EVALUATING THE CORRELATION BETWEEN SATELLITE AND GROUND-BASED NO_x MEASUREMENTS IN EASTERN AFRICA

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1. MOTIVATION

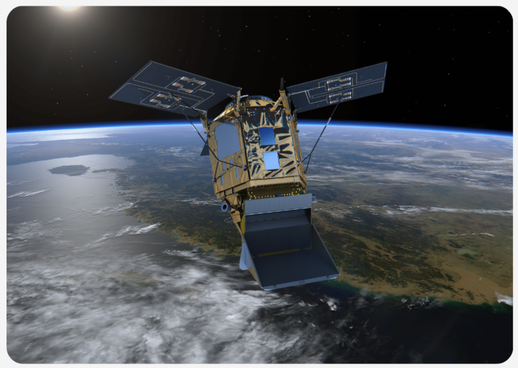
I. Expands Access to Air Quality Monitoring
Many developing regions, including Eastern Africa, lack dense networks of expensive ground-based NO_x monitoring devices due to financial and logistical constraints. This study investigates whether freely available satellite data can reliably fill these gaps, providing broader and more affordable environmental information.

II. Empowers Evidence-Based Decision-Making
Accurate NO_x data is crucial for shaping effective urban planning, transportation policy, and public health interventions. By improving the availability and reliability of this data, the research enables local governments to make science-informed decisions for healthier cities and population.

III. Promotes Climate and Environmental Justice
Satellite-based approaches improve access to air quality information, especially in historically underrepresented regions in environmental monitoring. This supports more inclusive global research efforts and helps address disparities in policy attention.

2. RESEARCH METHODS AND DATA RESOURCES

- **Research Method:**
  - Create visuals to measure the correlation between satellite and ground-level NOx data.
  - Compare trends and patterns from both sources.
  - Evaluate the reliability of using satellite data as a supplement to ground-level data.
- **Data Resources**
  - Ground-level: NOx Analyzer, which is an instrument that measures NO, NO_2, and NOx in the atmosphere on an hourly basis
  - Satellite: TROPOMI, which measures NO_2 daily and was made available by NASA and the European Space Agency via Google Earth Engine.



