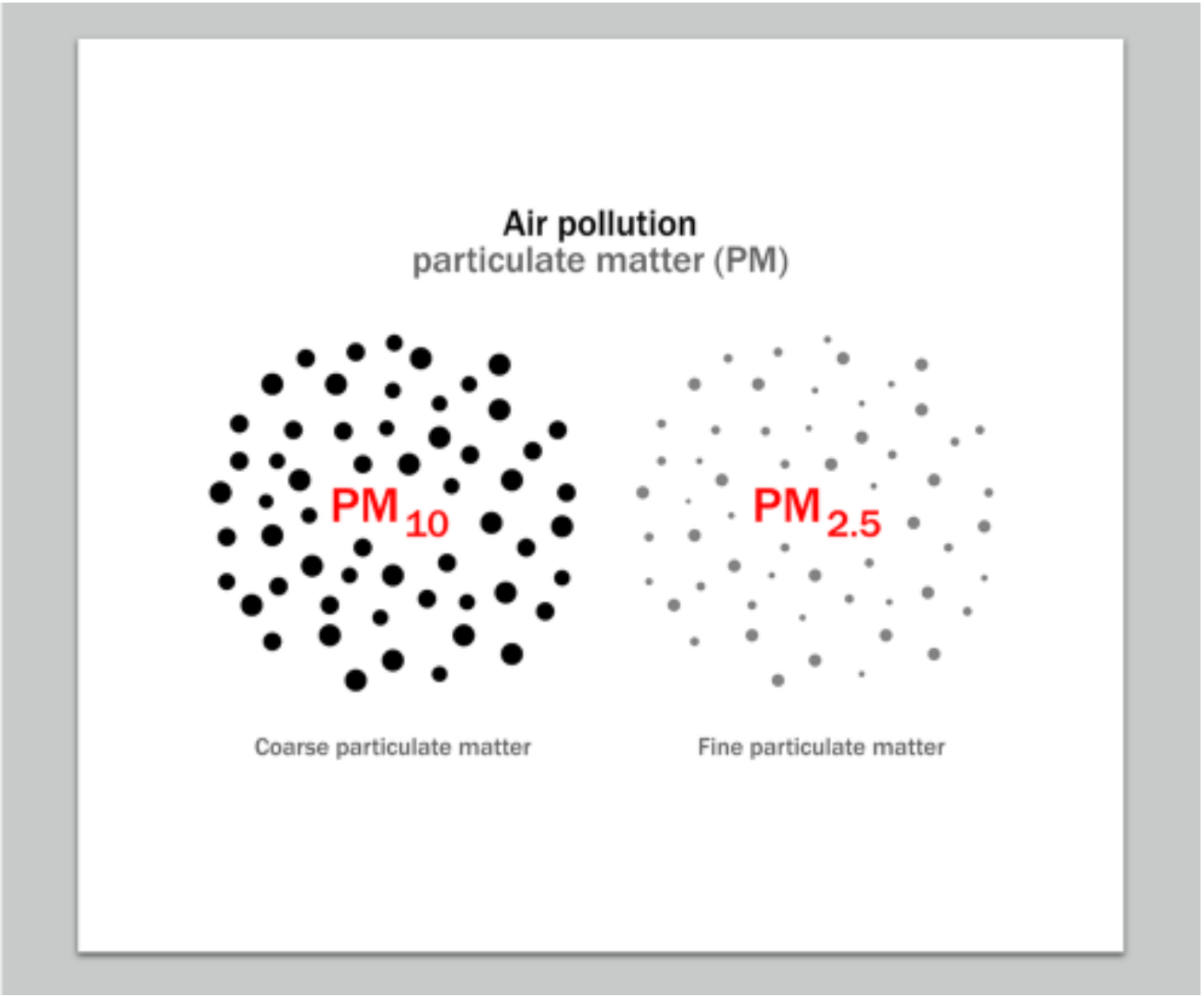
Particulate Matter 2.5 Before and During Lockdown

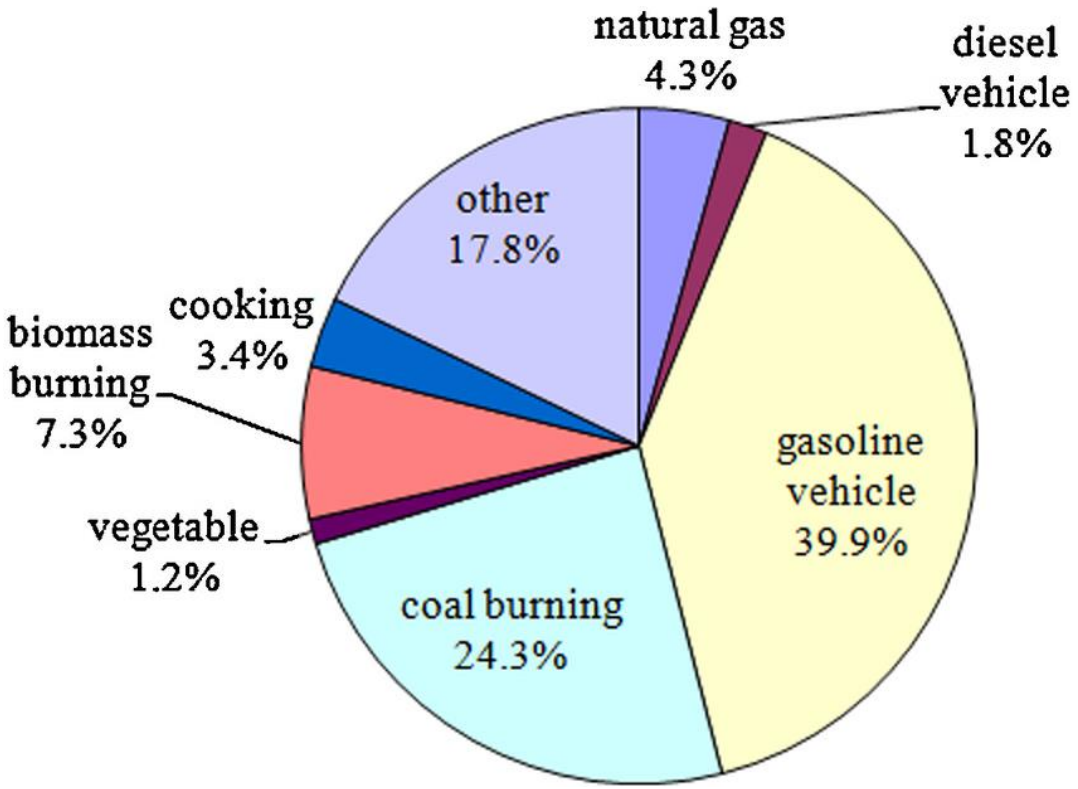
What Is Particulate Matter and what does it look like?

- Particulate Matter is not 'One' Pollutant.
- When people refer to 'Particulate Matter' (or 'PM') it often sounds like they're referring to just one pollutant, however particulate matter is not a unified pollutant at all. We use this term to refer to a family of particles suspended in the air and characterized by their size.

