Aerosols

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Abstract

This experiment focused on the question; What is the relationship between the many factors that influence air quality, including temperature, humidity, wind, pressure, PM2.5, AQI, precipitation? The hypothesis states if the temperature and humidity is high, the pressure is high, and there has not been rain in the past twenty four hours, then there will be higher Aerosols levels, most likely along with PM2.5 and AQI levels. Aerosols is a dirt particle in the air directly linked with the Air Quality (AQI). PM2.5 is the measurement of the dirt particles in the air at our breathing level which would also be directly linked to Air Quality. Data was collected outside by observing the cloud coverage, observing which way the wind was blowing, and measuring the Aerosols Optical Thickness, using a Calitoo sun photometer, and temperature. PM2.5 and AQI data was collected from the Arendtsville, PA Environmental Protection Agency (EPA) and Weather Underground to try to better understand the relationship between all values and air quality. The hypothesis was partially supported by the data. It seemed that when the pressure was low, the aerosols were high. This could be because low pressure signals a front coming through, possibly bringing in pollutants. When there was no rain, the aerosols were higher and larger. However, just after it rained, the aerosols were measured smaller and in low levels. When the PM2.5 and AQI levels were high, the aerosols were also high.

Keywords: PM2.5, aerosols, calitoo, clouds, temperature, relative humidity, pressure, AQI

Aerosols

Research Question and Hypothesis

The question this project focused on states; What is the relationship between the many factors that influence air quality, including temperature, humidity, wind, pressure, PM2.5, AQI, precipitation?

The hypothesis states if the temperature is high, there are few clouds, the wind is blowing, and the pressure is high, then there will be higher Aerosols levels, most likely along with PM2.5 and AQI levels.

Introduction

Aerosols Optical Thickness (AOT) is the measurement of urban haze, smoke particles, desert dust, sea salt and other particles distributed within a column of air from the instrument to the top of the atmosphere. AOT is measured with a sun photometer which is pointed directly at the sun. The student then records the largest voltage reading obtained during the testing. Aerosols decrease the amount of solar energy that reaches Earth. They increase haze, decrease visibility, and affect air quality. Aerosols is taken with either a sun photometer but in most cases it is taken with a Calitoo (NASA, 2005).

PM2.5 is the measurement of the amount of particles in the air. Unlike the Aerosols which measures the amount between us and the sun it measures the amount of particles that are at breathing level. PM2.5 is important because if there are a lot of particles then people will have a hard time breathing. PM2.5 is measured with a PM2.5 reader. These machines are mounted to a flat surface and as if it is human sucks in air and measures it. PM2.5 will be added into the project so that the student can further expand my project for other competitions. With this project the student will also be measuring cloud type, air pressure and humidity to track what is going on with the Aerosols (Pippin, 2018).

Cloud Type is the observation of the cloud type in the sky. Clouds are evaporated water vapor with the help of aerosols (GLOBE Cloud, 2018). Relative Humidity is the measurement of the amount of humidity in the air. It shows students that there is a limit to the amount of water vapor the air can hold. Relative Humidity causes water vapor to form. It is so hot at times that it causes a lot of water evaporation or when it is not so hot, only a little bit of evaporation (“GLOBE Humidity,” 2018).

Barometric Pressure is the measurement of the amount of pressure in the air. It can show through increase and decrease if there is an upcoming weather change (GLOBE Pressure, 2018). This project is important to people with asthma and people who use solar energy to power their homes. People with asthma are affected by the amount of AOT that is in the air, and people who heat their homes with solar energy are affected because if there is a greater amount of AOT it will block a lot of the sun’s solar energy rays from reaching the Earth. This is important because if there is constant high levels of AOT, then people with asthma will constantly have trouble breathing. People who use solar energy to power their home will have difficulty getting that energy because the Aerosols blocks most of the rays from reaching Earth. This project applies to the real world because it affects real people and it can contribute to problems such as Global Warming. If Global Warming is not stopped, then sea levels will rise and sea animals will be left without homes. Land will begin to disappear because of the rising sea levels and that means homes will be destroyed and people will be left without homes (NASA, 2005).

Materials and Methods

- 1 Barometer (A Division of Bel-Art Products)
- 1 Whirling Hygrometer (eisco)
- 1 Infrared Thermometer
- 1 GLOBE Cloud Reading Chart (GLOBE)
- 1 Calitoo (Sun Photometer) (cnes and Tenum)
- 1 DIY Wind Reader (Homemade)
- EPA PM2.5 Data retrieving site (cited in references)

Aerosols (as taken from GLOBE Protocols)

1. Turn the digital voltmeter and sun photometer on.

2. Select the green channel on the sun photometer

3. Hold the instrument about chest-high or, if possible, sit down and brace the instrument against the knees.

4. Adjust the pointing until the sunlight spot is centered over the appropriate dot. Be sure the pointing is stable before the voltages are recorded. Small movements of the sun photometer will cause the voltage to vary by a few millivolts.

5. Record the time at which the maximum voltage was observed as accurately and precisely as possible.

6. Select the other channel and repeat steps 6-8.

7. Repeat steps 4-9 at least twice and no more than four times.

8. Turn off both the sun photometer and the voltmeter (GLOBE, 2018).

Barometric Pressure (as taken from GLOBE Protocols)

1. Record the time and date.

2. Tap gently on the glass cover to stabilize the needle.

3. Read the barometer to the nearest 0.1 millibar (or hectopascal).

4. Record this reading as the current pressure.

5. Set the "set needle" to the current pressure (GLOBE, 2018).

Clouds (as taken from GLOBE Protocols)

1. Complete the top section of the Data Sheet.

2. Look at the sky in every direction.

3. Estimate how much of the sky is covered by clouds and contrails.

4. Record the cloud/contrail cover for the overall sky, as well as each level (GLOBE, 2018)

Relative Humidity (as taken from GLOBE Protocols)

1. Open the sling psychrometer case by pulling out the slider, which contains the two thermometers.

2. Wait three minutes to allow the thermometer to read the current air temperature

3. Sling the psychrometer for 3 minutes

4. Let the psychrometer stop whirling on its own! Do not stop it with hands or other objects.

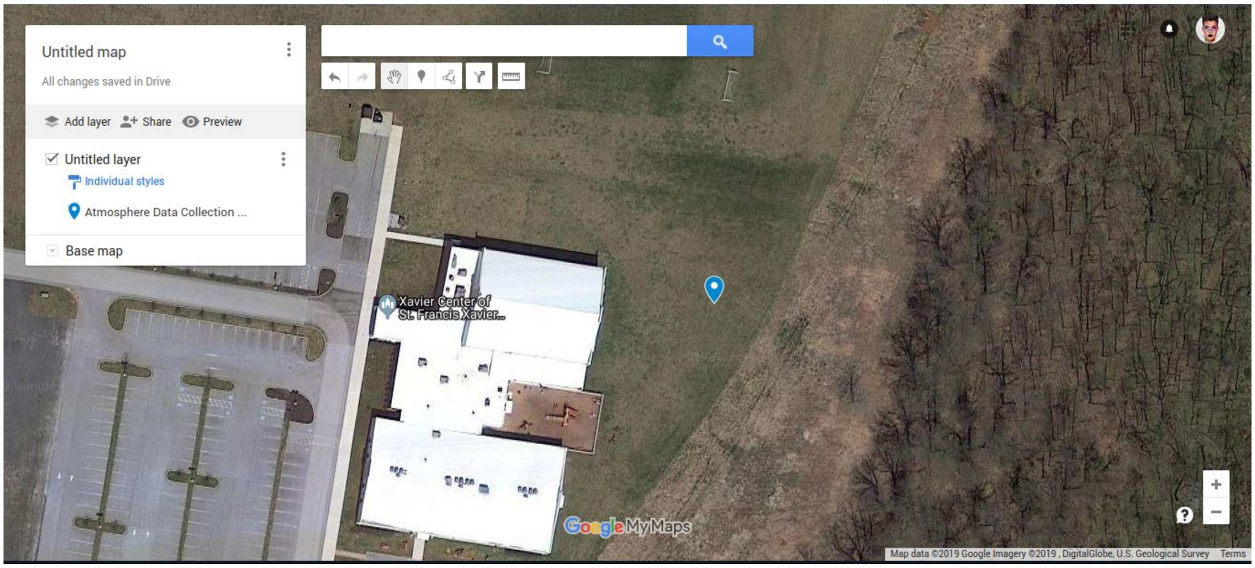
5. Read the wet bulb temperature to 0.5˚ C

6. Record the wet bulb temperature.

7. When the student is done with the instrument, close it up and return it to the shelter properly (GLOBE, 2018).

Wind (as taken from GLOBE Protocols)

1. Set DIY wind reader 3 feet above ground.
2. Record which way the wind is blowing (GLOBE, 2018).



Map 1: This map shows the data collection site located behind our school.

Data Summary

Date	Ave Temperature (Harrisburg PA, Hagerstown MD) (°C)	SFX Actual Temp (C)	Ave Humidity (Harrisburg PA, Hagerstown MD) (°C)	SFX Actual Humidity (%)	Ave Wind Speed (Harrisburg PA, Hagerstown MD) (°C)	Ave Pressure (Harrisburg PA, Hagerstown MD) (°C)	SFX Actual Pressure (mbar)	Ave Precipitation (Harrisburg PA, Hagerstown MD) (°C)	Rounded Ave AOT Red	Rounded Ave AOT Green	Rounded Ave AOT Blue	Daily Mean PM2.5 Concentration (ug/m3 LC) (York & Adams Stations)	Daily AQI Value (York & Adams Stations)	Wind Direction
Oct 1	21.7		92		17	1027		0.0				8.9	37	
Oct 2	23.1		94		21	1023		0.3				7.8	33	
Oct 3	22.0		92		23	1019		0.0				8.8	37	
Oct 4	22.3		97		23	1018		1.8				9.1	38	
Oct 5	18.9		87		19	1022		0.0				5.6	23	
Oct 6	20.0		92		17	1023		0.0				7.6	32	
Oct 7	24.8		95		12	1025		0.0				7.5	31	
Oct 8	24.5		97		26	1028		0.0				10.8	45	
Oct 9	24.5		94		19	1028		0.0				7.2	30	
Oct 10	24.8		94		27	1023		0.0				4.5	19	
Oct 11	21.2		93		41	1011		15.8				2.1	9	

Oct 12	14.5		71		46	1012		0.0				5.1	21	
Oct 13	11.1		86		35	1022		2.9				3.9	16	
Oct 14	9.7		88		15	1026		0.6				6.3	26	
Oct 15	15.9		95		37	1022		1.1				7.3	30	
Oct 16	11.7		67		35	1025		0.0				3.6	15	
Oct 17	12.8	15.1	80		48	1025	1018	0.0	0.048	0.051	0.062	4.3	18	North East
Oct 18	8.9	11.6	72		33	1031	1032	0.0	0.034	0.03	0.034	2.8	12	East
Oct 19	10.0		87		26	1029		0.3				1.6	7	
Oct 20	13.3		85		53	1012		1.4				2.7	11	
Oct 21	8.1		79		49	1025		0.6						
Oct 22	8.4	3.9	78	94	27	1027	1026	0.0	0.061	0.068	0.083			South West
Oct 23	13.1	11.7	83	91	39	1020	1018	0.0	0.086	0.134	0.124	2.6	11	South East
Oct 24	8.3		66		39	1026		0.0				3.8	16	
Oct 25	7.0	13	76		24	1026	1020	0.0	0.059	0.048	0.048	5.2	22	South
Oct 26	7.0		91		22	1021		6.1				7.9	33	
Oct 27	8.4		93		27	1012		16.9				3	13	
Oct 28	10.0		93		28	1011		3.3				3.9	16	

