Status of Air Quality in Nepal

Regional Dialogue on Transformative Action to End Open Burning of Waste in South Asia

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Sources of Air Pollution in Nepal

Air pollution depend on:

Emission sources, Metrological Condition (rain, wind speed, wind direction, temperature etc) and Geography

Emission Sources

- Emission from household
- Emission from industries
- Emission from Transport Sectors
- Emission from construction
- Agriculture residue burning
- **Municipal Waste Open Burning**
- Forest Fire
- Transboundary movement

MUNICIPAL WASTE OPEN BURNING

- Rapid Urbanization is the main cause of increase the municipal waste.

  (urbanization rate is 17% in 2011 to 66.17% in 2021)

- The haphazard urbanization trend is worsening the air quality and the environmental health of the city.

- Open burning of waste is a source of GHG and atmospheric pollutants emissions, like other types of combustion.

- Substances emitted include Carbon dioxide (CO_2), Methane (CH_4), SOx, NOx, Non-Methane Volatile Organic Compounds (NMVOCs), CO and NH_3, particulates (TSP, PM_{10}, $PM_{2.5}$, $PM_{1.0}$, BC and Organic Carbon).

- This is also a significant source of dioxins, Polychlorinated Biphenyls (PCBs) and Polycyclic Aromatic Hydrocarbons (PAHs)

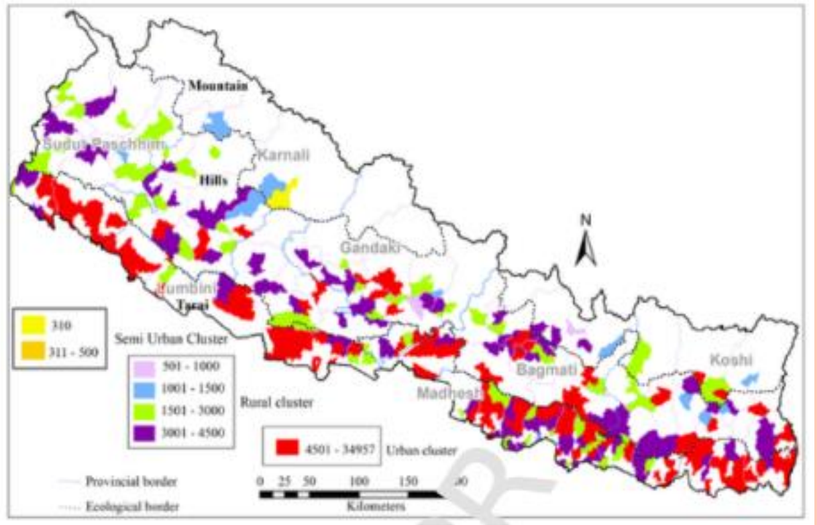


Fig 1 : Urbanization cluster in Nepal
Source : Bhattarai et al, 2023

Impact of Air Pollution

Human Health

- 99% of world population breathe polluted air. *(WHO 2021)*

- Premature death: 8.1 million *(Worldwide)*
  - 26 thousands – equivalent to a 3.4 year reduction in average life expectancy in Nepal, *(World Bank 2025)*

- 75% COPD, 46% strokes, 44% Heart Diseases, 41% lower respiratory infections, 38% Lung Cancer, 30% Neonatal issues and 20% diabetes *(Global Burden of Disease Study 2021, HEI)*

- One of major out of five cause of death *(Health Effects Institute & Institute for Health Metrics and Evaluation, 2019)*

Economy: (Aviation, Tourism, Agriculture, Education, Employment etc)

- 6% of GDP of Nepal affect by air pollution *(World Bank 2025)*

Ecosystem- loss on biodiversity

LEGAL FRAMEWORK

Law	National Policies	Acts and Regulation	Strategies

• Constitution of Nepal 2015 :Article 30.
  • To live in clean environment is Fundamental
  • Balance between development and environment
  • Polluter should pay compensation for the victim
	• National Environment Policy 2019
	• National Solid Waste Management Policy, 2022
	• National Urban Policy 2007 *(Focusing infrastructure, land use and environmental sustainability)*
		Environment Protection Act, 2019
		Environment Protection Regulation, 2020
		Solid waste management Act 2011
		Solid Waste Management Rules 2013
			•**Nepal's Long-term Strategy for Net-zero Emissions 2021 :**
			•net-zero greenhouse gas emission by 2045
			• **National Urban Development Strategy, 2017**
			•**Nationally Determined Contribution 2025 (NDC 3.0)**
			• Nepal commits to converting 30 percent of industrial boilers to electricity by 2030 and 70 percent by 2035.
			• All iron and steel industries are expected to shift to electric furnaces by 2035, while
			• Two cement plants must replace at least 35 percent of coal use with bioenergy (such as pellets or briquettes).
			• Expand renewable electricity generation to 14,000 MW by 2030 and 28,500 MW by 2035
			• Use of electric cook stoves to 2.1 million household by 2035
			• Transition of electric vehicle 90% of private and 70% of public by 2030 and 95% of private and 90% of public by 2035

LEGAL FRAMEWORK

Action Plan

- **Nepal's Sixteenth Five-Year Plan, 2081/82 to 2085/85 (2024/25-2028/29)**
  - Acknowledges the health and environmental impact of air pollution
  - Emphasizes the need for adopting stricter standards and implementing air pollution control measures.
  - The use of renewable energy and energy efficient technologies, such as electric boilers and furnaces is highlighted.
- **Kathmandu Valley Air Quality Management Action Plan 2019**
- Formulate the National Air Quality Management Action Plan (NAQMAP): (in process)

Standards and SOPs

National Health Care Waste Standard Operating Procedure, 2020

National Ambient Air Quality Standard, 2012

Nepal Vehicle Emission Standard 2025

Industry Specific Pollution Standards

Standard on Emission and Chimney Height for Industrial Boiler, 2069

Standard on Operation of Brick Kiln Industries, Standard on Chimney Height and Emission for Brick Kiln Industries, 2074

Standard on Emission for Cement Industries , 2069

Standard on emission from operation of diesel generator, 2069

Standard on Emission and Chimney Height for the operation of Incinerators, 2071

Standard on Emission for in-used vehicle, 2069

Standard on Emission for vehicle operated by LPG and gasoline, 2054

Gazette Notice

- Ban of incineration of hospital waste and should be treatment by autoclave technology
- Ban the open burning within the premise of Industries
- Ban the open burning of municipal waste

Institutional Framework for Air Quality Management

Constitution of Nepal and EPA gives the responsibility and authority on Environment Conservation and Pollution Control to all three tires of Government

Federal Local

- Ministry of Forest and Environment
- Ministry of Industry, Commerce and Supplies
- Ministry of Physical Infrastructure and Transport
- Ministry of Urban Development
- Ministry of Agriculture and Livestock Development
- Department of Environment
- Department of Industry
- Department of Transport
- Etc…

