Does Wind Direction Affect the Amount of Aerosols?

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Abstract

Our group researched many things on the internet. Our main objective was to see if there was any correlation between wind and the amount of aerosols and if it did affect, we wanted to know how and why it did. Our main question was asking if wind direction affects the amount of aerosols in a certain area. The research included what are aerosols and what do they affect. What is wind and does it have any effect on atmosphere particles? Does the wind direction affect the aerosols? Why does the wind direction change often during the day? These were some of the questions that we had to research and find information and answers to. For collecting our data, we used an instrument called a calitoo. A calitoo is a photometer used to measure the rate of aerosols in the atmosphere. We also used many websites including Hysplit and Wunderground, We found our conclusion by looking at our data collections and talking with Dr. Margaret Pippin to answer our questions and help interpret our data. We did find correlation between wind and aerosols because one day with a southeast wind it was extremely clean air and one day with a northwest wind it was dirty air. On Hysplit, a NOAA wind resource, there was a huge difference between the wind direction and the day's (10/20/17 and 11/02/17) AOT high and lows. We may have had errors due to the small amount of days we studied, which was two. There are still many questions that can and should be answered about aerosols and the atmosphere. There could be more questions relating to weather like does wind affect aerosols.

Research Questions

Everyone's environment is in danger because of pollution, but it may become worse for some areas not producing extreme pollution (factories, vehicles, etc.) when the wind blows it there. We have many questions about aerosols, and our group is whether the wind direction affects the aerosols in Virginia. In Virginia, we are assuming that when the wind blows from the east, we have less pollution, simply because it is the open Atlantic to the east. When it blows from the

south, we may have some, but less the further east you go because the coastline dips.

Introduction

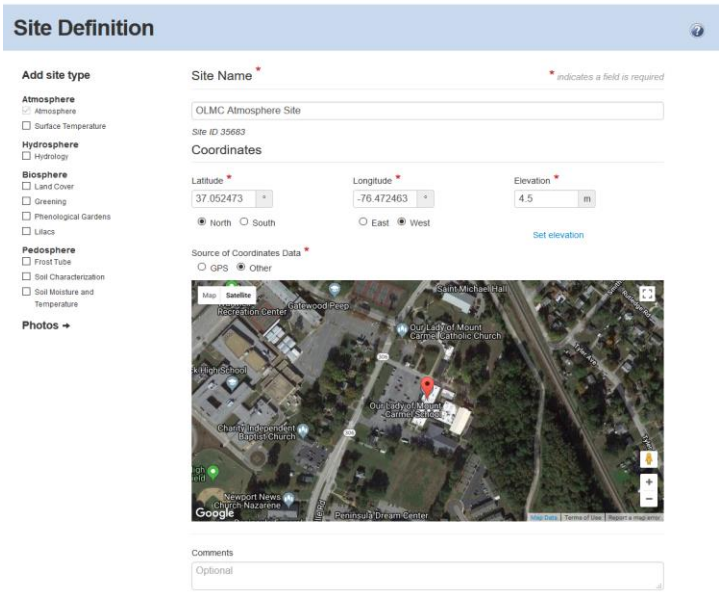
Our group is interested to know if wind direction affects the amount of aerosols in our area. Knowing this can help us answer questions about aerosols and how many there are and if the wind brings them with it. Wind is defined as the flow of gases on a large scale. Wind on the earth's surface is the movement of air and can provide transportation of gases, solids and liquids. Aerosols are defined as a colloidal system of solid or liquid particles in a gas. Aerosols can be found naturally in the air such as sea salt and pollen can be found in urban areas as pollution as dust, cigarette smoke, soot, or fumes from car exhaust or from businesses. One question that we want to answer is if one wind direction becomes more common we will have a decrease or increase in the amount of aerosols. We are thinking that if a wind from the land comes, it will have an increase in aerosols, and if it came from offshore it would have a decrease in aerosols.

