
The AirBeam and AirBeam2 are a low-cost devices that measure  $PM_{2.5}$  (fine particulate matter) as well as  $PM_{10}$  and  $PM_{10}$ . Measurements of  $PM_{2.5}$  and  $PM_{10}$  regulated by the US EPA and are used as an indicator air quality around the country and the world on a daily and yearly basis. The common unit of measurement for PM is micrograms per cubic meter,  $\mu g/m^3$ .

Across both AirBeam platforms,  $PM_{2.5}$  is measured. The US EPA National Ambient Air Quality Standard (NAAQS) for  $PM_{2.5}$  averaged over a year is  $12\mu g/m^3$ . The standard for  $PM_{2.5}$  over a 24 hour period is  $35\mu g/m^3$ , meaning over any 24-hour period the average  $PM_{2.5}$  concentration should not exceed  $35\mu g/m^3$ . The annual  $PM_{2.5}$  average in Los Angeles for 2017 was.... and the the daily average in Los Angeles county in 2017 ranged from 13 to 33  $\mu g/m^3$ .

Data collected by AirBeams can be very useful tools for communities to collect on the ground data that can indicate trends in  $PM_{2.5}$  exposures on the neighborhood level. This highly personalized data can reveal information about exposure patterns and environmental factors that influence such patterns.

Understanding the numbers associated with  $PM_{2.5}$  enable community members to more fully understand their exposure to this harmful pollutant. AirBeams can be easily worn or carried by people who travel on foot, by bike, or in motorized vehicles. Data collected by AirBeams and other low cost sensors are not regulated to obtain data that can be used to determine if air quality standards are being met.

[Link to infographic](#)





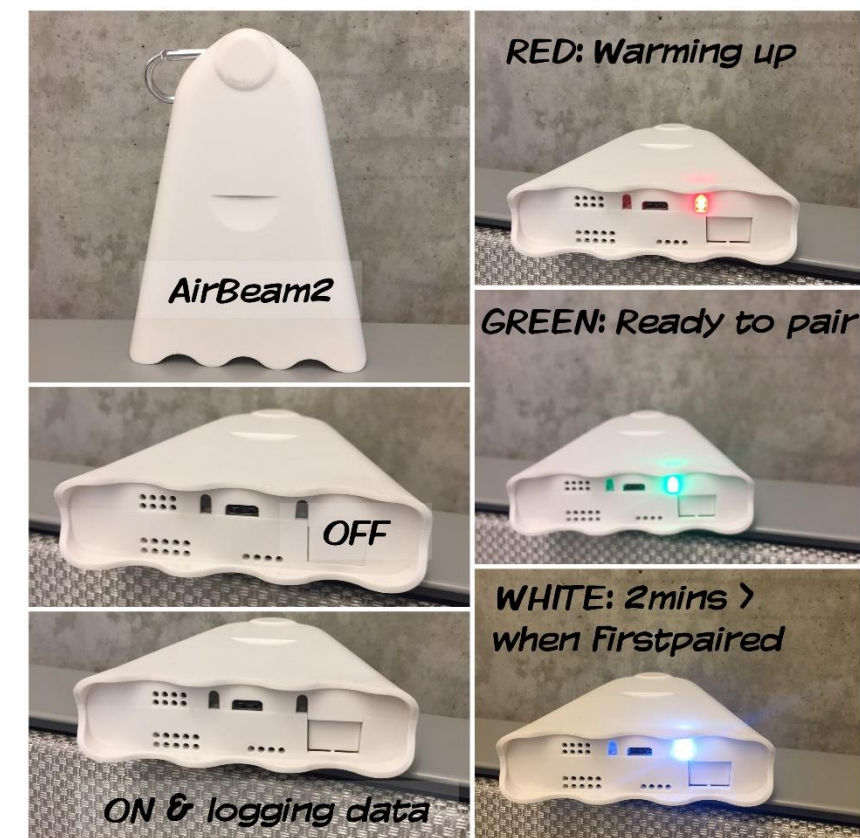
# AirBeam & AirBeam2



- There are two types of AirBeams. The black case device is referred to as *AirBeam* in this manual. The white case device is referred to as *AirBeam2* in this manual.
- The AirBeam is the second generation of the device.
- The AirBeam2 is the third generation device. It was released in Spring 2018.
- There are several differences between the two devices. The AirBeam2 measure 3 sizes of PM and the AirBeam measures PM<sub>2.5</sub>.



| Sensor                       | AirBeam | AirBeam2 |
|------------------------------|---------|----------|
| Temperature (F)              | X       | X        |
| Relative humidity (RH)       | X       | X        |
| PM <sub>1</sub>              |         | X        |
| PM <sub>2.5</sub>            | X       | X        |
| PM <sub>10</sub>             |         | X        |
| Sound (DB) *option via phone |         |          |



For information on the AirBeams go to [AirCasting.org](https://aircasting.org):

- Order [here](#)
- AirBeam2 specifications and performance [here](#)

# Start AirCasting: AirBeam2



Connect the AirCasting app to the AirBeam sensor by following these steps:

1. Make sure the AirBeam2 is off.
2. Open the AirCasting app on the Android phone.
3. Turn on the AirBeam2. The red light will blink for a few seconds, *when it turns green go to the next step.*
4. Press the Configure AirBeam2 button
5. **Available Devices:** Connect. (if you accidentally Pair New Device you will need to start the whole process over, you are not connecting a new device). Close the app, turn off the AirBeam and start over.
6. **Session Type:** Mobile
7. In 5-20 seconds, sensors (F, PM1, PM10, PM2.5, RH) from the AirBeam2 will appear on the screen and the green light will turn to solid white. After a couple of minutes the white light will go off. Don't worry, the AirBeam is still connected.

