

The use of a sensor monitoring network and modelling to quantify air quality, health, economic benefits of AQMP measures in Quezon City, Philippines

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Quezon City Air Quality Monitoring Network

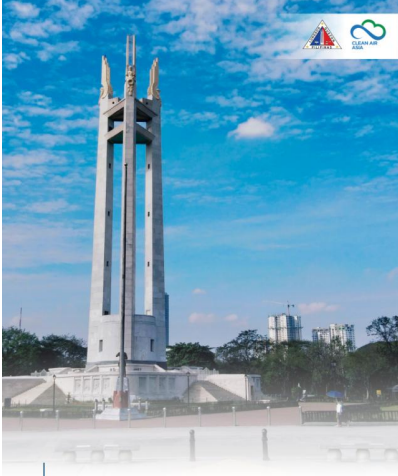
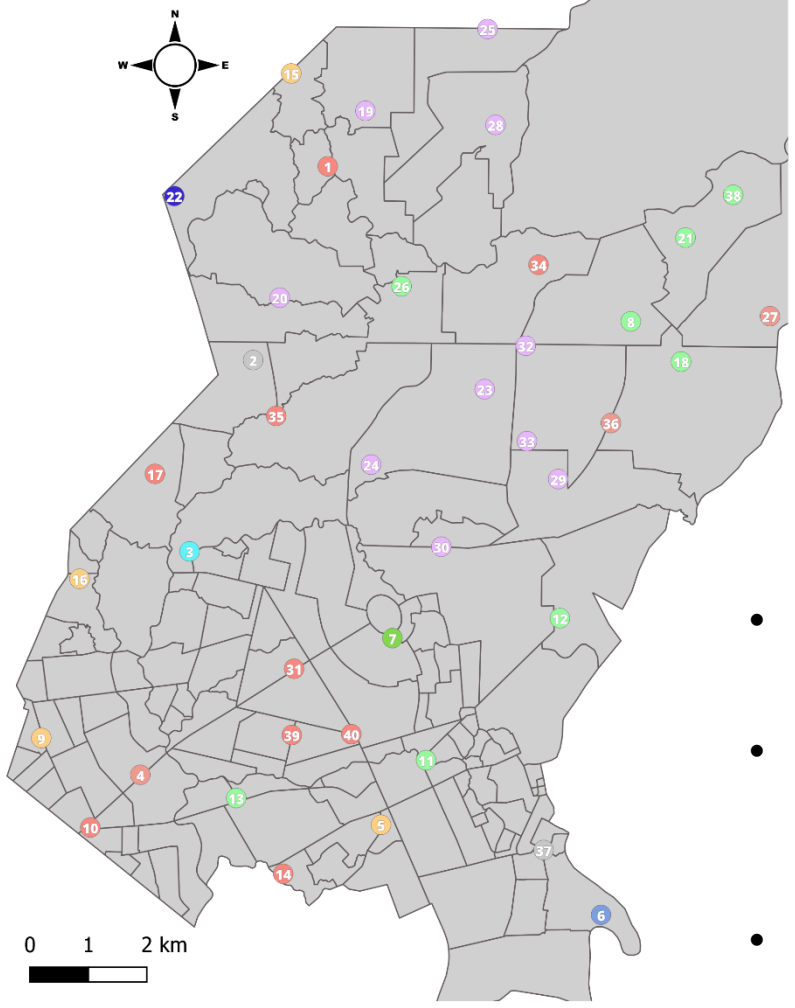
From air quality data to action



ID	Sensor
1	Nova_Market
2	Quirino_cor_Mindanao
3	QCGH
4	StoDomingo_Church
5	Cubao_Arayat
6	Obrero_Industria
7	QCPL
8	Commonwealth_BH
9	LaLoma_PS
10	Erod_Ave
11	Silangan_BH
12	Pansol_BH
13	Kalusugan_BHC
14	N_Domingo
15	Susano_Rd
16	Balintawak_Cloverleaf
17	Quirino_Dominic
18	BatasanHills_BH
19	Kaligayahan_ElemS
20	Korphil_QCU
21	Payatas_SHC
22	PDelaCruz
23	FEU_Diliman
24	PasongTamo_ES
25	Maligaya_EHS
26	Sauyo_BH
27	SanIsidro_Church
28	Lagro_HS
29	OldBalara_EHS
30	NewEra_Univ
31	QAve_SEsguerra_FB
32	Jose_Rizal_HS