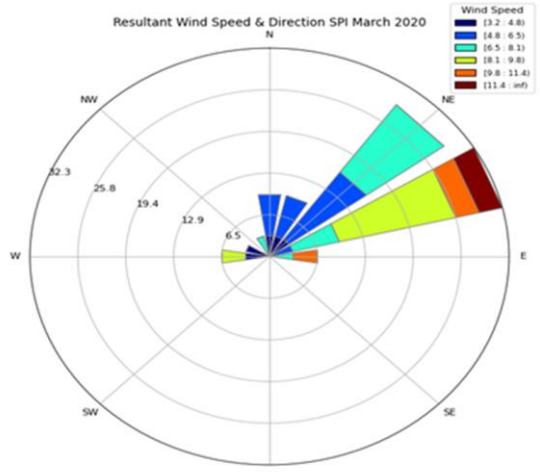


The source apportionments of PM2.5. Among the estimated seven sources, gasoline vehicle and coal burning emission were the most two major resources of the whole PM2.5.

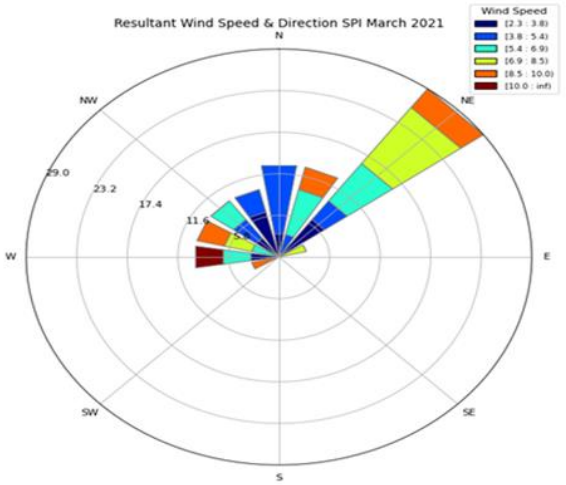
- When particles exceed the safe limits, they can start causing human problems such as headache, dizziness, irritation in eye and nose.
- Longtime exposure can cause cardiovascular, respiratory, and cardiopulmonary diseases such as bronchitis, lung cancer, developmental and reproductive effects. These can become chronic and can further exacerbate exposure to bacteria and viruses such as COVID-19.
- Additionally, PM can cause abrasions to plants, reduction in photosynthesis due to blocking radiation, and changes to soil chemistry (Grantz et al., 2003).



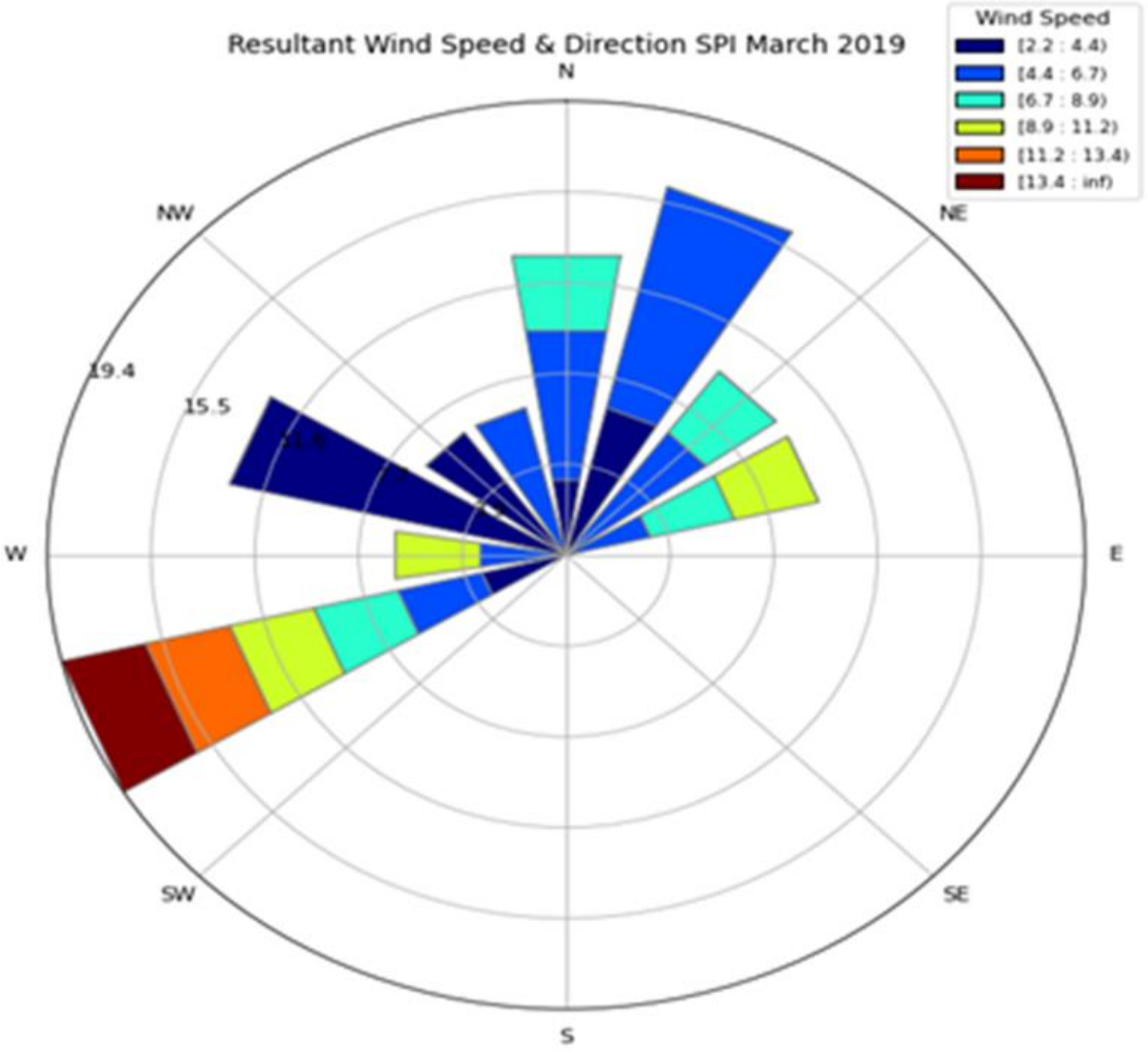
Wind Rose showing Average Monthly Wind Speed and Direction



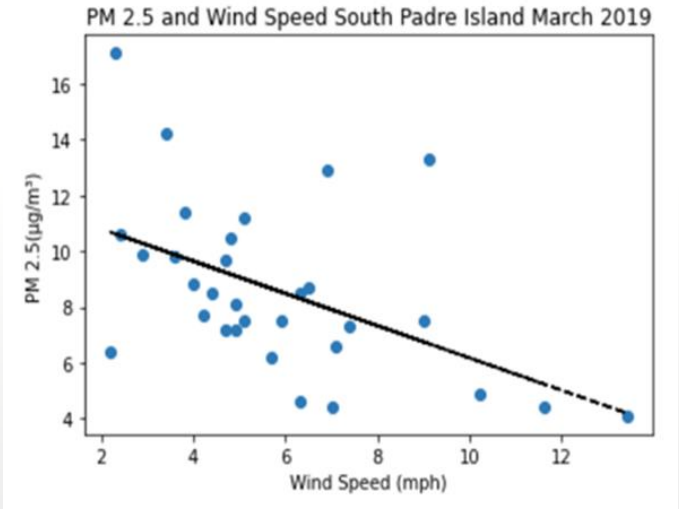
Average wind direction: 39°E of S, Average Wind Speed: 6.91 mph



