2022 Air Sensors International Conference

Advancing Science and Engaging Communities

May 11 – 13, 2022
Pasadena, California

C40 CITIES

Reminders

- Please silence your cell phones and computers for the duration of the sessions, but keep them at the ready for questions!
  - Use Whova for Q&A: **whova.com/portal/webapp/asic_202112/**
- Please remember that all sessions are timed and questions may be limited. Thank you for helping us stay on schedule!
- All sessions will be livestreamed through the virtual platform, Whova. Every Conference attendee has access to Whova.
  - If you need technical support, please contact the Conference Managers, Sandra Hall at sehall@ucdavis.edu and Olivia Schlanger at oschlanger@ucdavis.edu

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How and why cities are using new sensor technologies:

Successes, challenges, and funding to achieve air quality goals

C40 Cities, Clean Air Fund, and representatives from Addis Ababa, Denver, Lima, and Lisbon

Air Sensors International Conference

Friday, May 13th 2022

Cities contribute to climate change but cities are also home to solutions...

Cities are:

- Diverse and innovative.
- More nimble and progressive than nation states.
- Financial and economic hubs with political and monetary power.
- **And led by dynamic mayors who are:**
    - Advocates for a green and just recovery from COVID-19.
    - Global leaders in the fight against the climate crisis.

C40 is a network of mayors of nearly 100 world-leading cities collaborating to deliver the urgent action needed right now to confront the climate crisis. Together, we can create a future where everyone, everywhere can thrive.

© Alexis Gonzalez / Getty Images

Air quality

C40 works with cities to strengthen air quality management through increased data collection & analysis and policy development and implementation to put cities on a path towards meeting WHO guidelines

7 mil

premature deaths each year due to poor air quality

98%

of urban areas have PM2.5 concentrations above the WHO AQGs

6X

more cities are now monitoring air quality, compared to 10 years prior

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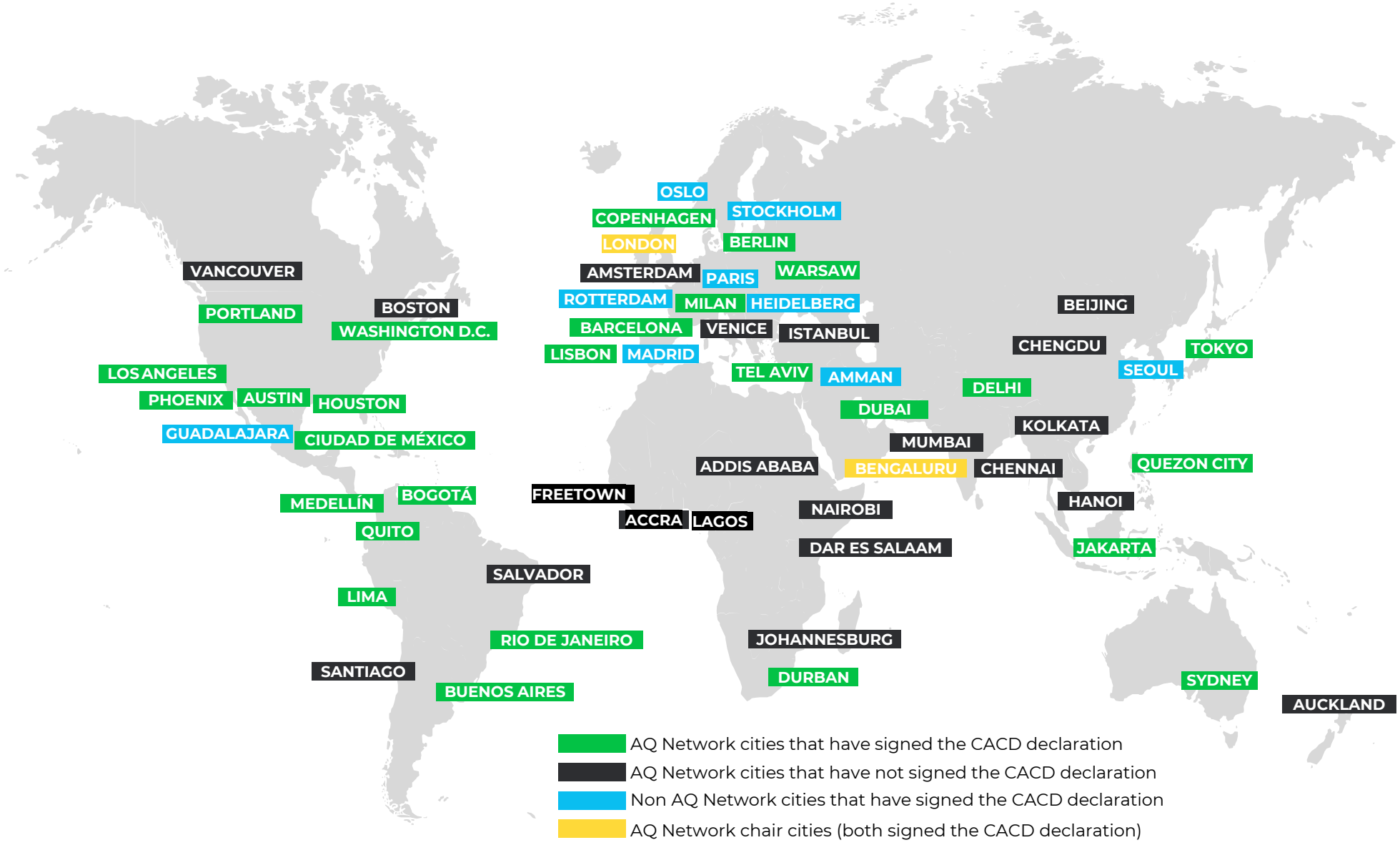
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ADDIS ABABA
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CHENNAI
QUEZON CITY
FREETOWN
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QUITO
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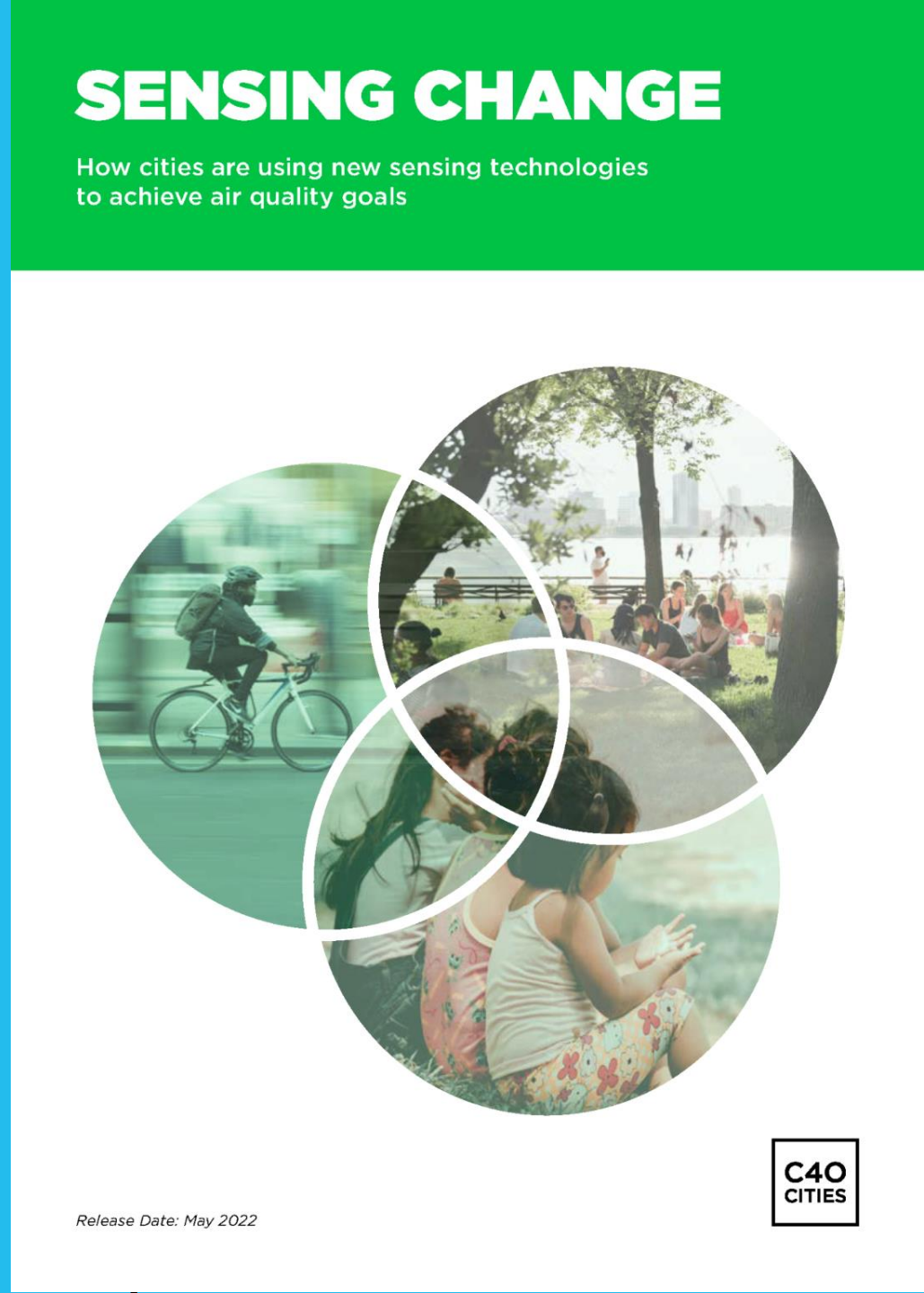
JAKARTA
SALVADOR
LIMA
RIO DE JANEIRO
JOHANNESBURG
SANTIAGO
DURBAN
SYDNEY
BUENOS AIRES
AUCKLAND
AQ Network cities that have signed the CACD declaration
AQ Network cities that have not signed the CACD declaration
Non AQ Network cities that have signed the CACD declaration
AQ Network chair cities (both signed the CACD declaration)

C40 lower-cost sensor working group

- A forum for interactive knowledge-sharing and problem-solving
- Insights and experiences from a diverse cohort of cities
- Best practices, recommendations, case studies

Report available at:
tinyurl.com/sensingchange



Sensing Change: Themes

1.