ID	Sensor
33	Holy_Spirit_ES
34	Pearl_Drive_FB
35	TandangSora_BH_FB
36	StPeterChurch_FB
37	Libis_BH_FB
38	Payatas_CDF
39	TomasMorato_SFernandez
40	EDSA_Timog_FB

- Marker Location Types**
- Church
 - Commercial
 - Commercial, Residential
 - Green Space
 - Hospital
 - Industrial, Residential
 - Residential
 - School
 - Traffic
 - Industrial
 - Primary Roads
 - Trunk Roads



2022 - 2023 **Quezon City Air Quality Management Project**

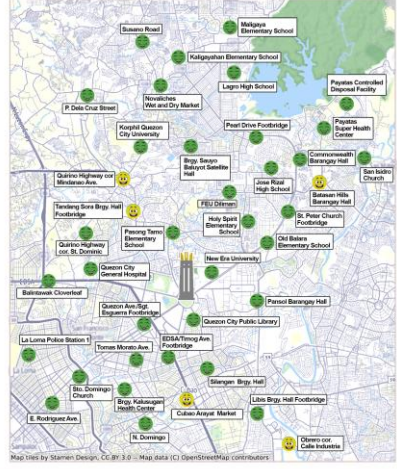
Air Quality in Quezon City

24 Hour PM_{2.5} AQI
8AM December 10 to 8AM December 11, 2024

Air Quality Index (AQI)

Ang AQI ay ginagamit upang mamalan ang air quality at mga padala upang malawasan ang masamang epekto na dulot nito sa kalusugan ng tao.

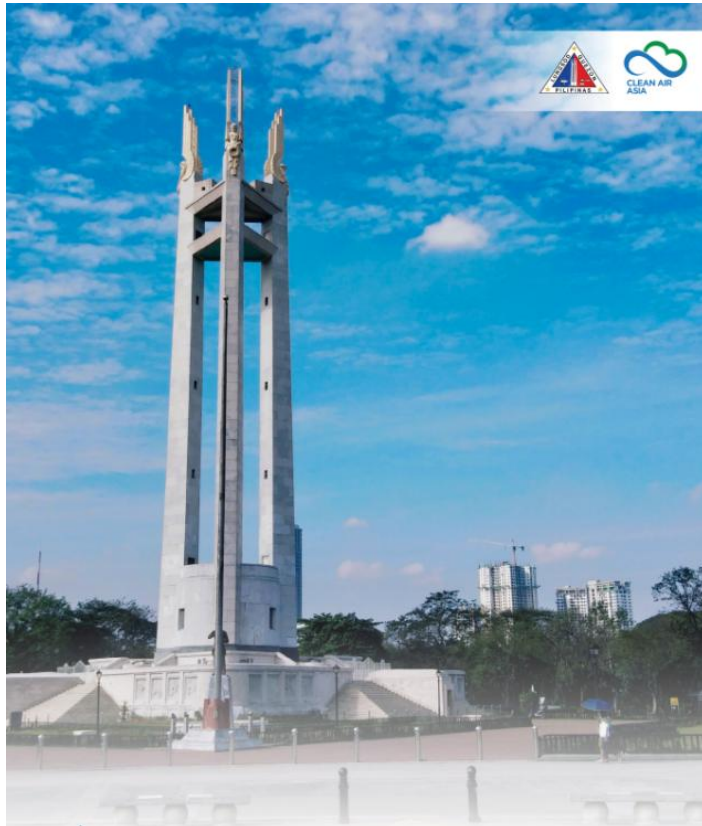
- **Good** (0-25 ug/m³) - Walang babala
- **Fair** (25.1-35.0 ug/m³) - Walang babala
- **Unhealthy for Sensitive Groups** (35.1-45.0 ug/m³) - Inaang limbas kung mayroong respiratory disease tulad ng tula.
- **Very Unhealthy** (45.1-55 ug/m³) - Inaang limbas ng bahay at limitang pangunahing paglalakbay. Inaang ang lugar na may matinding traffic. Hahanap at magaling sa bahay kung may heart/respiratory disease.
- **Acutely Unhealthy** (55.1-65 ug/m³) - Inaang limbas ng bahay. Manatili at magaling kung may heart/respiratory disease. Maaaring limitahan ang paggamit ng sasakyan at bansal ang mga gumagaling pang-industriya.
- **Emergency** (Above 65 ug/m³) - Ang lahat ay dapat manatili sa bahay ng bahay. Inaang limitahan ang paglalakbay ng sasakyan matibag ng madali't emergency ang bansal. Kailangang bansalan ang mga gumagaling pang-industriya matibag kung makatapos sa kalusugan at halagaan.