Oct 29	10.3	12.7	90	70	40	1018	1012	0.0	0.054	0.047	0.048	4.2	18	South
Oct 30	10.0	18.6	83		26	1022	1022	0.0	0.068	0.055	0.053	4.4	18	North
Oct 31	13.9	15	85	100	22	1021	1020	0.0	0.132	0.104	0.09	8.1	34	South
Nov 1	17.8	15	87	91	40	1013	1101	0.0	0.108	0.089	0.082	9.7	40	None
Nov 2	16.4		95		31	1006		37.6				2.6	11	
Nov 3	8.3		80		41	1030		0.0				4.8	20	
Nov 4	7.8	8.9	87	88	19	1035	1020	0.0	0.054	0.045	0.047	5	21	None
Nov 5	9.7		95		24	1029		25.2				2.6	11	
Nov 6	13.1		98		25	1017		12.1				1.3	5	
Nov 7	11.7		74		34	1022		0.0				3.7	15	
Nov 8	8.4		76		21	1028		0.0				5.3	22	
Nov 9	6.2		93		21	1028		20.8				4.7	20	
Nov 10	3.4		82		54	1029		0.0				4.4	18	
Nov 11	2.8		71		23	1032		0.0				6	25	
Nov 12	4.2		89		23	581		7.5				9.3	39	
Nov 13	5.6		93		41	1025		10.8				5.9	25	
Nov 14	3.3		59		28	1035		0.0				5.3	22	
Nov 15	-0.3		91		26	1035		28.0				4.1	17	
Nov 16	3.1		93		32	1019		4.6				5.3	22	

Nov 17	4.7		75		34	1028		0.0				14	55	
Nov 18	4.2		86		20	1029		0.0				12.6	52	
Nov 19	7.2		92		15	1021		0.0				21.2	70	
Nov 20	6.1		89		38	1021		0.0				13.9	55	
Nov 21	4.7		67		40	1027		0.0				12.1	51	
Nov 22	-2.2		53		36	1037		0.0				3.4	14	
Nov 23	-2.5		53		23	1038		0.0				7.7	32	
Nov 24	1.2		92		27	1026		28.2				10	42	
Nov 25	7.5		98		18	1015		0.0				11.4	48	
Nov 26	7.3		88		40	1012		5.4				8.4	35	
Nov 27	3.6		63		47	1006		0.0				4.4	18	
Nov 28	1.4		62		56	1016		0.0				5	21	
Nov 29	1.4		74		34	1020		0.0				7.4	31	
Nov 30	3.6		76		14	1022		0.2				11.7	49	
Jan 1	9.5		95		52	1024		0.0				2.5	10	
Jan 2	5.0		84		27	1028		0.0				5	21	
Jan 3	2.8		82		34	1019		0.0				5.1	21	
Jan 4	2.5		93		12	1018		1.6				14.5	56	
Jan 5	7.2		95		31	1011		7.5				5.8	24	

Jan 6	5.3		81		51	1029		0.0				6.4	27	
Jan 7	0.0		67		31	1034		0.6				2.7	11	
Jan 8	4.7		93		43	1022		3.6				7.6	32	
Jan 9	3.1		70		50	1012		0.3				3.3	14	
Jan 10	-0.3		58		55	1022		0.0				2.3	10	
Jan 11	-1.7		62		35	1032		0.0				3.9	16	
Jan 12	-2.5		92		16	1036		2.6				10.1	42	
Jan 13	-1.7		89		19	1031		1.9				10.8	45	
Jan 14	-2.8		82		15	1027		0.0				7.8	33	
Jan 15	-2.2		84		23	1025		0.0				18.7	65	
Jan 16	0.3		75		37	1026		0.0				11.1	46	
Jan 17	0.0		85		23	1029		1.6				6.6	28	
Jan 18	0.9		92		15	1024		0.7				21.9	72	
Jan 19	1.7		91		23	1024		23.7				14.5	56	
Jan 20	-3.9		95		56	1018		12.5				3.5	15	
Jan 21	-5.8		58		53	1036		0.0				2.4	10	
Jan 22	-7.3		68		23	1041		0.0				6.6	28	
Jan 23	2.8		83		23	1031		0.4				4.9	20	
Jan 24	5.6		98		54	1013		24.5				4.9	20	

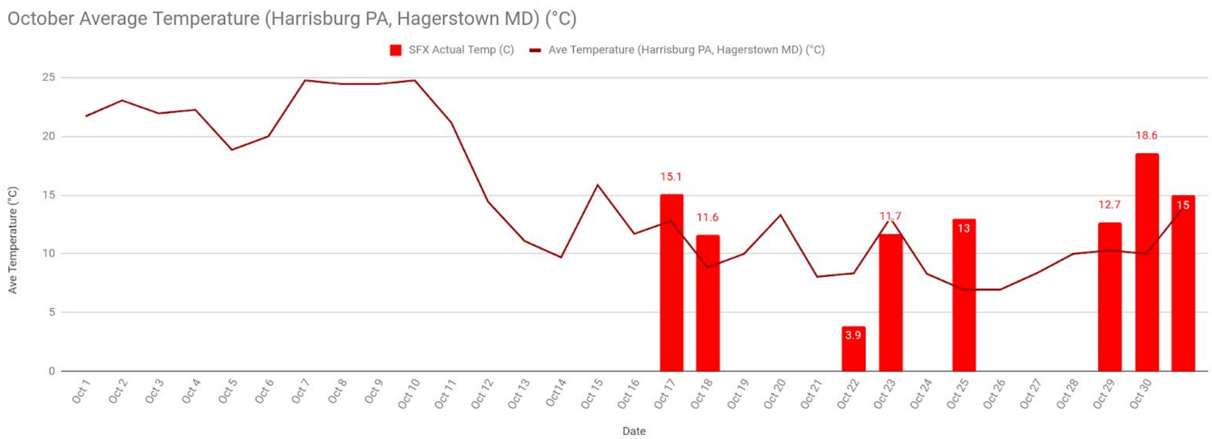
Jan 25	-1.4		63		48	1024		0.2				4.7	20	
Jan 26	-2.0		70		19	1025		0.0				7.1	30	
Jan 27	2.3		71		26	1021		0.0				6.1	25	
Jan 28	-2.8	3.4	62		19	1021	1017	0.0	0.05	0.048	0.041	10	42	None
Jan 29	-2.5		92		32	1017		2.6				12.9	53	
Jan 30	-8.9		70		60	1027		0.0				6.7	28	
Jan 31	-11.7		55		26	1029		0.0				5.8	24	
Feb 1	-10.3		86		11	1032		2.8				16.7	61	
Feb 2	-6.4		90		16	1031		0.0				32.2	93	
Feb 3	1.9		90		14	1023		0.0				25.8	80	
Feb 4	5.8	16.9	92		12	1021	1018	0.0	0.094	0.076	0.066	22.5	73	None
Feb 5	11.1		86		23	1021		0.0				17	61	
Feb 6	5.3		96		22	1022		2.8				8.4	35	
Feb 7	7.8		97		27	1020		0.3				10.9	45	
Feb 8	4.7		97		55	1031		2.8				5.1	21	
Feb 9	-2.2		50		44	1043		0.0				3.5	15	
Feb 10	-2.8		89		19	1041		2.5				8.8	37	
Feb 11	0.3		92		15	1028		9.1				19.1	66	
Feb 12	0.6		94		27	1027		19.8				9.3	39	

Feb 13	2.2		93		46	1014		0.0				6.9	29	
Feb 14	2.8		70		27	1021		0.0				5.9	25	
Feb 15	9.4		73		39	1012		0.0				5.1	21	
Feb 16	2.0		66		34	1020		0.0				5.5	23	
Feb 17	-1.1		78		27	1022		0.5				5.4	23	
Feb 18	2.5		96		48	1031		0.0				7.2	30	
Feb 19	-0.9		61		27	1039		0.0				4.8	20	
Feb 20	-0.6		89		27	1036		16.5				6.6	28	
Feb 21	5.9		93		25	1024		0.0				12	50	
Feb 22	5.0		67		21	1032		0.0				11.5	48	
Feb 23	2.3		91		18	1032		0.3				15.8	59	
Feb 24	7.0		92		60	1019		11.9				5.4	23	
Feb 25	3.1		40		64	1027		0.0				4	17	
Feb 26	2.0		49		27	1031		0.0				4.9	20	
Feb 27	1.2		70		27	1030		0.0				5.3	22	
Feb 28	2.5		76		33	1024		0.0				7.5	31	
Mar 1	1.4		92		19	1026		8.6				12.7	52	
Mar 2	5.6		92		18	1021		4.3				19.2	66	
Mar 3	3.6		91		21	1023		14.4				12.6	52	

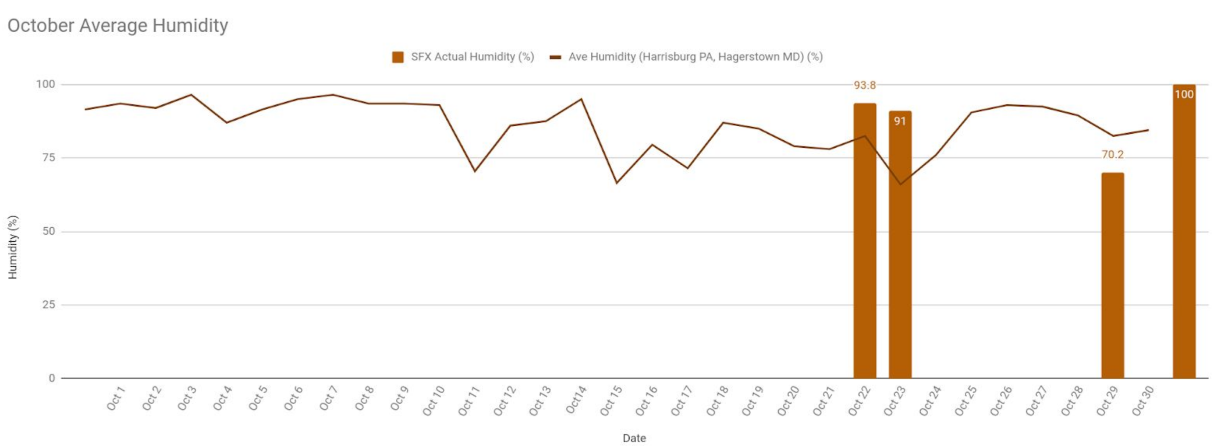
Mar 4	1.4		87		37	1020		0.0				8.2	34	
Mar 5	0.6		61		39	1021		0.0				6.7	28	
Mar 6	-3.3		64		39	1027		0.0				8.4	35	
Mar 7	2.0		62		32	1030		0.0				13.3	54	
Mar 8	1.4		87		21	1030		0.3				18.3	64	
Mar 9	6.4		89		23	1028		3.2				27.4	83	
Mar 10	10.9		96		31	1022		15.1				7.9	33	
Mar 11	13.9		77		43	1022		0.0				7.1	30	
Mar 12	9.2		61		39	1028		0.0				5.8	24	
Mar 13	13.9		71		27	1028		0.0				10	42	
Mar 14	20.8		76		31	1023		0.0				7.6	32	
Mar 15	24.5		70		52	1013		0.0				8.6	36	
Mar 16	10.0		57		50	1025		0.0				3	13	
Mar 17	8.6		56		31	1026		0.0				5	21	
Mar 18	8.6		53		23	1029		0.0				6.8	28	
Mar 19	10.0		69		19	1033		0.0				10	42	
Mar 20	6.9	-0.5	67		28	1030	1018	0.0	0.067	0.063	0.057	15.9	59	South East
Mar 21	7.8		91		31	1022		53.4				5.6	23	
Mar 22	10.0		83		61	1011		4.6				4.8	20	

Mar 23	10.6		61		48	1025		0.0				2.9	12	
Mar 24	17.0		57		25	1026		0.0				4.5	19	
Mar 25	13.1		87		22	1021		5.6				8.3	35	
Mar 26	8.9		82		27	1030		0.0						
Mar 27	11.1		63		23	1035		0.0						
Mar 28	16.4		69		29	1031		0.0				7.9	33	
Mar 29	17.0		75		15	1021		0.7				13.2	53	
Mar 30	24.4		90		39	1019		0.0				19.5	67	
Mar 31	18.4		66		52	1022		0.3				7.3	30	

Table 1: This data table shows all of the averages for Aerosols and all of the other comparison measurements that were put onto the graphs.

