

Air quality and pollution within Tijuana Estuary

Adam Benjamin Reid



Introduction

The Tijuana River feeds the Tijuana Estuary a majority of its water. I believe there is a connection to the pollution of the Tijuana river and the condition of this Estuary.

Hypothesis

If the Tijuana River affects the Tijuana Estuary, then the places that are fed by the Tijuana river will have differing air quality from aerosols.

Procedures

Each individual who tests for air quality was provided a particle counting device and a corresponding iPad to report and track the air particles collected.

I followed a strict time period of which I am allowed to record; from 1 pm to 5 pm. I recorded specific locations within specific time periods within this larger period. All recorded in the same sample to indicate the change throughout the area just as many species experience within this living space.

References

Google Earth - Image of map
[California Water Boards](#) - Evidence for water being different and poorer from Tijuana River

Results and analysis

Areas more tied to the Tijuana River experience massive jumps in particle count as well as mass changes in species richness and composition. However, not all sections with water have these spikes in particle counts.

Conclusion

Along with my air data, the California Waterboards concludes that the lower Tijuana watershed areas (Including Oneonta Slough) fed by the Tijuana river has worse water quality than other higher areas of the watershed, therefore, both air and water quality is decreased overall when being fed by the Tijuana River as a result of the pollution

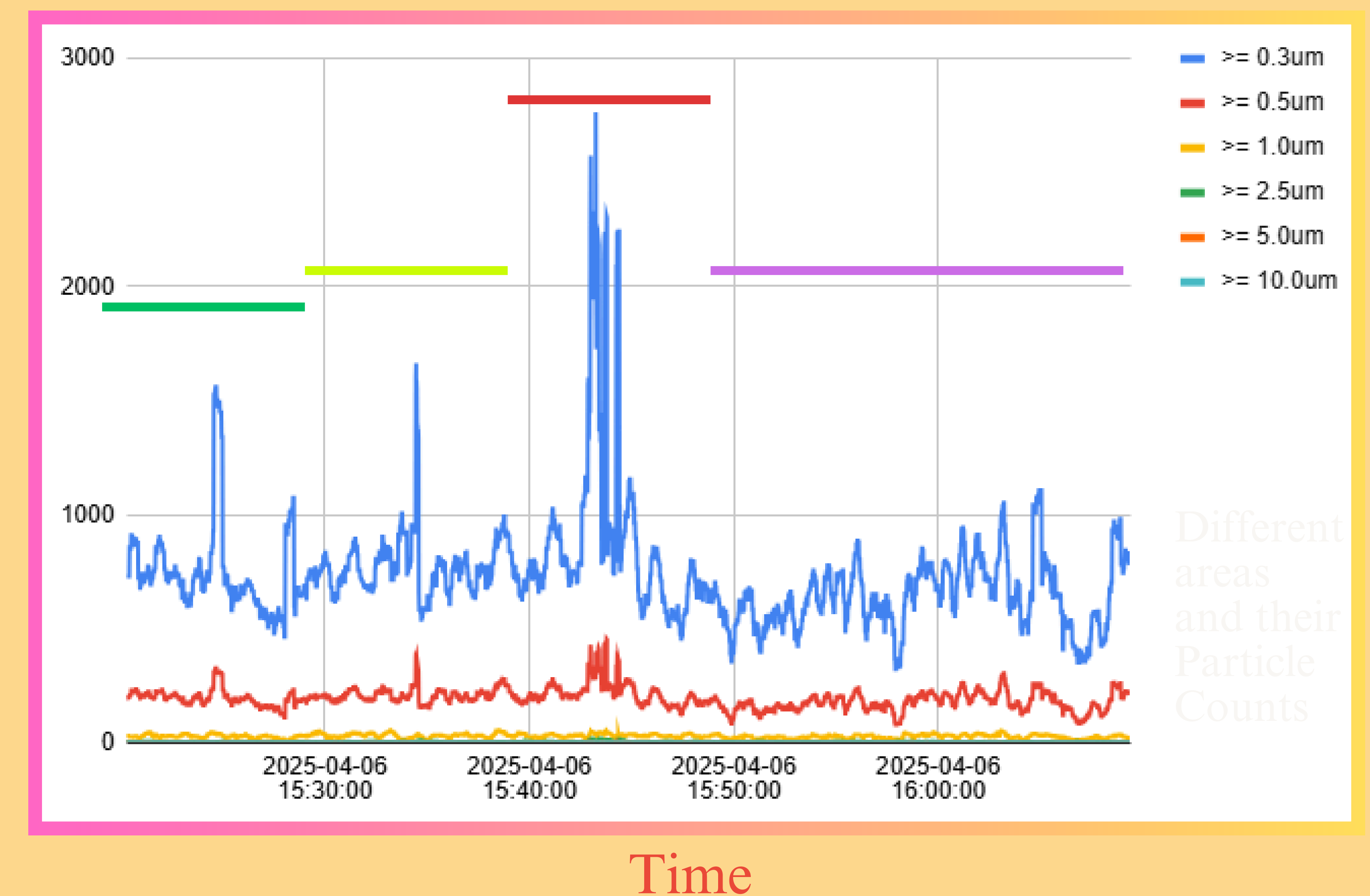
It also changed aspects such as odor, species richness and human presence.

Future work

We should compare this estuary to other estuaries like it. There is an estuary in Chula Vista that comes to mind in terms of similarity (Both contain the same ecosystem and climate only differing in variety of microbiomes).



Particle count and size



Details of observation

Purple - Open Chaparral with separate, closed off water bodies
Yellow - Small creek that connects through a dried river bed as well as a drainage system
Red - River and bridge Directly fed by Oneonta Slough
Green - Dry area close to dried riverbed

COMPARATIVE ANALYSIS OF PM LEVELS AT THE TIJUANA RIVER AND COASTLINE: OCCUPATIONAL EXPOSURE

Anabella Campos



HOW DOES PARTICULATE MATTER (PM) DIFFER BETWEEN THE TIJUANA RIVER AREA AND THE COAST OF IMPERIAL BEACH? WHAT ARE THE POTENTIAL EXPOSURE RISKS TO RANCHERS AND BEACH WORKERS, SUCH AS LIFEGUARDS?

INTRODUCTION

The Tijuana watershed spans the US - Mexico border and faces a chronic issue of pollution due to untreated sewage and urban runoff that flows from Tijuana into the US through the Tijuana River. When these contaminants reach the river outlet, they pose a significant environmental and public health risk, due to the **aerosolization of pollutants** which can interact with ambient particulates, influencing air quality and posing a risk to respiratory health through particulate matter (PM) (Pendergraft, 2023).

PROCEDURE

Air quality data was collected at two different locations: the Tijuana River site (inland) and the Imperial Beach site (coastal), and sampling occurred three times per week, on Tuesdays, Wednesdays, and Thursdays immediately after school (roughly 3:45PM). Each day I used wind direction to determine where to sample before recording data, first at the upwind site, then the downwind site to establish near the source of pollution (The Tijuana River) and near the coast. At each site, data was recorded for exactly 15 minutes using my portable PM sensor (all with a brief time deviation to allow for commuting between locations; 5-15 minutes) This procedure was repeated on a weekly basis for 4 weeks.

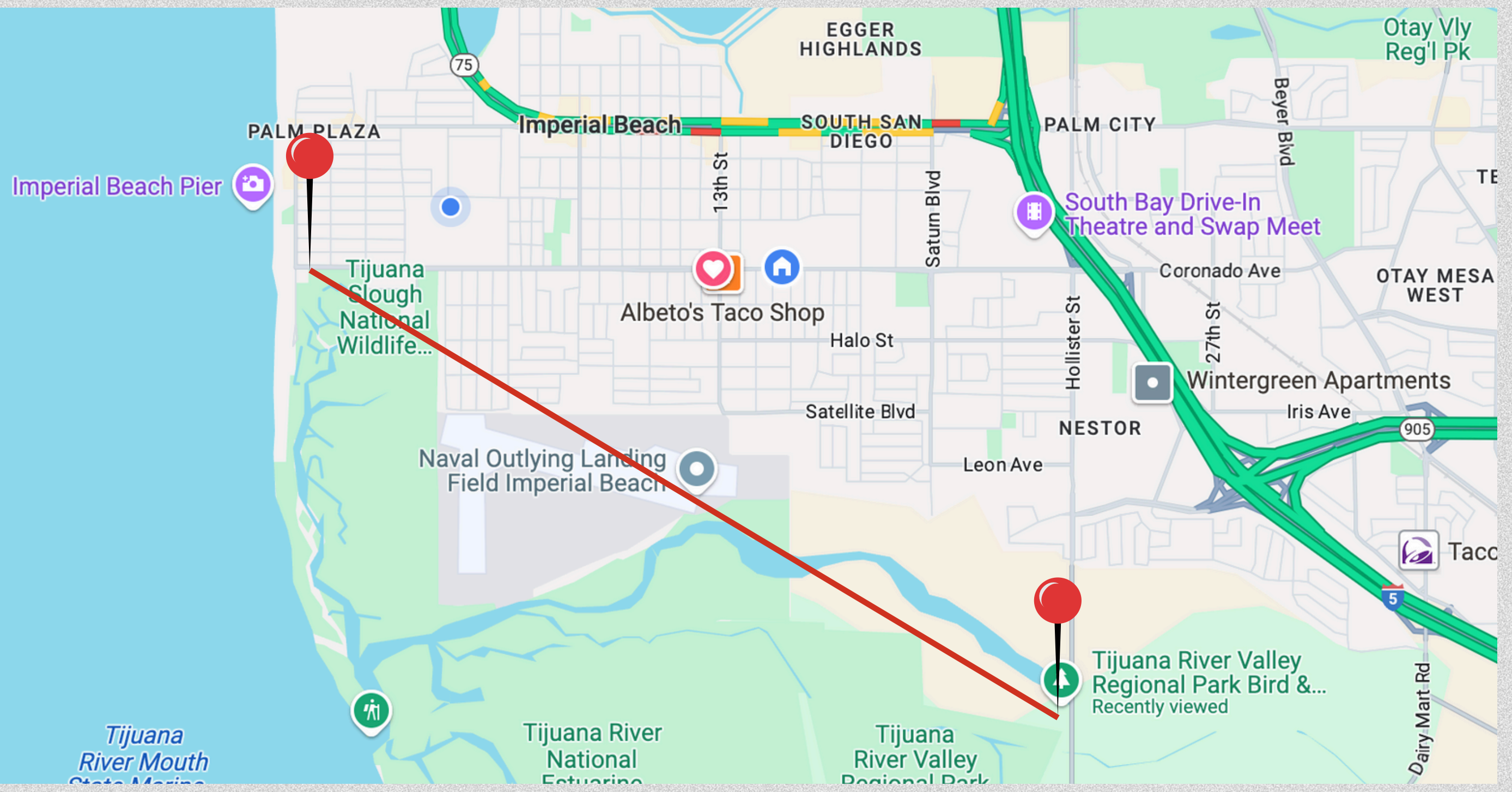
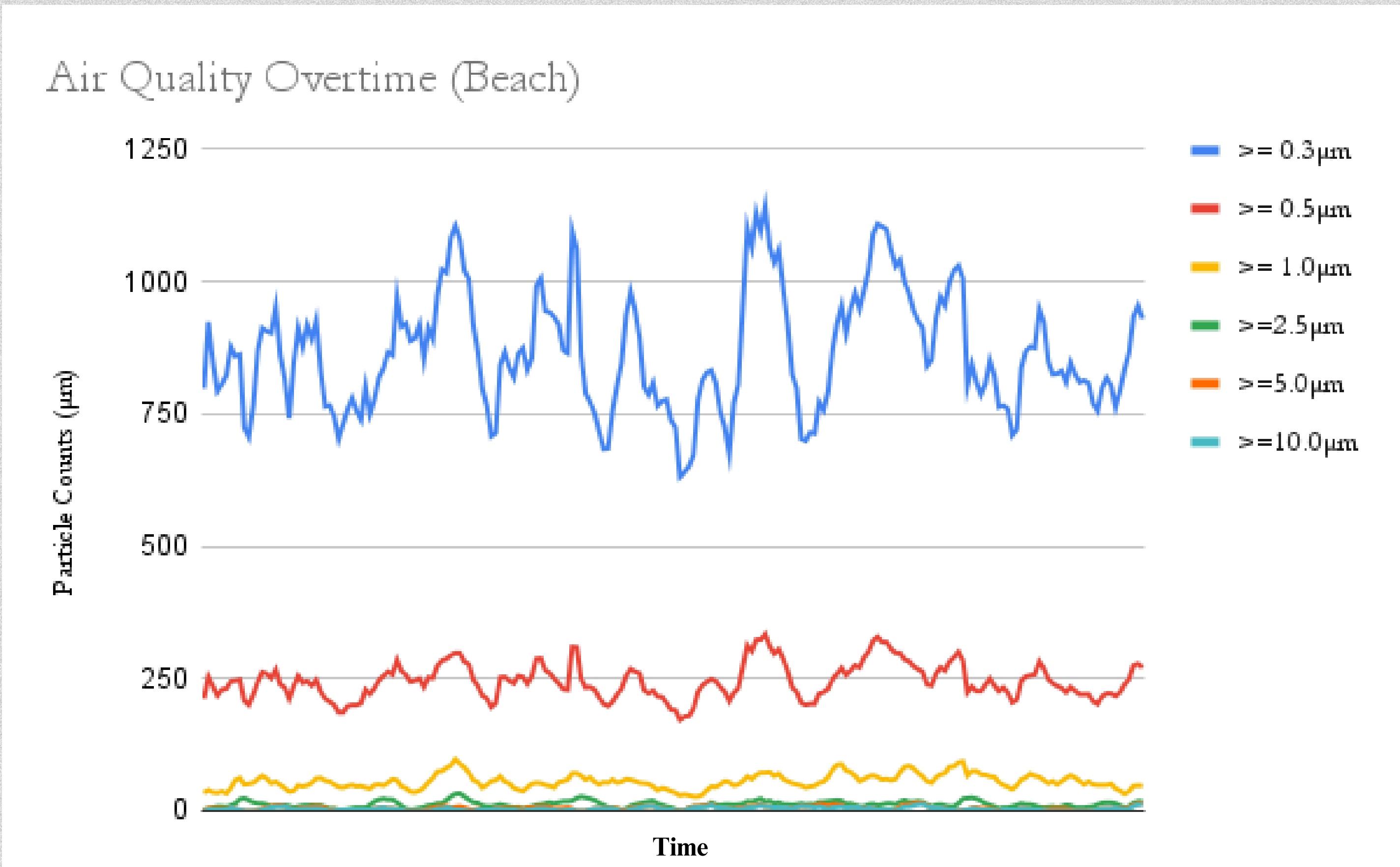


Figure No. 1 - I measured my data at two different locations: the lifeguard tower in Imperial Beach, and the Tijuana Bay Valley Butterfly Gardens, which sits nearly on top of the Tijuana River itself. In order to ensure data was properly taken, I measured at the southernmost location first.

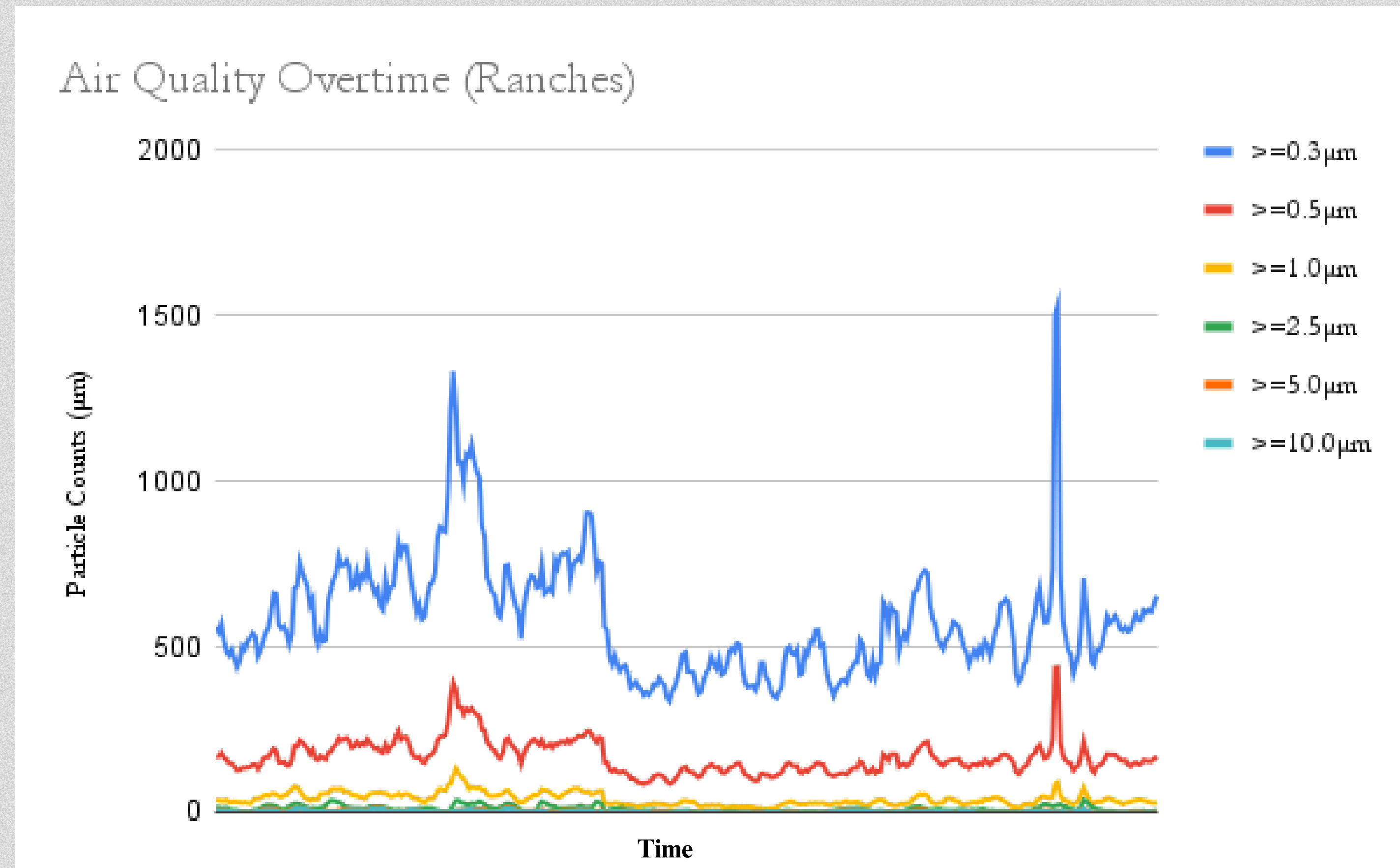
HYPOTHESIS

Air quality near the Tijuana River will have significantly higher PM concentrations compared to the Coastline.

RESULTS AND ANALYSIS



Beach air quality is consistently worse for smaller particles, such as the (>=0.3) and (>=0.5) with significant peaks and lows in the data, compared to ranch quality.



The data suggests that air quality is significantly better at the ranch site compared to the beach site. Although the overall data is lower, there are significant peaks and lows in the data that suggest worsening air quality.

CONCLUSION

Contrary to my hypothesis, PM levels were significantly higher at the beach site compared to the Tijuana River site across all particle counts. This suggests that costal workers, such as lifeguards, face a greater risk of exposure to airborne particulates. Factors that could largely play into this are sea-spray aerosol and wind-driven pollution. Other factors such as on-shore air flow could have impacted the results as they contradict prior studies.

FUTURE WORK

I am interested in the impact of pollution on people’s health. Therefore, in the future it would be interesting to dive deeper into how my results impact the health and well-being of both costal and inland workers. Collaborating with scientists and healthcare professionals would also help me do this, as well as researching additional pollution sources in both areas.

It would also help to expand my data collecting frame by an hour, therefore I am collecting data everyday at the same time for a longer period. This would help improve my work data collection.

- PENDERGRAFT, Matthew A. et al. Bacterial and chemical evidence of coastal water pollution from the Tijuana River in sea spray aerosol. Environmental science & technology, v. 57, n. 10, p. 4071-4081, 2023.

WORK HAS BECOME DIFFICULT?

While doing my oral history for this project, I interviewed local community members that worked at the Tijuana Estuary National Park as researchers. In my interview with the lead researcher, I learned that the sewage issue has made it difficult for them to properly do their jobs!

“We are limiting our water contact more. We’re trying to figure out different ways to sample-- that we don’t have to get in the water. . . The pollution itself is definately limiting our ability to do our job.”

The Impact of Wildfires on Airborne Particle Counts

Ana Karen Ramirez Pantoja



Introduction

Wildfires release large amounts of smoke and particulate matter into the atmosphere, severely affecting air quality. During the wildfires covering 6,600 acres of land in January 2025 near the U.S.-Mexico border in San Diego, smoke dispersed dramatically, reaching neighborhoods up to 4.98 miles away in Tijuana, with a specific impact on Colonia El Pipila. This research analyzes how wildfire activity influences the counts of airborne particles over time at a height of approximately 1.30 meters (4.3 feet), which corresponds to the average height of a child between 6 to 8 years old, using data collected during active fire periods.

Hypothesis

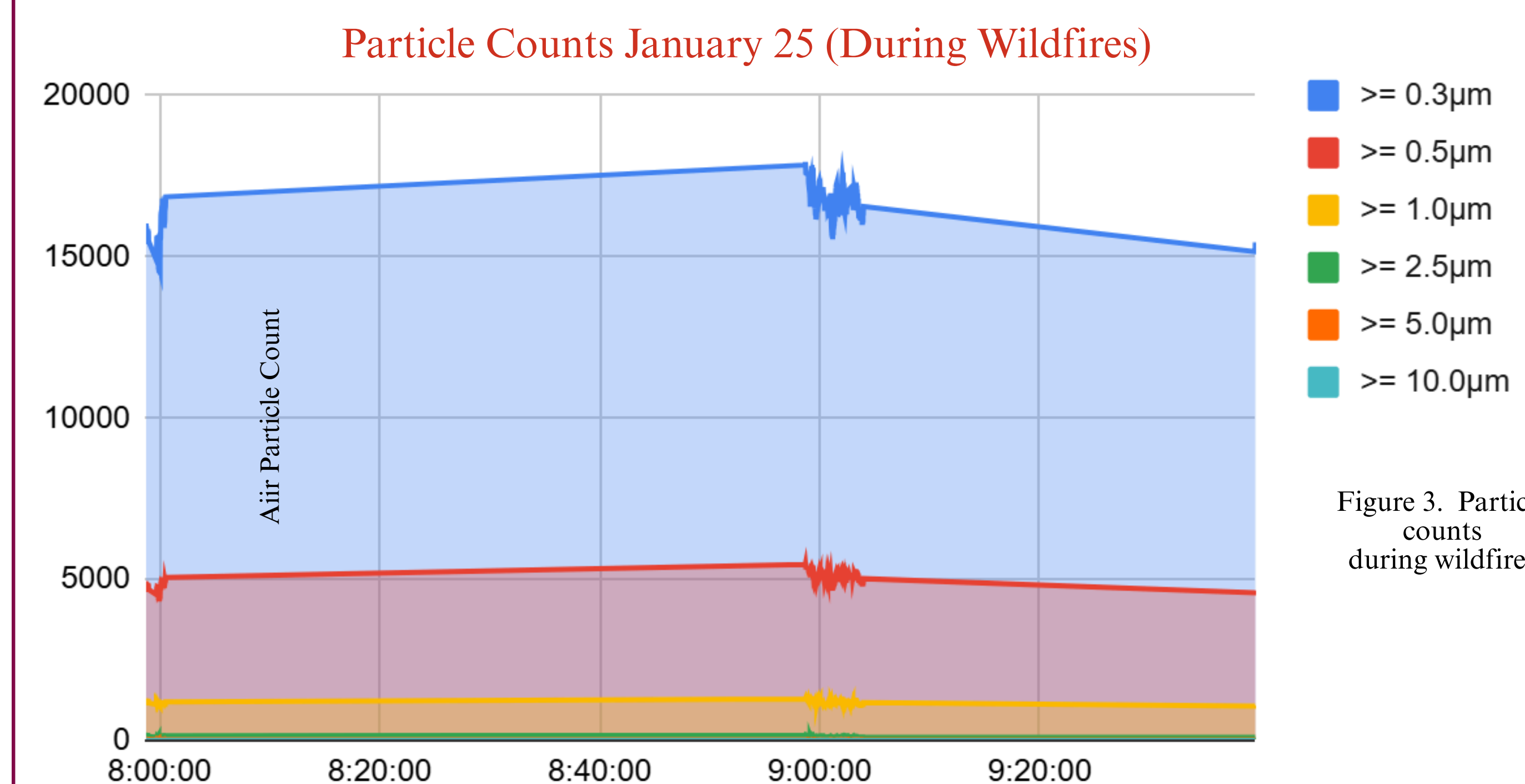
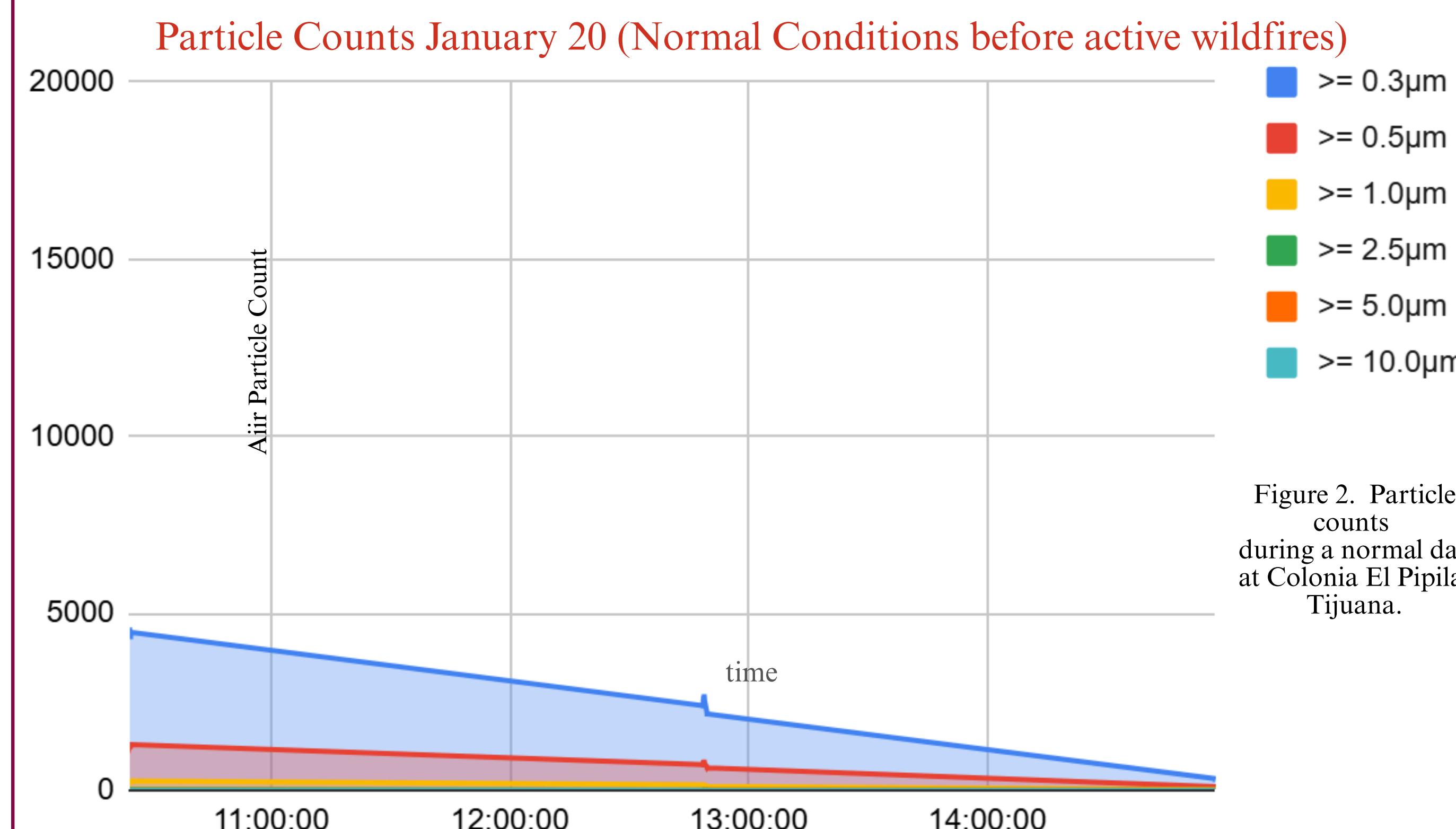
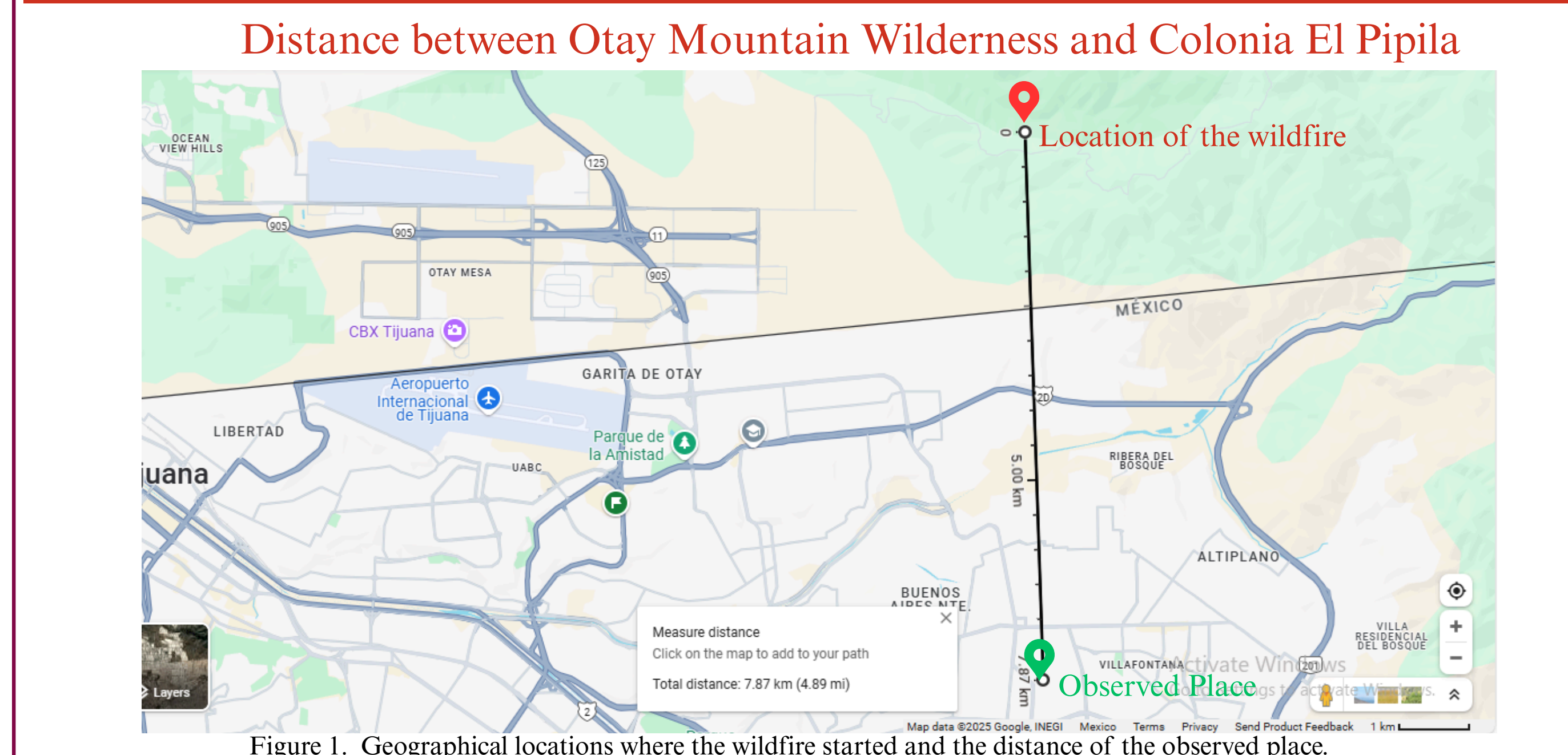
The counts of small airborne particles, specifically those measuring $0.3\text{ }\mu\text{m}$ (micrometers), will increase dramatically during wildfire events, particularly in areas like Colonia El Pipila, due to their proximity to the U.S.-Mexico border and the wind direction. This increase in $0.3\text{ }\mu\text{m}$ particles is expected to travel long distances, significantly impacting air quality in surrounding communities.

