openaq

Open Air Quality Data: The Global Landscape

Written by the OpenAQ Team with
contributions from the OpenAQ Community

December 2022

Contents

Executive Summary

Open Air Quality Data: The Global Landscape *is the only global assessment of whether and how national governments are producing and sharing air quality data with the public.*

Governments have a responsibility to address air pollution—a leading health concern across the entire world that disproportionately harms residents of low- and middle-income countries. Reliable data on air pollution are fundamental to understanding and taking corrective action to improve air quality. OpenAQ analyzed the world's countries to determine which have government-level air quality monitoring programs and whether and how those governments are opening their monitoring data to the public.

Trends and gaps in monitoring and sharing

More governments are monitoring air quality and publicly sharing the data they collect than ever before, but huge gaps in monitoring still exist. Our analysis found that in 61% of countries some level of air quality monitoring is conducted or sponsored by governments at the national or subnational level. But many of the most populated, polluted countries lack nationally coordinated air quality monitoring programs. This means that at least one billion people are living where their national government doesn't monitor the most serious environmental risk factor for their health.

On a positive note, governments can more easily monitor air quality with the relatively recent introduction of air sensors to the marketplace. These instruments tend to be lower-cost and easier to deploy than the standard reference-grade monitors used by governments, and thus allow less-resourced governments to conduct more monitoring.

We found that 53% of countries publicly share air quality data. However, of these, less than half do so in a way that is maximally useful (in formats that are easily harmonizable with other data sources and allow for the most use-cases to be built on top of the underlying data). For example, some countries share their data as an Air Quality Index (AQI), which is an excellent way to inform the public about the immediate danger of polluted air, but AQIs cannot be used for such purposes as predicting future air pollution or helping to determine sources of air pollution. This means that less than one-quarter of the world's countries provide open access to maximally useful air quality data.

Recommendations

We urge governments to monitor air quality and to make the data fully accessible to the public so that everyone across private, public, and civil society can innovate, collaborate, and apply effective solutions towards clean air. We recognize that many low- and middle-income countries need support to make this happen, and therefore urge such entities as development banks and philanthropies to support less-resourced governments and to include conditions for data transparency in funding agreements.

Less than one-quarter of the world's countries provide open access to maximally useful air quality data.

At least one billion people are living where their national government doesn't monitor air quality—the most serious environmental risk factor for their health.

About OpenAQ

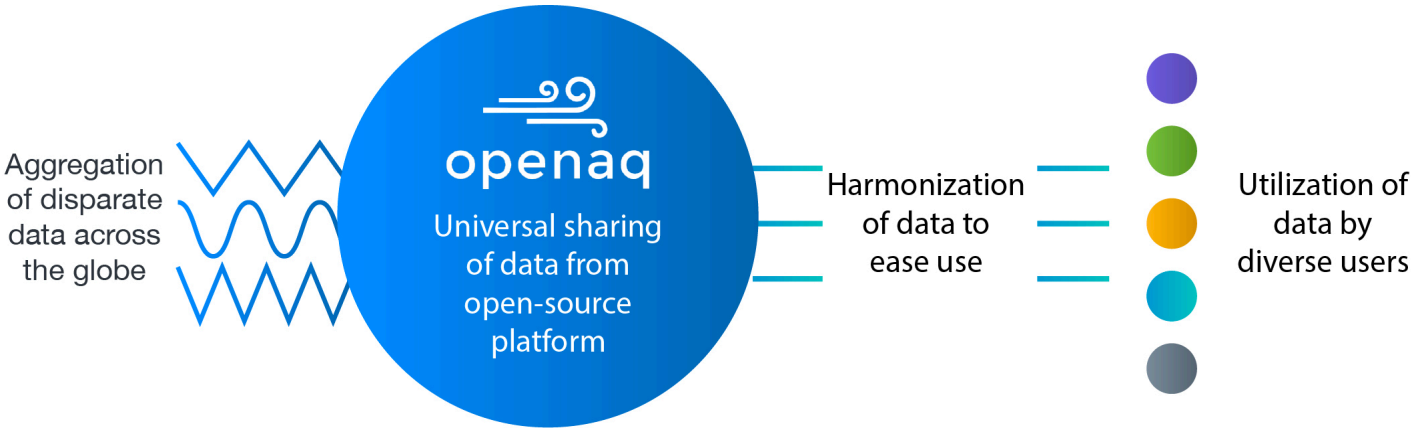


Figure 1: OpenAQ harmonizes air quality data from disparate sources into one single format so that the public can more fully maximize the uses—and ultimate impact—of the data.

OpenAQ's mission is to aggregate and harmonize open air quality data across the globe so that anyone concerned about air quality has unfettered access to the data they need to analyze, communicate and advocate for clean air. By providing universal access to data, OpenAQ empowers a global community of changemakers to solve air inequality—the unequal access to clean air.

The OpenAQ Platform aggregates disparate air quality data sources (station-level data produced by reference monitors and air sensors around the world), makes these data freely available programmatically on a fine temporal level, keeps underlying data-fetching software fully open, shares data in physical units rather than as an air quality index, and stores historical data not typically saved on other platforms.

By harmonizing the data into interoperable formats, the data are directly comparable and more easily analyzed across diverse applications.

The OpenAQ Platform is used for a wide variety of applications: air quality, health and climate change research and analysis; air quality forecasting; air sensor calibration; journalism; policy advocacy; and more. By filling a basic data-access gap, OpenAQ empowers a wide variety of individuals, organizations and sectors across the globe to apply data in pursuit of a clean air future.