Increasing quality, accessibility and clarity of city-scale data & information platforms

2.

Understanding impacts on vulnerable populations

3.

Informing decision-making and policy processes

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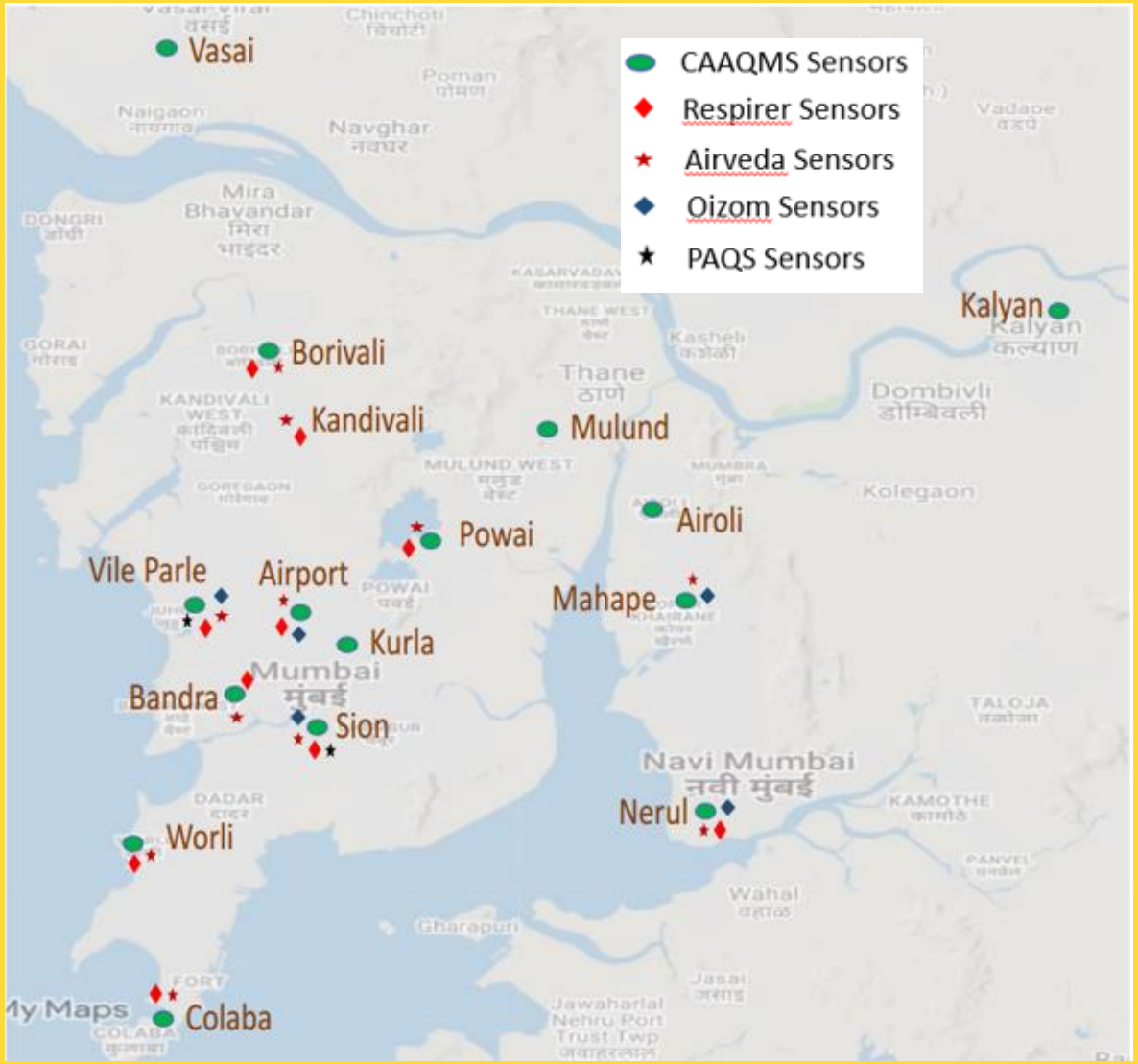
Dar es Salaam, Tanzania:
Collecting basic information about air pollution levels

Mumbai, India:

Piloting lower-cost sensors for national adoption



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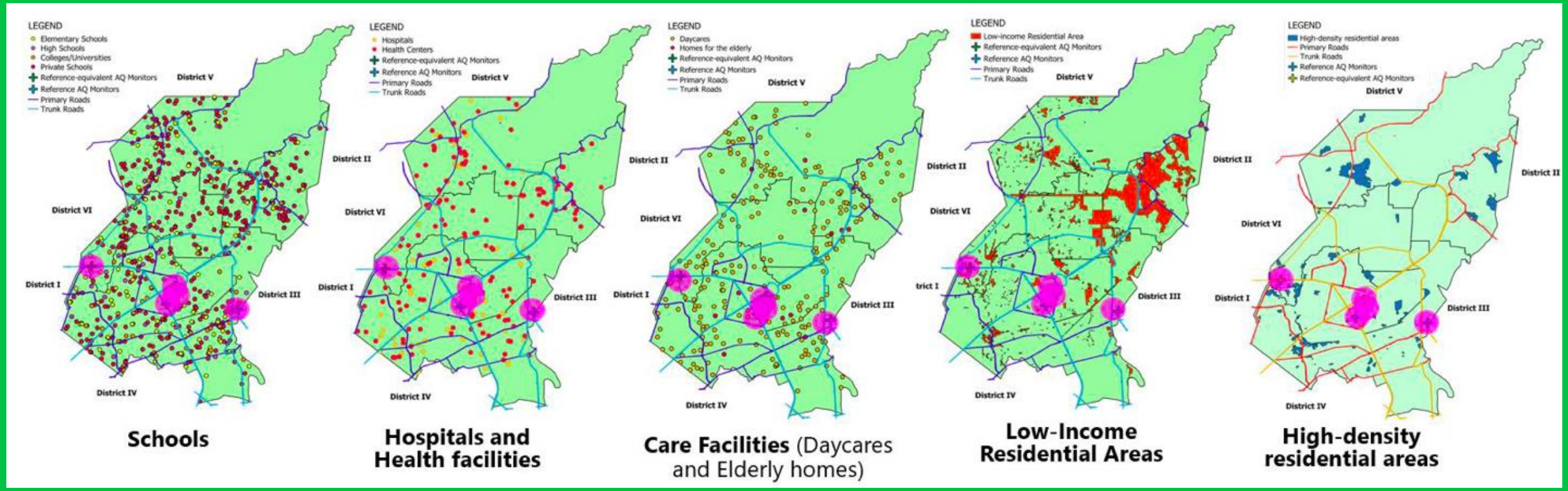
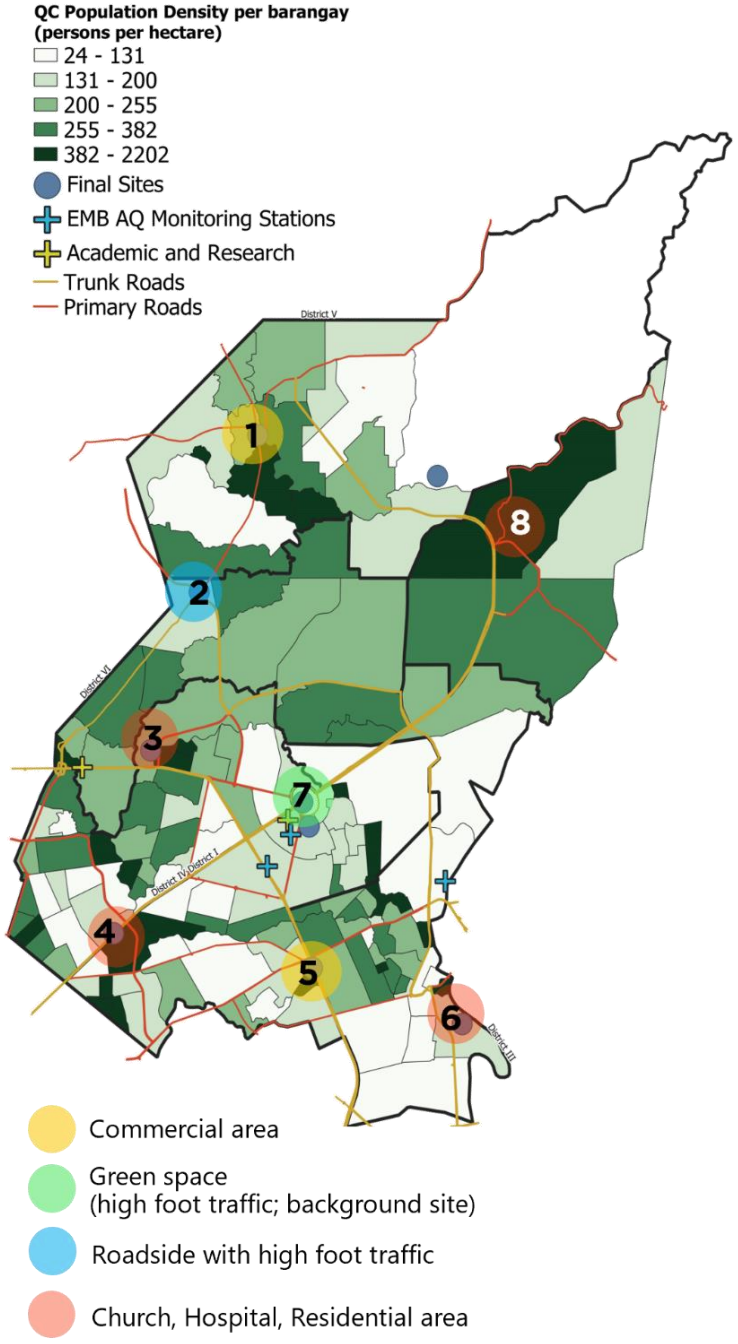
Quezon City, Philippines:

Collecting baseline data and identifying hotspots




QC Population Density per barangay
(persons per hectare)
24 - 131
131 - 200
200 - 255
255 - 382
382 - 2202
Final Sites
EMB AQ Monitoring Stations
Academic and Research
Trunk Roads
Primary Roads
District V
District VI
District IV
District I
District III
1
2
3
4
5
6
7
8
Commercial area
Green space
(high foot traffic; background site)
Roadside with high foot traffic
Church, Hospital, Residential area

CITY GENERAL HOSPITAL AND MEDICAL CENTER
PhilHealth

BERNADETTE
STORE

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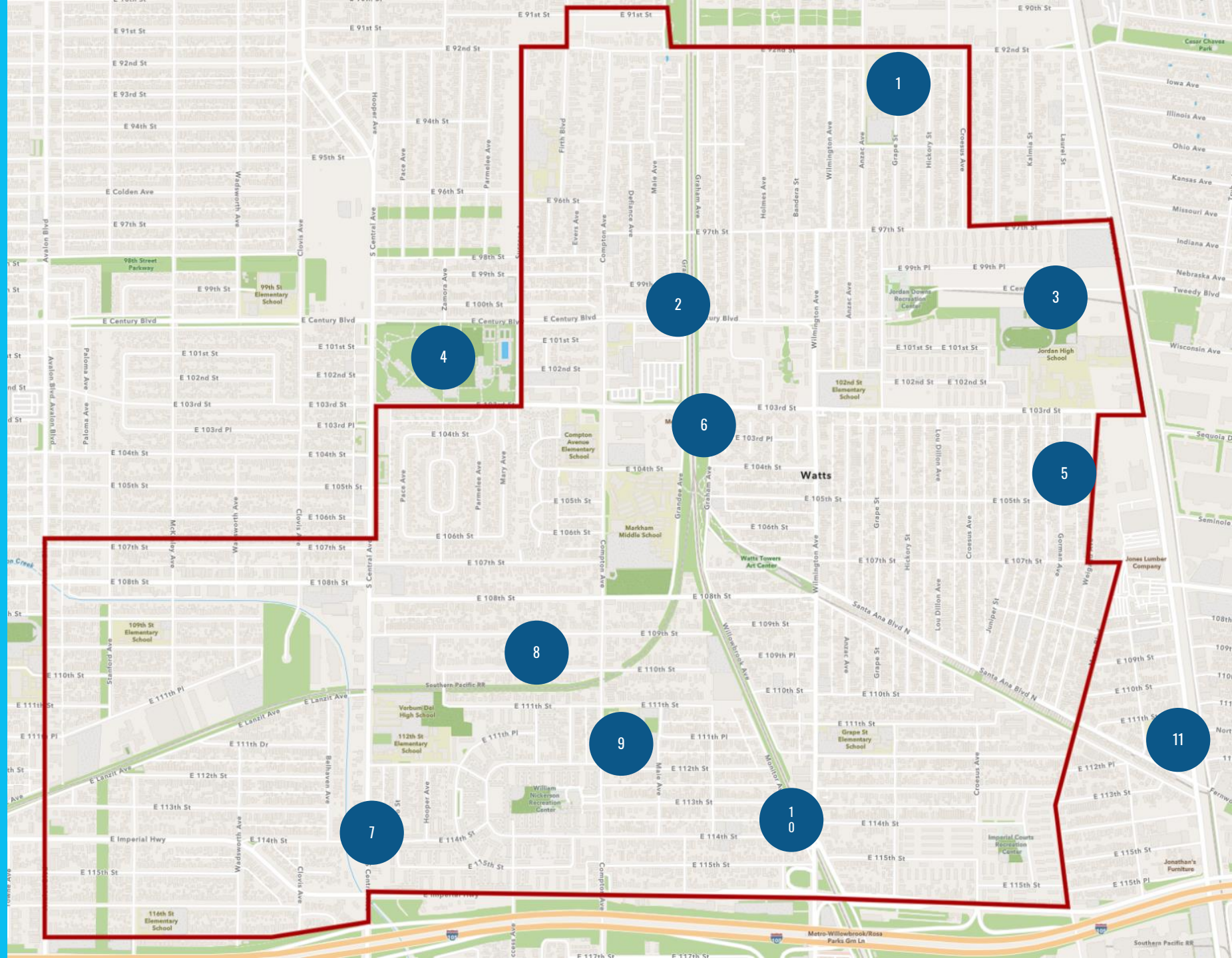
Los Angeles, United States: Empowering residents of historically disadvantaged communities with data through collaborative approaches



Los Angeles, United States: Empowering residents of historically disadvantaged communities with data through collaborative approaches

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New Resource:
Sensing change: how cities are using new sensing technologies to achieve air quality goals

Available on C40's Knowledge Hub:
tinyurl.com/sensingchange

Funding for this report, and several of the case studies, was provided by Bloomberg Philanthropies and the Clean Air Fund.

Bloomberg Philanthropies

CLEAN AIR FUND

City presentations

Lima	Addis Ababa	Denver	Lisbon
George Castelar Ulfe	Fantu Kifle	Aubrey Burgess	Pedro Oliveira

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LIMA'S NEW AIR FOR EARLY CHILDHOOD PROJECT

George Castelar Ulfe

METROPOLITAN MUNICIPALITY OF LIMA

AQ Monitoring Network

PROMOTING VISIBILITY AND REDUCING EARLY CHILDHOOD EXPOSURE TO AIR POLLUTION during the first years of life

CONVERGENCIA PARA LA ACCIÓN
RED DE LÍDERES: POR UN COMIENZO CON FUTURO

Horizonte Ciudadano

MUNICIPALIDAD DE LIMA

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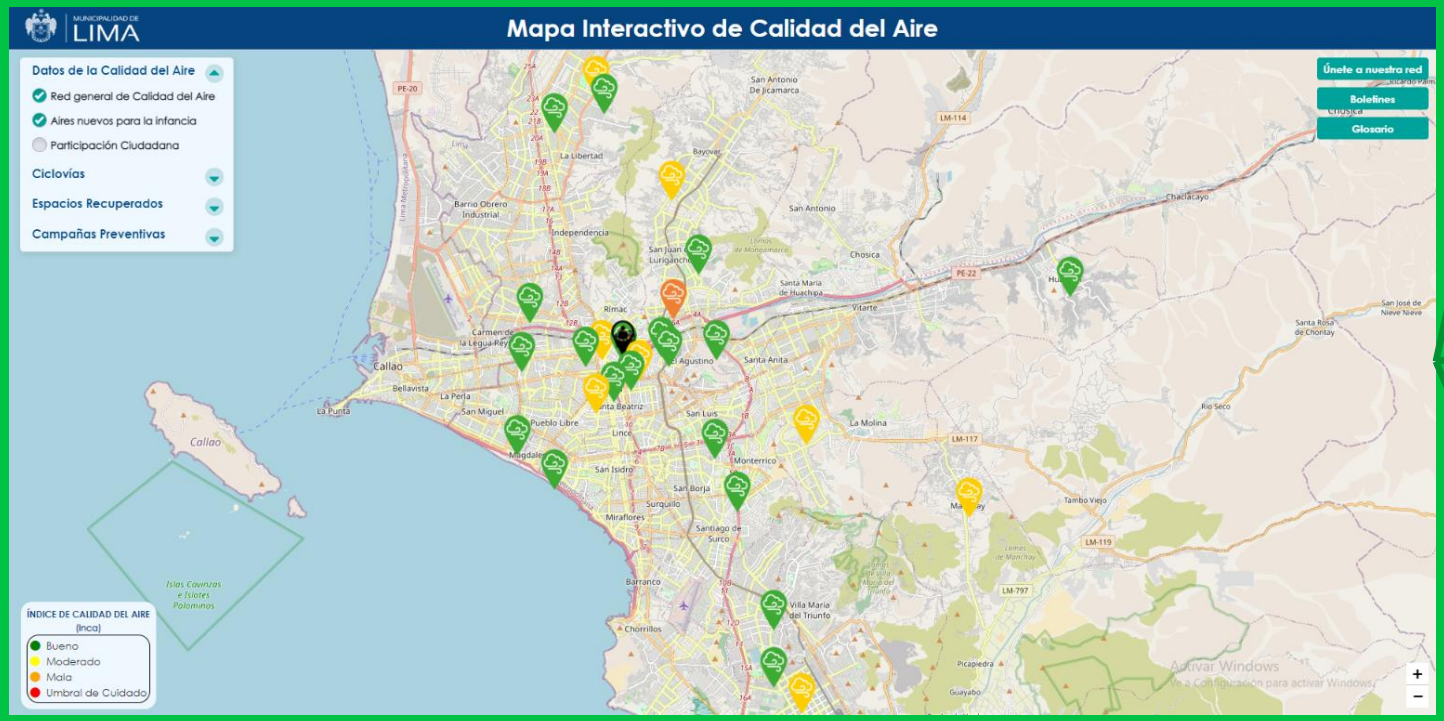
New Air for Early Childhood Lima Project

