

The Effects of Forest Fires on Air Quality

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Abstract

The question we explored was “Do fires have a detrimental effect on air quality?”. Our hypothesis was that they do have a detrimental effect on air quality. We decided this by creating graphs that allowed us to analyze the data more clearly. We found that the spikes in the data occurred during the high points of the fire. These spikes reached way past the accepted PM 2.5 and AOT, meaning that the air quality was very dangerous for humans, animals, and plants in the area. The PM 2.5 rose to over 300 micrograms, with the accepted amount being 35. These things led us to believe that the effect of these fires and other fires are definitely detrimental and can even be life threatening.

Research Question

- Do fires have a detrimental effect on air quality?

This is an important thing to know because many people suffer from breathing problems, such as asthma, and it would be helpful for them to know which areas have good air quality and which ones have bad air quality. Fires emit harmful gases which can be damaging to lungs not affected by a respiratory disease. Smoke effects PM 2.5. PM 2.5 consists of small particles that can go deep into the lungs and bloodstream. We want to find out how much pm 2.5 fires emit and if it stays in the atmosphere long after the fires have ended.

Introduction

In our project, we will be investigating if fires have a long term effect on air quality. Fires cause a significant increase in aerosol concentrations. Forest fires send partially burned organic carbon aloft (“Aerosols: Tiny Particles, Big Impact”). Due to the effects of forest fires, we wanted to find out whether the excess amount of particles will stick around after a forest fire. This can be useful to many scientists and civilians, because they will now know how safe it is outside after a large fire has occurred. Some people have respiratory issues, such as asthma or COPD, which can make it harder to breathe. The excess amount of aerosols in the atmosphere can contribute to the worldwide concern of global warming. This excess amount of aerosols can even harm people who are perfectly healthy. When pollution is abundant in the atmosphere, it can worsen air quality, and may have harmful side-effects.

Aerosols are a gaseous suspension of fine solid or liquid particles. Many things can affect the path, color, distance traveled and thickness of aerosols. Forest Fire smoke tends to be gray because these lower-temperature blazes release lighter-colored organic matter and brown carbon (wood and vegetation) (“How the Smoke Rises”). Although most aerosols remain suspended for short periods of time- periods typically between four days and a week- they can travel vast distances (“Aerosols: Tiny Particles, Big Impact”). These are the main source of the pollutants in our air. The difference between the amount of incoming solar radiation and the amount of outgoing terrestrial radiation is the radiation or energy budget. In other words, radiation budget is the difference between the energy from the sun and the radiation leaving earth.

There are many types of aerosols. Some are volcanic aerosols, desert dust, human-made aerosols, fires, and sea salt. Fires significantly contribute to aerosol concentration. Fires are the rapid oxidation of a material in the exothermic chemical process of combustion. They release heat, light, and reaction products. We will measure the Aerosol Optical Thickness(AOT), and the PM 2.5. AOT is the “degree to which aerosols prevent the transmission of light in the atmosphere”. (“Exploring Aerosol Optical Thickness”) PM 2.5 is an air pollutant that can be very dangerous if it gets into our systems. (“Fine Particles”)



Research Methods

- We used data from the California/Oregon fires this past summer-fall of 2018.
- PM 2.5 data was measured every day from August 8th until October 10th, 2018.
- AOT data was measured from June 13, 2018 to September 23, 2018.
- The data was measured by a teacher this summer.
- The weather was generally very hot during summer 2018.
- Measurements were taken of the PM 2.5 and the AOT in Athena, Oregon.
- We received the data, then put it into graphs, showing us more clearly when the high/low points were.
- We created our graphs using Google Sheets and Excel.
- We analyzed our data, looking for things that especially stuck out to us.



GLOBE Badges

Be a Collaborator

Leila Carey, Faith Garcia, and Abby Ryan all collaborated on this project. Faith Garcia collected most of our background research. Leila Carey was one of the writers and the editor. She also did graphing. Abby Ryan was one of the other writers who also did some of the graphing.

Be a Data Scientist

We used and analyzed data from the California/Oregon fires during the summer of 2018. Although we didn't make the measurements, we learned how to use a Calitoo and practiced with some. We compared the PM 2.5 and AOT data. We were looking for similarities and differences, and for the most part, they went up and down at the same times, hinting at high and low points during the fires.