- In combination with EI, LEAP-IBC, informed **Air Quality Management Plan** development
- Used to provide regular **AQ updates** and in the development of **school suspension guidelines** during pollution episodes
- Key in the implementation of **AQMP measures**

The most extensive city-level air quality monitoring network in the Philippines

Efforts of the Quezon City Local Government on Air Quality Management



Establishment of Quezon City-owned air quality monitoring network

- Pagkakaroon ng pinakamalawak na Air Quality Monitoring Network na may kaukulang dami na 40 non-reference air quality sensors, 7 automated weather stations at 1 reference monitoring station.

Air quality communication

- Communication strategy planning kasama ng mga QC stakeholders
- Pag-develop ng mga information dissemination materials

Emissions inventory and health mapping

- Pag-inventory ng lahat ng emission sources sa QC
- Pag-model ng benefits ng emission reduction measures
- Mapping ng respiratory health incidences sa siyudad

Air Quality Management Plan

- Pagbuo ng mga tiyak na hakbang at aksyon para mapabuti ang kalidad ng hangin na magsisilbing gabay sa paggawa ng mga polisiya para sa siyudad.



2022 - 2023

Quezon City Air Quality Management Project



Building confidence in the sensor data was key: Collocation experiments gained the trust of decisionmakers

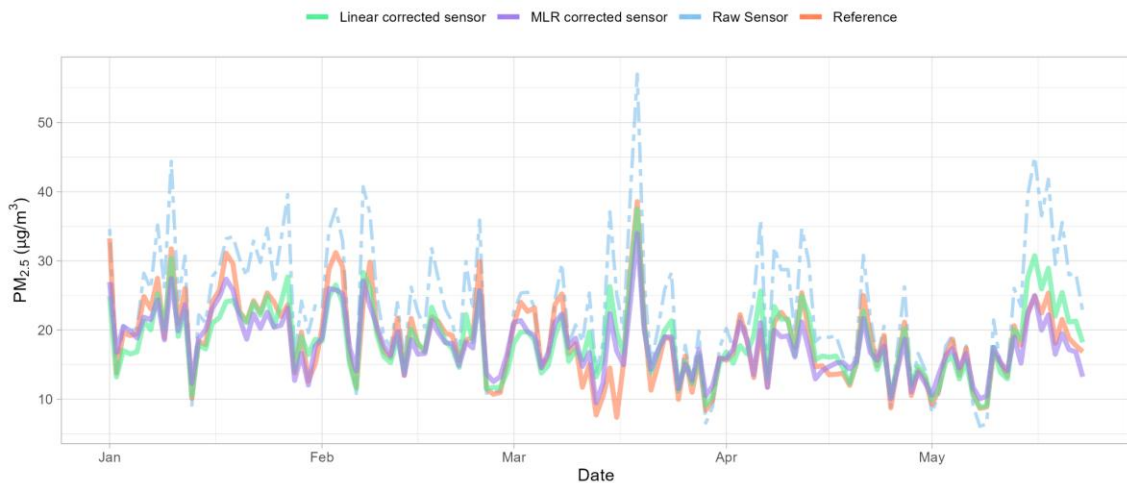


Sensor	Pollutant	Reference instrument	Units	Remarks	Start date	End date	No. of days
Clarity Node-S	PM _{2.5}	DENR EMB Mehan Garden, Teledyne T640	1	Long-term	29-Aug-20	23-May-22	633
Clarity Node-S	PM _{2.5}	Quezon City KorPhil, Envea MP101M	1	Long-term, Permanent	01-Aug-23	05-Dec-24	492
Clarity Node-S	PM _{2.5}	Quezon City KorPhil, Envea MP101M	10	Short-term batch	05-Sep-23	01-Oct-23	26
Clarity Node-S	PM _{2.5}	Quezon City KorPhil, Envea MP101M	10	Short-term batch	27-Dec-23	01-Feb-24	36
Airveda	PM _{2.5}	DENR EMB Paranaque, Teledyne T640	1	Medium-term	25-Nov-22	05-May-23	161
Airveda	PM ₁₀	DENR EMB Paranaque, Teledyne T640	1	Medium-term	25-Nov-22	05-May-23	161
AirGradient O-1PST	PM _{2.5}	DENR EMB Paranaque, Teledyne T640	3	Short-term	30-Jul-24	05-Sep-24	37
AirGradient O-1PST	PM _{2.5}	DENR EMB Paranaque, Teledyne T640	20	Secondary	11-Nov-24	08-Jan-25	58

More accurate sensor data is achieved with data correction

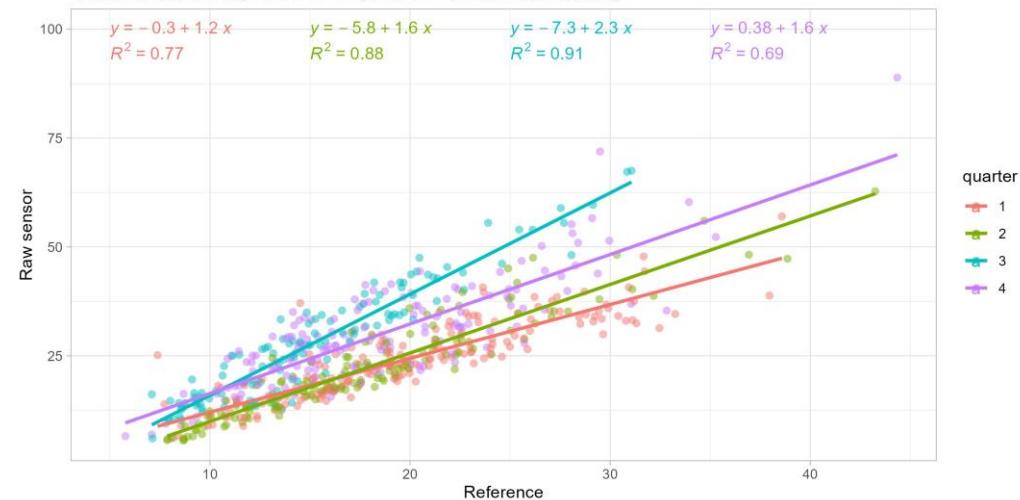
Time series of reference and sensor PM_{2.5} data (µg/m³) in Mehan Garden 2022