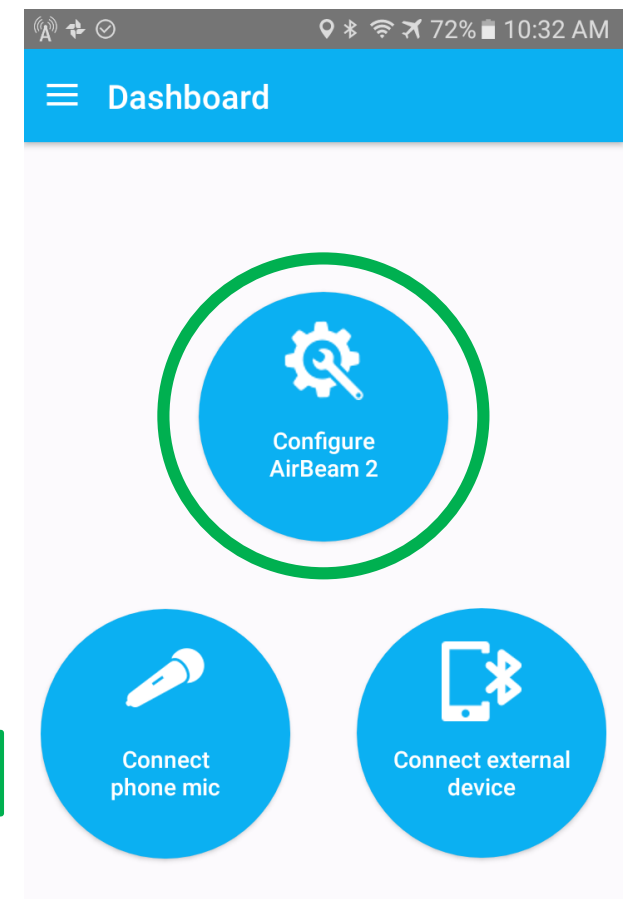
## Available Devices

Airbeam2:00189610501C

00:18:96:10:50:1C

connect

Pair New Device



## Session Type

Mobile

Fixed

**RED: Warming up**



**GREEN: Ready to pair**



**WHITE: 2mins > when Firstpaired**



**ON & logging data**



Environmental Health Centers

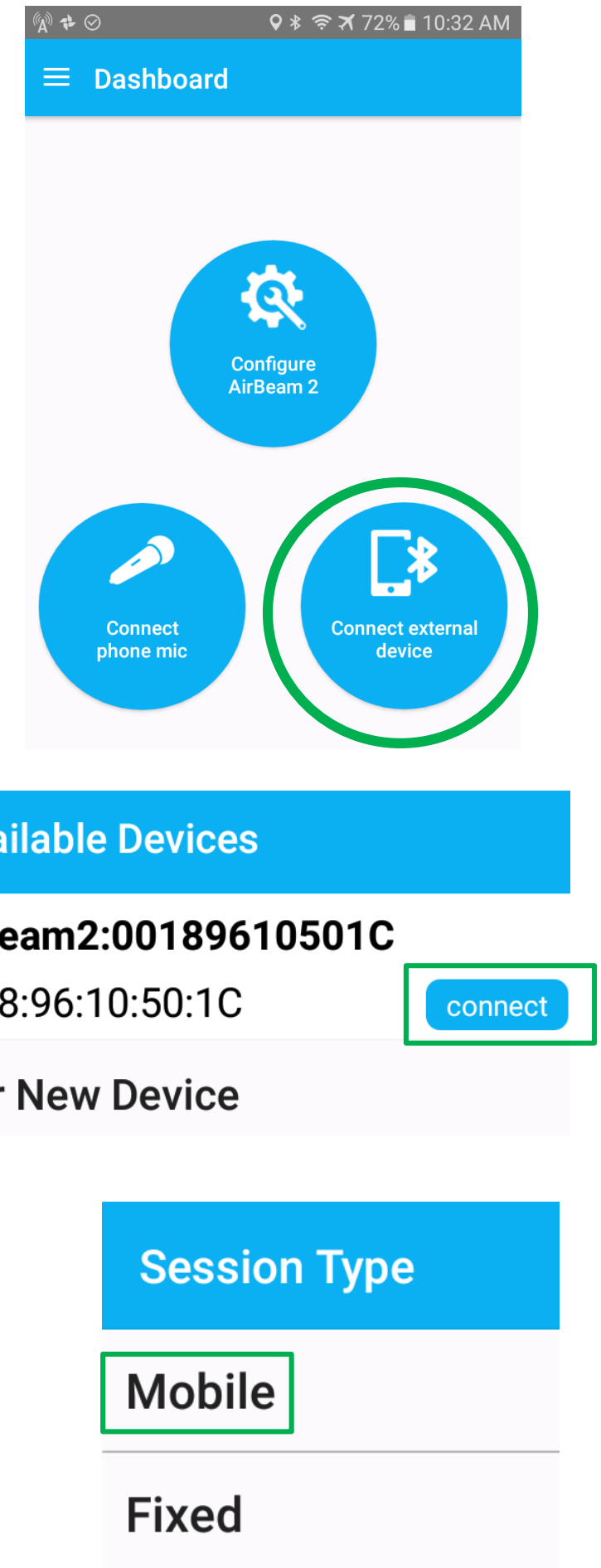




# Start AirCasting: AirBeam

Connect the AirCasting app to the AirBeam sensor by following these steps:

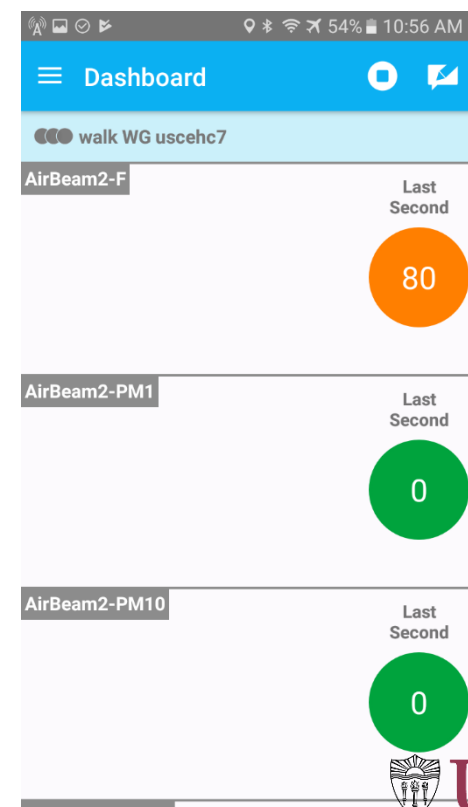
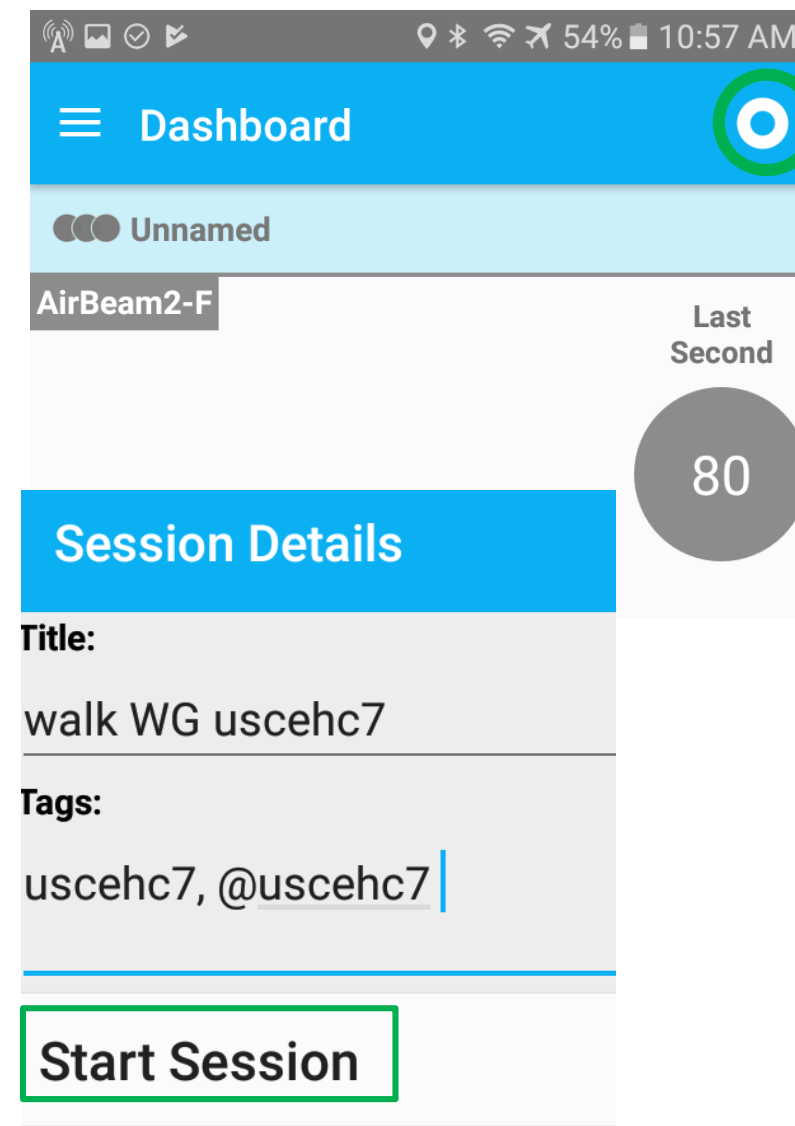
1. Make sure the AirBeam is off.
2. Open the AirCasting app on the Android phone.
3. Turn on the AirBeam: You'll know it's on when the red LED indicator begins blinking.
4. Press the *Connect external device* button
5. **Available Devices:** Connect. (if you accidentally Pair New Device you will need to start the whole process over, you are not connecting a new device). Close the app, turn off the AirBeam and start over.
6. **Session Type:** Mobile
7. In 5-20 seconds, sensors (F, PM, RH) from the AirBeam will appear on the screen and the blinking red light on the AirBeam will switch to solid red. You're connected!





# Recording an AirCasting session

- **Start recording a session:**
  - Press and Hold the circle button at the upper right of the **Dashboard** screen. "Start recording" appears. Let go and press the button again. The **Session Details** screen should appear
- **Session Details:**
  - **Name your session** with a naming convention that makes sense to you, or your group. Always indicate the name of the AirBeam in the session title and the tags. The USCEHC AirBeams have their names on the AirBeams and phones.
  - Click **Start Session**
- The session has started recording once the sensor bubbles turn from grey to various colors according to their levels.
- Identify the air intake and exhaust holes on the device make sure they are not covered up as you carry the device.







