

Investigating the Air Quality at Lake Merritt Park and National Wildlife Refuge, Oakland, CA

Lawrence Hall of Science

University of California, Berkeley

Donna Almendrala, Olivia Lustro, Alex Jasiulek, Brittany Collins, Maggie Li, Leon Ko

Abstract:

During a four week investigation, we took air samples and measured the air quality around Lake Merritt. To complete our research, we used specialized equipment to help us determine concentrations of particulate matter, carbon dioxide, ozone, and oxygen. These four very important components were used as indicators of air quality in and around Lake Merritt. We hypothesized that the Watergate area, Location 4 on the map in Figure 1, would have the worst air quality because it is surrounded by many traffic lanes and very little vegetation. We expected that the exhaust from vehicles would create a large amount of particulate matter, ozone, and carbon dioxide, and this would be aggravated by the lack of vegetation. We believed that the Rotary Nature Center, Location 6 on the map in Figure 1, would have the best air quality because it is because it surrounded by many plants, which will likely produce a greater amount of oxygen, and because it is less polluted as a result of being located a significant distance away from traffic lanes. The results of our investigation indicated that Location 7, on Grand Avenue, had the worst air quality: a carbon dioxide level of 497.5 ppm, and an oxygen level of 20%. We found that Location 2, along Lakeshore Avenue had the best air quality: a carbon dioxide level of 355.5 ppm and an oxygen level of 21.4%. We also found that there was more particulate matter concentrated over the surface of the lake than on solid ground surrounding it. However, based on high measured oxygen and low carbon dioxide levels, the air over the lake was of higher quality.

Introduction:

Particulate matter are tiny particles ranging from two to ten micrometers in size; they are present everywhere, and the amount of particulate matter in an area can cause serious respiratory problems in humans and animals. Carbon dioxide concentration is also important, not only because it is a greenhouse gas, but also because it is an indicator of pollution from cars and factories. Oxygen is an important factor to measure because it is necessary for all aerobic life, and its abundance is an indication of good air quality. Ozone is a dangerous pollutant in our atmosphere that causes damage to vegetation, and chest pains and throat problems in humans.

Lake Merritt Park and National Wildlife Refuge is a popular exercising spot and a fun place for kids to play located in the center of downtown Oakland, CA. Created in 1867 to serve as a city attraction by order of former mayor, Samuel Merritt, Lake Merritt Park consists of a fresh and salt-water lake and associated park areas. In addition to being a popular recreation spot, the park is the home to may birds and other wildlife. The lake is surrounded by well-driven streets such as Grand Ave., Lakeshore Ave., and Harrison St. The heavy volume of traffic contributes to higher than usual air and water pollution in the park. However, the northern bank of Lake Merritt is bordered by a lakeside park which helps to balance out the large amounts of pollutants delivered as a result of vehicle traffic.



Methods:

We sampled seven different locations along the edge of the lake, and collected samples from just above its surface at six locations. We chose these locations in order to create an overall air quality map of the lake and its surroundings. We used a Fluke 983 Particle Counter to measure the concentration of particulate matter. This instrument measures the size and concentration of the particulate matter in order to determine if it at the standard safety levels or if it is hazardous to our health. We used the Xplorer GLX data logger and assoicated probe-ware to measure the concentration of carbon dioxide and oxygen. To measure ozone levels, we used EcoBadge detectors, which are small pieces of specially treated paper that change color in the presence of ozone. Using an EcoBadge detector reader, we were able to determine the ozone levels in air at sample locations.

