Investigation of the correlation between noise level and particulate matter around Lake Merritt, CA

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Introduction:

According to the Environmental Protection Agency, particles less than 10 microns in diameter are associated with "adverse health effects, including premature mortality and higher instances of respiratory illness." Such particles include nitroxide and sulfuric acid, which are released from anthropogenic and natural sources. Because particles of this size are normally undetectable to the human eye, people may inadvertently expose themselves to high amounts of particulate matter, which can potentially harm their health.

In our research, we wanted to investigate the use of noise as a means to assess particulate matter in open areas around Lake Merritt. This could provide people a crude and indirect method to estimate the amount of particulate matter around them without using any special instrumentation.

Hypothesis:

Because areas with a lot of anthropogenic activities (e.g. traffic intersections) are generally noisy and are potential sources of particulate matter, we expect noise and particulate matter to be directly correlated. Sites around Lake Merritt such as construction zones, traffic intersections, and children's playgrounds are expected to have high amounts of particulate matter as well as high noise level. Conversely, residential areas and other areas with minimal activity are expected to have both low amounts of particulate matter and low noise level.

Selected sites around Lake Merrit

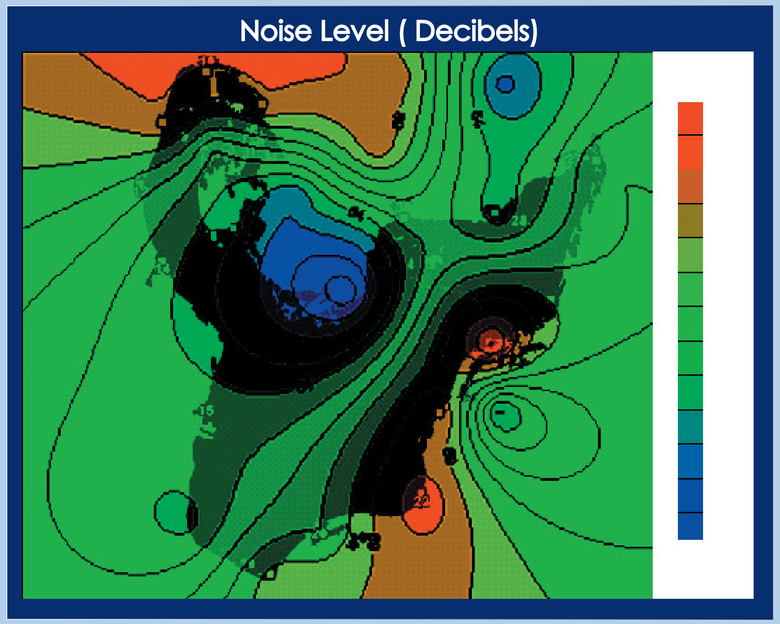
From Google Earth

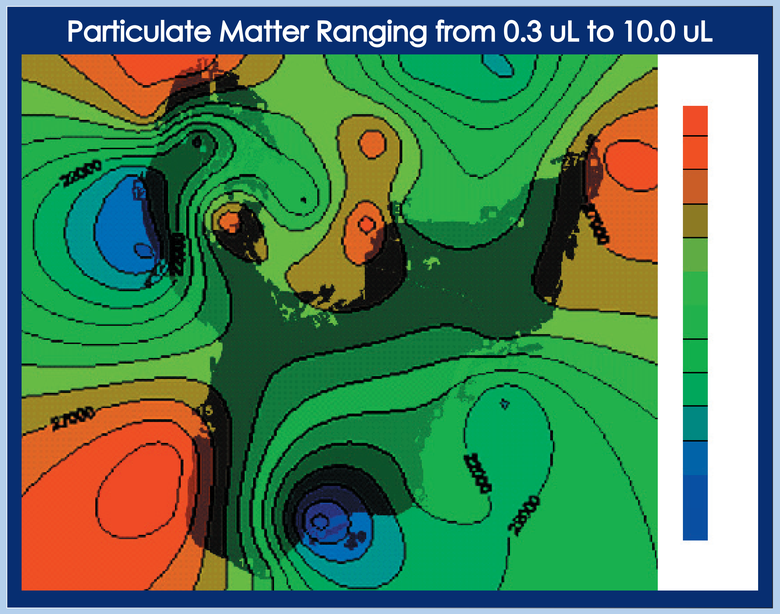
Methods:

Over the course of four weeks, we observed 27 sites around the Lake Merritt and measured the noise level and the amount of particulate matter three times at each site. We measured the noise level in two different directions, one towards the lake and one away from it, because of the differing noise level from both directions. We averaged the two directional measurements to accurately represent human's perception of sound. An Explorer GLX with a sound level sensor was used to measure noise level. When measuring particulate matter, we held a FLUKE particulate matter counter at eye level and collected one liter of air. The counter counted the particles based on size, which range from 10.0 µm to 0.3 µm in diameter.

Results:

The sites around the lake have differing amounts of particulate matter ranging from 17000 to 29000 particles per liter of air and noise level ranging from 52 dBA to 64 dBA. In areas of construction, there was a direct correlation between noise level and particulate matter, where both were relatively high. In residential areas, both noise level and particulate matter were low.





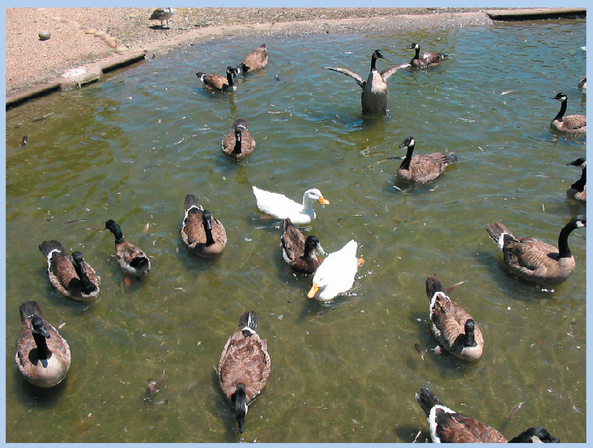
However, near the boat house (Site 1), where many birds reside, there was an inverse correlation—the noise level was low but the particulate matter was high. Areas around the lake with a high population of birds tend to have high particulate readings, but variant noise levels.

Conclusion:

Based on our results, there was no consistent correlation between noise level and particulate matter. In many of our sites, high noise level did not necessarily accompany high amounts of particulate matter, and vice versa. We saw both inverse and direct correlations at the nature center and church construciton sampling sites, respectively. One possible explanation for the inverse relationship at the nature center is the high concentration of birds around the area. Birds such as Canadian geese, ducks, and pigeons have feathers that could easily trap small particles and emit them in the air when perturbed. Therefore, areas with a high concentration of birds will lead to high particulate matter in the air, even when the area is relatively quiet.

The church construction site and the residential area showed a direct correlation, which is consistent with our initial hypothesis. However, not enough sites showed this correlation, and therefore, we cannot state a conclusive result.

There were many variables that could have affected our results. These variables include time of day, temperature, wind, and length of measurement. Because we only took measurements during the afternoon for one minute, the results may not be representative of the actual noise level and particulate matter at those sites year round. Also, measurements were not taken at every site on a consistent basis. A few sites were visited each day and the average was taken over a four week span. Wind and temperature could have affected the particulate matter measurements. Variations in data would arise each day because of the many uncontrolled variables.



Further Research:

In the future research, we would want to take measurements at every site on a daily basis rather than visiting a few sites each day and also take measurements for a longer period of time. This would minimize the unwanted variations in data between sites and improve the accuracy and precision of our averaged data. In areas of high activity, more measurements should be taken to map accurately the noise and particulate matter distribution.

We would also like to investigate the possible correlation between the populations of birds and the amount of particulate matter because it could provide an explanation for the inverse correlation between particulate matter and the noise.

ED41A-0084