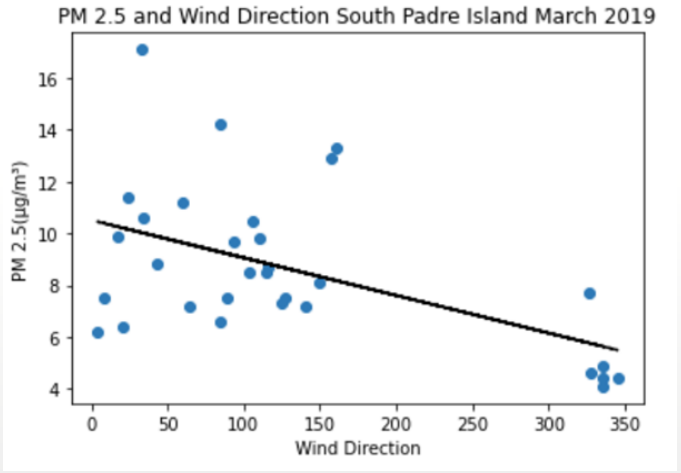
Average wind direction: 73°E of S , Average Wind Speed: 5.91 mph



Average wind direction: 48°E of S, Average Wind Speed: 5.80mph



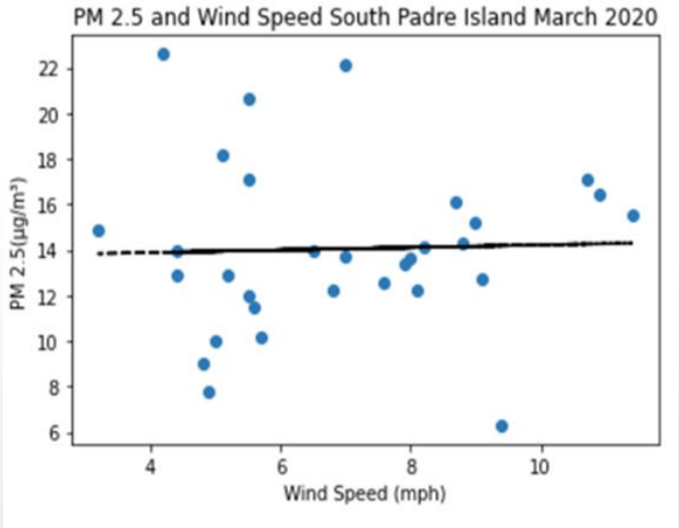
r = -0.504279



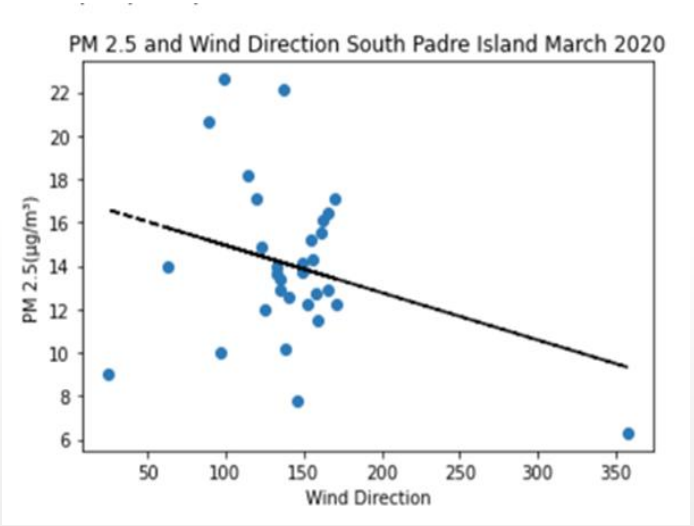
r = -0.522782

SPI, Tx	March 2019	PM2.5 (µg/m³)	R.W. Direction	R.W. Speed
March 2019	1	-0.11861	-0.073162	-0.000825
PM2.5 (µg/m³)	-0.011861	1	-0.522782	-0.504279
R.W. Direction	-0.073162	-0.522782	1	0.622344
R.W. Speed	-0.000825	-0.504279	0.622344	1

Both r values show a moderate negative linear relationship.



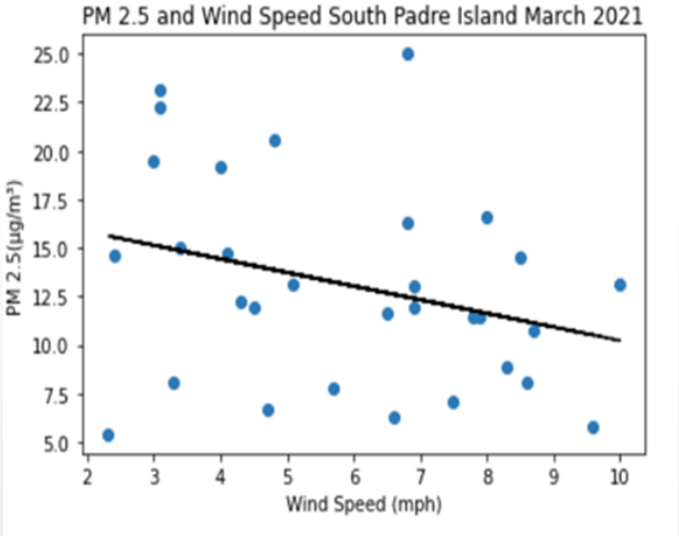
r = 0.034751



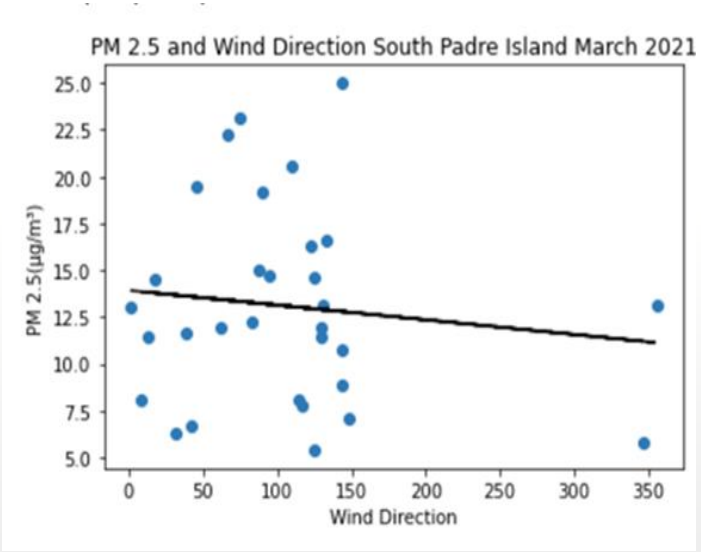
r = -0.245394

SPI, Tx	March 2020	PM2.5 (µg/m³)	R.W. Direction	R.W. Speed
March 2020	1	0.530486	-0.027561	0.336390
PM2.5 (µg/m³)	0.530486	1	-0.245394	0.034751
R.W. Direction	-0.027561	-0.245394	1	0.557678
R.W. Speed	0.336390	0.034751	0.557678	1

