AIR QUALITY ASSESSMENT OVER GULF COAST BY ESTABLISHING RELATIONSHIP BETWEEN MODIS-SATELLITE DERIVED AEROSOL OPTICAL THICKNESS (AOT) AND SURFACE PM$_{2.5}$ OBSERVATIONS

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Abstract: PM$_{2.5}$, particulate matter with less than 2.5 micrometers in diameter, sourced from industrial and combustion activities, is one of the major pollutants with high health risk as the fine particles when inhaled cause severe lung and respiratory problems. Air quality is generally assessed through a network of ground monitoring stations and so has the limitations of spatial and temporal resolution. More so, the assessment of PM$_{2.5}$ is restricted due to its large temporal and spatial variability and difficulties in sampling. Satellite remote sensing has the advantages of monitoring in remote and data sparse areas. Direct remote sensing of PM$_{2.5}$ as a direct measurement is not possible and needs an indirect assessment through one of their derived products. Satellite remote sensing is an important tool to monitor aerosols as they provide good spatial coverage at desired time intervals. Aerosol optical thickness (AOT), a parameter retrieved from satellites, is a vertical columnar measurement of aerosol with a higher AOT value meaning higher column aerosol loading. Several studies were attempted to use the satellite derived AOT to assess the air pollution from aerosols. MODIS (MODerate-resolution Imaging Spectroradiometer) Terra and Aqua satellites provide two daytime observations (10:30 a.m. from Terra and 1:30 p.m. from Aqua) of AOT at 10 km resolution. Attempts are being made to establish relationship between AOT and PM$_{2.5}$ for different region all over the globe as several factors including meteorological conditions and hysteresis affect the relationship. In this study, an attempt has been made to establish the relationship between MODIS columnar AOT and surface PM$_{2.5}$ with the study domain between 28.2899-32.9366N, 84.6452-92.8795W covering Mississippi Gulf coast region. All available surface PM$_{2.5}$ observations from monitoring stations within the study domain from EPA and MDEQ sources and MODIS AOT for the one year period of 2007 were collated to establish relationship. AOT value corresponding to each of the surface PM$_{2.5}$ observation was obtained using in-house developed software. Several alternatives of choosing the AOT values within the vicinity were examined. Choice of 4 nearest AOT data points and all AOT data within 50 km radius with constraint of at least 4 data points were considered. Surface PM$_{2.5}$ at the time of AOT pastime and daily values were separately used to assess the relationship. Results indicate that there is a positive relationship between MODIS AOT and surface PM$_{2.5}$ and the correlation coefficients are significant with values in the range of 0.3-0.5 99% statistical significance. The relationship between specific time AOT and surface PM$_{2.5}$ is better than daily values. At this time, with one year data simple relations were examined. With the collection of MODIS AOT and surface PM$_{2.5}$ for more years, separate relationships will be assessed for different seasons as the meteorological conditions are known to influence the relationship.

Key words: Air quality, PM$_{2.5}$, remote sensing, MODIS AOT