



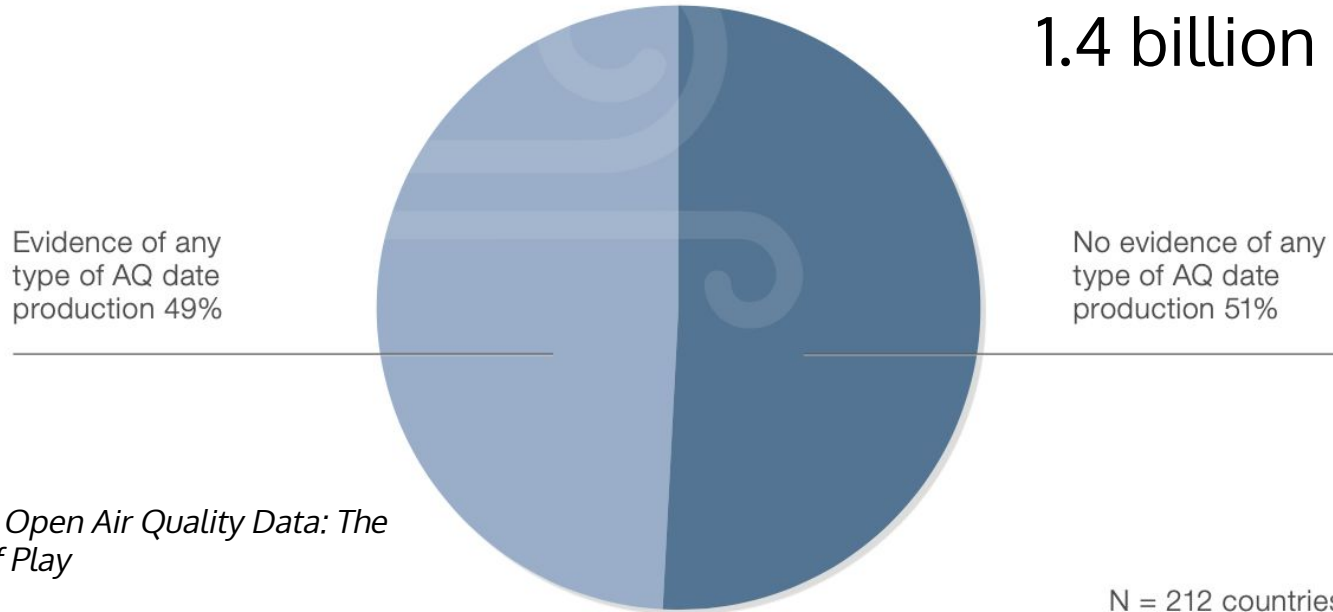
Wrangling the world's air quality data

ASIC Conference, May 2022
Session 5D: Standard, Supplemental and
Informational Monitoring

Aggregating and Harmonizing Air
Quality Data on a Global Scale
Chris Hagerbaumer, OpenAQ

Half of the world's governments produce Air Quality monitoring data

1.4 billion people



From the 2020 Open Air Quality Data: The Global State of Play

tinyurl.com/OpenAQData2020

N = 212 countries



Air Quality Open Data Landscape

- ~100 Countries
- Disparate formats, some temporarily exist
 - JSON
 - FTP
 - Web pages
 - XML
- Not designed to be globally (or often even nationally) interoperable with one another and often not fully accessible to the public

