

## Q & A on air quality monitoring

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*Q1: Why do we need to monitor air pollution?*

A1: Monitoring is essential to understand the quality of the air that we breathe.

It is not enough to only measure the emissions that are being released by a certain activity, for example from the burning of coal for power generation, from the tailpipe of a car or from construction processes for two reasons:

First, once released, air pollutants react in the air and can form complex mixtures, so what's actually in the air may be quite different from what was being released. Sulphur emitted through fuel combustion contributes to the formation of particulate matter, the pollutant which is of greatest concern to health. Ground-level ozone, another air pollutant, is not emitted directly into the air, but is the result of a chemical reaction of nitrogen oxides in the sunlight.

Second, air pollutants travel over long distances and concentrations in any one place vary over time. Pollutants can even cross whole continents. The pollutants in the air of a city may not be the same as what is being emitted at the source, and concentrations may fluctuate significantly over the course of a single day.

Thus only the data on the concentrations of air pollutants allows for conclusions on the quality of the air, and how people's health is impacted. It also enables us to see where the pollution hotspots in a city are. Data from monitoring also helps to determine the right kind of policy-measures.

Air monitoring provides information on the short and long term exposure to pollutants and related health impacts.

*Q2: What is the situation on air monitoring in Bengaluru?*

A2: Currently, there are only 10 online monitoring stations operating in real-time in the city, providing data 24/7. Five of these went live in January 2018 and are located in Hebbal, Jayanagar, Kavika, NIMHANS, Silk Board[i].

The real-time data however is not available in an user-friendly format. There are three agencies, including the state pollution control board that are responsible for disseminating data. The availability of data on the KSPCB site makes it a complex and tedious process to understand access for location-specific data.

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In addition to the online monitoring stations that measure PM2.5 concentrations, the state pollution control board also has 14 manual monitoring stations which measure PM10 or the RSPM (Respirable Suspended Particulate Matter) on any two days in a week. In addition to the existing network, there is also a mobile van in place for any emergency measurements that may be needed.

This low number is inadequate to adequately assess the health impacts on the population. Researchers of the Urbanemissions project concluded in 2016 that “at least 41 continuous air monitoring stations [were required] to statistically, spatially, and temporally, represent the mix of sources and range of pollution in the city”<sup>1</sup>

In addition, the installed stations do not measure air quality at people’s breathing height and therefore do not provide information about pollution hotspots and individual exposure levels.

There are also some spots where manual monitoring takes place periodically. However, the data from this manual monitoring is not publicly available, but only upon request or in monthly summary reports.

Information on the results of the 10 online real-time monitoring stations, plus the ones that collect data from time to time is provided through monthly summary reports. These reports provide information on concentrations of PM10, PM2.5 and other pollutants, and also give an air quality index. This index is based on average PM10, PM2.5 and gases concentrations. Possible health impacts are described for each scale.

In the official monitoring bulletins the number of monitoring sites is given as 21, as both the real-time monitors as well as the sites with occasional monitoring are counted. However, only 10 of these actually record continuous data.

*Q3: Has there been any community monitoring?*

Overview of various community monitoring activities in this Citizen Matters article:

<http://bengaluru.citizenmatters.in/organisations-working-on-air-quality-in-bangalore-23290>

A3: In 2018, a report published by Climate Trends and Citizen Matters highlights the huge gaps in air quality information in Bengaluru <http://bengaluru.citizenmatters.in/bangalore-air-pollution-above-safe-limits-23220>

Using mobile devices, the groups monitored air quality over a 7 day period, for peak times at 7 selected transport intersections (The seven arterial routes had a common starting point—Jayanagar/Banashankari touching Marathahalli, Silk Board, Electronic City, White Field, Uttarahalli, MG Road and Mekhri Circle)

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<sup>1</sup> <http://www.urbanemissions.info/india-apna/bengaluru-india/>



The results are not directly comparable to official monitoring data, as the time frame was shorter. However, the averages observed over the four-hour auto rides carried out in two parts consistently generated averages above 200  $\mu\text{g}/\text{m}^3$  PM<sub>2.5</sub>, which indicates that very poor air quality levels prevail for several hours every day owing to traffic congestion. The WHO recommendation for the daily average of PM<sub>2.5</sub> is 25  $\mu\text{g}/\text{m}^3$ .

Another project was carried out by Sensing Local, 'Breathe Bengaluru' is a collaborative study, conceived to develop a hyperlocal, scalable, 'Neighbourhood model' to understand deteriorating air quality in the context of the Indian city fabric and its impact on public health, ground up. The exercise brought together a coalition of experts in the fields of urban planning, atmospheric sciences, public health, traffic modelling and technology (sensor makers) in conjunction with local resident community groups. A key aspect here, was the focus on 'assessing local air', as opposed to ambient air, so that AQ data is more reflective of the experience of air pollution on ground. <https://www.sensinglocal.in/breathe-bengaluru>

*Q4: What is the concern about the official Bengaluru air quality index?*

A4: The possible health impacts in this air quality index do not reflect the actual health threat.