Linear and multiple regression correction of raw sensor data



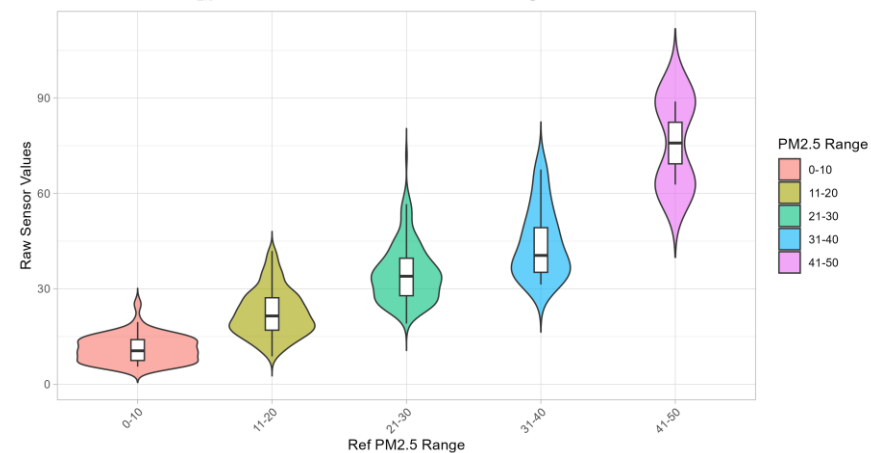
Scatter plot of raw sensor and reference PM_{2.5} data (µg/m³)

Collocation period: Aug 29, 2020 - May 23, 2022 (Linear Fit per quarter)



It is crucial to understand sensor performance and consequently correct data prior to communication and use in further analyses

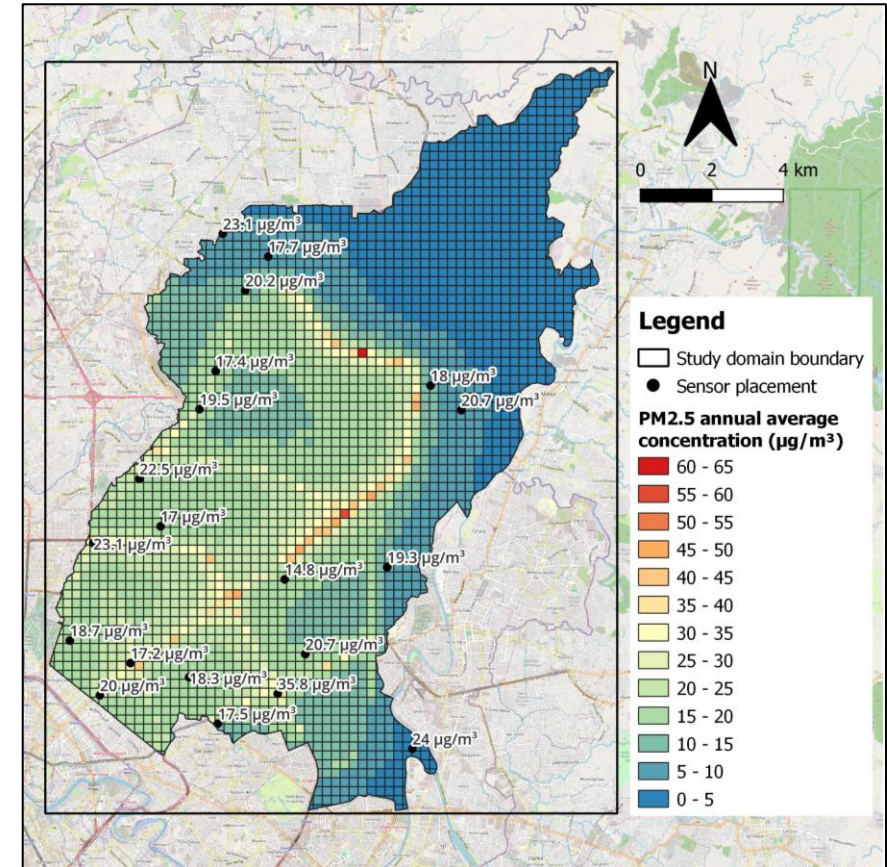
Distribution of PM_{2.5} Sensor Data Across Concentration Ranges