Central Scotland

Monitoring site	Running 8 Hour mean Ozone (ppm ³)	Hourly mean Nitrogen Dioxide (ppm ³)	Max 15 min Sulphur Dioxide (ppm ³)	Running 24 Hour mean PM _{2.5} Particles (ppm ³)	Running 24 Hour mean PM ₁₀ Particles (ppm ³)	Last updated
Auchincloss Moss Timeseries Graph	45 (2 Low)	n/m	n/m	0 (1 Low)	6 (1 Low)	23/09/2015 21:00:00
Bush Estate Timeseries Graph	51 (2 Low)	3 (1 Low)	n/m	n/m	n/m	23/09/2015 21:00:00
Dumbarton Roadside Timeseries Graph	n/m	4 (1 Low)	n/m	n/m	n/m	23/09/2015 21:00:00
Edinburgh St Leonards Timeseries Graph	29 (1 Low)	15 (1 Low)	6 (1 Low)	6 (1 Low)	6 (1 Low)	23/09/2015 21:00:00
Glasgow Great Western Road Timeseries Graph	n/m	18 (1 Low)	n/m	n/m	n/m	23/09/2015 21:00:00



Pollutants		Ozone O ₃	Ozone O ₃	Nitrogen dioxide NO ₂	Visibility	Carbon monoxide CO	Sulfur dioxide SO ₂	Particles PM ₁₀	Particles PM _{2.5}
Average Periods		1-hour average	rolling 1-hour average	1-hour average	1-hour average	rolling 1-hour average	rolling 1-hour average	rolling 24-hour average	rolling 24-hour average
Sydney East	Randwick	2.9	2.8	0.4	0.09	0.1	0.1	10.4	2.8
	Rozelle	2.9	2.2	0.4	0.03	0.2	0.0	10.4	2.8
	Lindfield	3.0	2.4	0.2	0.06	0.0	0.0	10.3	3.7
Sydney North-west	Chulona	3.0	2.4	0.5	0.08	0.2	0.0	12.8	4.5
	Earlewood	2.8	2.3	0.3	0.06	0.0	0.0	10.3	3.7
	Rosewood	2.7	2.5	0.2	0.06	0.0	0.0	8.9	3.6
Sydney South-west	St Marys	3.0	2.5	0.0	0.04	0.0	0.0	9.1	3.6
	Vineyard	3.1	2.5	0.1	0.06	0.0	0.0	10.6	3.6
	Prospect	2.8	2.4	0.3	0.10	0.0	0.0	12.0	6.2
Illawarra	Bargo	2.8	2.9	0.0	0.04	0.0	0.0	7.2	3.2
	Erongry	2.9	2.5	0.1	0.06	0.0	0.0	9.8	3.2
	Camden	3.0	2.9	0.0	0.05	0.0	0.0	7.0	2.6
Lower Hunter	Campanian West	2.8	2.7	0.1	0.07	0.2	0.0	11.7	3.6
	Liverpool	2.8	2.5	0.3	0.04	0.0	0.0	10.3	3.6
	Dalziel	2.8	2.7	0.0	0.04	0.0	0.0	6.4	3.2
Wollongong	Wollongong	2.7	2.6	0.4	0.00	0.1	0.0	12.8	4.4
	Kembla Grange	2.6	2.8	0.2	0.05	0.0	0.0	8.9	3.2
	Alton Park Stn	2.8	2.7	0.0	0.04	0.0	0.0	8.9	2.4
Wallsend	2.8	2.7	0.0	0.08	0.0	0.0	9.0	4.1	

Gobernación ICAP-MP10



Click on the city name for more detailed information.

[printable summary](#)