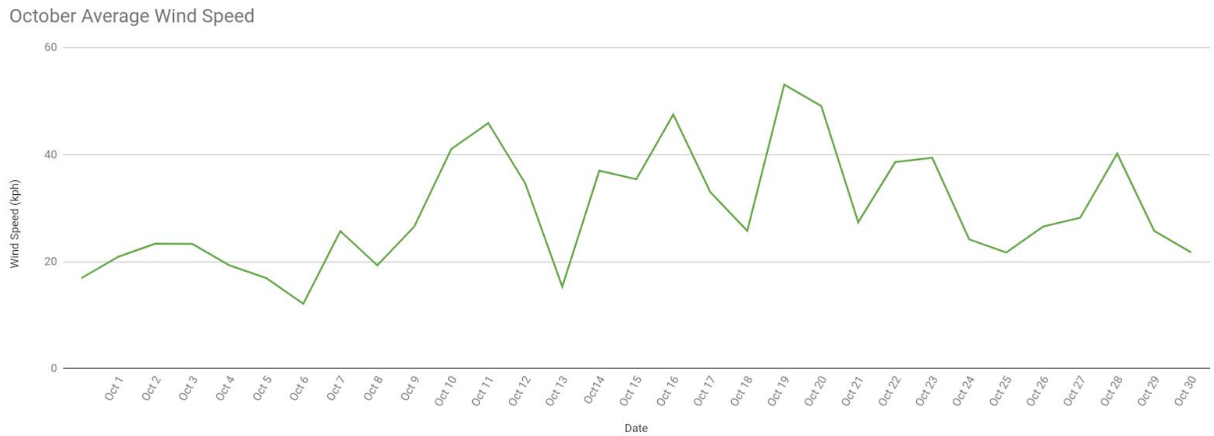


Graph 1: This graph shows the average temperature for the month of October as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It also includes actual measurements taken directly at St. Francis. There does not seem to be a clear relationship between temperature and aerosols, but more data is needed to be sure.

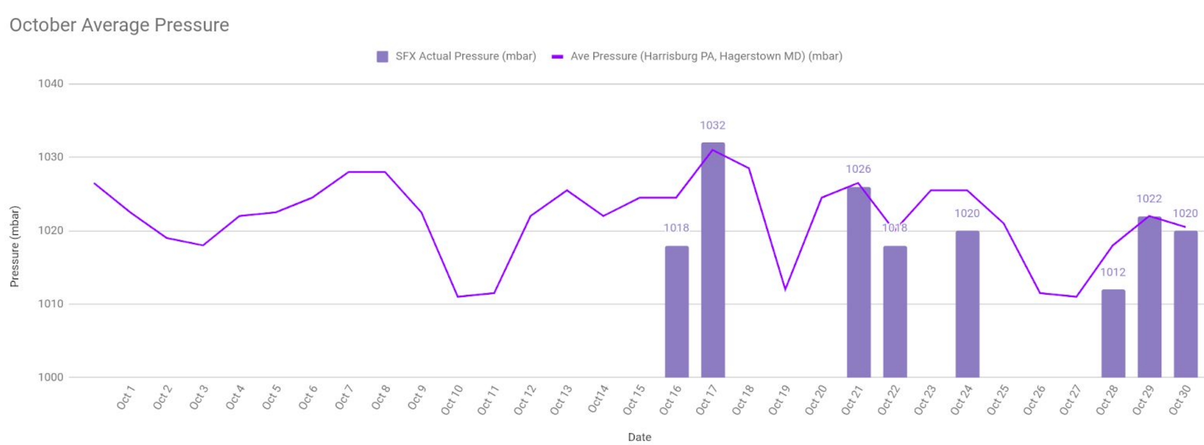


Graph 2: This graph shows the average humidity for the month of October as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg.

It also includes actual measurements taken directly at St. Francis. It seems as though when the humidity is high, the aerosols are high and smal for the most part.

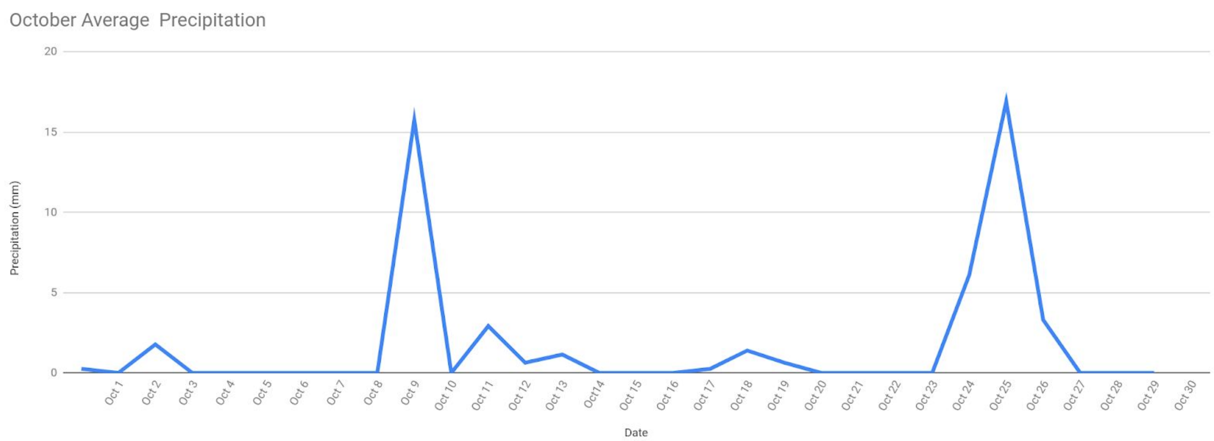


Graph 3: This graph shows the average wind speed for the month of October as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It seems as though there might be a pattern that when the wind speed is low, the aerosols are low, but more data is needed to be sure.

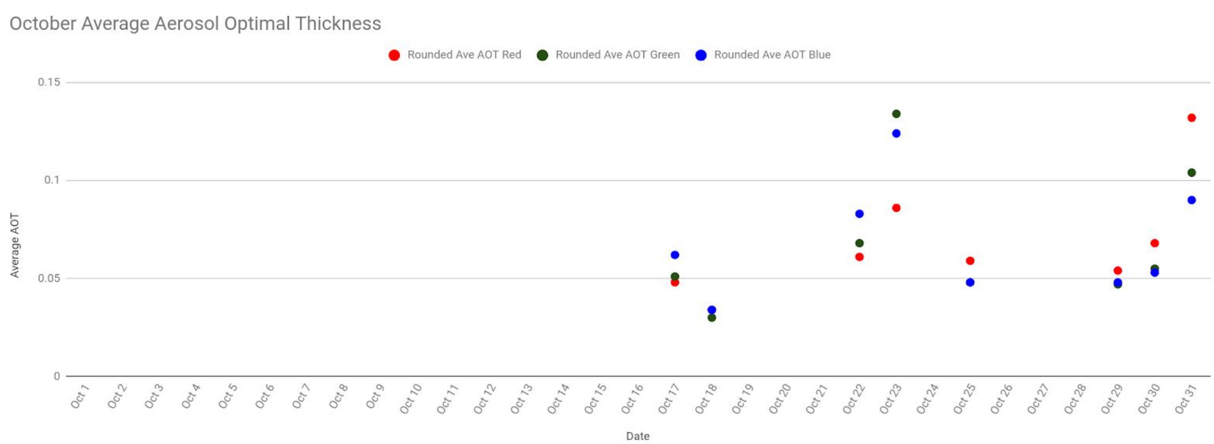


Graph 4: This graph shows the average pressure for the month of October as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It also

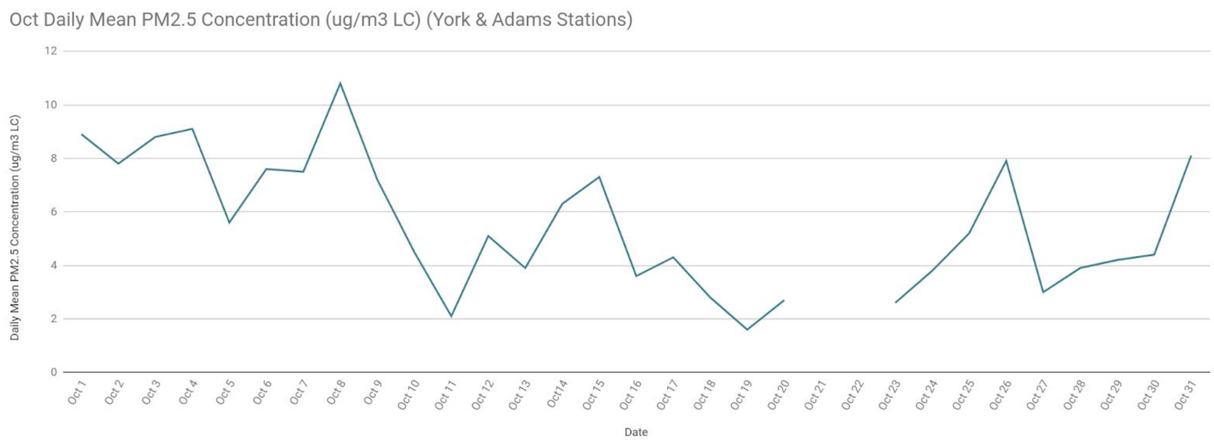
includes actual measurements taken directly at St. Francis. It seems as though when pressure is high, aerosols are low and when pressure is low, aerosols are high.



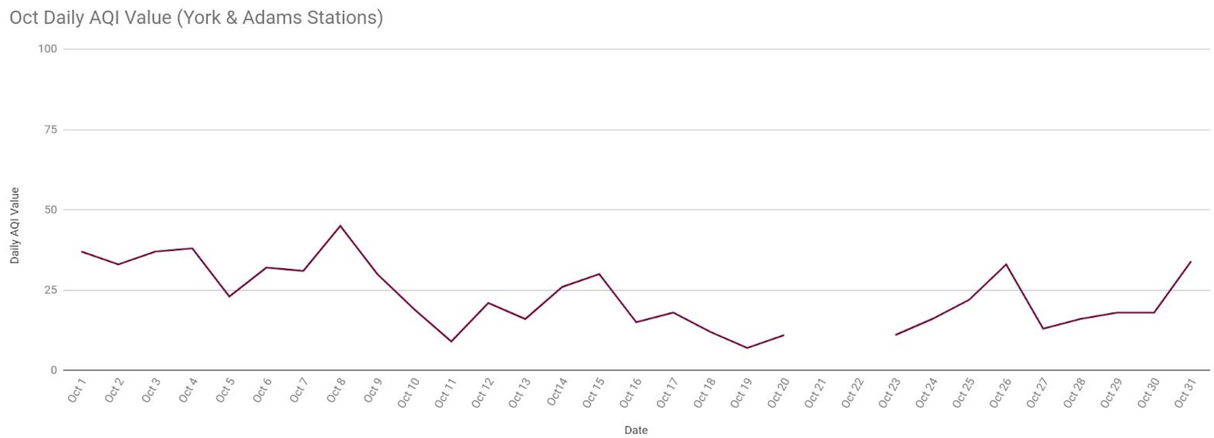
Graph 5: This graph shows the average precipitation for the month of October as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It seems as though when there is no rain, the aerosols are high and large. Right after it rains, the aerosols seem to get lower and smaller.



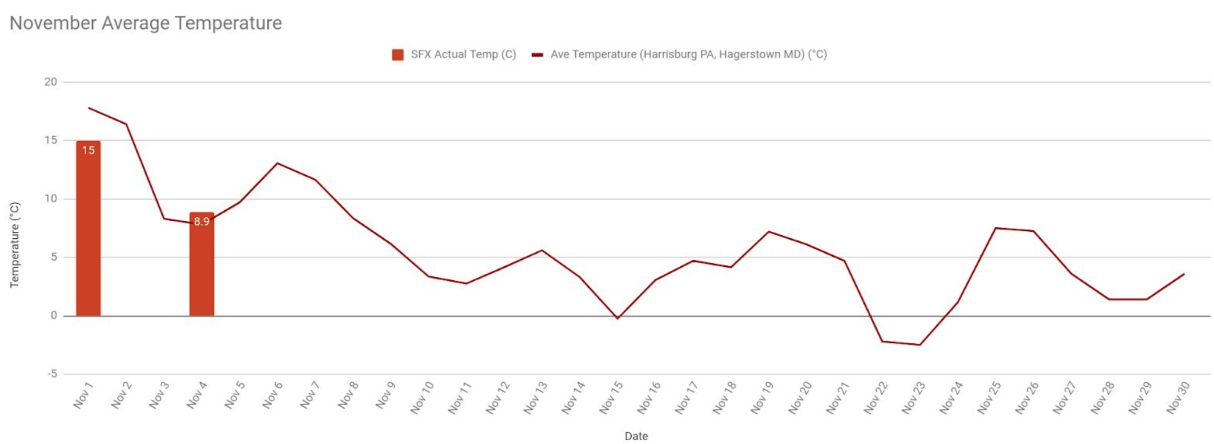
Graph 6: This graph shows the aerosols for the month of October as measured at St. Francis with the Calitoo. When the dots are farther apart it means the particles are smaller and when the dots are close together, the particles are larger.