Procedures

A particle counter was placed 1.30m above ground level to represent typical human breathing height, especially for children, facing the direction of the wind to capture the movement of airborne particles. To observe changes in particle counts, measurements were taken on two different days:

- January 20, 2025 (normal conditions in Colonia El Pipila, Tijuana): Data was collected from 10:24 a.m. to 2:57 p.m.
- January 25, 2025 (date when the wildfire happened near the Otay Mountain Wilderness Sign): Data was collected from 7:58 a.m. to 9:39 a.m., during active wildfire conditions.

Results



Analysis

The particle counts taken on January 20 were approximately equal to the air conditions observed on a normal day at Colonia El Pipila, TJ. From the size bin .3 micron, the concentration was 303 particles per cm^3 .

Analysis

On the other hand, the counts for January 25 were taken when the wildfires at Otay Mountain Wilderness were active. The lowest count was 14526 of $0.3\text{ }\mu\text{m}$ and the highest count was 17943 of $0.3\text{ }\mu\text{m}$ at Colonia El Pipila.

Conclusions

The study of the changes in the particle count before and during an active wildfire that reached Colonia El Pipila asserts the hypothesis in how this environmental event greatly impacted the counts of $0.3\text{ }\mu\text{m}$ in the observed place. These findings also shows how some particles that were emitted to the atmosphere can also be concentrated 1 meter above ground level, which is the approximate height of children. There was more than 10,000 particle count difference between January 20 and January 25.

Future Work

Future studies should focus on how particle concentrations change during different wildfire phases, such as active burning, smoldering, and after the fire is extinguished, to expand the research on how wildfires impact airborne particle counts. Also get the particle counts from the point of fire to a 8 miles home away from the place inside the US, and 8 miles home away outside the US in Tijuana, to help us contrast information inside and outside the US and see if there are any patterns on both sides and understand if the different environments contributes or helps diminish the particle counts during the different phases of a wildfire.

References

CBS 8 News Staff. (2025, January 25). Fire near U.S.-Mexico border in San Diego's South Bay. CBS8. www.cbs8.com

Particle Counts and Public Health Around the Tijuana River Mouth

Aydin Palkovic



Introduction

The pollution in Imperial Beach is often seen as solely impacting the residents' ability to go into the water, but that is simply not the case. The pollution additionally could be affecting public health inside of Imperial Beach and in the surrounding communities. Initially I wanted to examine the difference between micron counts near the Tijuana River Valley at the end of Hollister St, and in Imperial Beach near Mar Vista High School. However, once I began collecting narrative data I became interested in how I could measure future quantitative data (micron counts) based around the on-the-ground qualitative data (oral history), hoping to understand any health connections present.

Hypothesis

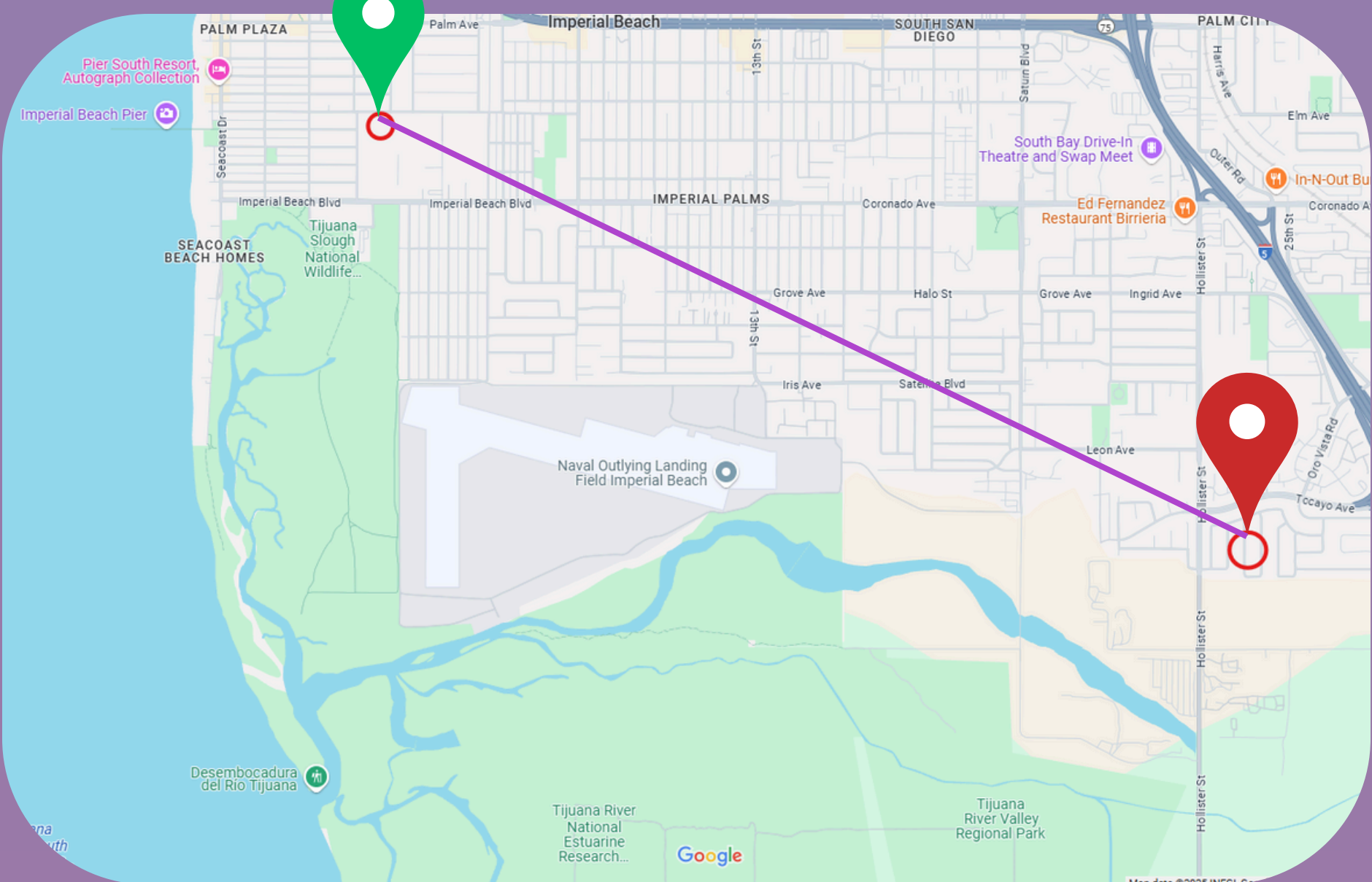
IF the Tijuana River (where the rotten egg smell is reported the most) is the source of the pollution impacting Imperial Beach, **THEN** particle counts should be higher at the end of Hollister Street near the river valley as opposed to at Mar Vista High School inside Imperial Beach.

Procedure

Every Tuesday night I recorded particle counts in the neighborhoods at the end of Hollister Street, and on Thursday nights I recorded in Imperial Beach by Mar Vista High School (multiple 20 minute long instances for both). Simultaneously, I interviewed community members who live in the river valley area and in Imperial Beach to try and understand their knowledge of the pollution and how they have been impacted by it over the years.

These are the two different locations, the green pin being near Mar Vista High School and the red pin being in the river valley neighborhoods.

Map of the two data locations



Analysis

The collected data shows that particle sizes ≥ 0.3 microns collected at night seemed much higher near the river valley averaging at 2242 particles per cm^3 . While the particle sizes ≥ 0.3 microns collected at night averaged at 413 particles per cm^3 . This difference was very clear and is what focused my research more towards how that difference affects the community.

Results: Quantitative

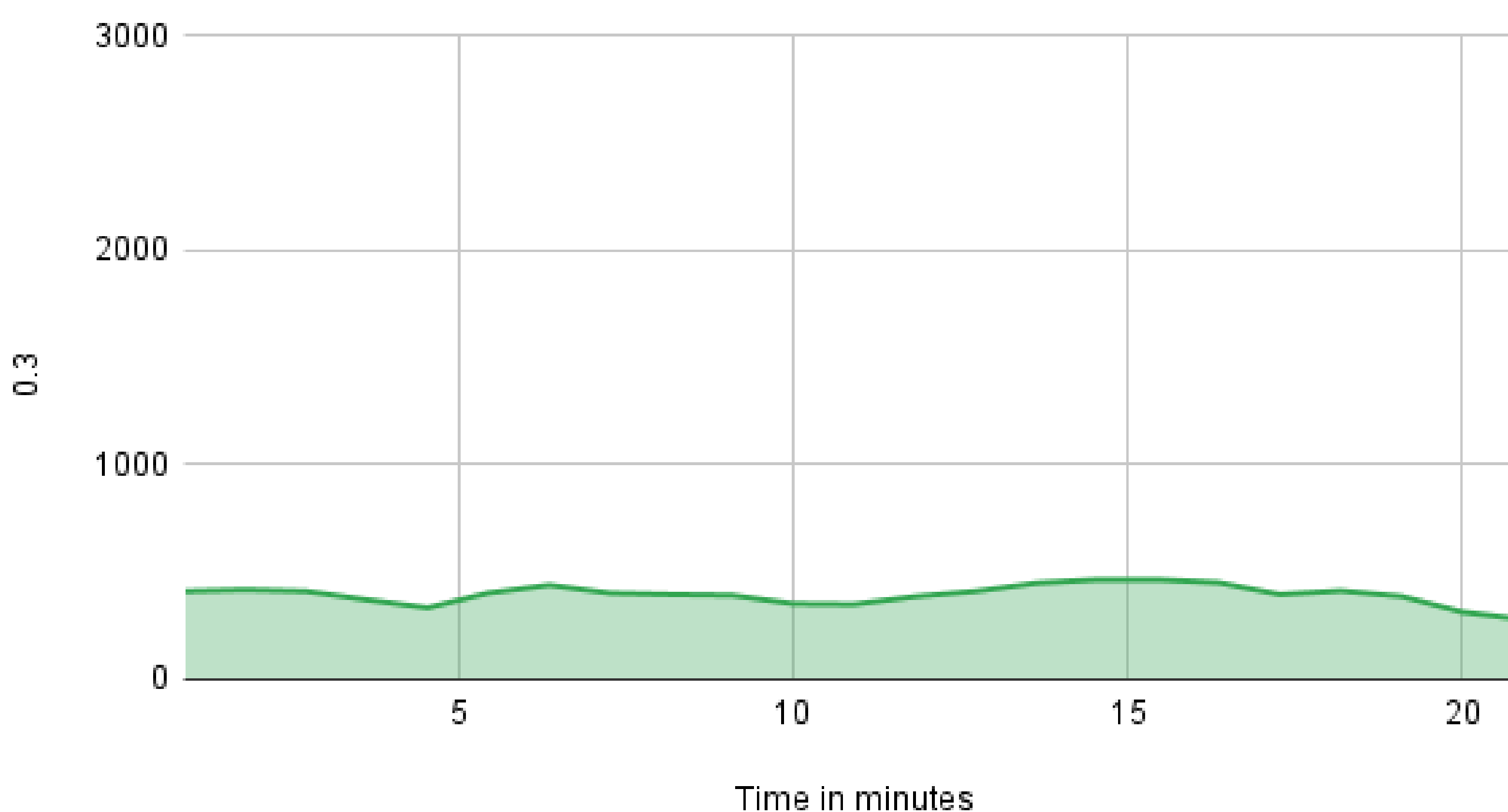
Data taken in the two distinct locations, between the hours of 9pm and 12am, each increment adding up to 20 minutes

Micron Count at Night at end of Hollister Street



(Particle count of size ≥ 0.3 microns near the Tijuana River Valley at the end of Hollister St)

Micron Count at Night Near Mar Vista High School



(Particle count of size ≥ 0.3 microns inside Imperial Beach at Mar Vista High at night)

Results: Qualitative

Pneumonia

After moving into a house in the neighborhood closest to the River Valley, a community member I interviewed claimed to develop pneumonia that has since stuck with her after moving. She also stated that nights when the smell of the pollution was worse were often accompanied with worse coughing fits.

Hepatitis A

Living in Imperial Beach almost his entire life, a community member I interviewed built a close connection with the beach. However, he stated that after going surfing one day after a rain event he contracted Hepatitis A. He was hospitalized and claims that his liver and other aspects of his health have never fully recovered years later.

Conclusion and Further Work

The pollution in Imperial Beach is more complicated than it seems, because of its aerosolization it has begun impacting the everyday lives of the residents of Imperial Beach and the surrounding communities. While my work is limited due to a finite access of resources and more advanced collection methods, I suspect a correlation is present but further research branching into the public health aspect of the pollution is absolutely necessary. Quantitative research is crucial but incorporating people's health experiences into this research is just as important.

Carmina R. Rendon

Introduction

Untreated sewage from Mexico is being released into the Tijuana River. In the city of Imperial Beach, many farms and ranches are operated extremely close to (or on) the river. Due to the proximity, the air quality on the ranches has harmful affects on workers, affecting business operations and personal well-being. Although the particles are also high inland, I wanted to compare the air quality right by the river versus on the beach shore.

Hypothesis

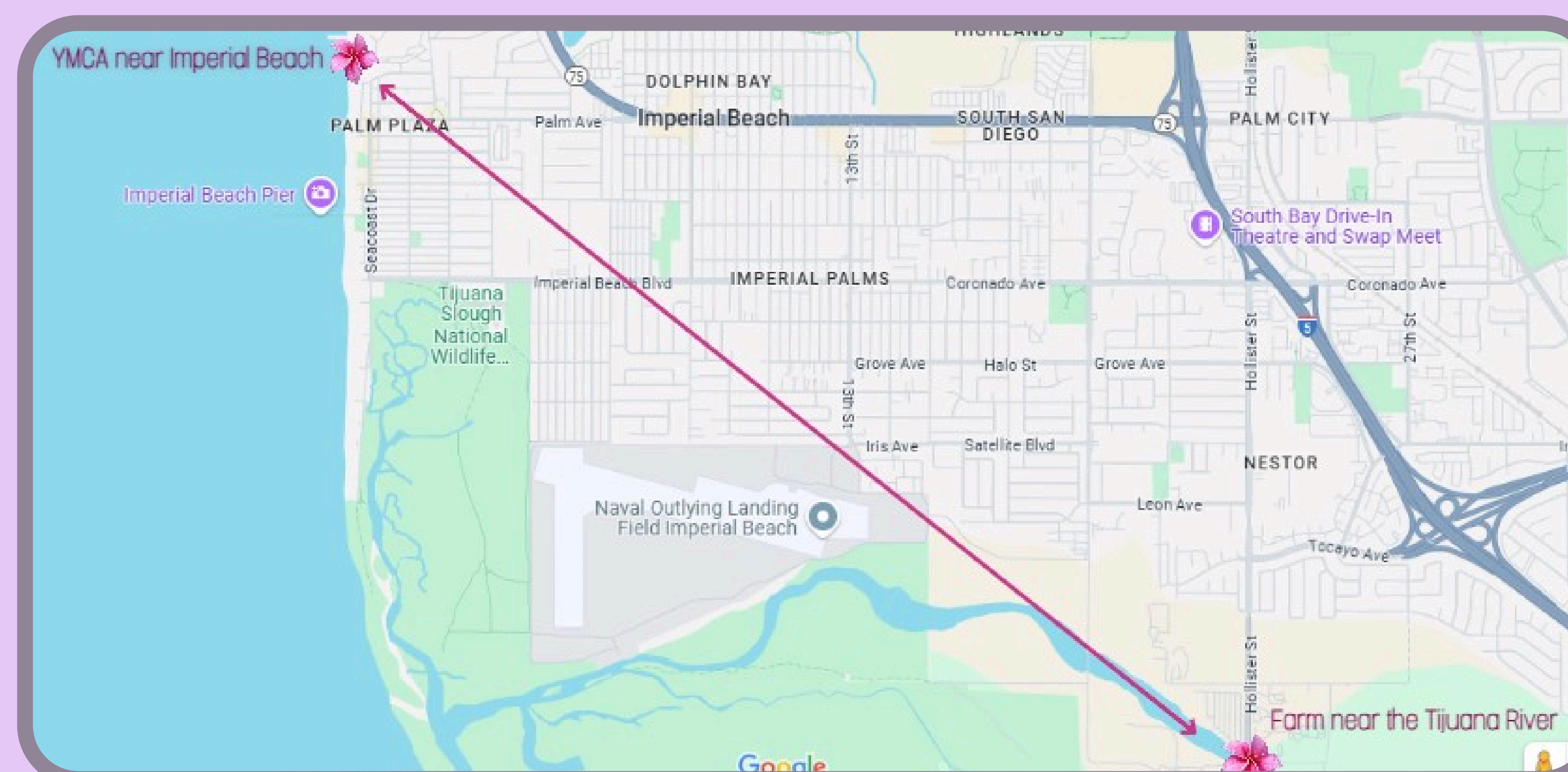
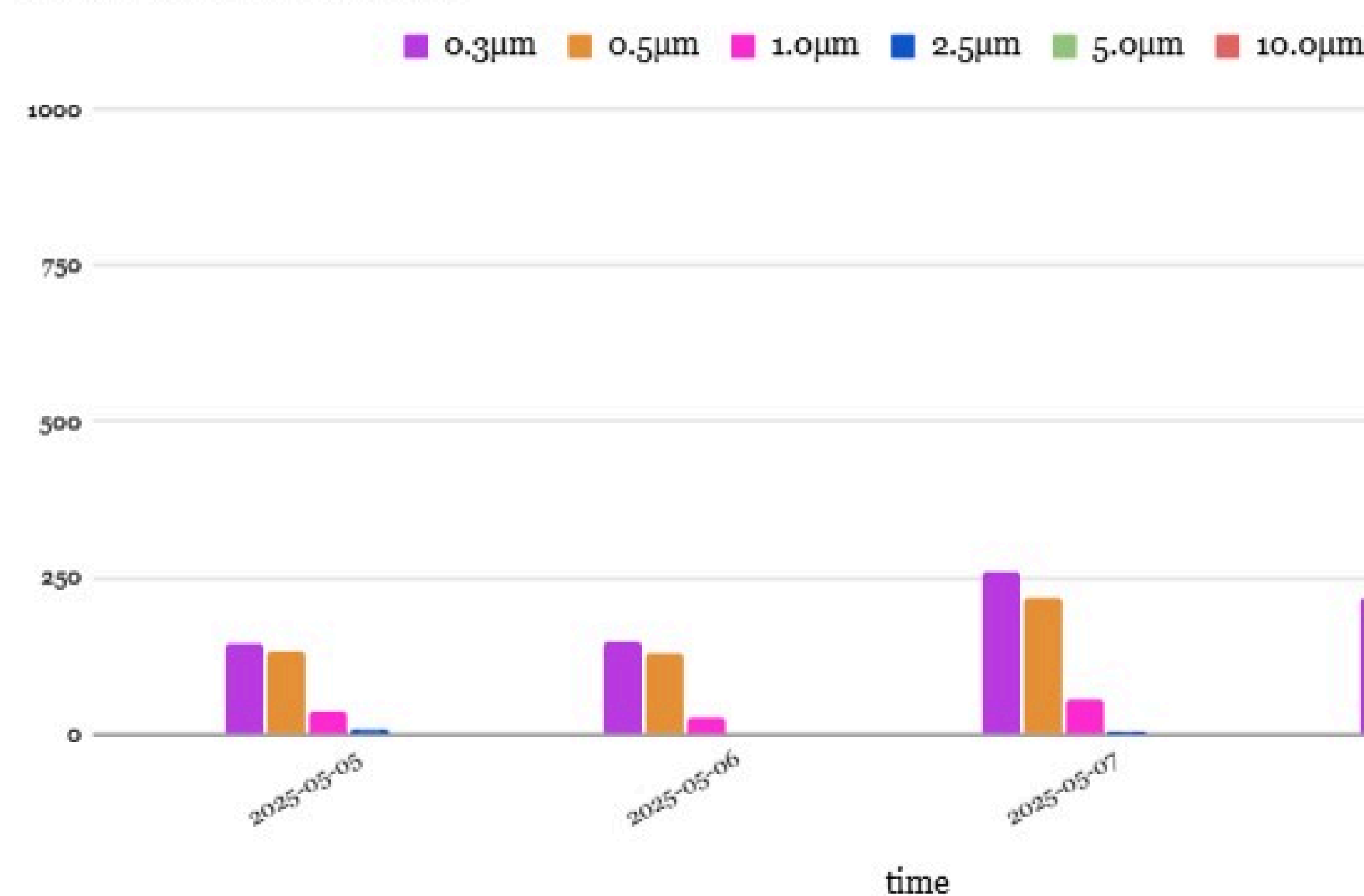
I tested the air quality on ranches on the Tijuana River and the air quality at the YMCA in Imperial Beach. My hypothesis was that the ranches air quality would present a higher number of air particles compared to the particles near the beach.

Procedures

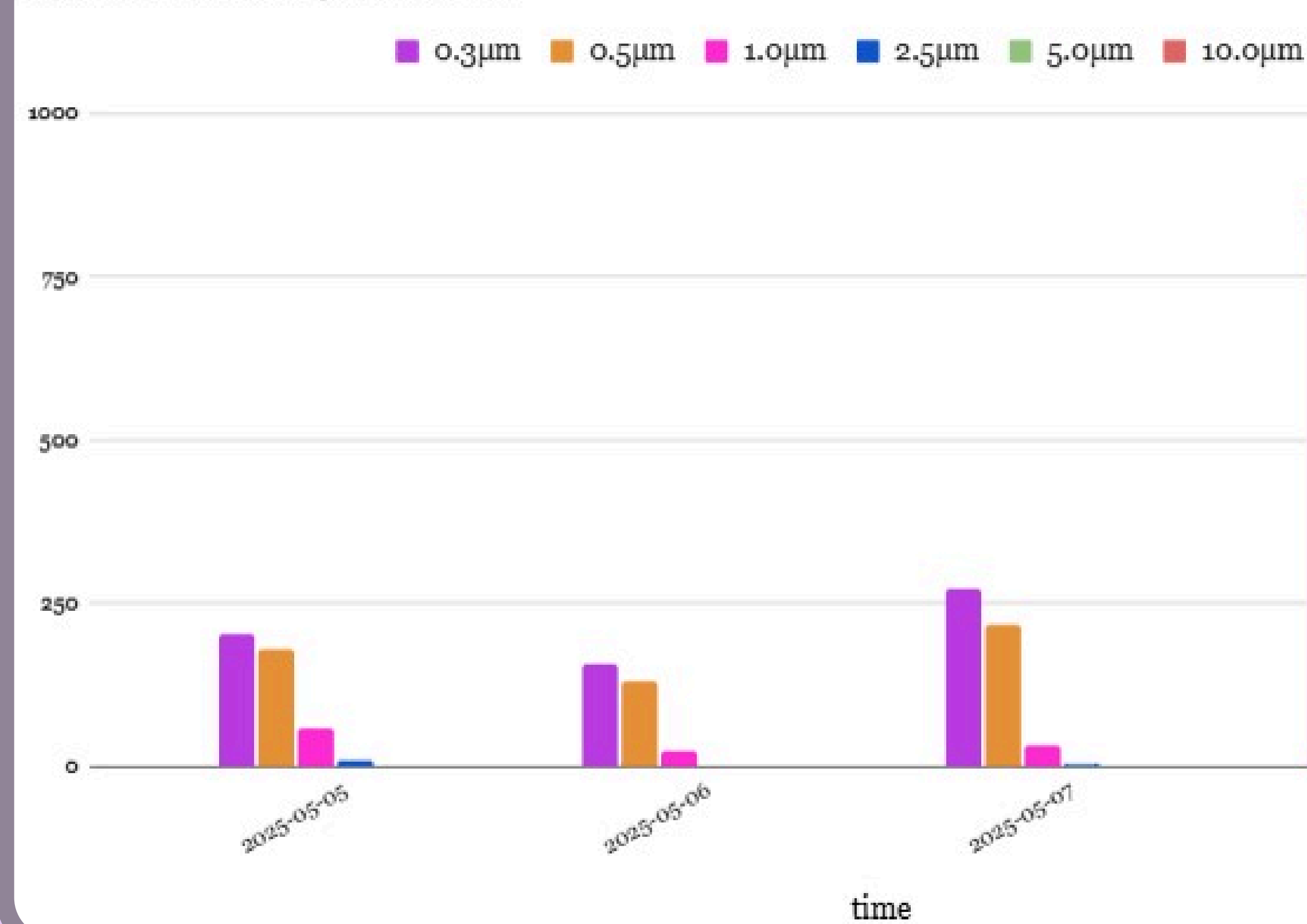
- An air PM sensor was taken to areas right outside ranches on the Tijuana River and the YMCA parking lot which is very close to the beach shore
- Data was collected for four business days after 4 pm from May 5th 2025 to May 8th 2025
- Data was collected for exactly 10 minutes each time

Results

YMCA in Imperial Beach



Ranches on the Tijuana River



Analysis

The air quality is worse on the Tijuana River than the YMCA. The particle count on the river is 11%-39% higher than the particle count at the YMCA. After analyzing the data, it is apparent that the air closer to the Tijuana River contains higher levels of particles in comparison to the air at the YMCA.

Conclusions

From these results, its clear that the levels of particles 0.3µm in size and other particles are more present on the Tijuana River compared to the YMCA location. What is still not clear is whether working around animals affects the the air quality.

Future Work

- Collecting more data not just in ranches in Imperial Beach, but throughout San Diego county
- Comparing the air quality or amount of pollutants around ranches in Imperial Beach to other places around San Diego county with similar occupational conditions
- Interviewing farm workers in these working conditions and compare the results

OUTDOOR AIR QUALITY POLLUTION IN THE SOUTH BAY IN RELATION TO MOTOR VEHICLE VOLUME

Celeste Bonilla



CAR EXHAUST PRODUCED A HIGH NUMBER OF AIRBORNE PARTICLES

INTRODUCTION

Air pollution in Imperial beach doesn't come from just sewage contamination. My research is about car exhaust, and if the amount of particles present in the air correlates with the amount of motor vehicles present. Would the amount of particles decline as less vehicles were present? Would they increase if more cars were present?