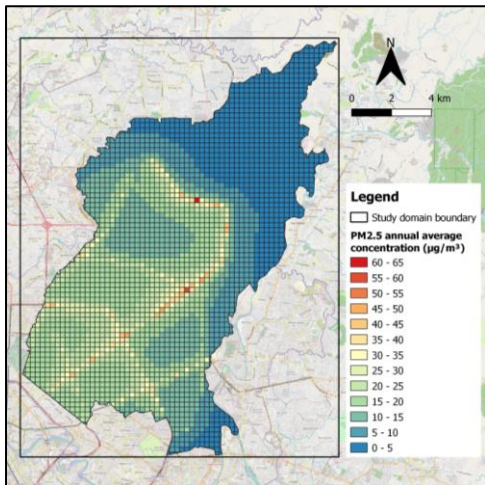
Modelling the distribution of PM_{2.5} from air pollution sources

- Contribution of emission sources to PM_{2.5} concentration vary by location and proximity to source.
- The transport sector has the most significant contribution to PM_{2.5}

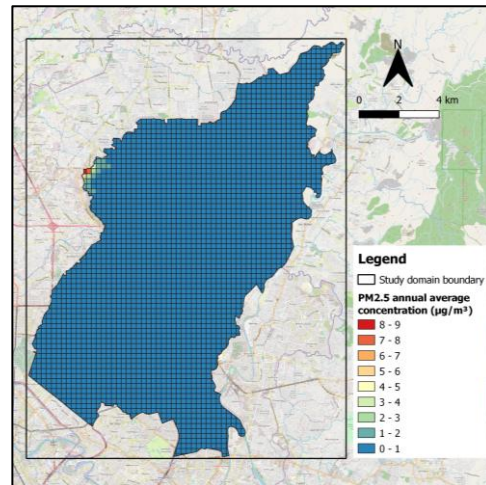
2023 Air quality modelling results and monitoring locations



