XULA Surface-Based Measurement Initiative for Environmental/Air Quality Monitoring

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INTRODUCTION

Xavier_Univ_LA is a newly established AERONET site which started operations in May 2024. This poster represents some of our preliminary studies seeking to characterize local atmospheric aerosols, particularly $PM_{2.5}$ since the current focus of our work is in air quality. We also seek to identify local and regional aerosol sources impacting the New Orleans area.

The data from all instruments shown here was taken in the May thru July 2024 time period. In the plots of AERONET Cimel data, multi-day gaps in the dataset are present. We believe these gaps are mostly due to overcast conditions on those days. All of the AERONET Cimel data shown here has undergone level 1.5 processing.

THE XAVIER SITE

Figure 1: Instruments located on rooftop of campus building

- Instrument Coordinates: 29.96430° N, 90.10740° W, Elevation: 10.0 m
- Located in metro New Orleans with the Mississippi River less than 5 miles to the south and Lake Pontchartrain less than 5 miles to the north; the site is about 50 miles from the Gulf of Mexico (see Figure 3)
- Co-Located Instruments: Pandora, Purple Air Sensor, Davis Air Sensor, GPM

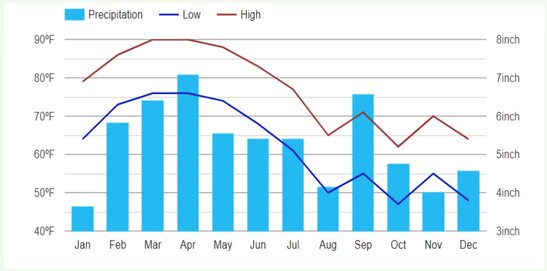

Figure 2: Climate Data for New Orleans area Source: usclimatedata.com

New Orleans has a humid, subtropical climate with very hot and humid summers and mild, short-lived winters. The area experiences high annual rainfall, most of it occurring in spring and summer.

LOCAL AND REGIONAL SOURCES OF $PM_{2.5}$

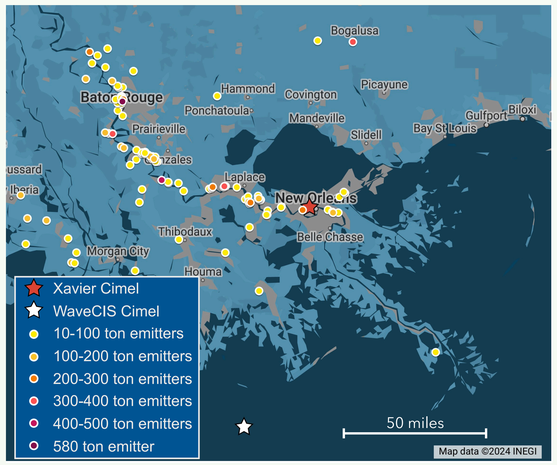

Figure 3: Louisiana industrial sites within 100 miles of the Xavier Cimel that emitted 10 tons or more of $PM_{2.5}$ in 2023, Data Source: Louisiana Department of Environmental Quality (LDEQ)

Local and regional aerosol sources include:

Industrial Sites

Figure 3 shows the abundance of Louisiana industrial locations emitting $PM_{2.5}$ in the region. Note that it does not show ALL emitters, only those emitting 10 tons or more annually. There are 111 sites included in the figure with their total 2023 emissions equaling 9631.5 tons. The majority of sites are from the petrochemical industry. The other sites are mostly power plants and sugar refineries.

Vehicles

The Xavier site is located near the center of the city of New Orleans. Xavier is in a high traffic area with several main throughfares and an elevated expressway adjacent to campus.

Agricultural Activities

Key agricultural activities in the region surrounding New Orleans include:

- Use of Pesticides, Herbicides, and Fertilizers: Emits volatile organic compounds (VOCs), nitrous oxide, and ammonia
- Livestock Farming and Machinery: Produces ammonia, and particulate matter from animal waste and machinery emissions

Nearby bodies of water

Sea salt aerosols are likely produced by wave action in Lake Pontchartrain and the Gulf of Mexico.

