Estimation and Analysis of Aerosol Optical Thickness (AOT) in Metro Manila from 2015 to 2018 using Remote Sensing and GIS

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Abstract: Air pollution has been one of the major environmental issues in the Philippines for the past years. Air quality reports released by the Department of Environment and Natural Resources in 2015 indicated that there is a huge increase in the number of observed firms that contribute to air pollutants in the country especially in Metro Manila or the National Capital Region (NCR). However, there are only few operational air quality monitoring stations in the Philippines and these reports are based on the ground measurements produced by these stations. In large urban areas like the NCR, which constitutes 17 cities with dense buildings and population, there is a need to have an adequate number of monitoring stations to provide comprehensive assessment on the status of the air quality. This study aims to utilize satellite images and remote sensing techniques in determining the spatial distribution of aerosols in these cities. The aerosol optical thickness (AOT) is calculated using radiative transfer equation and derived from Landsat 8 imageries. Image-derived AOT values were validated using measurements from the AERONET station of the Manila Observatory. Spatial trends on the monthly AOT values from 2015 to 2018 were determined using the GIS-based method Optimized Hotspot Analysis. The results show a seasonal trend in the AOT values, in which they are higher during the dry season (November to April) as compared to the values during the wet season (May to October). AOT maps also show that high AOT values cluster around major roads, business districts, and industrial areas. Further analysis are done using precipitation data which concludes that the AOT values decrease when total rainfall amount increases. These information are essential in creating programs and policies for managing air quality problems in urban areas. The remote sensing methodologies presented serve as an alternative for the costly and time-consuming ground-based measurements and may be easily implemented on a larger scale.

Keywords: Air quality, Metro Manila, Remote sensing, AOT, Hotspot analysis