Research Methods

From examining a graph and using Hysplit for October 25, 2017, we noticed that we got polluted air that day and some other days. We used it to see where the wind came from. We compared this wind data with data from a Calitoo which measures wavelengths of light to measure AOT (Aerosol Optical Thickness) for the 465 nm, 540 nm, and 619 nm wavelengths. A Calitoo is an instrument for determining the rate of aerosols in the atmosphere and to characterize their size distribution. AOT means Aerosols Optical Thickness. We also pulled NASA Langley Research Center (LaRC) Aeronet data to see wavelength data. We used Microsoft Excel to plot our data, and converted Aeronet data to comparable wavelengths. We used Hysplit to get Hysplit backward trajectories models for the 17 and 20 of October as well as to know where the wind direction

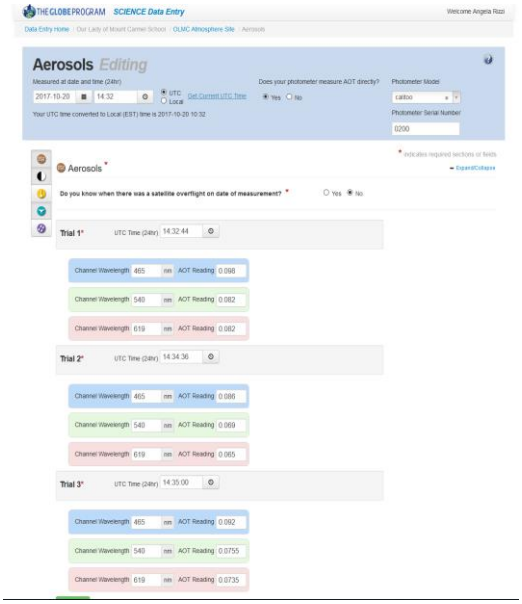
was coming from. Hysplit models are models that show you the wind direction and what altitude it was coming from.

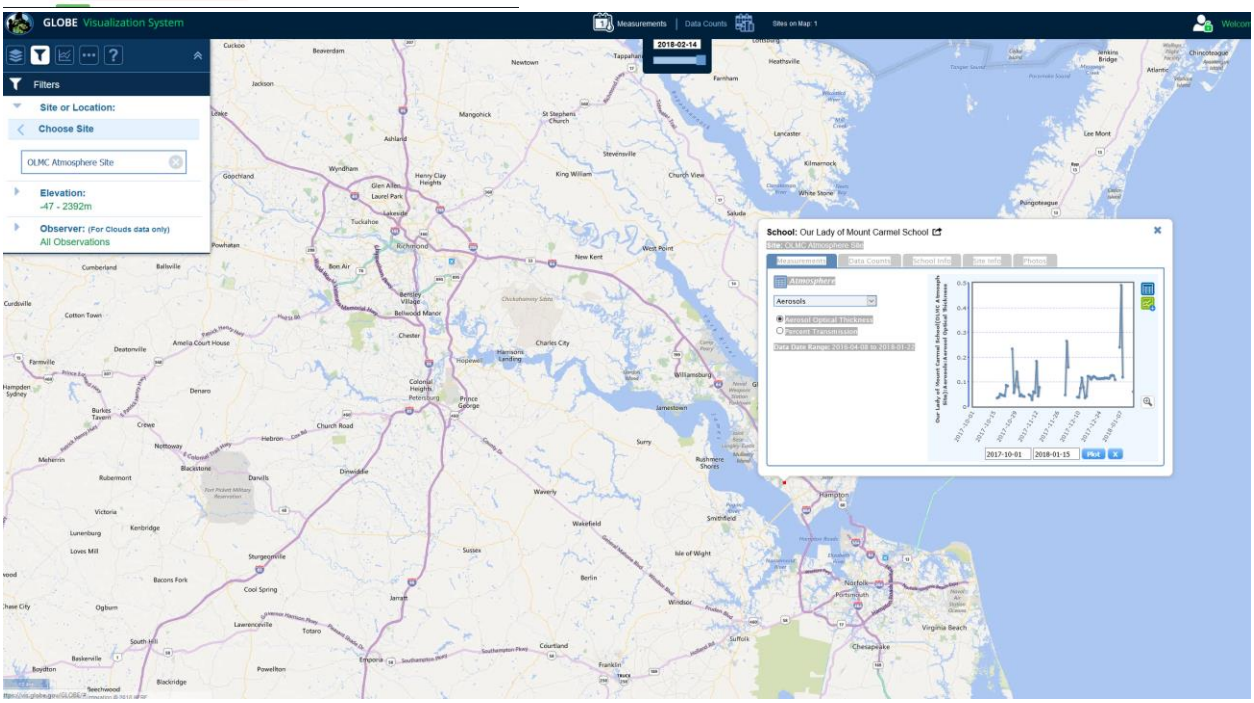
The picture below shows our site map. This is our school where we got some of our data from by using the calitoos around the campus.



