

Introduction

Did the Texas lockdown hinder PM 2.5 concentrations for the years 2020 and 2021? Upon the outbreak of (SARS-CoV-2) or COVID-19, on January 30th, 2020, the World Health Organization declared a global health emergency. In Texas, to decelerate the spread of this virus, most non-essential activities were inhibited. The industries most affected were airlines, food, and beverage, automotive, travel, education, oil gas and drilling, retail, and sports and entertainment. All these sectors have one variable in common, and that is the need of transport. The lockdown measures have involved us in an involuntary experiment, and we can respond to the actual situation with the following question: If we eliminate nearly all combustion vehicles from the cities by allowing only public transport and the transport of basic supplies, what would be the air quality? (Baldasano, 2020). In some of the recent research, the improvement in air quality during lockdown period was related to the closure of industries and reduction in vehicle transit (Selvam et al., 2020).

Background

Although all pollutants are hazardous to human health, PM 2.5 is of the most concern. These particles are so small, as they are inhaled, they can travel into the lungs and can also reach the blood stream (Godish, Davis and Fu). Particulate matter is not a single pollutant, but is made up of particles of many different sizes and chemical composition, from a wide range of natural and anthropogenic sources (Holman, 1999). These particles are toxic, and inhalation of these substances can lead to decreased lung function. Particulate matter is the sum of all solid and liquid particles suspended in the air. It is a complex mixture which includes both organic and inorganic particles such as pollen, dust, soot, bacteria, smoke, allergens, and liquid droplets (Godish et al., 2015). These particles vary greatly in size, composition, and origin. Some particulate matter comes

directly from the atmosphere, for instance when fuel is burnt or when dust is carried by wind. These particles are known as primary particulate matter. Some particulate matter develops through chemical processes or chemical reactions amongst primary particulate matter. These particles are known as secondary particulate matter. The classification based on size of particles is widely accepted and used worldwide (epa.gov criteria air pollutants). The 24-hour standard level is 35 $\mu\text{g}/\text{m}^3$ and an annual average level of 12 $\mu\text{g}/\text{m}^3$ is the current acceptable value. 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). These can become chronic and can further exacerbate exposure to bacteria and viruses such as COVID-19.

Methods

Study Location

The objective of this research is to assess the Particulate Matter 2.5 ($\mu\text{g}/\text{m}^3$) average, daily observations of two ports along the Texas coast. The data used are the hourly concentrations of particulate matter 2.5 along with meteorological parameters that include hourly wind speed and wind direction. Quantitative data will be analyzed through numerical comparisons and statistical inferences. The observations will be for the month of March for the years 2019, 2020, and 2021. And that is, with the purpose of evaluating the effects on air quality generated by the Texas lockdown. The first data collected comes from an air quality monitoring station in the city of

Corpus Christi, Texas (figure 1). The site coordinates are Latitude: 27° 48' 16" North (27.8044887°) and Longitude: -97° 25' 54" West (-97.4315532°), elevation 6.0 m.



Figure 1 EPA site 483550032 CAMS 0098. Nueces County, address: 3810 Huisache Street 78407.

The second air quality monitoring location is in the city of South Padre Island, Texas (figure 2), lying between Latitude: 26° 4' 16" North (26.0711000°) and Longitude: -97° 9' 28" West (-97.1577000°), elevation 3.0 m. PM_{2.5} measurements, resultant wind speed and direction were downloaded from the Texas Commission on Environmental Quality (TCEQ) at the Environmental Agency of Texas (www.tceq.texas.gov).