Provincial Level

- Ministry of Forest and Environment
- Ministry of Industry

Local Level

All the 753 local Governments (Municipalities)

Institutional Framework Solid Waste Management

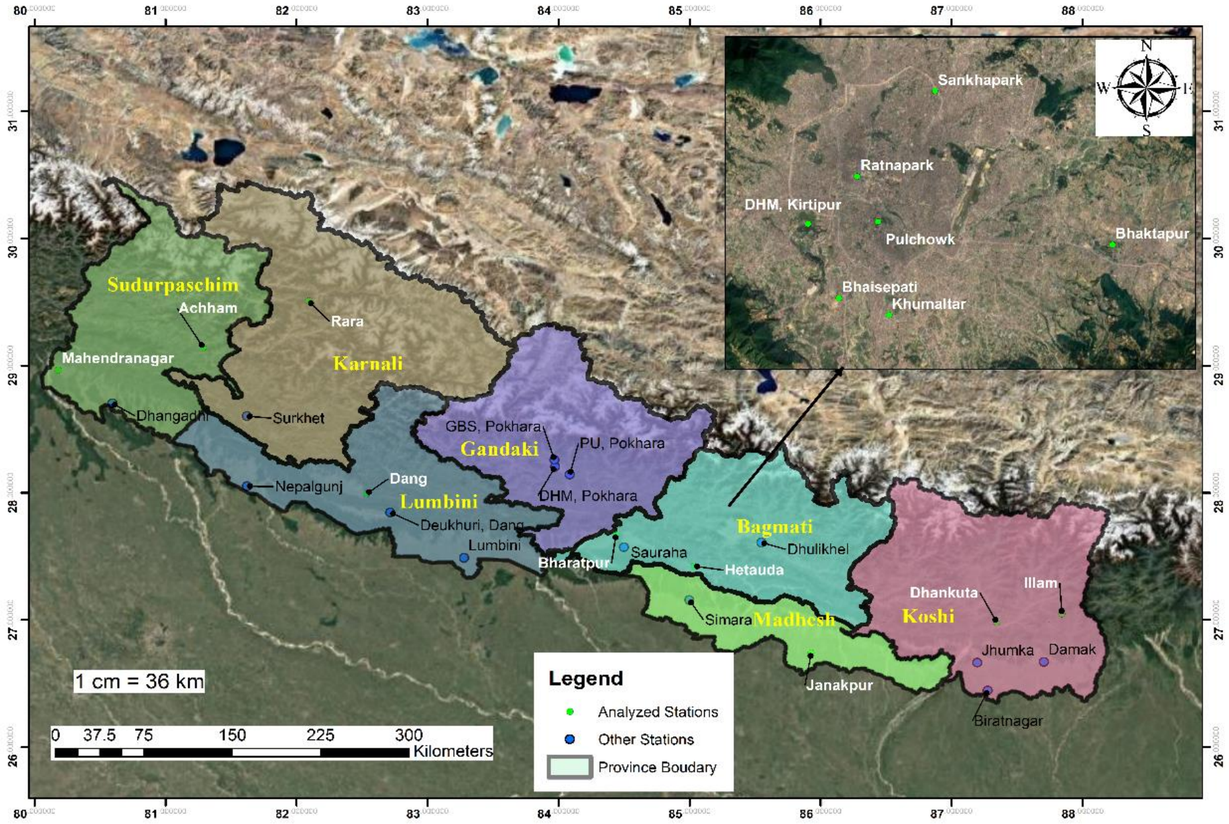
Federal Level

Formulate National Policy, Rules and Regulations: Ministry of Physical Structure and Urban Planning

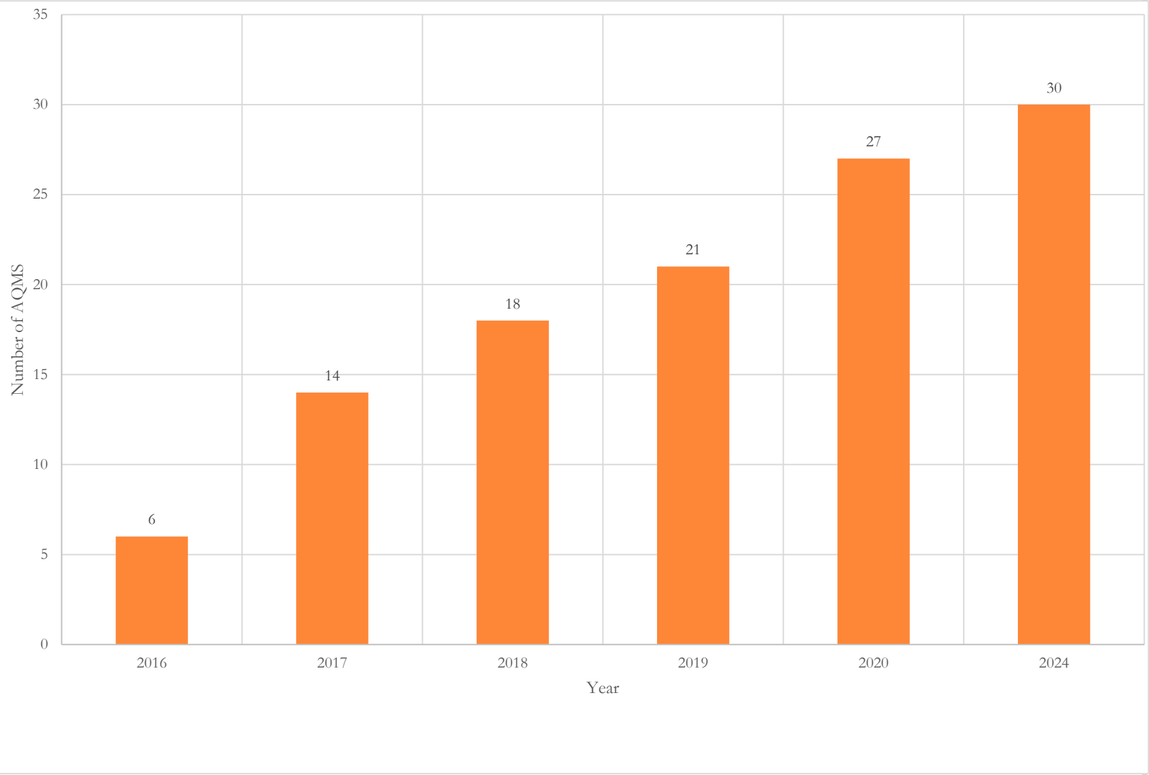
Local Level

Implementation: All the 753 local Governments (Municipalities)