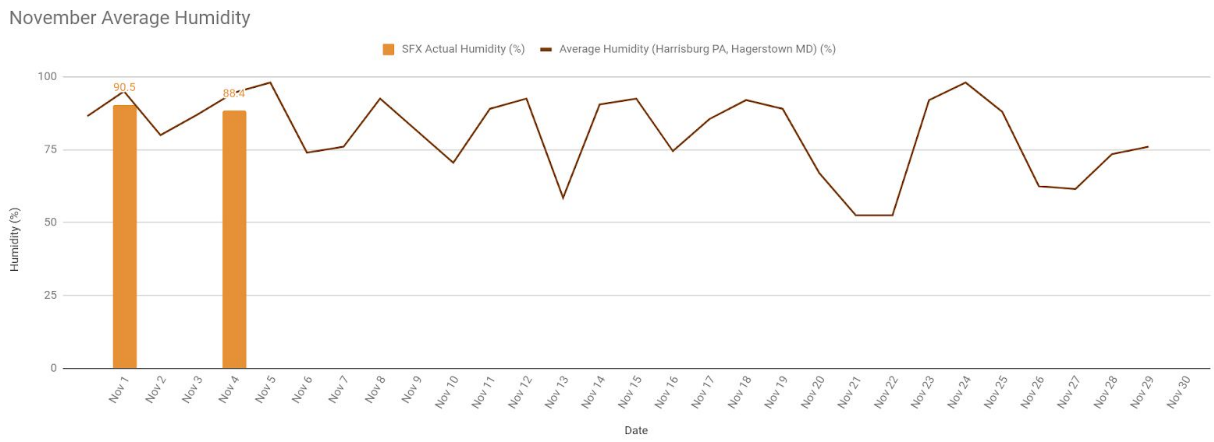
Graph 7: This graph shows the average PM2.5 concentration for the month of October as taken from the York and Adams stations, the two closest to Gettysburg. It seems as though when the PM2.5 is low, the aerosols are as well. When the PM2.5 levels are high, the aerosols are high as well.



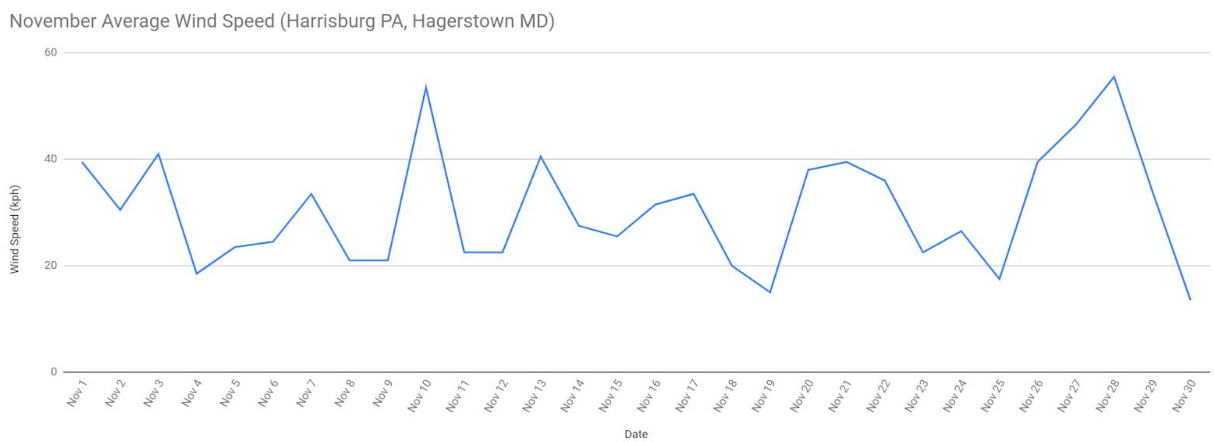
Graph 8: This graph shows the average AQI value for the month of October as taken from the York and Adams stations, the two closest to Gettysburg. It seems as though when the AQI is low, the aerosols are as well. When the AQI levels are high, the aerosols are high as well.



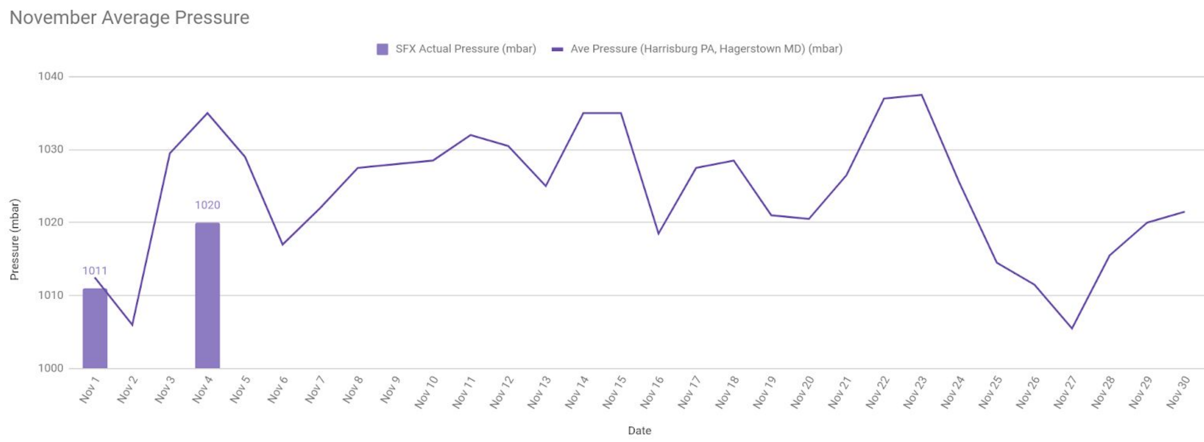
Graph 9: This graph shows the average temperature for the month of November as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It also includes actual measurements taken directly at St. Francis. There does not seem to be a clear relationship between temperature and aerosols, but more data is needed to be sure.



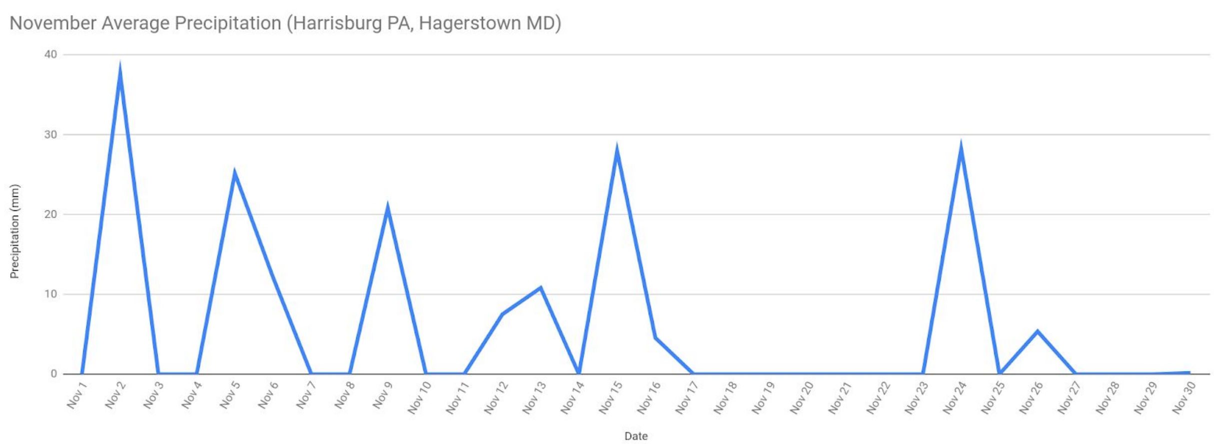
Graph 10: This graph shows the average humidity for the month of November as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It also includes actual measurements taken directly at St. Francis. It seems as though when the humidity is high, the aerosols are high and smal for the most part.



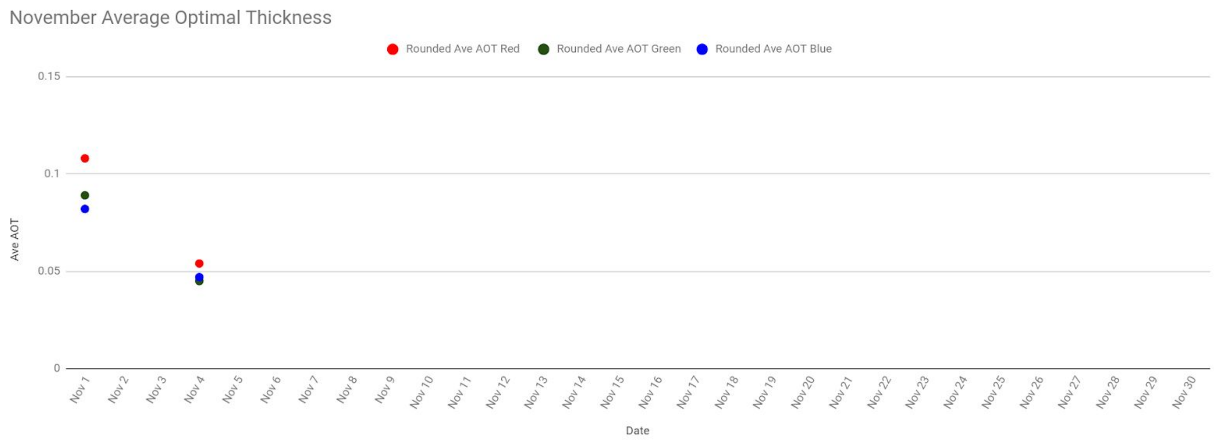
Graph 11: This graph shows the average wind speed for the month of November as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It seems as though there might be a pattern that when the wind speed is low, the aerosols are low, but more data is needed to be sure.



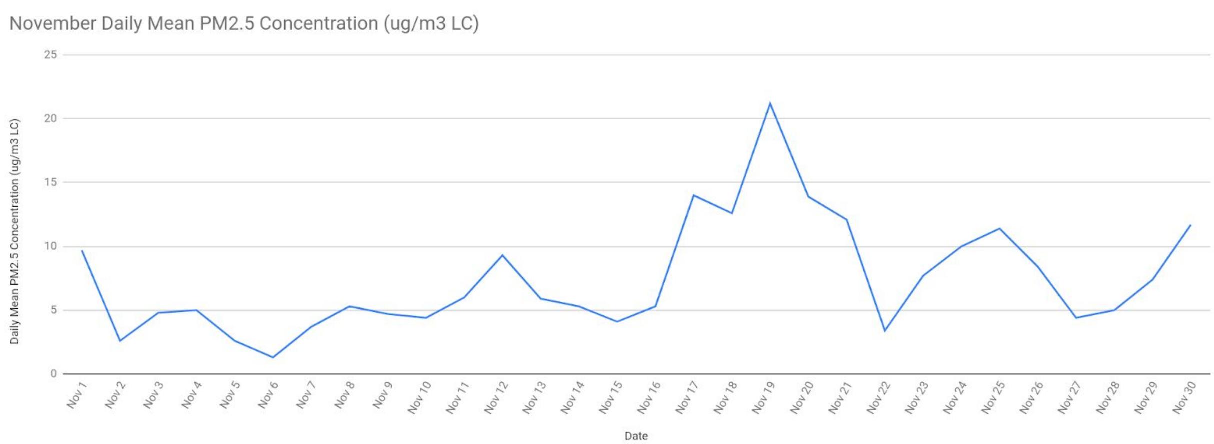
Graph 12: This graph shows the average pressure for the month of November as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It also includes actual measurements taken directly at St. Francis. It seems as though when pressure is high, aerosols are low and when pressure is low, aerosols are high



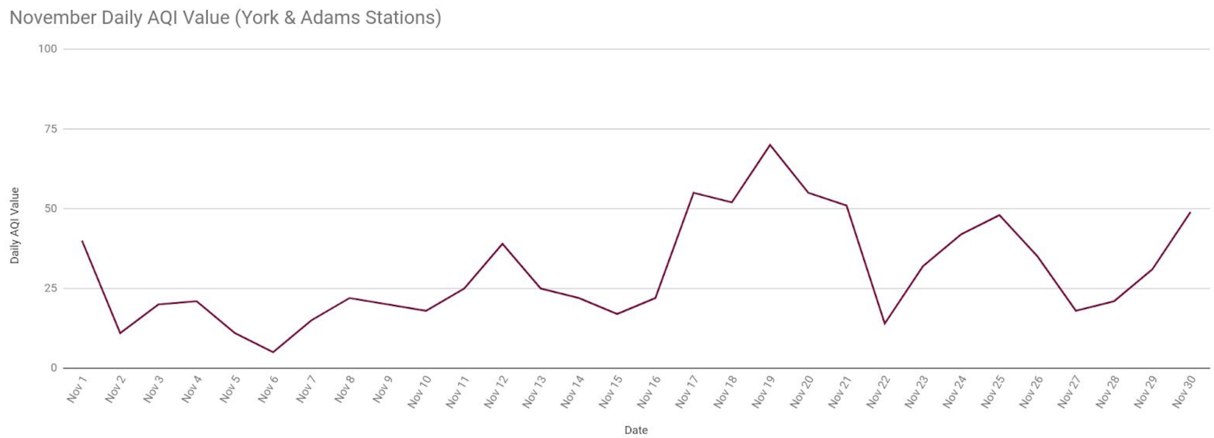
Graph 13: This graph shows the average precipitation for the month of November as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It seems as though when there is no rain, the aerosols are high and large. Right after it rains, the aerosols seem to get lower and smaller.