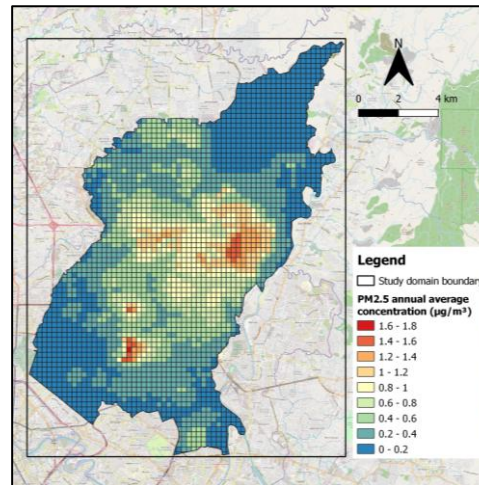
Mobile Sources



Point Sources



Area Sources

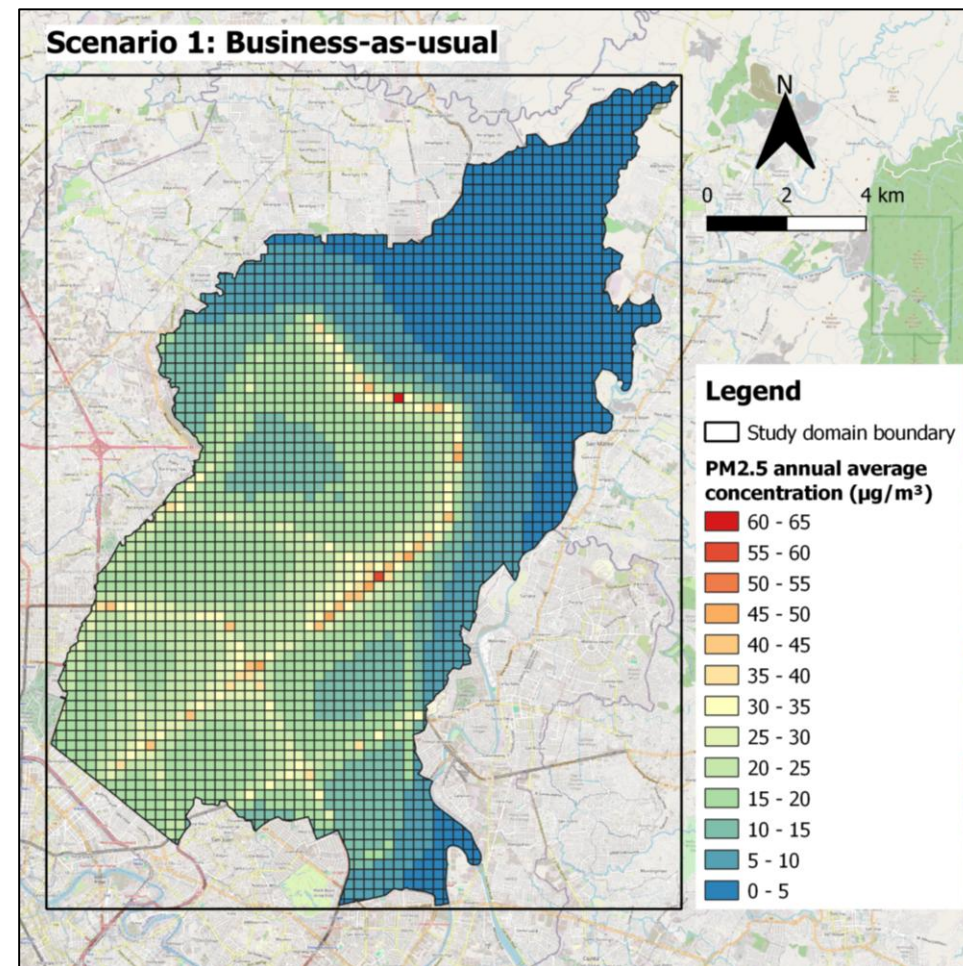


Air quality improvement with transport solutions



Attributable total PM_{2.5} concentration (µg/m³) under different emission reduction scenarios

Scenarios	Conditions	PM _{2.5} contribution (µg/m ³)
Scenario 1: Business-as-usual	estimated emission rates based on the usual activities of emission sources without intervention	0.4 - 64.7
Scenario 2: Active mobility	active use of bike lanes, resulting in an assumed reduction of 5% in the share of passenger cars	0.4 - 64.7
Scenario 3: Electric vehicles	10% of passenger cars, sports utility vehicles, buses, and motorcycles, and 100% of 2-stroke tricycles transitioning to EVs	0.4 - 60.3
Scenario 4: Euro 4 emission standards	transition of 95% of all vehicles to comply with Euro 4 emission standards	0.2 - 13.6
Scenario 5: Combination of all transport measures	combination of increased use of bike lanes, EV adoption, and compliance with Euro 4 emission standards	0.2 - 12.4

