Red ciudadana de Calidad del Aire - A low cost air quality monitor community-based project.

Universidad de Monterrey

Keywords: Air quality, low-cost monitors.

Literature review

According to the World Health Organization (WHO, n.d.), around 91% of people worldwide live in areas where the air quality limits are over the WHO limits. Air pollution can be classified as indoor and outdoor; specifically, the last can have many sources such as energy generation, vehicles, agriculture, industry, and waste incineration. Air pollution can be found in many different forms, from smog to particulate matter (PM). Particulate matter has been linked to health issues, specifically PM2.5, respiratory illness, stroke, lung cancer, reproductive problems, and premature death (Feenstra, B. 2019). It is estimated that around 8 million people die every year due to PM2.5 exposure (Zamora, M. 2020).

Many metropolitan areas use air quality index systems to assess air quality status and link it to health issues. Now, it is more common to generate complex connections linking air pollutants and health risks within the community (Maji, S. 2020). According to the Environmental Protection Agency from the United States, Air Quality Index (AQI) ranges from 0-500. The lower the value, the better the air quality and the lower the health risk. The AQI is conformed from five different pollutants, ground ozone levels, particulate matter (PM10 and PM2.5), sulfur dioxide, and nitrogen dioxide.

Low-cost monitors to analyze particulate matter have been purchased and installed worldwide; this action is to provide a more dense network than the available networks in many places (Tryner, J. 2020). Low-cost-monitors' prices range from 150-3000 USD making them accessible to more people, besides the technological advances near real-time data (Feenstra, B. 2019). The advances in low-cost air quality monitors allow researchers and individuals to collect their data and use it for different purposes (Zamora, M. 2020). All these benefits will come with a trade-off in the quality of data collected.

Challenges and risk of using low-cost monitors

Methods

Area of study

The Metropolitan Area of Monterrey (ZMM) is formed by a group of 13 municipalities (Apodaca, Cadereyta, El Carmen, García, San Pedro Garza García, General Escobedo, Guadalupe, Juárez, Monterrey, Salinas Victoria, San Nicolás de los Garza, Santa Catarina & Santiago). This complex dynamic of multiple municipalities being part of a more significant entity brings out numerous socio-environmental issues, including air quality. For this study, we chose to work in two cities from the metropolitan area, Monterrey (1,142,994 inhabitants in 2020) and San Nicolas (412,199 inhabitants in 2020).

Monterrey is located in the Northeastern part of Mexico, and it is one of the most industrialized areas in Mexico. Due to its industrial origin plus the enormous size of the metropolitan area and the lack of efficient public transportation, low air quality is one of the most relevant issues. Affecting people of all ages and socio-economic backgrounds, but most critical affecting children and older people. Considering infants as the central part of the project guide us to locate the monitors in daycare centers and work with families with children.

Monitor locations.

Cendis (Centro de Desarrollo Infantil) are state daycare centers for children from zero to five years old in low-income areas. In the ZMM are 13 Cendis, but the monitors were installed only in five locations. The locations can be found in the following map or using the coordinates below.

Map with locations

https://www.google.com/maps/d/u/0/edit?mid=1G5rxexFF88h0f9OhihO8cZwGdeQDVQgs&usp=sharing

GPS coordinates of Cendis.

Centro de Desarrollo Infantil 3 “Jose Marti” 25°46'09.6"N 100°22'27.5"W

Centro de Desarrollo Infantil 4 “ Generaro Vazquez” 25°44'03.3"N 100°21'42.6"W

Centro de Desarrollo Infantil 1 “Felipe Angeles” 25°44'13.6"N 100°20'07.0"W

Centro de Desarrollo Infantil 12 “Jean Piaget” 25°44'49.0"N 100°18'34.1"W

Centro de Desarrollo Infantil 5 “Diana Laura Riojas de Colosio” 25°38'02.4"N 100°17'45.0"W

Study baseline

The air quality monitors began their operation the second week of January of this year. Taking the information generated up to the first week of April, the average amount of pollutant was calculated and the days were classified as dictated by the AQI US.