Metropolitan Washington	FORECAST		CURRENT AQI
	Wed Sep 23	Thu Sep 24	
	33	38	44



Air Quality Open Data Landscape

01/

Disparate audience

Multiple small data sources
all over the place

02/

Technical audience

Data platform providing open/free
programmatic data access

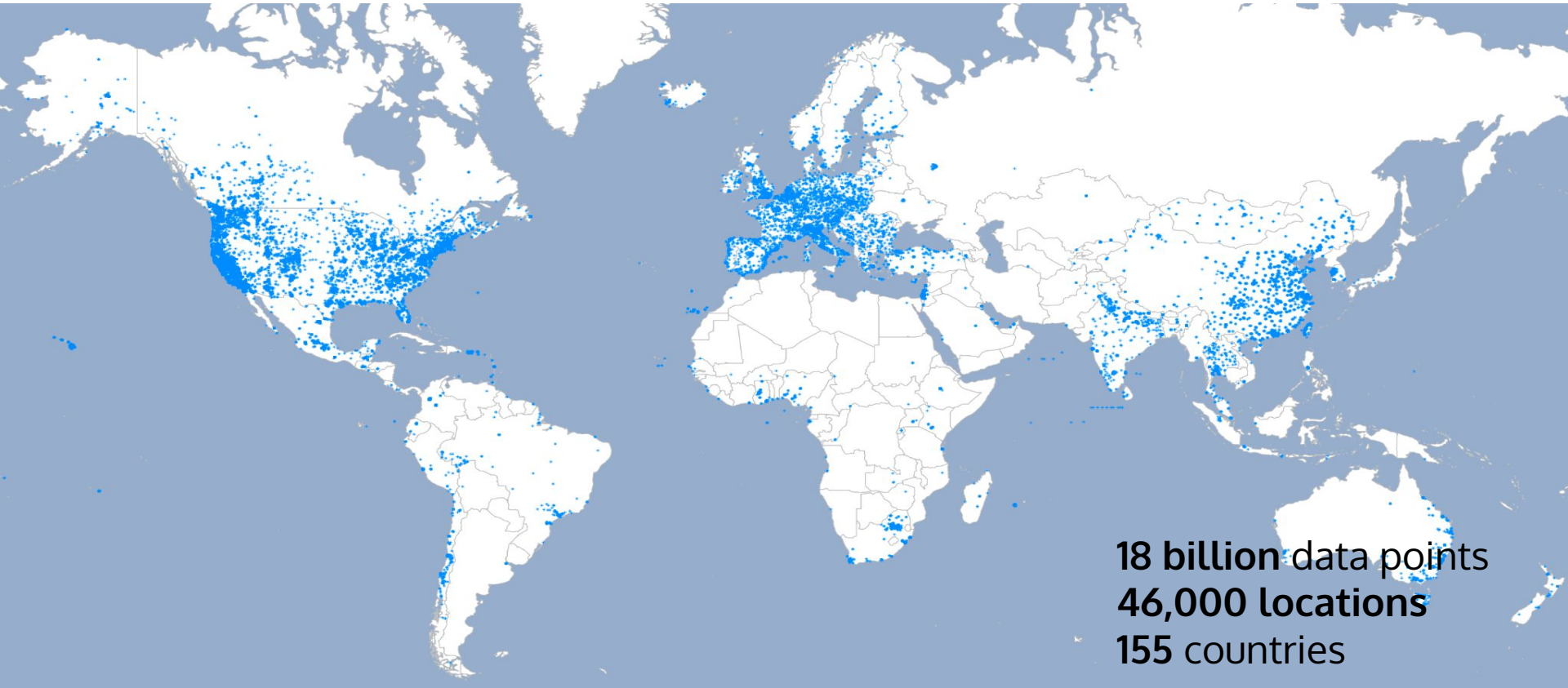
03/

Public audience

Apps, Open source tools,
Media, Research, Policy.