Air quality monitoring network with a focus on children



Shelter

Hospital

School

1 **Network implementation and growth**

- Installation of air quality sensors
- Empowerment of caregivers
- Environmental education workshops for boys and girls

2 **Recovery of spaces**

3 **Environmental Activations**

4 **Scientific Investigations**

5 **Mobile monitoring at 95 cm**

6 **Municipal ordinance clean air for children**

Phases of the project

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Main results

Determination of AQ and periods of least pollution per hour and day. This information will be useful in planning children's outdoor activities at times and days with less pollution.

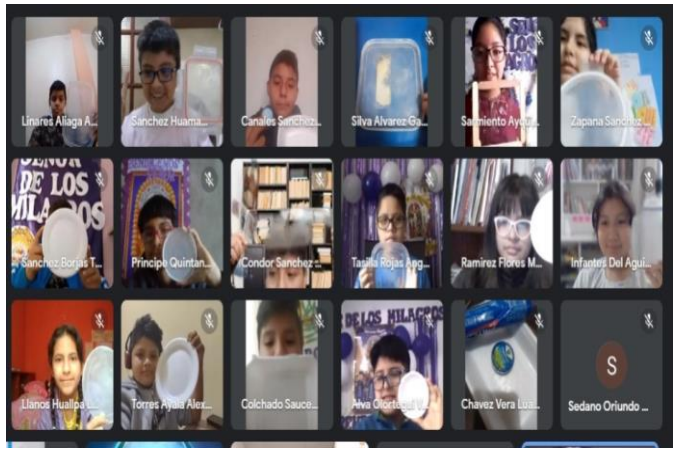
Dissemination of information

Newsletters with information from the network, available to all citizens

Average concentration of $PM_{2.5}$

Hora	Lun	Mar	Mie	Jue	Vie	Sab	Dom
0	39	30	31	22	29	40	39
1	42	38	28	24	34	34	39
2	40	38	32	25	27	26	36
3	42	47	32	23	31	28	36
4	38	54	30	19	32	28	36
5	46	49	30	20	30	25	34
6	51	46	36	21	33	24	34
7	42	43	41	18	28	27	34
8	29	40	43	18	26	28	33
9	26	30	36	21	28	23	29
10	21	30	26	15	19	19	26
11	15	28	17	13	13	15	22
12	12	20	20	16	12	15	21
13	11	17	19	16	12	15	22
14	12	15	20	19	11	12	19
15	13	15	18	17	12	12	17
16	15	16	18	19	14	12	16
17	20	24	21	21	16	15	19
18	20	31	20	24	22	20	20
19	30	28	20	25	26	25	29
20	35	27	23	26	31	29	39
21	33	25	24	30	37	29	41
22	32	31	25	27	42	37	43
23	32	35	28	31	44	38	37

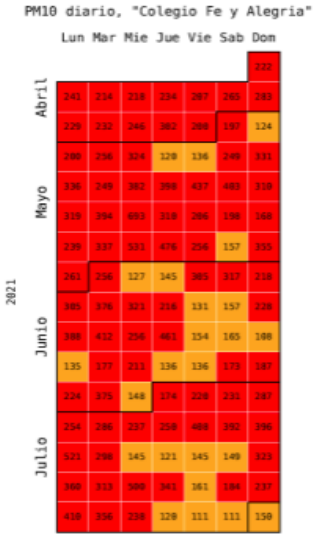
Workshops to raise awareness and involve children in caring for the air



Buena | Moderada | Mala | Umbral de cuidado

1st Intervention Based on Science

Before



1 Problem identified:

Exposure of boys and girls from the surroundings of Fe y Alegría N°4 school to highly polluted air.

2 Intervention objective:

Adapt a space in Los Olivos park that facilitates less exposure to polluted air and promotes the comprehensive development of children from 0 to 5 years of age hand in hand with their caregivers, under an eco-pedagogical approach.

Bare soil

No vegetation

Place for delinquency

After

Up to **45% improvement in air quality**

436 m² planted with species

583 m² of transformed space to avoid dust

81 m² Recovered facade with art

Additionally:

- Neighbourhood **involvement**
- Implementation of a **calm zone and a safe route**
- **Low cost play furniture** placement

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Projection in public spaces

of messages about clean air and childhood

The Big Grey Bubble

Thank you

MUNICIPALIDAD DE LIMA

George Castelar Ulfe

george.castelar@munlima.gob.pe

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ADDIS ABABA: Quality, Accessibility, and Clarity of City-Scale Data and Information Platforms

Fantu Kifle

ADDIS ABABA ENVIRONMENTAL PROTECTION AGENCY

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love my air

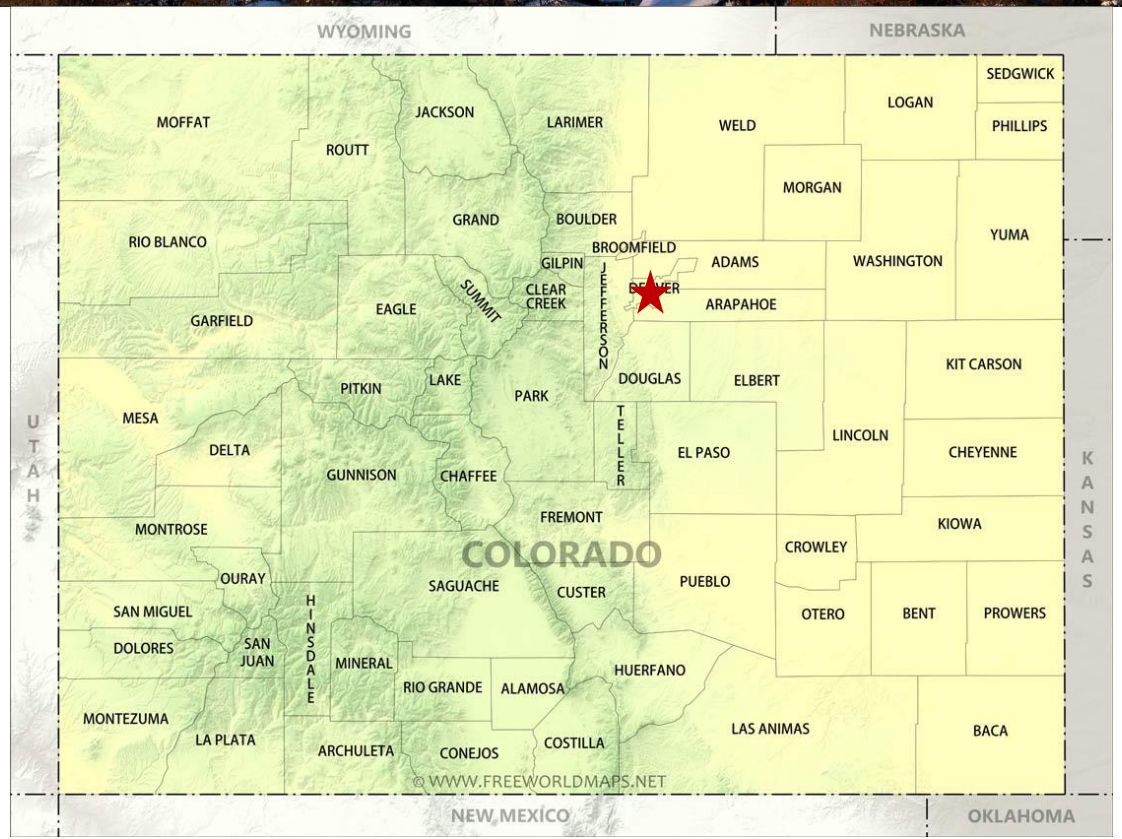
Empowering communities to live better and longer by reducing air pollution and limiting exposure through behaviour change, advocacy and community engagement

Aubrey Burgess, Love My Air Program Manager
City and County of Denver

City & County of Denver

- Denver, Colorado has the 36th worst air quality among major US cities
- Only 53% of Denver residents realize the potential effects of poor air quality, such as increased asthma rates and symptoms
- Denver families spend an average of $3,100 a year on asthma-related medical costs

The Solution: The City and County of Denver is working to improve air quality by installing cutting-edge air pollution sensors around schools. The program provides data and programmatic options for adoption by schools to allow for customised solutions tailored to the unique needs of individual school communities.