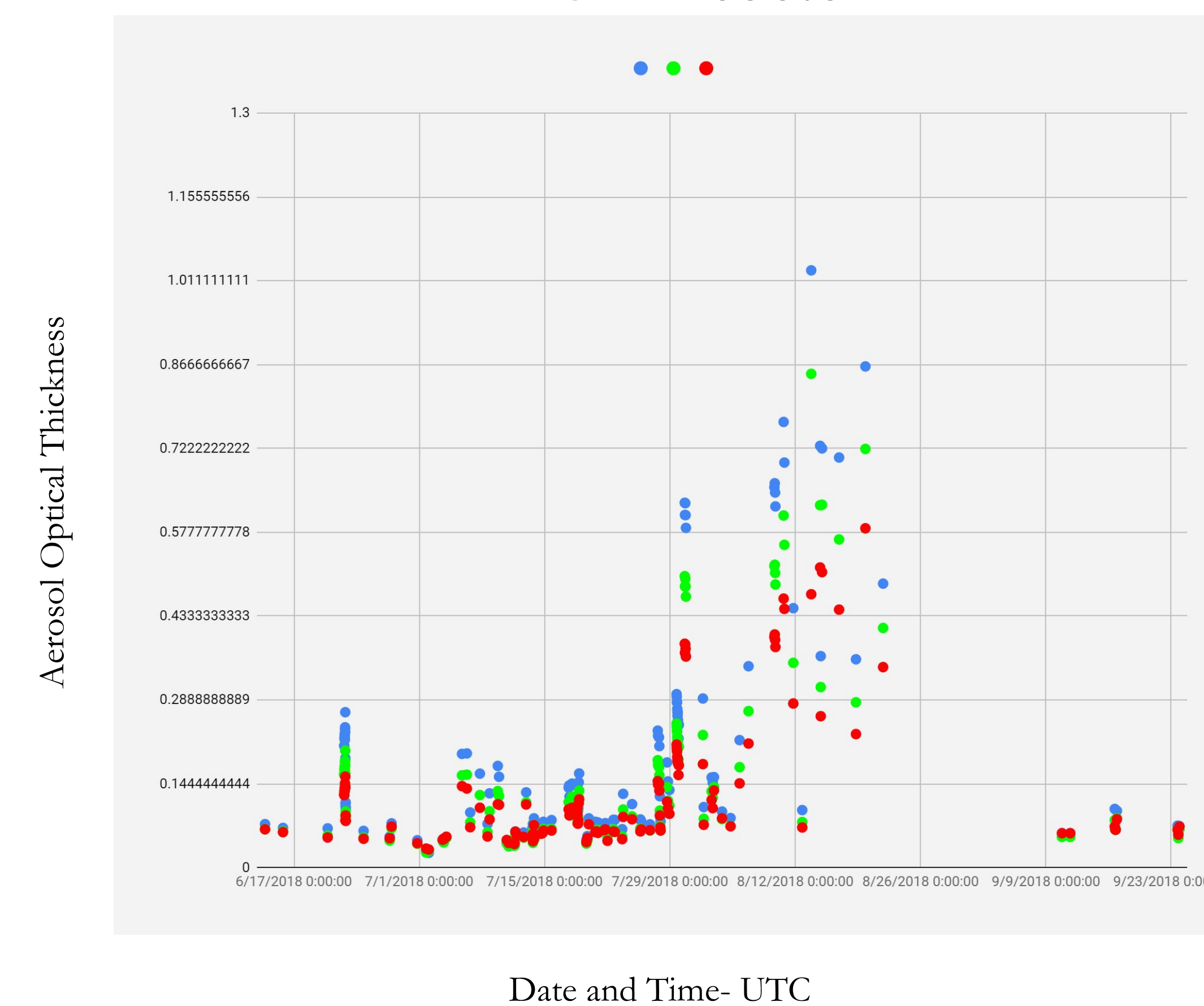
Be a STEM Professional

We received assistance from NASA scientist Margaret Pippen, who helped us to gather our information and showed us many important things about our data, such as strange high and low points. We were also helped by Marile Colon-Robles, who talked to us about clouds.