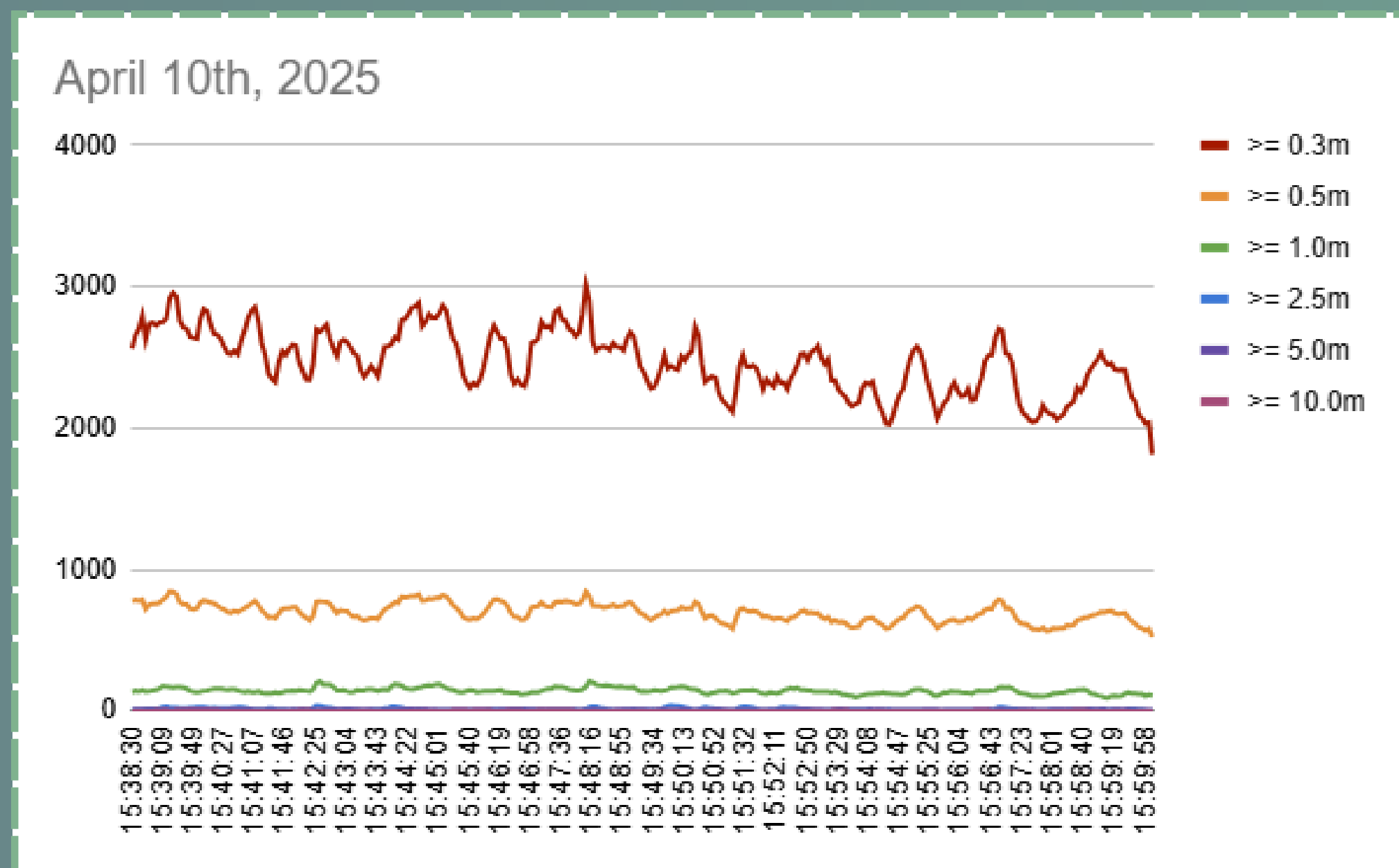
HYPOTHESIS

When the concentration of cars in one area is higher, the particles counts will be higher as a result of exhaust.

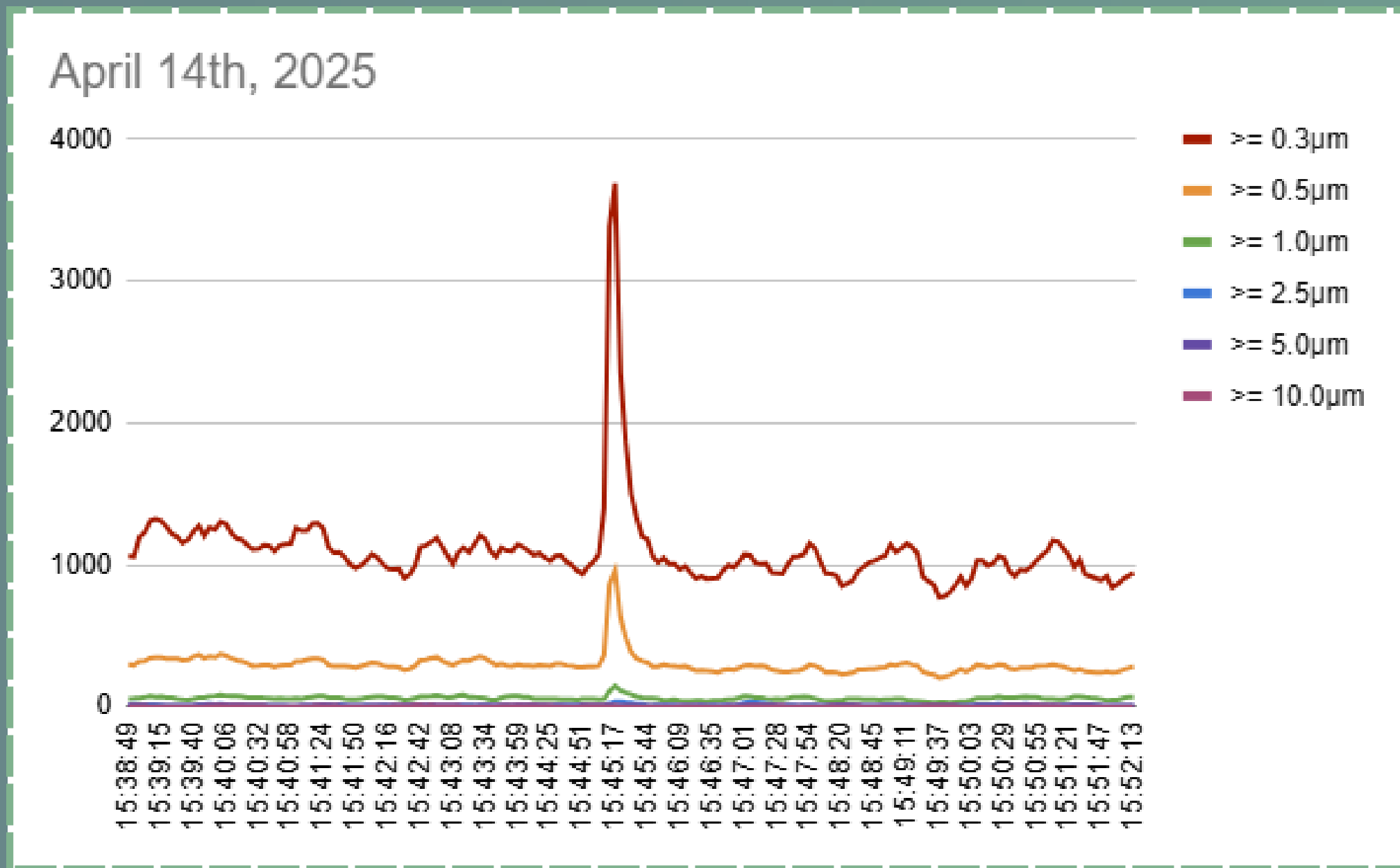
PROCEDURES

I waited out by the front street of the school right after school (3:35, typically) for at least 15-20 minutes at a time. I compared each set of data points I had taken at relatively the same time to determine if there was any correlation between them.

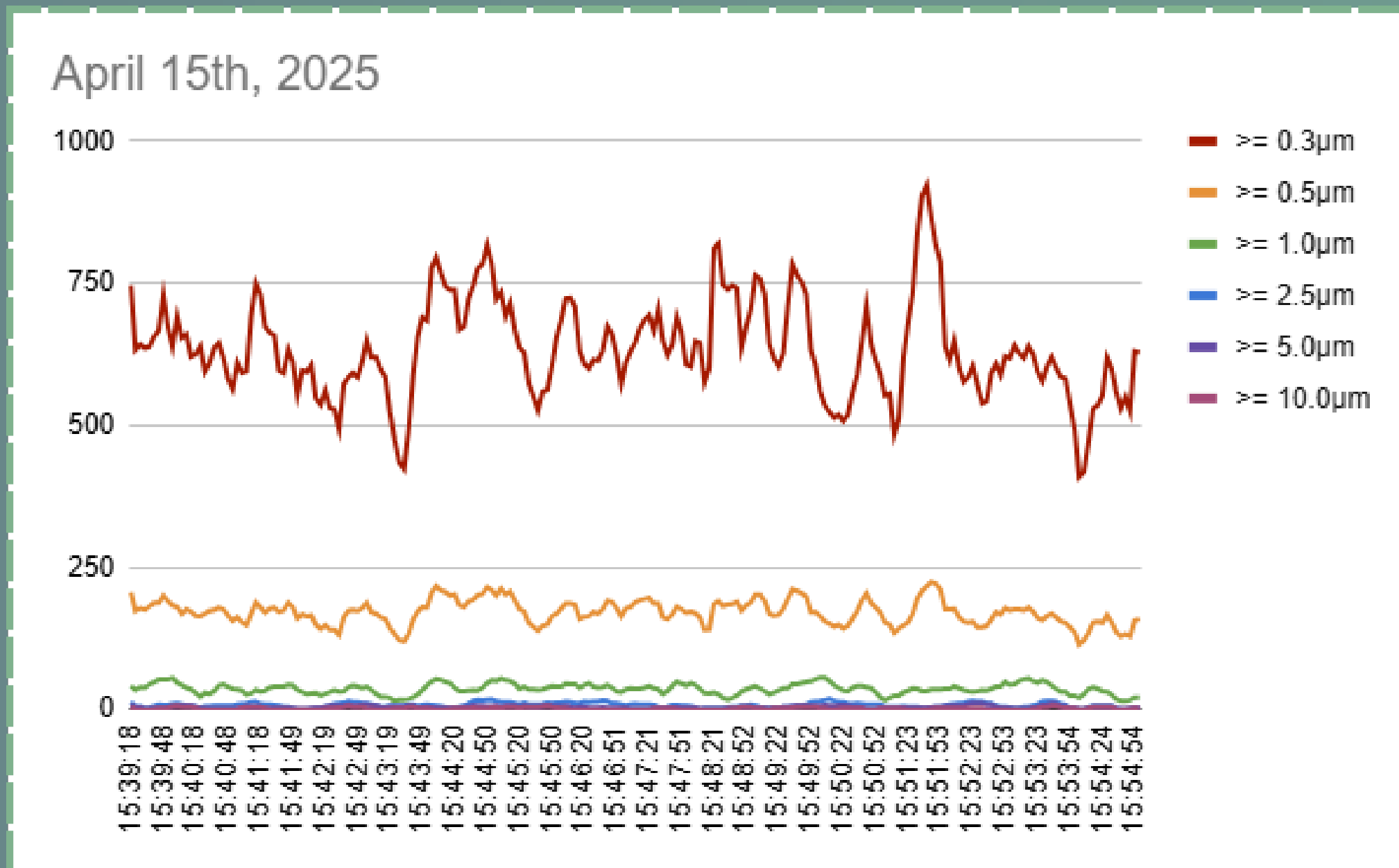
RESULTS



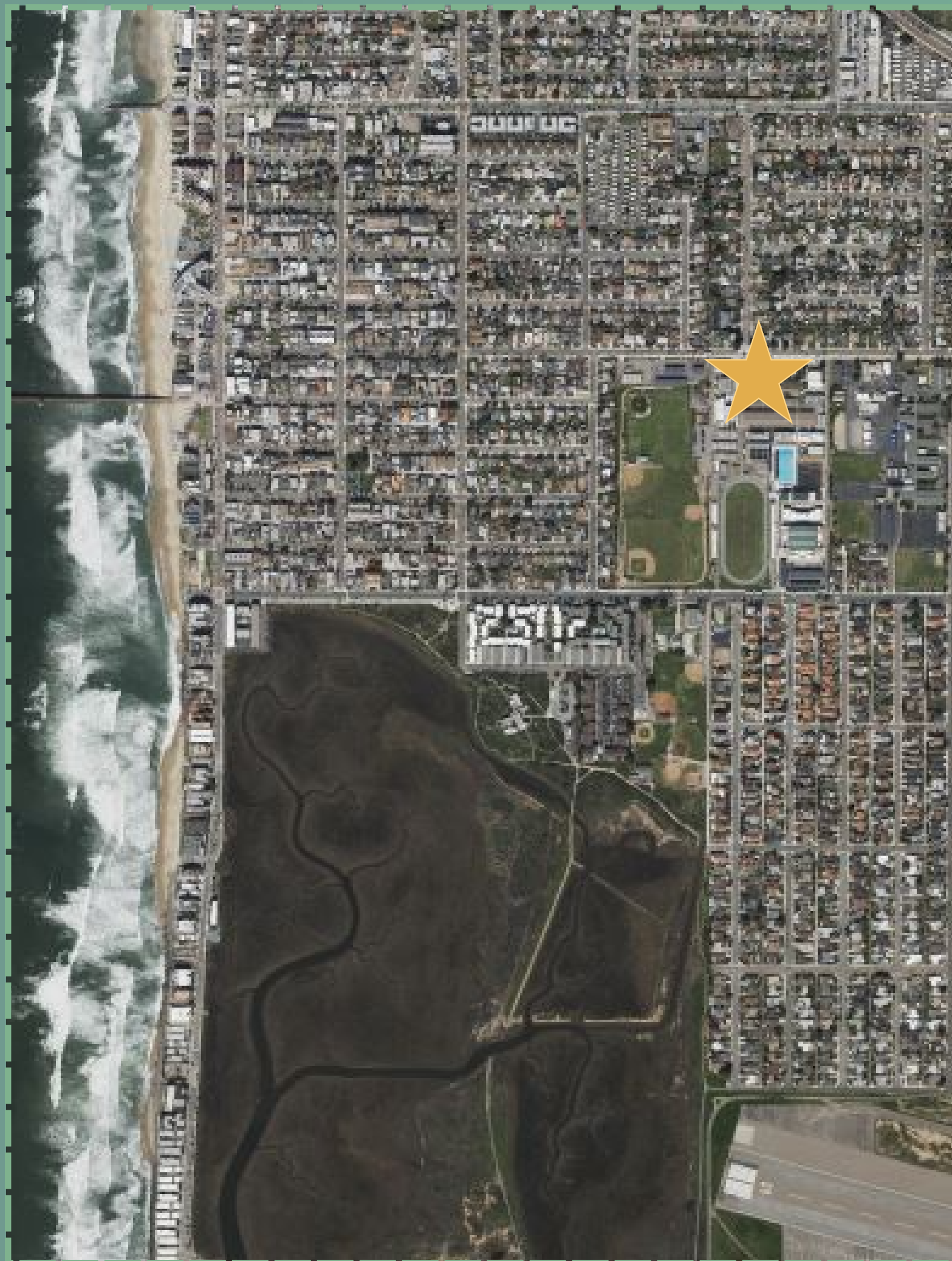
Regular day ending at 15:35



Regular day ending at 15:35



Regular day ending at 15:35



Partial map of Imperial Beach

FUTURE WORK

- 1) Comparing these results to those from areas closer to sources of pollution (Beach and estuary). Are they comparable? How can this support our cause?
- 2) Compare these results to other streets (Busy like palm or empty like alleyways).

CONCLUSIONS

As the amount of cars present dwindles over time, so do the particle counts. After amount 10 minutes when the number of cars in my chosen location reduces, particle counts slowly drifted down and once there were nearly no cars present the number of particles in the air reduced drastically.

REFERENCES

[pmc.ncbi.nlm.nih.gov](https://pubmed.ncbi.nlm.nih.gov)
[epa.gov](https://www.epa.gov)

Introduction

Indoor air quality is a growing concern. I decided to focus my research on air quality in public indoor spaces, mainly focusing on businesses near the coast and contaminated areas. These businesses have been heavily impacted by the sewage crisis. I wanted to uncover how different factors, including the location and ventilation, impacted the particle count in these spaces.

Hypothesis

How does ventilation affect indoor air quality in heavily contaminated regions? Buildings that are closer to the coast and have less ventilation will typically have a higher particle count.

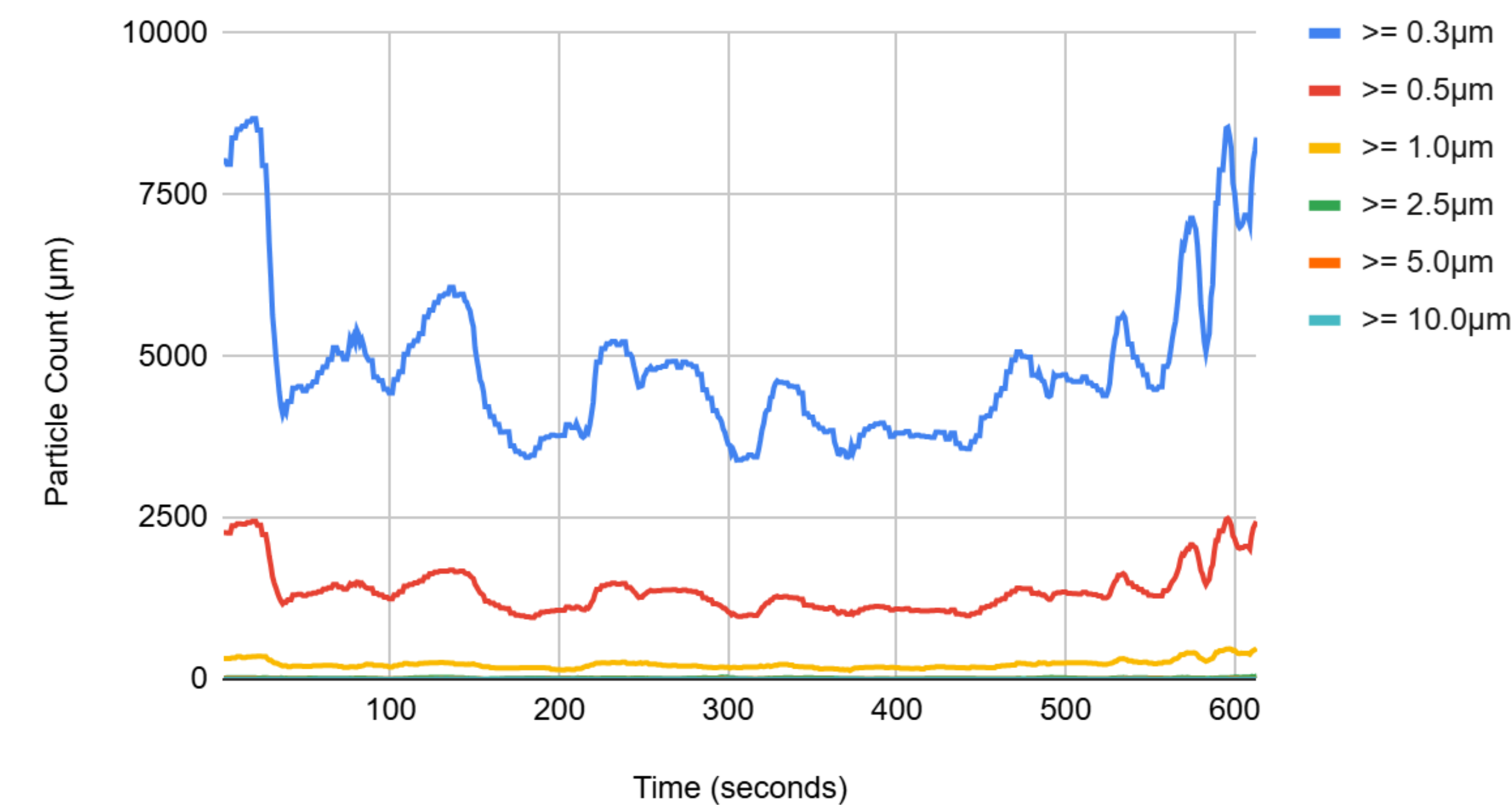
Procedures

I used an air particle monitor to record the particle count of particles of various sizes in one second intervals. I took samples in different businesses, including restaurants and retail stores. I compared buildings with different ventilation and compared their particle counts to reveal how ventilation impacts indoor air quality. I considered how many windows and doors were open. I also recorded the height of the ceilings.

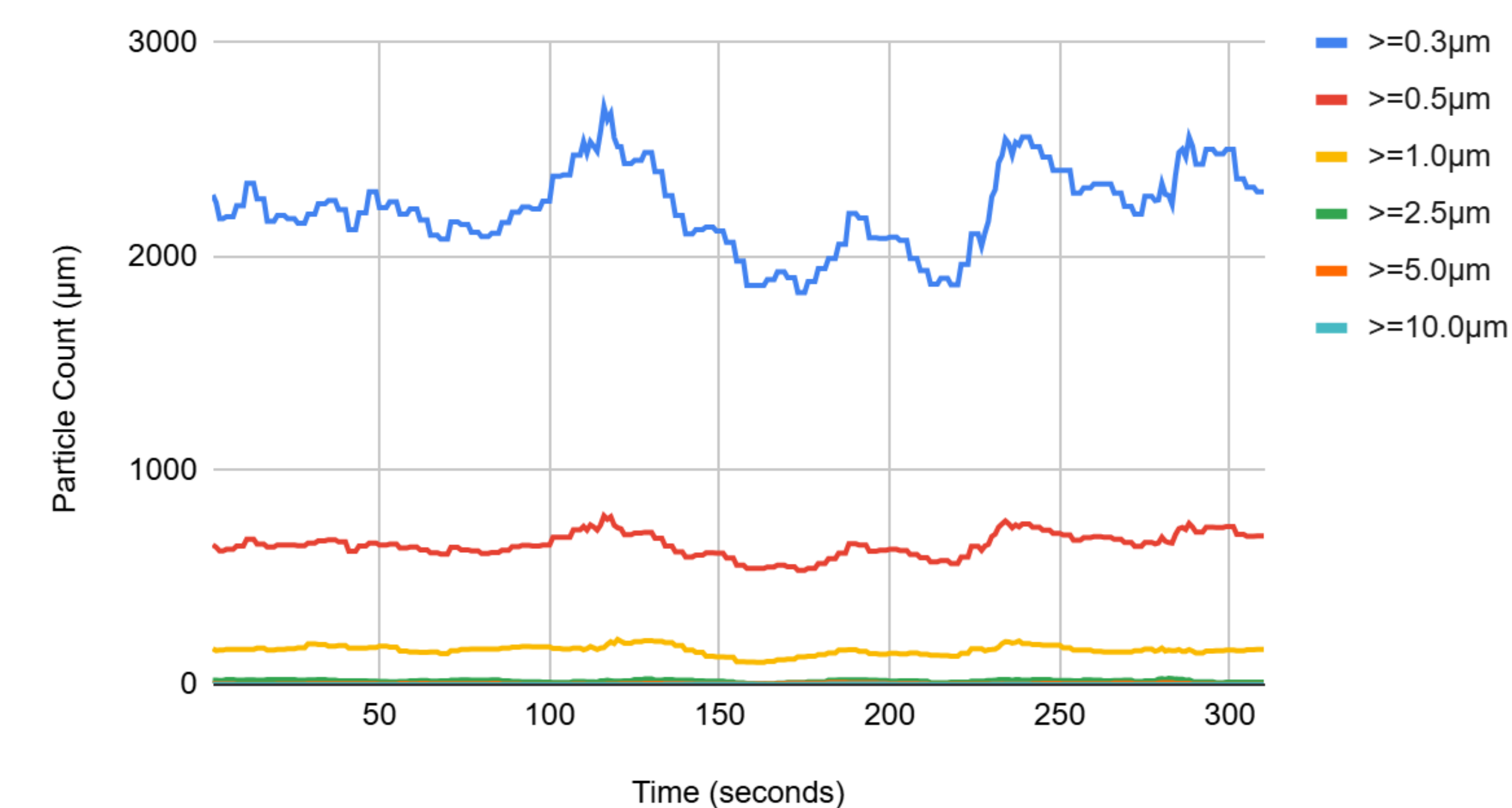
Conclusions

I can conclude that more ventilation and open windows/doors had no correlation with lower particle counts. It is still unclear if human activity in these indoor spaces affect particle count. The ceiling height was a major factor in air quality. The distance from contaminated areas also affected air quality as the contamination entered the buildings.

Indoor Air Quality Over Time (Pizza Shop)



Indoor Air Quality Over Time (Record Shop)



Indoor Air Quality Over Time (Library)

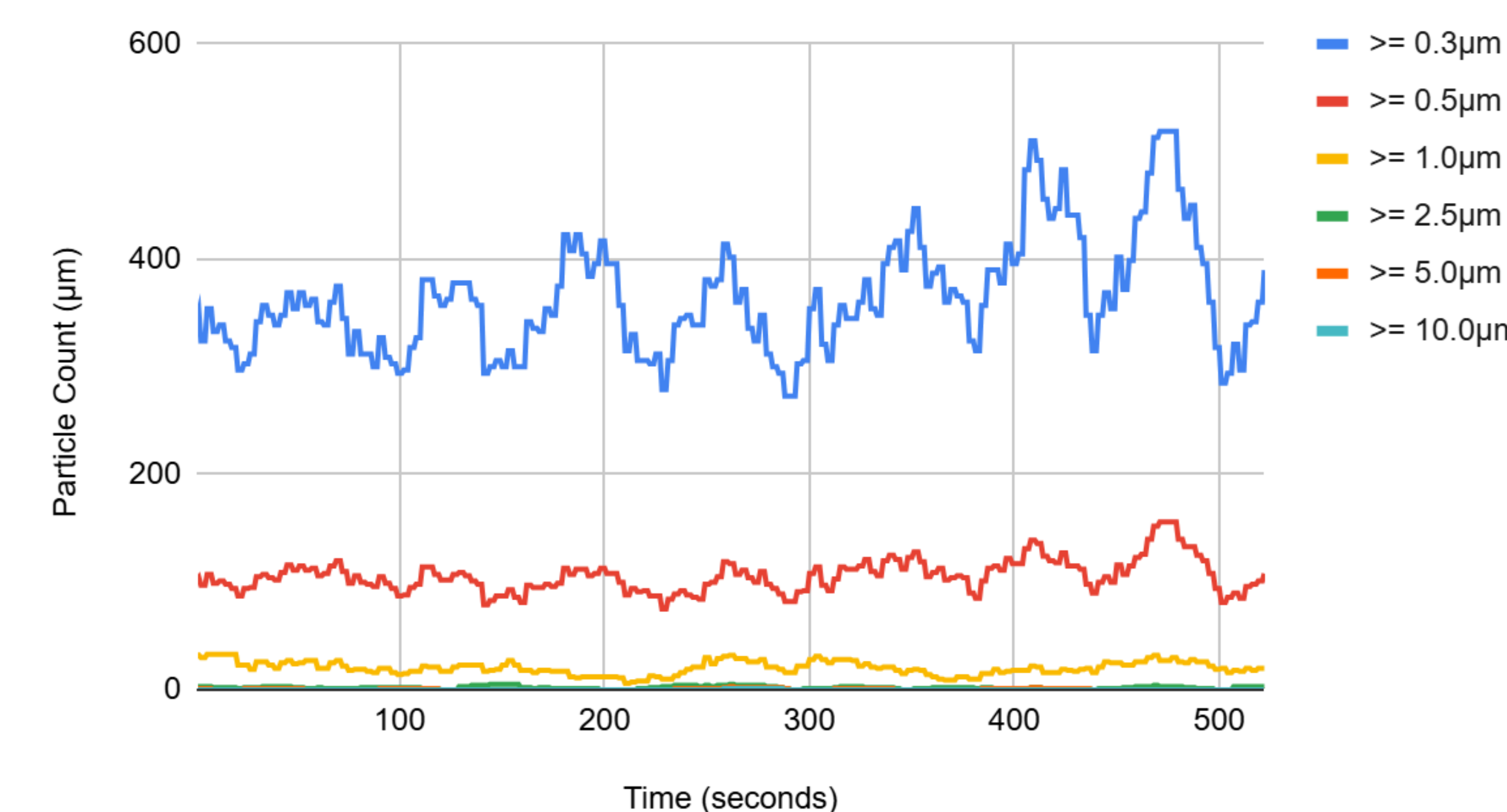


Figure 1: Open door, open window, low ceilings, and exposure to an indoor kitchen (possibly a contributor to poor air quality)

Figure 2: Open door and low/medium ceilings

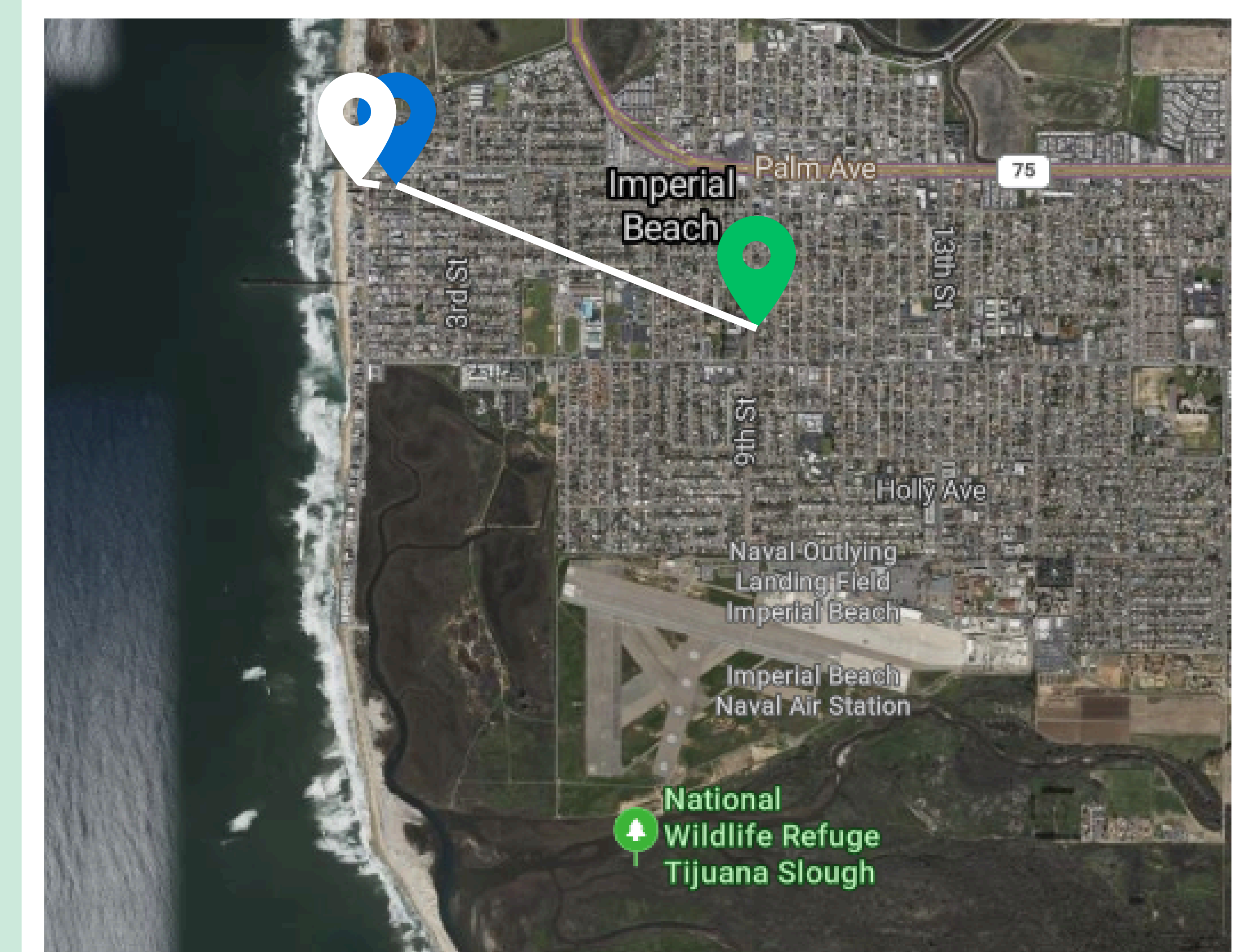
Figure 3: Closed doors, closed windows, and high ceilings

Future Work

In the future, I can interview multiple business owners or send out a survey to discover how the sewage crisis has affected their businesses. I can also suggest different ventilation systems for these businesses and research how the air quality changes. We should also consider when the buildings were constructed. Older buildings tend to have poorer air quality because of deteriorating materials and outdated ventilations systems. We can find a relationship between these two factors in the future.