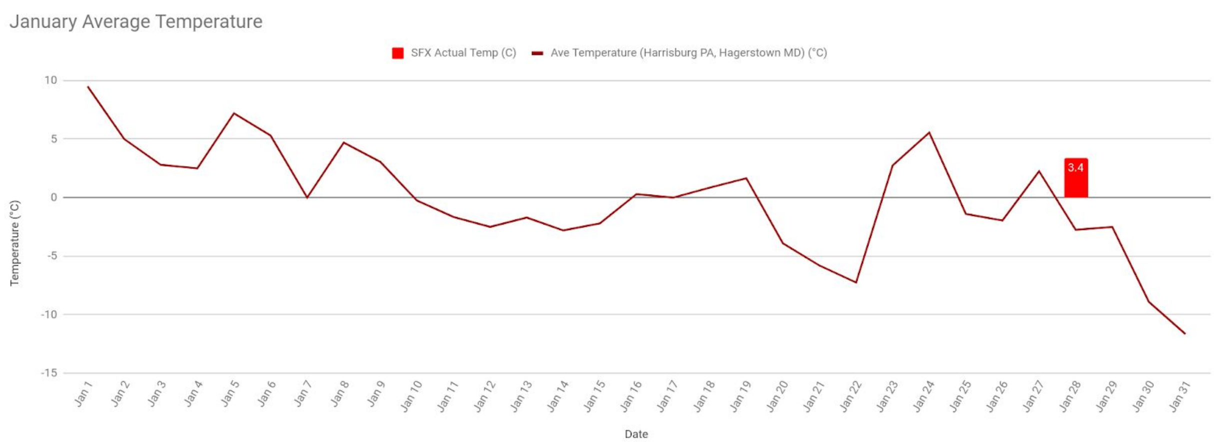
Graph 15: This graph shows the aerosols for the month of November as measured at St. Francis with the Calitoo. When the dots are farther apart it means the particles are smaller and when the dots are close together, the particles are larger.



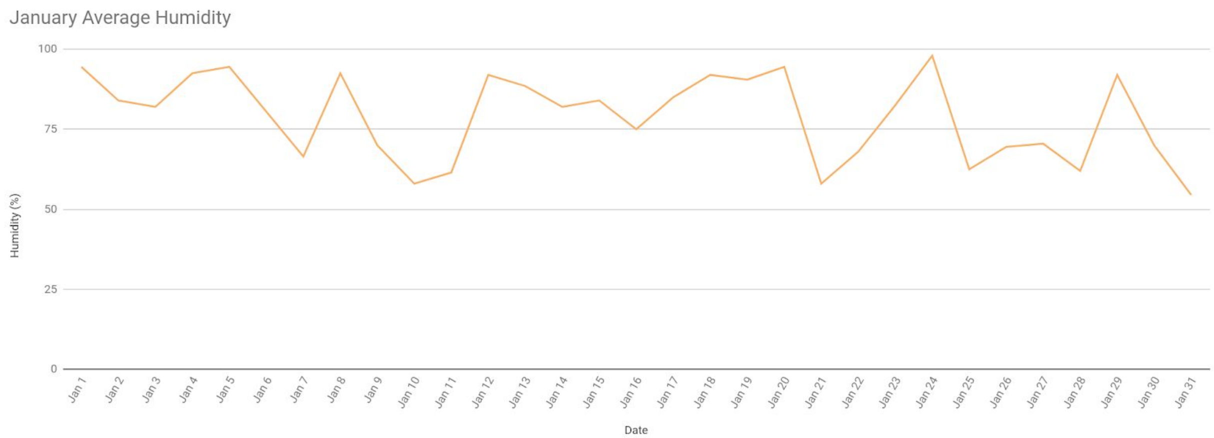
Graph 16: This graph shows the average PM2.5 concentration for the month of November as taken from the York and Adams stations, the two closest to Gettysburg. It seems as though when the PM2.5 is low, the aerosols are as well. When the PM2.5 levels are high, the aerosols are high as well.



Graph 17: This graph shows the average AQI value for the month of November as taken from the York and Adams stations, the two closest to Gettysburg. It seems as though when the AQI is low, the aerosols are as well. When the AQI levels are high, the aerosols are high as well.



Graph 18: This graph shows the average temperature for the month of January as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It also includes actual measurements taken directly at St. Francis. There does not seem to be a clear relationship between temperature and aerosols, but more data is needed to be sure.



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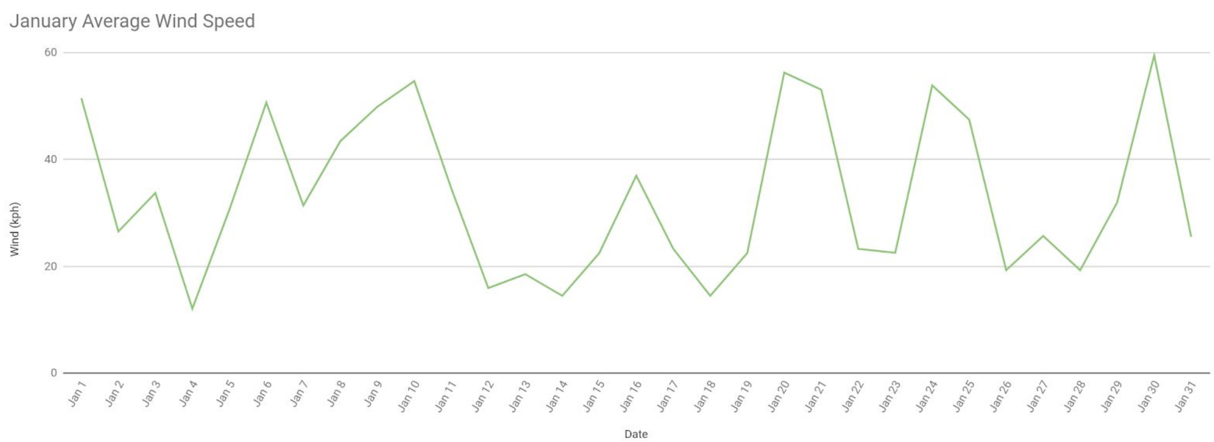
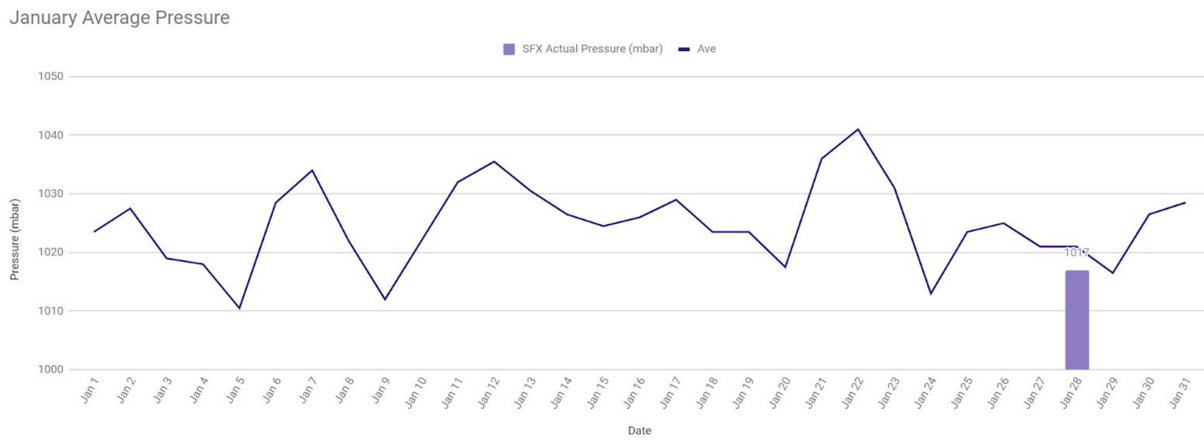
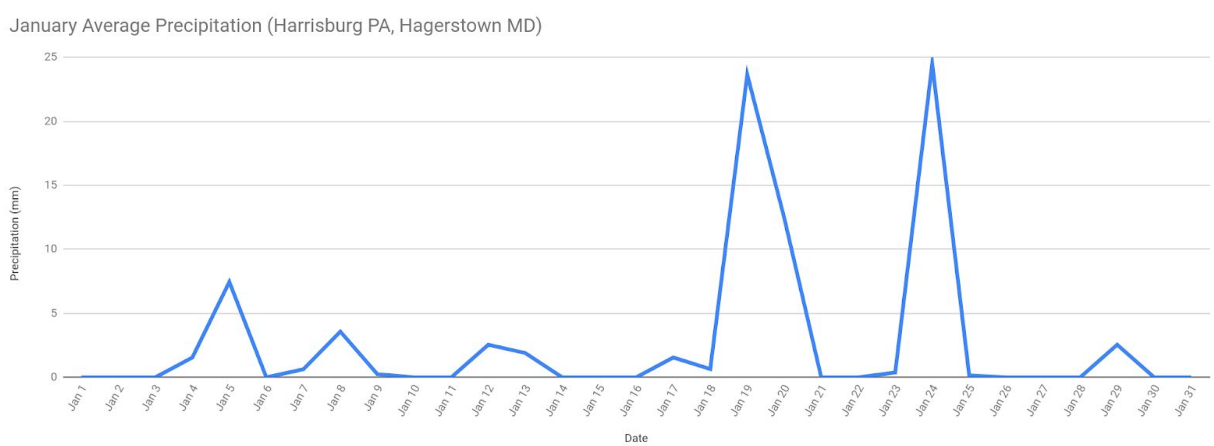


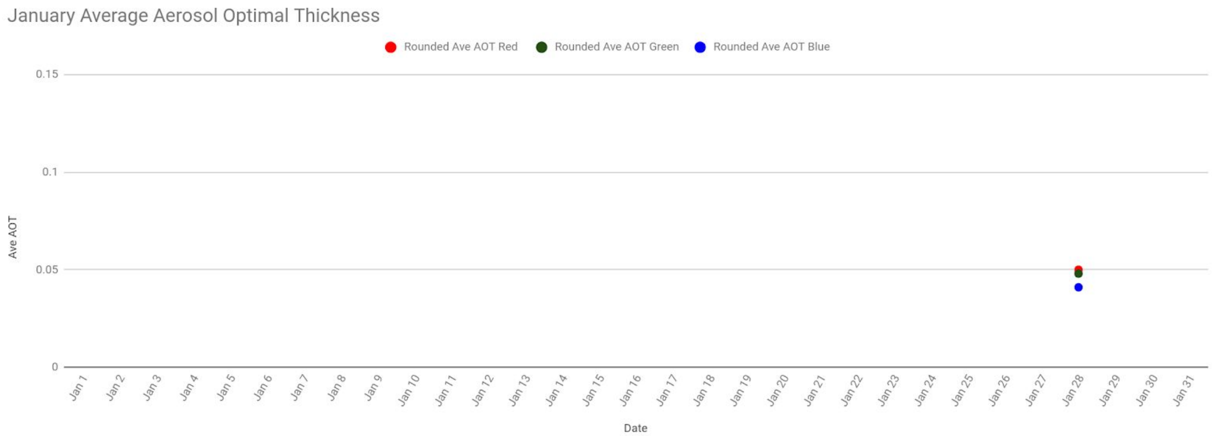
Graph 20: This graph shows the average wind speed for the month of January as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It seems as though there might be a pattern that when the wind speed is low, the aerosols are low, but more data is needed to be sure.