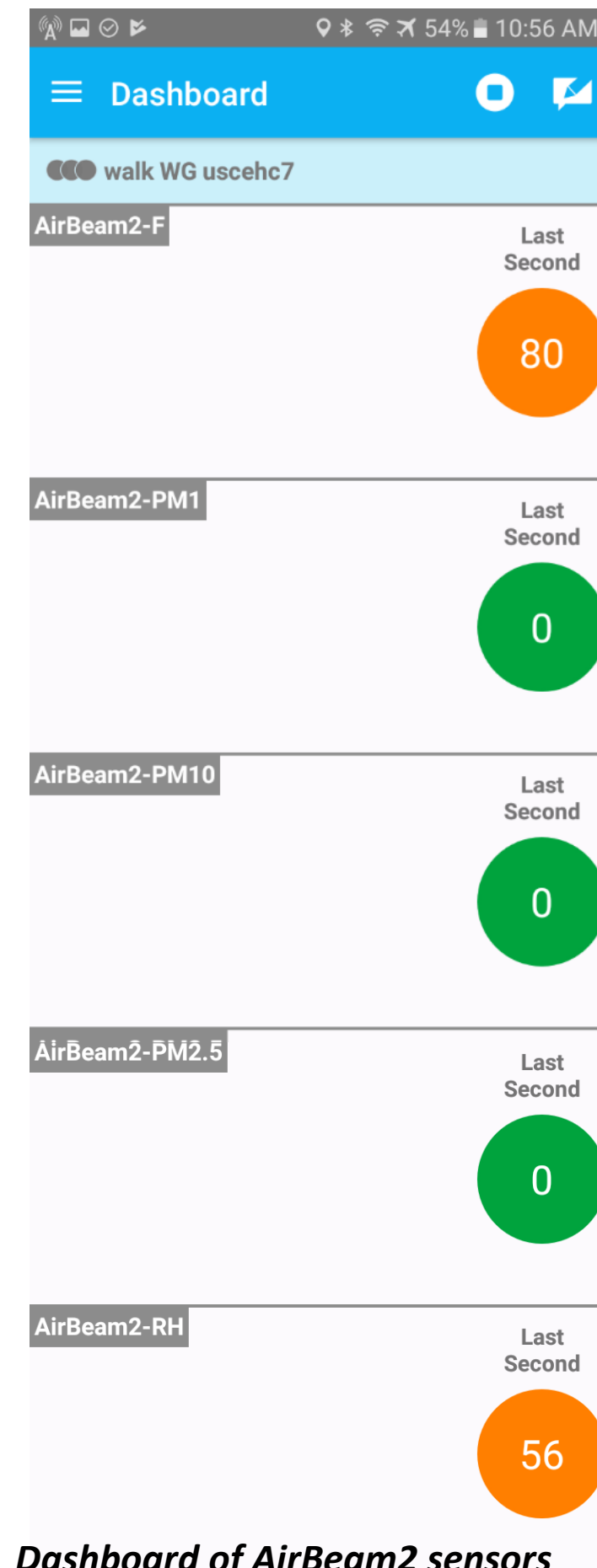
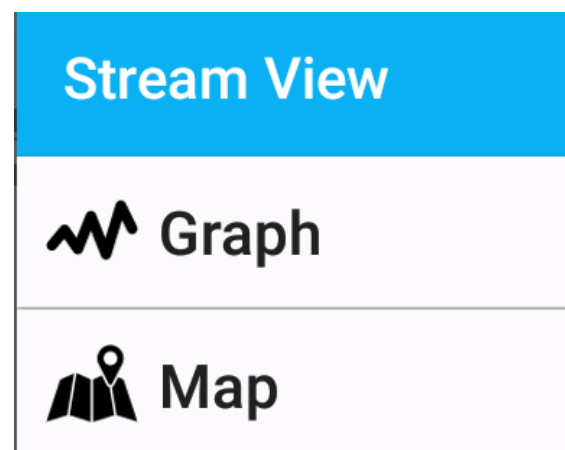
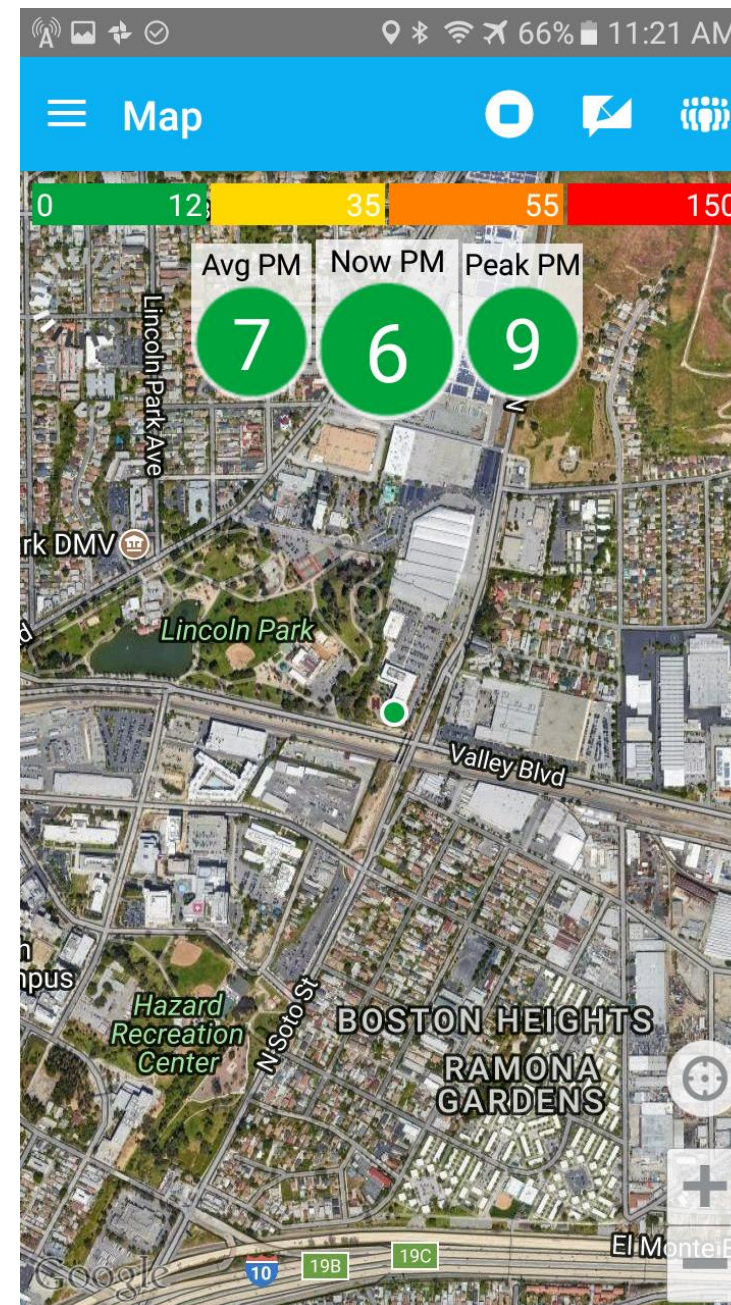
# During your AirCasting Session

**While recording a session:**

Map or Graph view:

- To see your session as it is recording in on the Map or Graph View, press and hold the color sensor bubble of your choice. (We select PM 2.5 most of the time.)
- The Map/Graph window will appear, select how you want to view the stream of data.
- In the map or graph view, to see the levels from another sensor, click the NOW bubble in the middle. A list of the sensors will appear, select the sensor you want to view.