Ambient Air Quality Monitoring stations network in Nepal

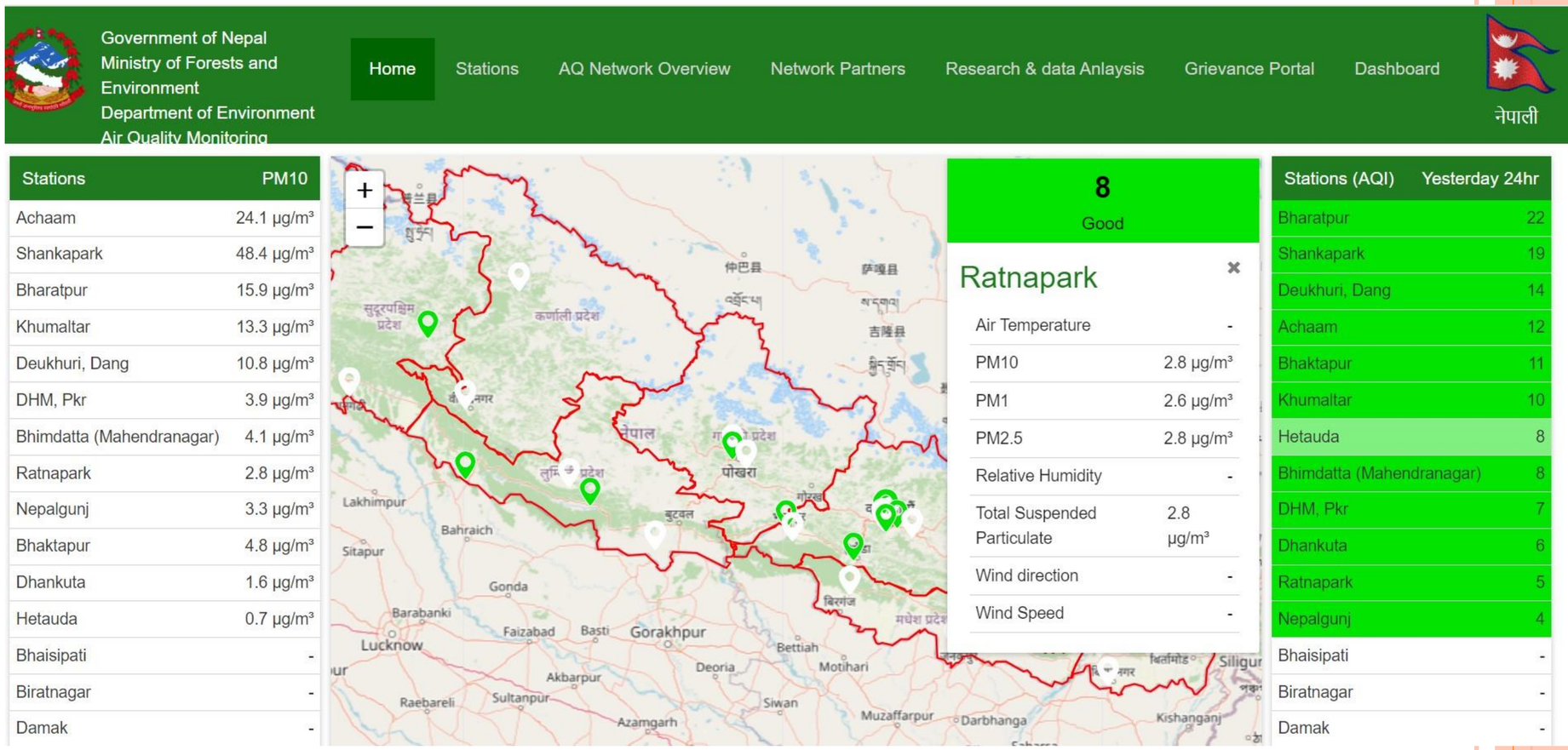


Air Quality Monitoring Station, Rara

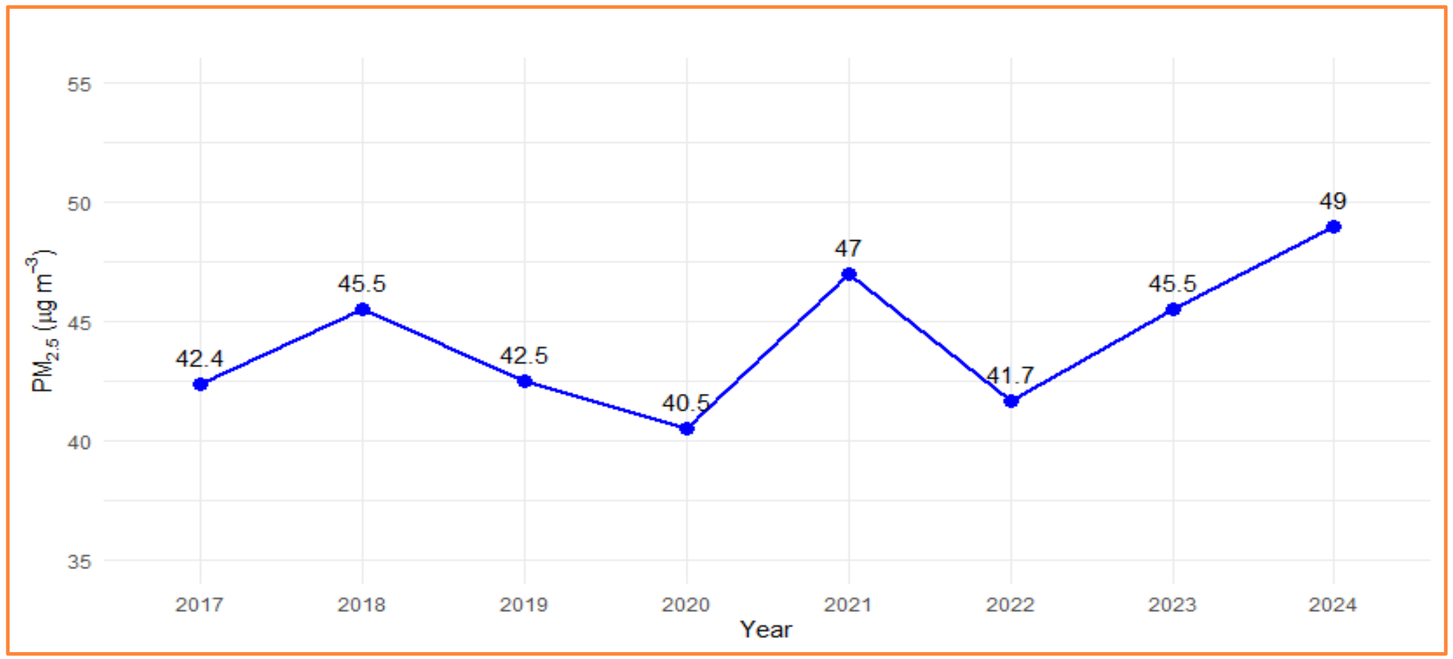


Access to air quality data communication National Dashboard

- Real time data from air quality monitoring stations can be accessed through www.pollution.gov.np
- Access the real time data for one week from dashboard
- Annual report available in department website