OpenAQ is the largest open-source air quality data platform in the world.

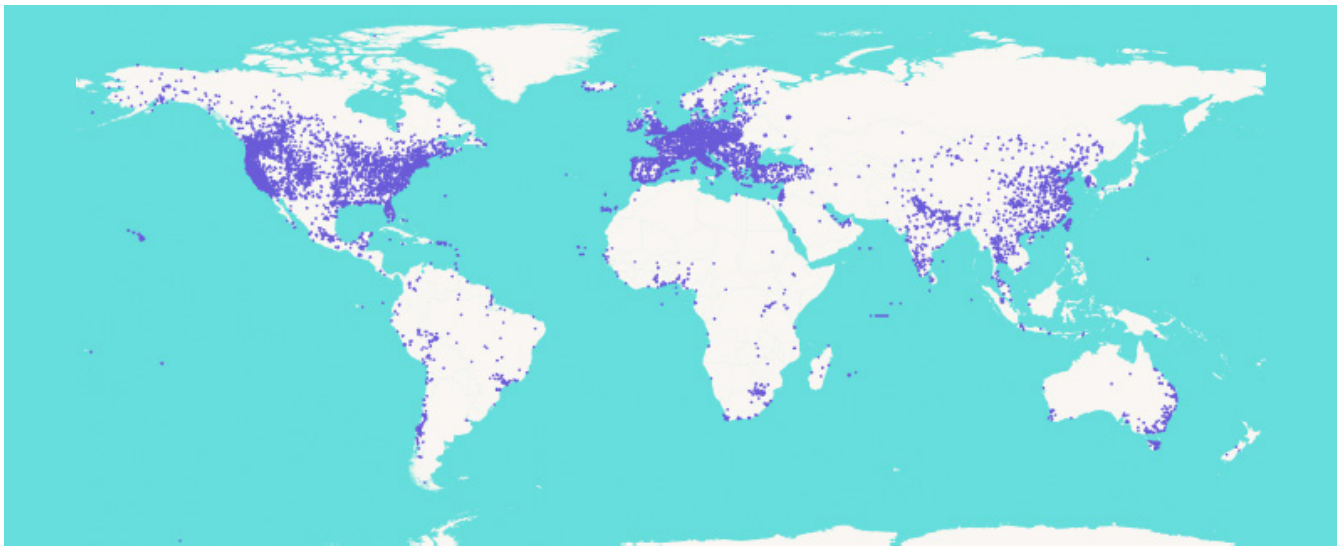


Figure 2. As of December 2022, OpenAQ ingests more than 25 billion air quality measurements from about 48,000 locations worldwide, on the order of 10 to 12 million measurements ingested per day.

Harmonized air quality measurements facilitate research.

The lead author of an award-winning paper investigating nitrogen dioxide and ozone levels across the world during COVID-19 restrictions (Keller, et al, 2021) said, "This paper would not have been possible without OpenAQ." Aggregated, harmonized data allow researchers to focus on analysis rather than having to find, gather and wrangle disparate data into a consistent format.

This assessment represents the current state of knowledge as gathered via public resources and the OpenAQ community. If you would like to contribute new information or submit corrections, please email info@openaq.org.

For the purposes of this assessment:

- "Air quality open data" is shorthand for ambient, ground-level and station-specific pollutant ($PM_{2.5,}$ PM_{10}, SO_2, NO_2, CO, O_3, and/or BC) data collected by or commissioned/sponsored by national or subnational governments.
- "Real-time data" is shorthand for data produced on daily or sub-daily levels and released on an approximate daily or sub-daily level.
- "Reference monitor" is shorthand for "government monitor," "reference-grade monitor" and "research-grade monitor."
- "Air sensors" is used to describe what are commonly referred to as "low-cost sensors."

1. Goals of This Assessment

This assessment reviews the global landscape of air quality data produced by governments.

Air quality data underpin all actions on air pollution. They tell us how much pollution is in the air we breathe. They predict how air pollution will change in space and time. They shape our understanding of how air pollution impacts human health, climate change, ecological health and economic well being. Air quality data serve as an important foundation for the design, implementation, enforcement and assessment of the effectiveness of pollution control policies.

Open data spurs pollution reductions.

Since 2008, the United States has installed more than 50 air quality monitors on its embassies around the world, sharing the data openly and tweeting real-time reports on air quality. In these host countries, fine particulate concentration levels have fallen substantially. (Jha and Nauze, 2022)

This global air quality data assessment identifies countries where no known air quality data are currently generated by government programs, pinpointing the most strategic locations for launching new monitoring and data-sharing efforts. It also identifies regions where a small, strategic investment in existing air quality data-sharing infrastructure could dramatically open up data access to the public.

In this assessment, we:

- Outline key criteria for sharing openly accessible air quality data.
- Use these key criteria to describe the current global landscape of government air quality data accessibility to the best of our knowledge and to identify opportunities to fill air quality data collection and data-sharing gaps.
- Share this information in such a way that the air quality community can provide feedback, corrections and updates.

2. How Air Quality Is Monitored

There are many ways to monitor air quality, including ground-based, airborne, mobile and satellite measurements. This assessment focuses on stationary ground-based monitoring networks, including reference monitors, air sensors and those in between (see sidebar).