R values show a weak-positive and weak negative linear relationship.



r = 0.300220



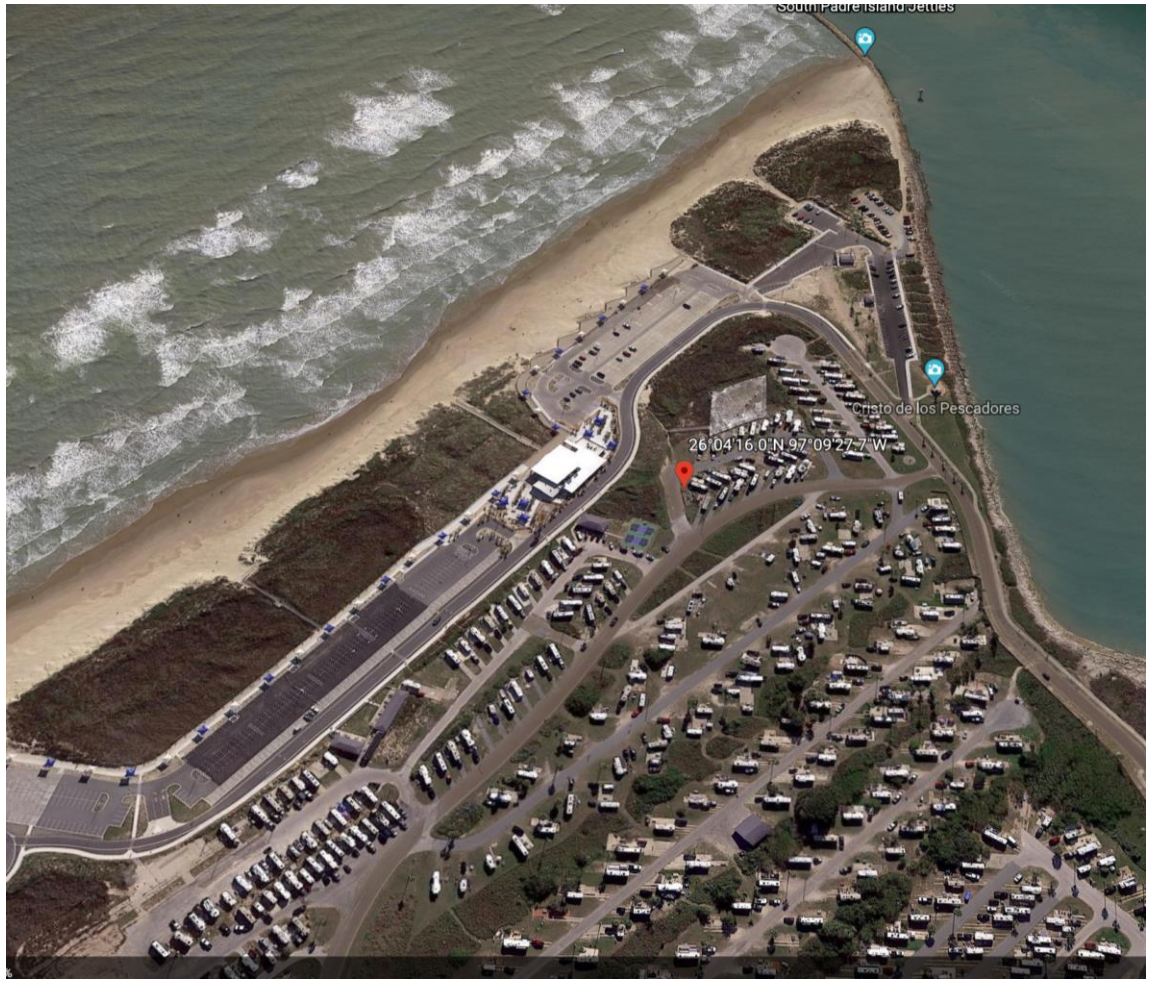
r = -0.118461

SPI, Tx	March 2021	PM2.5 (µg/m³)	R.W. Direction	R.W. Speed
March 2021	1	0.355071	-0.286470	-0.055950
PM2.5 (µg/m³)	0.355071	1	-0.118461	0.300220
R.W. Direction	-0.286470	-0.118461	1	0.462796
R.W. Speed	-0.055950	0.300220	0.462796	1

R values show a weak-positive and weak negative linear relationship.

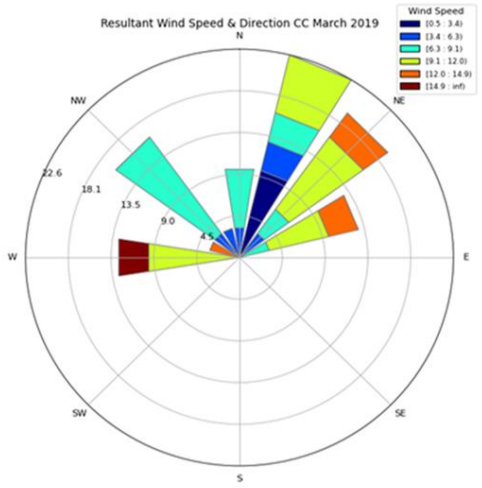
South Padre Island, Texas

Results show that for the year 2019, 2020, and 2021 the average wind direction was S48°E, S39°E, and S73°E respectively. Average speed was 5.80 mph, 6.91 mph and 5.91 mph, respectively. Wind direction was similar for the three years with orientation from the South to Southeast. None of the R-values in the Pearson's correlation test showed a strong negative or positive relationship between PM2.5 and its meteorological parameters, therefore the wind speed and direction held no dictation on how the pollution was distributed.

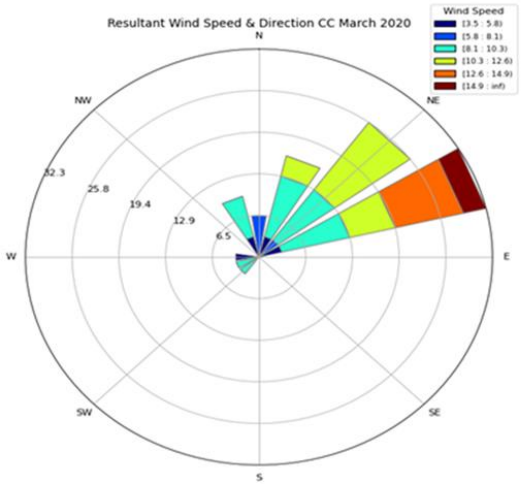


Location of Air Quality Monitor, South Padre Island, Tx.