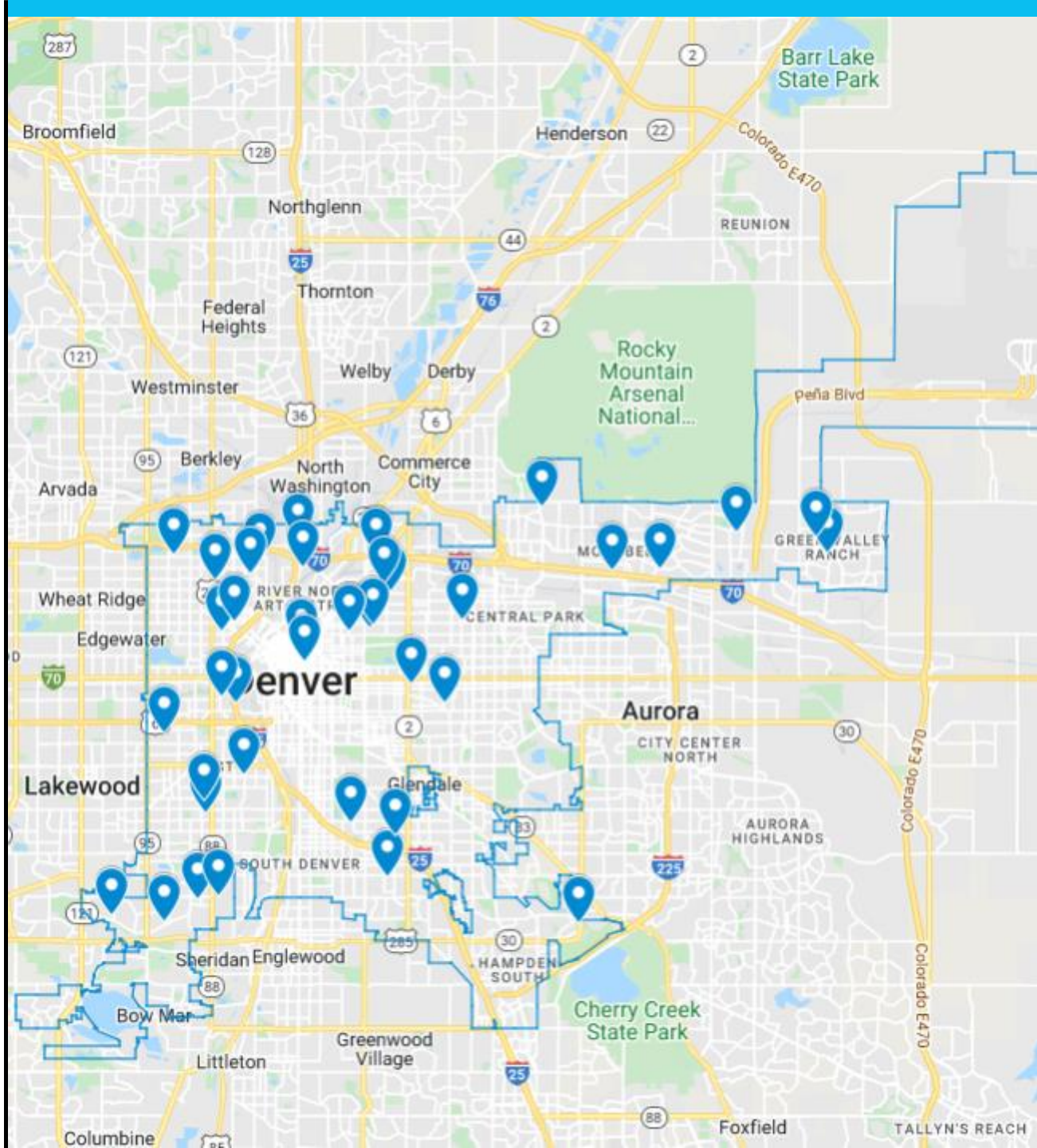


American Lung Association. (2021). State of the Air 2021..
United States Census Bureau. (2019). Estimates of Resident Population Change and Rankings: July 1, 2017 to July 1, 2018 - United States -- Metropolitan Statistical Area; & for Puerto Rico.
Photos: Marriott, One Stop Map

love my air

Understanding & addressing inequities

- Prioritize schools by looking at indicators such as:
  - Asthma rates at schools
  - Free/ reduced lunch rates at schools
  - Historic environmental justice neighborhoods, near major roadways, railways, industry, etc.
  - Other health inequities such as access to parks, medical services, etc.
- Programs focus on:
  - Reducing asthma exacerbation through nurse education
  - Reducing traffic-related air pollution, especially from idling
  - Increasing access to real-time air quality information



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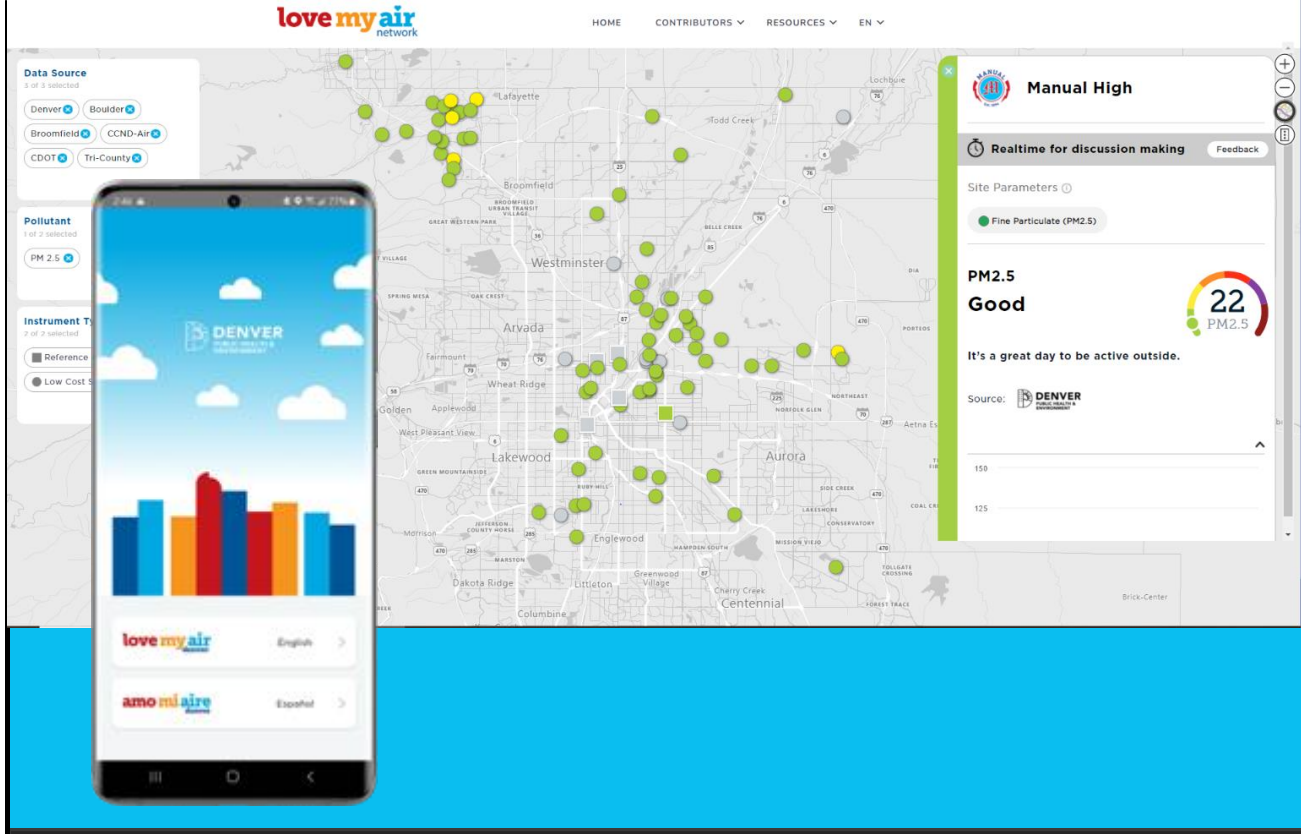
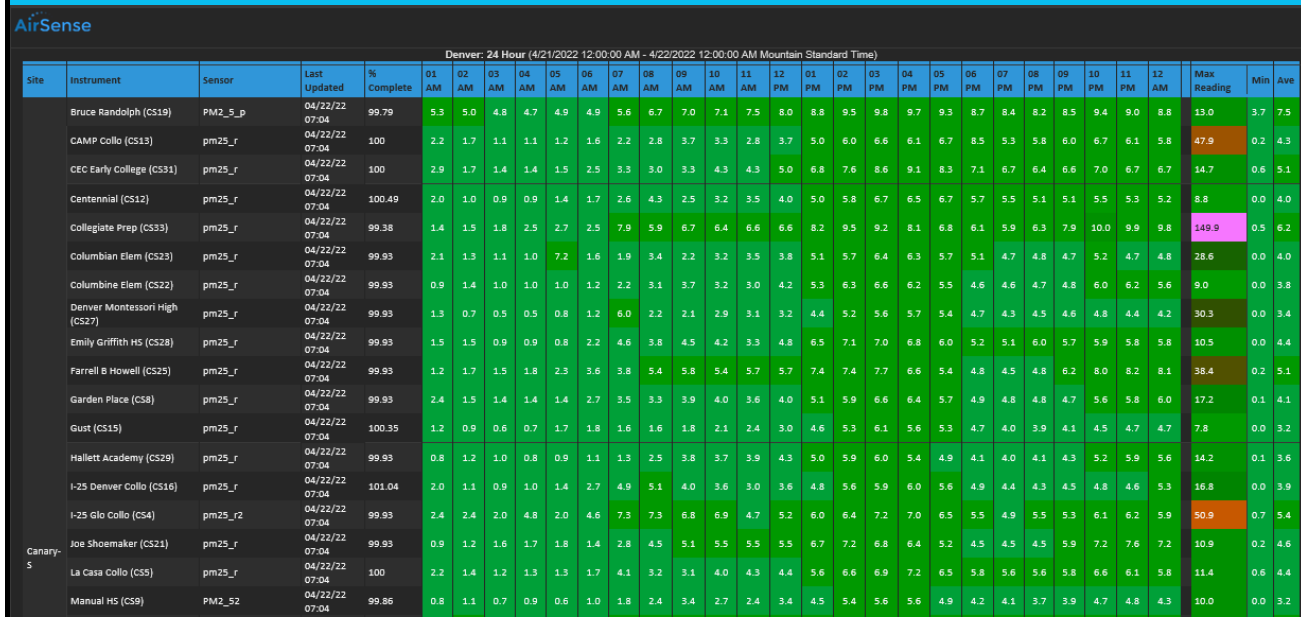
Data accessibility