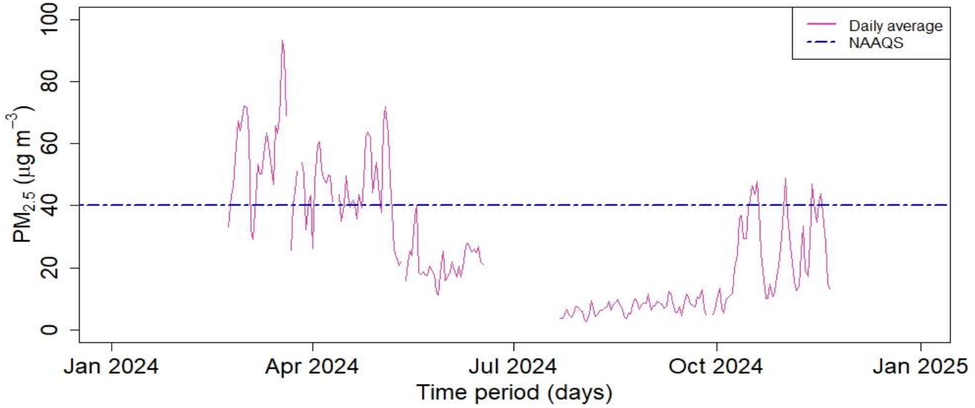


Yearly average of $PM_{2.5}$ at for Kathmandu Valley

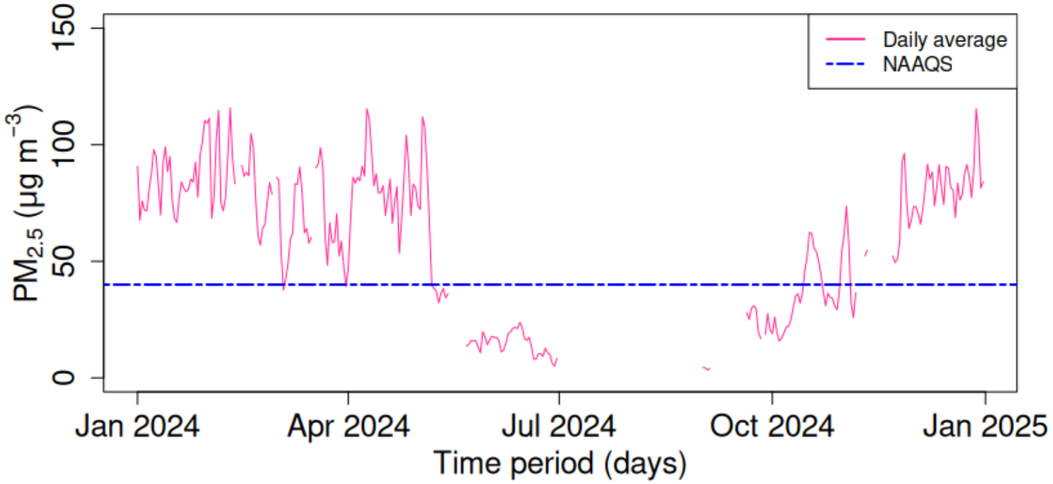


Yearly average of PM_{25} for Kathmandu based on ground and model data (Ratnapark station and MEERA2 data)

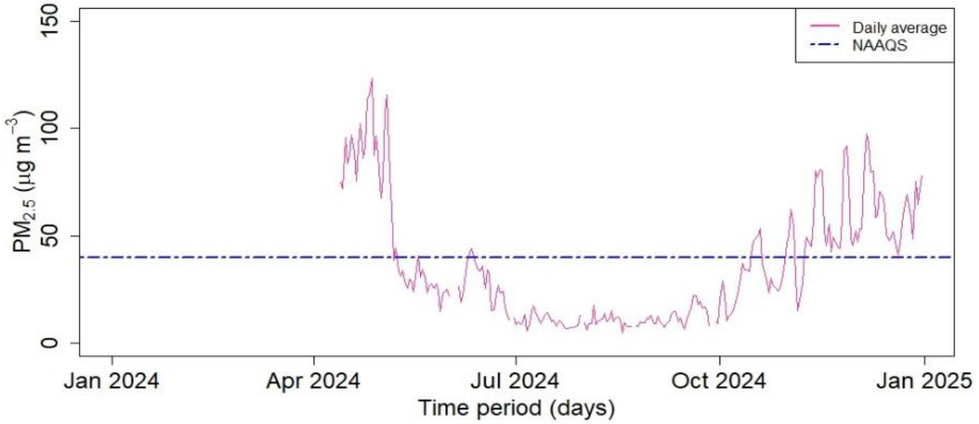
DAILY AVERAGE OF $PM_{2.5}$ AT DIFFERENT LOCATION OF THE COUNTRY