The picture below shows the Globe data entry screen that we used on our graphs for

our data collections.





Results

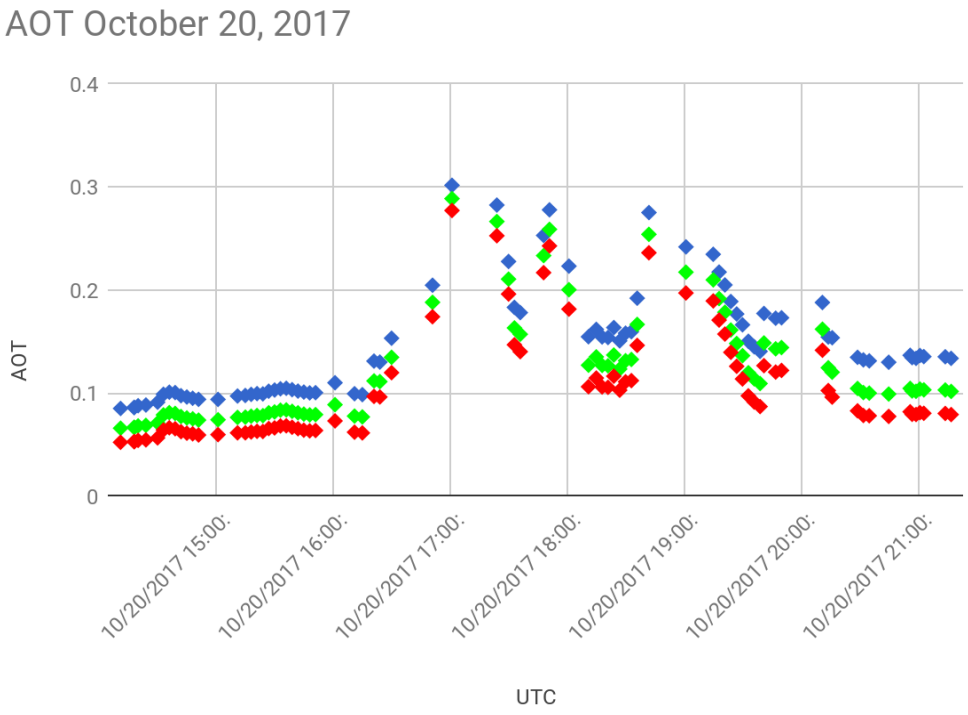
From examining a graph and using Hysplit for days in Fall 2017, we noticed that we got polluted air some days and not a lot some other days. In southeastern Virginia, we saw that when the wind blows from the south and east, we have non-polluted air. But when it comes from the north and west, we get much more polluted air compared to the south. Because the

open Atlantic is to the east only after a miniscule amount of land there is few aerosols with an east wind. With a northwest wind there is a lot of land so there is polluted air. We did find correlation between wind and aerosols because one day with a southeast wind it was extremely clean air and one day with a northwest wind it was dirty air.