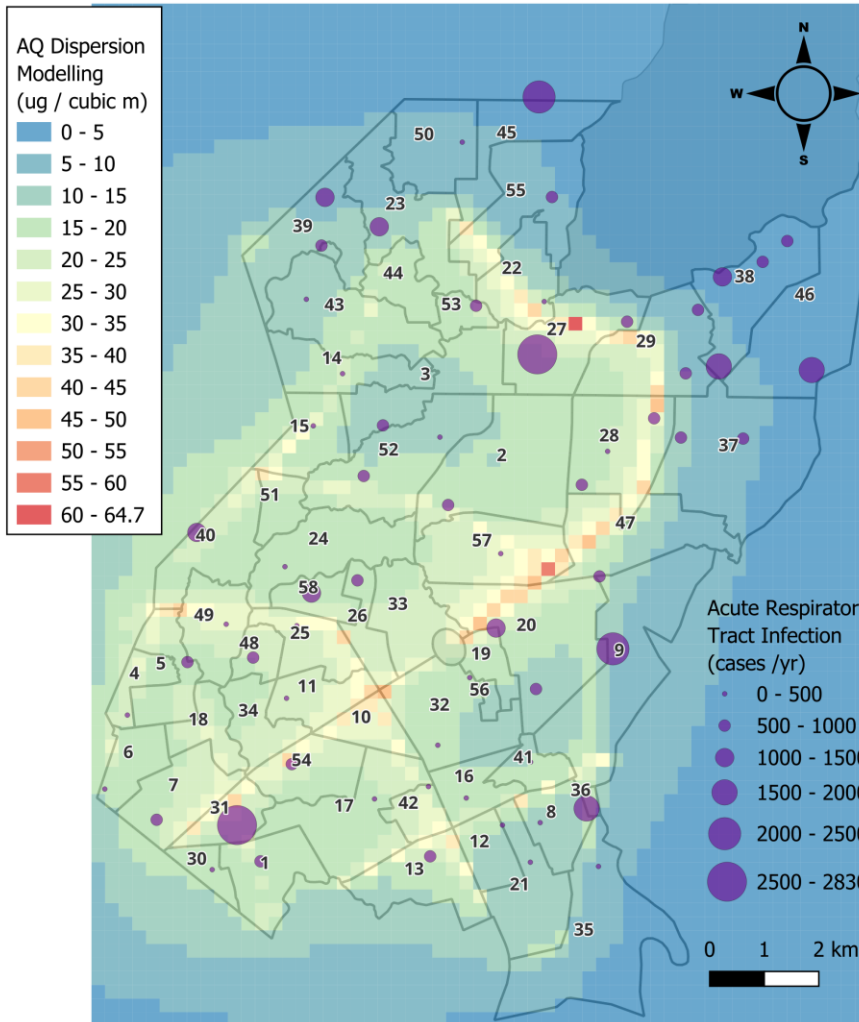


Air quality and health incidence of acute respiratory infection



id	Health District
1	Kalayaan HC
2	MH Pedro HC
3	Sauyo HC
4	San Jose HC
5	Balingasa HC
6	La Loma HC
7	Mercedes de Joya HC
8	Project 4 HC
9	Pansol HC
10	Bernardo HC
11	Paltok HC
12	Socorro HC
13	Cubao HC
14	Bagbag HC
15	Tandang Sora HC
16	Ermin Garcia HC
17	Kamuning Super HC
18	Masambong HC
19	San Vicente HC
20	Krus na Ligas HC
21	Murphy Super HC
22	North Fairview HC
23	Arsenia de Jesus Maximo HC
24	Toro Hills HC
25	Project 7 HC
26	Bagong Pag-asa HC
27	Fairview HC
28	Holy Spirit HC
29	Commonwealth HC
30	Galas HC
31	Tatalon HC
32	Pinyahan HC
33	Project 6 HC

id	Health District
34	San Francisco Super HC
35	Libis HC
36	Escopa HC
37	Batasan Hills Super HC
38	Payatas Super HC
39	Nagkaisang Nayon HC
40	Baesa HC
41	E. Rodriguez HC
42	Bernardo HC
43	San Bartolome
44	Gulod HC
45	Maligaya HC
46	Bagong Silangan HC
47	Old Balara HC
48	San Antonio HC
49	Apolonio Samsón HC
50	Kaligayahan HC
51	Sangandaan HC
52	Melchora Aquino HC
53	Santa Lucia Super HC
54	Roxas HC
55	Greater Lagro HC
56	Krus na Ligas HC
57	Wenceslao dela Paz HC
58	Bago Bantay HC
59	Capri HC



Provided guidance on which communities/ areas to prioritize for action

Avoided health impacts and costs due to transport solutions



Cause	Avoided cases	Avoided health costs
Mortality due to Hypertension	11	Php 163,000,000 (2.7 million USD)
Mortality due to Pneumonia and PTB	5	
Morbidity due to Hypertension and Heart Disease	965	Php 19,689,119 (331,000 USD)
Morbidity due to ARI, PTB, Pneumonia, Asthma	3845	Php 74,986,470.00 (1.3 million USD)

This provided the evidence that there would be more cost savings if we act on air pollution, justifying investments and prioritization



Key messages

- Detailed, accurate data gives policymakers confidence to prioritize, implement, and invest in actions
- There is always a better method and a more detailed analysis approach, but it must be balanced with what questions can already be answered NOW

Thank you for listening!