*To return to the Dashboard, select the menu icon in the left corner of the screen and go back to the Dashboard*



**Dashboard of AirBeam2 sensors**



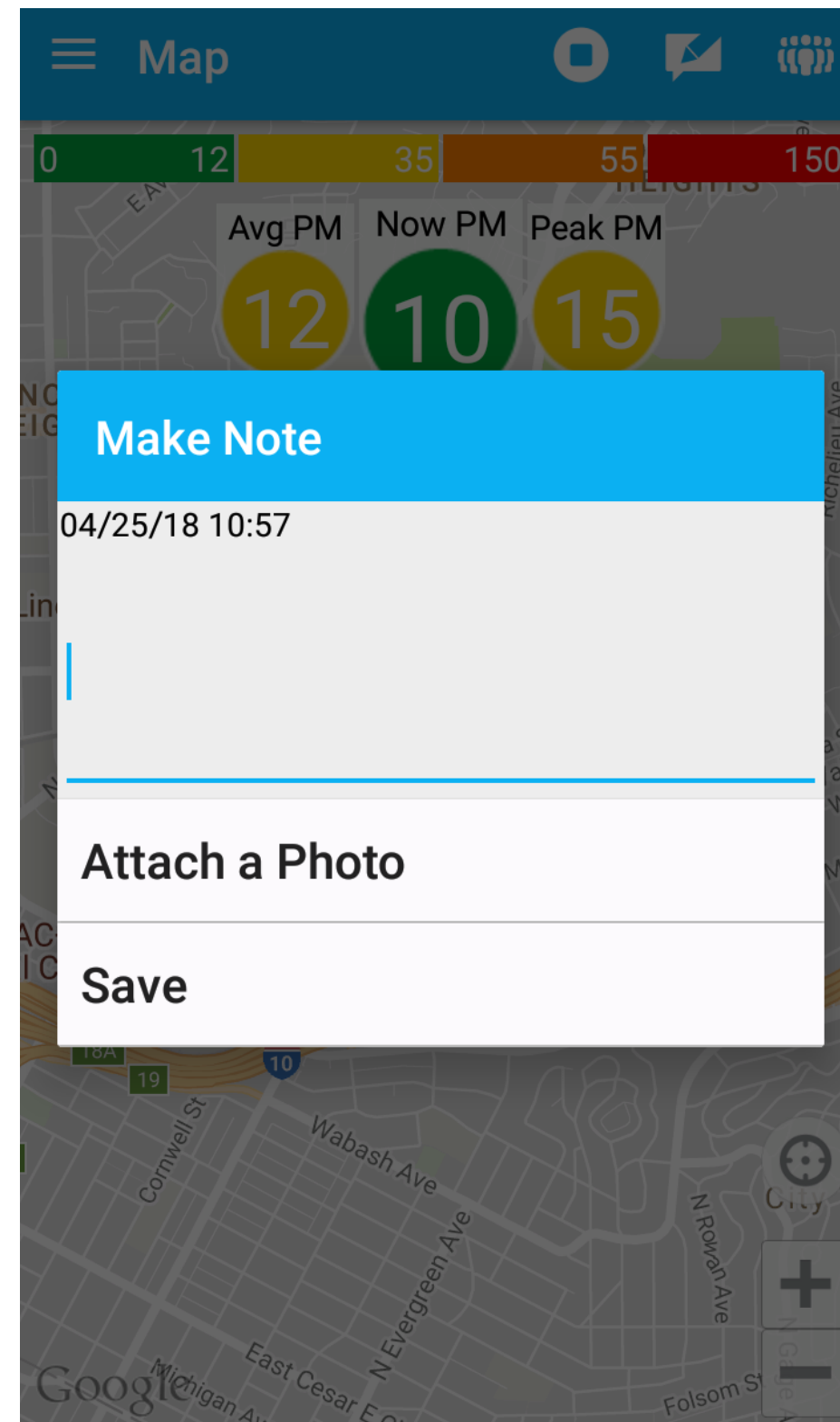
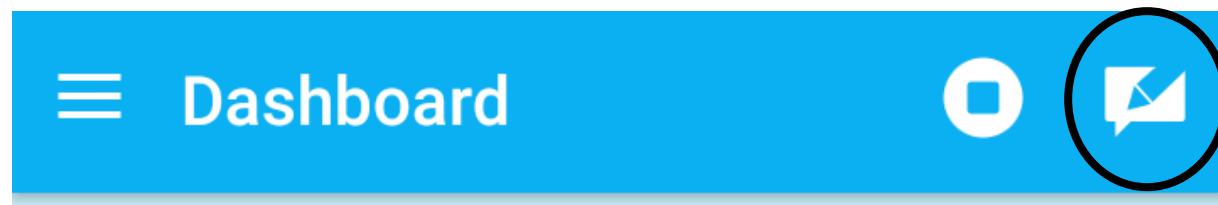


# During your AirCasting Session



## While recording a session:

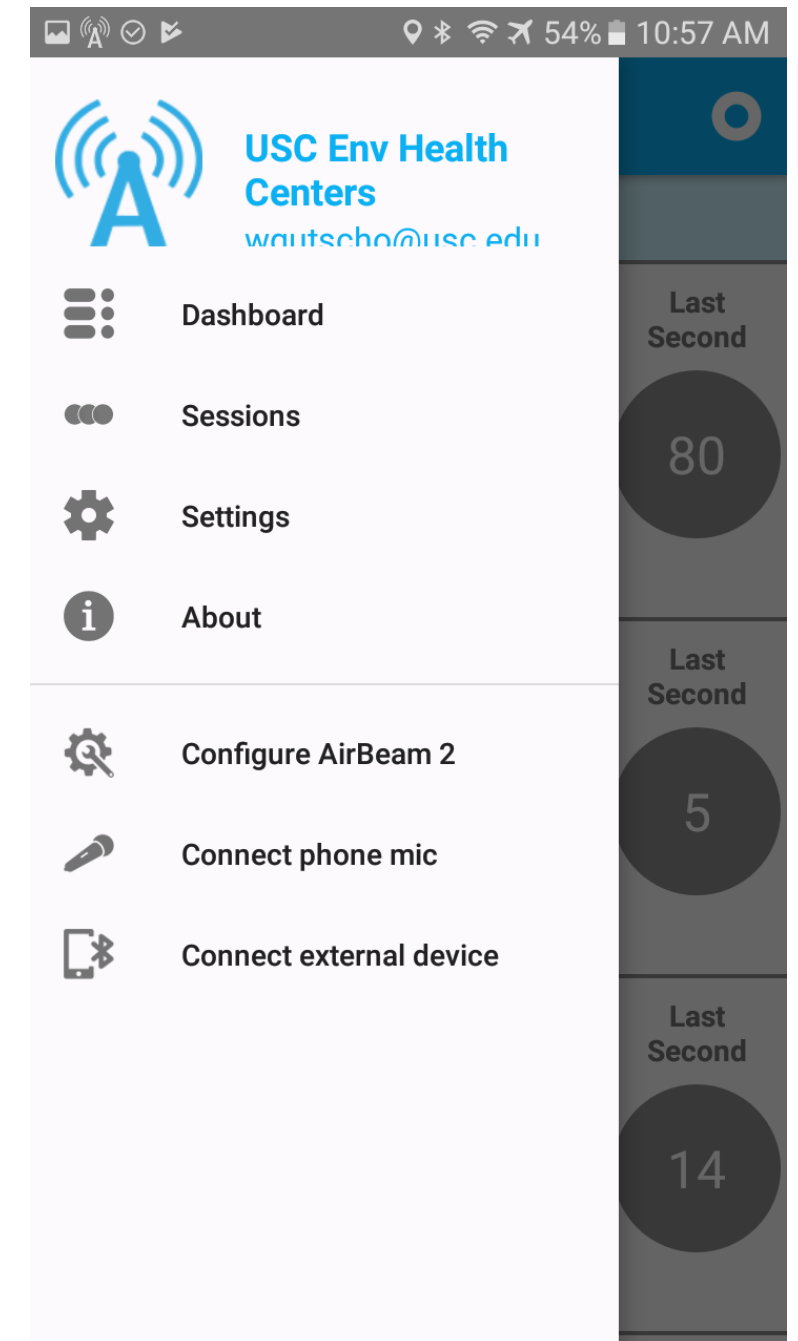
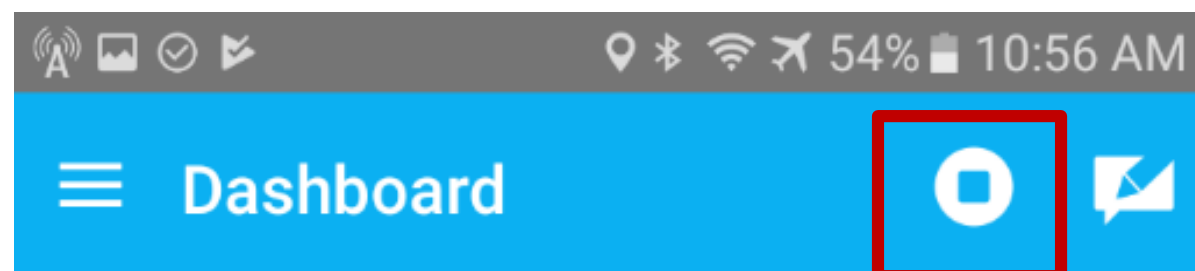
- Make a note: if you want to record your observations of your session on the phone, click the Note icon (pen/paper) in the upper right corner and make your note.
- You may also take photos of your session within the make a note feature.