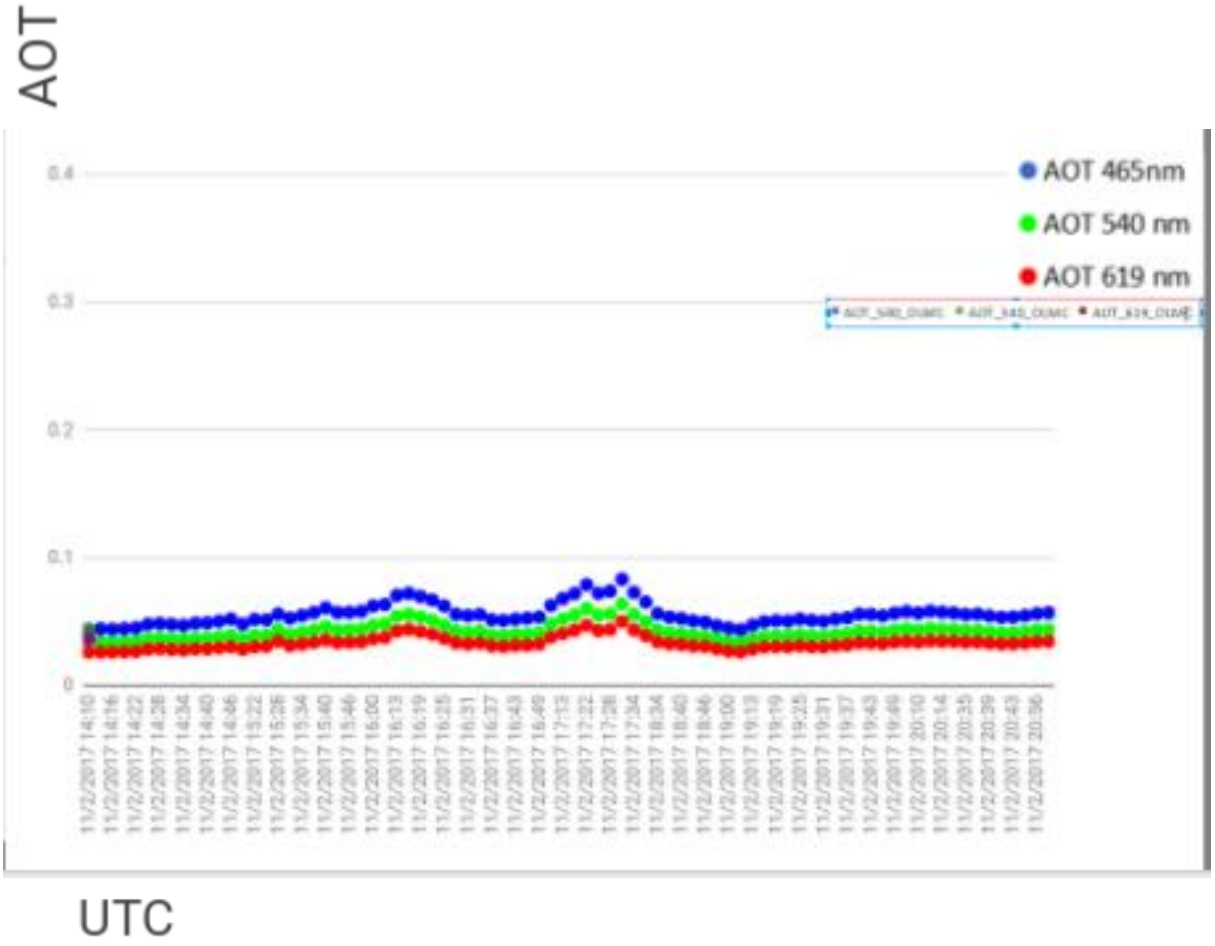
Discussion

From our results and research we have come to the conclusion that many things affect aerosols, one of those things being wind. Our results do support our hypothesis. We found a direct link between the wind direction and pollution in the air. A possible source of error could be that we didn't look at enough days of data. If we looked at more days with data maybe we could've realized that there was just something in the air that day.