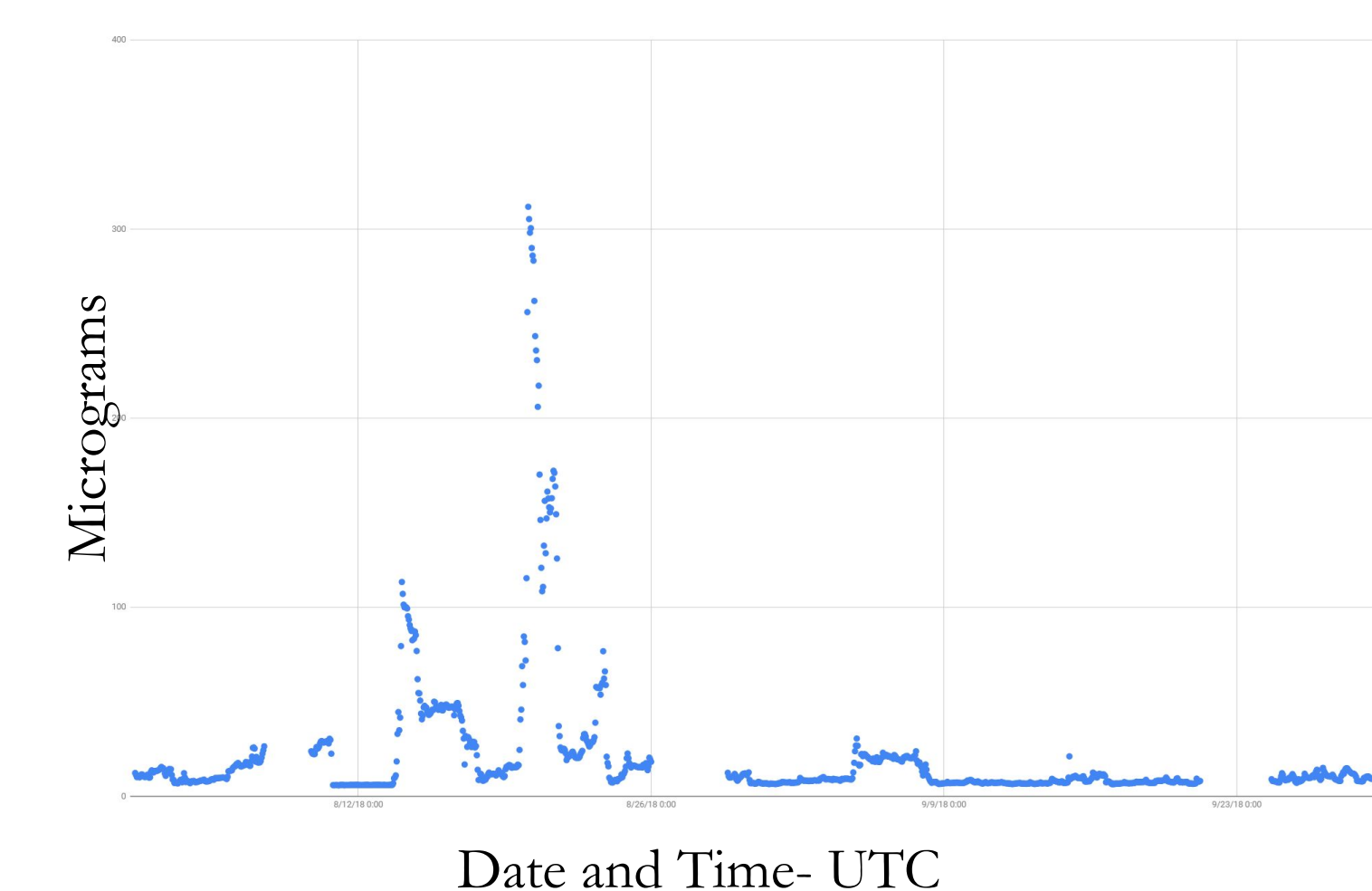
Results

Yes, Forest fires have a very large effect on air quality. Because the smoke gets thicker as the fires build up, the amount of aerosols grows and spreads all over the world. We first looked at the AOT and PM 2.5 and made charts using the data. We made a chart comparing the PM 2.5 and AOT data. We found that in this chart, the spikes and low points matched pretty well, suggesting that something significant was occurring during the fires at these specific points. Figure 3 is the chart we used to compare AOT PM 2.5.

