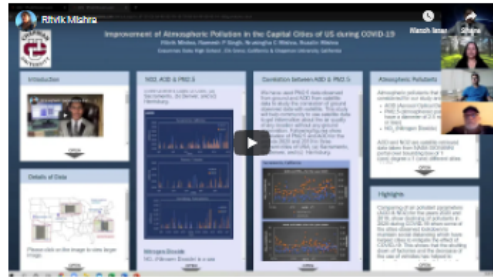# Improvement of Atmospheric Pollution in the Capital Cities of US during COVID-19

Ritvik Mishra (mishraritvik@yahoo.com, 916-944-9723), Ramesh P Singh, Nrusingha C Mishra, Rozalin Mishra

Cosumnes Oaks High School , Elk Grove, California & Chapman University, California

Introduction

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Details of Data

Please click on the figure above to view larger image.

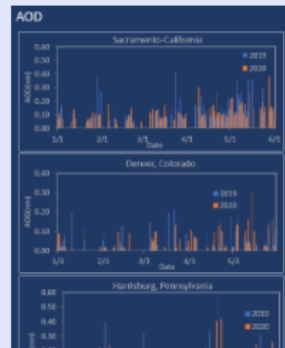We have studied 20 state capitals that

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NO2, AOD & PM2.5

Aerosol Optical Depth

AOD (Aerosol Optical Depth) is the amount of aerosols in a column of air from the Earth's surface to the atmosphere. Examples of this aerosol include smoke, dust, and sea salt. The burning of fossil fuels, forest fires, emissions from factories and vehicles, are the main causes of the increase of AOD and poor air quality.

Poor air quality is a threat to people who suffer with asthma, diabetes, and lung problems.

Following plots show the variations of AOD for the years 2020 and 2019 in three different cities of USA; (a) Sacramento, (b) Denver, and (c) Harrisburg.
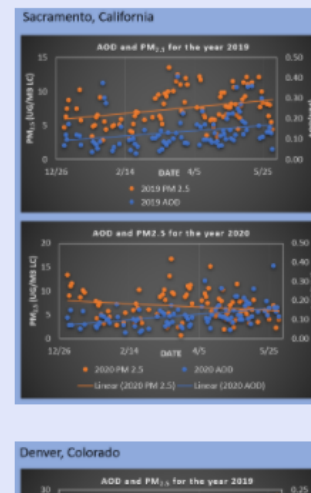

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Correlation between AOD & PM2.5

We have considered PM2.5 data observed from ground and AOD data from satellite to study the correlation between data observed from Earth surface and from satellite. This study will help the community to use satellite data to get information about air quality from any location without any ground observation.

Following figures show the correlation of PM2.5 and AOD for periods 2020 and 2019 in three different cities of USA; (a) Sacramento, (b) Denver, and (c) Harrisburg.

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Atmospheric Pollutants

Atmospheric pollutants that we have considered for our study are:

- AOD (Aerosol Optical Depth)
- PM2.5 (atmospheric particles that have a diameter of 2.5 micrometers or less)
- NO_2 (Nitrogen Dioxide)

AOD and NO2 are satellite retrieved data taken from NASA GIOVANNI portal over a bounding box of 1 (one) degree X 1 (one) degree over
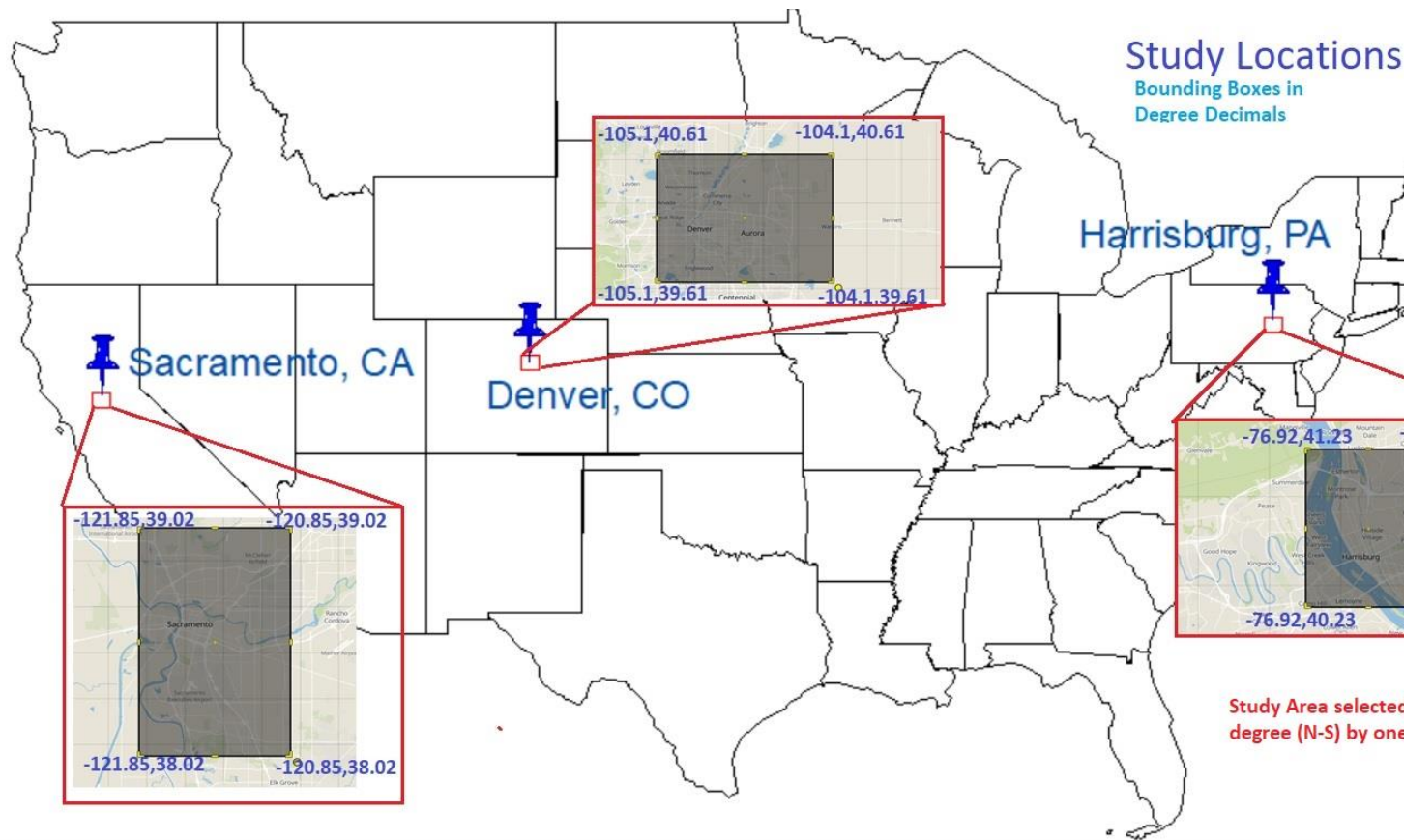
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Highlights