Measurement methods may also be classified as online (also sometimes referred to as continuous or real-time) or offline. Beta attenuation monitors and optical particle counting techniques are classified as online, as these do not require additional laboratory techniques to determine the mass concentrations. On the other hand, offline methods, such as 24-hour filter-based gravimetric methods for particulate matter (PM) or cartridge-based sampling for gases, require laboratory analysis post-collection and thus are not reported in "real-time." For the purpose of this assessment, we focus on real-time data and use the term "real-time" so as to not confuse the term "online" with being available on the internet. However, note that both the US Environmental Protection Agency and the European Commission consider gravimetric methods to be the reference method. Offline methods also allow for further chemical composition analysis on PM samples.

Governments typically evaluate the state of air quality using data from ground-based monitors that are held to a "reference method" standard. Codified reference methods vary across the world, but as long as the monitors are well maintained, data from reference-grade monitors tend to be highly accurate. Therefore, measurements gathered from ground-based reference-grade monitors are the gold standard for measuring pollutant concentrations, and as such, remain the tool for regulatory compliance (Berman & Ebisu, 2020). In this report, the term "reference monitor" is shorthand for "government monitor," "reference-grade monitor," and "research-grade monitor."

In recent years, new instrumentation to measure air quality have been developed—these "air sensors" tend to be more compact, portable and affordable than reference monitors and have thus been dubbed "low-cost" sensors. However, the term "low-cost" is relative as these sensors range from a few hundred to a few thousand US dollars. Furthermore, significant resources are often needed to calibrate and maintain the sensors. In this report, we drop the descriptor "low-cost" and simply use the term "air sensors."

The small size, portability and affordability of air sensors has contributed to their easy deployment and has resulted in a surge in their use in the last several years, including by some government entities that have incorporated air sensors into their air quality monitoring networks, allowing for greater geographic coverage.

The quality of data from air sensors varies due to such factors as the technology used, differences in validation and calibration efforts, and weather conditions. While reference monitors remain the gold standard, air sensors are playing an increasingly important role in helping governments and other air quality stakeholders understand what is in the air.

3. Motivation for Focusing on Air Quality Monitoring and Data Sharing by Governments

Access to air quality data is critical for public, private and civil society initiatives to improve the air we breathe. Accurate, timely and sustained monitoring provides the evidence needed to develop targeted solutions to air pollution.

When shared openly, ground-level air quality monitoring performed or sponsored by governments provides unique value to air quality stakeholders. **Government** efforts offer:

Despite these benefits, a number of gaps exist in government monitoring and data sharing, particularly in countries where data on air quality are most needed, including low- and middle-income countries, especially those that are highly populated and heavily polluted.

For example, plotting the number of locations where OpenAQ ingests open data from reference monitors against population on that longitude or latitude shows that regions with a lower occurrence of reference monitors tend to be more populated.

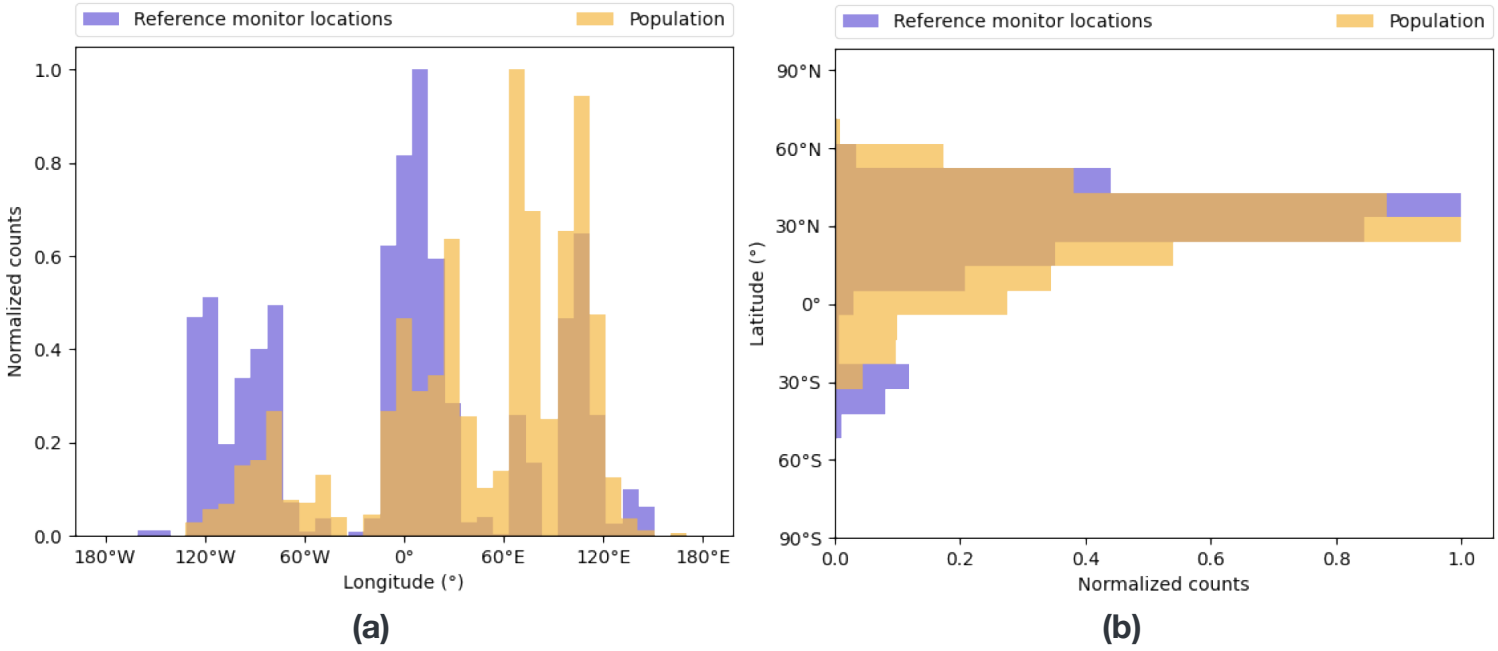


Figure 3. Two parameters—population (shown in orange bars) and aggregate air quality data ingested by OpenAQ from reference monitors (shown in purple bars)—plotted as a function of (a) longitude (i.e., west to east) and (b) latitude (i.e., north to south). For the y-axis on (a) and x-axis on (b), normalized counts[1] are used rather than absolute counts for ease of comparison of the two parameters on one scale.