- Increase air quality literacy
- Develop an approachable, public-facing brand
- Work with other regional partners
  - Municipalities
  - Public health agencies
  - Research institutions
  - Industry leaders
- Phone app and web dashboard





Site	Instrument	Sensor	Last Updated	% Complete	01 AM	02 AM	03 AM	04 AM	05 AM	06 AM	07 AM	08 AM	09 AM	10 AM	11 AM	12 PM	01 PM	02 PM	03 PM	04 PM	05 PM	06 PM	07 PM	08 PM	09 PM	10 PM	11 PM	12 AM	Max Reading	Min	Ave
Canary-s	Bruce Randolph (CS19)	PM2_5_p	04/22/22 07:04	99.79	5.3	5.0	4.8	4.7	4.9	4.9	5.6	6.7	7.0	7.1	7.5	8.0	8.8	9.5	9.8	9.7	9.3	8.7	8.4	8.2	8.5	9.4	9.0	8.8	13.0	3.7	7.5
	CAMP Collo (CS13)	pm25_r	04/22/22 07:04	100	2.2	1.7	1.1	1.1	1.2	1.6	2.2	2.8	3.7	3.3	2.8	3.7	5.0	6.0	6.6	6.1	6.7	8.5	5.3	5.8	6.0	6.7	6.1	5.8	47.9	0.2	4.3
	CEC Early College (CS31)	pm25_r	04/22/22 07:04	100	2.9	1.7	1.4	1.4	1.5	2.5	3.3	3.0	3.3	4.3	4.3	5.0	6.8	7.6	8.6	9.1	8.3	7.1	6.7	6.4	6.6	7.0	6.7	6.7	14.7	0.6	5.1
	Centennial (CS12)	pm25_r	04/22/22 07:04	100.49	2.0	1.0	0.9	0.9	1.4	1.7	2.6	4.3	2.5	3.2	3.5	4.0	5.0	5.8	6.7	6.5	6.7	5.7	5.5	5.1	5.1	5.5	5.3	5.2	8.8	0.0	4.0
	Collegiate Prep (CS33)	pm25_r	04/22/22 07:04	99.38	1.4	1.5	1.8	2.5	2.7	2.5	7.9	5.9	6.7	6.4	6.6	6.6	8.2	9.5	9.2	8.1	6.8	6.1	5.9	6.3	7.9	10.0	9.9	9.8	149.9	0.5	6.2
	Columbian Elem (CS23)	pm25_r	04/22/22 07:04	99.93	2.1	1.3	1.1	1.0	7.2	1.6	1.9	3.4	2.2	3.2	3.5	3.8	5.1	5.7	6.4	6.3	5.7	5.1	4.7	4.8	4.7	5.2	4.7	4.8	28.6	0.0	4.0
	Columbine Elem (CS22)	pm25_r	04/22/22 07:04	99.93	0.9	1.4	1.0	1.0	1.0	1.2	2.2	3.1	3.7	3.2	3.0	4.2	5.3	6.3	6.6	6.2	5.5	4.6	4.6	4.7	4.8	6.0	6.2	5.6	9.0	0.0	3.8
	Denver Montessori High (CS27)	pm25_r	04/22/22 07:04	99.93	1.3	0.7	0.5	0.5	0.8	1.2	6.0	2.2	2.1	2.9	3.1	3.2	4.4	5.2	5.6	5.7	5.4	4.7	4.3	4.5	4.6	4.8	4.4	4.2	30.3	0.0	3.4
	Emily Griffith HS (CS28)	pm25_r	04/22/22 07:04	99.93	1.5	1.5	0.9	0.9	0.8	2.2	4.6	3.8	4.5	4.2	3.3	4.8	6.5	7.1	7.0	6.8	6.0	5.2	5.1	6.0	5.7	5.9	5.8	5.8	10.5	0.0	4.4
	Farrell B Howell (CS25)	pm25_r	04/22/22 07:04	99.93	1.2	1.7	1.5	1.8	2.3	3.6	3.8	5.4	5.8	5.4	5.7	5.7	7.4	7.4	7.7	6.6	5.4	4.8	4.5	4.8	6.2	8.0	8.2	8.1	38.4	0.2	5.1
	Garden Place (CS8)	pm25_r	04/22/22 07:04	99.93	2.4	1.5	1.4	1.4	1.4	2.7	3.5	3.3	3.9	4.0	3.6	4.0	5.1	5.9	6.6	6.4	5.7	4.9	4.8	4.8	4.7	5.6	5.8	6.0	17.2	0.1	4.1
	Gust (CS15)	pm25_r	04/22/22 07:04	100.35	1.2	0.9	0.6	0.7	1.7	1.8	1.6	1.6	1.8	2.1	2.4	3.0	4.6	5.3	6.1	5.6	5.3	4.7	4.0	3.9	4.1	4.5	4.7	4.7	7.8	0.0	3.2
	Hallett Academy (CS29)	pm25_r	04/22/22 07:04	99.93	0.8	1.2	1.0	0.8	0.9	1.1	1.3	2.5	3.8	3.7	3.9	4.3	5.0	5.9	6.0	5.4	4.9	4.1	4.0	4.1	4.3	5.2	5.9	5.6	14.2	0.1	3.6
	I-25 Denver Collo (CS16)	pm25_r	04/22/22 07:04	101.04	2.0	1.1	0.9	1.0	1.4	2.7	4.9	5.1	4.0	3.6	3.0	3.6	4.8	5.6	5.9	6.0	5.6	4.9	4.4	4.3	4.5	4.8	4.6	5.3	16.8	0.0	3.9
	I-25 Glo Collo (CS4)	pm25_r2	04/22/22 07:04	99.93	2.4	2.4	2.0	4.8	2.0	4.6	7.3	7.3	6.8	6.9	4.7	5.2	6.0	6.4	7.2	7.0	6.5	5.5	4.9	5.5	5.3	6.1	6.2	5.9	50.9	0.7	5.4
	Joe Shoemaker (CS21)	pm25_r	04/22/22 07:04	99.93	0.9	1.2	1.6	1.7	1.8	1.4	2.8	4.5	5.1	5.5	5.5	5.5	6.7	7.2	6.8	6.4	5.2	4.5	4.5	4.5	5.9	7.2	7.6	7.2	10.9	0.2	4.6
	La Casa Collo (CS5)	pm25_r	04/22/22 07:04	100	2.2	1.4	1.2	1.3	1.3	1.7	4.1	3.2	3.1	4.0	4.3	4.4	5.6	6.6	6.9	7.2	6.5	5.8	5.6	5.6	5.8	6.6	6.1	5.8	11.4	0.6	4.4
	Manual HS (CS9)	PM2_52	04/22/22 07:04	99.86	0.8	1.1	0.7	0.9	0.6	1.0	1.8	2.4	3.4	2.7	2.4	3.4	4.5	5.4	5.6	5.6	4.9	4.2	4.1	3.7	3.9	4.7	4.8	4.3	10.0	0.0	3.2

love my air

Using data to make decisions

- Individual
  - Empowered to reduce contribution and exposure to pollution
  - Real-time health-based messaging
- School
  - Outdoor activity guidance
  - Implement anti-idling campaigns
- City
  - Institute best practices around construction, traffic
  - Advocate for state policy
  - Clean air shelters
- Regional
  - Coordinated wildfire response
  - Free transit days
  - Consistency in monitoring and messaging

love my air

love my air denver

AIR QUALITY OUTDOOR ACTIVITY GUIDE

DENVER PUBLIC HEALTH & ENVIRONMENT

Spending time outside in bad air quality can have an impact on your health.
This chart helps you decide what outdoor activities are safer for you during different air quality conditions.

The chart uses the U.S. Environmental Protection Agency's (EPA) Air Quality Index (AQI) to report how polluted air.
The AQI has six categories, each with a color and health level.
For each level, the chart provides advice on what you should do outside.