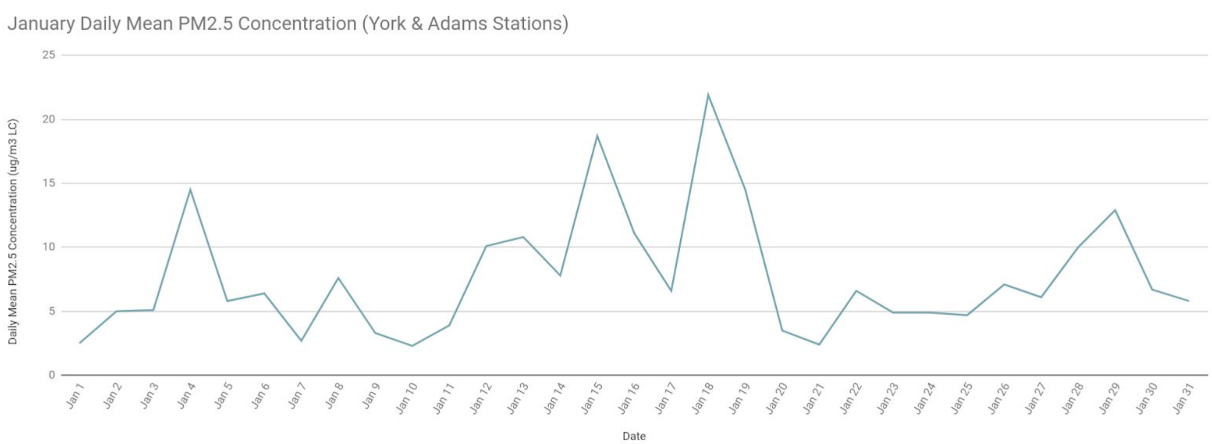
Graph 21: This graph shows the average pressure for the month of January as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It also includes actual measurements taken directly at St. Francis. It seems as though when pressure is high, aerosols are low and when pressure is low, aerosols are high



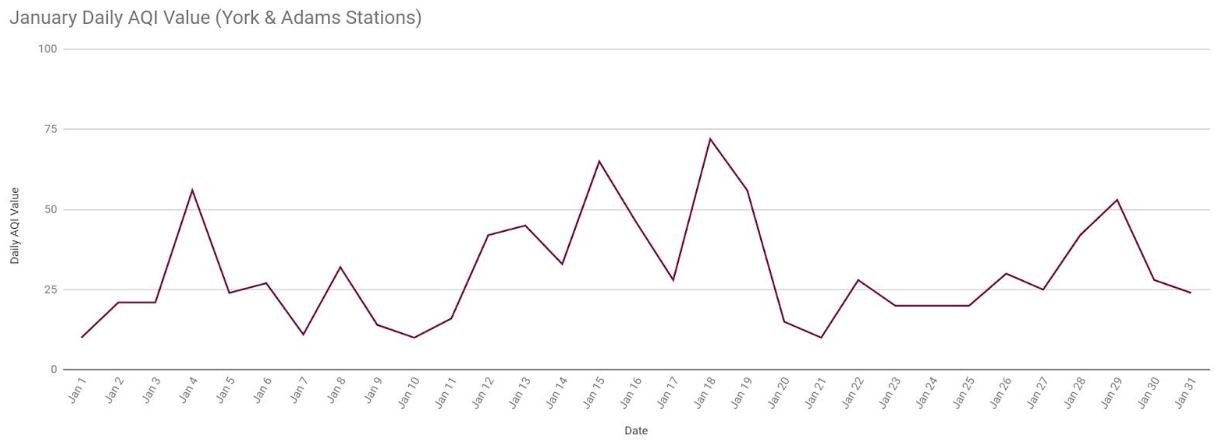
Graph 22: This graph shows the average precipitation for the month of January as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It seems as though when there is no rain, the aerosols are high and large. Right after it rains, the aerosols seem to get lower and smaller.



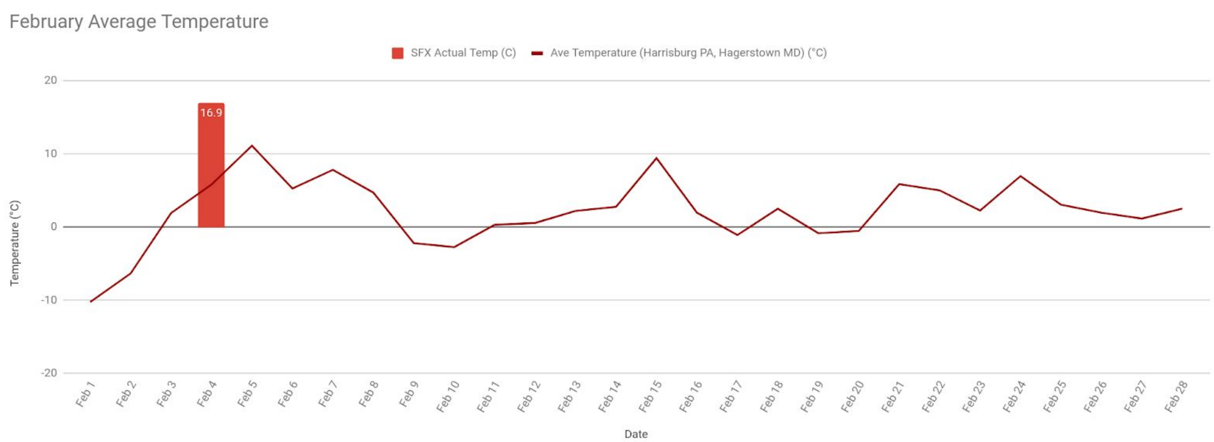
Graph 23: This graph shows the aerosols for the month of January as measured at St. Francis with the Calitoo. When the dots are farther apart it means the particles are smaller and when the dots are close together, the particles are larger.



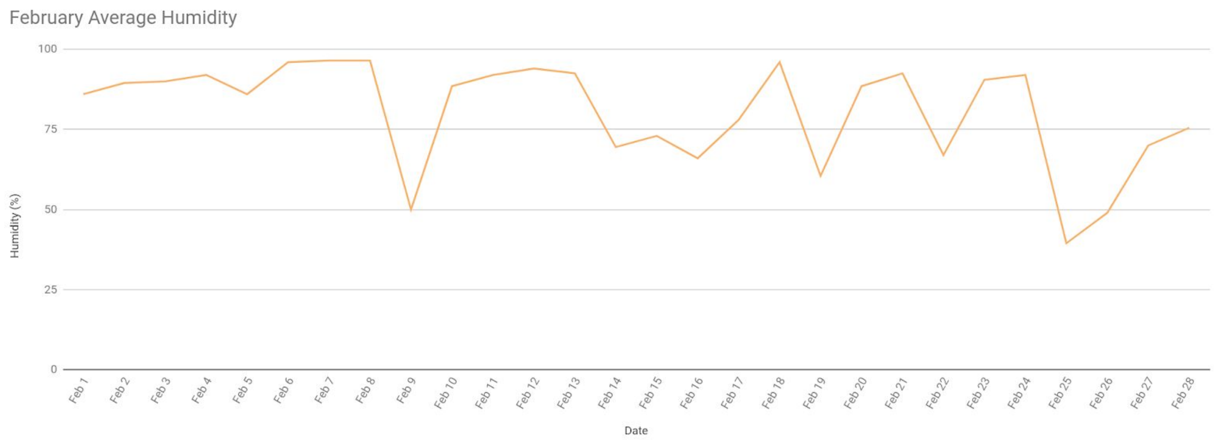
Graph 24: This graph shows the average PM2.5 concentration for the month of January as taken from the York and Adams stations, the two closest to Gettysburg. It seems as though when the PM2.5 is low, the aerosols are as well. When the PM2.5 levels are high, the aerosols are high as well.



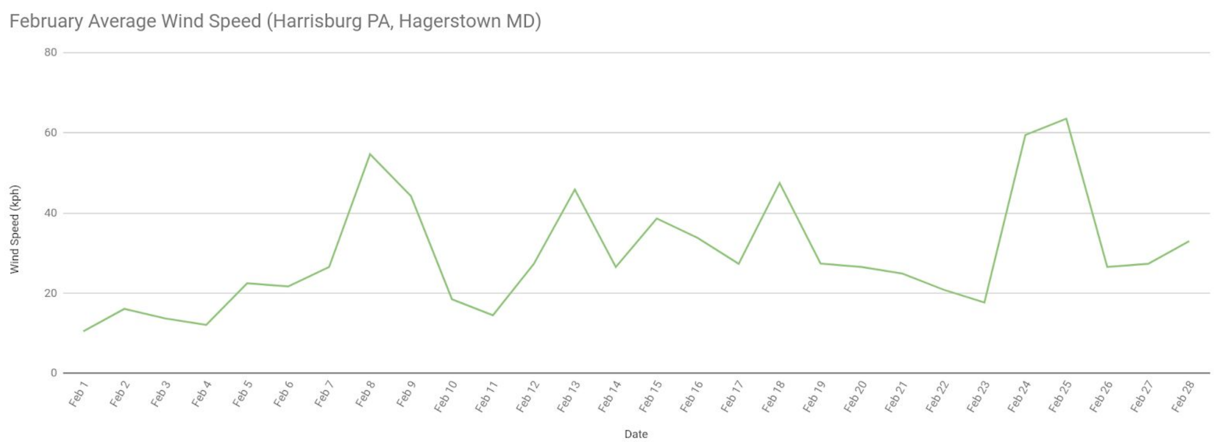
Graph 25: This graph shows the average AQI value for the month of January as taken from the York and Adams stations, the two closest to Gettysburg. It seems as though when the AQI is low, the aerosols are as well. When the AQI levels are high, the aerosols are high as well.



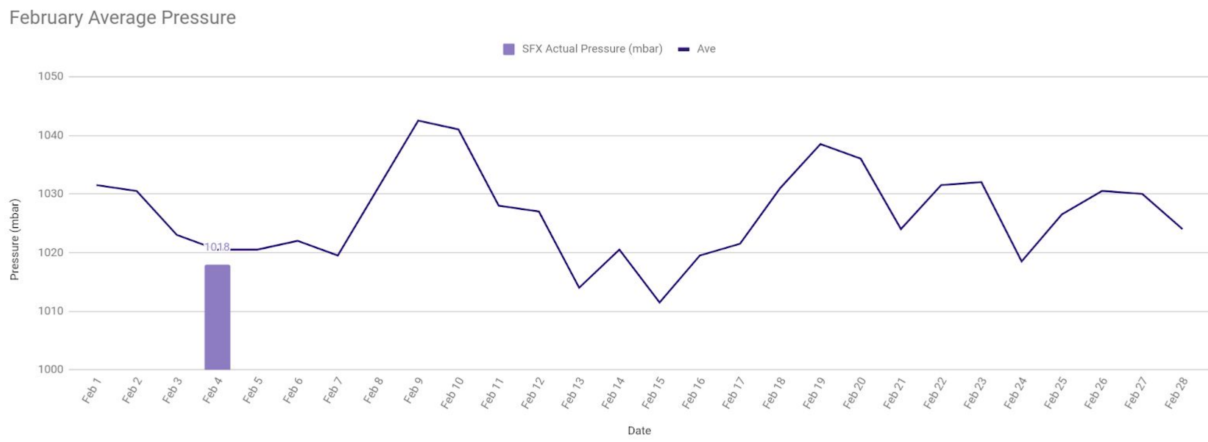
Graph 26: This graph shows the average temperature for the month of February as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It also includes actual measurements taken directly at St. Francis. There does not seem to be a clear relationship between temperature and aerosols, but more data is needed to be sure.