This assessment of the global air quality open data landscape therefore focuses on gaps in government monitoring and gaps in sharing of air quality data in order to encourage best practices that support the role of data in efforts to clean up the world's air and protect its most vulnerable citizens.

[1] For both population and reference monitor counts, normalized counts = (parameter count per location – minimum value) / (maximum value – minimum value), where parameter is either population or reference monitor counts.

4. Four Key Criteria for Fully Open Air Quality Data

While air quality is monitored and publicly reported in at least 110 countries and territories, there is considerable variability in how these data are shared and their consequent ability to be used impactfully by the public.

Governments maximize the usefulness of ambient air quality open data when they provide the data in formats that: (a) are easily 'harmonizable' with other data sources into a single format, and (b) allow the most use-cases to be built on top of the underlying data.

More specifically, this assessment deems a governmental source of air quality data as fully accessible and open if the source meets the following Four Key Open Data Criteria:

A. Physical Units Data are shared in physical units, as opposed to a country- (or organization-) specific Air Quality Index (AQI), Air Pollution Index, or AQI-like quantities.

> Example: $PM_{2.5}$ data are shared in units of micrograms per cubic meter, as opposed to a single country-defined and unitless Air Quality Index system.

B. Station-Specific Coordinates: Data are provided at the most transparent geographic scale at which they are collected—station-scale—and with location metadata in the form of readily available geographic coordinates, ideally to five places past the decimal.

> Example: Data that are provided originate from a single station, as opposed to an aggregation or average of several stations over a city. Additionally, the geographic coordinates from which the data originate are also shared (e.g., the station is located at: 101.89322° N, 30.29571° E).

C. Timely Fine-Scale Temporal Information [near Real-Time]: Data are provided at daily or sub-daily levels in near real-time or in a timely manner with time-of-collection stamps and averaging periods.

> Example: Data are shared as hourly averages within a few hours after they are produced (or, at the very least, within a month), as opposed to yearly averages of pollution levels shared a couple of years later.

D. Programmatic Access: Data and metadata as defined in the preceding criteria are publicly accessible in a programmatic or machine-readable form.

> Example: Data are shared via an Application Programming Interface (API), FTP server, or other method that allows machine-to-machine interaction, as opposed to data shared as a static file (such as PDF or CSV) or on a website as a graphic, table or spreadsheet form that requires a user to click a 'download' button.

We base these criteria on the qualities of a government data source that makes it easily digestible into the OpenAQ Platform and easily converted to OpenAQ's harmonized data format. The harmonized data format, in turn, is designed to capture the available data and metadata that allow broad usage downstream of the OpenAQ Platform.

Programmatic access

Programmatic access is a key but misunderstood and overlooked criterion. Although sharing air quality data with the public in a static format on a website is a valuable first step, such data have limited use. If the data are also provided in a machine-readable, analysis-ready form, many more use-cases—and ultimately, impact—can be derived from the data. The key is to enable full data use to those who are not the data producers. An analogy can be made with art: Imagine a world in which only those who produced art supplies (data producers) were able to be artists (data users). How greatly limited the creative scope of art in the world would be! The same goes for data: If full access is limited to those who produce the data, the uses of the data will be much more limited in scope than if the data were programmatically accessible and available for the public at large to apply their expertise.

Open data raises public awareness.

The mobile app Sht I Smoke! compares air pollution to cigarette smoking, helping people understand the severity of air pollution. Smokey, an air quality chatbot on Facebook Messenger and Twitter answers two questions for users: "How bad is the air quality around me right now?" and "What can I do about it?" Both of these digital tools for the public were built by individuals and rely on open air quality data.**

5. Global Assessment of Government Air Quality Monitoring

We conducted a comprehensive review of government air quality monitoring in all United Nations member states and in dependencies with populations greater than one million [N=197] (for the purposes of brevity, we use the term "countries" for the remainder of this report). We looked for electronic media evidence of a currently operational air quality monitoring program that is either led by or sponsored/commissioned by a national or regional government and is conducted on a regular basis. We included monitoring programs using air sensors, and we included countries with limited monitoring (e.g., in one city).

A variety of sources were used in the process, including: government agency websites and reports, the World Health Organization's ambient air pollution database, publicly open air quality data platforms (e.g., AQICN, OpenAQ, PurpleAir), reports by multinational nonprofit organizations working in the field of air quality, peer-reviewed scholarly articles, and consultations with OpenAQ community members and other experts in the field. We allowed for diverse types of monitoring technologies and different types of programs. We accounted for the evolving landscape of air quality monitoring with new technologies being featured in government programs. We designed our review process as per the 'scoping review' methodology originally developed in Arksey and O'Malley (2005) along with notable improvements that have followed, such as inclusion of expert consultations to complement original methodology and refining search strategy iteratively. A detailed methodology can be found in this report's supplementary materials. Figure 4 illustrates the steps we took to categorize the countries we researched.