Figure 1: Map of Lake Merritt

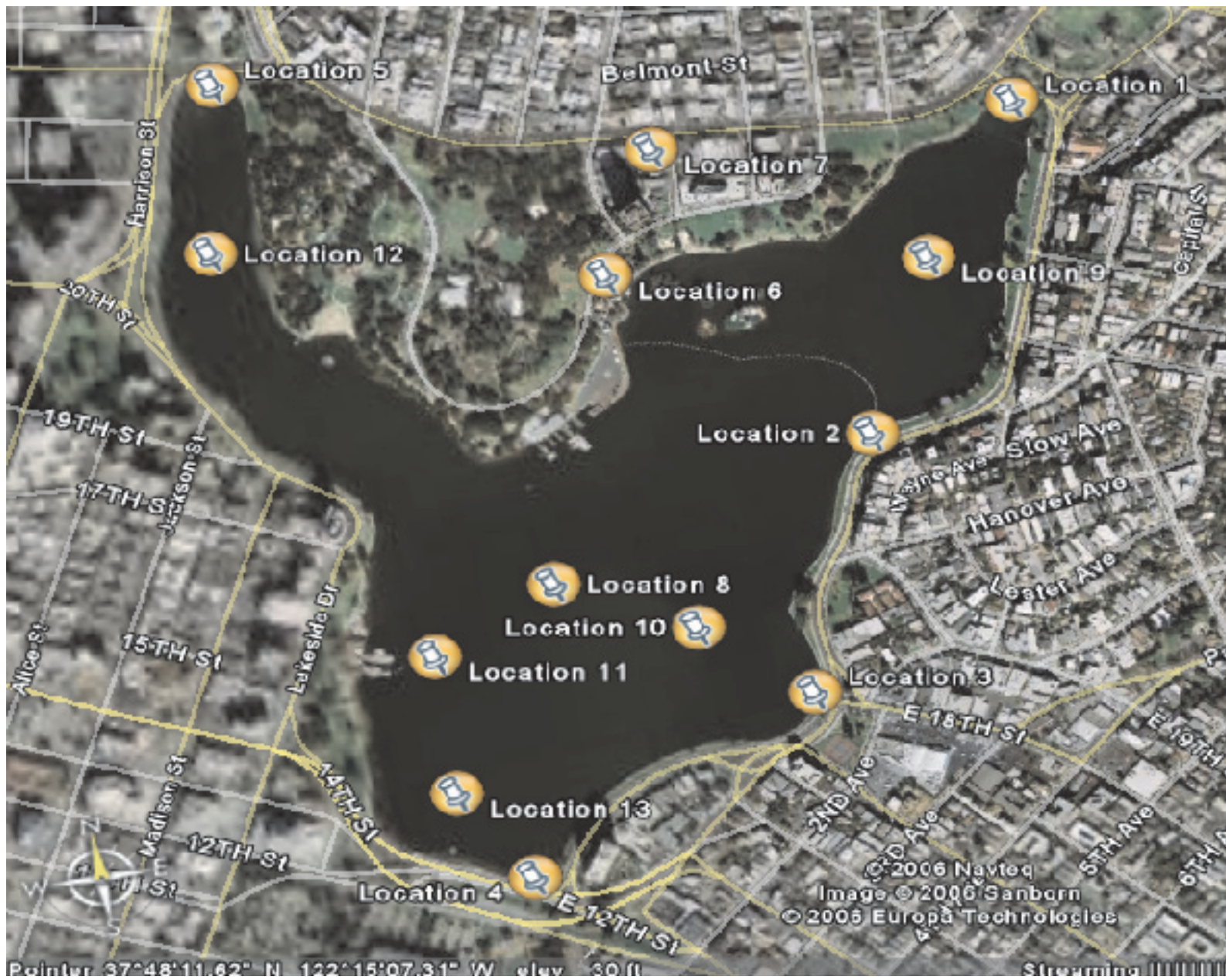


Figure 2: Land Particulate Matter