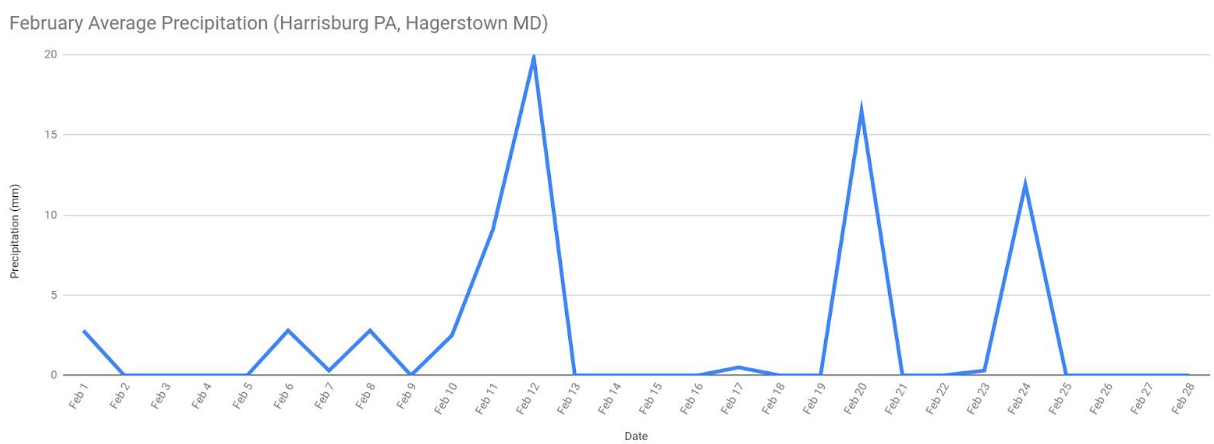
Graph 27: This graph shows the average humidity for the month of February as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It also includes actual measurements taken directly at St. Francis. It seems as though when the humidity is high, the aerosols are high and smal for the most part.



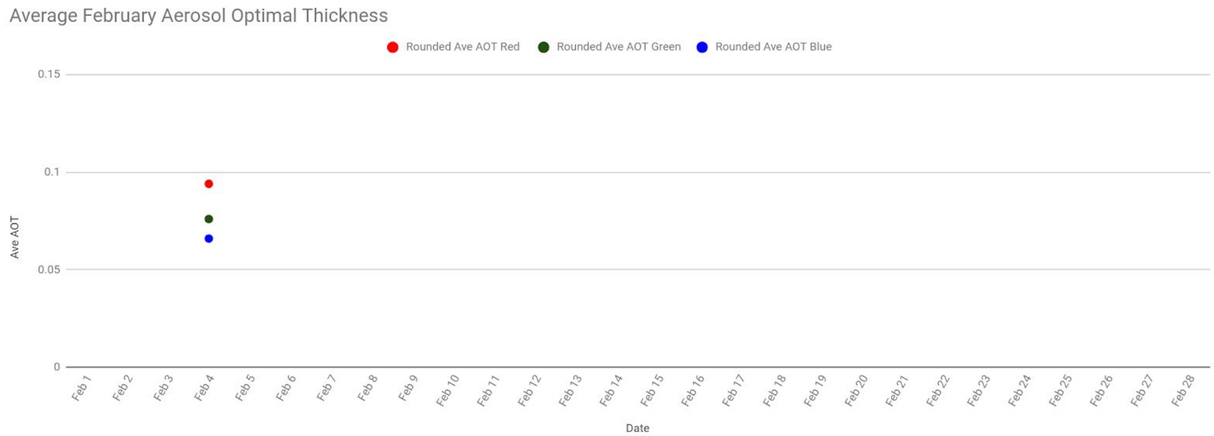
Graph 28: This graph shows the average wind speed for the month of February as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It seems as though there might be a pattern that when the wind speed is low, the aerosols are low, but more data is needed to be sure.



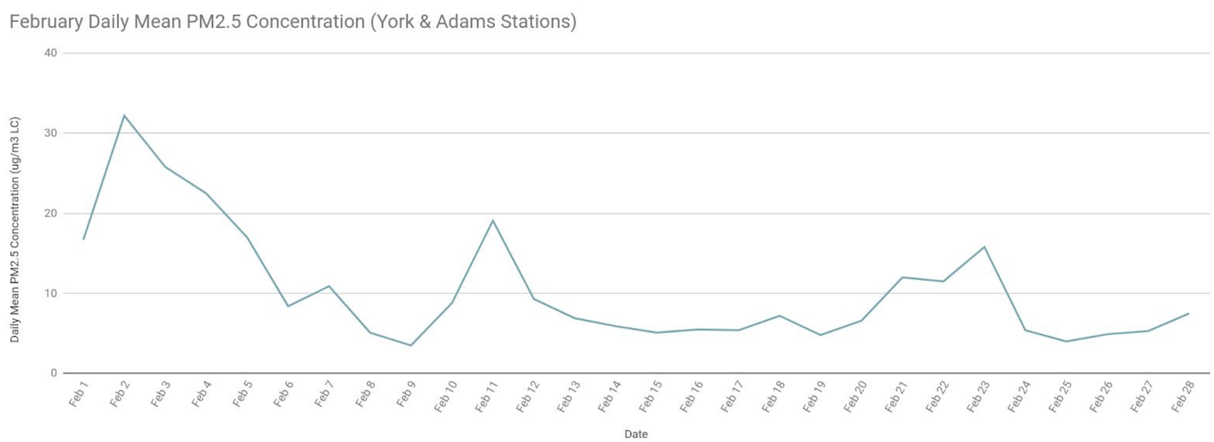
Graph 29: This graph shows the average pressure for the month of February as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It also includes actual measurements taken directly at St. Francis. It seems as though when pressure is high, aerosols are low and when pressure is low, aerosols are high



Graph 30: This graph shows the average precipitation for the month of February as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It seems as though when there is no rain, the aerosols are high and large. Right after it rains, the aerosols seem to get lower and smaller.



Graph 31: This graph shows the aerosols for the month of February as measured at St. Francis with the Calitoo. When the dots are farther apart it means the particles are smaller and when the dots are close together, the particles are larger.



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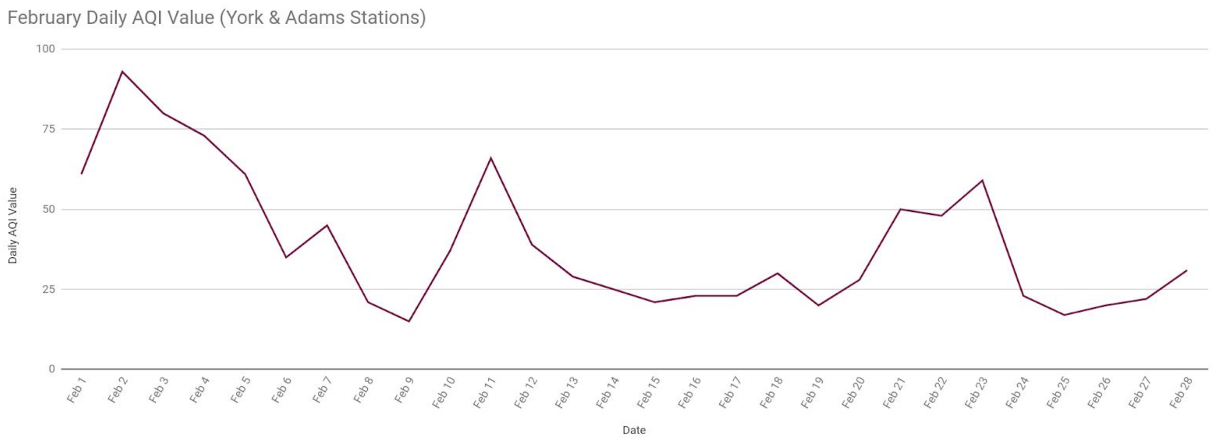
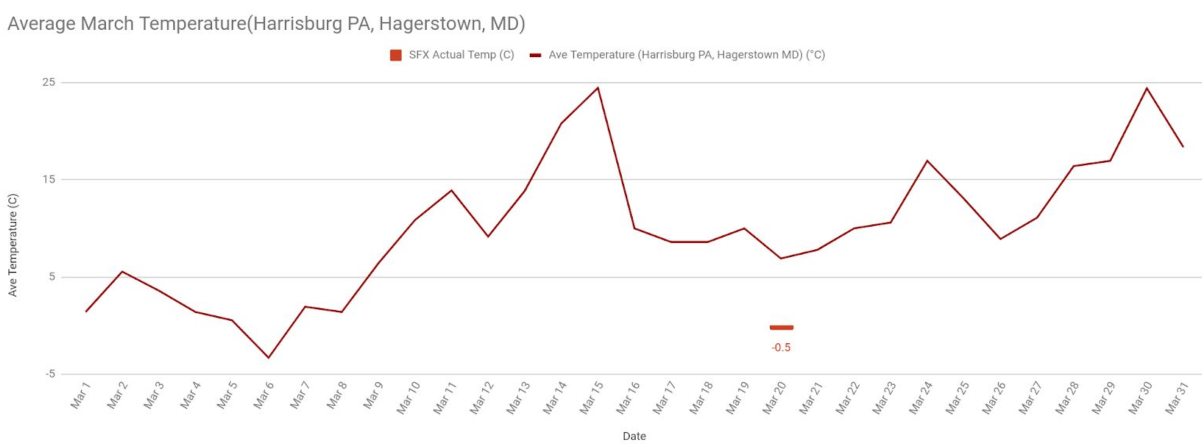
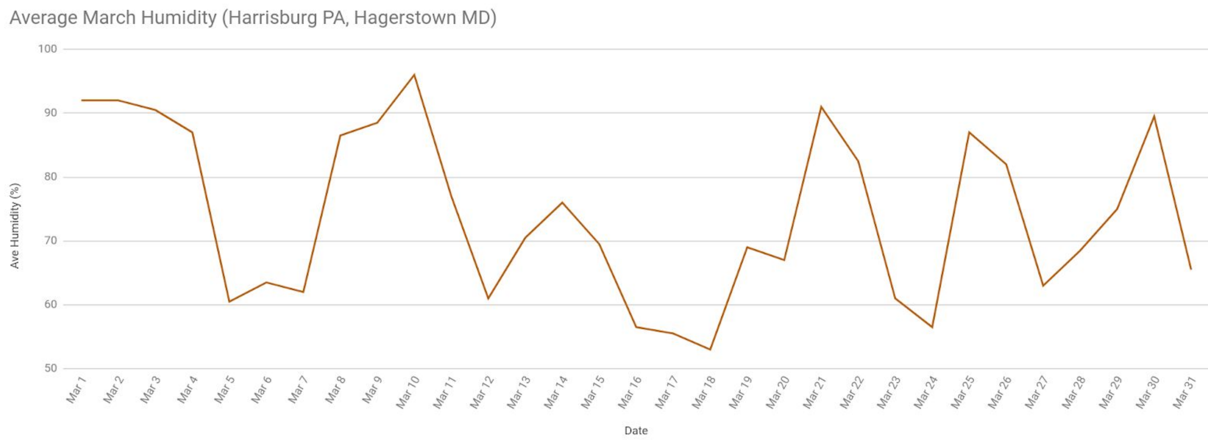


Graph 33: This graph shows the average AQI value for the month of February as taken from the York and Adams stations, the two closest to Gettysburg. It seems as though when the AQI is low, the aerosols are as well. When the AQI levels are high, the aerosols are high as well.