The OpenAQ Platform



18 billion data points
46,000 locations
155 countries



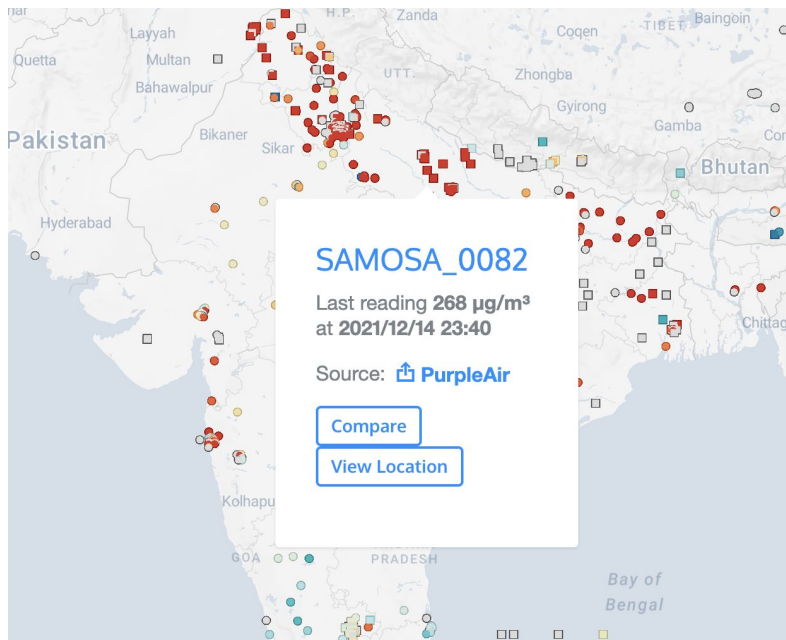
Reference grade monitoring



OpenAQ *initially* ingested data only from government air quality monitors.



Low-cost Sensors

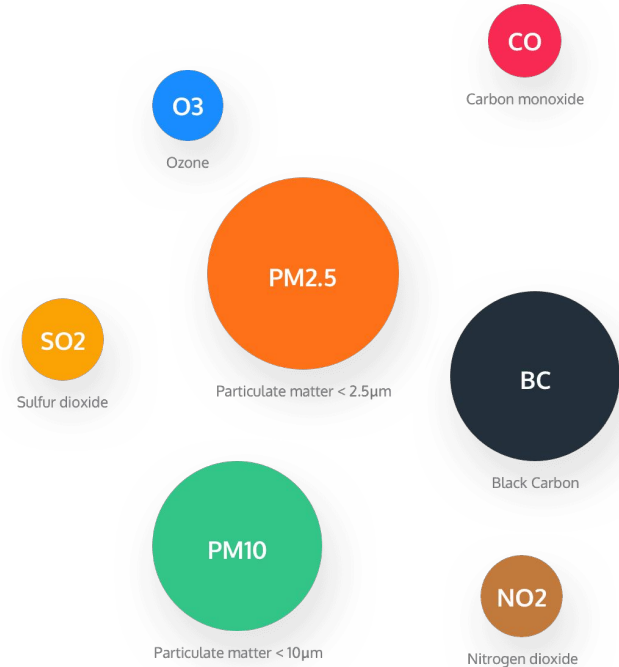


- Added LCS in 2021
- Fill key data gaps in the Global South and EJ communities
- ~130 countries + ~34,000 locations
- Foster a data-sharing ecosystem among research institutions, private sector companies, and non-profit organizations
- Instill accountability for data transparency