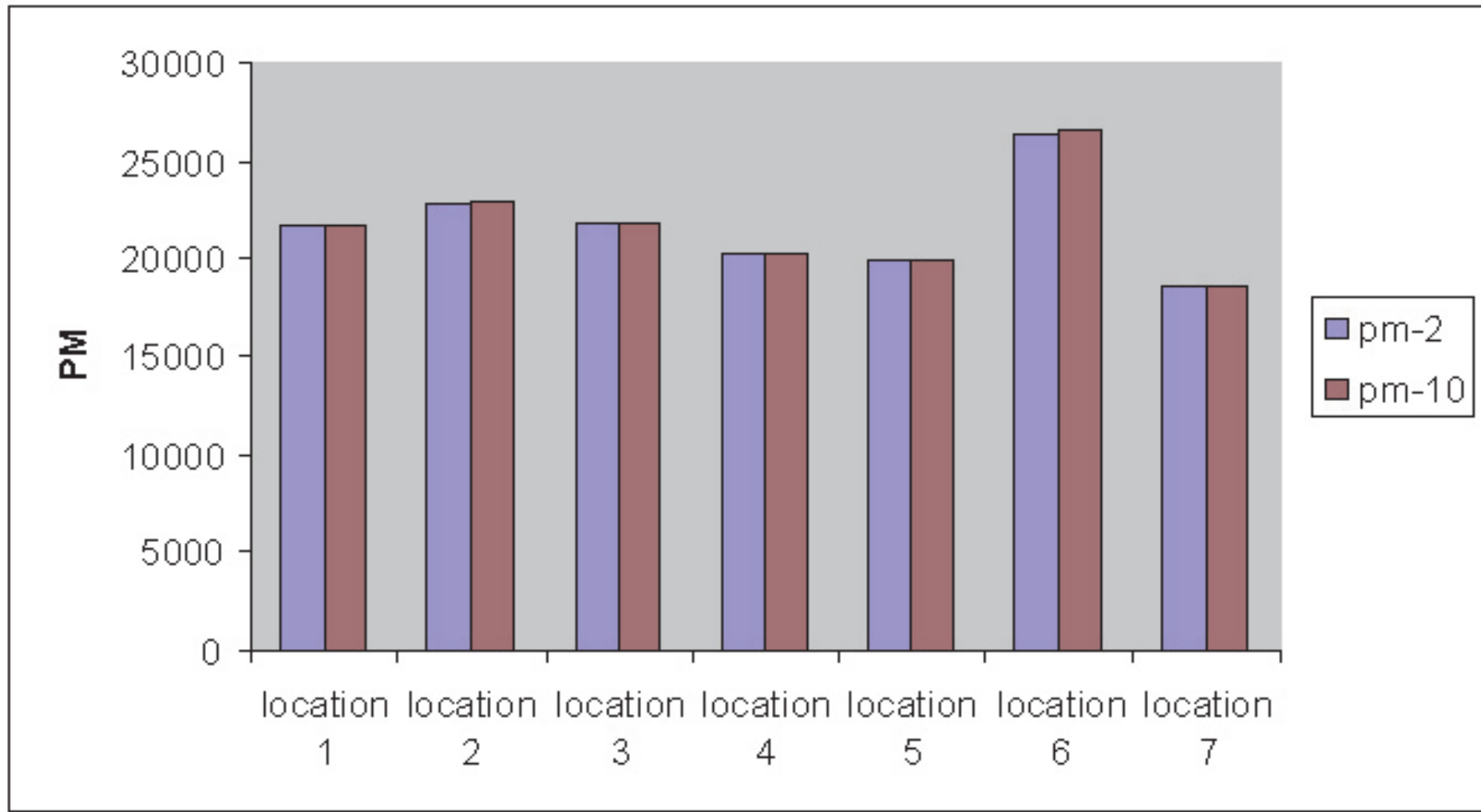
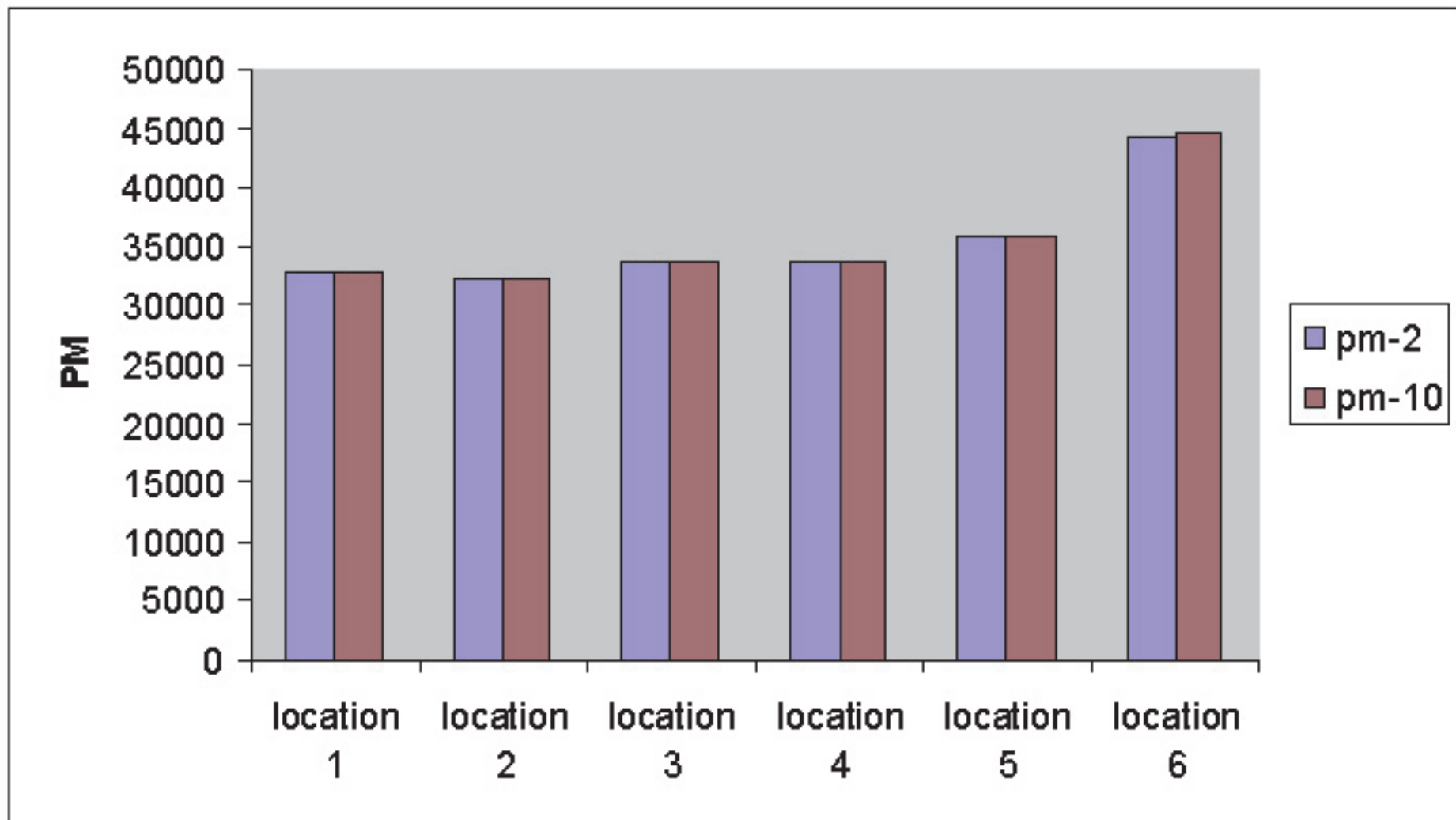