Comparing of air pollutant parameters (AOD & NO2) for the years 2020 and 2019, show a decline of pollutants in 2020 during COVID-19 when some of the cities observed lockdown to maintain social distancing which have helped cities to mitigate the effect of COVID-19. This shows that the shutting down of factories and the decrease of the use of vehicles has

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Introduction

COVID-19 is a deadly pandemic affecting cities in the US, which slows down life and has affected many different sectors of our daily lives such as business, travel, hospitality, and education. With the growing COVID-19 cases, some of the states have issued advisories to the people to stay home and keep social distancing. It has been observed that people have followed the social distancing regulations in some states, whereas in others the regulations were not heeded. We have analyzed various atmospheric parameters over the capital cities of the US during the COVID-19 lockdown. We have carried out an analysis of the daily Aerosol Optical Depth (AOD) and Nitrogen Dioxide (NO2) data derived from the MODIS Terra, Aqua, and AIRS satellite, which could provide information about the decline in traffic emissions during the period January – June 2020. Comparison of this data with the same period of 2019 shows a decline in AOD and NO2 which can be because some of the US capitals have strictly followed social distancing and some of the states ignored it and as a result the COVID-19 cases have surged in many cities. We have studied PM 2.5 using the published data from the Environmental Protection Agency (EPA) and the total column of ozone from NASA's OMI satellite data. A correlation can be made that in some cities, there has been a decline in the particle matter (PM 2.5) and a slight increase of the total column of ozone. The COVID-19 lockdown has had a positive effect on the atmosphere due to the decrease in manmade pollution.

Study Area

We have studied 20 state capitals that are located across the United States of America. We have presented three cities in this poster.

The figure shows the study locations, which are the following capital cities in the United States America:

- Harrisburg, Pennsylvania
- Denver, Colorado
- Sacramento, California

The data used for the study is considered from:

- NASA's Giovanni portal
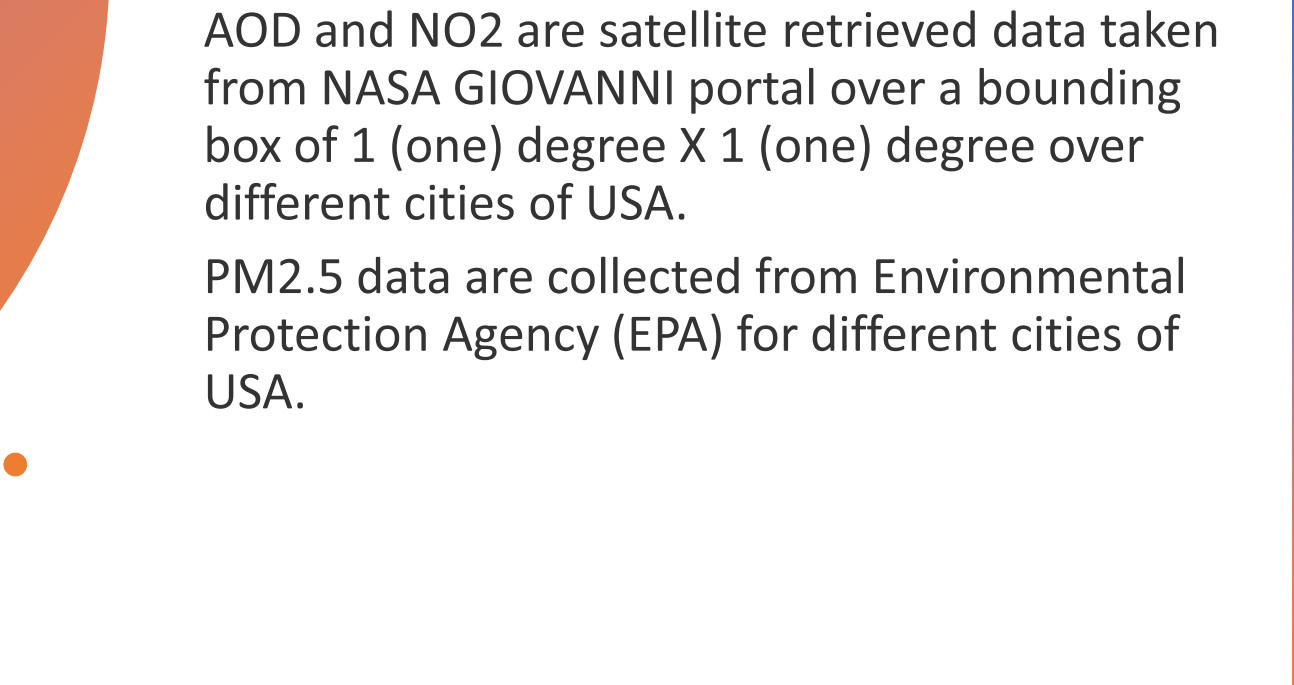- Environmental Protection Agency (EPA)