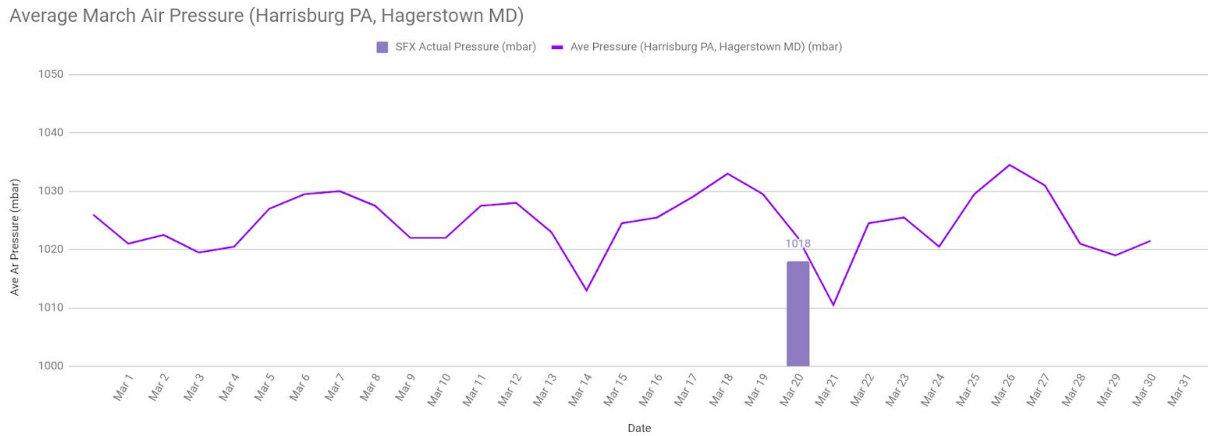


Graph 34: This graph shows the average temperature for the month of March as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It also includes actual measurements taken directly at St. Francis. There does not seem to be a clear relationship between temperature and aerosols, but more data is needed to be sure.

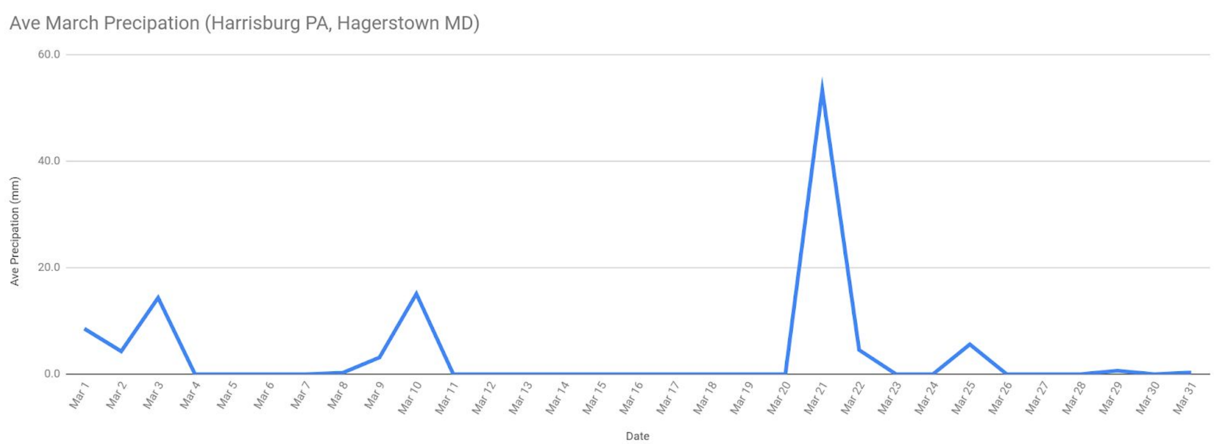


Graph 35: This graph shows the average humidity for the month of March as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It also includes actual measurements taken directly at St. Francis. It seems as though when the humidity is high, the aerosols are high and smal for the most part.

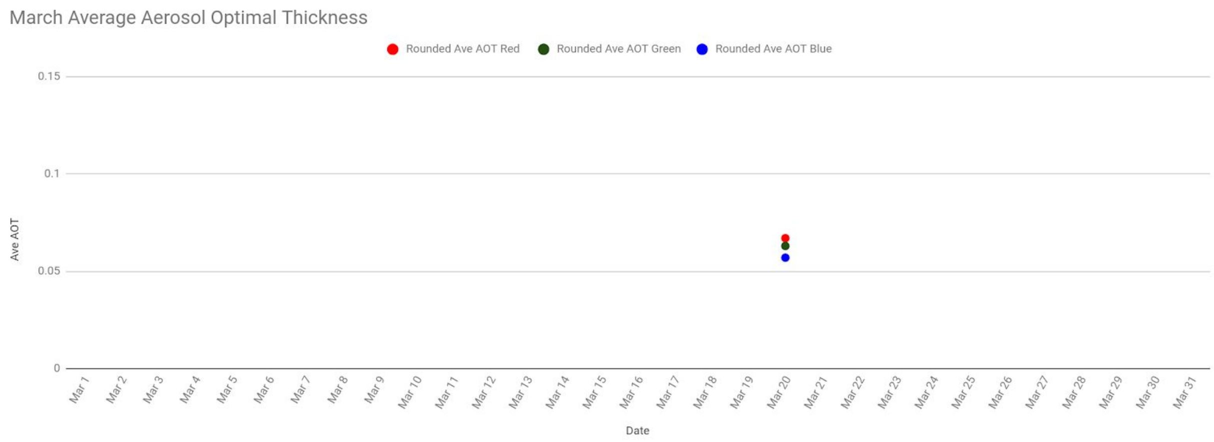
Graph 36: This graph shows the average wind speed for the month of March as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It seems as though there might be a pattern that when the wind speed is low, the aerosols are low, but more data is needed to be sure.



Graph 37: This graph shows the average pressure for the month of March as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It also includes actual measurements taken directly at St. Francis. It seems as though when pressure is high, aerosols are low and when pressure is low, aerosols are high



Graph 38: This graph shows the average precipitation for the month of March as taken from Weather Underground at the Harrisburg and Hagerstown stations, the two closest to Gettysburg. It seems as though when there is no rain, the aerosols are high and large. Right after it rains, the aerosols seem to get lower and smaller.



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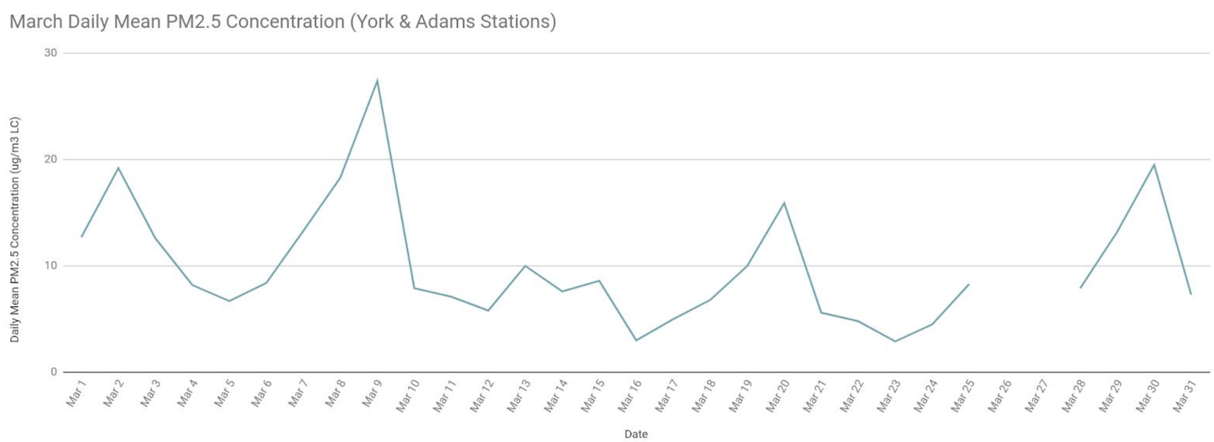
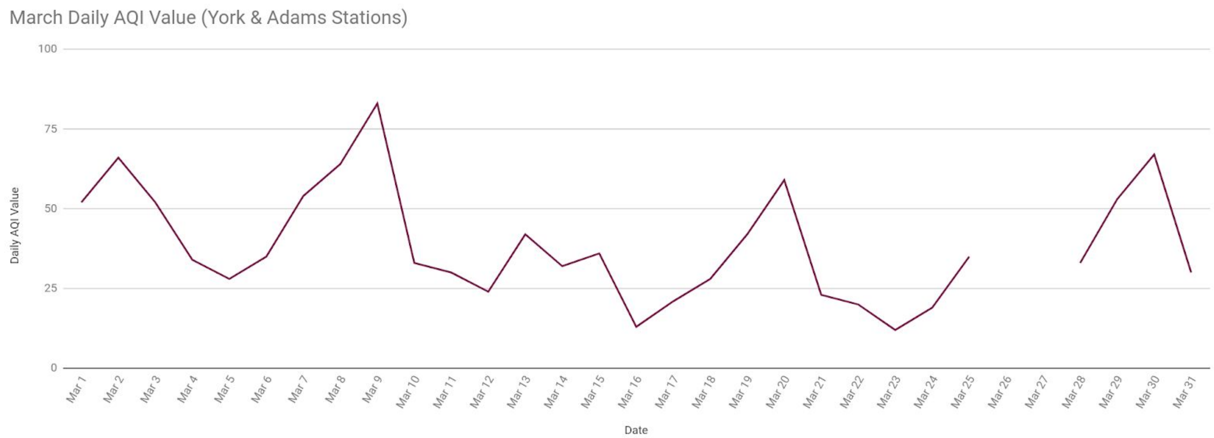


Graph 40: This graph shows the average PM2.5 concentration for the month of March as taken from the York and Adams stations, the two closest to Gettysburg. It seems as though when the PM2.5 is low, the aerosols are as well. When the PM2.5 levels are high, the aerosols are high as well.



Graph 41: This graph shows the average AQI value for the month of March as taken from the York and Adams stations, the two closest to Gettysburg. It seems as though when the AQI is low, the aerosols are as well. When the AQI levels are high, the aerosols are high as well.

Analysis and Results

The temperature, humidity, and wind seemed to have little effect on the aerosols. The last date Aerosols was taken, the AQI (Air Quality Index) was abnormally high, pairing with a higher PM2.5. This was the highest aerosols measurement taken in the entire project. The wind direction had little to no effect on the aerosol, but according to Dr. Pippin, it could sometimes affect it if it was blowing pollutants possibly from wildfires or cities. It seemed that when the pressure was low, the aerosols were high. This could be because low pressure signals a front coming through, possibly bringing in pollutants. When there was no rain, the aerosols were higher and larger. However, just after it rained, the aerosols were measured smaller and in low levels. When the PM2.5 and AQI levels were high, the aerosols were also high.

Conclusion

The question this project focused on the question; What is the relationship between the many factors that influence air quality, including temperature, humidity, wind, pressure, PM2.5, AQI, precipitation? The hypothesis states if the temperature is high, there are few clouds, the wind is blowing, and the pressure is high, then there will be higher Aerosols levels, most likely along with PM2.5 and AQI levels.

The pressure and the wind had little effect on the aerosols. The last date Aerosols was taken, the AQI (Air Quality Index) was abnormally high, pairing with a higher PM2.5. This was the highest aerosols measurement taken in the entire project. The wind direction had little to no effect on the aerosol, but according to Dr. Pippin, it could sometimes affect it if it was blowing pollutants possibly from wildfires or cities. The hypothesis was partially supported by the data. It seemed that when the pressure was low, the aerosols were high. This could be because low pressure signals a front coming through, possibly bringing in pollutants. When there was no rain, the aerosols were higher and larger. However, just after it rained, the aerosols were measured smaller and in low levels. When the PM2.5 and AQI levels were high, the aerosols were also high. There was some difficulty during the project which consisted of near constant rain which prevented the collecting of aerosols. There will be a continuation of this project for further competitions. In these future experiments, water vapor and weather fronts will be added to see how they might affect the Aerosols and PM2.5 as well.

Acknowledgements

I would like to acknowledge Mrs. Woods my amazing science teacher who got me through so much and gave up so much of her time to help me succeed in the best way possible even though sometimes I didn’t listen to her, Dr. Pippin who showed me the best way to set my project up and who help me so much, Mr. Floess who showed me the best way to write my paper and was always there when I needed an answer to one of my questions, and Mr. Toth who got me all of the equipment that I needed and showed me how to use it, and was always ready to answer my questions. Thank you all so much for all the help and time that you put into my project and making it the best it could possibly be.

GLOBE Student Research Badges

STEM Professional

I have listed all of the ways that Mr. Todd Toth, Dr. Pippin, and Mr. Jumper have helped me more accurately collect my data for my project and find historic data to add to my project.

Data Scientist

I have analysed my data and compared it to other students and data collecting sites data. I have compared my measurements with other measurements of my own, and compared my measurements with historical data, taken from local weather stations and Weather Underground.

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