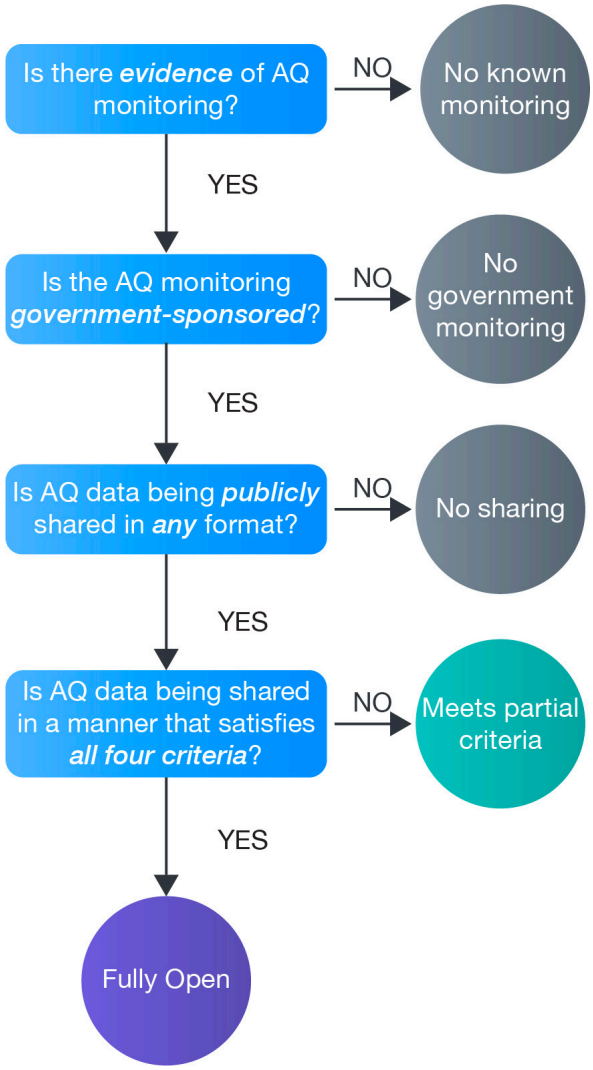
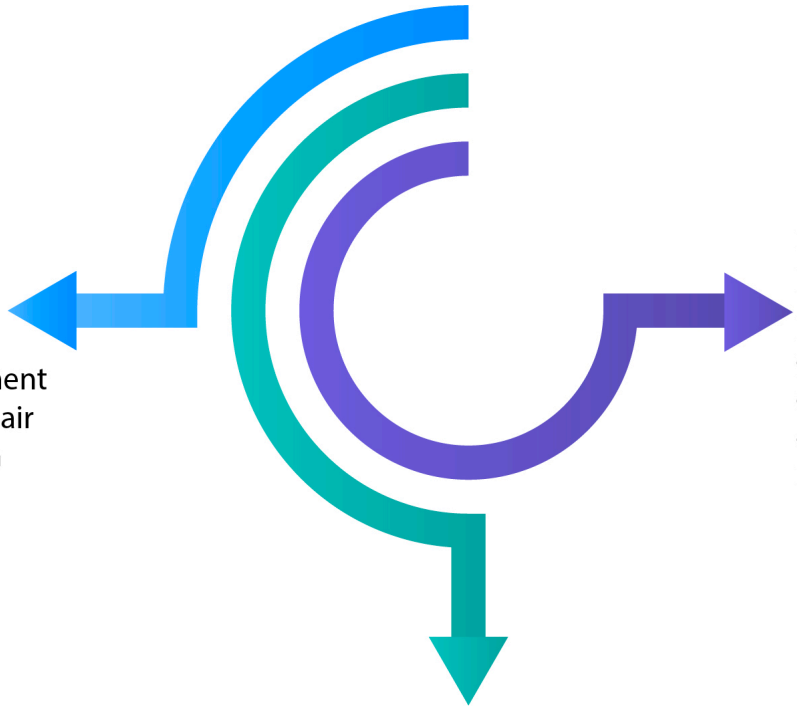


Figure 4. Flowchart of the scoping procedure done in this review.

The Four Key Open Data Criteria embody the ideal for air quality monitoring programs across the world. Unfortunately, most countries are lacking in their air quality data generation and sharing practices.



Our review of 197 countries finds no evidence of government operated/sponsored air quality monitoring in nearly 40% of them.

Upon application of the Four Key Open Data Criteria to the publicly available, government-produced air quality data, less than one-quarter of countries meet all four criteria.

Among those countries with evidence of air quality monitoring, only a small majority have shared the data openly with the public.

By highlighting where countries are situated with regard to air quality monitoring and data sharing, we paint a picture of progress and help interested parties understand where their efforts could make a difference in instigating more monitoring and more data sharing. See the next section for key insights.

6. Four Key Insights

Key Insight #1: Only half the world's governments publicly share air quality data. A few more generate data, but do not share it.

We found evidence that 61% of the world's countries[2] [N=197] are generating air quality data on a regular basis.

We found further evidence that 53% of the world's countries have shared air quality data publicly through the internet (either data portals or reports). There is a non-trivial gap (~8%) between countries that conduct monitoring activities on a regular basis (61%) and those that share the data publicly and openly (53%). This gap corresponds to 16 countries.