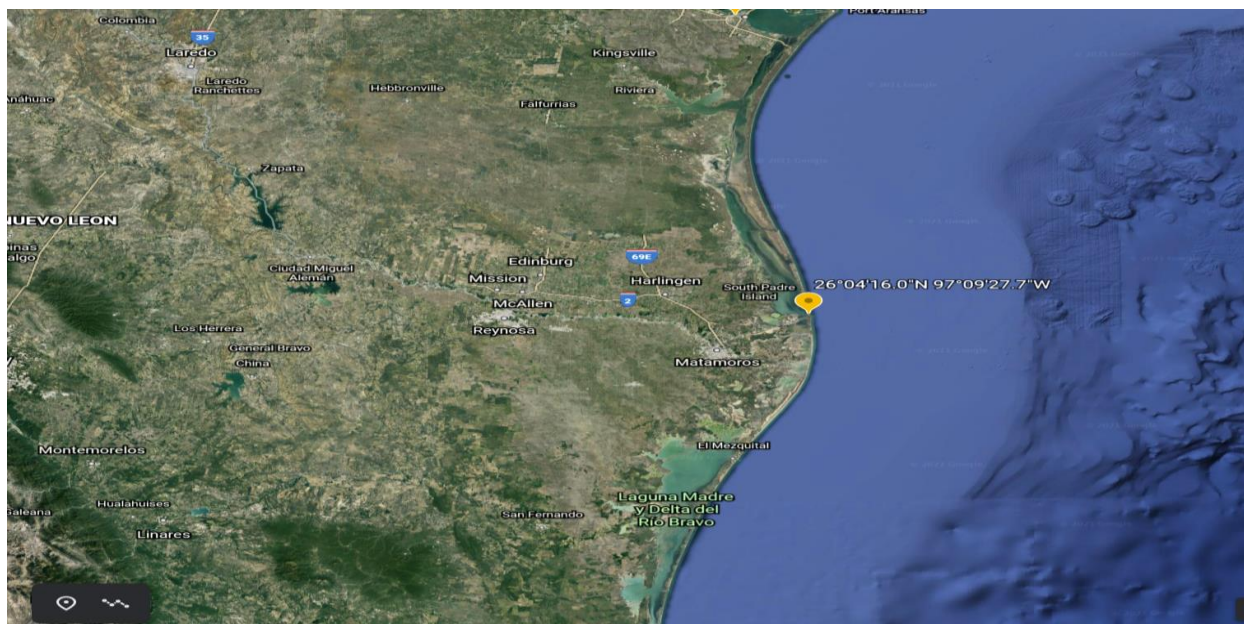


Figure 2 EPA site 480612004 CAMS 0323, 0667. Cameron County, Address: Lot B 69 ½ 78597

Collecting data from these resources is the best methods to answer my research questions because data from the instruments used meets EPA quality assurance criteria for regulatory purposes. Because not all sectors of industrial manufacturing, transportation of goods, and automotive were shut down, I hypothesize that air quality for the two cities in question will show no shift, change or improvement from the year prior or a year after the pandemic.

The timeline for completion of this work is as follows:

Research phase	Objectives	Deadline
1. Background research and literature review	<ul style="list-style-type: none">• Present abstract with initial discussion• Conduct an extensive review of relevant literature• Refine my research question• Develop a theoretical framework• Explain why the research problem under study exists	5th April
2. Research design planning	<ul style="list-style-type: none">• Design figures/plots• Identify online and offline channels for data collection• Finalize data analysis methods	7th April
3. Data collection and preparation	<ul style="list-style-type: none">• Download data• Conduct statistical analyzation• Transcribe and code data	12th April
4. Data analysis	<ul style="list-style-type: none">• Statistically analyze data• Draft the results and discussion questions	14th April
5. Writing	<ul style="list-style-type: none">• Complete a full thesis draft• Talk with professor to discuss feedback and revisions	19th April
6. Revision	<ul style="list-style-type: none">• Redraft based on feedback• Get Dr. Harrison approval for final draft• Proofread• Print, bind/code and submit	21st April

Screenshot of bibliography manager

The screenshot displays the Zotero application window, which is used for managing bibliographies. The interface is divided into several sections:

- Left Panel (Library Structure):** Shows a hierarchical view of the library. Under "My Library", there are folders for "MARCH_FOLDER", "TEST OVERLEAF TO ZOTERO", "Untitled", "My Publications", "Duplicate Items", "Unfiled Items", and "Trash".
- Central Panel (Reference List):** A table listing references. The selected reference is "Ecological effects of particulate matter" by Grantz et al. The list includes the following entries:
 - COVID-19 lockdown effects on air quality by NO₂ in the cities of Barcelona and Madrid (Spain)
 - Impact of SARS-CoV-2 on Ambient Air Particulate Matter in Tehran
 - Ecological effects of particulate matter (Selected)
 - 8 - Sources of Air Pollution
 - Long-term Measurements of PM_{2.5} Concentrations in Lubbock, Texas
 - Demystifying a Possible Relationship between COVID-19, Air Quality and Meteorological Factors: Evidence from Kuala Lumpur, Malaysia
 - SARS-CoV-2 pandemic lockdown: Effects on air quality in the industrialized Gujarat state of India
 - Impact of the COVID-19 Event on Air Quality in Central China
 - Faridi et al. - 2020 - Impact of SARS-CoV-2 on Ambient Air Particulate Ma.pdf
 - the_health_costs_of_air_pollution_from_cars_and_vans_20180518.pdf
- Right Panel (Item Details):** Provides detailed information about the selected item. It shows the "Item Type" as "Journal Article", the "Title" as "Ecological effects of particulate matter", and the "Author" as "Grantz, D. A". The "Abstract" section contains the following text:

Atmospheric particulate matter (PM) is a heterogeneous material. Though regulated as un-specified mass, it exerts most effects on vegetation and ecosystems by virtue of the mass loading of its chemical constituents. As this varies temporally and spatially, prediction of regional impacts remains difficult. Deposition of PM to vegetated surfaces depends on the size distribution of the particles and, to a lesser extent, on the chemistry. However, chemical loading of an ecosystem may be determined by the size distribution as different constituents dominate different size fractions. Coating with dust may cause abrasion and radiative heating, and may reduce the photosynthetically active photon flux reaching the photosynthetic tissues. Acidic and alkaline materials may cause leaf surface injury while other materials may be taken up across the cuticle. A more likely route for metabolic uptake and impact on vegetation and ecosystems is through the rhizosphere. PM deposited directly to the soil can influence nutrient cycling, especially that of nitrogen, through its effects on the rhizosphere bacteria and fungi. Alkaline cation and aluminum availability are dependent upon the pH of the soil that may be altered dramatically by deposition of various classes of PM. A regional effect of PM on ecosystems is linked to climate change. Increased PM may reduce radiation interception by plant canopies and may reduce precipitation through a variety of physical effects. At the present time, evidence does not support large regional threats due to un-specified PM, though site-specific and constituent-specific effects can be readily identified. Interactions of PM with other pollutants and with components of climate change remain important areas of research in assessment of challenges to ecosystem stability.
- Bottom Panel (Tags):** A list of tags associated with the selected item, including "Air quality", "Biodiversity", "COVID-19", "Deposition mode", "Ecosystem response", "Heavy metals", "Lockdown measures", "Nitrates", and "Nitrogen dioxide (NO₂)".

The Windows taskbar at the bottom shows the system clock as 9:25 PM on 4/4/2021.

References:

Baldasano, J. M. (2020). COVID-19 lockdown effects on air quality by NO₂ in the cities of Barcelona and Madrid (Spain). *Science of The Total Environment*, 741, 140353. <https://doi.org/10.1016/j.scitotenv.2020.140353>

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](https://doi.org/10.1016/S0160-4120(02)00181-2)

Holman, C. (1999). 8—Sources of Air Pollution. In S. T. Holgate, J. M. Samet, H. S. Koren, & R. L. Maynard (Eds.), *Air Pollution and Health* (pp. 115–148). Academic Press. <https://doi.org/10.1016/B978-012352335-8/50083-1>

Selvam, S., Muthukumar, P., Venkatramanan, S., Roy, P. D., Manikanda Bharath, K., & Jesuraja, K. (2020). SARS-CoV-2 pandemic lockdown: Effects on air quality in the industrialized Gujarat state of India. *Science of The Total Environment*, 737, 140391. <https://doi.org/10.1016/j.scitotenv.2020.140391>