Overview on

An Analysis of Aerosol Optical Properties and VOCs in Houston Air Quality

Houston air quality is influenced by local emissions, industrial emissions, and biomass burning. Especially during the summer months of July and August, elevated temperatures and stagnant atmospheric conditions can exacerbate pollution levels. This leads to concerns over public health and environmental impacts. This R programming tutorial explores the temporal variation of aerosol optical properties and volatile organic compounds (VOCs) in Houston during July and August while focusing on identifying potential biomass burning events. The core research questions are: How do Absorption Ångström Exponent (AAE), Scattering Ångström Exponent (SAE), and VOCs vary over time? And are there indicators of biomass burning during this period?

Having a large amount of missing data, a data imputation technique has been applied in the R script named "VOC_MDL_Timeseries.R" prior to making a time series plot. Visualization of the data gives an idea about the distribution, range, and potential outliers. Diurnal variation of VOCs along with sources of emissions such as vehicular emissions can be perceived through the trend of changes of the concentration over time. An R script called "AAE_SAE.R" is the code for AAE and SAE. AAE offers insight into aerosol chemical composition. Black Carbon (BC) is typically associated with AAE ≈ 1; on the contrary, Brown Carbon (BrC)—a common marker of biomass burning—exhibits AAE >> 1. An AAE threshold of 1.2 is used to distinguish brown carbon (BrC) influences. SAE relates to aerosol size; smaller particles yield higher SAE. An SAE threshold of 1 is applied. Events are identified as biomass burning if both AAE > 1.2 and SAE > 1 persist for at least four hours.

This tutorial involves the development of time series visualizations of AAE, SAE, and VOCs using Houston data. These aerosol and optical data can also be found from the ARM (Atmospheric Radiation Measurement) Archive (https://www.arm.gov/data/). The R script provided is fully reproducible and designed for researchers to apply to similar datasets. It includes handling missing data, filtering specific time ranges, event identification logic, and graphical outputs suitable for publication. By applying these methods, researchers can assess not only seasonal trends in atmospheric composition but also detect episodic biomass burning impacts, with clear implications for public health and climate-related studies.