References

Allen, J. G. (2024). Recommitting to Ventilation Standards for Healthy Indoor Air Quality. American Journal of Public Health, 114(10), 991-993.



The data on this poster was partially supplemented by Aydin Palkovic's efforts and I want to thank him for sharing his files.

Difference in Air Quality in Imperial Beach vs. Coronado

Dhara Jost



Introduction

The river often carries pollutants into the ocean, which may impact nearby air quality. By measuring and comparing air in both Coronado, CA and Imperial Beach, CA, this study explores how ocean pollution from the river may affect the surrounding environment. This project compares air quality in both locations - two nearby cities with contrasting incomes as well as different distances from the Tijuana River.

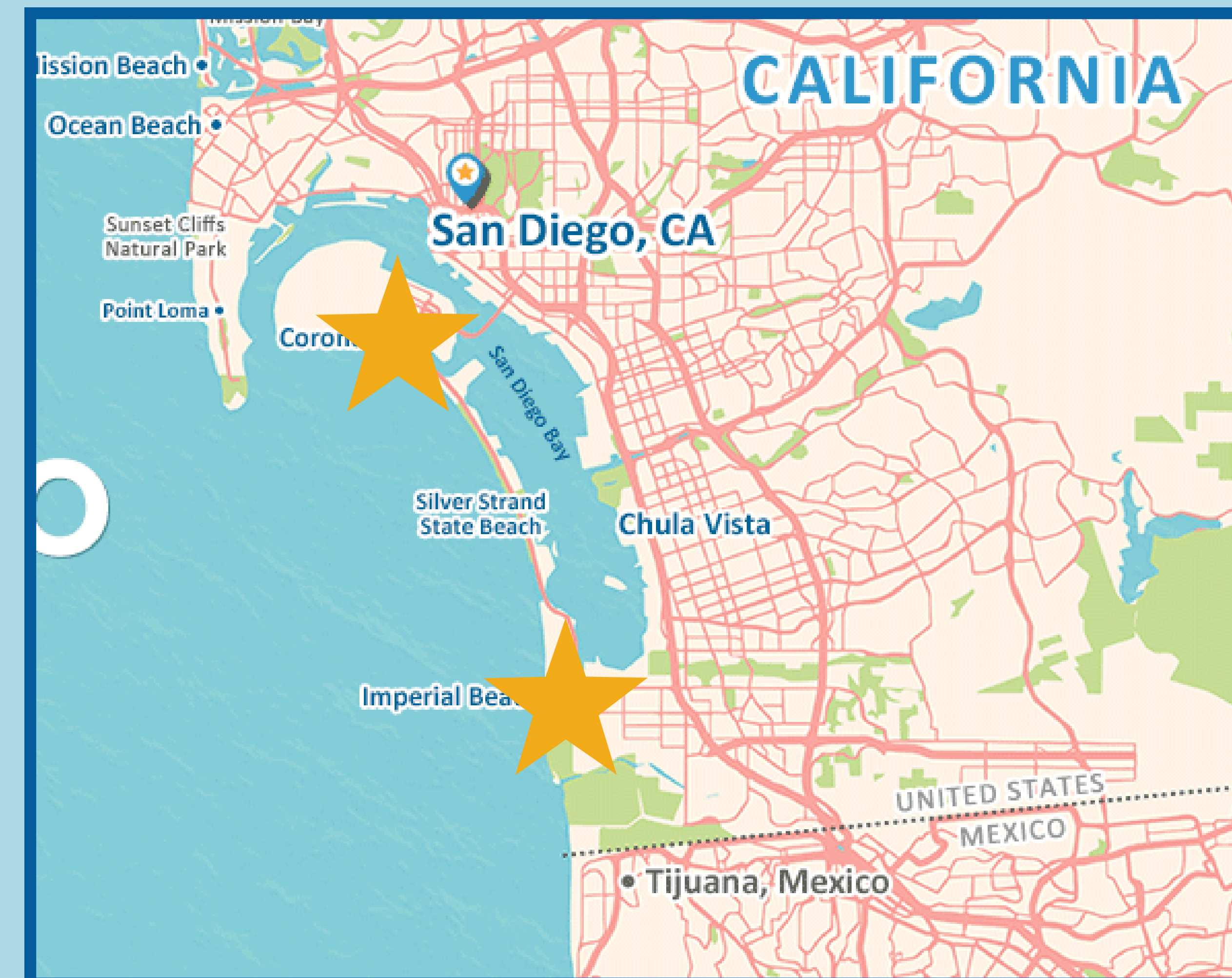
Hypothesis

Imperial Beach will have poorer air quality than Coronado due to its proximity to the Tijuana River, which contributes to the possible aerosolized pollution in the air.

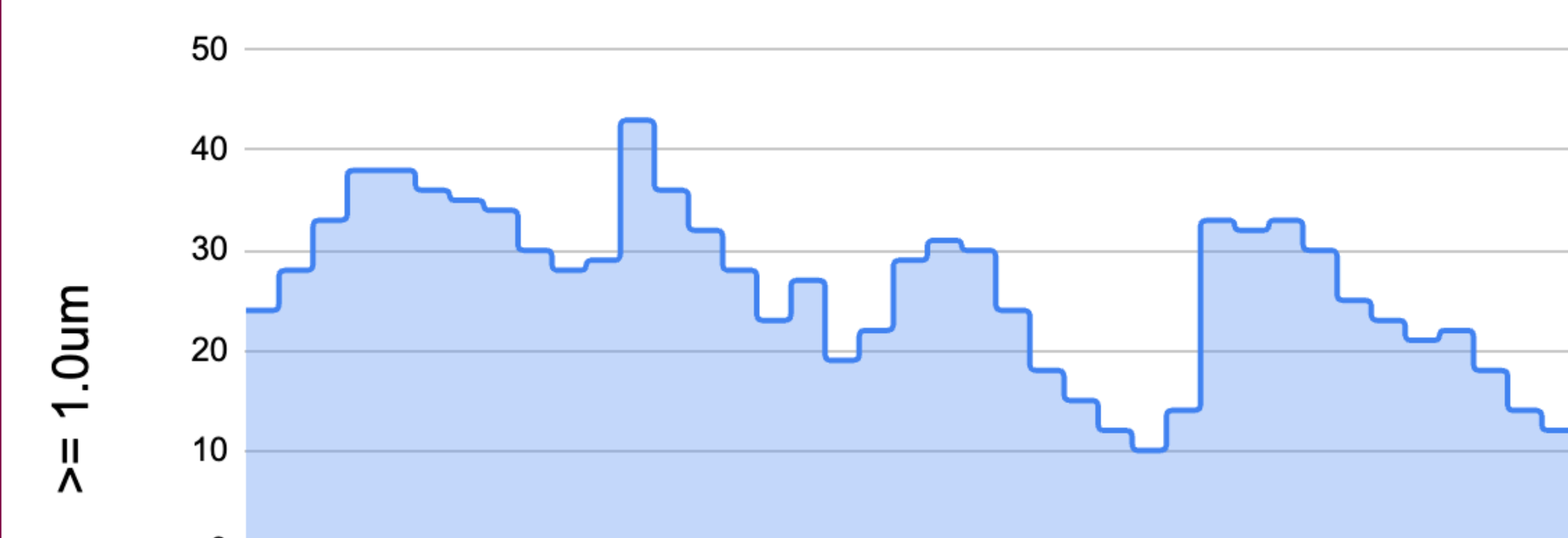
Procedures

Using my air particle counter from UCSD, I measured the air quality at central Coronado Beach for 15 minutes every Monday, Tuesday, and Wednesday in March 2025.

I then looked at the data provided by QuantAQ for the Imperial Beach coast data. Given the same day and time, I compared the two to see what the particle counts looked like.

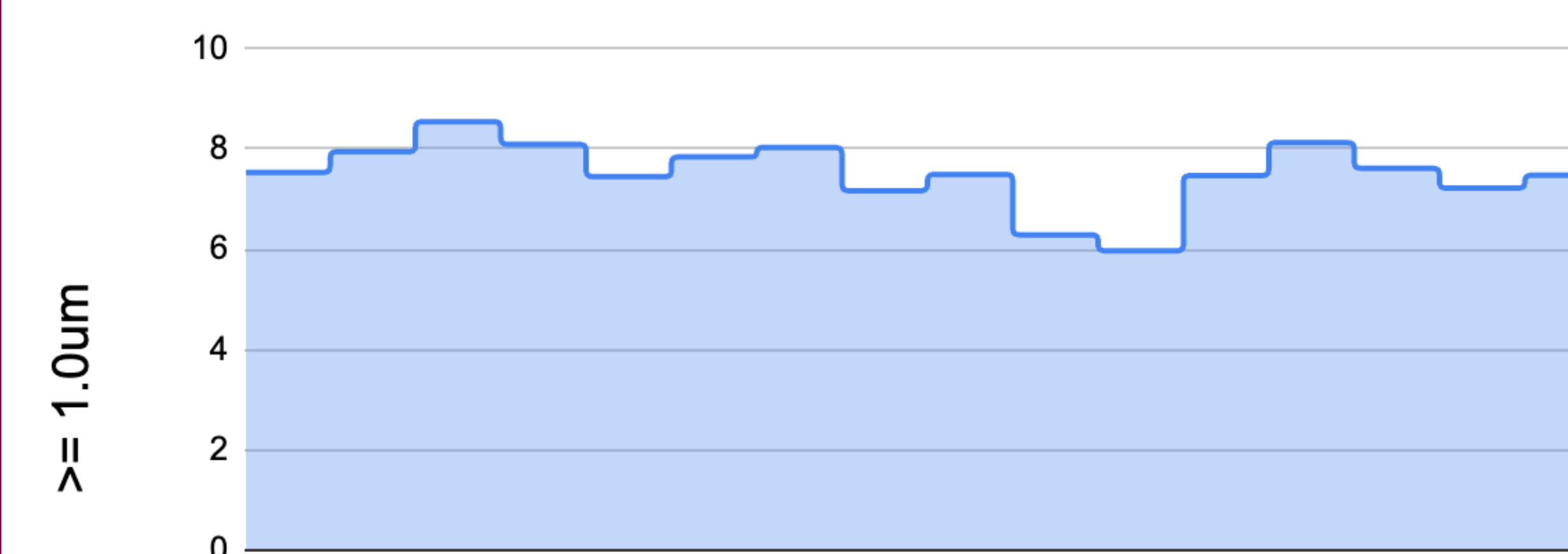


3/4 Coronado PM $\geq 1.0\mu\text{m}$



3/4/2025 (15:55pm-16:10pm)

3/4 IB Coast PM $\geq 1.0\mu\text{m}$



3/4/2025 (15:55pm - 16:10pm)

Conclusions

Based on my data, it is evident that Coronado's particle counts for PM $\geq 1.0\mu\text{m}$ are on average, about 5 times greater than the particle counts for the IB coast area. Referencing other graphs I made throughout the month of March, this is a common trend. Therefore, my hypothesis was proven wrong. Based on my data, I have found that Imperial Beach has better air quality than in Coronado **based on PM counts**. This could be the case due to Navy air traffic, but this is something I'm not entirely sure about.

Future work

This data provides a good argument regarding the importance of attention to PM data in Coronado. A lot of people overlook Coronado, when in reality, a lot of parts of San Diego county are affected by this issue.

I think more tests done in Coronado would definitely be beneficial to figure out why these data points are higher, and, if they are always higher in Coronado. Looking on the internet, current literature does not elaborate on air quality in Coronado. We need to update that and raise more awareness to the issue.

References

QuantAQ website to access data for Imperial Beach.

Air Quality Transect: Tracking from the Tijuana River Estuary to Rosarito and Back

Emily Tiscareño



Introduction

The U.S.-Mexico border region is a complex area influenced by a variety of environmental and human factors that can impact air quality. This project investigates the changes in particulate matter (PM 2.5) concentrations along a geographical transect starting at the Tijuana River Valley Estuary in Imperial Beach, extending through the bustling border region into Mexico, and continuing south along the freeway towards the coastal city of Rosarito. Understanding these spatial variations in air pollution is crucial for assessing potential environmental and health impacts on the communities in this interconnected region.

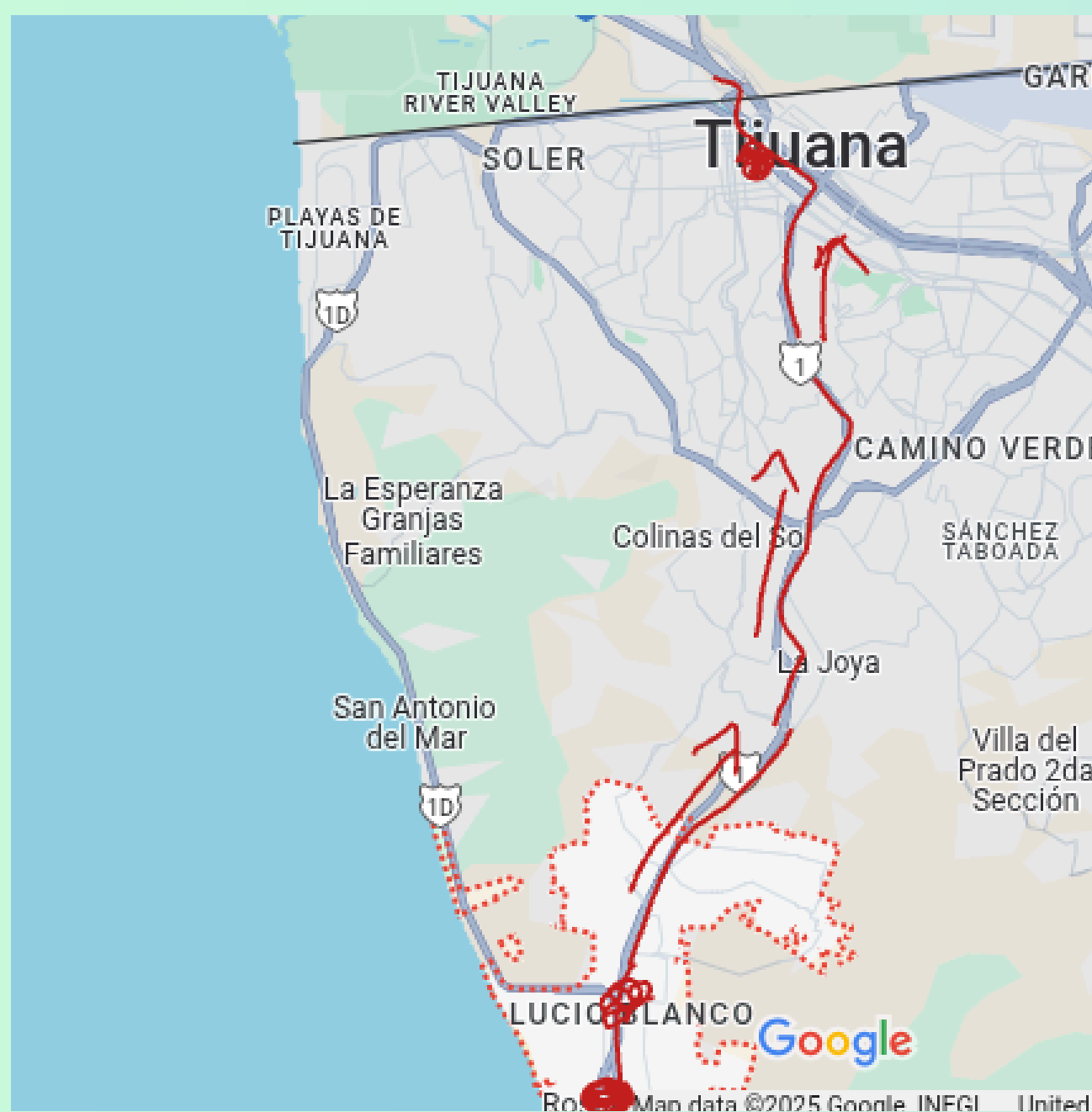


Figure 1 (Route Map): Shows the full sampling route from the estuary to Rosarito.

Procedures

- Route: One vehicle trip from the Tijuana River Estuary, through the San Ysidro border, down the freeway to Rosarito.
- Data: PM 2.5 was recorded continuously with GPS tracking and time stamps.
- Estuary (Start): Used as a baseline near the Tijuana River Valley.
- Border: High-traffic area at San Ysidro crossing.
- Freeway: Data collected at intervals heading south.
- Rosarito (End): Final readings in the coastal area.

The sensor ran inside the car (windows [open/closed]) and logged PM 2.5 every [insert time if known]. GPS data helped match air quality readings to specific locations.

Hypothesis

We hypothesized that PM 2.5 levels would be highest at the heavily trafficked Tijuana border crossing. As we moved south along the freeway towards the less congested coastal region of Rosarito, PM 2.5 concentrations were expected to decrease, influenced by increased oceanic ventilation. However, localized variations were anticipated due to intermittent traffic and urban development along the route.

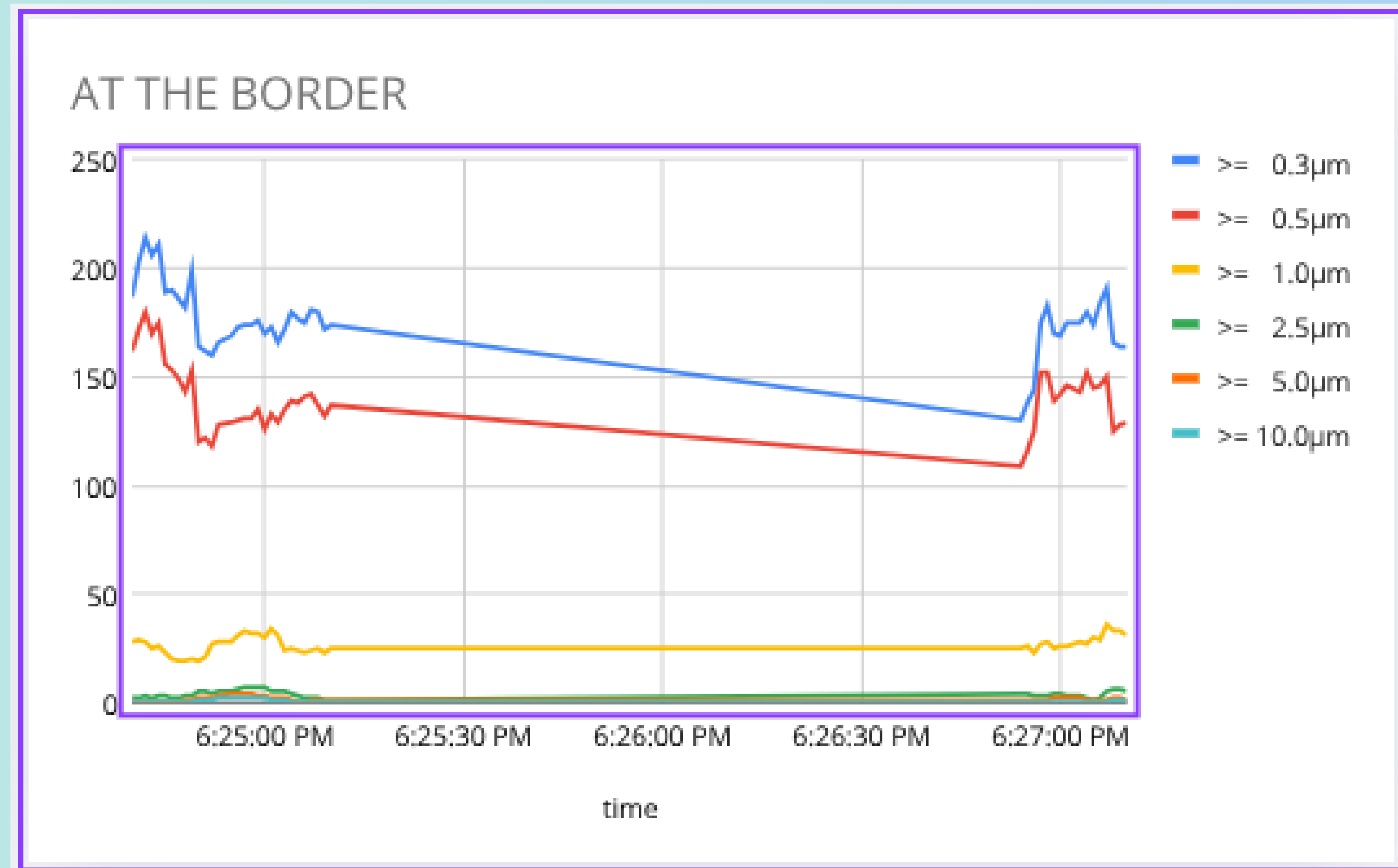


Figure 2 (Border): PM 2.5 peaked at the San Ysidro border, especially in smaller particles (0.3–1.0 μm), likely from car exhaust.

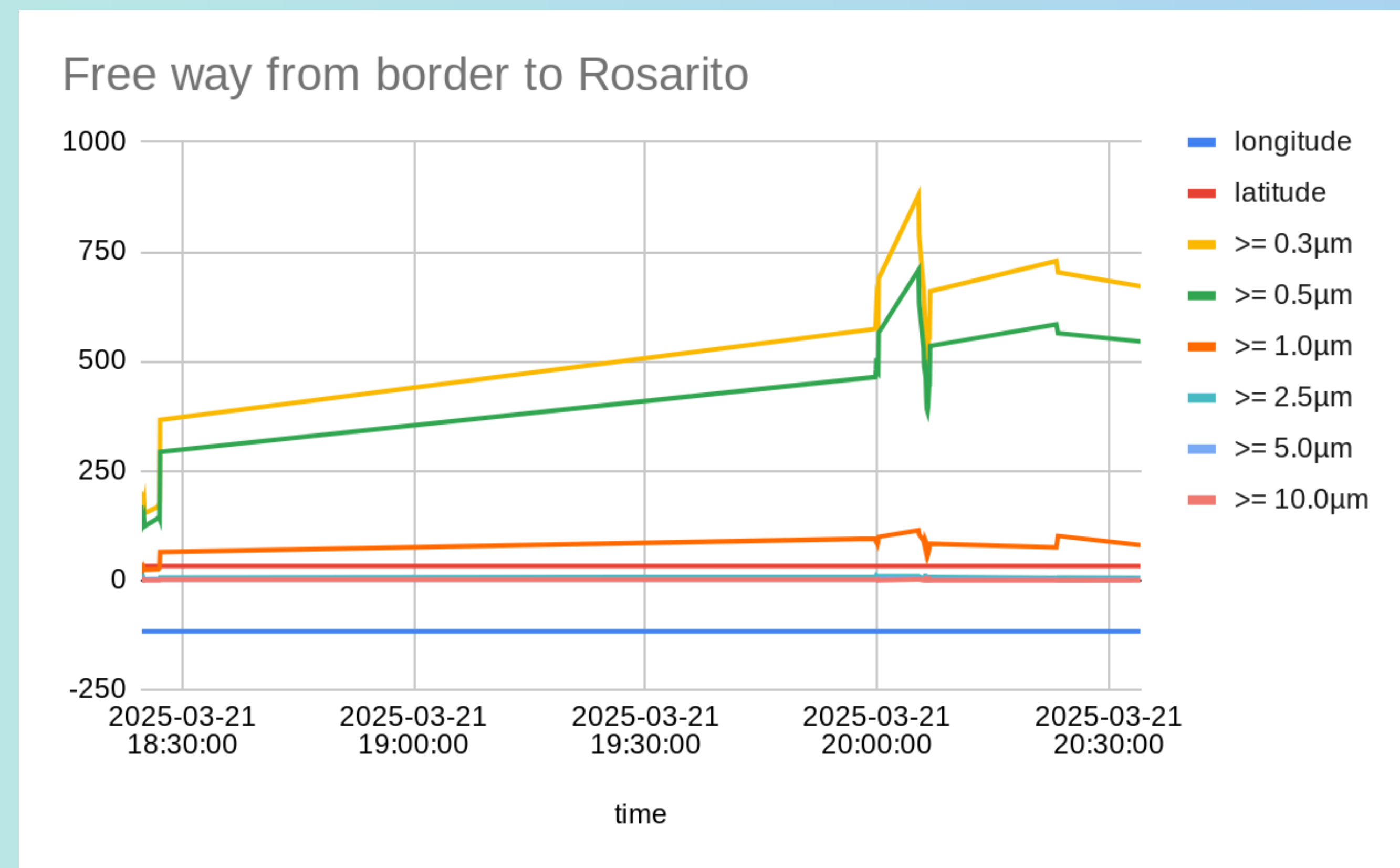


Figure 3 (Freeway): PM 2.5 generally decreased as we moved south, showing a possible link between lower traffic and cleaner air.

References

ProQuest Central (via MVH Library Access) used to research peer-reviewed articles on PM 2.5, air pollution near the U.S.–Mexico border, and environmental health risks.



Figure 4 (Rosarito): Air quality improved significantly near the coast, supporting the idea that marine air helps lower pollution.

Conclusions

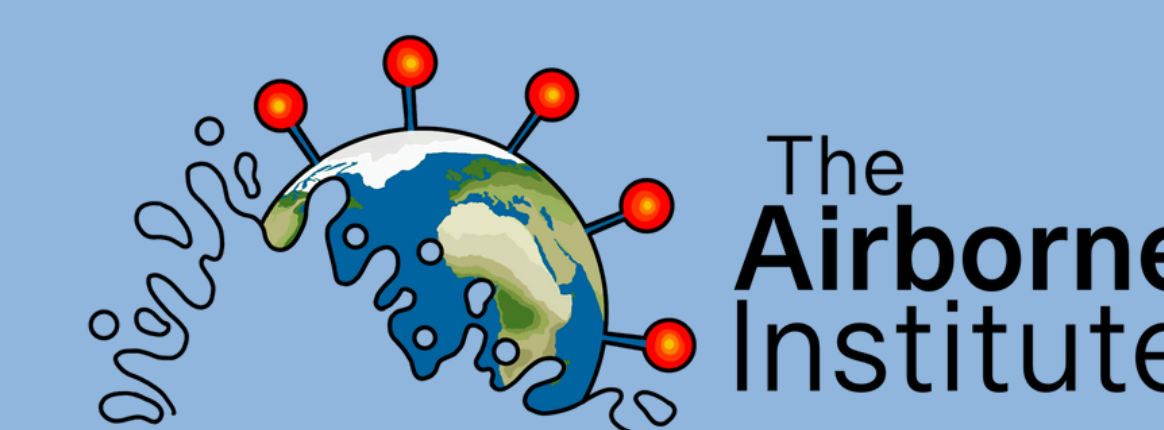
This study shows that air pollution (PM 2.5) changes depending on where you are between Imperial Beach and Rosarito. The highest pollution levels were found at the U.S.–Mexico border, probably because of all the cars and traffic there. As we traveled south along the freeway, the pollution levels started to go down, especially near Rosarito by the coast. This suggests that areas near busy roads have worse air quality, while places closer to the ocean might have cleaner air because it can spread out more easily.

Future work

More research should be done at different times of the day and week to see how air quality changes. It would help to include weather data like wind speed and direction to understand how pollution spreads. Using GPS can show more exact spots with high pollution. Studying what's actually in the air (the chemicals) could help find out where the pollution is coming from. It would also be useful to check air quality in specific spots in Rosarito to better understand how clean the air is near the coast.

What is the impact of traffic hours on PM counts

Jesus Chavarria



Introduction

There are many homes next to the highway which is often very congested which can cause potential health risks to those who live near so I captured the PM released during traffic hours. I wanted to figure out how people who live near the highway like me are affected and how we could solve these possible issues.

Procedures

For a month between the days Monday and Friday I turned on the air particle counter between 3-4pm (one hour) in the same spot and compared the data collected between Palm Avenue.