Atmospheric Pollutants Studied

Atmospheric pollutants that we have considered for our study are:

- AOD (Aerosol Optical Depth)
- PM2.5 (atmospheric particles that have a diameter of 2.5 micrometers or less)
- NO_2 (Nitrogen Dioxide)

AOD and NO2 are satellite retrieved data taken from NASA GIOVANNI portal over a bounding box of 1 (one) degree X 1 (one) degree over different cities of USA.

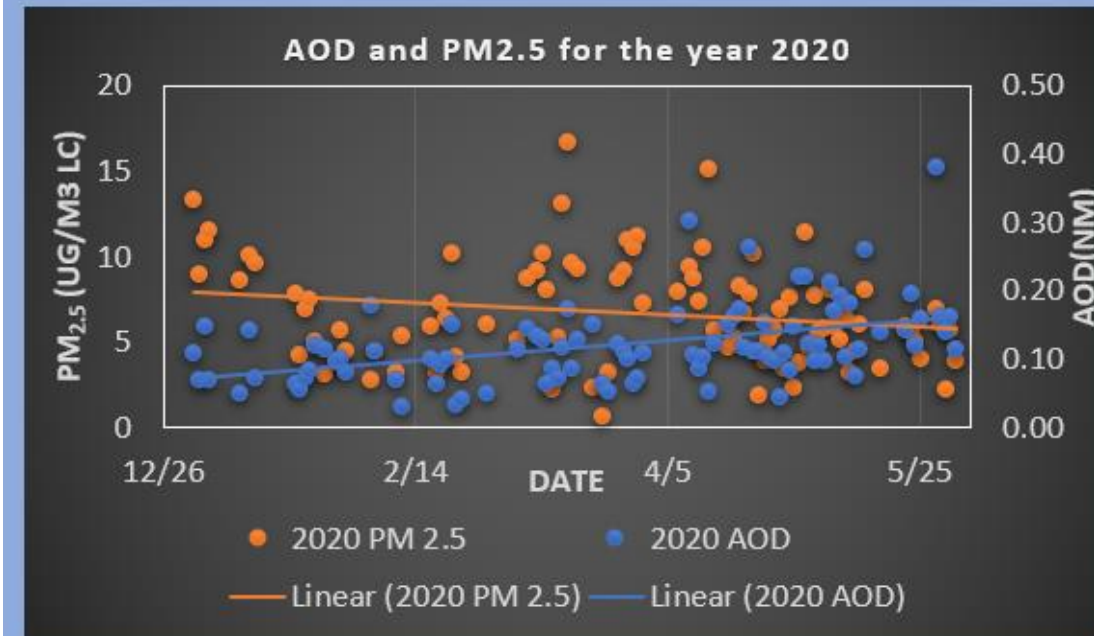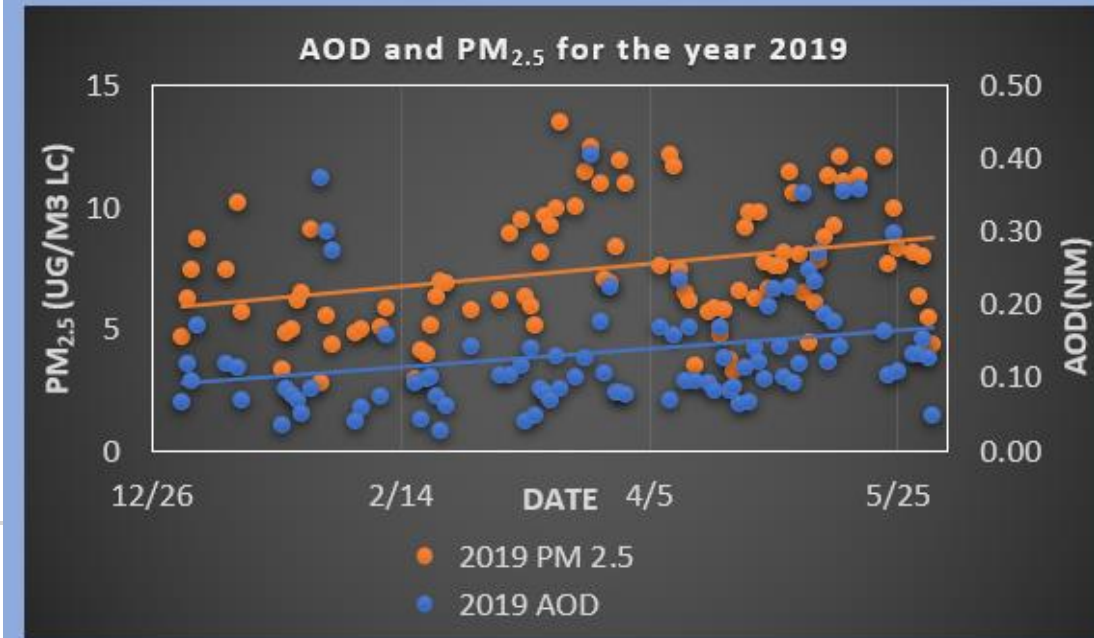PM2.5 data are collected from Environmental Protection Agency (EPA) for different cities of USA.

