Satellite Data for Local PM_{10} Sources: Case Study in the Oceano Dunes

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Executive Summary

Satellite-derived estimates of particulate matter (PM) can complement the ground-monitor-based approach used to provide PM_{10} concentration estimates in the United States. This application of satellite data allows for continuous spatial detection of atmospheric aerosols at resolutions as fine as 1km x 1km. Based on a conversation with the San Luis Obispo County Air Pollution Control District (SLO County APCD), we conducted an analysis of satellite data capabilities to detect and identify lofted mineral dust (hereafter referred to as dust), in the Oceano Dunes State Vehicular Recreation Area (ODSVRA).

Background

- The ODSVRA is a state park located on the coast of California. This park has a sandy area that is approximately 6 miles long where off-highway vehicles are allowed.
- The ODSVRA and surrounding dunes totals about 14 miles along the coastline.
- The ground monitor closest to the ODSVRA is the Arroyo Grande CDF monitor.

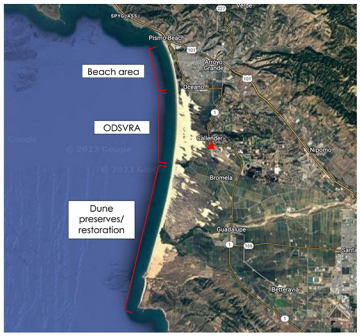

Figure 1: Location of ODSVRA relative to other dune preserves, restoration projects, and beach. The total length of the coastal dune system is about 14 miles. The red triangle indicates the location of the CDF ground monitor.

Methods

- The MAIAC aerosol optical depth (AOD) data was plotted using Google Earth Engine following the recommended quality guidelines provided in the MAIAC User Guide.
- Monthly AOD was averaged and plotted from 2013-2022 (**Figure 2**).
- AOD from a high PM_{10} day at the CDF monitor was plotted with wind barbs (**Figure 3**).

AOD Imagery

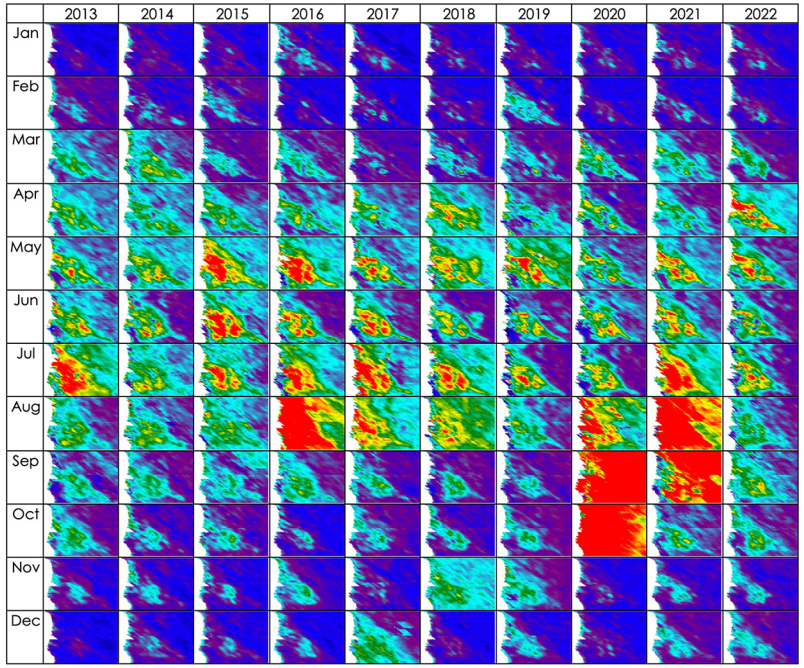

Figure 2: Monthly average AOD value from the years 2013-2022.

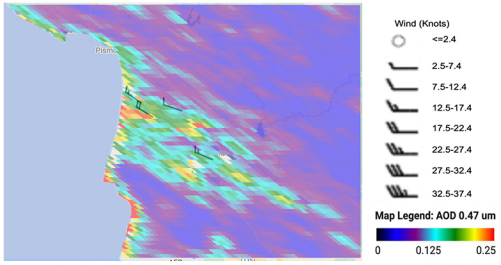

Figure 3: Wind barbs from May 22, 2013, at 2pm PT overlayed on MAIAC AOD without quality mask.

Map Legend: AOD 0.47 um
0 0.125 0.25

- Variability in AOD is seen over time (**Figure 2**). The first and fourth quarters of the year tend to have fewer aerosols present than the second and third quarters.
- The aerosols appear to be originating from the beach and/or ocean when a "typical" plume is detected. This is supported by the shape of the plume and the wind barbs on high PM_{10} days (**Figure 3**).
- Wildfire pollution contributes aerosols to the region during certain months. This is most common in the months of August, September, and October. Specifically in 2020 and 2021.

Next Steps

- Compare the change in AOD from specifically the ODSVRA to the entire dune system (pictured below).
- Compare PM_{10} concentration measured at CDF monitor to AOD at the location of the monitor.
- Account for background levels of aerosols.
- Incorporate precipitation rates and wind speed in analysis.
- Use AOD imagery to refine SLO County APCD AQI forecast zones

Figure 4: Red: estimated plume area from ODSVRA. Blue: Estimated plume area of entire dune system. Black: Background concentration.

Summary

- Local aerosol plume detected near the ODSVRA and surrounding dune system.
- Speciation of the aerosols is undetermined. Possible sources include sea spray, aerosolized microbes, the surface of the dune system, the ODSVRA specifically, and/or fires.

Acknowledgements

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