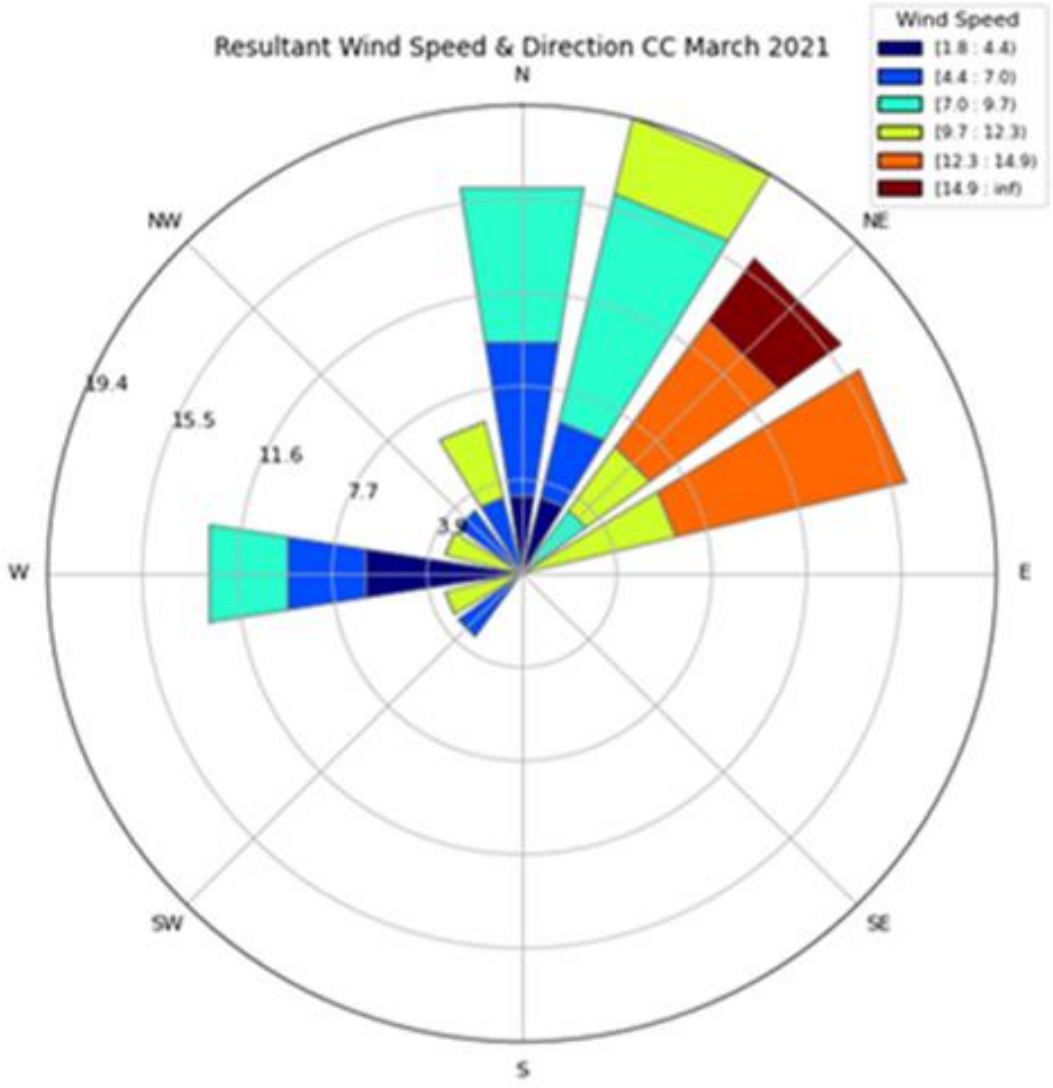
Wind Rose showing Average Monthly Wind Speed and Direction



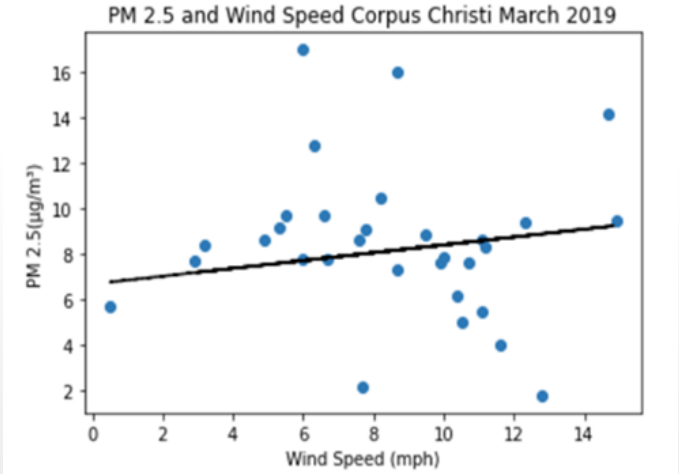
Average wind direction: 68°E of S, Average Wind Speed: 8.49mph



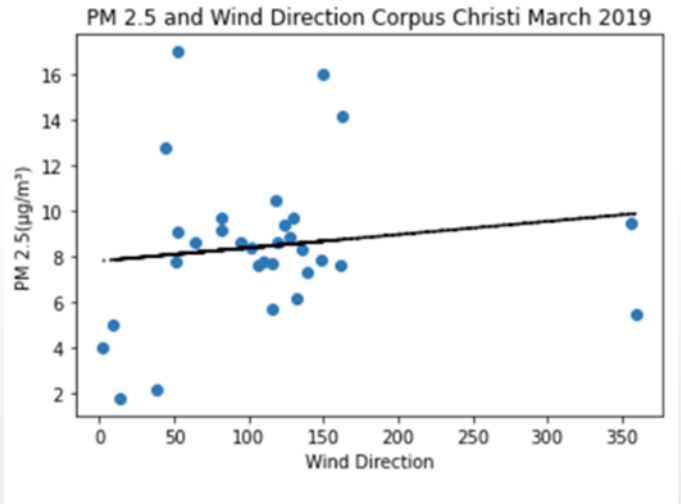
Average wind direction: 68°E of S, Average Wind Speed: 9.46mph