PM2.5 vs. AOD in 2019 and 2020 over Sacramento, California

We have considered PM2.5 data observed from ground and AOD data from satellite to study the correlation between data observed from Earth surface and from satellite. This study will help the community to use satellite data to get information about air quality from any location without any ground observation.

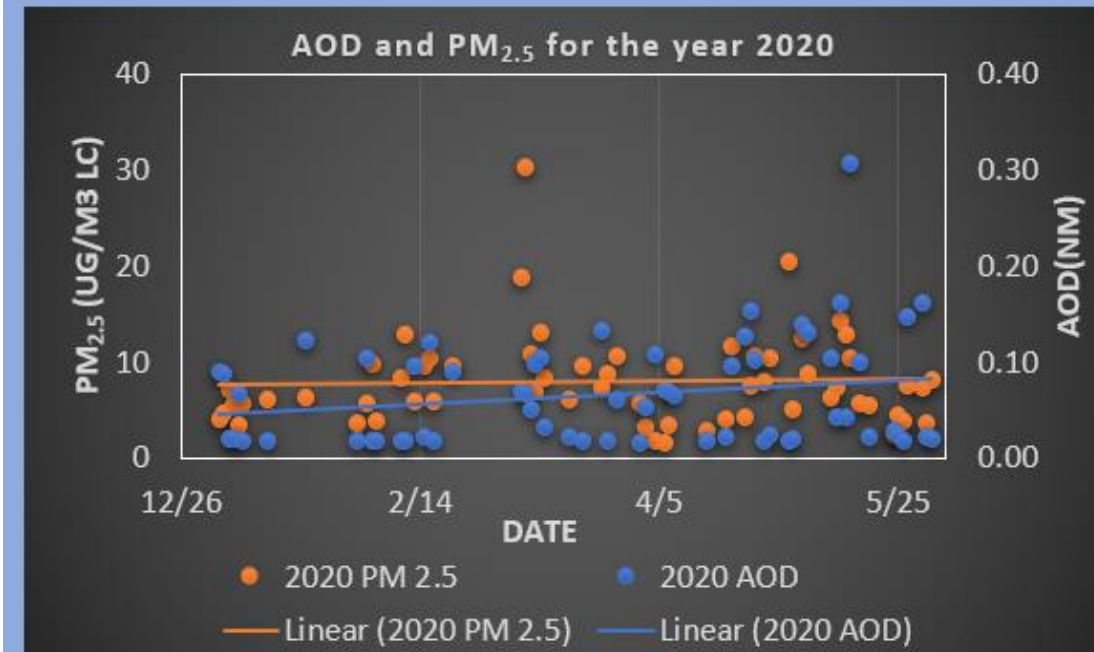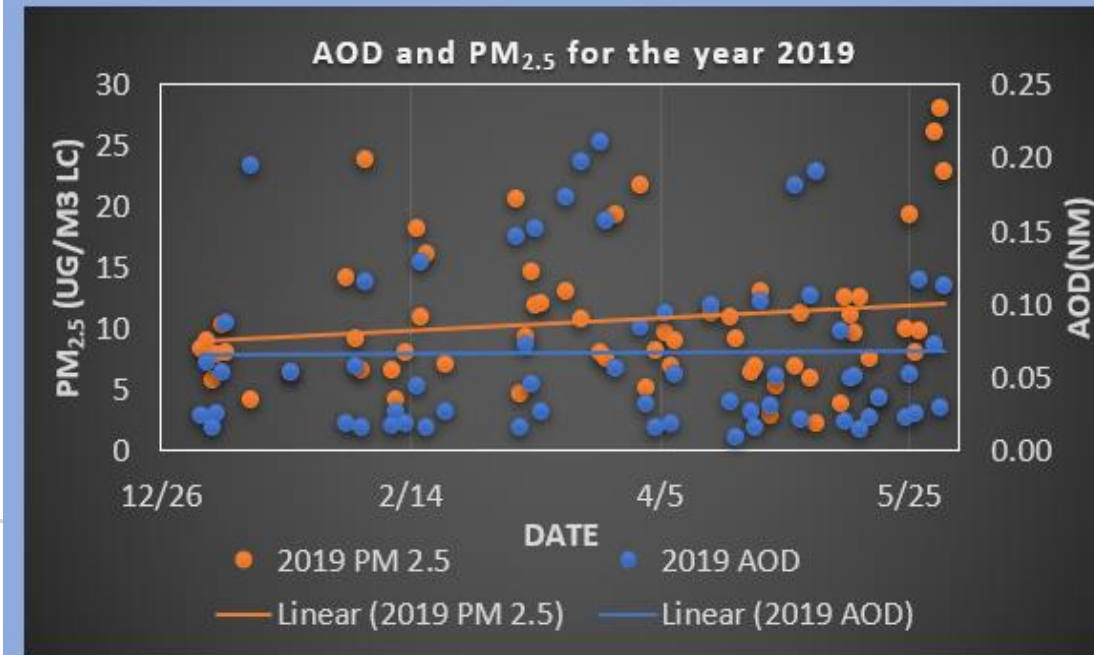These figures show the correlation of PM2.5 and AOD for periods 2020 and 2019 over Sacramento, CA, USA.