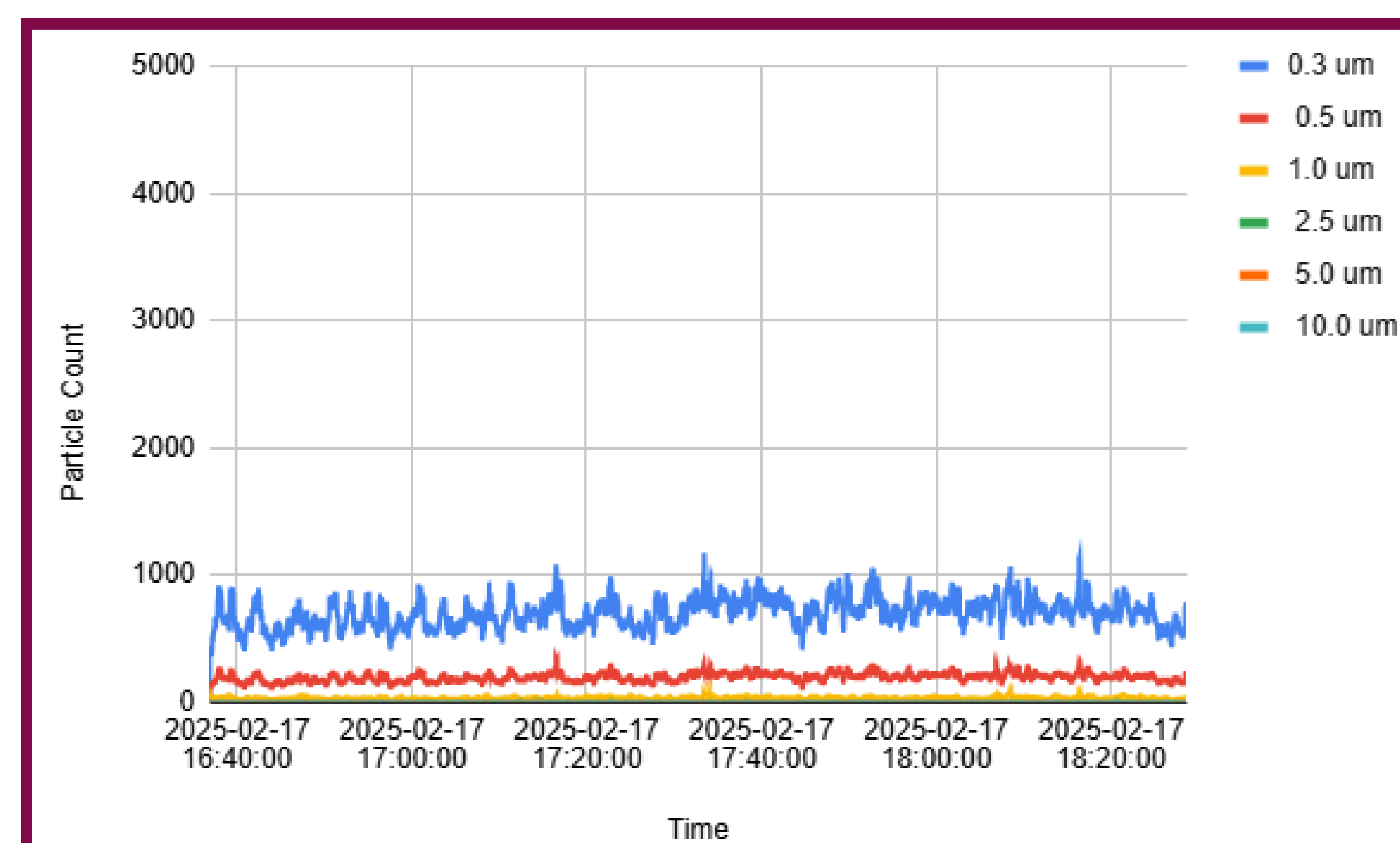
Hypothesis

Do the days of the week (Monday & Friday) release different amounts of particles? If so does this difference cause a greater impact to public health?

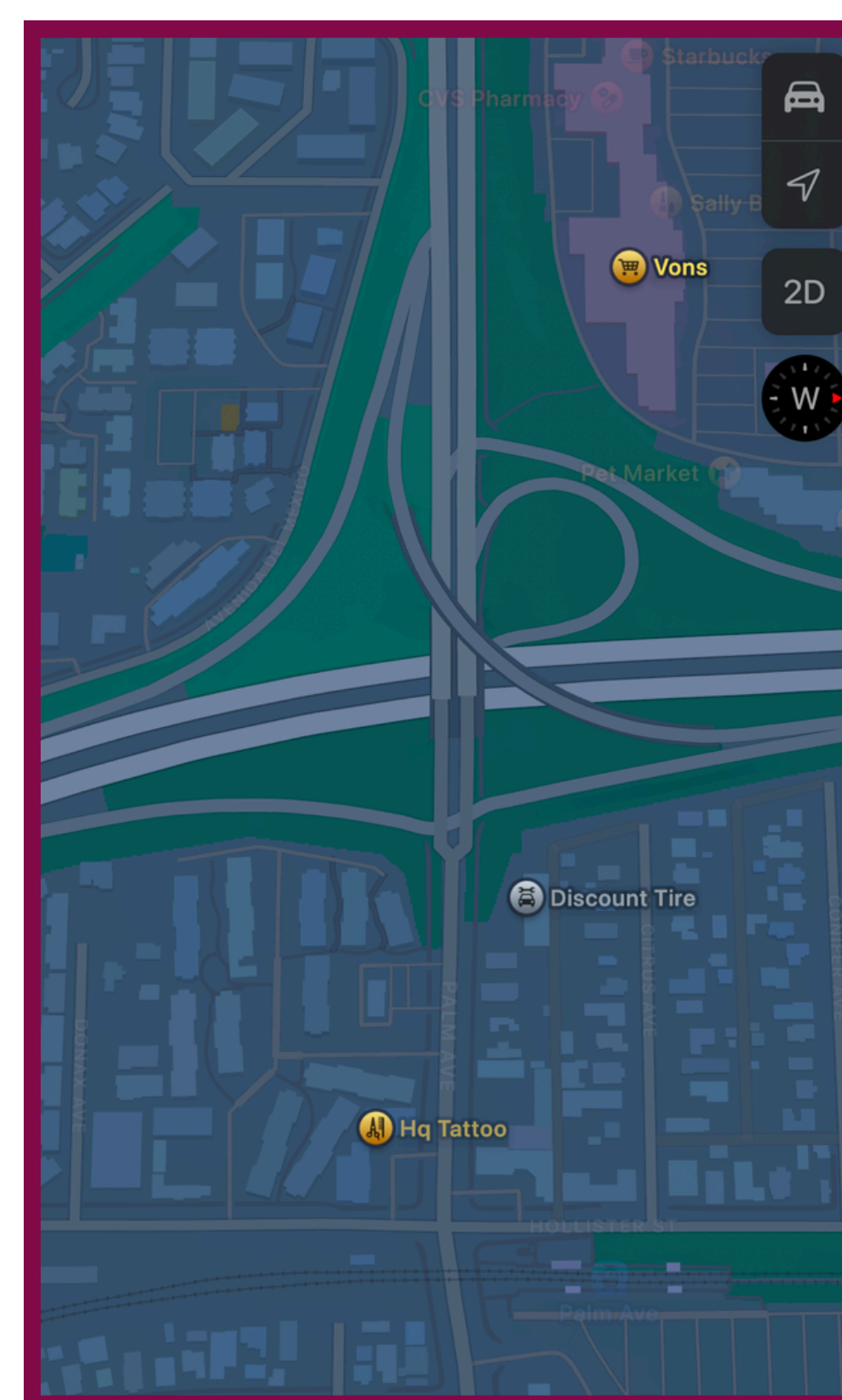
Conclusions

From the data, I have collected I can conclude that traffic hours on Fridays usually release a greater amount particles compared to Mondays.

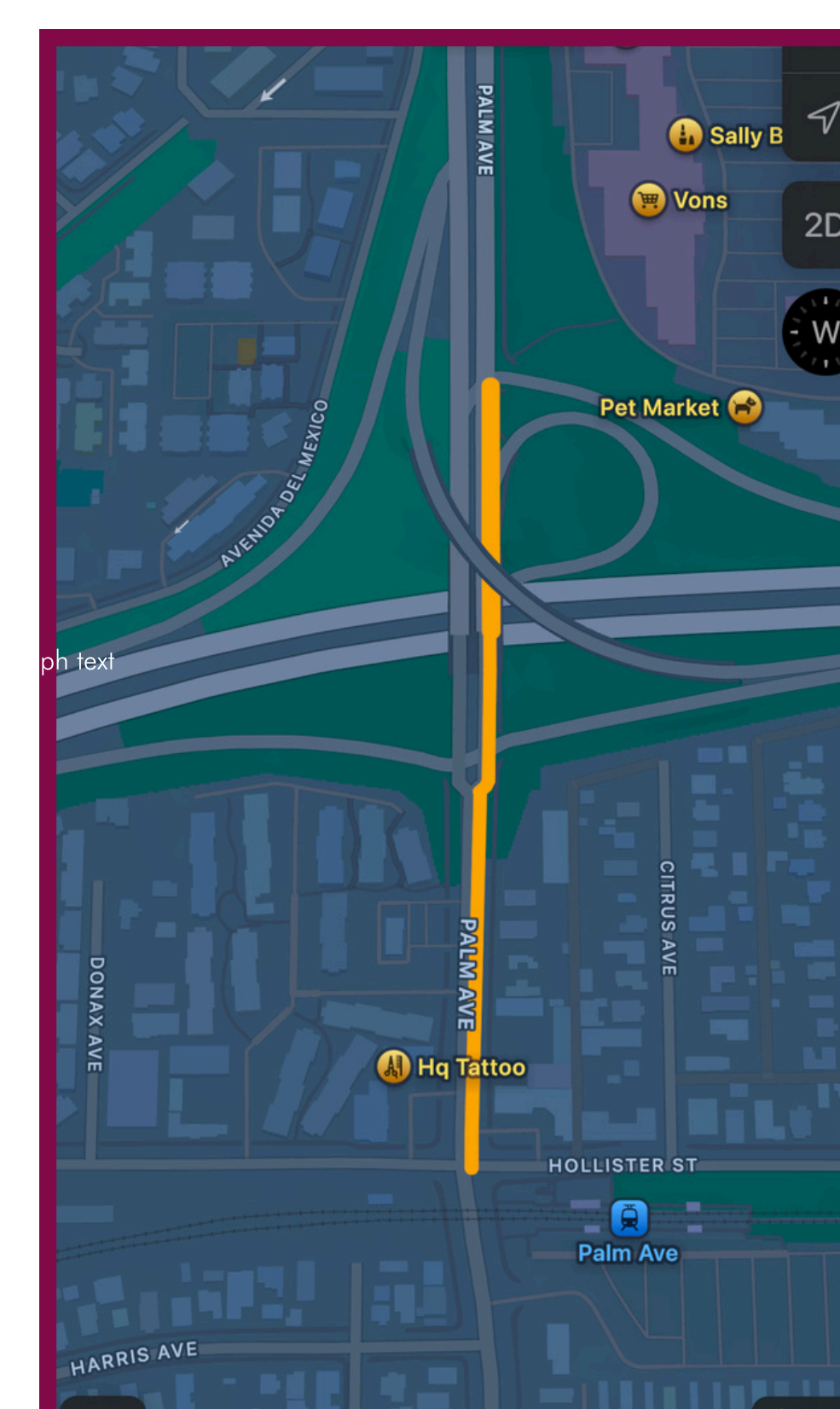
Monday



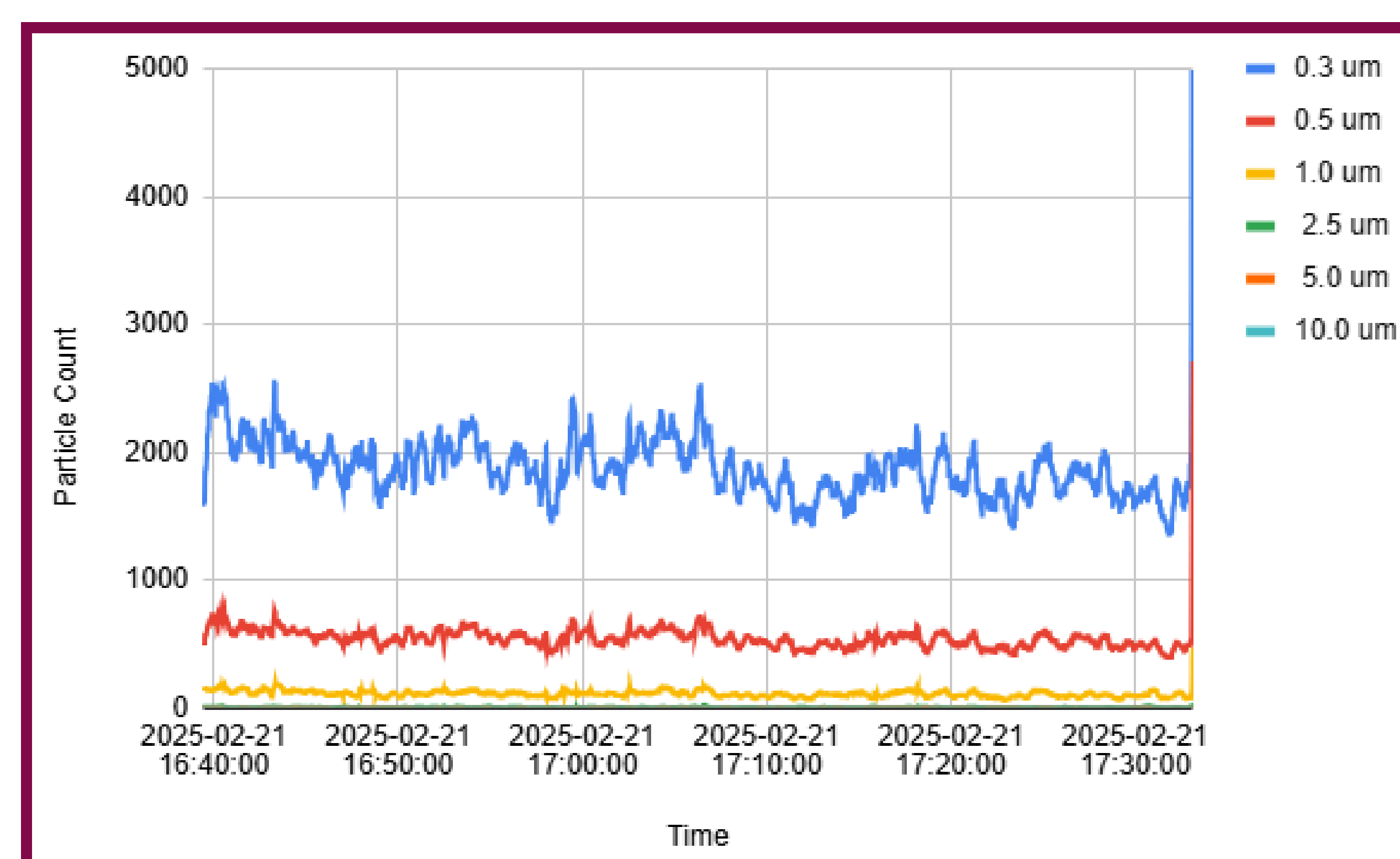
Google Maps Image of traffic on Monday = no congestion



Google Maps Image of traffic on Friday. Yellow line = medium congestion



Friday



Results and analysis

The data collected during Monday traffic hours seemed to be releasing less particles compared to traffic hours on Friday's, where it shows a greater spike. I believe this happens because on Fridays during rush hour people are trying to get home and start their weekend, compared to Monday where they might be taking a longer break or stagger to start the weekend. Another reason could be for when people are traveling out of town or are traveling for vacation.

Future work

I'd like to expand the time frame from one hour to the whole day. It could help show which times people are the most busy and which areas could be most impacted. I'd also like to target specific areas affected and interview people with recent health issues.

For example: I would like to observe a community member who always walks their dog around the time of traffic rush hour and has reported respiratory issues that they've never had before. Future work could focus on the impact that rush hour traffic has on people's physical health.

Changes in PM counts from entering and exiting Tijuana

Mardie Pimentel



Introduction

Walking through the streets of IB and seeing the “Leave the Sewage in Mexico” posters has deeply frustrated me because those who are advocating for us aren’t doing it the right way. It’s important for the people to understand that it’s a binational crises that’s not only affecting citizens of the United States but also Mexican citizens. The incentive behind this research is to demonstrate the severity of this issue in Tijuana, an industrial center that’s extremely affected by the river and particles coming partly from traffic congestion.

Procedures

- Entering TJ (air samples taken 6:30-7:30, April 16)
- Exiting TJ (air samples taken 7:30-8:30, January 19)
- Samples taken in the car as windows were open throughout the route from San Diego-TJ and Rosarito-TJ

Hypothesis

We expect that as we get closer to the Tijuana River Valley, particle counts will be higher due to increased emissions and potential accumulation in low-lying areas that are easily vulnerable to flooding due to their low elevation and proximity to a water source.

Routes

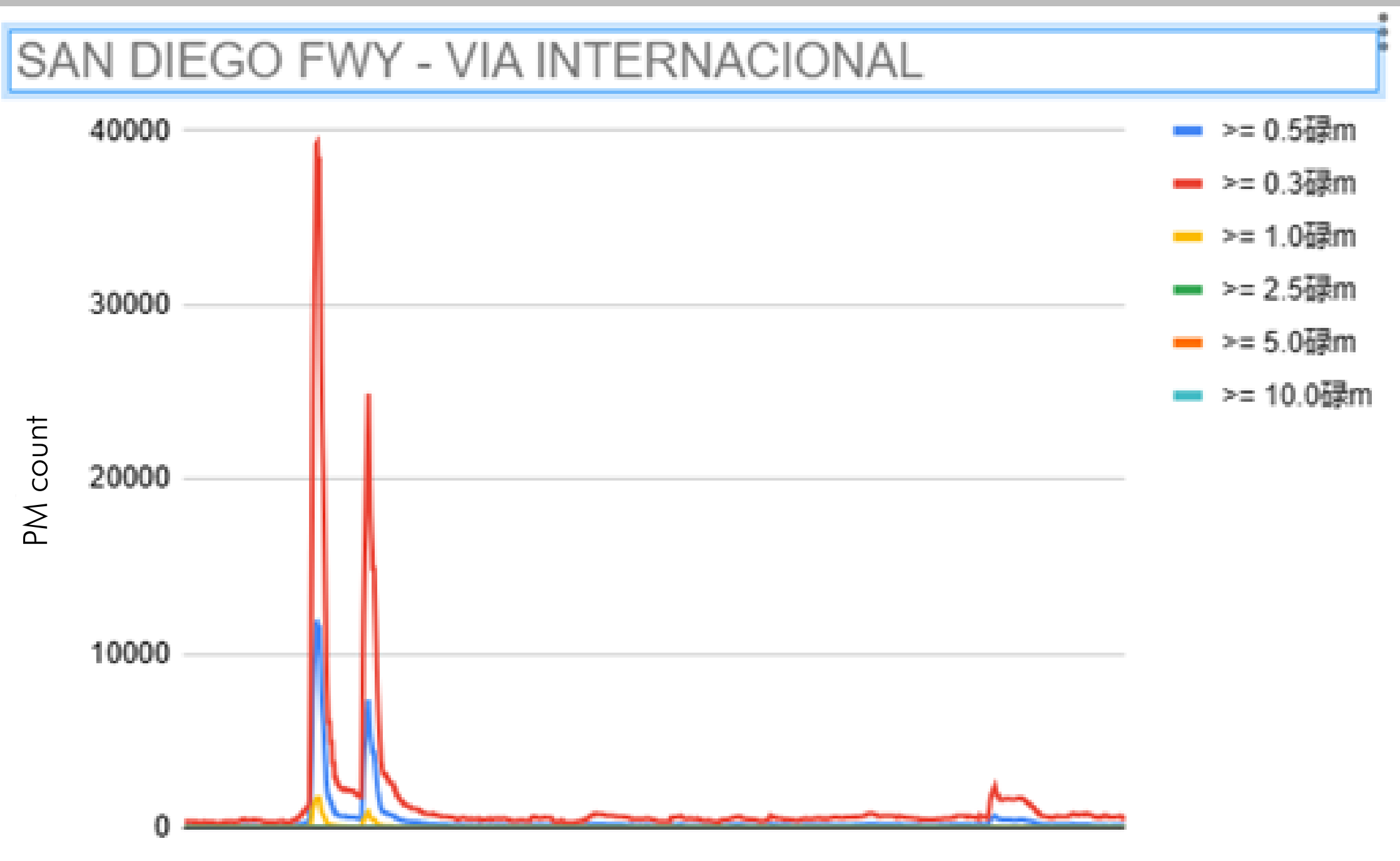


Route A

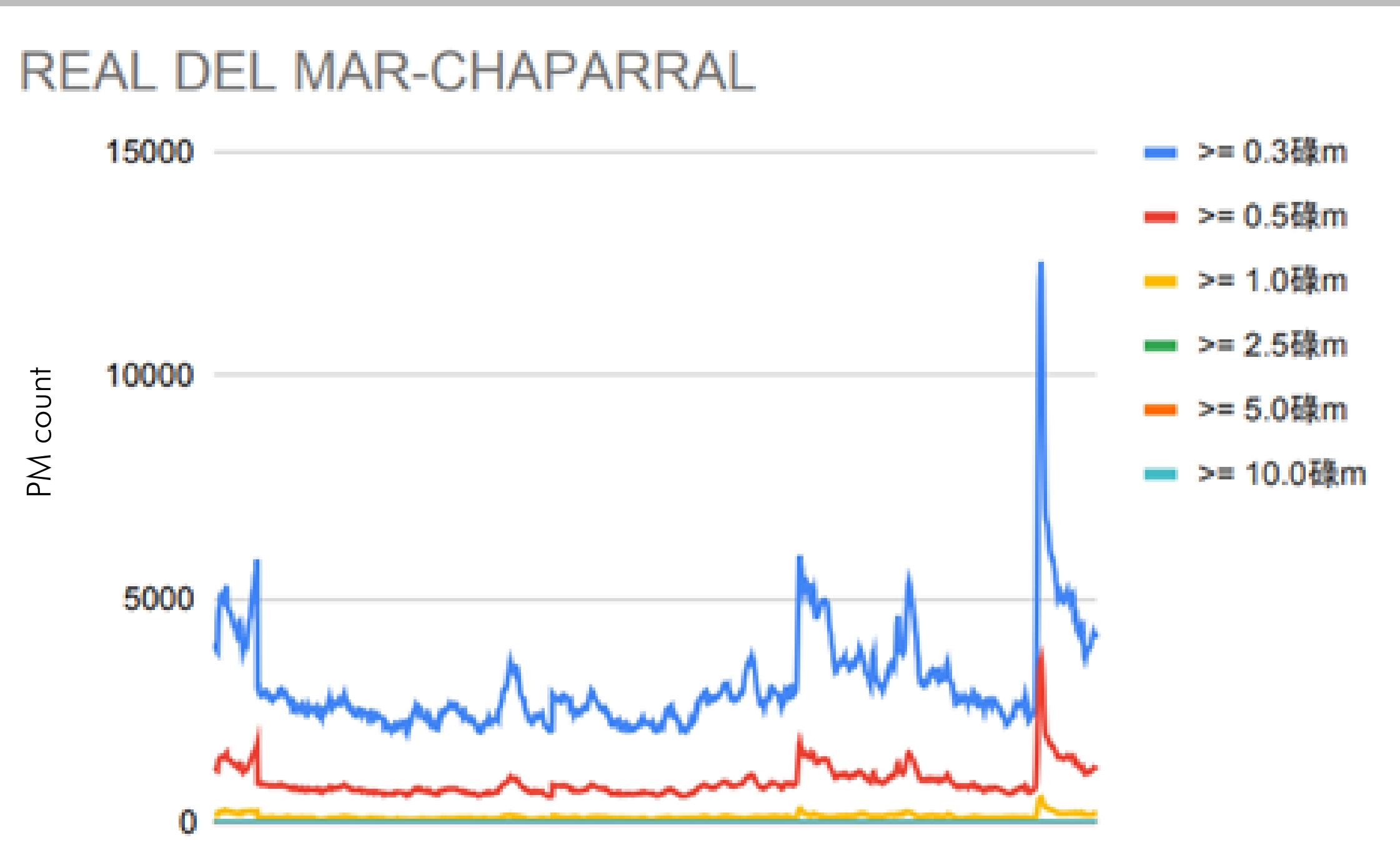


Route B

Results



Route A - Entering TJ (air samples taken 6:30-7:30, April 16)



Route B - Exiting TJ (air samples taken 7:30-8:30, January 19)

Conclusions

The center of Tijuana reports higher particle counts especially when I was driving on bridges above the river canal one of them being the “Cuauhtemoc Bridge” and the “Libramiento Sur Freeway”.

- Cuauhtemoc Bridge = peak of 12549
- Freeway = peak of 39291 (went down as we went up the freeway).

Freeway’s peak may also have been a result of human activity such as construction of the new freeway they are currently building. Both were areas of high concentrated traffic but the bridge approached the river canal directly as for the freeway it passed through a water leakage that was coming out of the CESPT water plant. Lower levels of elevation reported higher particle counts (center of TJ) and numbers decreased as elevation increased through the freeway.

Future work

For future research, I would like to take measurements of Tijuana’s air pollution at night and IB’s to compare both particle counts to see if there’s an increase or decrease. If possible maybe even utilize research from peers specifically on particle counts at night in IB to see if the smell is stronger here or in Mexico. I’ve heard from many relatives and friends that they have noticed an increase in the smell when they cross the border and not so much over in Tijuana. How can the flow of sewage drastically change as it approaches the Pacific Ocean? What changes in the water currents contribute to the release of small aerosol particles that lead to the heavy smell of sewage?

Air particulate matter differences by housing area near the Tijuana River vs more northern location

By: Joshua Nungaray



Introduction

As a resident living in close proximity to the Tijuana River but also spending time along Imperial Beach, I have observed a striking contrast between public and my own perception. While many attribute the region's pollution issues solely to broken sewage pipelines discharging directly into the ocean, my personal observations suggest that the areas nearest to the Tijuana River exhibit significantly stronger sewage odors, indicating a potentially more concentrated source of pollution from the Tijuana river. My data assessed the concentration of airborne particulate matter (PM) across various housing areas at increasing distances from the Tijuana River. By collecting and analyzing air quality data, I intend to understand how does the concentration and type of airborne particulate matter vary across different housing areas surrounding the river, and how is this variation related to proximity to pollution sources.

Procedures

Air samples taken from 4-6pm Mondays and Wednesdays at the same time through 2 different locations, using portable particle tester at my house and a farther location outside of the bike path near the silver strand, which is closer to the beach by about 1 mile.