Average wind direction: 56°E of S, Average Wind Speed: 8.65 mph



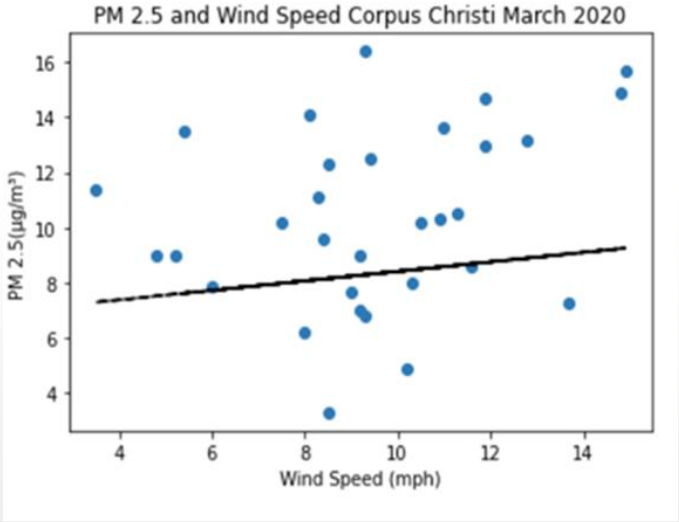
r = -0.072141



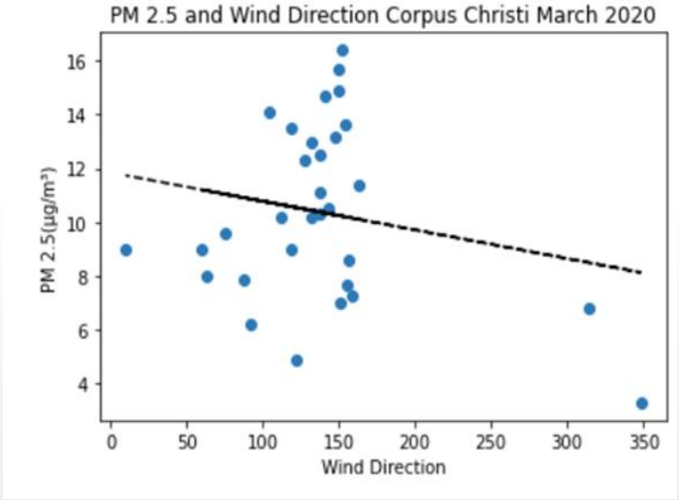
r = 0.137441

Corpus Christi, Tx	March 2019	PM2.5 (µg/m³)	R.W. Direction	R.W. Speed
March 2019	1	-0.254009	-0.199347	-0.023767
PM2.5 (µg/m³)	-0.254009	1	0.137441	-0.072141
R.W. Direction	-0.199347	0.137441	1	0.336978
R.W. Speed	-0.023767	-0.072141	0.336978	1

R values show a weak-negative and a weak positive linear relationship.



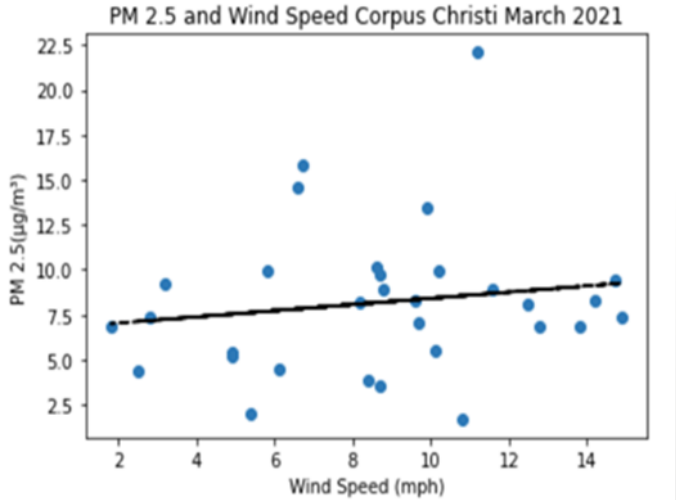
r = 0.263736



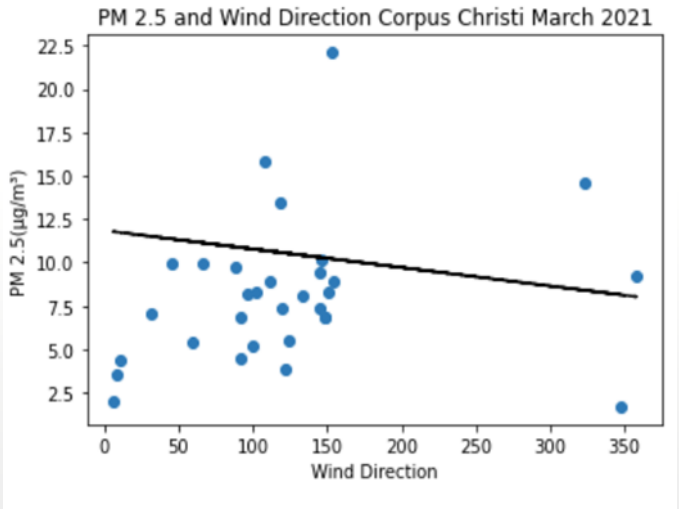
r = -0.203627

Corpus Christi, Tx	March 2020	PM2.5 (µg/m³)	R.W. Direction	R.W. Speed
March 2020	1	0.525340	-0.389969	-0.046712
PM2.5 (µg/m³)	0.525340	1	-0.203627	0.263736
R.W. Direction	-0.389969	-0.203627	1	0.229016
R.W. Speed	-0.046712	0.263736	0.229016	1

R values show a weak-positive and a weak negative linear relationship.



r = 0.152140



r = 0.211921

Corpus Christi, Tx	March 2021	PM2.5 (µg/m³)	R.W. Direction	R.W. Speed
March 2021	1	0.413722	0.276648	0.124601
PM2.5 (µg/m³)	0.413722	1	0.211921	0.152140
R.W. Direction	0.276648	0.211921	1	0.151638
R.W. Speed	0.124601	0.152140	0.151638	1

Both r values show a weak-positive linear relationship.