PM2.5 vs. AOD in 2019 and 2020 over Denver, Colorado

We have considered PM2.5 data observed from ground and AOD data from satellite to study the correlation between data observed from Earth surface and from satellite. This study will help the community to use satellite data to get information about air quality from any location without any ground observation.

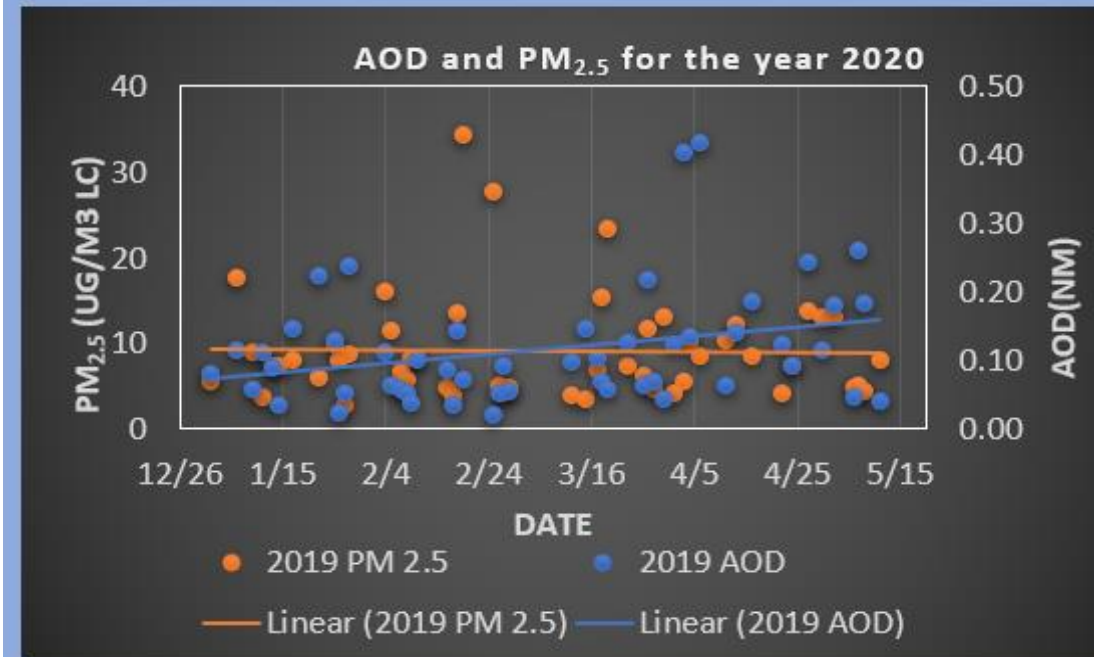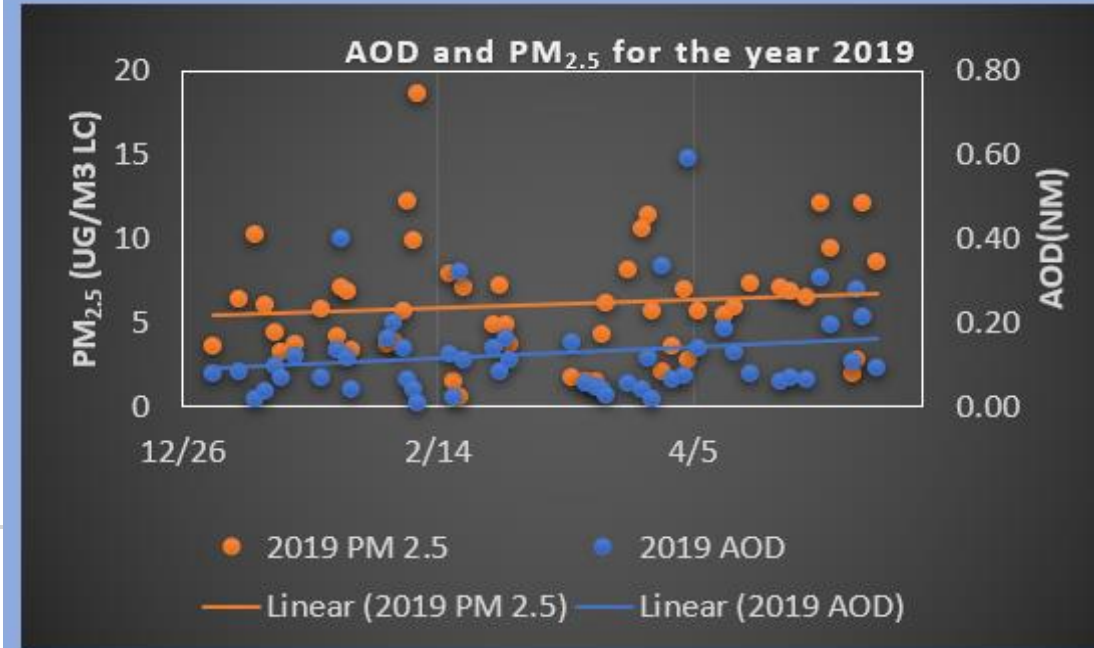These figure show the correlation of PM2.5 and AOD for periods 2020 and 2019 over Denver, CO, USA.