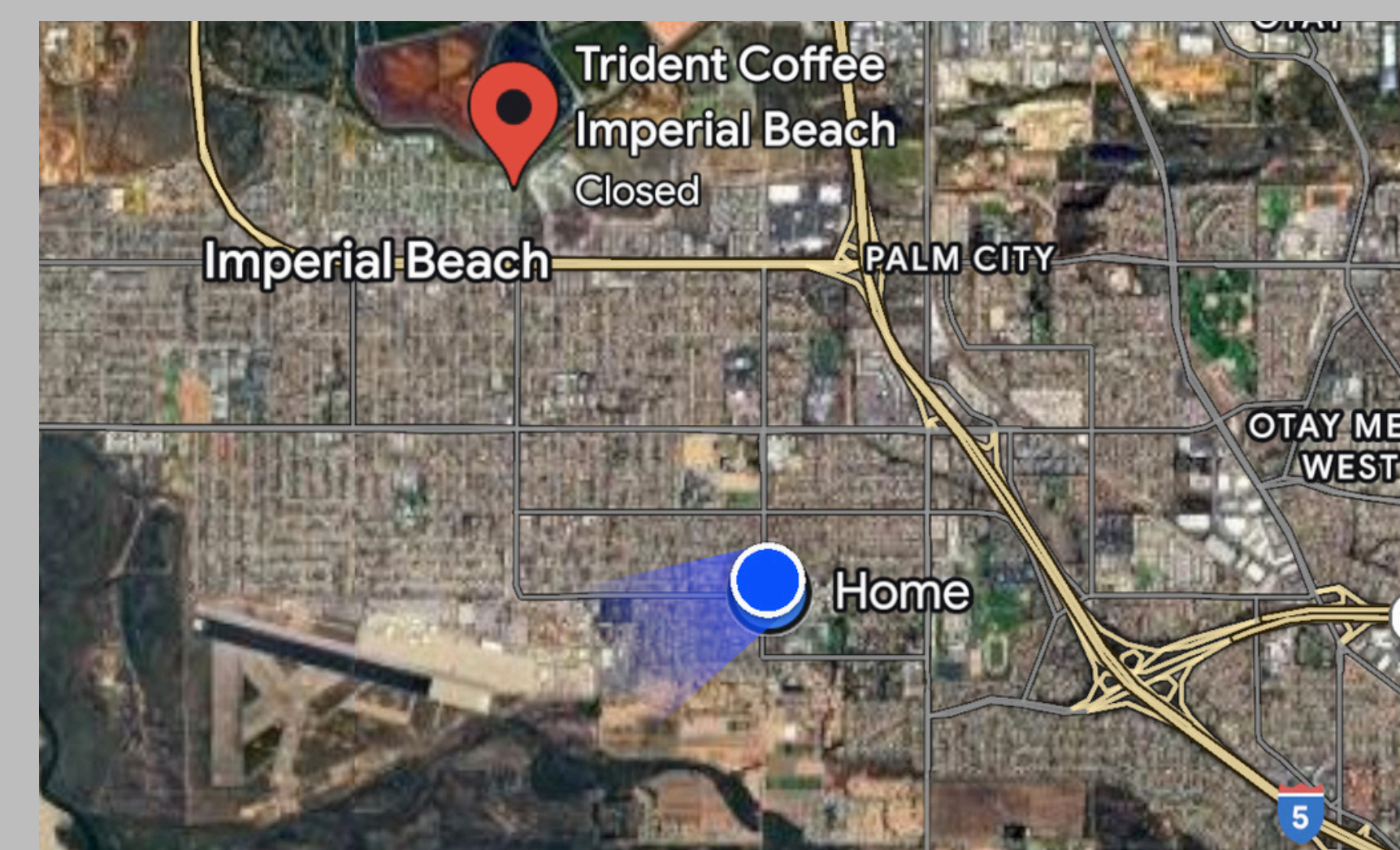
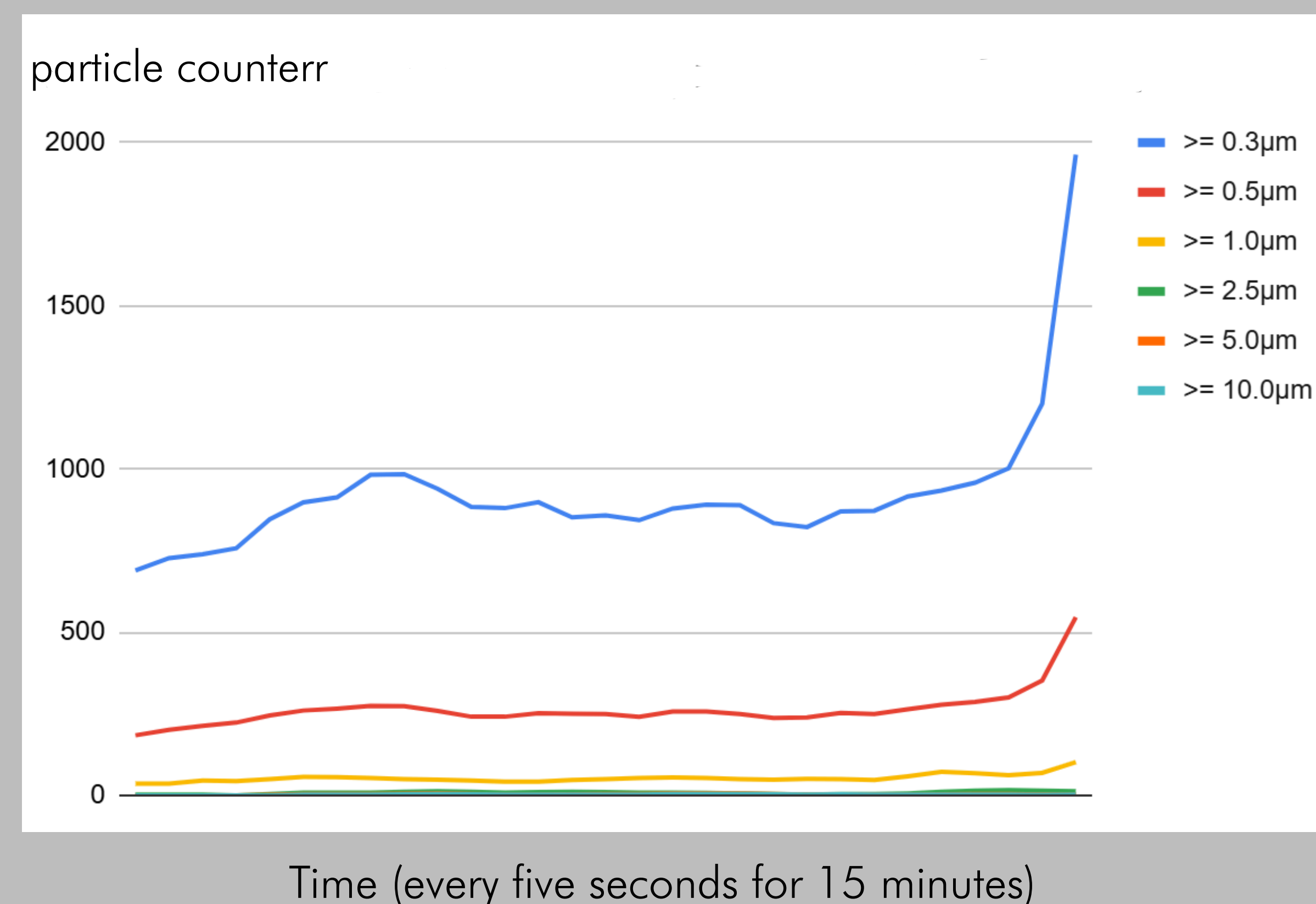
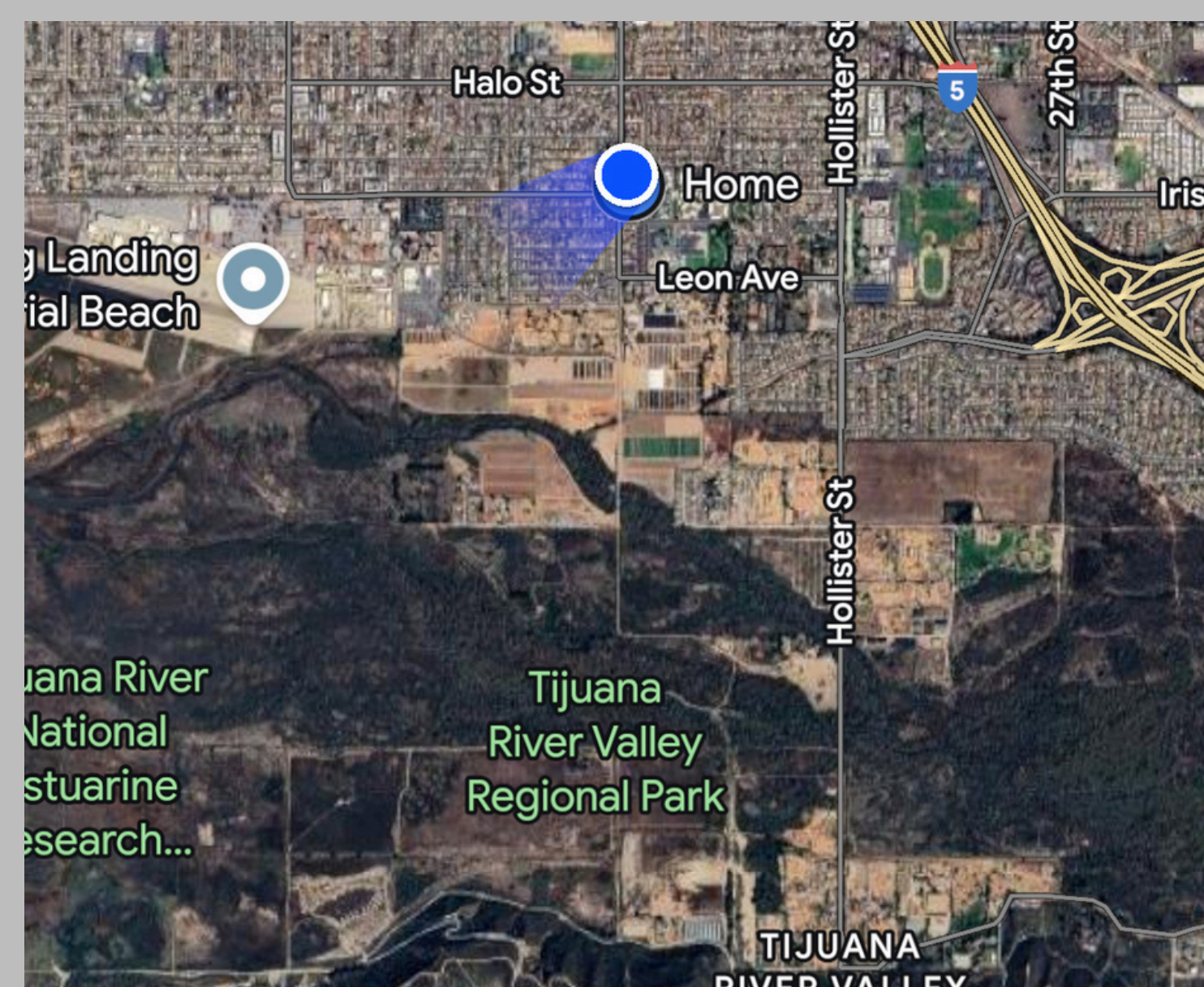
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Hypothesis

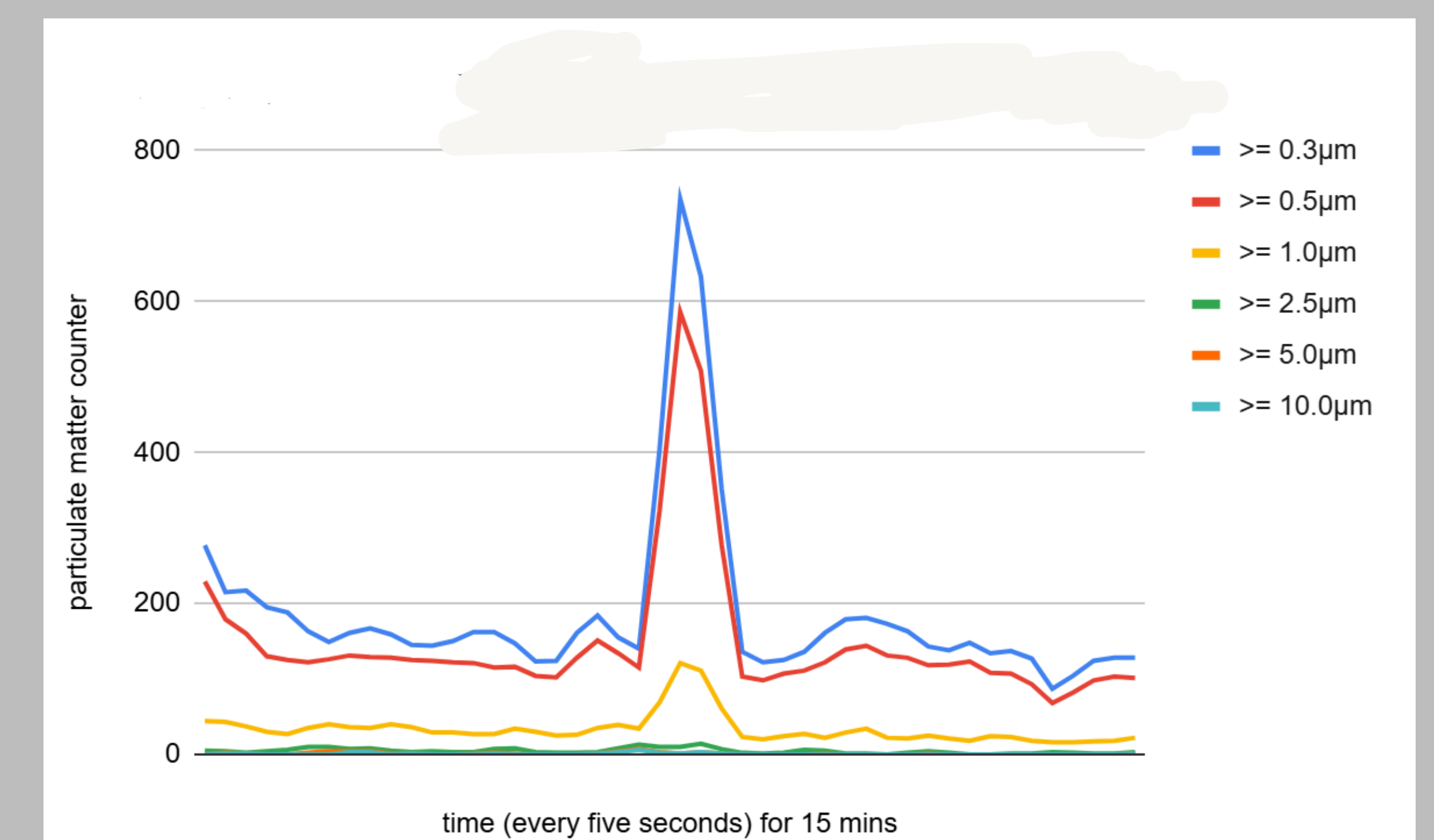
Housing areas located closer to the Tijuana river and adjacent pollution sources, such as waste sites, will exhibit higher concentrations of airborne particulate matter (PM), than housing areas further away including those closer to the beach.

Results

Average data graph gathered from the air particle testing NEAR the tijuana river (own house)



average data graph gathered AWAY from the tijuana river



Conclusions

Data collected from air quality monitoring across various housing areas surrounding the Tijuana river support the initial hypothesis: **areas in closer proximity to the river and known pollution sources such waste discharge sites exhibited significantly higher concentrations of airborne particulate matter.**

These elevated levels were consistent with increased sewage-related odors and visible environmental degradation reported by local residents.

The findings highlight the environmental health disparities faced by communities closest to the Tijuana River.

Future work

In the future, I would like to be able to see what type of particle it is that I am capturing with my tester, as my data may support my hypothesis but the specific particles may not be sewage particles and could be chemicals among other pollutants, which could link the issue to a specific type of pollution, such as detergent.

Rain events & traffic: Friend or Foe?

Ana Avila (Kai)



Introduction

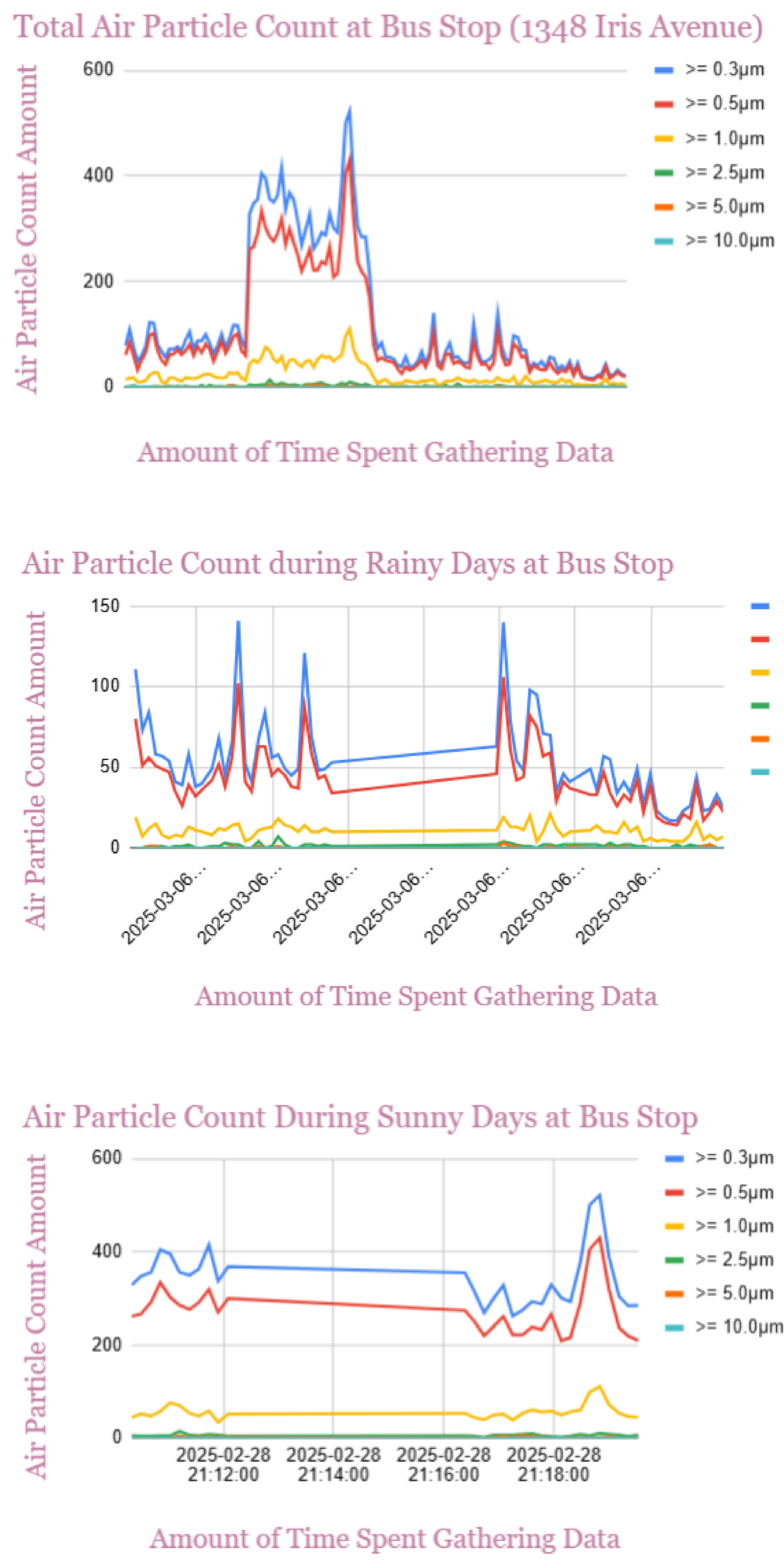
As a resident of Imperial Beach for almost 10 years, it had become evident that the environmental conditions in the area began declining. As a way to find answers and feedback on this issue I began interviewing my environmental science teacher on the issue and he believed that this ongoing issue was such a run around. Connecting his lessons regarding pollution and environmental problems- I believe that weather can impact the intensity of particle count and environmental conditions in our community.

Hypothesis

Originally, I believed that weather, including rain would have an impact on particle count. I hypothesized that PM counts would be higher on rainy days.

Procedures

Using the PM air sensor, I would go to the bus stop around noon and start measuring the particle counts for about 10-15 minutes, some before, and some after the bus arrived. I would follow this procedure during rainy days as well. This procedure took place 1-2 times a month and results were consistent.



Results

These results demonstrate the difference in PM count between sunny and rainy days. Rainy days result in lower PM counts than clear days. As the location was at bus stops, we can see that buses driving by spike the data, indicating a temporary increase in PM counts.

Conclusions

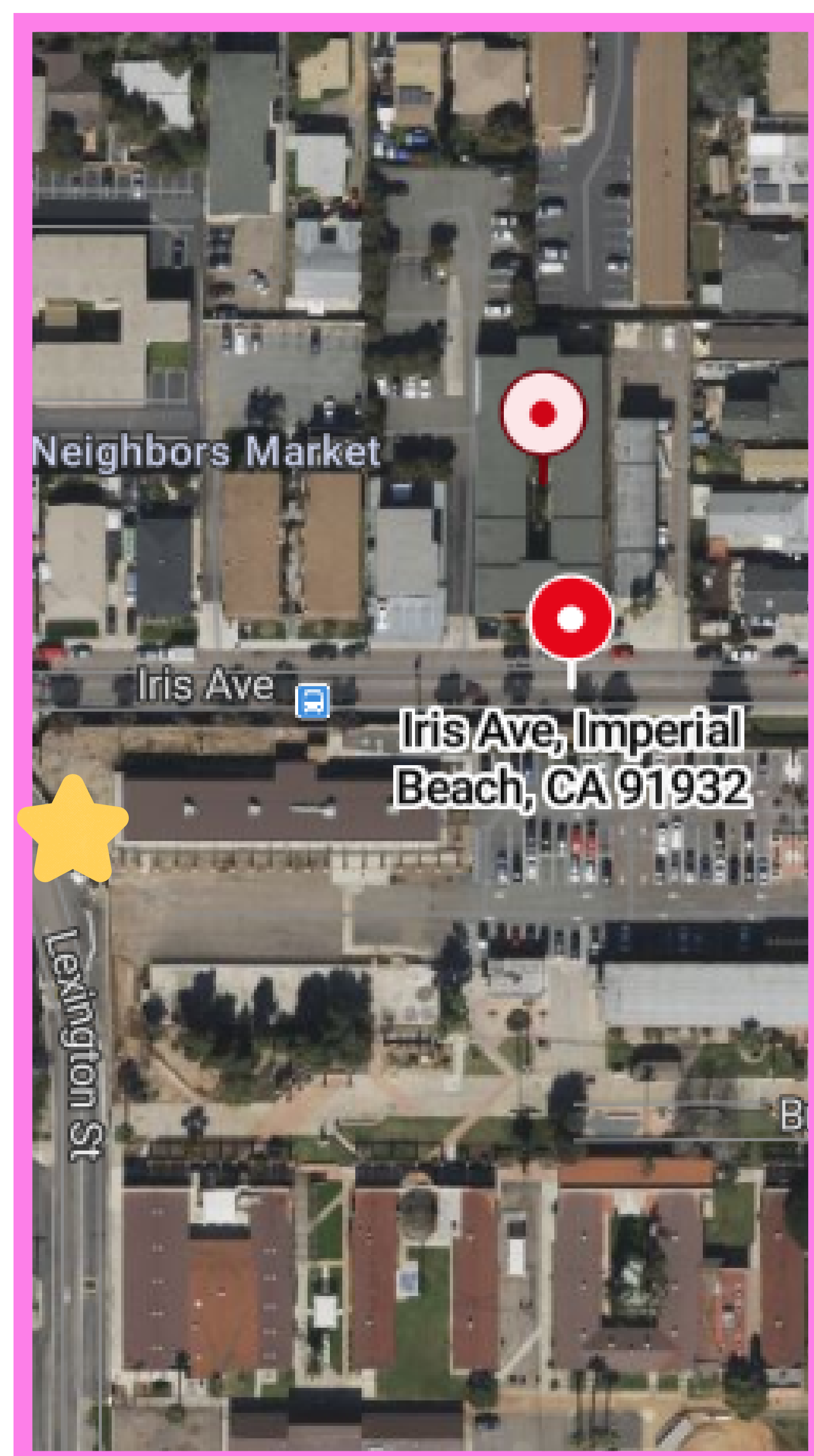
Despite my hypothesis being null, I discovered that rain can temporarily clean the air, however because of our location, we are coated with the pollution from the rain. We think of rain as a good thing, as a cleanser, but in IB it coats the town with the surrounding pollution.

Future work

There needs to be more testing done on the effect of rain on a town like IB that has polluted water systems. Furthermore, I can compare my research to the research done by my peers in YCA that are recording particle counts in different areas of Imperial Beach. Lastly, maybe more oral research could be of use and speaking to people of environmental non-profit organizations as a way to gather more information/perspectives.

References

<https://pulitzercenter.org/stories/californias-most-polluted-beach-making-change-residents-are-still-suffering-effects>



How Air Quality Changes from the Tijuana Border via Car/Public Transportation

Melina Jimenez Esparza



Introduction

I started by interviewing my mom, a resident of TJ. She explained the changes she has seen not only physically in TJ, such as population growth and high traffic. She doesn't see any solutions to the overarching problem of overpopulation and cars. I wondered how the PM count in TJ would compare to that of public transportation, since a lot of TJ residents take it, as a result of working a job in SD and living in TJ.

Hypothesis

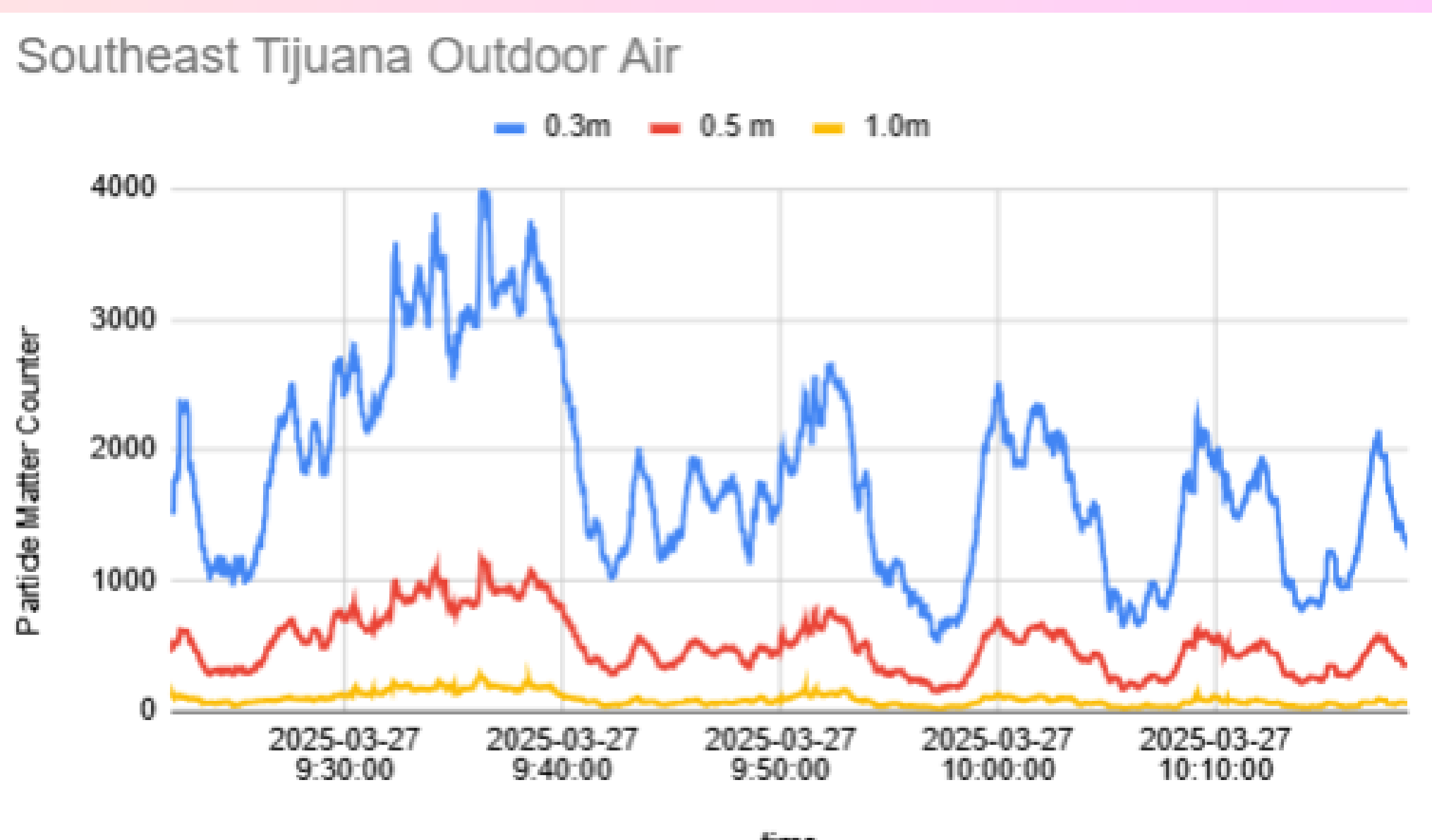
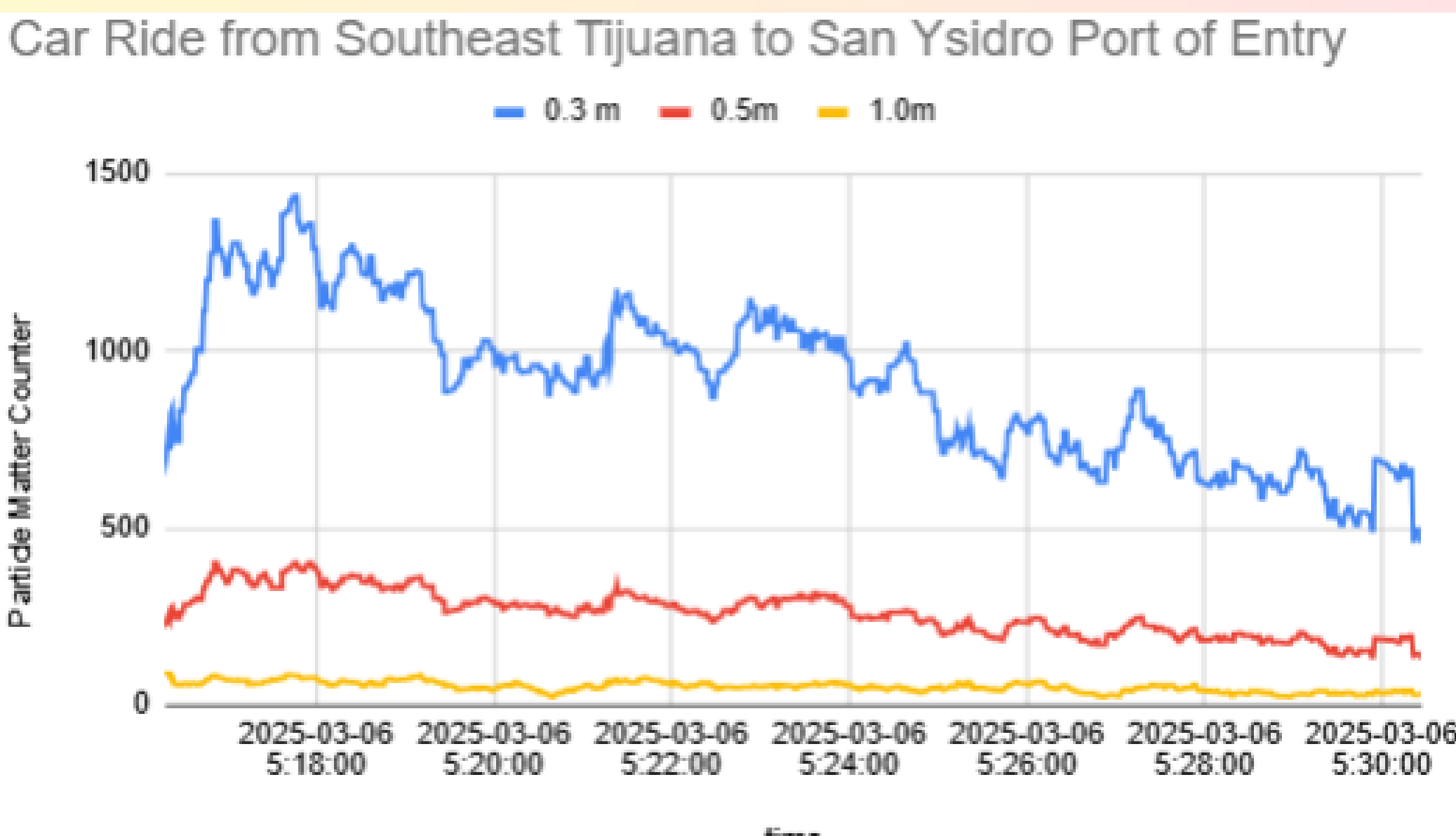
By collecting transportation PM data going to/from Tijuana and comparing it to a Tijuana residential neighborhood, they'll have similar rates.