Corpus Christi, Tx

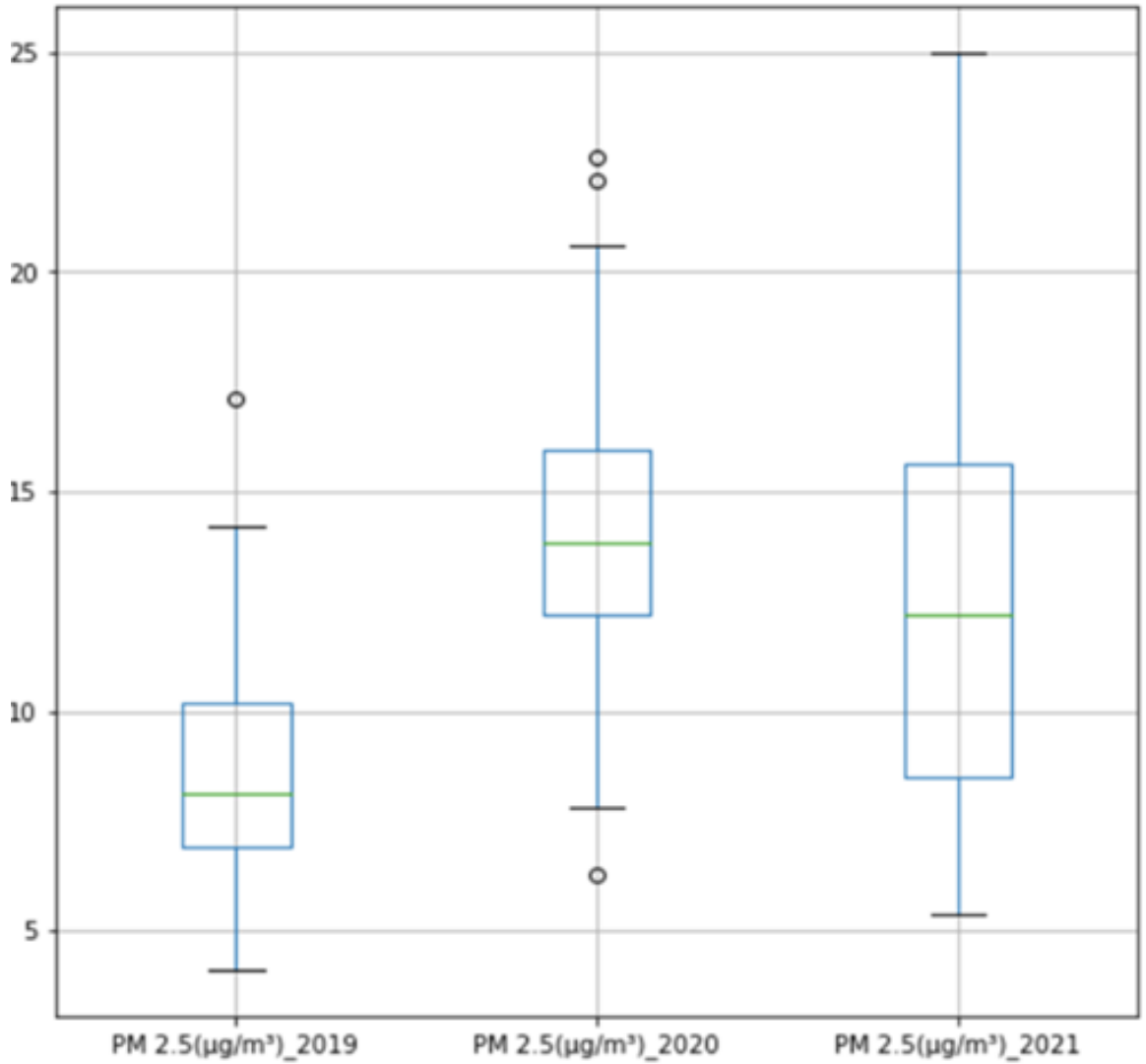
Based on the data for Corpus Christi, Tx, Results show that for the year 2019, 2020, and 2021 the average wind direction was S68°E, S68°E, and S56°E respectively. Average speed was 8.49 mph, 9.46 mph and 8.65 mph, respectively. Wind direction was similar for the three years with orientation from the South to Southeast. None of the R-values in the Pearson's correlation test showed a strong negative or positive relationship between PM2.5 and its meteorological parameters, therefore, the wind speed and direction held no dictation on how the pollution was distributed.

Location of Air Quality Monitor, Corpus Christi, Tx.

South Padre Island, Tx

- For 2019, the Q1 is 6.6, Q2 is 8.1, Q3 is 10.5 and the IQR is 3.9. The range is 13 and there is an outlier of 17.1.
- For the year 2020, Q1 is 12.2, Q2 is 13.7, Q3 is 16.1 and the IQR is 3.9. The range is 16.3 and there were some outliers in the range of (6.3, 22.1, and 22.6). These measurements are 1.5 times the length of the box and therefore the values are not normally distributed.
- For the year 2021, the Q1 is 8.1, Q2 is 12.2, Q3 is 16.3, and the IQR is 8.2. The range is 19.6 and there are no outliers.

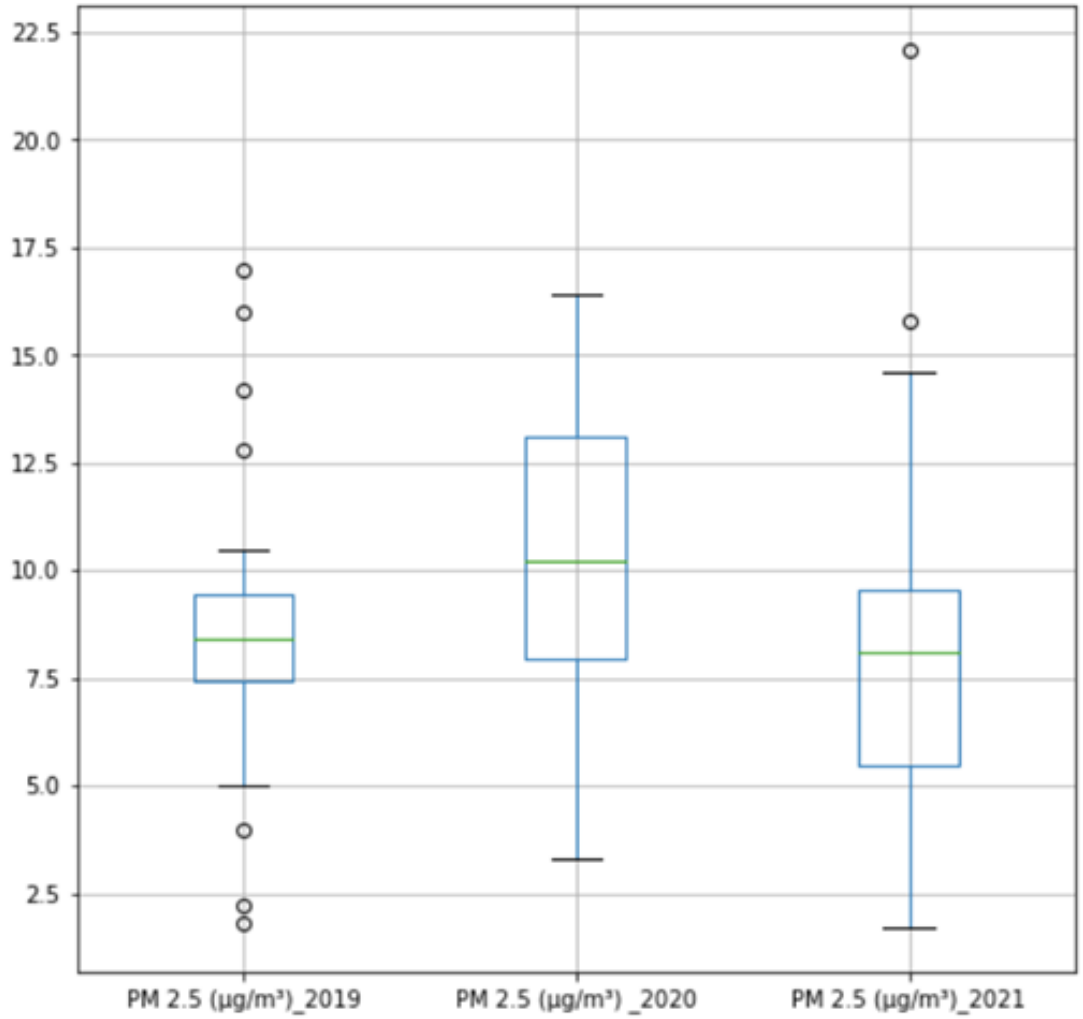
Box and Whisker Plot for South Padre Island, Tx. Showing distribution of PM2.5