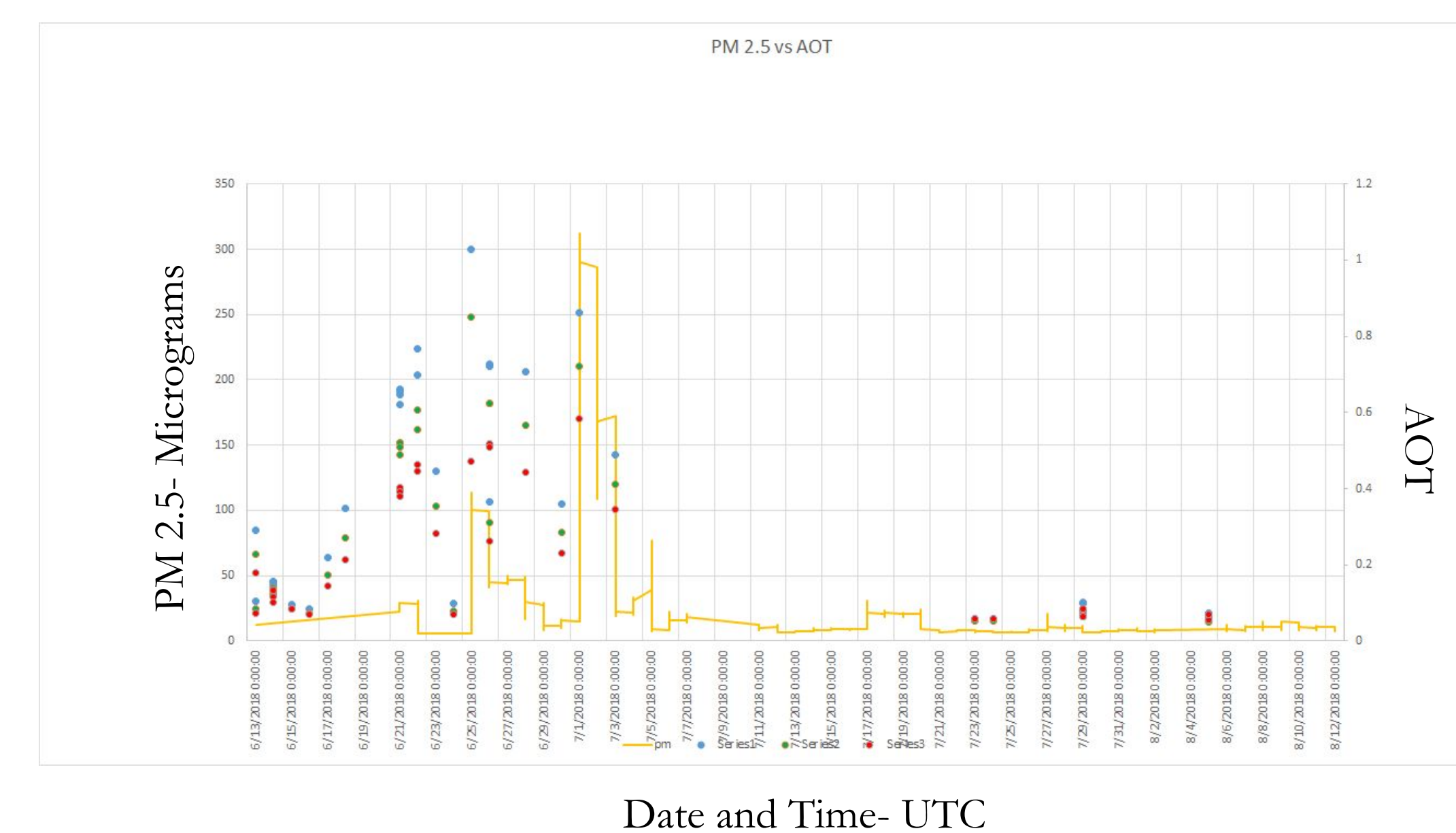
AOT Levels



PM 2.5 Air Quality



PM 2.5 vs AOT

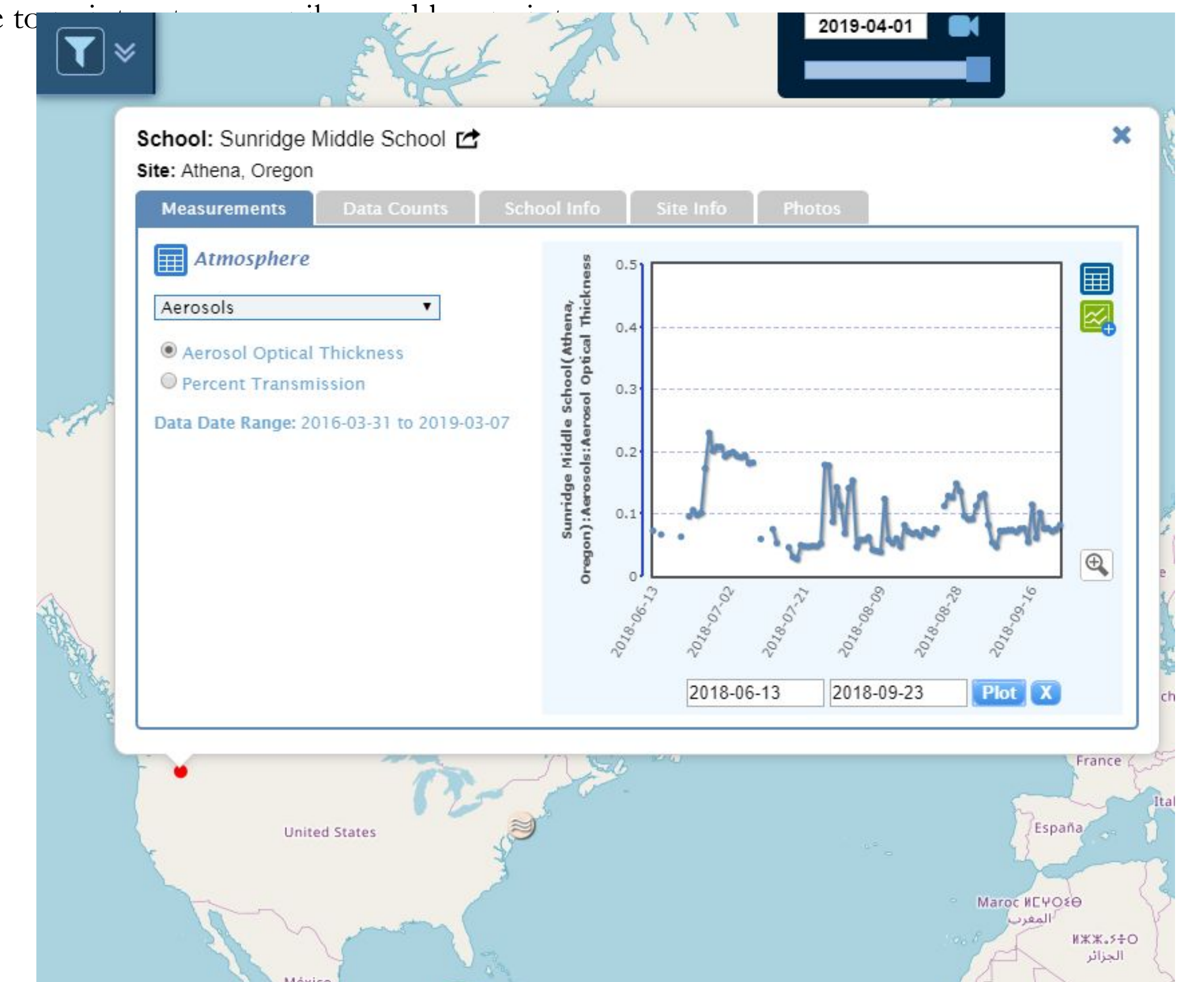


Discussion

The results acquired from this project were very significant. The data we collected showed us that fires do have an effect on air quality. We discovered that fires have a lot to do with the air quality around us. The results supported our hypothesis by proving that the amount of aerosols from fires did have major effects on the air quality. We found that the PM 2.5 and AOT both went up during the middle of the fire. This must've been one of the most violent points of the fire.

Because of our discoveries, we would advise people with breathing problems to evacuate at first sign of fire. The accepted PM 2.5 is 35 micrograms per cubic meter of air, and our results showed that at many times, the PM 2.5 was way above that, causing severe health threats. These particles travel deep into our lungs, possibly causing respiratory and cardiovascular issues. (“Fine Particles”)

Our experiment could have been better if we had AOT data for the same days we had PM 2.5 data. This would close up the gaps between the data we had for AOT and P.M 2.5 and we would be able to



Conclusions