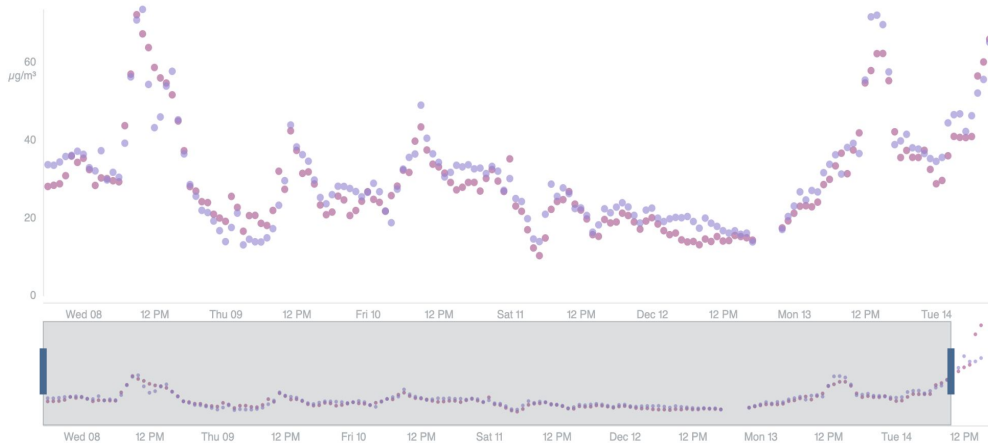


OpenAQ Data

- We collect data on the following pollutants (depending on what each monitor measures):
 - PM2.5
 - PM10
 - Sulfur Dioxide (SO₂)
 - Nitrogen Dioxide (NO₂)
 - Carbon Monoxide (CO)
 - Black Carbon (BC)
 - Ozone (O₃)



Comparison Tool



- Geospatial search feature
- Compare air quality data between low-cost sensors and reference-grade monitors
- Compare up to 3 sensors
- Identify data gaps spatially
- Compare sensor performance with nearby sensors

UPDATED 2 HOURS AGO

■ **Sensor #1**

RS0028A

in Grad Beograd, Serbia

Sensor Type: **reference grade**

Reporting: SO₂ mass, CO mass, NO₂ mass, PM2.5, PM10

[REMOVE](#)

UPDATED 2 HOURS AGO

■ **Sensor #2**

RS0037A

in Grad Beograd, Serbia

Sensor Type: **reference grade**

Reporting: SO₂ mass, O₃ mass, NO₂ mass

[REMOVE](#)

UPDATED 2 HOURS AGO

■ **Sensor #3**

RS0036A

in Grad Beograd, Serbia

Sensor Type: **reference grade**

Reporting: SO₂ mass, PM2.5, NO₂ mass, O₃ mass, PM10, CO mass

[REMOVE](#)



Use Cases

1. Scientific analysis
2. Journalism
3. Citizen-engagement software
4. Policy



Global COVID-19 Impacts

Zander et al. (PNAS, 2020) accessed ground monitoring data from OpenAQ and satellite data from TROPOMI to analyze the immediate impact of COVID Lockdowns on AQ for 34 countries.