# Stop and Save AirCasting

1. Press and hold the *Stop Recording* button to close out your session. Click the button again. Within 10-15 seconds the sensor bubbles will turn back to grey.
2. App crashes: sometimes when stopping a session the AirCasting app will crash.
3. If the app crashes, it will let you know it has crashed. The sessions are saved when the app crashes.
4. View your saved session by clicking the menu icon and clicking Sessions.



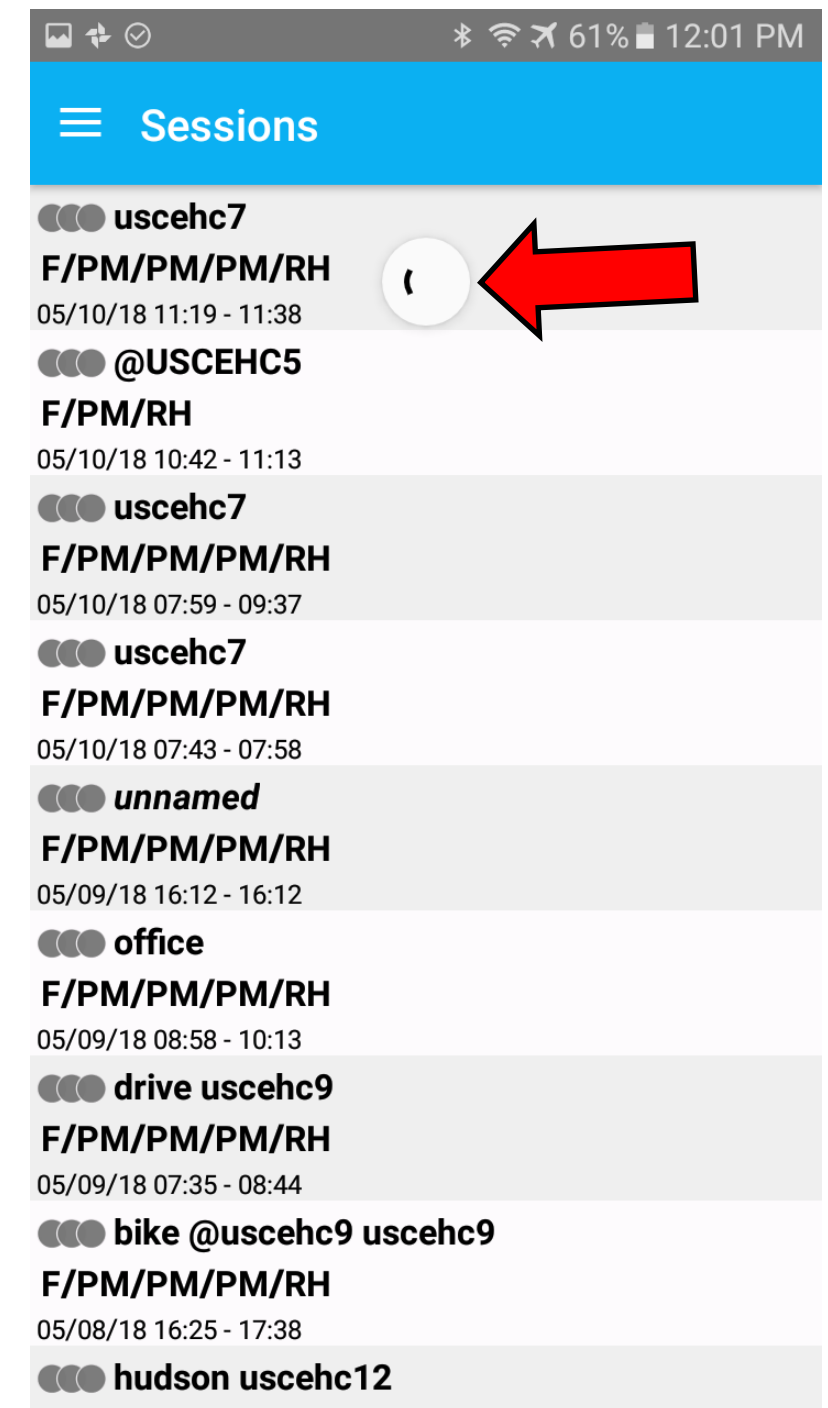


# Connect to Wifi and SYNC your AirCasting Sessions:

At the end of the day when you are done using the AirBeam, or when possible, SYNC your AirCasting sessions to the Cloud. By doing this, they will be available to be viewed in the AirCasting.org website:

Connect the phone to WiFi:

1. Click on the **Settings** App on the Samsung phone screen
2. In Settings find **Connections** (at the top of the screen)
3. Connect the Wifi to your network. If it is a public/unsecured network that is fine.
4. Open AirCasting App, press menu button in the upper left corner of the screen.
5. Click on **Sessions**.
6. The list of sessions you have recorded (and others recorded before yours) will appear in a list.
7. To make sure the sessions SYNC, swipe down anywhere on the screen and a circle will appear on the screen indicating it is Syncing.



# Viewing your AirCasting Sessions: Phone

There are several ways to view your recorded AirCasting Sessions.