Our hypothesis was proved through our research. We predicted that the fires would significantly damage the air quality at least for a short amount of time. Our question was “Do fire have a detrimental effect on air quality?”. We came to our conclusion by analyzing our data, looking for high and low areas. We found that the PM 2.5 and AOT both spiked at around the middle of the data collection period, when the fires were at their worse. These high levels tell us that the air quality was severely damaged during this time. Luckily, it went down quite a bit shortly after the spike.

Our experiment could've been better if we found data to fill in the gaps. Mrs. Rizzi and Dr. Pippen significantly helped our experiment by helping us see important things in the data and create graphs.

Bibliography

- “Department of Health.” *Fine Particles (PM 2.5) Questions and Answers*, www.health.ny.gov/environmental/indoors/air/pm2_5_a.htm.
- “Aerosols: Tiny Particles, Big Impact.” *NASA*, NASA, earthobservatory.nasa.gov/features/Aerosols/page4.php.
- “How the Smoke Rises.” *NASA*, NASA, earthobservatory.nasa.gov/images/144658/how-the-smoke-rises.
- “Exploring Aerosol Optical Thickness Using MODIS Satellite Imagery in NEO.” *Datasheets*, 25 Sept. 2018, serc.carleton.edu/usingdata/datasheets/aerosolopticalthick.html.