	Good	Moderate	Unhealthy for Sensitive Goups	Unhealthy	Very Unhealthy	Hazardous
AQI	0-50	51-100	101-150	151-200	201-300	301-500
Recess (15 minutes)	Enjoy outdoor activities!	Good day to be outside!	It's okay to be outside for short activities.	Consider exercising indoors and take more breaks, possibly reschedule activities.	No outdoor activity.	No outdoor activity.
Gym Class (1 hour)	Enjoy outdoor activities!	Good day to be outside!	It's okay to be outside for short activities.	Consider exercising indoors and take more breaks, possibly reschedule activities.	No outdoor activity.	No outdoor activity.
Athletic Practices (2-4 hours)	Enjoy outdoor activities!	Good day to be outside!	It's okay to be outside for short activities.	Exercise indoors or limit hard outdoor activity with increased breaks.	No outdoor activity.	No outdoor activity.
Sports Leagues or Events (4-8 hours)	Enjoy outdoor activities!	Good day to be outside!	It's okay to be outside for short activities.	Exercise indoors or limit hard outdoor activity with increased breaks.	No outdoor activity.	No outdoor activity.

Love My Air Denver is a partnership program of Denver's Department of Public Health and Environment and Denver Public Schools.

FOR MORE INFORMATION ABOUT OUR WORK:
Visit us at **LoveMyAirDenver.com** | Follow us at **#LoveMyAirDenver**

Thank you!

Aubrey Burgess
Love My Air Program Manager
City and County of Denver,
Department of Public Health and Environment
Aubrey.Burgess@denvergov.org

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Air Sensors International Conference
May 11-13, 2022

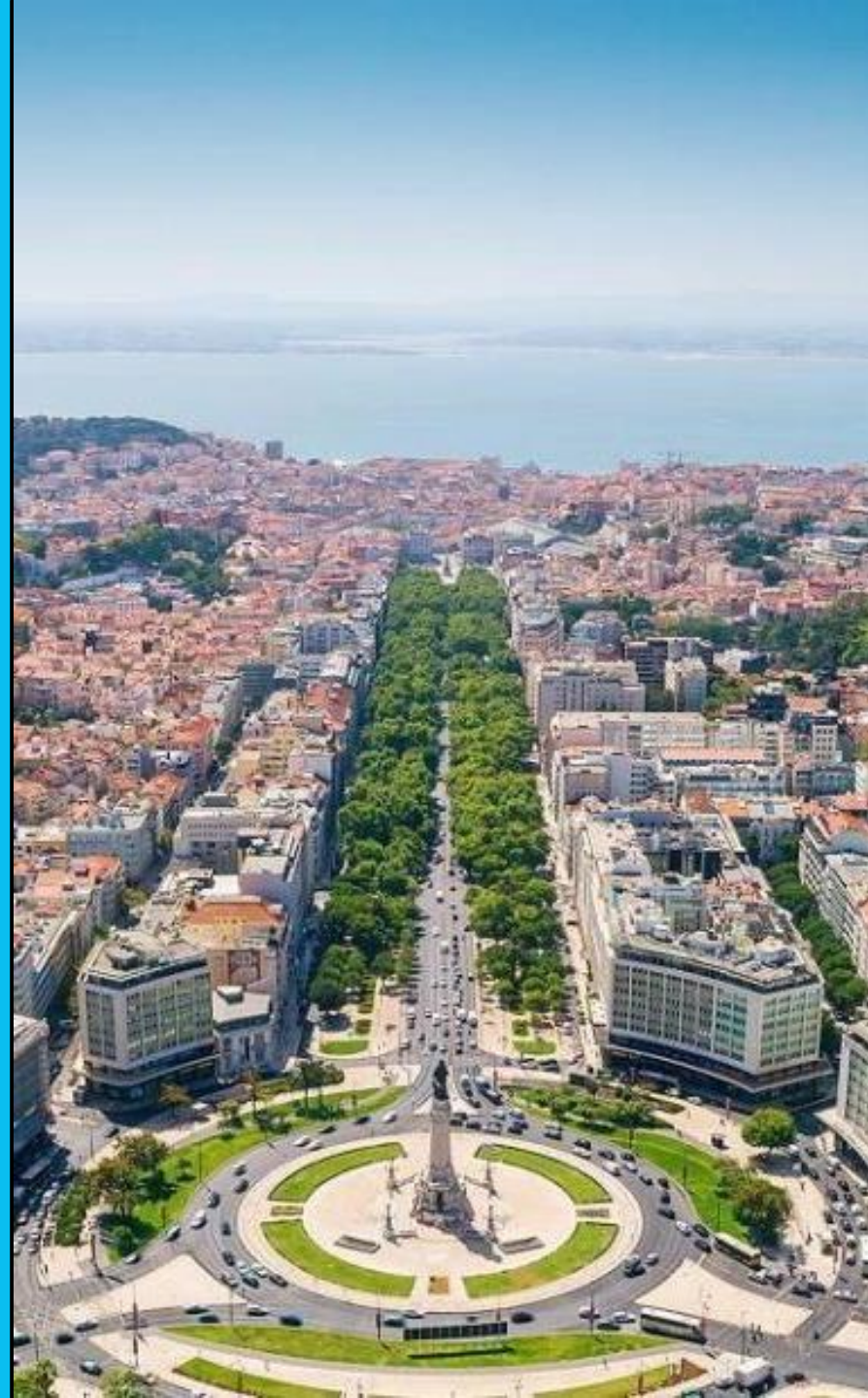
ASIC

C40 CITIES

Lisbon Monitoring Network

Strategy & Challenges

Pedro Oliveira
(pedro.oliveira@cm-lisboa.pt)
Municipality of Lisbon



Environmental Monitoring Network

1 - Air Quality: SO_2, O_3, CO, C_6H_6, NO, NO_2, PM_{10}, $PM_{2.5}$

3 - Noise: LAeq

2 - Weather: Humidity, Temperature, Pressure, Precipitation; Wind (Direction, Speed); UV Index, Total Radiation

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80 monitoring sites

+ 650 sensors

17 parameters

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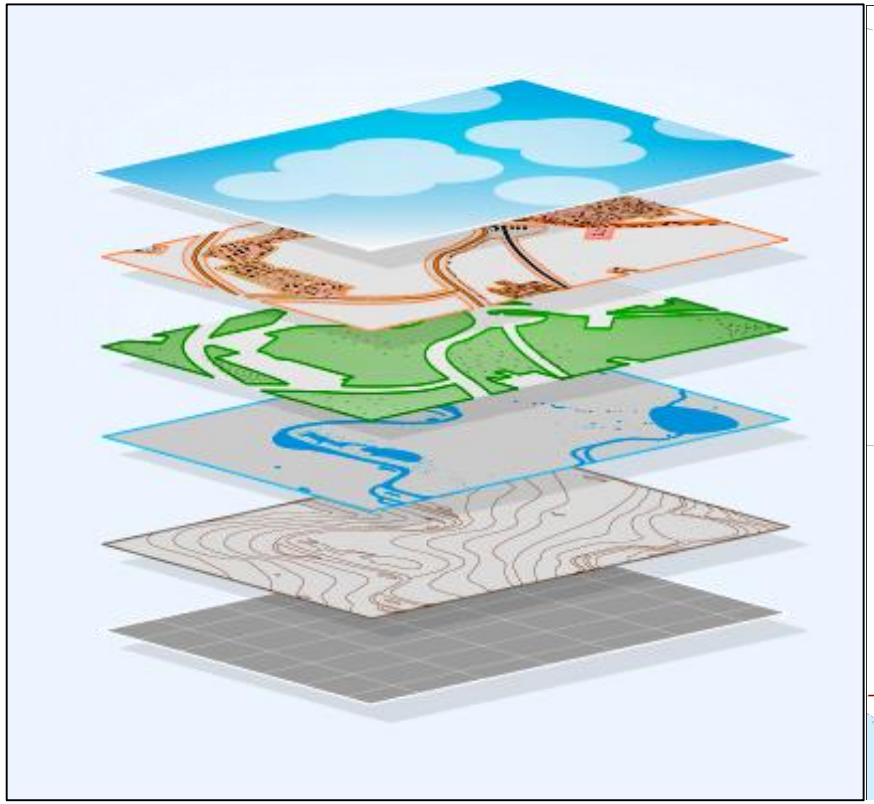
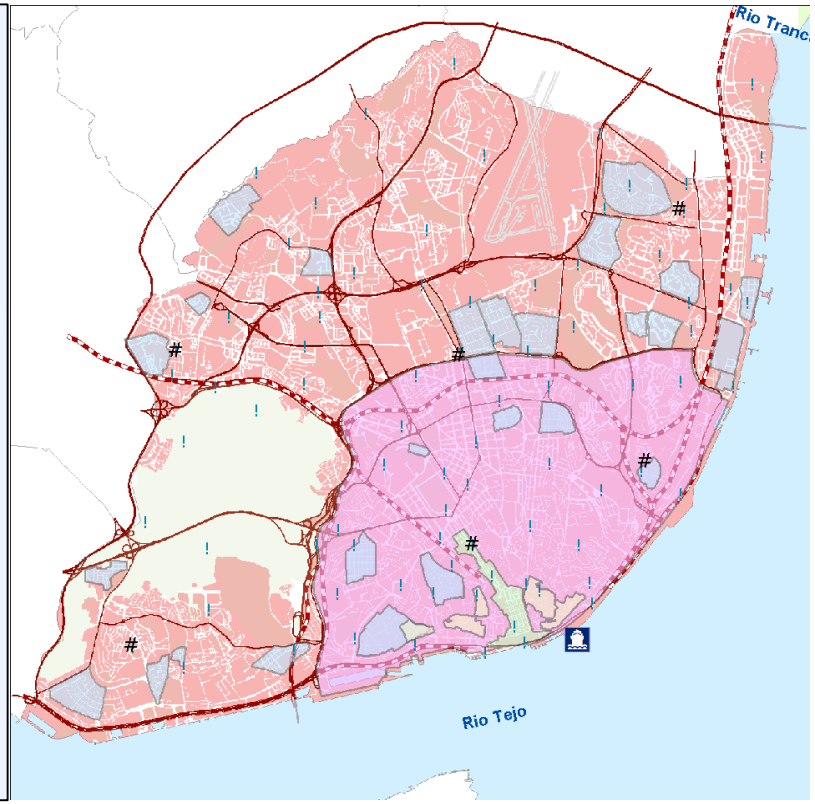
Spatial Coverage