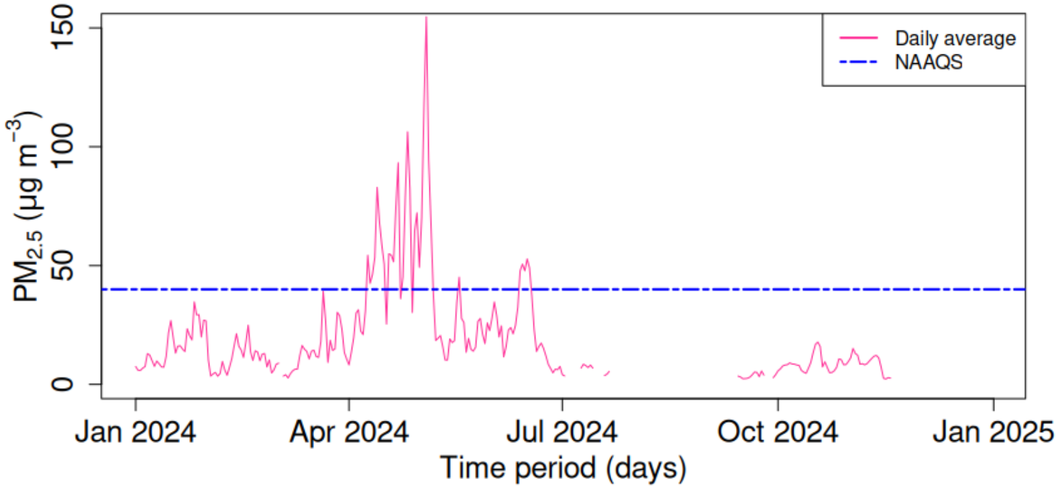
a. Dhankuta station



b. Ratnapark Station



c. Bharatpur station

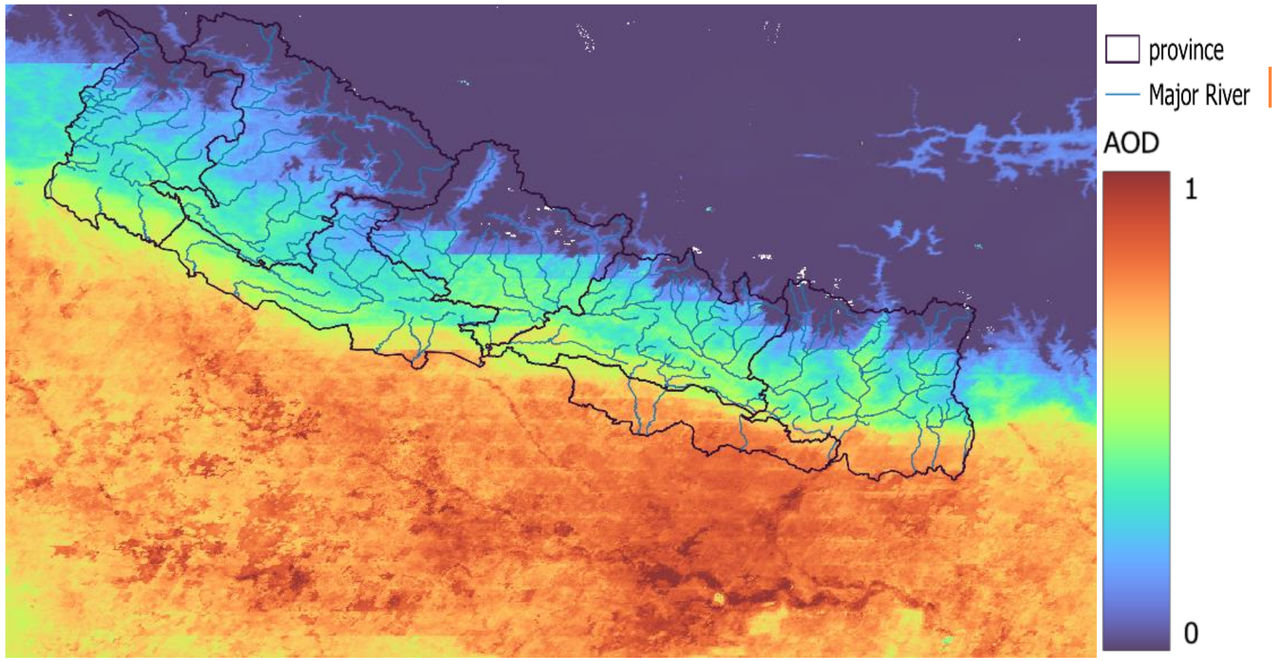


d. Rara station

Evidence from Satellite Data

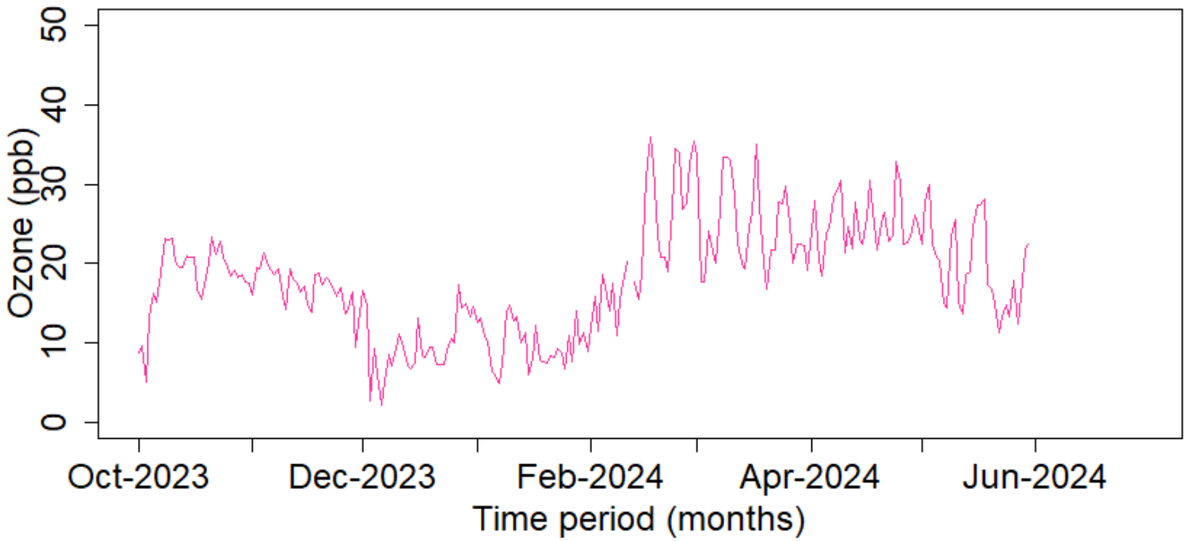
The high annual average Aerosol Optical Depth (AOD) from NASA's MODIS satellite indicates elevated $PM_{2.5}$ Pollution levels in the terai region.

The AOD value is more in the Eastern Terai Compared to Western Terai

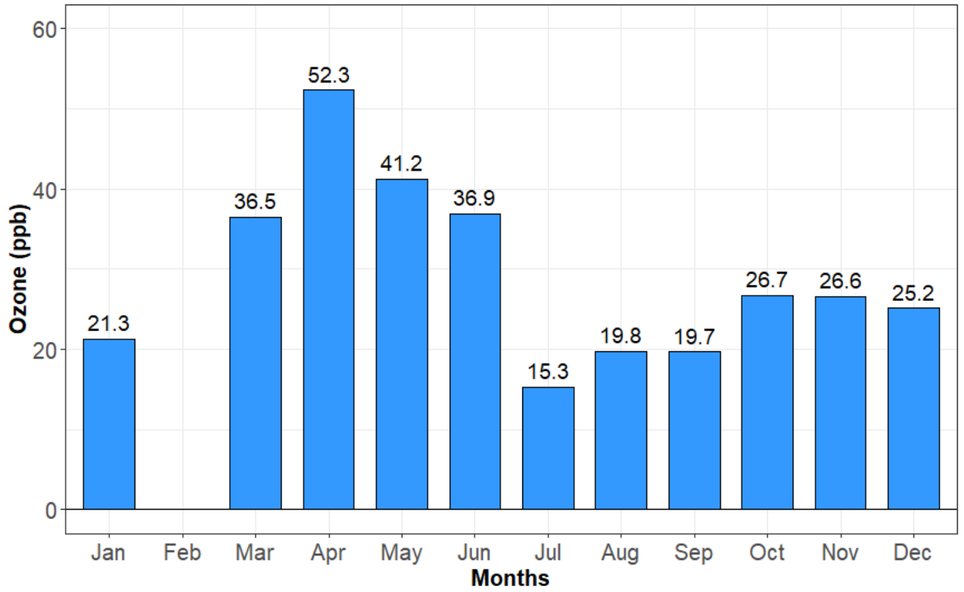


Annual average of AOD for 2024

Tropospheric Ozone (O_3)