The Air Quality Index is understood to be a comprehensive measurement based on eight different parameters, including ozone and carbon monoxide. The daily air quality bulletin generated by the Central Pollution Control Board reflects that the data used from the State Pollution Control Board varies from time to time on the number of monitoring stations and the parameters used to collate the index.

However it is difficult to compare this air quality index with WHO recommendations.

Using a unit of one month makes it difficult to compare to health-based WHO recommendations which are either average levels for a single day, or for one year. For PM<sub>10</sub>, WHO recommends a maximum average concentration of 50  $\mu\text{g}/\text{m}^3$  for daily exposure, and 20  $\mu\text{g}/\text{m}^3$  for one year.

It is also not clear on why the possible health impacts in the scale have been defined the way they are: is the scale giving possible impacts for short-term or long term exposure? Why are health impacts in healthy people only predicted to start at severe PM<sub>10</sub> pollution concentrations of over 400  $\mu\text{g}/\text{m}^3$ ?

The World Health Organization has repeatedly stated that there is no safe level of PM exposure.

*Q5: What are the Healthy Air Coalition's plans for monitoring air quality?*

A5: One of the aims of the Healthy Air Coalition is to provide accessible, high quality air pollution data to the public, policy-makers and health experts, to assess the health burden of air pollution in the city and use that information to drive specific measures for improving Bengaluru's air.

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The Healthy Air Coalition will be installing 40 stationary monitoring devices across our city in spring 2019, with the first 15 monitors installed and generating data available to the public by April 5, 2019. The Coalition is committed to maintaining these monitors for at least a year, so that by the end of the monitoring period health experts can carry out a robust comparative analysis of annual average concentrations against WHO recommendations and Indian standards, in addition to assessing daily concentrations.

The Coalition will also collaborate with other actors and initiatives focused on addressing air pollution in Bengaluru, such as the BBMP and the Clean Air Platform, to ensure that this air quality data and related analyses and findings helps to inform their plans to improve ongoing air quality monitoring efforts in Bengaluru in the long term.

The location of these monitors has been chosen in collaboration with health members of our coalition, especially health experts at St. John's Research Institute. They are being set up near pollution hotspots, and within a network of Primary Health Care Centers of BBMP, where groups that are more vulnerable to pollution impacts are regularly exposed. This includes schools, kindergartens, and hospitals. For the list of monitoring sites, see below.

In addition to stationary, regulatory-grade monitors, the Coalition will also be leading community-based monitoring efforts with mobile monitoring devices. In comparison to fixed stations, mobile monitoring allows for the tracking of an individual's exposure in different locations, over a short-period of time. As individuals pass through their day, from home to work, to leisure, and back home, mobile monitoring shows the air pollution concentrations in these locations. By supporting such community-based monitoring efforts, health professionals involved in the Healthy Air Coalition will both gather important, policy-relevant insights about the health effects of air pollution in key hotspots across the city and engage different citizens groups in the solutions agenda.

*Q6: What kind of monitoring devices are in use by the coalition?*

A6: The past few years have seen a huge increase in the availability of low-cost sensors to monitor air quality, which has enabled individuals and experts to carry out monitoring in addition to the official monitoring that takes place in cities across the world.

Sensors that record air pollution can be either fixed (stationary) or mobile devices; both offer certain advantages.

The global partners of the Healthy Air Coalition (GCHA, GCCA and HEAL) have carried out a review of available sensors, in India and internationally, and carefully checked against the monitoring needs in Bengaluru. On the basis of this analysis, the Coalition has decided to begin monitoring efforts with the following fixed and mobile devices:

The network of 40 monitoring stations will be a fixed system, for which monitors are provided by Clarity Air Monitoring Solutions. This system of fixed devices will provide high-quality  
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readings of pollution concentrations throughout the coming year with a high degree of reliability, and low maintenance costs. This will allow experts to analyse the health impacts of long-term exposure to air pollution (assessments of short-term exposure are also possible).

These fixed sensors provide real-time measurements of two key air pollutants: particulate matter (PM2.5) and Nitrogen dioxide (NO<sub>2</sub>), as well as Temperature (T) and Relative Humidity (RH), data which is necessary to provide properly calibrated data.

Real time data collected by each sensor will be made available to the public via [openmap.clarity.io](http://openmap.clarity.io) and [www.unmaskmycity.org](http://www.unmaskmycity.org)

The system will use 'smart calibration' to compare the results of the devices with local environmental parameters and government-operated regulatory monitoring devices, as well as machine learning algorithms to improve aggregate data estimations over different areas of the city.

As of March 2019, Clarity Air Monitoring Solutions has deployed air quality monitoring networks in 50+ cities, throughout 30+ countries across six continents.

For mobile monitoring activities the Healthy Air Coalition will be using the AirBeam monitor, which also allows for a visualization of pollution concentrations using smartphone graphs and online, crowdsourced maps.