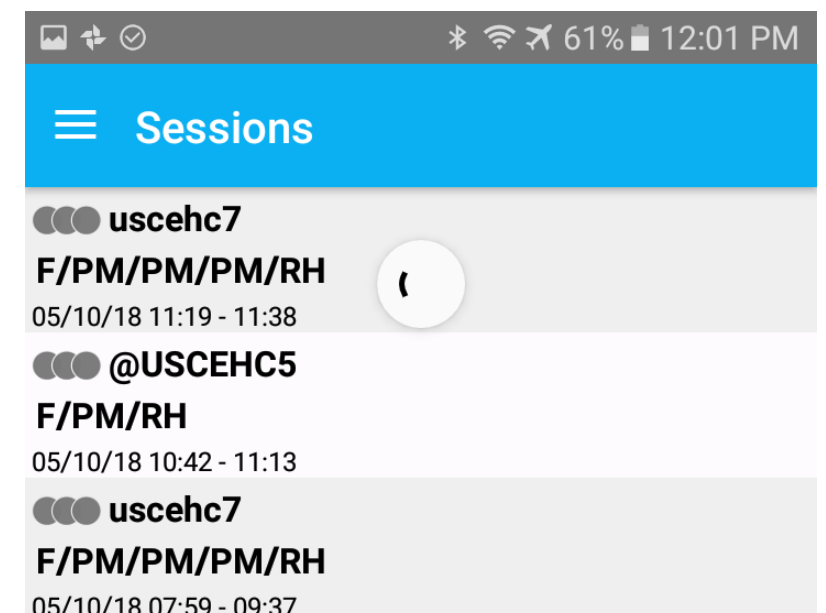
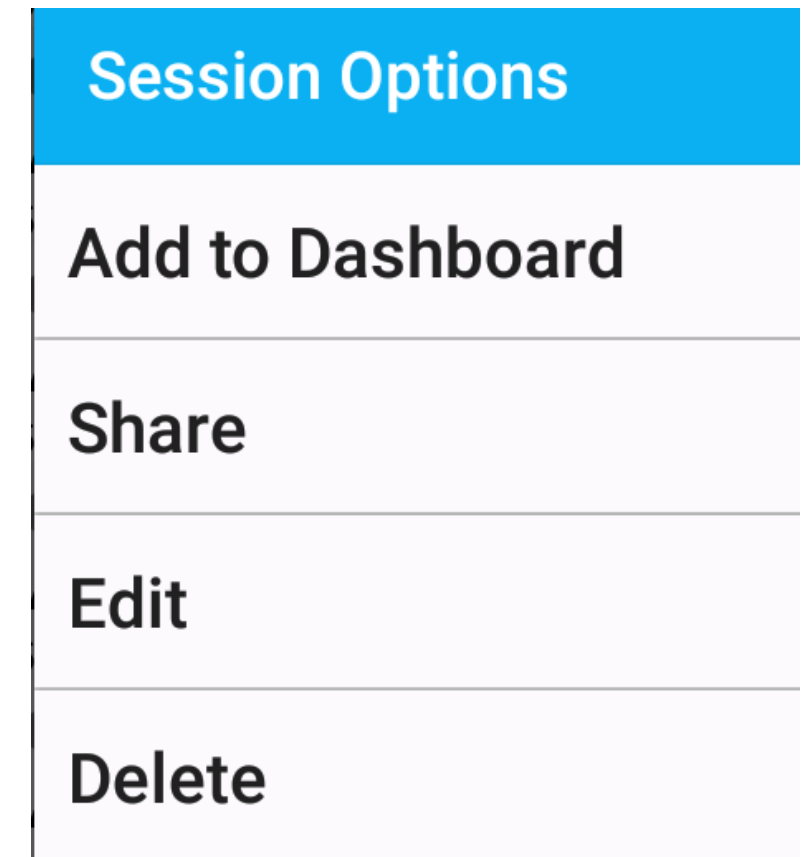
Phone: Go to the list of Sessions and click the session you would like to view. The session options menu appears.

**Add to Dashboard:** add the session to the dashboard. From the dashboard you can view the session graph or map as explained previously. You can add multiple sessions to the Dashboard. To get rid of viewing a session on the Dashboard, select the Broom icon at the top right of the screen.

**Share:** you can email the session in a CSV file format or a link to the AirCasting.org version of the session. If you choose either option, a GMAIL screen from the address [scehsc@gmail.com](mailto:scehsc@gmail.com). This is the USCEHC gmail. Feel free to type your email in and send the file or link to yourself or others using this method.

**Edit:** you may edit the title and tags of the session.

**Delete:** this will permanently delete a session.



# Viewing your AirCasting Sessions: Website

There are several ways to view your recorded AirCasting Sessions.

The most comprehensive way to view your sessions is on the AirCasting.org website.

Link: if you emailed the link of your session to yourself, click on the link sent via email on a computer to view your session.

How to find your sessions on AirCasting.org by searching the website: <http://aircasting.org/map#>

Click on the mobile tab on the right sidebar

In the Profile names field type in your group's profile name (you can see the profile name where you sign in to your account in the AirCasting app on the phone).

Pull down the menu in the "Parameter Sensor" field and scroll down to select one of the following:

**AirBeam:** Particulate Matter-AirBeam-PM ( $\mu\text{g}/\text{m}^3$ )

**AirBeam2:** Particulate Matter-AirBeam2-PM2.5 ( $\mu\text{g}/\text{m}^3$ )

*If you do not select the correct option, your sessions will not appear in the left sidebar.*

Once you are viewing the sessions you want to see, adjust the Heat Legend Units in the right sidebar. This allows you to see more variation in color/levels of sensor data in your sessions. See the screen shot for some numbers you can input to visualize the sessions. Once you input the numbers click "SAVE"

The screenshot displays the AirCasting.org website interface. On the left, a sidebar contains search filters: 'Fixed', 'Mobile', and 'CrowdMap' tabs; a 'Parameter - Sensor' dropdown menu set to 'Particulate Matter-AirBeam-PM ( $\mu\text{g}/\text{m}^3$ )'; a 'Location' section with an address input field and a 'Within' radius dropdown set to '10 Miles radius'; a checkbox for 'Limit my search to the current map view'; a 'Profile names' input field containing 'USC Env Health Centers'; a 'Tags' input field; and a 'Time Range' dropdown. Each filter section has 'reset' and 'submit' buttons. On the right, a 'Sessions' sidebar shows a list of recorded sessions, each with a checkbox, location, date, and time range. The third session is selected and highlighted in blue. Below the sessions list is a 'Heat Legend Units' section with a scale from 0 to 150  $\mu\text{g}/\text{m}^3$ , color-coded from green to red. A 'reset' button and a 'save' button are at the bottom right.

Fixed Mobile CrowdMap

Parameter - Sensor  
Particulate Matter-AirBeam-PM ( $\mu\text{g}/\text{m}^3$ )

Location  
Address, Intersection, or Zip  
Within  
10 Miles radius  
☐ Limit my search to the current map view  
reset submit

Profile names  
USC Env Health Centers,  
reset submit

Tags  
reset submit

Time Range

Sessions export non

- ☐ PYA @USCEHC4  
API Forward Movement,  
10/19/2017, 16:07-16:37  
dB/F/PM/RH
- ☐ PYA @USCEHC4  
API Forward Movement,  
10/20/2017, 07:24-07:37  
dB/F/PM/RH
- ☒ PYA @USCEHC4  
API Forward Movement,  
10/20/2017, 11:50-12:22  
dB/F/PM/RH
- ☒ PYA @USCEHC4  
API Forward Movement,  
10/20/2017, 12:30-12:37  
dB/F/PM/RH
- ☒ PYA @USCEHC4  
API Forward Movement,  
10/20/2017, 13:35-14:40  
dB/F/PM/RH
- ☐ PYA @USCEHC4  
API Forward Movement,  
10/20/2017, 18:58-19:31  
dB/F/PM/RH
- ☐ PYA @USCEHC4  
API Forward Movement,  
10/20/2017, 20:20-21:22