PM2.5 vs. AOD in 2019 and 2020 over Harrisburg, Pennsylvania

We have considered PM2.5 data observed from ground and AOD data from satellite to study the correlation between data observed from Earth surface and from satellite. This study will help the community to use satellite data to get information about air quality from any location without any ground observation.

These figure show the correlation of PM2.5 and AOD for periods 2020 and 2019 over Harrisburg, PA, USA.
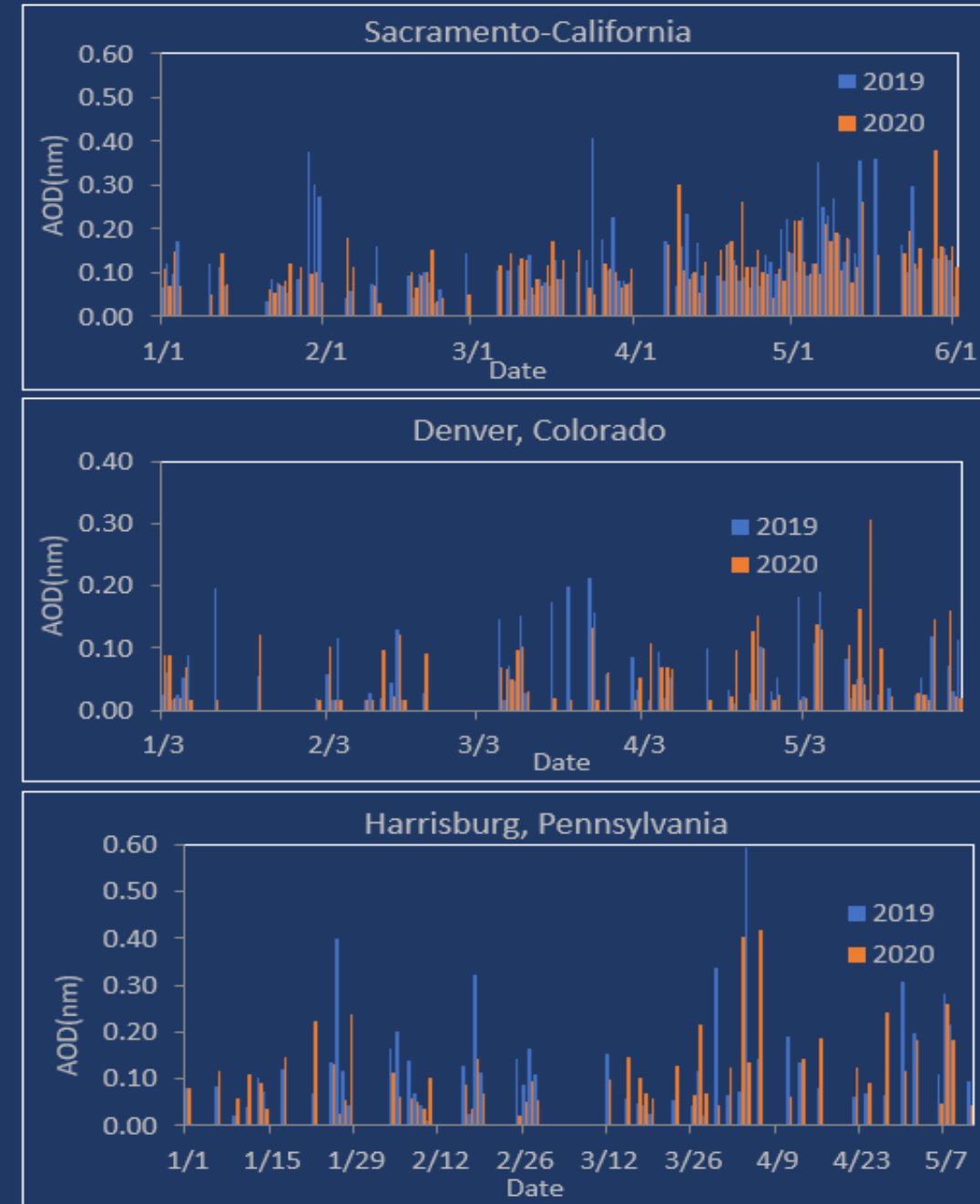

Harrisburg, Pennsylvania

Variations of AOD in 2019 and 2020

AOD (Aerosol Optical Depth) is the amount of aerosols in a column of air from the Earth's surface to the atmosphere. Examples of this aerosol include smoke, dust, and sea salt. The burning of fossil fuels, forest fires, emissions from factories and vehicles, are the main causes of the increase of AOD and poor air quality.