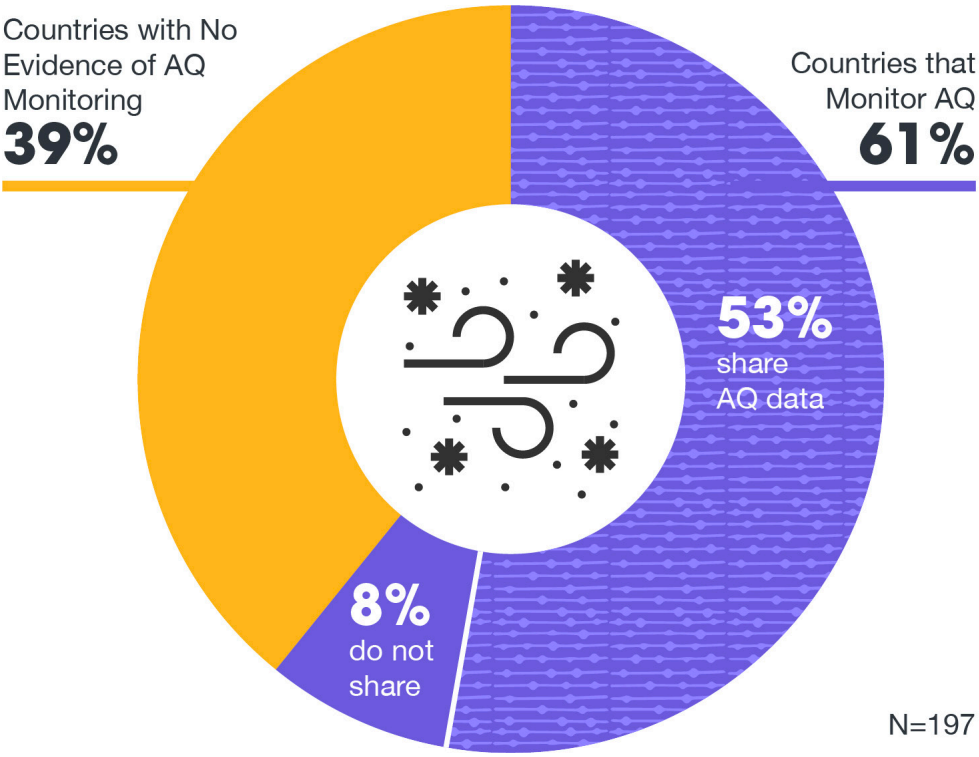


Figure 5. Percentage of countries (and dependencies with more than 1M people) that do/do not generate air quality data and do/do not share their data publicly.

In locations where we found no evidence of government monitoring, at least[3] 6% of those countries have conducted ad hoc air quality measurements/studies in the past. This indicates an interest in and willingness to better understand the quality of the air.

[2] United Nations member states and dependencies with populations greater than one million

[3] 6% is a conservative estimate as our search strategy was designed to find regular monitoring programs, not to find all ad hoc air quality monitoring that may have been undertaken in the past.

One deterrent to establishing a regular monitoring program is resource constraints (financial, technical expertise, etc.). A 2022 survey covering 110 countries, primarily low- and middle-income, found that less than one-third have been able to successfully implement monitoring networks due to these challenges (see Strengthening Air Quality Management Guidance: Achieving Scale and Impact). Direct financial support through such entities as development banks and philanthropies could support countries unable to monitor regularly. Disturbingly, air quality funding represents only 0.1% of total philanthropic spending as of 2021, as per the The State of Global Air Quality Funding 2022 report.

Key Insight #2: Investing in national government air quality monitoring programs in just 17 countries could affect 1 billion people.

Air pollution and its impact on a country's population are not immediately solved by monitoring air quality; however, securing baseline measurements, conducting ongoing monitoring, and sharing monitoring data publicly are vital steps in the process.

Table 1 shows 17 of the most populous countries, equating to a total population of 1 billion people, in which there appears to be no evidence of a public national-level* government program for long-term ground-level ambient air quality monitoring. These are also countries where particulate matter (PM) pollution ranks as one of the top 10 risk factors for death and disability according to the Global Burden of Disease study. For 11 of these countries, PM ranks in the top 2, and for another 5 of these countries, it ranks in the top 5. Effectively 1 billion people live where their national government doesn't monitor the most serious environmental risk factor for their health.

Country	Population (in millions)**	2019 ranking of 'air pollution' as an in-country risk factor for death and disability, as determined by the Global Burden of Disease (includes ambient & indoor pollution)	Number of Deaths Attributable to Air Pollution***
Pakistan	229	#2	237,500
Ethiopia	119	#2	77,000
Congo, Democratic Republic	94	#2	69,500
Tanzania	63	#2	no data
Myanmar	54	#1	74,500
Kenya	53	#4	27,700
Uganda	45	#2	27,700
Sudan	5	#3	28,200
Algeria	44	#7	22,200
Iraq	43	#7	25,600
Afghanistan	40	#2	37,000
Angola	34	#4	14,400
Yemen	33	#2	21,200
Ghana	33	#2	23,800
Venezuela	28	#9	12,600
Côte d'Ivoire	27	#2	23,100
Cameroon	27	#4	22,400

Table 1. Populous high-risk countries without evidence of a public national-level government air quality monitoring program.*

* "Public National-level" connotes a nationally coordinated multi-region effort, as opposed to a single city-led or sub-national led effort, where information on the program is available on a publicly accessible website. *[In Pakistan, we found AQ monitoring in the capital by national authority and a separate network in Punjab province by its regional authority, but no indication of this being a nationally coordinated effort.]*

** 2021 population estimates from UN World Population Prospects.

*** Numbers pulled from Health Effects Institute State of Global Air 2020; Data source: Global Burden of Disease 2019.

World's most comprehensive study of causes of death, diseases, and injuries relies on open air quality data.