The AirBeam is an open source air quality monitor developed by US NGO HabitatMap in partnership with the Mechatronics Technology Center at the New York City College of Technology, and the New York Hall of Science, and has been used by health professionals across the globe as part of the *Unmask my City* initiative.

The AirBeam uses the light scattering method to measure fine particulate matter, or PM2.5. Air is drawn through a sensing chamber wherein light from a laser scatters off particles in the airstream. This light scatter is registered by a detector and converted into a measurement that estimates the number of particles in the air. Results are then displayed through the Aircasting smartphone app, and are also fed onto crowdsourced maps on the *Unmask My City* website. The results can also be converted to visual light signals through LED-equipped devices, for example face masks.

The scale used by the Aircasting app to categorise PM2.5 measurements is based on the revised Air Quality Index for PM2.5 annual averages by the US EPA.

Corresponding colour scale descriptions are:

- **Green:** Good quality air with little to no risk (<12 µg/m<sup>3</sup>)
- **Yellow:** Moderate risks for those unusually sensitive to air pollution (12 to 35 µg/m<sup>3</sup>)
- **Orange:** Unhealthy for sensitive groups (35 to 55 µg/m<sup>3</sup>)
- **Red:** Unhealthy for everyone, with sensitive groups potentially facing serious health effects (above 55 µg/m<sup>3</sup>).

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First generation Airbeams devices used by the Healthy Air Coalition are not able to accurately measure PM2.5. values greater than 150 µg/m3.

*Q7: Why did you choose a US company for monitoring in Bengaluru?*

A7: The Healthy Air Coalition is using monitoring solutions that offer the best mix of quality, reliability, maintenance support, and cost. Clarity’s diverse, international team of young professionals, including co-Founder Baljot Singh of Indian origin, grew out from the University of California - Berkeley and, critically, has valuable experience from development of its global network of next generation, solar powered air quality monitoring devices. The Healthy Air Coalition will continue to review ongoing development of viable Indian alternatives and consider these for any future monitoring efforts.

*Q8: Where are the devices located?*

A8: The location of the first 15 of the total 40 devices of the fixed monitoring system is as follows:

No	Institution	Location	RFID	Active
1	St. John’s	Bannerghatta Road	ANFLVMRB	Yes
2	St. John’s	Mathikare	AKKMZZTM	Yes
3	St. John’s	MS Ramaiah City	ADYYP61M	Yes
4	St. John’s	St. John’s Research Institute, Koramangla	ADRMGGNB	Yes
5	St. John’s	Brigade Road Intersection	AGSDMHMM	No
6	BBPM	BBMP Head Office, Corporation Circle	AN86LJRX	Yes
7	Varsha Kej	Indiranagar	AVVXRF39	Yes
8	Yogesh Ranganathan	Azim Premji Philanthropic Initiative Initiatives, Sariapur	A61RWNQK	Yes

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9	Dr Lata/Dr Sudarshan CHO	Ulsoor RH	A8VYQKP6	Yes
10	Clements/Ferns Paradise	Doddanekund, White Fielsi	A9GDZF8D	Yes
11	Springfield/SriDevi/Meera Nair	Springfield Society	AT627RHW	Yes
12	BBMP Public Health Care Center	Camridge Road, Near Police Station, Ulsoor, Bangalore- 560008.	A8VYQKP6	Yes
13	BBMP Public Health Care Center	Next to Lions Eye Hospital, Off J C Road, H Siddaiah Road, Bangalore- 560002.		
14	BBMP Public Health Care Center and Maternity Care	NR COLONY - Subbaramma Shetty Road, Basavangudi, Bangalore- 560004.		
15	BBMP Public Health Care Center	SUBHASH NAGAR UPHC – opposite BBMP School, Srirampura		

Further devices will be placed in consultation with the healthy air coalition partners.

If you have a recommendation on where to place a device, please contact [aishwarya@env-health.org](mailto:aishwarya@env-health.org)

*Q9: What are your plans for monitoring in the upcoming months?*

A9: The fixed monitoring station will generate data that will be analysed by health experts at defined intervals (e.g. one month after installation, 3 months, 6 month, 1 year).

In addition we will be carrying out mobile monitoring with selected participants to better understand individual exposure and hotspots in our city.

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*Q10: Where will the data gathered be accessible and how will it be used?*

A10: The data gathered by the fixed and mobile monitoring will be available on open source websites, so free for everybody to use. Health experts and researchers of the Healthy Air Coalition, St. John's Research Institute and others will then be carrying out health impact analysis of the data, to understand the burden of disease from air pollution in Bengaluru.

The pollution data and health impact assessments will also be shared with policy-makers, for deliberations on air quality measures in the city.

Data can be accessed here - [openmap.clarity.io](http://openmap.clarity.io) and [www.unmaskmycity.org](http://www.unmaskmycity.org)

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