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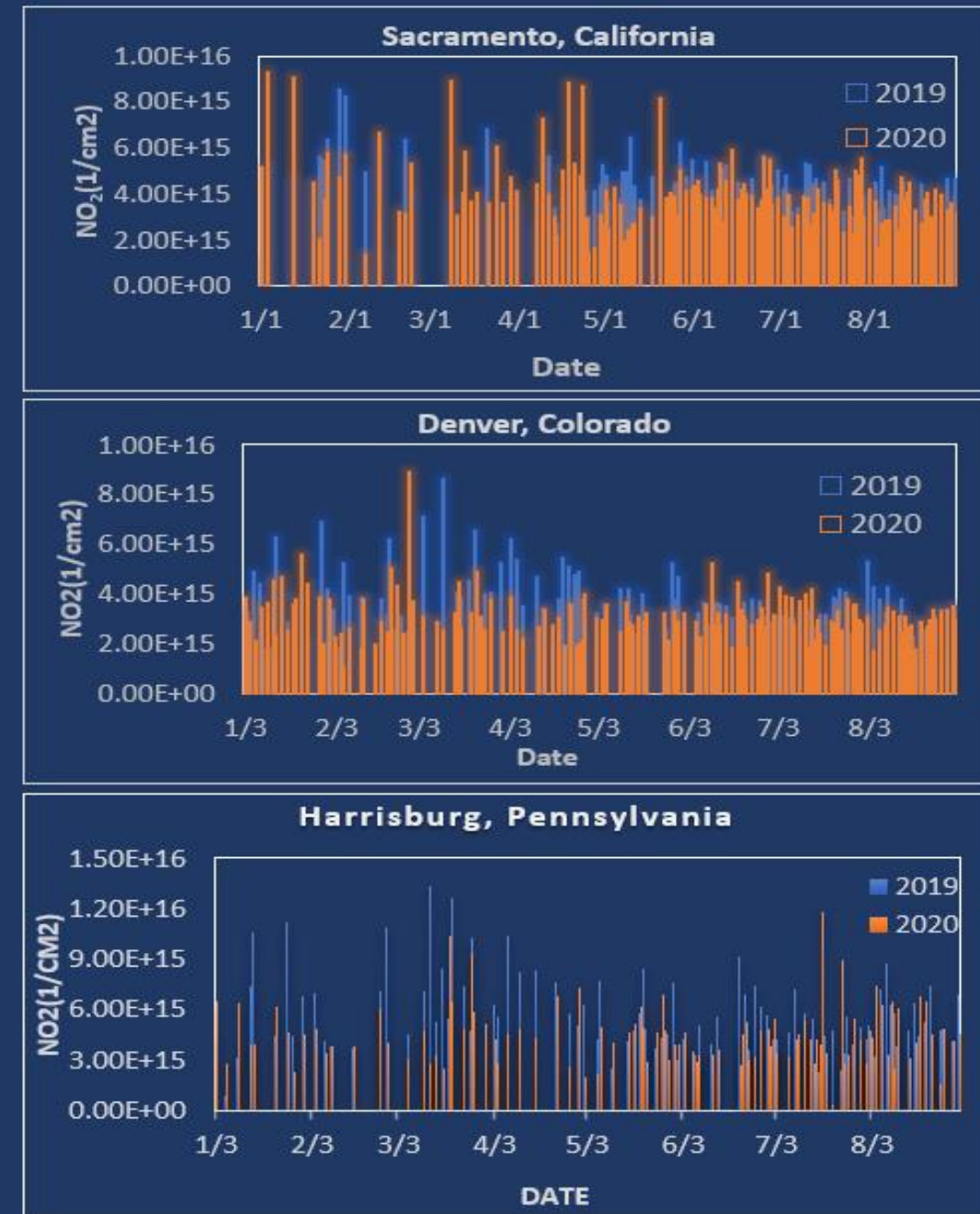
These plots show the variations of AOD for the years 2020 and 2019 in three different cities of USA; (a) Sacramento, (b) Denver, and (c) Harrisburg.

Variations of NO2 in 2019 and 2020

NO_2 (Nitrogen Dioxide) is a gas composed of one Nitrogen atom and two Oxygen atoms. NO_2 is released through vehicles, power plants, and off-road equipment. NO_2 can cause worsened symptoms for respiratory diseases, asthma, coughing, and difficulty breathing.