The Global Burden of Disease (GBD) study is a critical resource for informed policymaking worldwide. GBD air quality publications and tools rely on open air quality data.

Key Insight #3: Only one-quarter of countries share maximally useful air quality data.

Honing in on countries that share air quality data (105, 53% of total, Figure 5), we found that only 43% of them share data in a manner that meets all Four Key Open Data Criteria (Table 2). This means that less than one-quarter of the world's countries (45) provide open access to maximally useful air quality data.

N=105, countries that share AQ data in some format	(A) Physical Units	(B) Station-Specific Coordinates	(C) Timely Fine-Scale Temporal Information (Real-Time)	(D) Programmatic Access	All Four Key Open Data Criteria Met
No of countries that meet the criteria	88 *(84%)*	78 *(74%)*	92 *(88%)*	47 *(45%)*	45 *(43%)*

Table 2. Of countries that share air quality data (N = 105), the percentage that meet the four key open data criteria described in Section 4. The full list of countries and tags indicating whether the criteria are met can be found here.

The countries that share data in a manner that doesn't satisfy Criterion A [Physical Units] (16%) often share it in the form of air quality indices (AQIs). While AQIs aim to simplify air quality information for the general public, the lack of data on physical parameters allows limited data analysis required to address the complexity and nuances of air pollution specific to a region, and thus limits further identification of possible corrective actions.

The countries that do not meet Criterion B [Station-Specific] (26%) often share the data in the form of regional aggregates or averages. Some of these countries share data per station, but no information on the station location (e.g., exact geolocations, accurate representation on a map). Location-specific information on physical air quality parameters is crucial to understand the spatial variability as well as pollution sources and to use this information to design and enforce appropriate regulations.

Out of 105 countries that share air quality data, we found that 88% and 45% of them satisfy criteria C [Real-Time] and D [Programmatic Access], respectively (Table 2). Capacity constraints likely play a role in countries that do not satisfy these criteria. Autonomous monitoring equipment able to collect and share data at sub-daily time intervals (e.g., hourly, half-hourly, real-time), which satisfies Criterion C [Real-Time], or information-technology infrastructure that can provide programmatic access, which satisfies Criterion D [Programmatic Access], both require potentially significant financial and technological resources, which many countries do not have access to. The global community has stepped up in a few cases to fill that gap through foreign aid, technology transfer and philanthropy, but more is needed.

As Figure 6 shows, out of 105 countries that share air quality data, 25% meet Criterion C [Real-Time] but fail to meet either A or B. For example, some countries provide a dashboard reporting live data, but only with air quality indices, or they report data for a large region as an aggregate without specifying the exact location/s of the monitoring station/s. This implies that even amongst countries that exhibit the capacity to generate and share data in real-time, a significant number of them have not implemented relatively low-cost measures that will make their air quality data more transparent and useful.

In addition, with regard to Criterion D [Programmatic Access], some countries undervalue open data and others actively oppose transparency. The international Open Data Charter outlines six principles developed by governments, civil society and experts around the world that describe the value of open data in helping to advance sustainable development goals.

Given that less than one-quarter of the world's countries share air quality data in a fully open manner, significant opportunities exist to improve data openness.

