

Analysis of Seasonal Total Column Ozone & Nitrogen Dioxide (NO₂) for 2021-2022 in Klang Valley Using Tropospheric Monitoring Instrument (Tropomi)

Wardina Athirah Tamlikhan & Arnis Asmat*

Structured Abstract

Background: Rapid urbanization in the Klang Valley has led to significant environmental challenges, particularly in terms of deteriorating air quality. The presence of key atmospheric pollutants such as nitrogen dioxide (NO₂) and total column ozone (TCO) has raised health and sustainability concerns. NO₂, primarily emitted from vehicle exhaust and industrial sources, contributes to the formation of tropospheric ozone (O₃) through photochemical reactions. While surface ozone is commonly monitored, satellite-based measurements like TCO offer a broader understanding of ozone distribution across all atmospheric layers. However, studies on TCO variation and its relationship with meteorological factors in Malaysia, especially in Klang Valley, remain limited.

Methods: This study employed a combination of satellite data from the Tropospheric Monitoring Instrument (TROPOMI), ground-based measurements, and meteorological parameters (humidity, temperature, wind speed, wind direction) to assess seasonal and spatial patterns of NO₂ and TCO across Klang Valley from 2021 to 2022. Data were analyzed using multiple linear regression to evaluate the relationship between TCO and meteorological factors. Spatial distribution was visualized using Inverse Distance Weighting (IDW) interpolation in GIS, enabling identification of pollution hotspots during different monsoon phases.

Results: The results revealed seasonal peaks of NO₂ during the Southwest Monsoon, particularly in high-density areas such as Kuala Lumpur, Subang, and Petaling Jaya. In contrast, TCO levels were highest during the Northeast Monsoon, especially in February and March, influenced by stable weather and increased solar radiation. A significant negative correlation was observed between humidity and TCO ($r = -0.283$), while temperature and wind speed showed moderate positive correlations.

Conclusion: In conclusion, this study highlights the value of integrating satellite and ground-based data to understand spatiotemporal pollution patterns. The findings provide essential insight into how monsoonal dynamics and meteorological variables affect air quality, which is crucial for developing effective mitigation strategies in urban environments like Klang Valley.

Keywords: Total Column Ozone, Nitrogen Dioxide, TROPOMI, Klang Valley, Spatial Distribution

*Correspondence: rnis_annis@uitm.edu.my

School of Chemistry & Environment, Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Malaysia