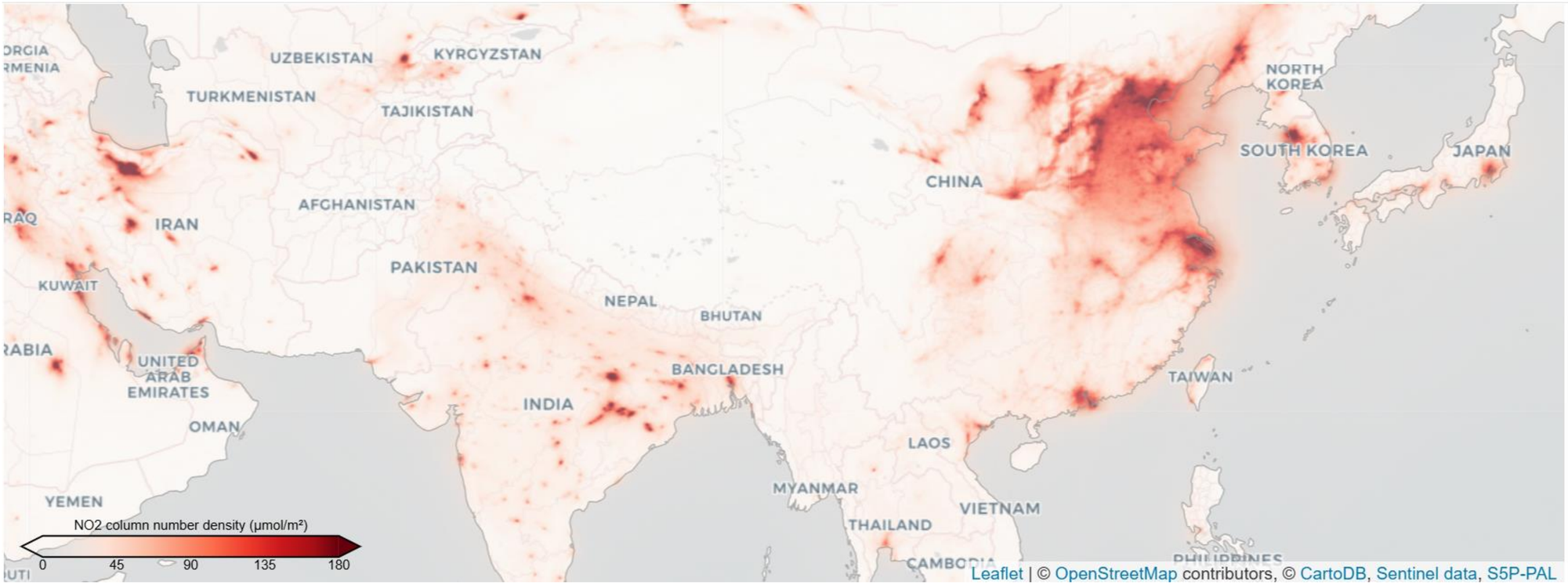
Daily average of Ozone in 2024



Monthly average of Ozone in 2024

The Ozone data from Khumaltar Monitoring station (Within Kathmandu valley)

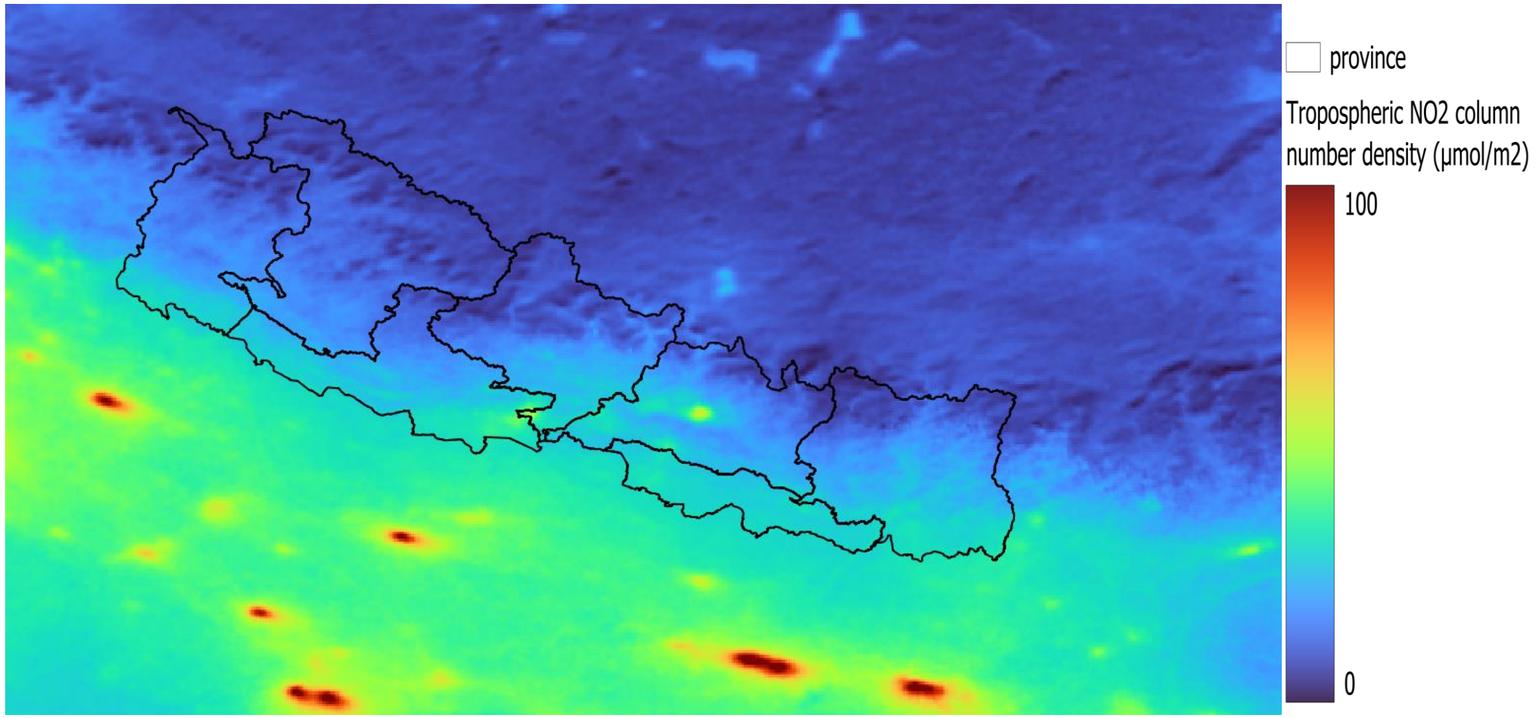
Nitrogen Oxide NO_x



It is not only an important air pollutants but also precursor of Ozone.
Although ground-based data are limited, satellite observations provide important insights.
Compared to neighboring countries, the yearly average NO_2 concentration in Nepal is very low, as shown by TROPOMI NO_2 data for 2024.