Figure 3: Water Particulate Matter



Data and Results:

Table 1

Location	CO2 (ppm)	O2 (%)	O3(ppb)	Winds (M/S)
1	479.5	20.65	20.5	2.4
2	355.5	21.4	24.5	2.4
3	475	19.6	23	2.45
4	445.5	20.4	24.5	2.2
5	481	20.75	29.5	2.05
6	399	21.15	21	0.85
7	497.5	20.6	20	5.8

Table 2

Location	CO2 (ppm)	O2 (%)	Windspeed (M/S)
8	388	21.7	0.3 NE
9	388	21.9	0.4 NE
10	370	21.3	2.0 S
11	383	21.4	1.8 W
12	369	20.6	7.4 NW
13	366	21.4	2.6 S

Figure 2 shows a bar graph of the data that was collected for the particulate matter (PM), sizes 2 to 10 micrometers, over the locations on land; Figure 3 shows the data that was collected over the lake. The PM concentration just above the surface of the lake was significantly higher than that measured on dry land. During our sampling activities, we noted that the wind speed just above the surface of the lake was lower than that on dry land, which suggests that the higher concentration of PM is the result of the particles not being effectively dispersed. The location with the highest PM concentration on dry land was the Rotary Nature center because of the many birds present. Natural PM can occur in just as large an amount as man made PM.

Tables 1 and 2 show the data collected for locations on land (1-7) and just above the surface of the lake (8-13). Based on data that we have collected so far, the area with the best air quality was Location 2, a location surrounded by trees on Lakeshore Avenue, which had the highest oxygen concentration and a low carbon dioxide concentration. The area with the worst air quality was Location 7, located near streets with heavy traffic; it has the highest carbon dioxide concentration and a low oxygen concentration.

Overall, we found that the air quality over the water was generally better over the water than over the land in Lake Merritt Park. This is most likely due to there being less disturbance from human pollutants (e.g. those from cars and nearby construction sites) in areas sampled.

Conclusion:

Particulate matter, carbon dioxide, and ozone are factors that contribute to air pollution, and our research suggests that locations with high carbon dioxide levels also have lower oxygen concentrations; lower oxygen levels are detrimental to the health of humans and other living organisms. Wind speed is another parameter that affects the quality of the air in the Lake Merritt area since moving air can disperse pollutants dangerous to people and animals using this important recreational park. Cars appeared to be the greatest source of pollutants in the Lake Merritt region due to the exhaust and other chemicals that they release into the air.

With regard to future investigation of air quality at Lake Merritt, we recommend that measurement of air quality factors be conducted over a longer period of time. This would be useful in terms of helping to identify trends and associations associated with the different levels of carbon dioxide, oxygen, ozone, and particulate matter as well as and how they vary with wind speed, seasons, time, and other variables.

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