Graphs



This graph above shows the AOT for October 20, 2017. This graph made us think and believe that wind had an affect on the AOT.



Badges

Collaboration:

Team Members:

Allie Beavers: She is not officially in our group, but she helped tremendously in collecting most of our data from our school. Without her data from OLMC, it would have been harder to do our project because we would have fewer points.

Brendan Janasiewicz: He helped interpret the wind data from Wunderground, which is a website that provides weather forecasts and

weather history, and connected the wind times and the AOT times. Without his help, the wind data would be not connected to the AOT levels, the basis of our project. He had the idea to do this project.

Student 3: He collected Hysplit data, which is a NOAA website that provides wind directions. He also collected Wunderground wind data and explained to the rest of the Group how Hysplit works. Without his help explaining Hysplit, we would have never been able to look at the data there and connect it to wind data. He had the idea to hypothesise the different wind directions possible AOTs.

Travis Brand: He put together our Data and Graphs. Without his help collecting the data into a document and putting it all into graphs, we would have never been able to do our project. This is because without the graphs, it would be difficult to see the effects of the wind on the data. He had the idea that wind direction did affect aerosols, and that built onto Brendan's original question.

Daniel Baez-Perez: He helped look at our wind data with Student 3 and also explained to the group how Hysplit worked. Without his help explaining Hysplit, we would have never been able to look at the data there. He had the idea to assume where the aerosol pollution was coming from. He really helped with computers also.

The Benefits Of Collaboration:
It would have been very difficult for any one of us to work individually on this project. Collecting the data, putting together graphs, and interpreting wind data all on one's own would be difficult and time-consuming. Therefore, groups were an excellent idea for our class's projects. Some

7th graders also proofread our work on google docs and other google products where our whole group worked together.

Connecting to a STEM Professional

The STEM professional that helped improve our project was Dr. Margaret Pippin. During one longer than normal science class, she and another scientist came in and helped our groups with our projects. She also came in two more times. With our group, she helped Daniel and Student 3 understand how Hysplit, a NOAA wind database, works. With that knowledge, they explained to Brendan and Travis how hysplit runs. She showed Brendan how to interpret wind data from Wunderground. In case you don't know what Wunderground is, it is a weather resource that provides weather forecasts and weather history. She explained that the wind directions were shown in degrees, from 0 to 360. This was extremely beneficial to our project, because our project revolves around wind direction. With Travis, she helped him interpret his data. His data for AOT went up to 0.3, and according to her, that is a high number. Brendan's went up to 0.056, and she suggested comparing wind direction data for those two days including November 2nd, another clean day. This was a very useful suggestion. Without her help, it would've been harder to interpret our AOT data values and our data would've been less precise.

Conclusion

Working with a mentor such as Dr. Margaret Pippin really improved the quality of our project and helped us reach our conclusion. She explained to us how to interpret wind direction data. She also explained to us what AOT counted as high, and which counted as low. Mrs. Rizzi, our science teacher, also explained aerosols to us. She also helped put together our graphs. After this project, we could look into whether wind speed could affect the amount of aerosols in the air. We could also look into what kinds of aerosols come from where. This is important and relevant to science because if we saw if one wind direction became more regular if that would increase or decrease the aerosol amount in the air. However, we did not find a direct link between wind direction and the days we looked at. It

could have been that something like wildfire smoke had been moving through the air for part of the day, and then moved out. On Hysplit, a NOAA wind resource, there was miniscule difference between the wind direction and the day's (10/17/17 and 10/20/17) AOT high and lows. We did find a correlation between wind direction and aerosols. This may be due to the amount of days we studied, which was two.

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