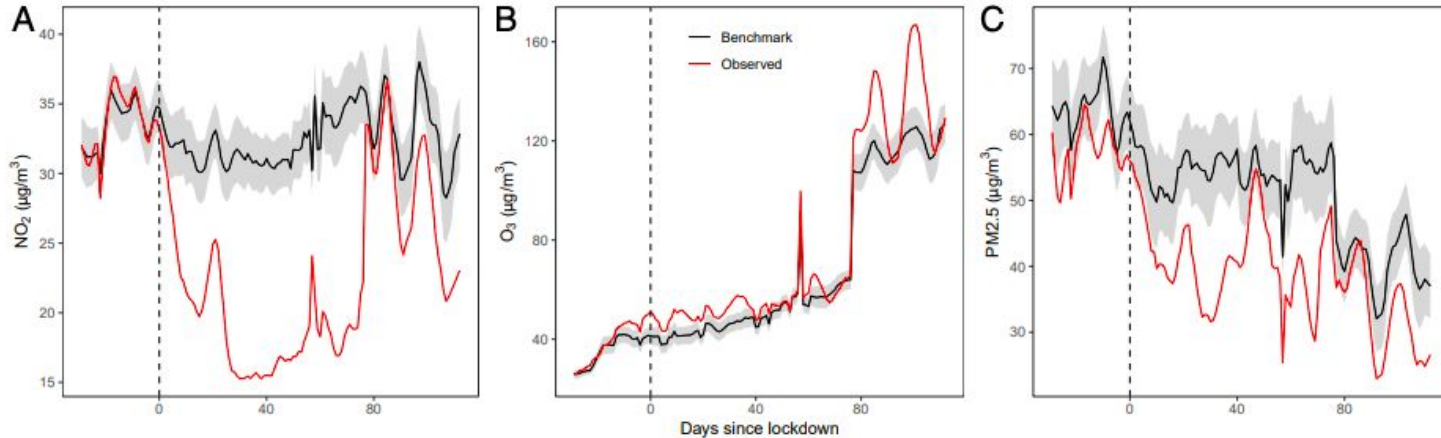
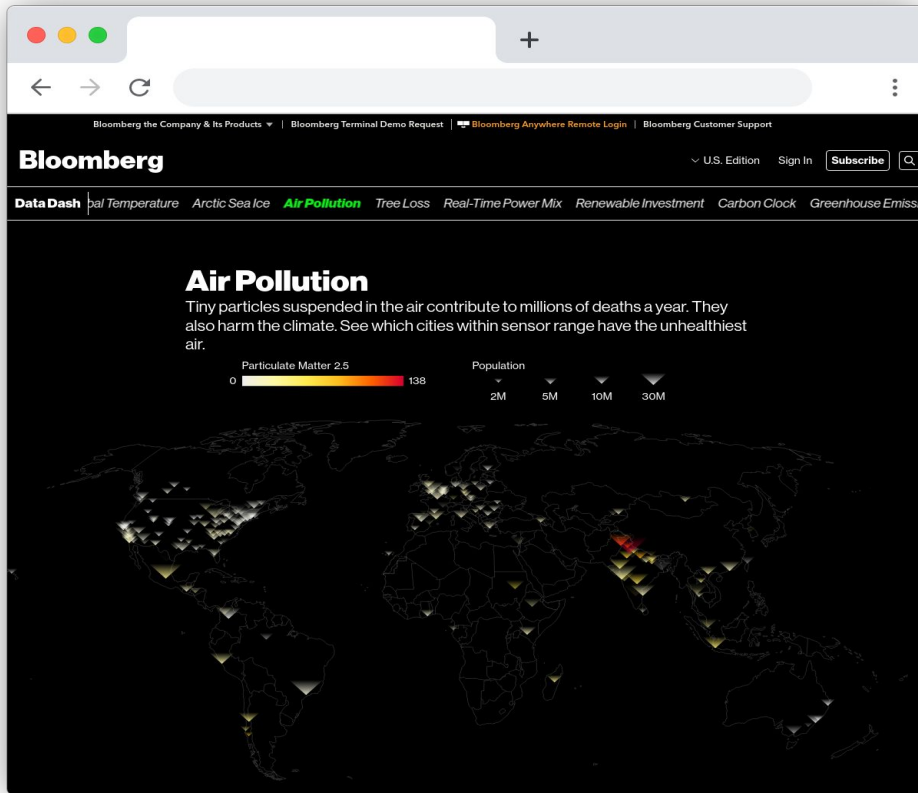


Fig. 2. Lockdown ground-level air pollution anomalies relative to weather benchmarks for NO_2 (A), O_3 (B), and $\text{PM}_{2.5}$ (C). The daily population-weighted average ($n = 34$ countries) ambient pollutant concentrations observed 1 mo before and up to 15 May after lockdowns are plotted in red. Benchmark levels which represent expected concentrations considering time of year and prevailing weather are plotted in black with 95% CIs.