Nitrogen Oxide NO_x

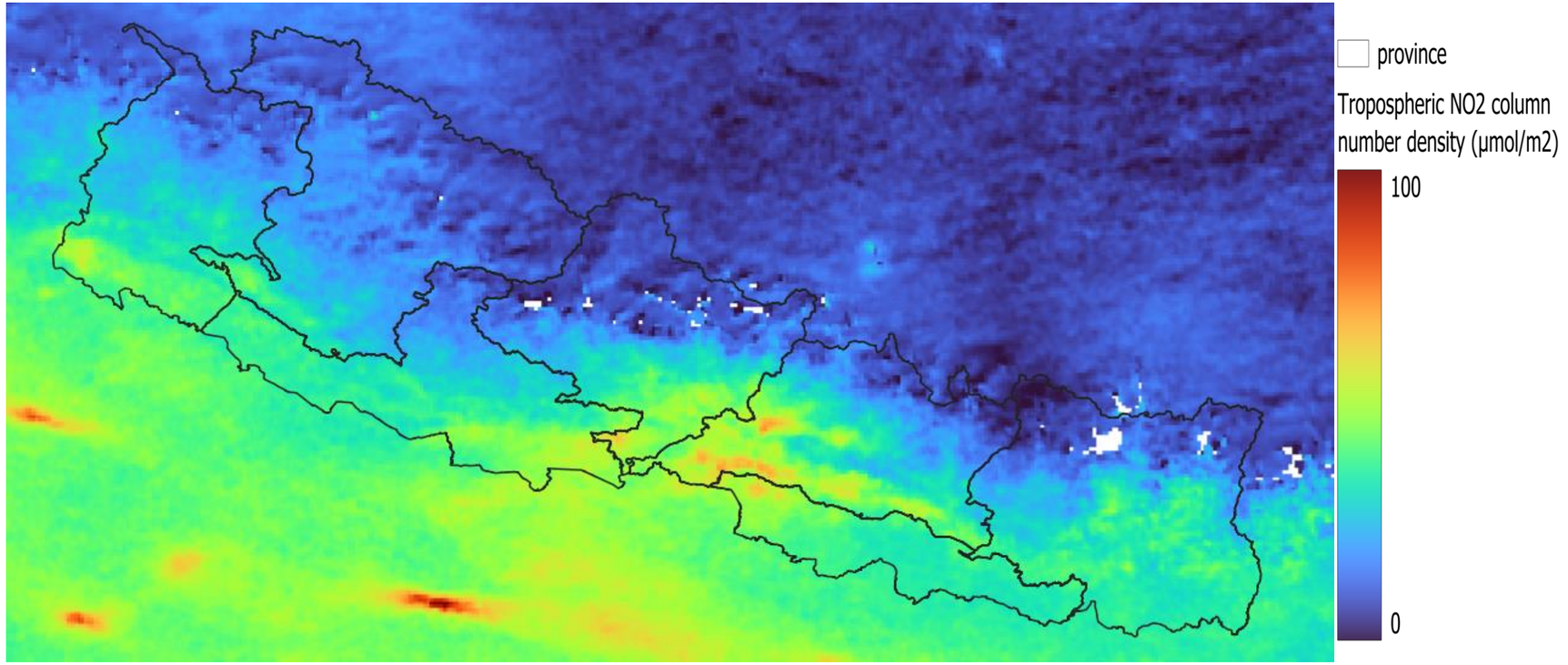
Within Nepal, NO_2 levels are relatively higher in Kathmandu and in other areas with large industrial activities.



The annual average NO_2 concentration in 2024, as observed by TROPOMI Satellite

Nitrogen Oxide NO_x

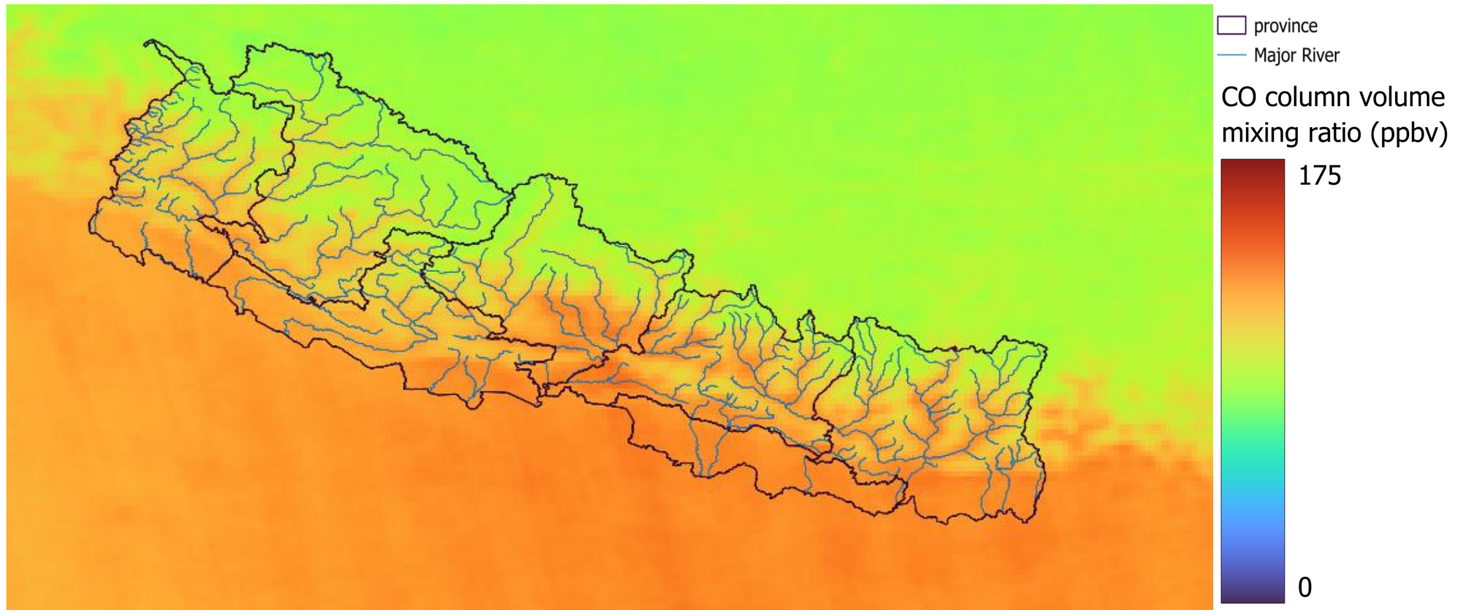
However, during the forest fire season, NO_2 levels can rise in many parts of the country, which may also lead to elevated ozone concentrations.



