Evaluating the Correlation Between Satellite and Ground-Based NO_x Measurements in Eastern Africa: Identifying Main Sources of Pollution

Elsevar Zeynalov[1], Daniel M. Westervelt[2], Abhishek Anand[2], Godwin Opinde[3], Tedy Mutisya[3]

[1]Columbia University, New York, [2]Lamont-Doherty Earth Observatory, Palisades, New York, [3]Kenyatta University, Nairobi, Kenya

Many developing regions, such as Eastern Africa, do not have enough access to expensive ground-based nitrogen oxides (NO_x) monitoring devices due to financial limitations. This research project evaluates whether the freely available satellite data from the Tropospheric Monitoring Instrument (TROPOMI) can serve as a supplement to the ground-based NO_x measuring instruments in Eastern Africa. Ground-level data were obtained from an NO_x analyzer providing hourly concentrations of NO, NO_2, and NO_x, while satellite-based daily NO_2 data were accessed via Google Earth Engine. As a consequence of correlation analyses, trend comparisons, and diurnal pattern evaluations, the study revealed that there is a weak correlation between NO_x concentrations from the two datasets, primarily due to spatial differences in measurement. Despite the fact that ground-based instruments measure concentrations in a specific location, satellite measurements calculate the average of vertical and horizontal concentrations in larger urban areas. However, both datasets successfully show the same overall decreasing trend in NO_2 concentrations from 2021 to 2025. The main reasons for this decline are the following: noticeable infrastructure improvements, the removal of the roadside cooking machines, and the enforcement of the 2022 Nairobi Air Quality Act. Moreover, consistent diurnal peaks during morning and evening hours indicate that vehicular traffic remains a main source of air pollution in nearby urban areas. This research project concludes that we can use satellite-based NO_2 as a complementary tool to ground-level instruments in data-scarce regions such as Eastern Africa.