Spatio-temporal analysis of Total Column Ozone (TCO) and its precursor, Nitrogen Dioxide (NO_2) in 2021 using satellite retrieval in Klang Valley, Malaysia

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Abstract

In urban areas, photochemical reactions involving nitrogen dioxide (NO_2) contribute to increasing levels of ozone (O_3), especially due to anthropogenic activities. This study aims to analyse the spatio-temporal variations of Total Column Ozone (TCO) and NO_2 across six districts in Klang Valley, including Putrajaya, for the year 2021. Satellite datasets were obtained from the Ozone Monitoring Instrument (OMI) and the Tropospheric Monitoring Instrument (TROPOMI) and were analyzed using trend and geospatial techniques. Monthly averages of TCO and NO_2 concentrations from both satellites revealed noticeable differences due to spatial resolution and unit conversion. TCO levels ranged from 230 to 330 Dobson Units (DU) using OMI, while TROPOMI recorded values between 1.6×10^{16} to 1.8×10^{16} mol/m², approximately equivalent to 230–340 DU. Both datasets showed a consistent trend in NO_2 concentrations across all districts. Daily comparisons between TROPOMI and OMI highlighted short-term pollution peaks, often linked to weekday and weekend activity patterns in urban settings. The analysis also found that Kuala Lumpur and Klang recorded the highest concentrations of NO_2 and TCO among the districts studied, suggesting a need for targeted air quality control strategies in these areas. Overall, the study offers valuable insights into the spatial and temporal behavior of ozone and nitrogen dioxide levels in urban environments using satellite observations.

Keywords: Spatiotemporal analysis; Total Column Ozone; Nitrogen Dioxide; Satellite observation.