Corpus Christi, Tx

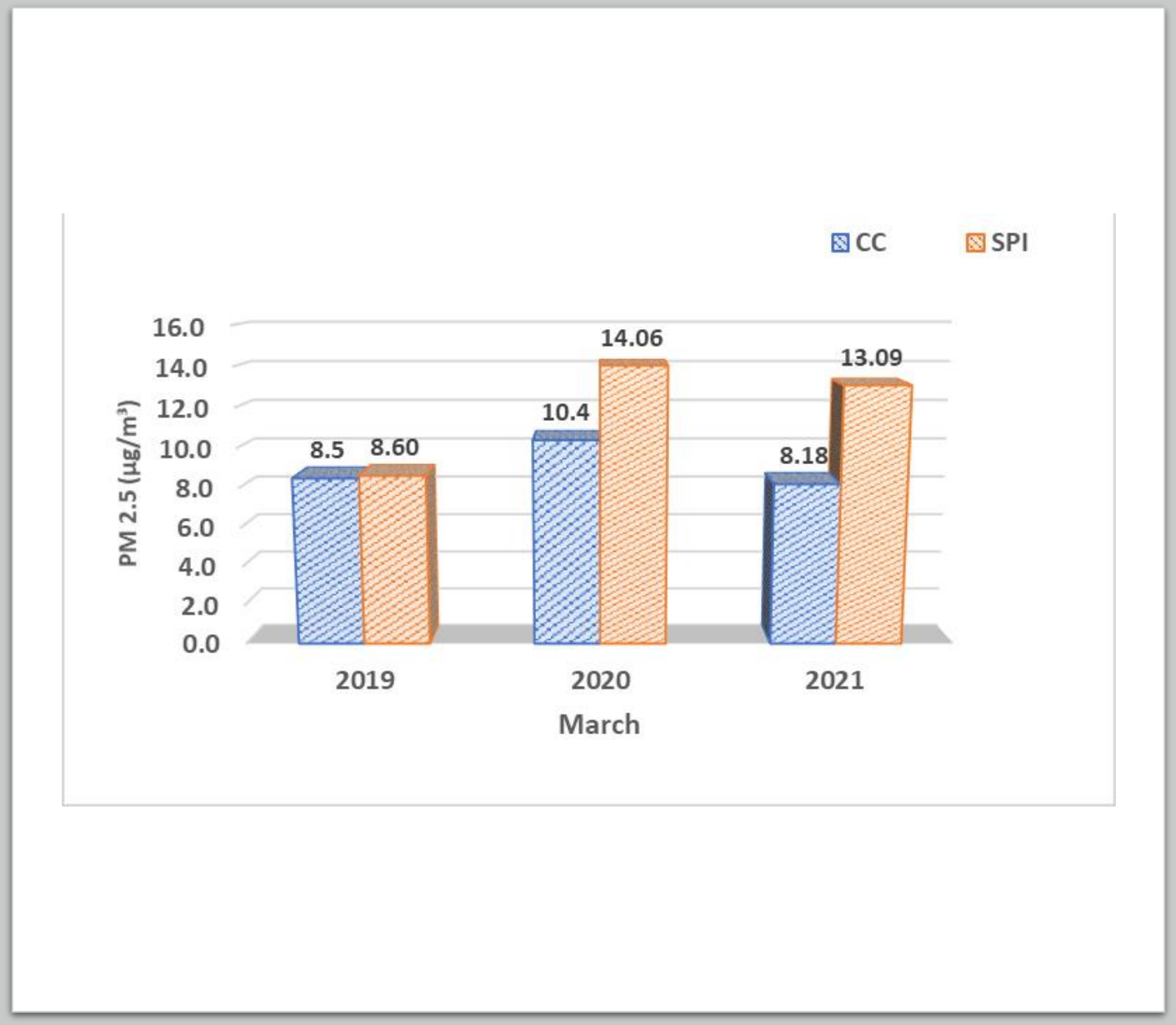
- For 2019 the Q1 is 7.3, Q2 is 8.4, Q3 is 9.5 and the IQR is 2.2. The range is 15.2 and there are outliers of (1.8, 2.2, 14.2, 16, 17) indicating that the values are not normally distributed.
- For the year 2020, the Q1 is 7.9, Q2 is 10.2, Q3 is 13.2 and the IQR is 5.3. The range is 13.1 and there are no outliers.
- For the year 2021, the Q1 is 5.4, Q2 is 8.1, Q3 is 9.7, and the IQR is 4.3. The range is 20.4 and there was an outlier with the value of 22.1.

Box and Whisker Plot for Corpus Christi, Tx. Showing distribution of PM2.5



- For South Padre Island, Tx. The average PM2.5 for 2019 was 8.60 µg/m³, had an increase in 2020 of 14.05 µg/m³ and a slight decrease in 2021 of 13.09 µg/m³. For the year 2020, there was a 63.48% PM2.5 increase and for 2021 there was a 6.89% decrease. Overall, there was a 52% increase from 2019 to 2021, reflecting that there was change therefore, for the city of South Padre Island, Tx we reject the null that there was no shift or change in pollution levels.

- For Corpus Christi, Tx. The average PM2.5 for 2019 was 8.47 µg/m³, had an increase in 2020 of 10.38 µg/m³, and a slight decrease in 2021 of 8.18 µg/m³. For the year 2020, there was a 22.35% PM2.5 increase and for 2021 there was a 21.55% decrease. Overall, there was a 3.76% decrease from 2019 to 2021, reflecting that there was change therefore, for the city of Corpus Christi, Tx we reject the null that there was no shift or change in pollution levels.



Conclusion

- Based on the data for South Padre Island, Tx. Results show that for the year 2019, 2020, and 2021 the average wind direction was S48°E, S39°E, and S73°E respectively. Average speed was 5.80 mph, 6.91 mph and 5.91 mph, respectively. Wind direction was similar for the three years with orientation from the South to Southeast. None of the R-values in the Pearson's correlation test showed a strong negative or positive relationship between PM2.5 and its meteorological parameters, therefore the wind speed and direction held not dictation on how the pollution was distributed.
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- Based on the data for Corpus Christi, Tx, Results show that for the year 2019, 2020, and 2021 the average wind direction was S68°E, S68°E, and S56°E respectively. Average speed was 8.49 mph, 9.46 mph and 8.65 mph, respectively. Wind direction was similar for the three years with

orientation from the South to Southeast. None of the R-values in the Pearson's correlation test showed a strong negative or positive relationship between PM2.5 and its meteorological parameters, therefore, the wind speed and direction held not dictation on how the pollution was distributed.

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Resources:

Grantz, D. A., Garner, J. H. B., & Johnson, D. W. (2003). Ecological effects of particulate matter. Environment International, 29(2), 213–239. https://doi.org/10.1016/S0160-4120(02)00181-2

Fig. 1. The source apportionments of PM2.5. Among the estimated seven... (n.d.). ResearchGate. Retrieved May 2, 2021, from https://www.researchgate.net/figure/The-source-apportionments-of-PM25-Among-the-estimated-seven-sources-gasoline-vehicle_fig1_282002127