Assessments of Sentinel 5P TROPOMI dataset on Urban Pollutants in the State of Selangor and their Correlation with Meteorology

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Abstract

Air pollutants such as nitrogen dioxide (NO_2), carbon monoxide (CO), and formaldehyde (HCHO) are some of the most common pollutants found in urban environments. These pollutants originate from human activities, particularly from industrial processes, emissions, and biomass burning, leading to various impacts on human health. This study provides a detailed evaluation of the monthly and yearly behaviour of these pollutants, along with their relationship to meteorological factors in the state of Selangor over a five-year period from 2019 to 2023. Pollutant concentrations, measured by Sentinel-5P TROPOMI, and meteorological variables from the ERA5 Land Reanalysis—such as temperature, precipitation, surface pressure, and wind speed—were processed and visualised using Google Earth Engine, Python, and ArcGIS Pro. Seasonal trends revealed that NO_2 and SO_2 peak during months dominated by the South West Monsoon (SWM). CO displays an opposite trend, prevaling during months when the North East Monsoon (NEM) and inter-monsoon seasons are dominant. Correlation analysis between pollutants and meteorological variables indicates that precipitation (CO $r = -0.83$ to -0.20, NO_2 $r = -0.20$ to -0.00, SO_2 $r = -0.40$ to 0.00) and wind speed (CO $r = -0.63$ to -0.26, NO_2 $r = -0.26$ to 0.00, SO_2 $r = -0.37$ to -0.14) have a strong to weak negative correlation with all three pollutants, suggesting pollutant washout and dispersion. Conversely, temperature (CO $r = 0.82$ to 0.86, NO_2 $r = 0.39$ to 0.42, SO_2 $r = 0.00$ to 0.36) and surface pressure (CO $r = 0.82$ to 0.85, NO_2 $r = 0.36$ to 0.46, SO_2 $r = 0.00$ to 0.35) exhibit a strong to moderate positive correlation, indicating stable meteorology-pollutant interaction patterns. Overall, CO demonstrates the most stable correlation patterns, while NO_2 and SO_2 display more variability year-to-year, emphasising the importance of continuous monitoring to understand pollutant-meteorology dynamics in urban atmospheric environments.

***Keywords**:* Air pollutants, TROPOMI, Google Earth Engine, Meteorology, ERA 5