Heat Legend Units

150 values greater than this won't be displayed

35

20

12

0 values less than this won't be displayed

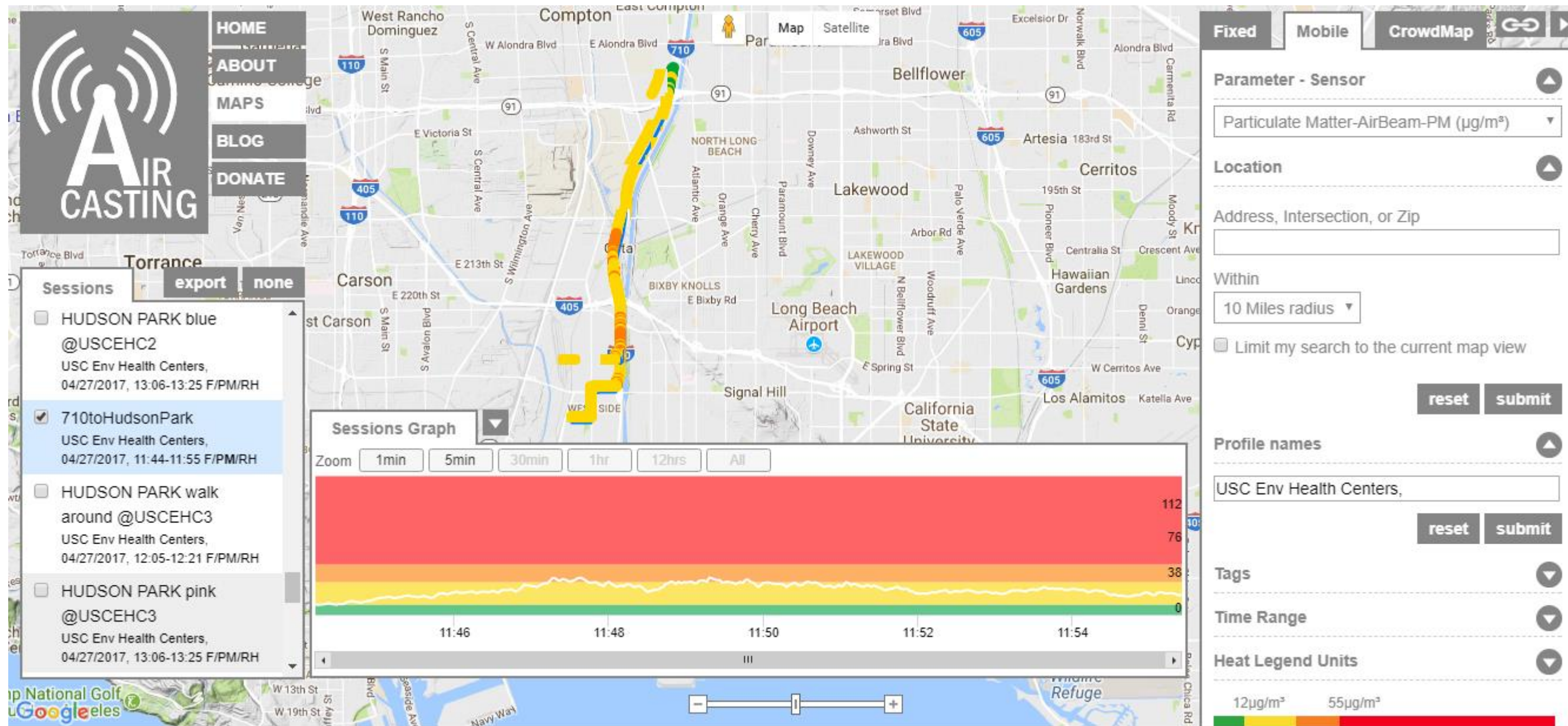
reset save

12 $\mu\text{g}/\text{m}^3$  35 $\mu\text{g}/\text{m}^3$

0 $\mu\text{g}/\text{m}^3$  150 $\mu\text{g}/\text{m}^3$



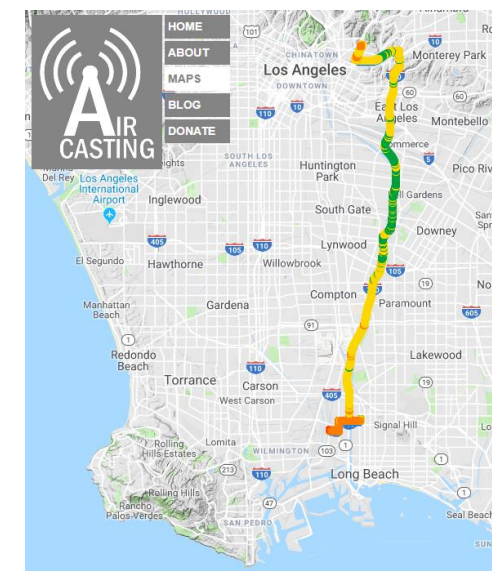
# AirCasting Website: [aircasting.org/map#](http://aircasting.org/map#)



- After session is saved on AirCasting app, sync session when on WiFi network
- Search for session and visualize your route and any of the data variables that were recorded (PM, temp, humidity, sound)

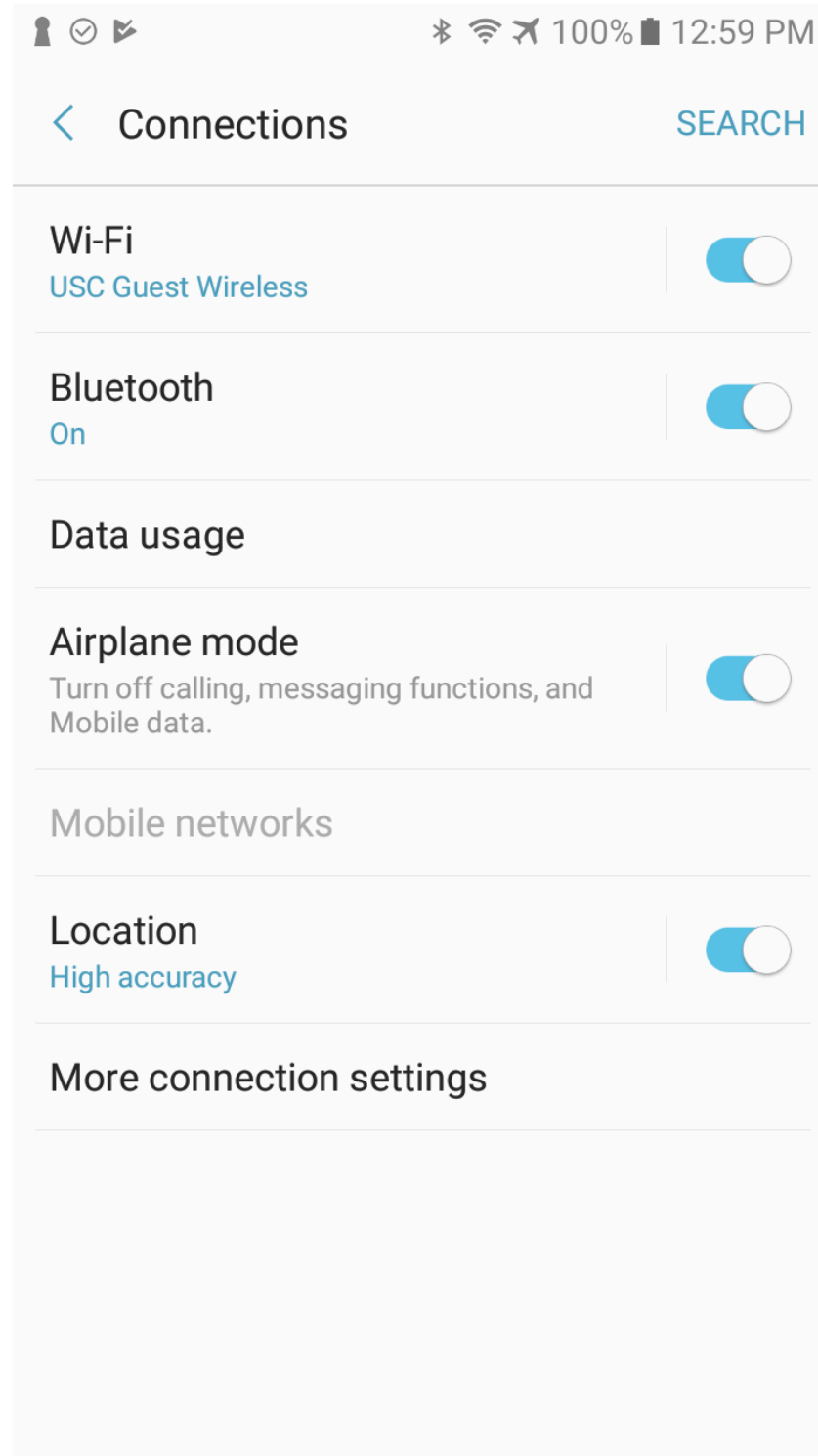


# Setup info + Troubleshooting





# Settings for Android Phone



The following settings are suggested for an Android phone when using the AirCasting app without a data plan on the phone.