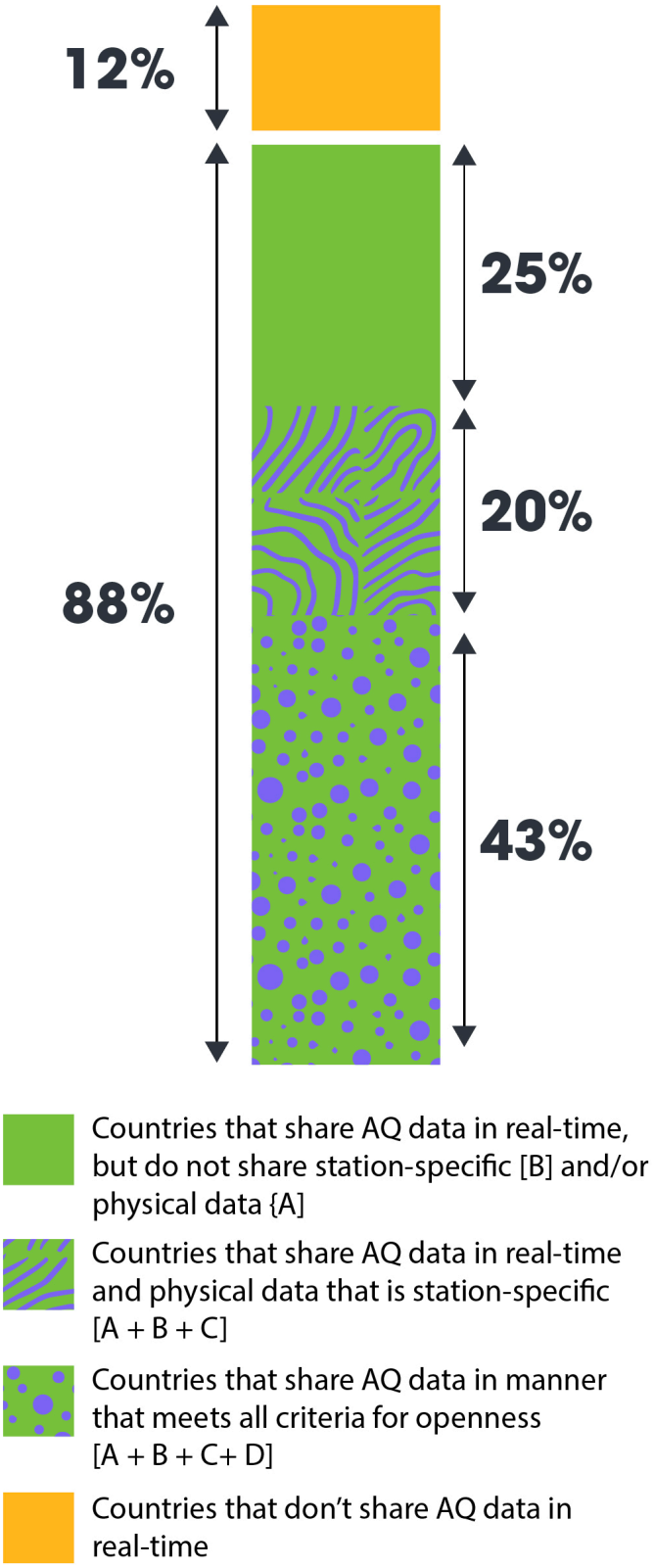


Figure 6. For countries sharing data (N=105), how they are meeting the Four Key Open Data Criteria expressed as a percentage. All columns in green satisfy Criterion C.

Air sensors are increasingly being used globally as discussed in Section 2, including these examples of government deployments:

- **Cambodia's** Department of Air Quality and Noise Management has installed 44 air sensors across its provinces. The data generated are shared daily through the Facebook page of the Ministry of Environment. The data are also displayed outside the ministry building on a large screen for the general public to see.
- **Guyana** has deployed five air sensors donated to its Environmental Protection Agency by Swiss-based IQAir. The data are available on IQAir's platform, and the Guyana EPA links to them from its webpage. The director of the agency believes that availability of these devices is opportune as the country is experiencing a significant development boom accompanied by increasing air pollution.
- **Madagascar** collects air quality data from PurpleAir sensors installed in multiple locations in its capital Antananarivo. The meteorological agency of the country shares the data on its website in real-time and as weekly reports. PurpleAir, a US-based company, also shares the data on its platform.
- In **Uganda**, Kampala Capital City Authority is using multiple air sensors manufactured by US-based Clarity Movement Co. The data are shared on the authority's website through a map plugin which shows the location and real-time measurements of PM2.5 and the AQI. In 2022, Kampala also added a network of over 30 monitors installed and operated by AirQo, a Uganda-based air quality monitoring company, which the city authority plans to incorporate into their air quality data sharing platform.

Key Insight #4: Greater data transparency would benefit billions of people.

Many populous countries have partially shared their air quality data, but over 4 billion people would benefit from greater transparency through continued capacity building.

Countries with populations over 50 million in which real-time air quality data are produced in some format, but not in a fully open manner on a national-level by the home government*:

Country	Population (in millions)**	Key Open Data Criteria Not Met
China	1,426	• Programmatic Access • Station-Specific Coordinates
India	1,403	• Programmatic Access
Indonesia	273	• Station-Specific Coordinates • Programmatic Access
Brazil	214	• Station-Specific Coordinates • Programmatic Access
Russian Federation	145	• Programmatic Access
Japan	125	• Station-Specific Coordinates • Programmatic Access
Philippines	113	• Programmatic Access
Egypt	108	• Physical Units • Programmatic Access
Vietnam	97	• Physical Units • Programmatic Access
Iran	88	• Physical Units • Station-Specific Coordinates • Programmatic Access
Thailand	72	• Programmatic Access
South Africa	59	• Programmatic Access

Table 3. Most populous countries in the world and the Key Open Data Criteria they have yet to meet.

* "Fully-open data" is defined as a data source meeting the Four Key Open Data Criteria articulated in Section 4.

** 2021 population estimates from UN World Population Prospects.

7. Conclusion & Recommendations

Governments have a responsibility to address air pollution—a leading health concern across the entire world that disproportionately impacts low- and middle-income countries. Reliable data on air pollution are fundamental to taking corrective action to improve air quality, but only 61% of the world's countries and territories generate air quality data on a regular basis.

Furthermore, when air quality data are shared openly, clean air action is accelerated. But of countries that generate air quality data, just barely over half share the data publicly, and slightly less than one quarter share the data in a way that maximizes potential uses.

We urge governments to monitor air quality and to make the data fully accessible to the public so that everyone across private, public and civil society can innovate and apply effective solutions towards clean air.

We urge philanthropic efforts related to public health, air quality and climate change to ensure their investments promote data transparency and openness. Doing so—through the criteria outlined in this report—will unlock the full potential applications from the data and lead to improved air quality as a result.

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Lead researcher and author: Viraj Sawant

Supporting authors: Chris Hagerbaumer, Colleen Marciel F. Rosales, Margaret (Maggie) Isied, Russ Biggs

Reviewers: Heidi Yoon, Pallavi Pant, Tom Grylls

Data leads: Antonio Banze, Daniel Westervelt, Daniela Cala Suarez, Elena Solohin, George Mwaniki, Levi Stanton, Madina Tursumbayeva, Prakash Doraiswamy, Zhaniya Aldekeyeva, and other anonymous support

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PagerDuty

UCLA Institute of the Environment & Sustainability

Resources

Link to methodology

Link to full list of countries and their category tags

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