These plots show the variations of NO_2 for the years 2020 and 2019 in three different cities of USA; (a) Sacramento, (b) Denver, and (c) Harrisburg.
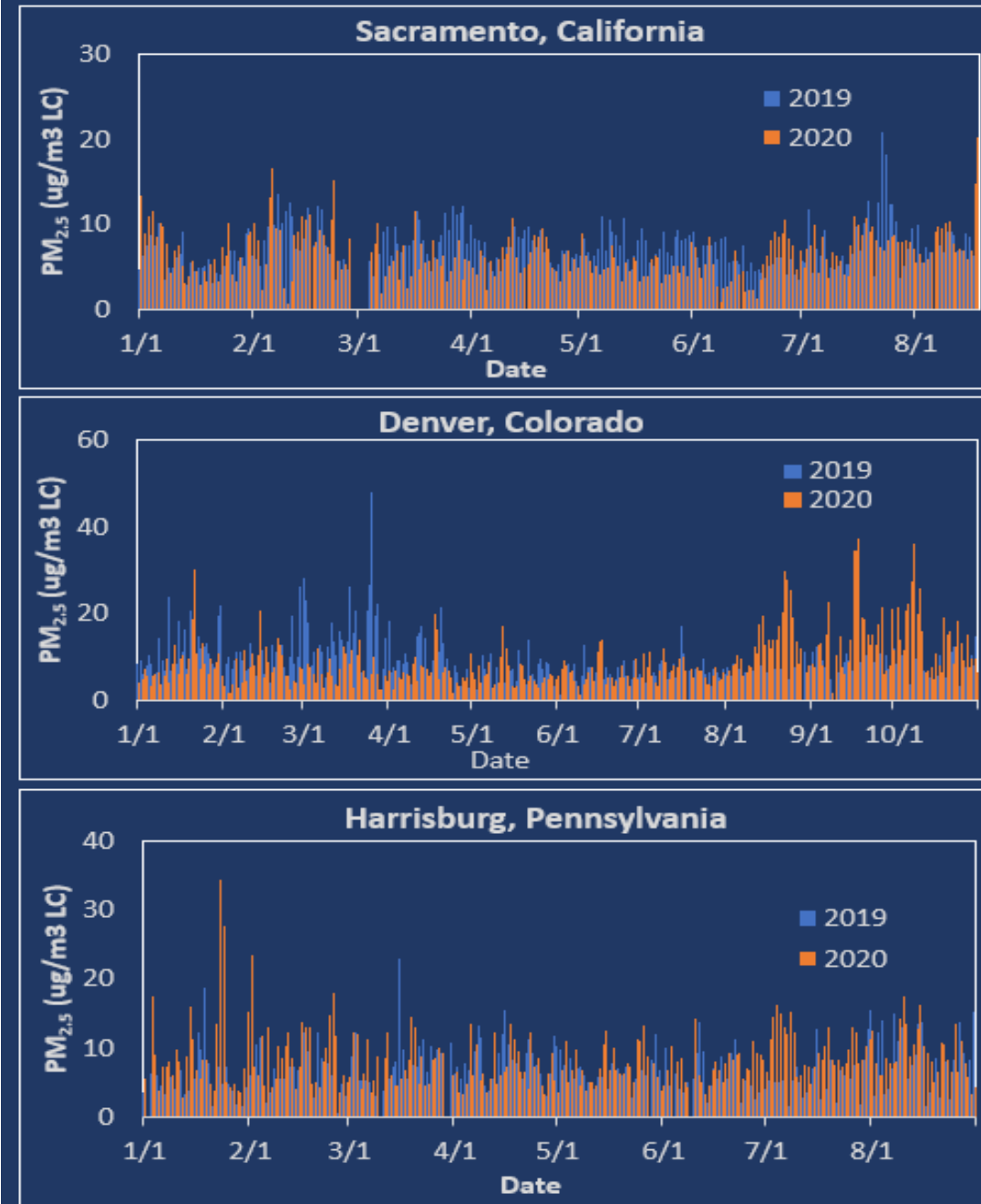
Variations of PM2.5 in 2019 and 2020

PM2.5 are particles in the atmosphere having diameter of 2.5 micrometers or less. Examples of this pollutant include dust, ash, and sea spray. High concentrations of PM2.5 in the atmosphere is the source of poor air quality that can reduce visibility, throat irritation, lung problems, worsened medical conditions, and asthma.

These plots show the variations of PM2.5 for the years 2020 and 2019 in three different cities of USA; (a) Sacramento, (b) Denver, and (c) Harrisburg.

Highlights

Comparing of air pollutant parameters (AOD & NO2) for the years 2020 and 2019, show a decline of pollutants in 2020 during COVID-19 when some of the cities observed lockdown to maintain social distancing which have helped cities to mitigate the effect of COVID-19. This shows that the shutting down of factories and the decrease of the use of vehicles has helped to reduce the amount of pollutants in the atmosphere. If we continue this type of situation after the lockdown is over, the air quality will improve. Our results will attract attention of the city council for planning transportation mechanisms in some of the cities which are facing problem of air quality.

References

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- https://www.esrl.noaa.gov/gmd/grad/surfrad/aod/

- https://earthobservatory.nasa.gov/global-maps/MODAL2_M_AER_OD

- http://www.greenfacts.org/en/nitrogen-dioxide-no2/index.htm

- https://www.health.ny.gov/environmental/indoors/air/pmq_a.htm#:~:text=How%20can%20PM2.5%20affect%20my%20health%3F&text=Exposure%20to%20fine%20particles%20can,as%20asthma%20and%20heart%20disease.

- https://www.EPA.gov