Multi Criteria:

- 2x2km grid (all city covered)
- Sharing Cities project requirements
- 24 parishes
- Low Emission Zone (LEZ)
- Land use (green | blue areas – river front, public services, schools)
- Road network levels
- Potential pollution hot spots (cemeteries, airport, cruise terminal)

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+ 10 criteria

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Location typologies

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8
Location typologies

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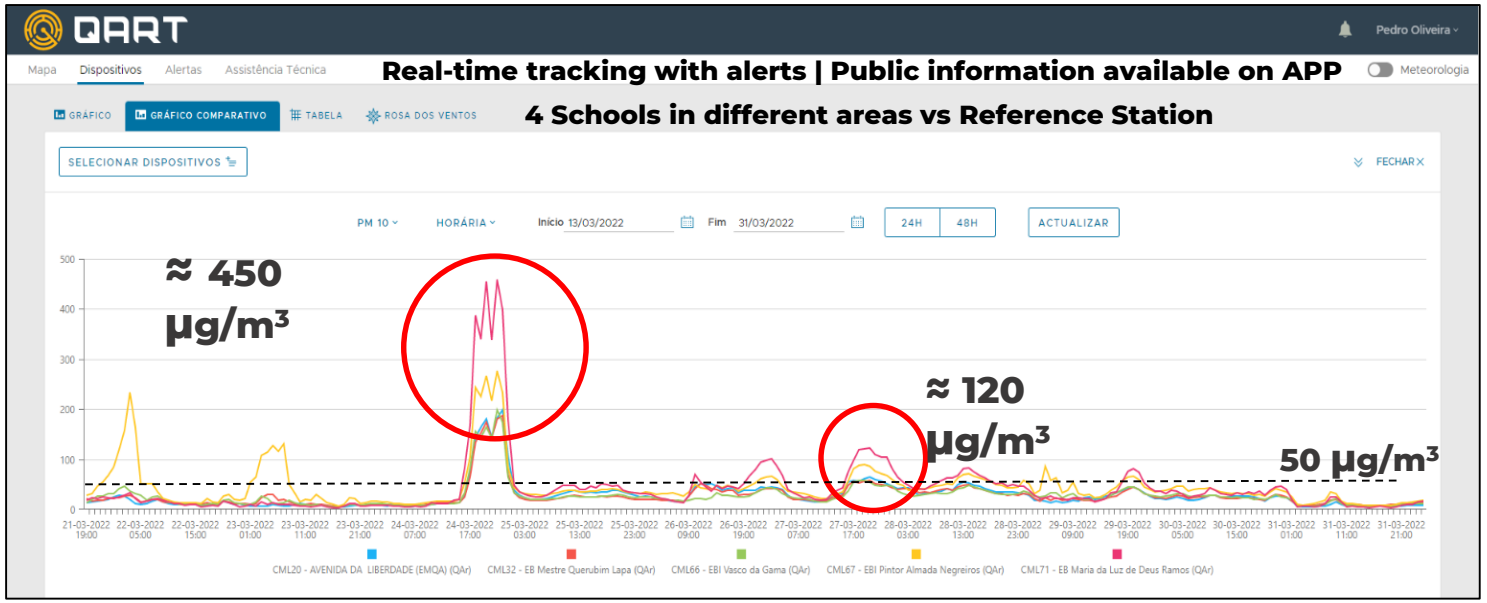
Transport of mineral dust from North African deserts



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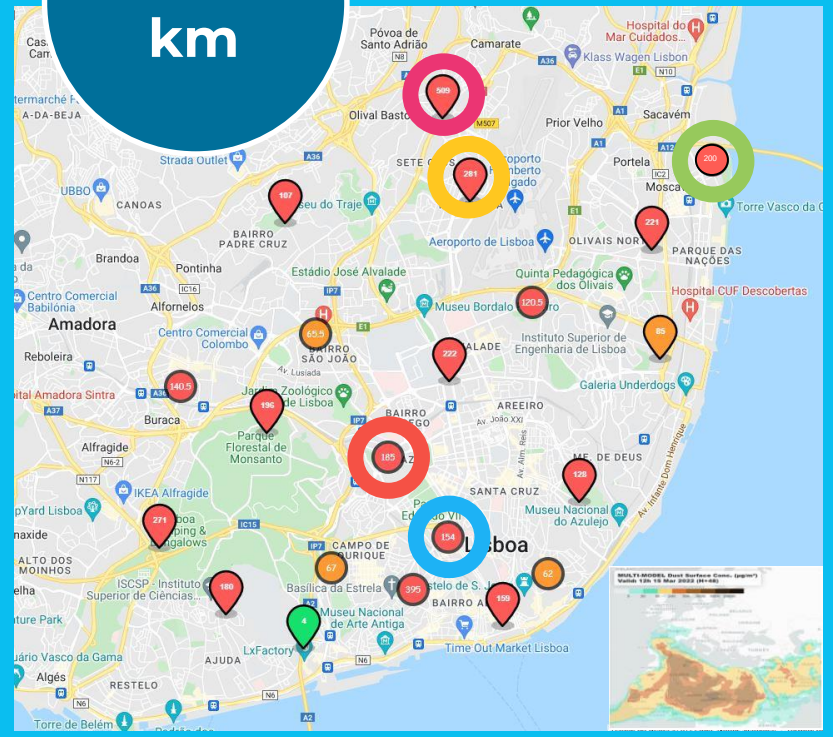
+ 900 km



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Challenges to overcome

Cost

Partners

Communication

Coverage

Real time

Energy

Validation

Data Integration

Data Quality

Analytics

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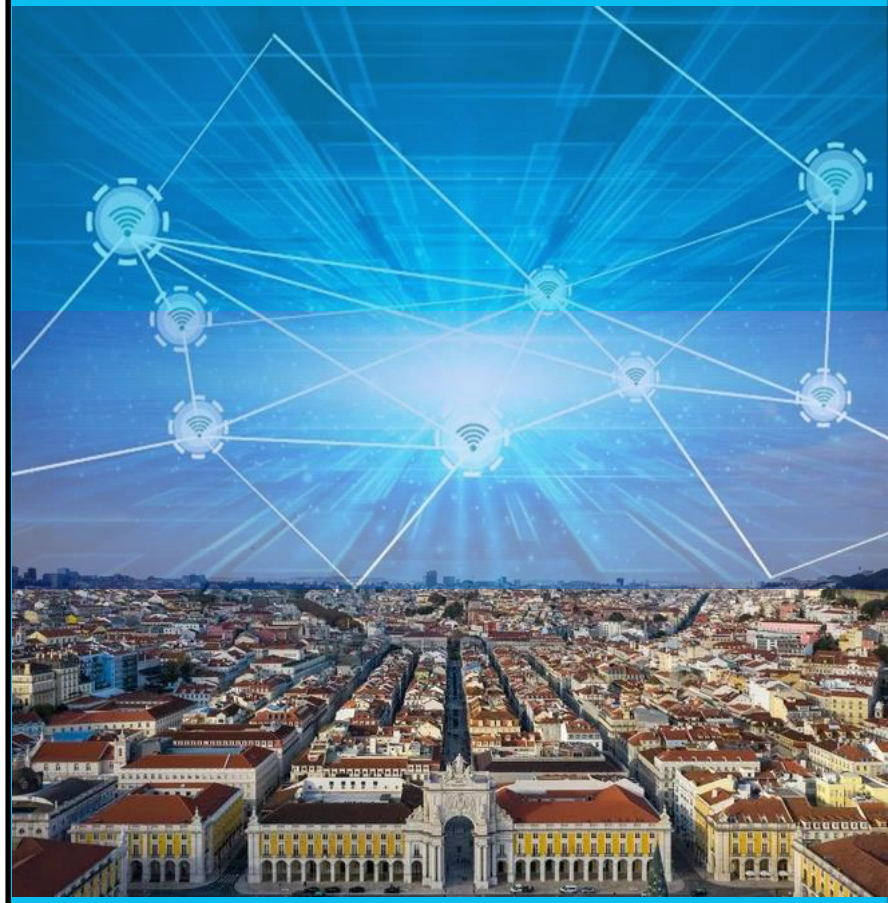

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Lisbon has chosen to lead a Greener and Healthier city

Thanks for your attention

Pedro Oliveira
(pedro.oliveira@cm-lisboa.pt)

CLEAN AIR FUND

Matt Whitney

Portfolio Manager

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