3. RESULTS

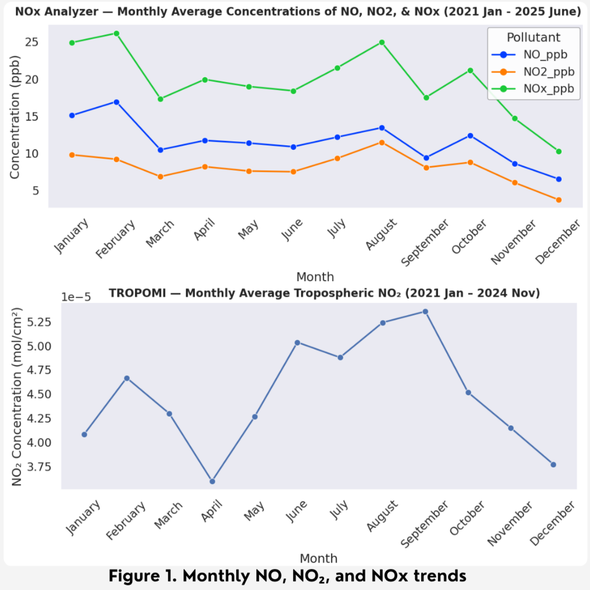


Figure 1. Monthly NO, NO_2, and NOx trends

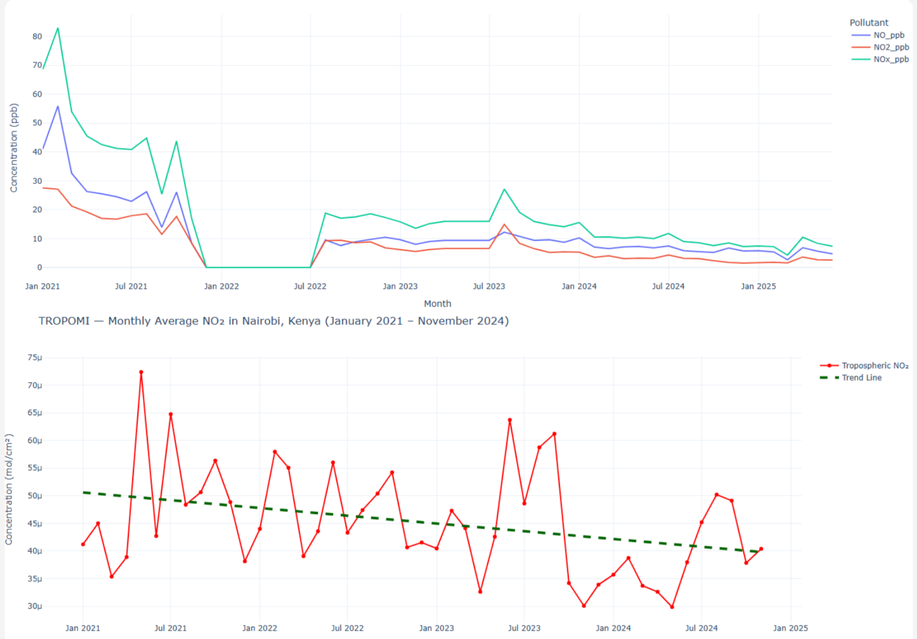


Figure 2. NO, NO_2, and NOx trends from 2021 to 2025

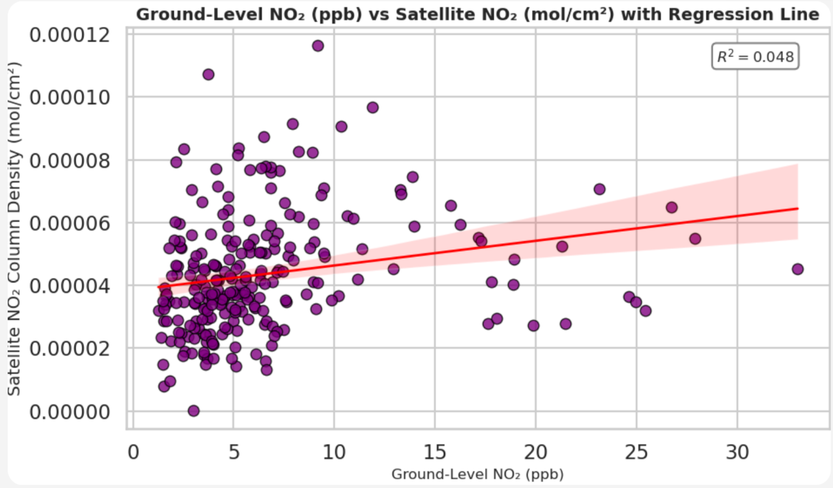


Figure 3. Scatter plot showing correlation between satellite and ground-level NO_2

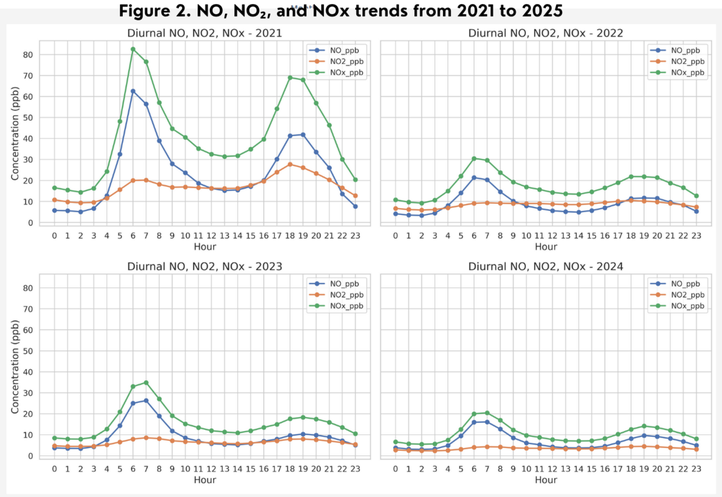


Figure 4. Daily NO, NO_2, and NOx concentrations

4. SUMMARY

- This research found **a weak correlation between satellite-based NO_2 observations and ground-based NO_x analyzer** in Eastern Africa. The weak correlation is largely due to the difference in the scope of measurements. While ground-based analyzers measure NO_x at a single fixed point, satellites average concentrations over the entire city of Nairobi.
- Despite these limitations, the TROPOMI data still captured **the same decreasing overall trend in NO_2 levels**, supporting that it can be used as **a supplementary tool in data-scarce regions**, such as Eastern Africa.
- A notable **decrease in NO_x levels was recorded** from 2021 to 2025. This declining pattern is likely influenced by infrastructure improvements, regulation of roadside cooking machine sales, and the partial enforcement of the Nairobi Air Quality Act, signed in 2022.
- The diurnal patterns, especially the morning and evening peaks in NO_x concentrations across all years, suggest that **vehicular emissions from traffic** are a main source of air pollution in the region's urban areas.