Phone must have all the following ON:

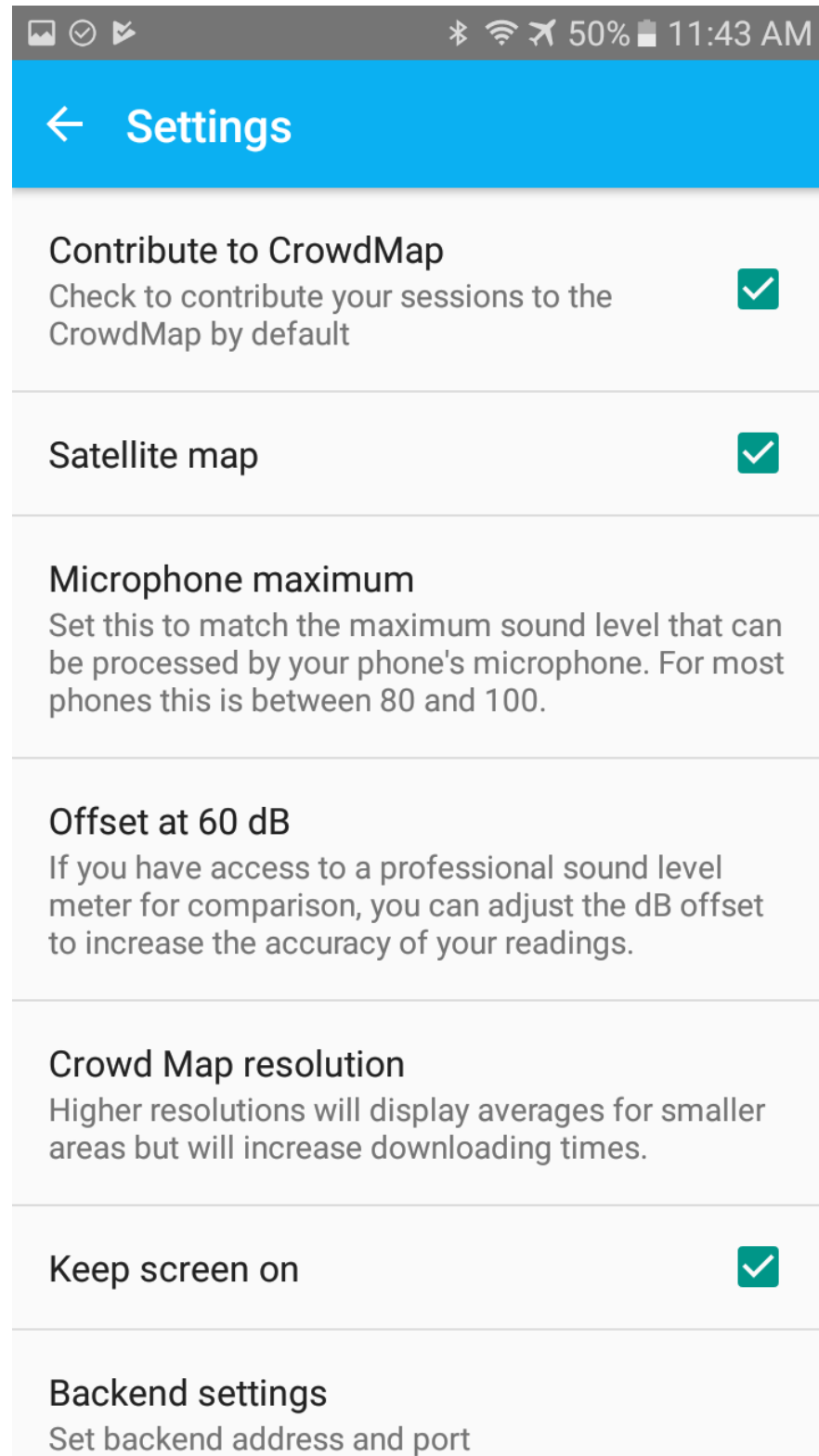
- Airplane Mode
- Bluetooth
- Wifi (it does not have to be connected to a network)
- Location: High Accuracy

Even if the phone is not connected to Wifi, it needs to have Wifi in order to record the location on the map.





# Settings for AirCasting App:



In the Settings of the AirCasting App, the screen should look like these two screen shots.

To find the Settings Menu: press the menu icon and select Settings.

Sync only through Wi-Fi ☒

Show route trace ☒


Show graph metadata ☐

Disable Maps



# Screens that might pop-up sometimes:

If this screen pops-up on the AirBeam, it is from a past session that ended without being saved. SAVE the session according to how you save sessions and then proceed with using the device.

 Session details

AirCasting recovered a session, possibly from a crash.

Title:

Tags:

Description:


Save session

Discard session

If this screen appears, select “SAVE and contribute”

59  
Humidity %

12  
Particulate Matter

 Contribute to

Do you want to contribute your AirCasting session to the CrowdMap? Sessions contributed to the CrowdMap are publicly accessible.

Yes, save and contribute

Save but don't contribute

AirBeam-F

Phone Microphone



# Technical Notes

Health Risk and the Air Quality Index: *When taking air quality readings from AirBeams, the USC CPHE team uses the EPA's Draft Sensors Scale to help AirBeam users understand approximate health risks.*

Often users of low cost sensors including AirBeams are interested in knowing what levels of PM<sub>2.5</sub> air quality readings would indicate health risks for people exposed to any given level of PM<sub>2.5</sub>. AirBeams, with their 1 minute readings provide a snapshot of air quality. However scientific studies have not used this type of data when researching the health effects of particulate matter. Research spanning the past several decades has used data from regulatory monitors to study the short and long term health effects associated with PM<sub>2.5</sub>. AirBeams are not regulatory monitors and because the data coming from them is does not meet regulatory standards, air quality readings (in micrograms per cubic meter) coming from AirBeams cannot be directly correlated with health effects seen in health studies documenting the effects of PM<sub>2.5</sub>.

Over the past several years, as low cost sensors have become more widely tested and used, the US EPA has done research to compare short term data from low cost sensors to the regulatory monitoring data (FRM FEM). Through this research the EPA has developed a scale for PM<sub>2.5</sub> (and Ozone) that can be used when considering the levels of PM detected by low cost sensors and how they equate with the health risks outlined in the Air Quality Index.

*"While we can't tell people what a 1-minute exposure means for their health, we understand that sensor users will want to know how minute-by-minute data might be useful for them. That led EPA to develop the sensor scale – an indication of whether air quality values fall into low, medium or high ranges for ozone or particle pollution. Used in conjunction with the Air Quality Index (AQI), the sensor readings can give you a good idea of when you may want to adjust your outdoor activities to protect your health."* – [EPA Draft Sensor Scale website](https://www.epa.gov/air-sensor-toolbox/what-do-my-sensor-readings-mean-sensor-scale-pilot-project)

On the following page the EPA Draft Sensor Scale for PM<sub>2.5</sub> can be found as it aligns with the Air Quality Index and associated health risk recommendations.

<https://www.epa.gov/air-sensor-toolbox/what-do-my-sensor-readings-mean-sensor-scale-pilot-project>





# EPA Draft Sensor Scale for 1 minute readings: PM 2.5

(Not for regulatory purposes)

| <i>PM 2.5 readings on low cost short term sensor:</i> | <i>Health Risk is....</i> | <i>What to do:</i>   |
|---|---------------------------|--|
| 0-29 µg/m3  | LOW                       | Enjoy outdoor activities   |
| 30-69 µg/m3   | MEDIUM                    | If medium readings continue for an hour or more use the AQI to plan outdoor activities                                 |
| 70-499 µg/m3  | HIGH                      | You may be near a source of particle pollution like dust, smoke, or exhaust. Check the AQI to plan outdoor activities. |
| >500 µg/m3  | VERY HIGH                 | (Same as above)<br>ALSO: Very high readings may mean the sensor is not working properly.                               |

## Air Quality Index: PM 2.5

| <i>When the AQI is in this range:</i> | <i>Air quality conditions are</i> | <i>What to do, who is at risk</i>  |
|---------------------------------------|-----------------------------------|--|
| 0 to 50                               | Good                              | Air quality is considered satisfactory, and air pollution poses little or no risk.   |
| 51 to 100                             | Moderate                          | Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution. |
| 101 to 150                            | Unhealthy for Sensitive Groups    | Members of sensitive groups may experience health effects. The general public is not likely to be affected.  |
| 151 to 200                            | Unhealthy                         | Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.   |
| 201 to 300                            | Very Unhealthy                    | Health alert: everyone may experience more serious health effects.   |
| 301 to 500                            | Hazardous                         | Health warnings of emergency conditions. The entire population is more likely to be affected.  |



USC

## Environmental Health Centers



Southern California  
Children's Environmental Health Center

Community Engagement Program on Health and the Environment

For question regarding the content of this document, please contact

Wendy Gutschow [wgutschow@usc.edu](mailto:wgutschow@usc.edu)