The monthly average NO_2 concentration in April, 2025, as observed by TROPOMI Satellite

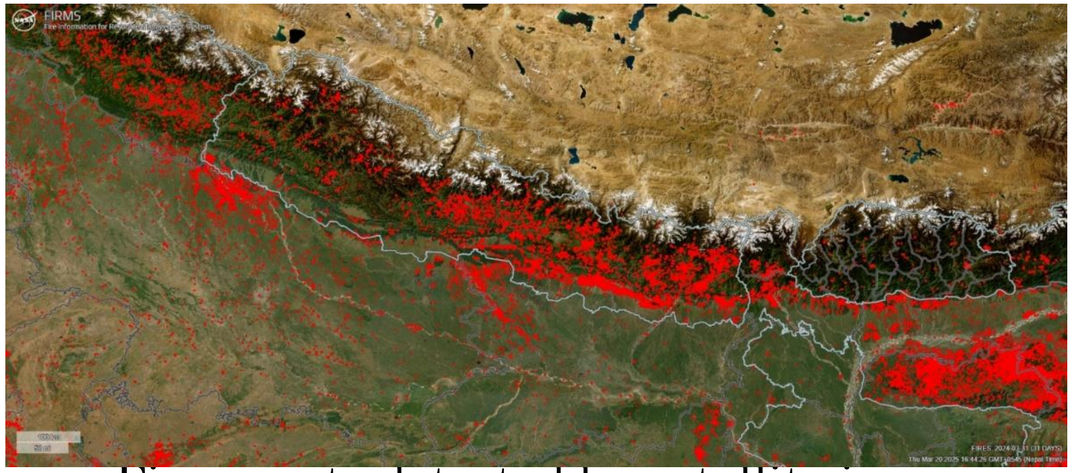
Carbon Monoxide(CO)

Elevated CO concentrations observed across many regions of Nepal are indicative of biomass burning and incomplete fuel combustion

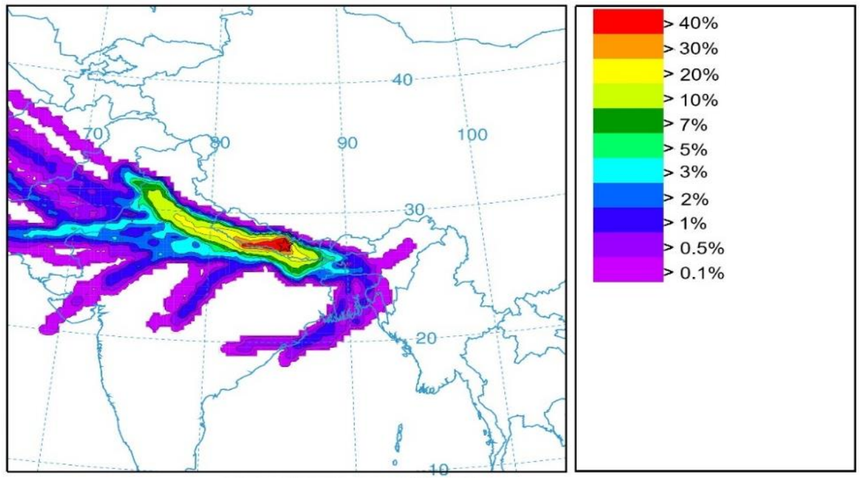


The yearly average CO concentration in 2024, as observed by TROPOMI Satellite

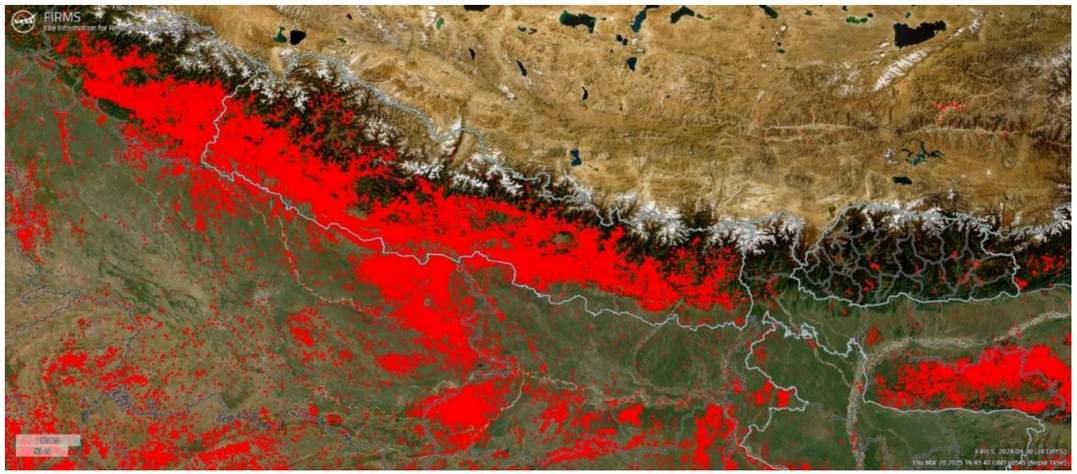
Forest fire, Agricultural Residue and Waste Open Burning



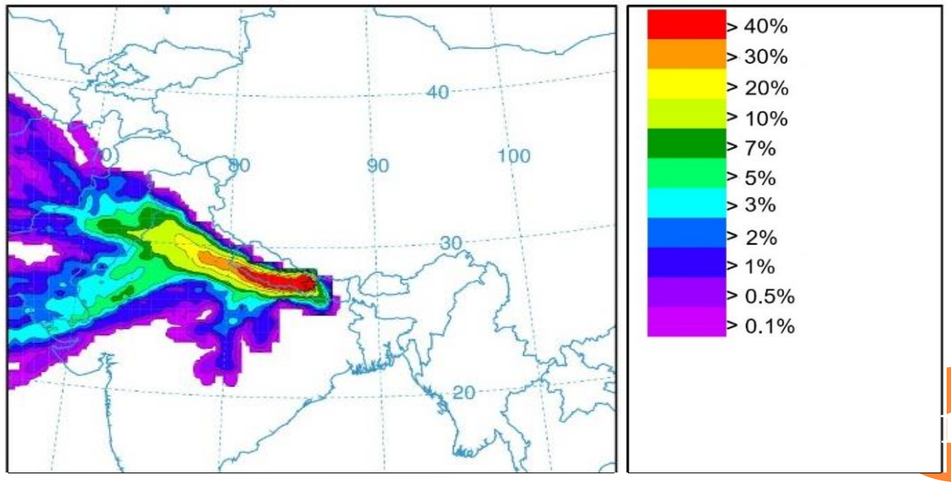
Fire events detected by satellite in March, 2024, Source: FIRMS



Hysplit Backward Trajectory Frequency for Kathmandu in March, 2024



Fire events detected by satellite in April, 2024, Source: FIRMS



Fire events detected by satellite in April, 2024, Source: FIRMS

Challenges/Gap in Addressing Air Quality

- Coordination among the stakeholders
- Constraint in allocation of resource
- Rapid and unplanned Urbanization
- Lack of science based policy making system
- Lack of competent human resources *for compliance monitoring, operation, data analysis, maintenance and calibration of monitoring equipments, pollution transfer modeling, forecasting etc*
- Quantification of the contribution of pollution from the specific sources *(eg emission inventory, source apportionment)*
- Modeling and air quality forecasting system
- Transboundary air pollution effects
- Regional cooperation, coordination and harmonization is necessary
- Difficult to change the attitude of people (behavior change) including policy maker

Thank you for your kind attention

For more information, kindly contact
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