COMPARISON OF AOD AND $PM_{2.5}$ MASS CONCENTRATION

AOD measurements from the Xavier Cimel were compared with $PM_{2.5}$ concentration measurements made with a Purple Air sensor located with the Cimel. One purpose to this comparison was to test how reliable AOD measurements could be in measuring $PM_{2.5}$ that would affect surface air quality. Another purpose is to eventually gain insights into aerosol altitudes, size, and perhaps other characteristics.

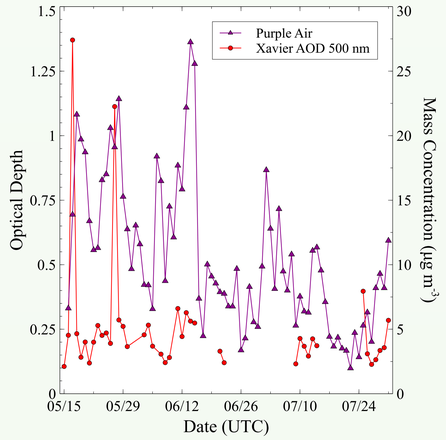

Figure 4: Daily averages of $PM_{2.5}$ concentration (Purple Air) compared to AOD 500 nm (Cimel). The instruments are co-located.

The graph in Figure 4 indicates only a weak correlation at best between $PM_{2.5}$ concentration and AOD. There could be a variety of reasons for this such as the altitude of the aerosols, humidity, particle size and perhaps other factors. We are in the process of further investigating these variations.

COMPARISONS WITH NEAREST AERONET SITE

WaveCIS_Site_CSI_6 is the nearest active AERONET site and is located in the Gulf of Mexico about 80 miles south of Xavier (see Figure 3). Comparisons between the two sites were performed to see if possibly the same aerosols were reaching both sites.

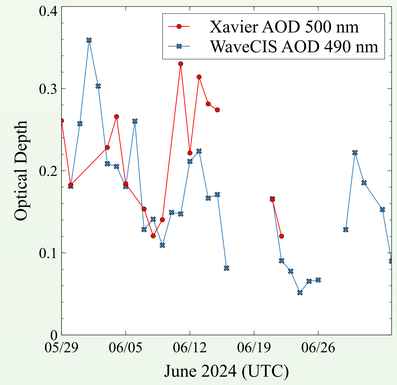

Figure 5: Daily averages of AOD are shown for both sites.

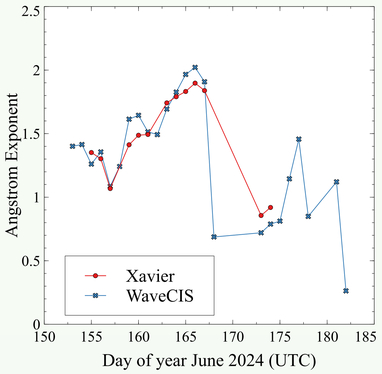

Figure 6: Daily averages of Angstrom exponent (440-675 nm) are shown.

Figures 5 and 6 both show some amount of correlation between the two sites for the first half of June indicating the possibility that both sites were subject to the same aerosol source during that time.

Figure 6 shows the Angstrom exponent at both sites had a dominance of fine particles (exponent > 1) during the first half of June. These large exponent values indicate that those aerosols were not sea salt, but instead came from a land source or sources.

FUTURE WORK

- Further characterization of aerosols (identify source and how aerosols move in the region)
- Investigate the role of aerosols in local and regional climate patterns
- Comparison of AERONET ground-based measurements with satellite data from instruments like MODIS, MISR, and VIIRS
- Educational and outreach programs
- Environmental justice and health disparities research (investigate the impact of aerosol pollution on underserved communities)
- building machine learning based prediction model for AQI for surrounding region
- building machine learning based prediction model for precipitable water, O_3, and NO_2 based on AERONET measurement for the surrounding region

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