Table 1. Number of days per air quality level

	Good	Moderate	Unhealthy for sensitive groups	Unhealthy	Very Unhealthy	Hazardous	No Data available
CENDI1							
Jan	3	7	8	1	-	-	-
Feb	6	17	4	1	-	-	-

Mar	5	21	5	0	-	-	-
Aprl	3	6	-	-	-	-	-
CENDI3							
Jan	5	8	6	-	-	-	-
Feb	8	16	4	-	-	-	-
Mar	18	13	-	-	-	-	-
Aprl	5	4	-	-	-	-	-
CENDI4							
Jan	3	7	8	1	-	-	-
Feb	6	17	4	1	-	-	-
Mar	5	21	5	-	-	-	-
Aprl	3	6	-	-	-	-	-
CENDI5							
Jan	8	6	3	2	-	-	
Feb	9	11	5	-	-	-	3
Mar	5	22	4	-	-	-	
Aprl	3	5	1	-	-	-	
CENDI12					-	-	
Jan	4	7	6	-	-	-	-

Feb	16	9	3	-	-	-	-
Mar	9	22	-	-	-	-	-
Aprl	5	4	-	-	-	-	-

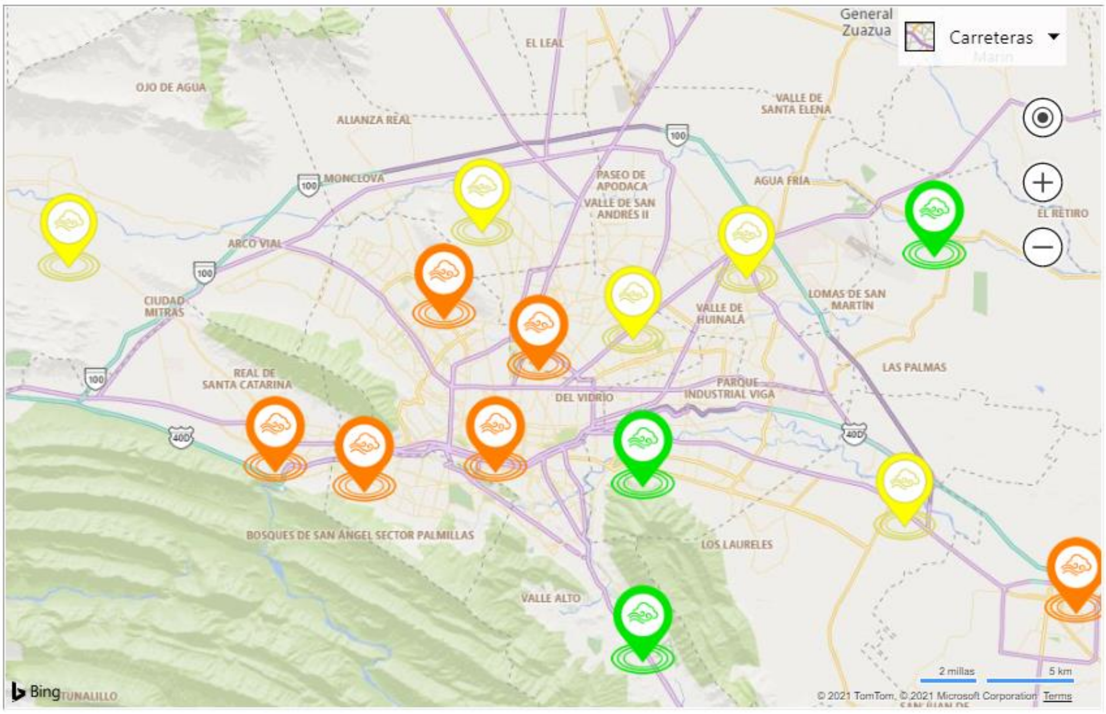
Data compilation for location

The Sustainable Development Office of the Nuevo Leon State, through the Environmental Monitoring System (SIMA, by its acronym in Spanish), is responsible for providing information about the meteorological parameters and air quality.

The air quality meters are distributed in the urban area as follows.

Figure 1.

Location or air quality meters in MMA (http://aire.nl.gob.mx/map_calidad.html)



Challenges

The state Sustainable Development Office's data regarding air quality is only available from Jan-Jul to 2020. The lack of real-time data or the year in progress is an opportunity to use low-cost monitors as a community engagement tool. For the study, we will use two different approaches; the first one will be assessing the number of days with bad air quality and how people interact and react to the daily data. The challenge will be to identify if there are extraordinary events that might affect our data and the level of knowledge of air quality people.

Figure 2. Locations of the IQAir monitors (blue markers).

References

CENDI (n.d.). ¿Quiénes somos?. Available at https://www.cendinl.edu.mx/quienes-somos/

EPA (n.d.). AQI Basics. https://www.airnow.gov/aqi/aqi-basics/

Feenstra B. et al. (2019). Performance evaluation of twelve low-cost PM2.5 sensors at an ambient air monitoring site. Atmospheric Environment, Volume 216, https://doi.org/10.1016/j.atmosenv.2019.116946.

Maji, S., Ahmed, S., Ghosh, S., & Garg, S. K. (2020). Evaluation of air quality index for air quality data interpretation in Delhi, India. Current Science (00113891)