Procedures

Since transportation is the leading cause of air pollution in border cities, I measured particulate matter count in public transportation (the trolley's blue line from SY to Iris Ave and the bus from Iris Ave to MVHS).

Basically, those traveling away from the San Ysidro Border. I also measured the PM count traveling towards southeast Tijuana in a private vehicle starting at the San Ysidro border and regular outdoor air in TJ in order to compare these two.

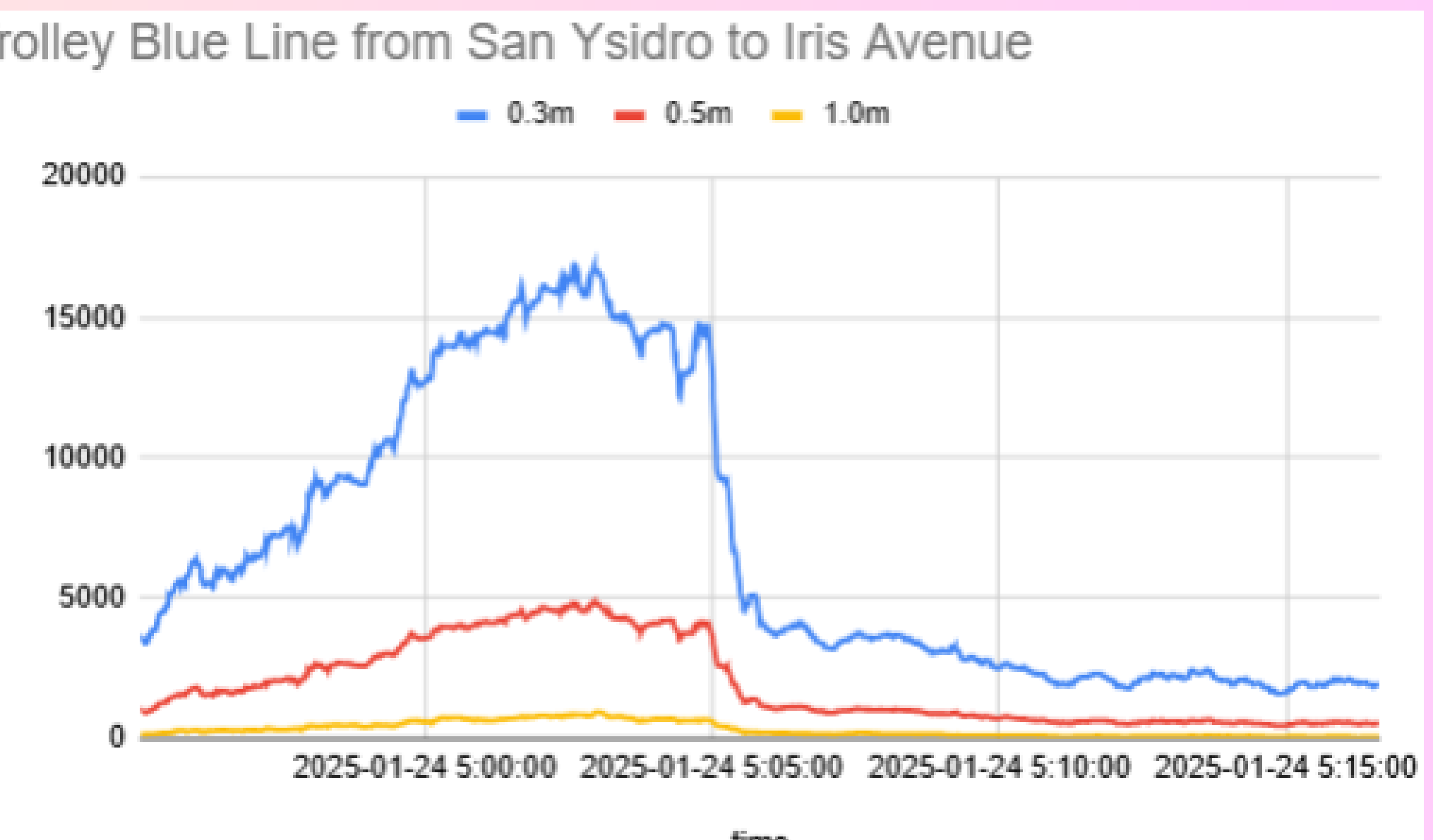
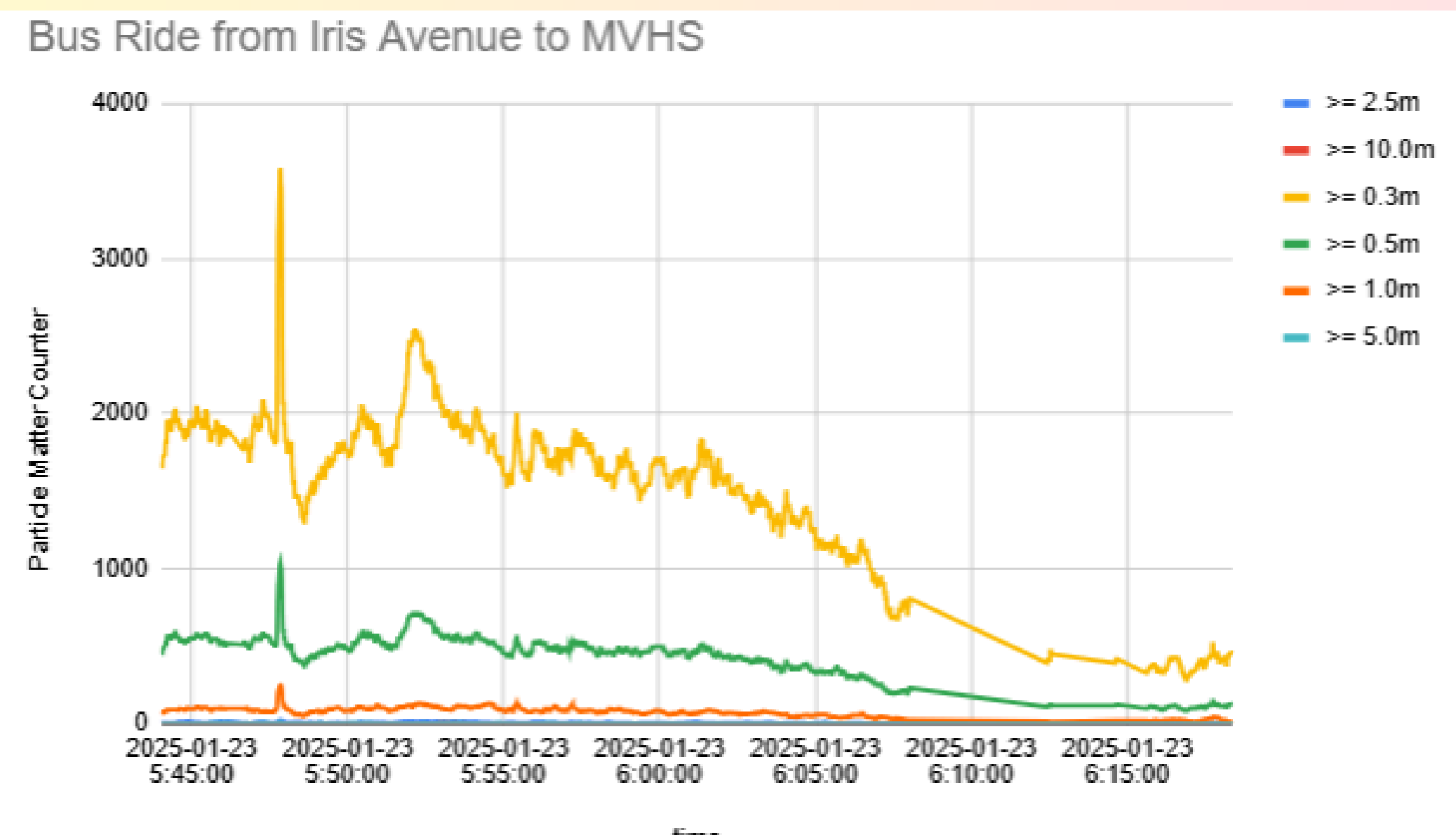
Results and analysis



Originally, I was curious about the link between transportation use on the border and the PM rates in interior Tijuana, as it is the busiest border crossing in the world.

In the end, the data I collected on the US side was useful for telling me about PM rates in Tijuana.

I found that as I traveled North from Southeast Tijuana, the particulate matter count would decrease. This indicates that the deeper you go into Tijuana the higher levels of PM in the air.



Sites where I collected data:



Conclusions

Although my hypothesis was null, the results I found were even more interesting than my beginning plan. Looking at my results, it makes sense for PM to be higher deeper into TJ as some contributing factors to this are population density, maquiladoras and industry, but most importantly transportation.

Future work

I would like to further investigate "hotspots" of air pollution in Tijuana. An idea that came to mind would be comparing southeast Tijuana with spots that are closer to the border that have nearby maquiladoras because of the convenient location.

References

Honkanen, Imma, "Environmental Health and Policy at the Tijuana-San Diego Border" (2020). Undergraduate Honors Theses. 72. https://digital.sandiego.edu/honors_theses/72

Changes in Air Particle Counts at Select SD County Locations Relative to Tijuana River



Navya Arora



Introduction

Air quality in South Bay has been consistently degrading over the decades, which has adversely affected residents' lives and commerce. Previous research has shown that the sewage and pollutants flowing into the Tijuana River, and subsequently the Pacific Ocean, affect the air quality. The oral history component of this YCA Project 24'-25' was an interview which supported the fact that air quality is getting worse. This is due to untreated sewage and industrial effluent being dumped into the Tijuana River, Tijuana River Watershed, and subsequently, the Pacific Ocean. This study aims to test whether proximity to the Tijuana River affects the air quality, as indicated by air particle counts.

Hypothesis

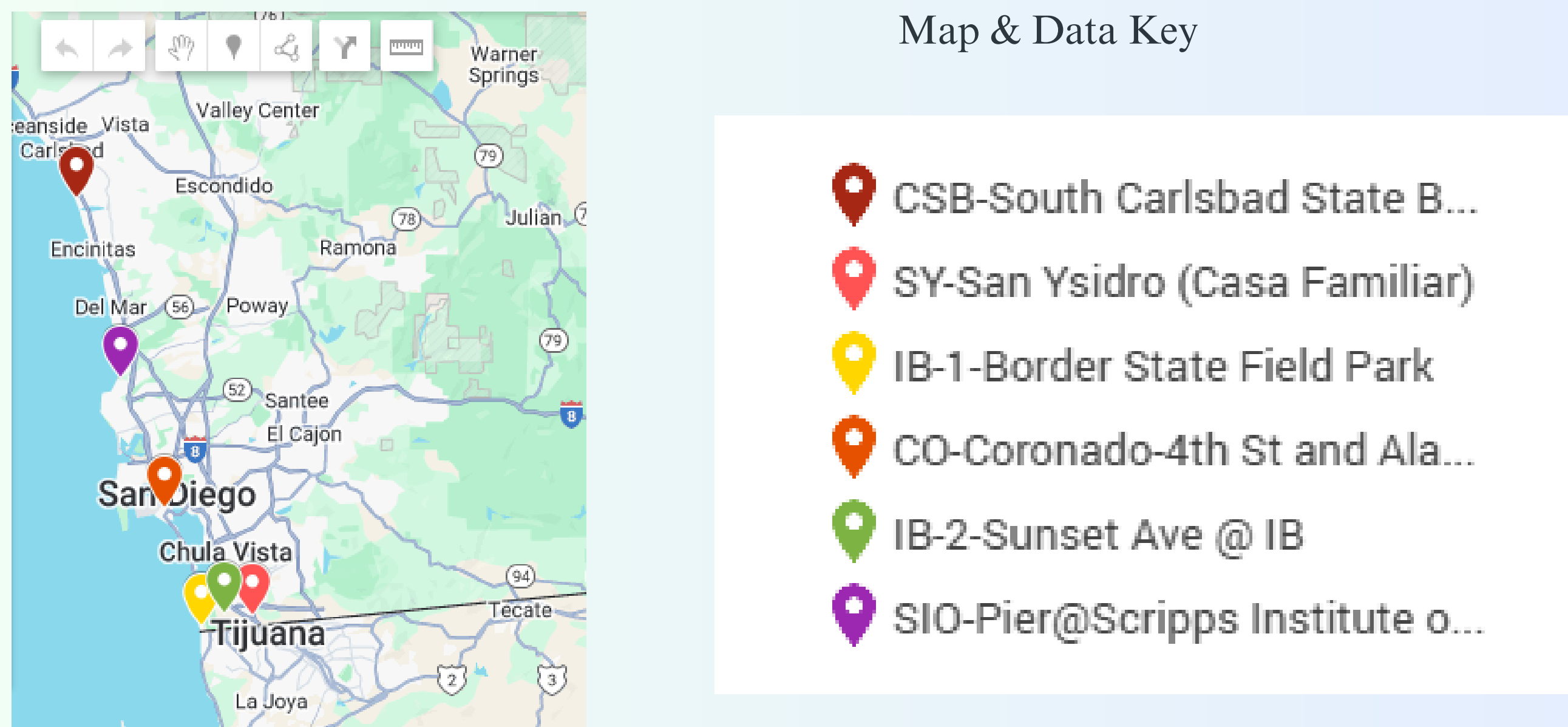
The air particulate matter counts will increase the closer we get to the Tijuana River.

Procedures

The air samples were collected between 4-5 p.m. on March 3, 4, and 5, 2025, at South Carlsbad State Beach. The data was collected for 10 minutes, and the average was taken. The Airborne Institute designed air particle counter was used to collect the air samples, which were compared with data from QuantAQ, Inc. (Modulair™) sensors for the same time/date. Only three particle sizes were compared: PM 1, PM 2.5, and PM 10.

References

1. Erik Anderson / Environment Reporter Contributors: Julianna Domingo / Producer, Reporter, E. A. / E., Anderson, E., & Media, K. P. (2023, March 3). New research shows dirty ocean water is fouling the air in Imperial Beach. KPBS Public Media. <https://www.kpbs.org/news/local/2023/03/02/new-research-shows-dirty-ocean-water-is-fouling-air-in-imperial-beach>
2. California Air Resources Board. Inhalable Particulate Matter and Health (PM2.5 and PM10) | California Air Resources Board. (n.d.). <https://ww2.arb.ca.gov/resources/inhalable-particulate-matter-and-health>
3. Alter, N. C., Whitman, E. M., Bellinger, D. C., & Landrigan, P. J. (2024). Quantifying the association between PM2.5 air pollution and IQ loss in children: a systematic review and meta-analysis. Environmental Health, 23(1), 101.



Map 1: Locations where air data was collected.

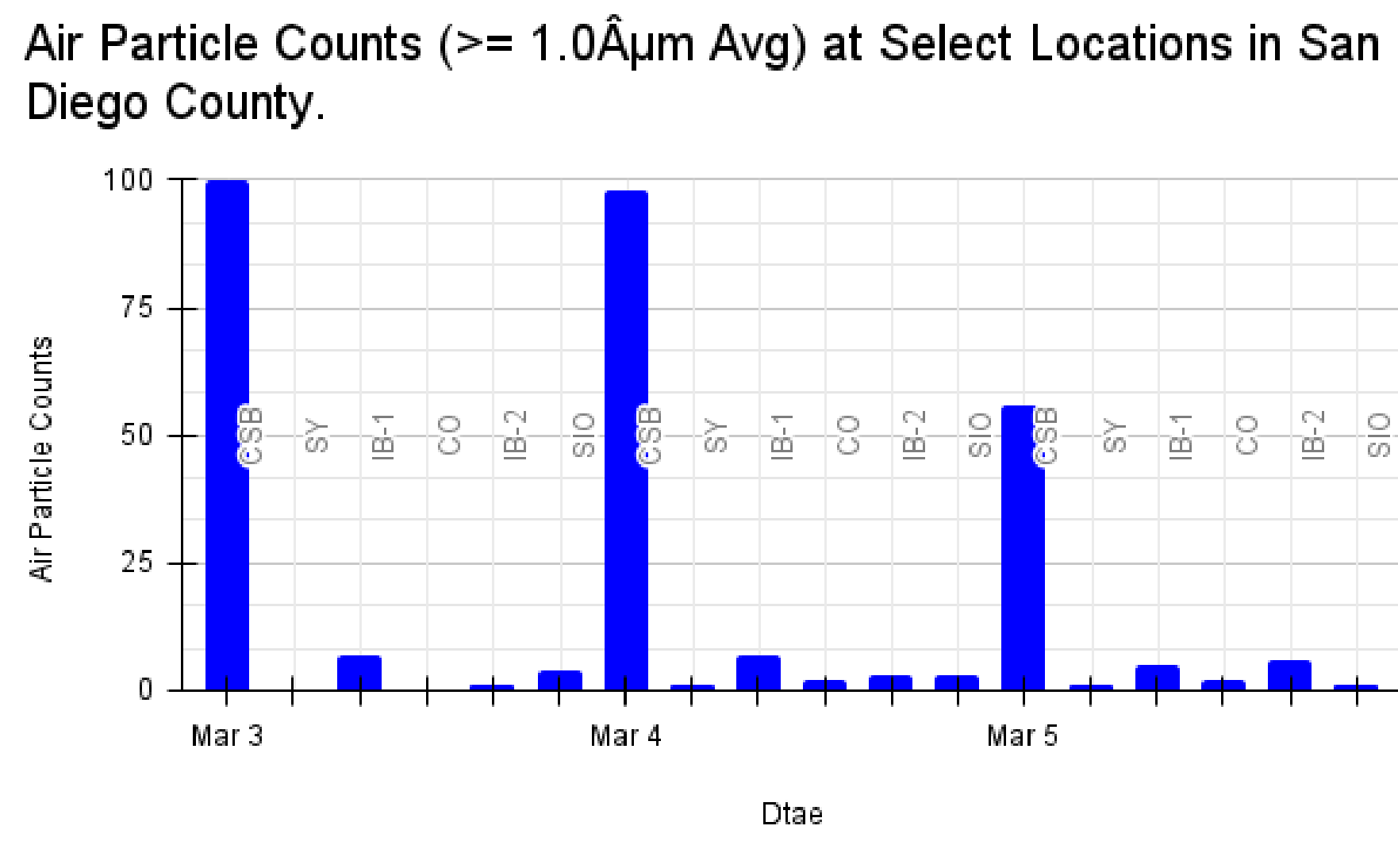


Figure 1. Air Particle Counts (>= 1.0µm Avg) at Select Locations in San Diego County.

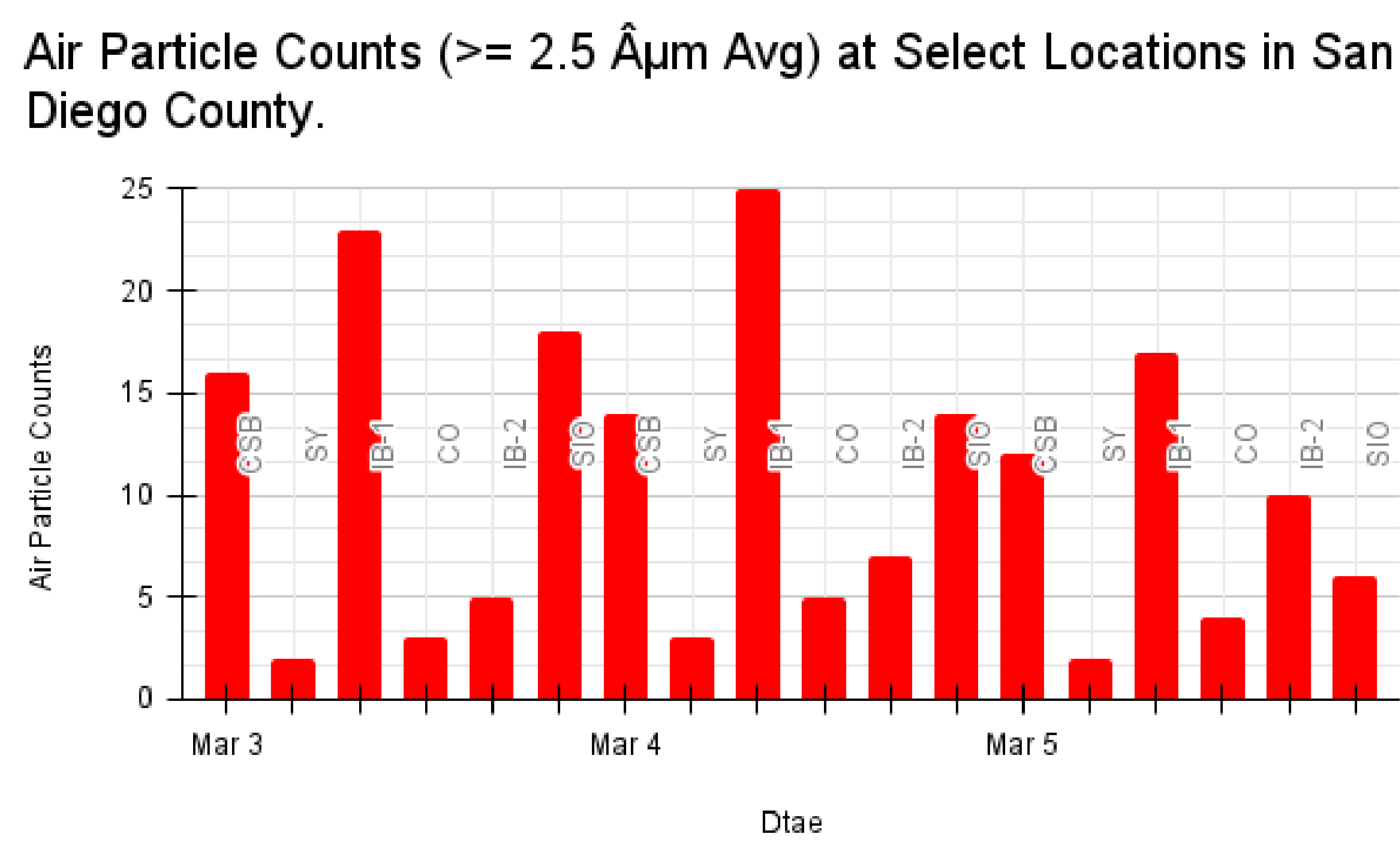


Figure 2. Air Particle Counts (>= 2.5µm Avg) at Select Locations in San Diego County.

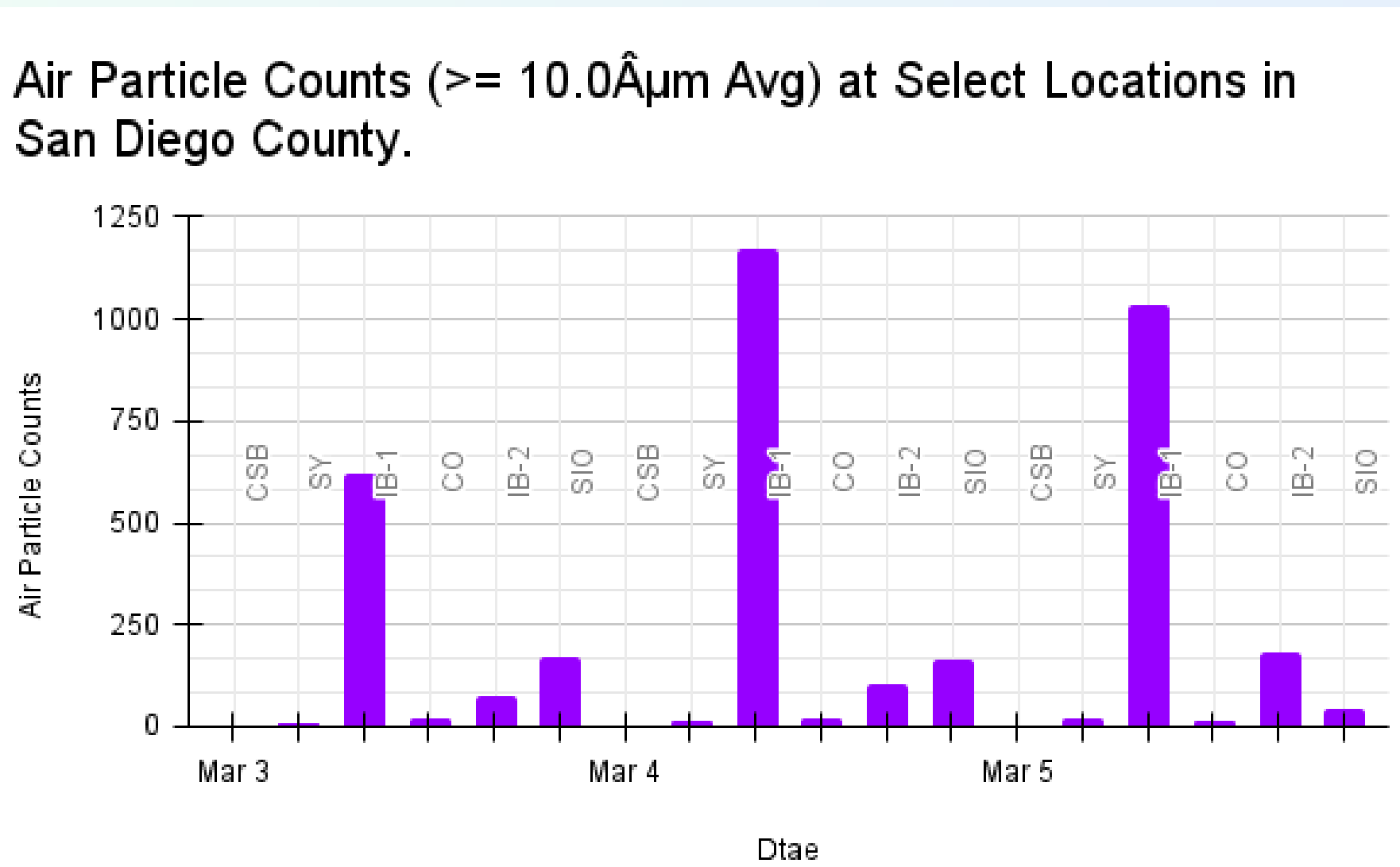


Figure 3. Air Particle Counts (>= 10.0µm Avg) at Select Locations in San Diego County.

Results

Between March 3-5, 2025:

1. IB-1 had the highest PM 2.5 & 10 counts of all sites
2. CSB had the highest PM 1 counts of all sites
3. The sites closest to the beach/ocean had higher PM 2.5 counts than the land sites
4. Among the land sites, IB-2 had the highest PM 1 & 2.5 counts

Conclusion

The study found the highest particle counts at sites closest to the ocean (at the beach) compared to any inland sites. We expected to find the highest PM counts near the Tijuana River (IB-2 site). Although IB-2 had the highest PM 1 & 2.5 counts of the three land sites. IB-1 (Border Field State Park) had the highest PM 2.5 & 10 counts. CSB (South Carlsbad State Beach) had the highest PM 1 counts compared to other sites.

Future Work

Our study shows that IB-2 has a higher PM 2.5 count than other land sites. Previous studies have suggested a link between high PM 2.5 counts and adverse health outcomes in vulnerable people and neurobehavioral issues in children. Future studies need to be designed to document the long-term effects of these pollutants on the South Bay residents. We also need to devise short- and long-term strategies to mitigate the effects of these exposures. Additionally, we should examine the factors, possibly seasonal, driving elevated PM levels near ocean-adjacent sites. Runoff from rivers, watersheds, and the city of Tijuana, which sits at a higher elevation and is heavily industrialized and densely populated, may carry sewage and unidentified aerosols. Sea breeze could transport these pollutants inland especially, in warmer weather.

Impact of the Tijuana Sewage Crisis on Air Particle Levels in Central vs. North Imperial Beach

Taylor Miller



Introduction

Living In Imperial Beach, the foul smell at night is no surprise. I started noticing that the sewage pollution was only getting worse. I decided to interview a community member, who lives close to the estuary to learn how it affects his day-to-day life. This interview made me wonder how I might be affected, or even my friends. I collected data from both of our neighborhoods and used them to compare.