Bloomberg Green PM2.5 Tracker

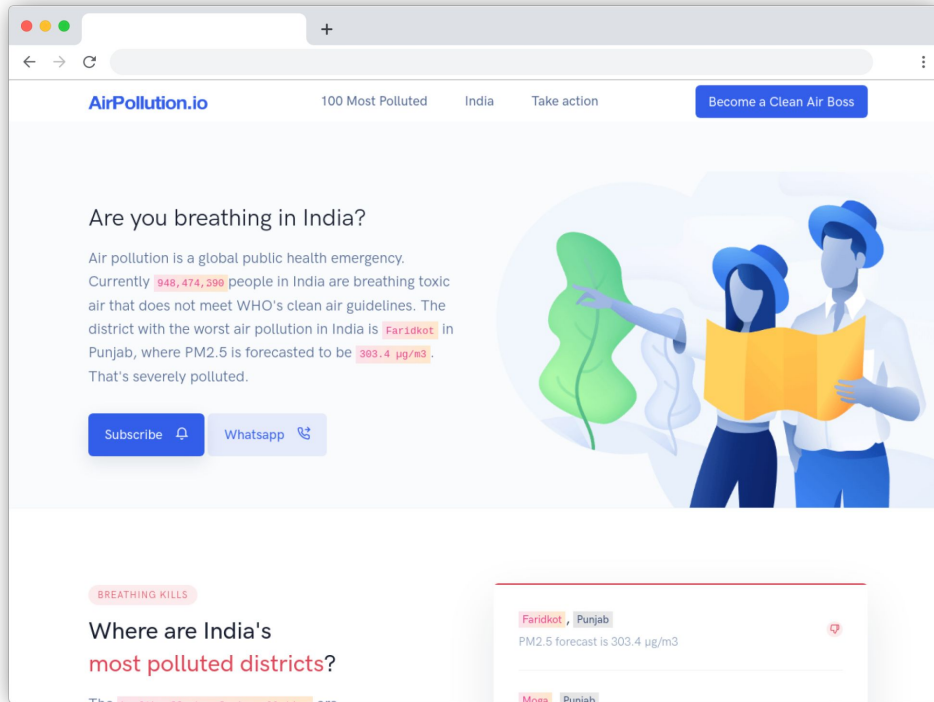


**Bloomberg
Green**

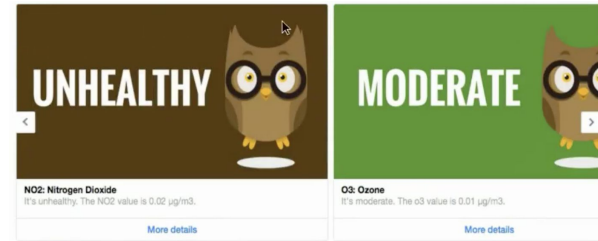
- Interactive platform
- PM2.5 levels based on population density in cities across the globe
- Evidence-based journalism



Smokey Air Pollution Bot



- Chatbot
- Real-time air quality data
- Communicates hazard levels and methods to safeguard personal health
- Software development contributors

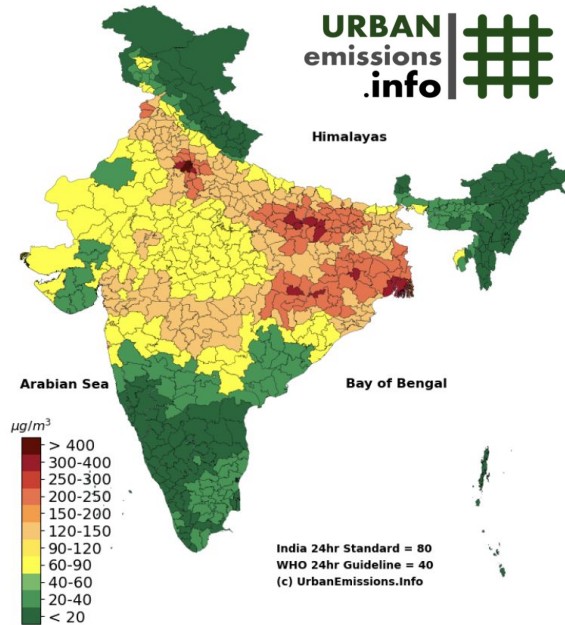


All India Air Quality Forecast System

India Air Quality Information: 3-day forecasts

Particulate Matter (PM_{2.5})

24hr Average for 14Dec2021 Tuesday



- Visualize trends on effects of high pollution events (ex: dust storms, Diwali)
- Long-term air quality management plans
- Public health alert systems