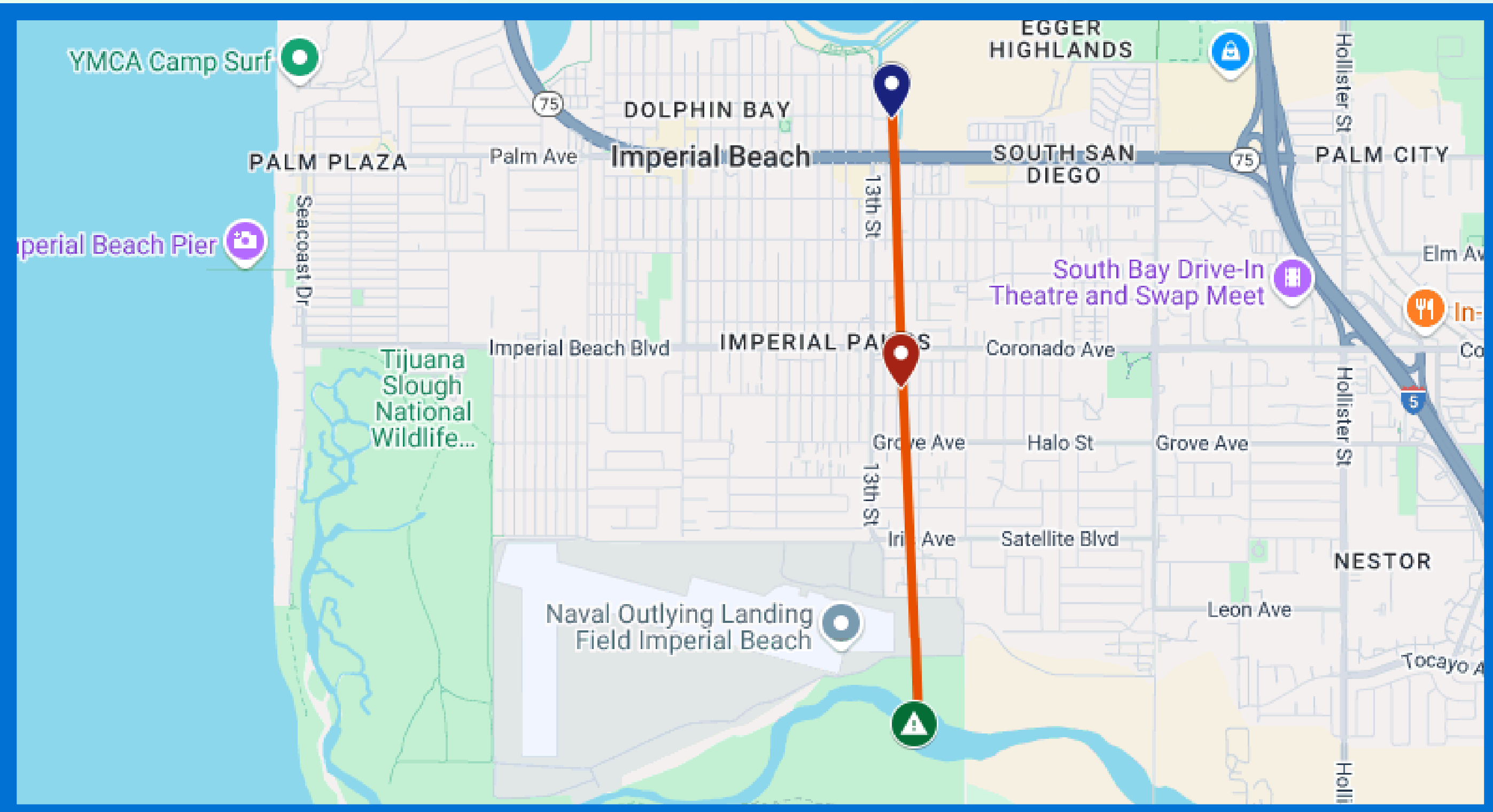
Hypothesis

Central Imperial Beach will exhibit higher levels of particulate matter compared to levels recorded in North Imperial Beach due to the Proximity of the Tijuana River.

Procedures

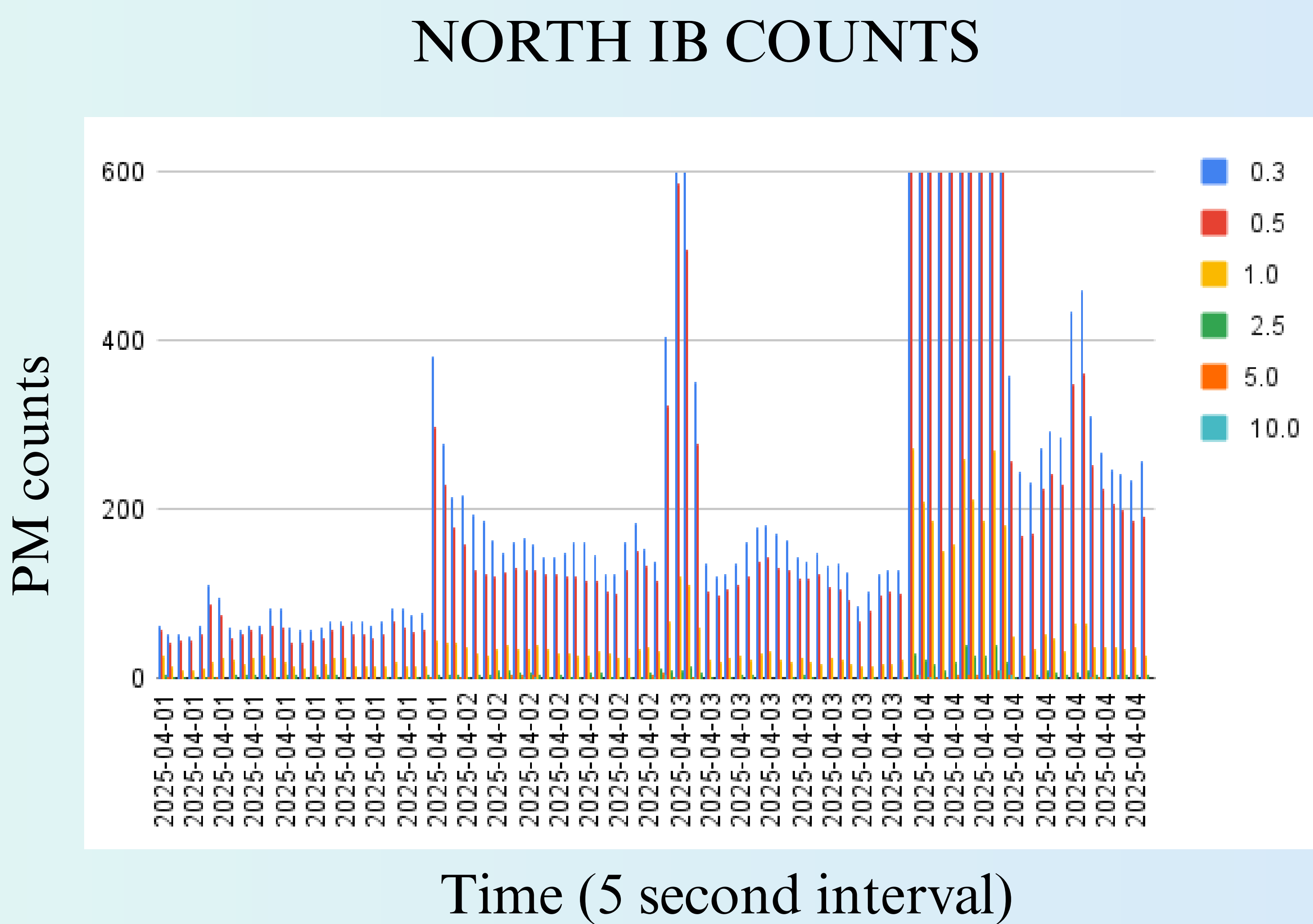
The provided air particle measurer was used between 8-9 pm, at two different locations for four days for two weeks.

I measured outdoors from Tuesday - Friday when the smell seemed most pungent.

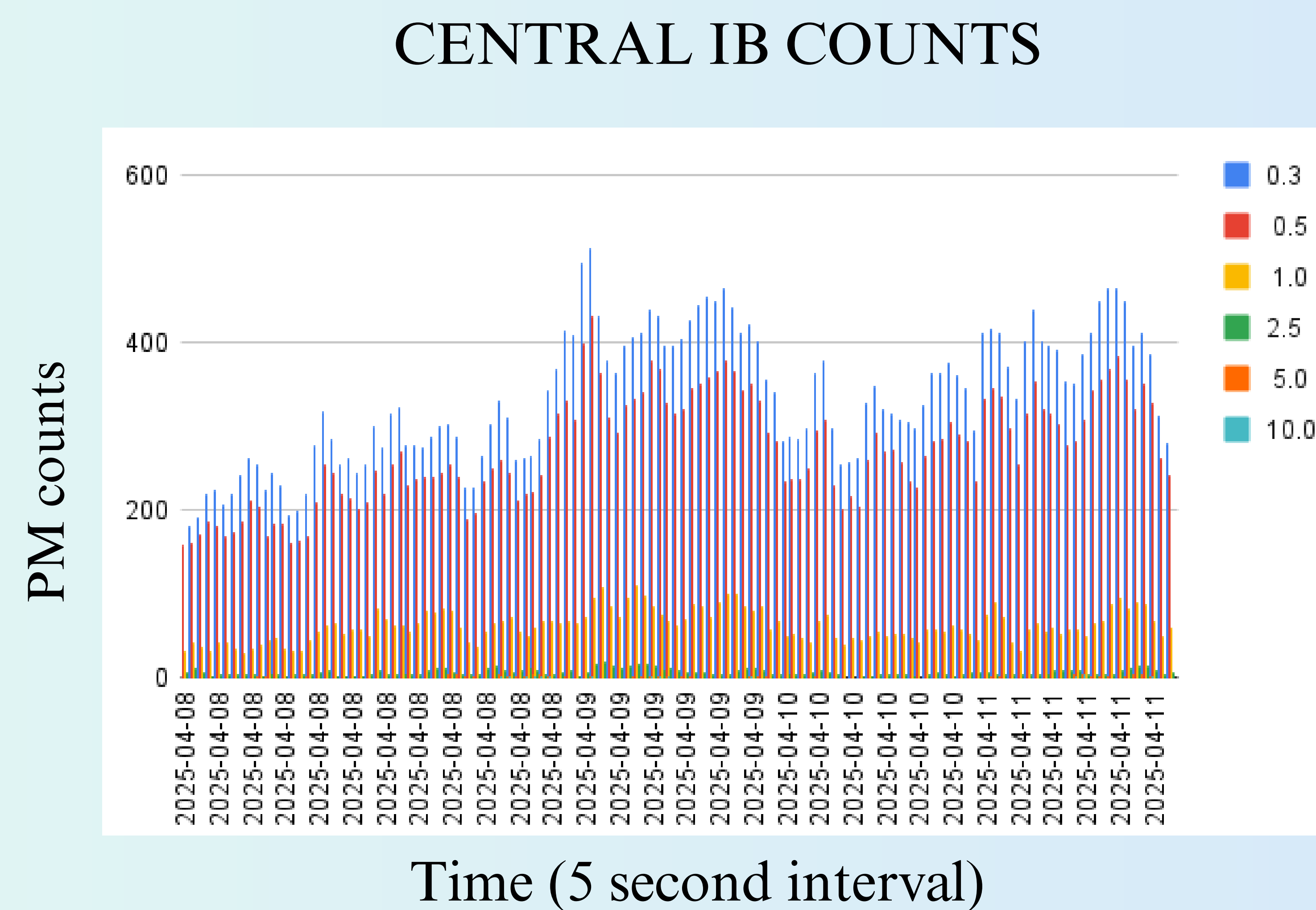


A visual map of where data was taken, from distance of the Tijuana River (green). Central IB is in red, North IB in blue.

Northern Vs. Central Imperial Beach PM counts



Tuesday April 1st - Friday April 4th (first week) at location in North Imperial Beach 8-9pm.



Tuesday April 8th - Friday 11th (Second week) at location in Central Imperial Beach 8-9pm.

Results and analysis

Looking at the graph from week one, we can notice some outliers on day four, (April 4th) where the 0.3 PM count reached up to over 1100. This may be caused by the pollution being worse on that specific day at that time or from other external factors. For example, traffic or smoking. Other than that, we can notice that at location two the PM count averaged above 200 for 0.3 PM and 0.5 PM counts. I can conclude that the particulate matter recorded in the neighborhood in central IB, closer to the river was higher than the particulate matter collected in the neighborhood in North IB.

Conclusions

After I finished my data collection between those two weeks, I noticed that when the “rotten egg” smell was more pungent, the PM counts were significantly higher. Specifically on day nine, I took note of the foul smell that occurred at location two and the graph shows that the 0.3 PM count reached the highest out of the four recorded days. This brought me back to when I interviewed my interviewee, where he stated that neighborhoods close to the river suffer the most from the foul smell at night. This is an interesting correlation because it demonstrates that PM counts, which we cannot physically see are in relation to something we can sense.

Future work

I would like to test the neighborhood closer to the Tijuana River at different times in the day, to further prove if the smell is corelated to the recorded PM counts. This could be done by recording during the day, where no foul smell is pungent - at an hour early in the morning (e.g. 11 AM) and compare these results to a time where foul smell is present, which is around 9 PM.

Comparison of Air Quality between Imperial Beach and Inland North San Diego

Vivian Zhang



Introduction

An oral history interviewee wonders: “Is my cough from breathing the air, or am I just losing it?” This research aims to address her question and find a possible connection between air quality and respiratory health. This was done by measuring PM2.5 concentration in the air on the Imperial Beach coast near the polluted region of the Tijuana River and an inland residential area within the same time/date range. The air quality under different weather conditions is also analyzed to study the variations caused by weather conditions in inland San Diego.

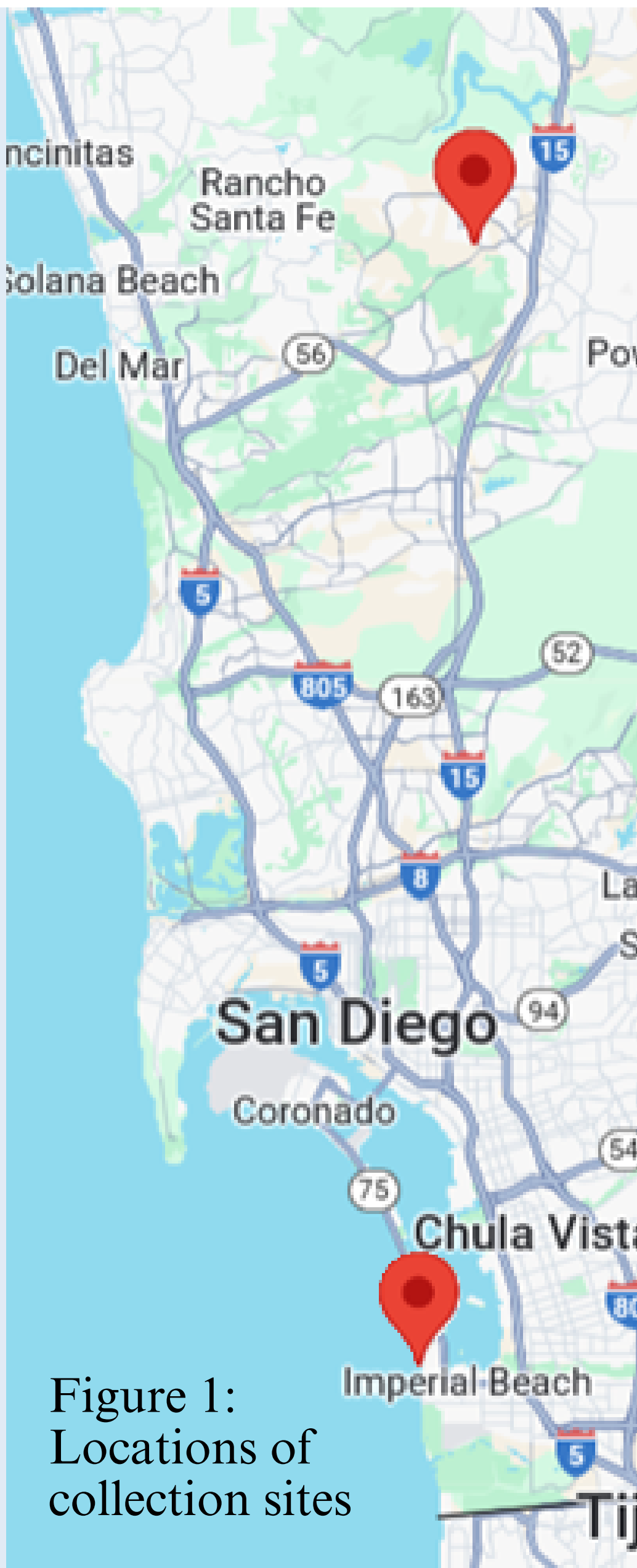


Figure 1: Locations of collection sites

Hypothesis

- 1.The air quality of the Imperial Beach coast is significantly affected by the nearby sewage pollution.
2. Air quality conditions vary significantly with differing weather conditions.

Procedures

- 1.Inland air quality data was collected using a high quality airborne particle concentration sensor from 4:10 - 4:25 pm using a 5-second interval to ensure the day-to-day comparability of the concentration data
- 2.Results from each day were averaged and plotted onto a graph
- 3.Air quality data near Imperial Beach was pulled from records made by specialized QuantAQ sensors
- 4.QuantAQ sensor data was averaged based on each day and plotted onto a separate graph.

Results and Analysis

- Daily average PM2.5 counts were significantly higher on almost all sampling days in Imperial Beach compared to inland San Diego (longitude -117.109, latitude 33.006, Figure 1) (Figure 2a).
- This conclusion was magnified in Figure 2b which shows one sampling day’s data between IB and inland San Diego from 4:10 pm-4:25 pm
- PM2.5 counts were significantly lower on rainy days (~0) compared to sunny days (Figure 3)

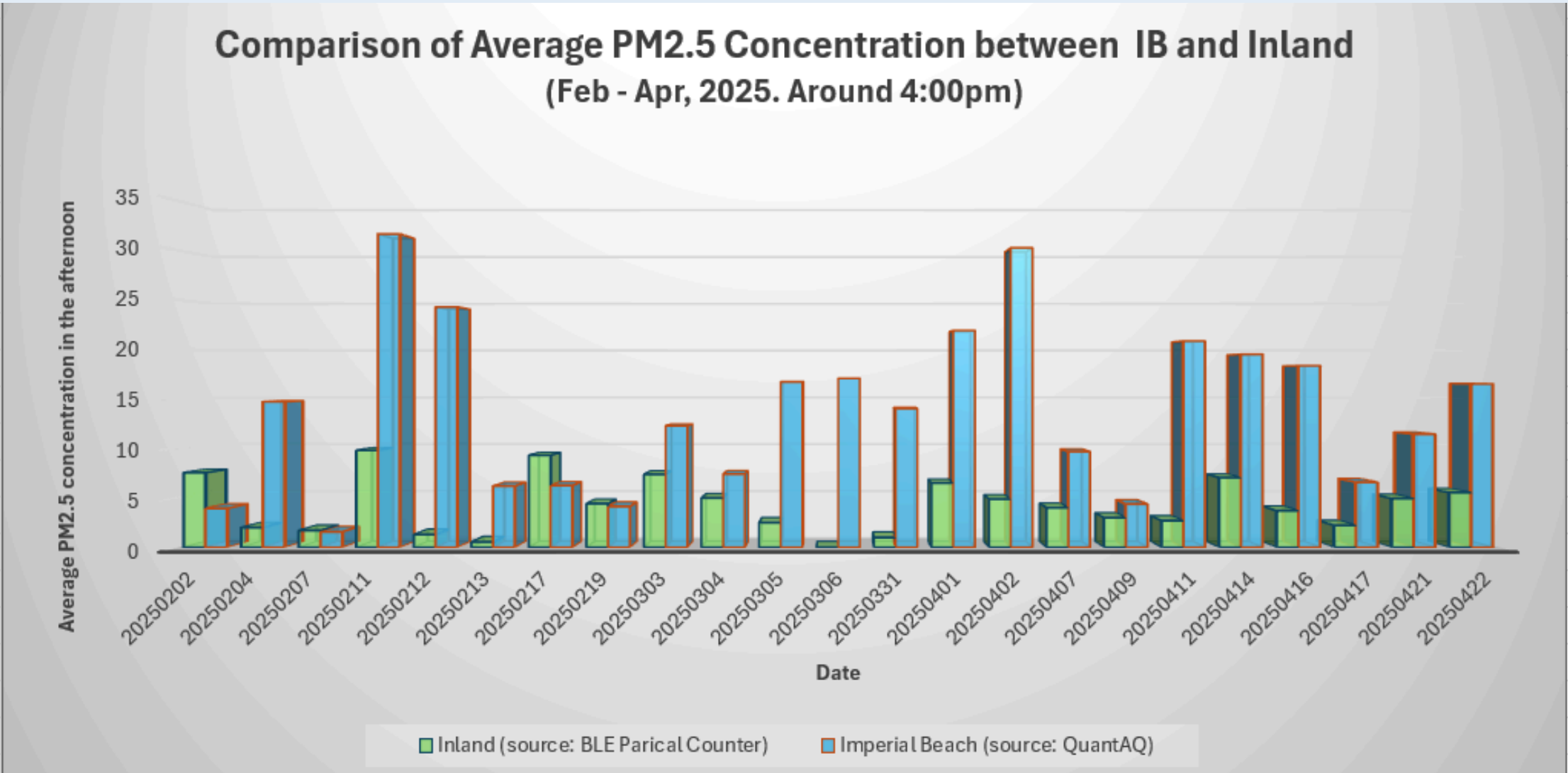


Figure 2a: Comparison of daily average PM2.5 Concentration between IB and Inland

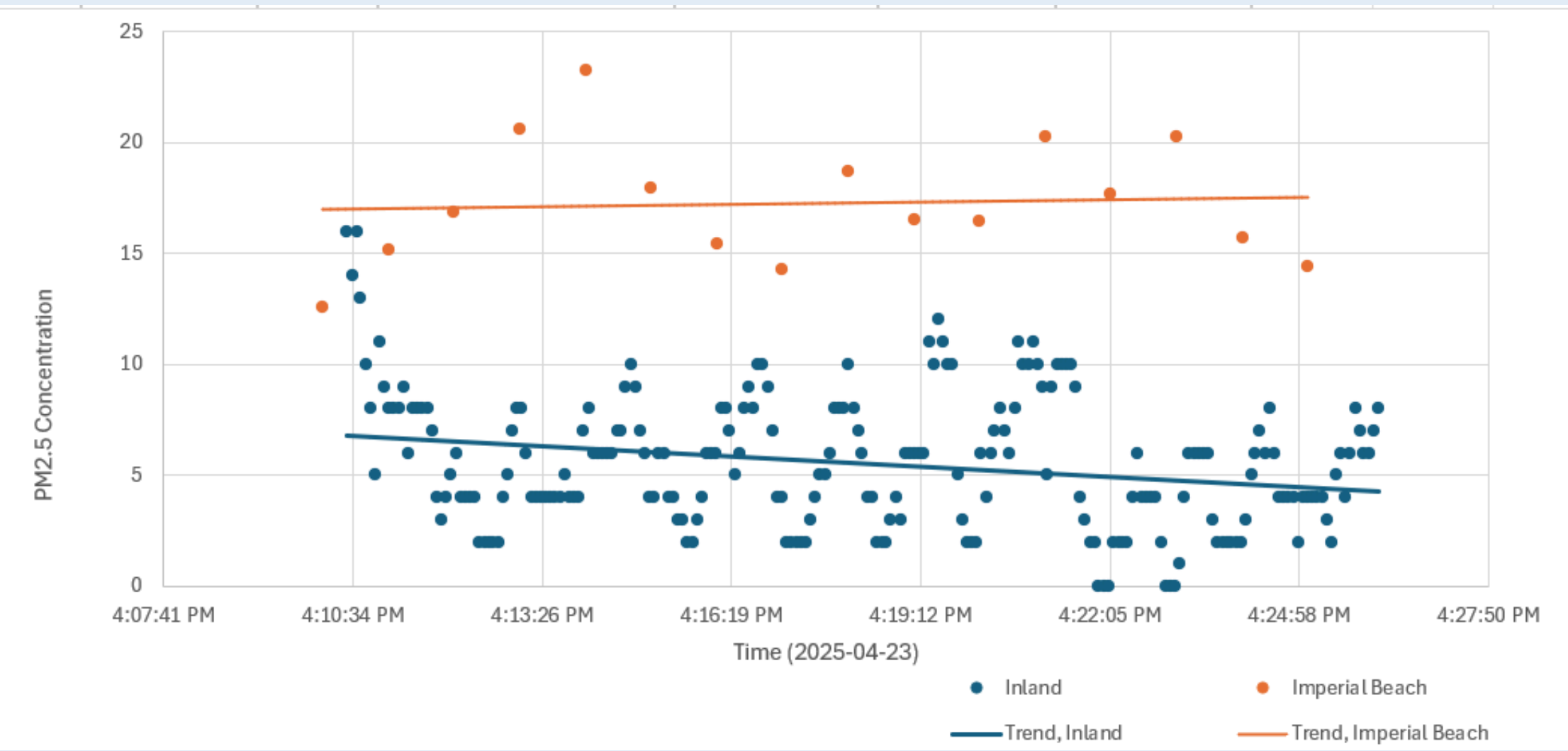


Figure 2b: Comparison of instantaneous PM2.5 Concentration collected at a 5-second interval between IB and Inland

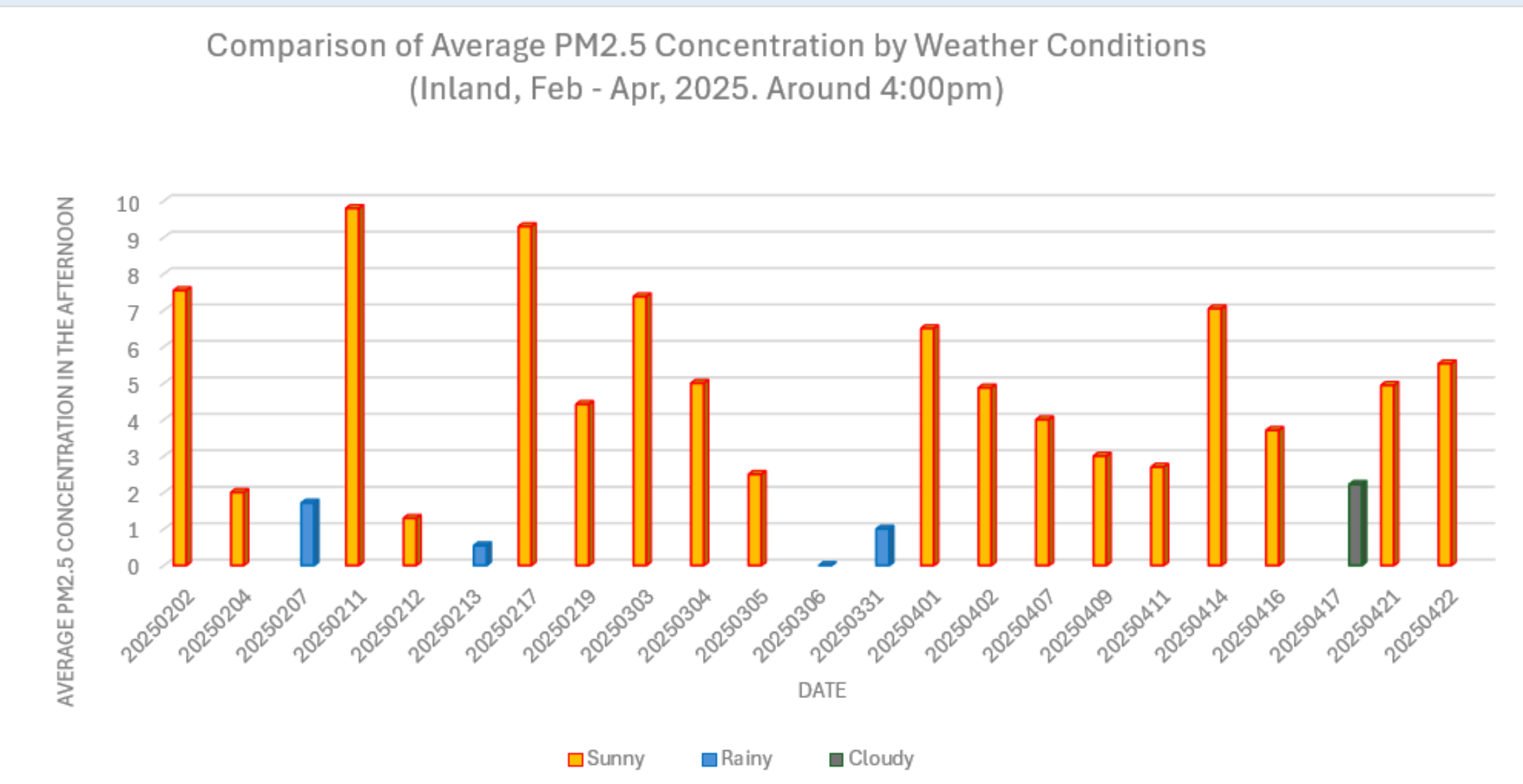


Figure 3: Comparison of daily average PM2.5 Concentration under various Weather Conditions

Concentrations of various sizes of airborne particle in the inland area (longitude -117.109, latitude 33.006) are measured with a portable BLE airborne particle sensor, but PM2.5 particle data was chosen in particular due to its critical impact on human health[1]. Comparing the daily average concentration between the two sites shows significant differences, illustrating the worsened air quality in the Imperial beach area. It’s also noteworthy that weather conditions have significant influence on particle concentrations in inland San Diego. On rainy days, PM2.5 concentrations are close to zero, significantly lower than on sunny days. Cloudy and windy days also see lower PM2.5 concentrations, but not as low as those in rainy days. This observation confirms the effect of the wet deposition process, i.e. rain helps remove particle matter in the air.

Conclusions

From the data analysis, it can be concluded that sewage pollution can deteriorate air quality through airborne aerosols, which contributes to the particulate matter pollution (such as PM2.5) in the air near Imperial Beach. Comparison of the measurement results under different weather conditions shows that wet deposition can significantly reduce the particulate matter concentration in the air. My interviewee is not “losing it”. The worsened air quality, as illustrated in this research, may have caused her health issues.

Future work

In this study, the dependence of air quality on weather conditions is tested in inland San Diego. It is proven that rainy conditions improve PM counts in inland San Diego. However, rain in Imperial Beach has been found to worsen air quality due to its proximity to a pollution site, the Tijuana River.

Therefore, in terms of future work, data should be collected for air quality in Imperial Beach on rainy days and compared to rainy-day data from inland San Diego to quantitatively see if rain has a negative impact on air quality in Imperial Beach.

References

- [1] California Air Resources Board, “Inhalable Particulate Matter and Health (PM2.5 and PM10)”, 2025

