AIR POLLUTION IN UZBEKISTAN: SCIENTIFIC ASSESSMENT OF CURRENT CONDITIONS AND POLICY CHALLENGES (NOVEMBER 2025)

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Abstract

This article provides a scientific analysis of Uzbekistan's air pollution as of November 2025. Using publicly available environmental datasets, satellite observations, and regional climate modeling summaries, it evaluates critical pollutants—PM2.5, PM10, NO_2, SO_2, and CO—along with their sources, health impacts, and spatial distribution. Particular focus is placed on Tashkent, Fergana Valley, and industrial southern regions. Policy gaps, governmental actions, and climate-related amplifiers are also analyzed. The study concludes with recommendations for mitigation and monitoring improvements to strengthen Uzbekistan's environmental management.

Introduction

Air pollution remains one of Uzbekistan's most significant environmental health challenges. Rapid urbanization, increased automobile use, industrial activity, and climate-related dust intensification contribute to worsening air quality. Recent monitoring data from 2024–2025 indicate that several urban centers routinely exceed WHO guidelines for PM2.5 and PM10 concentrations[1]. These exceedances have spurred renewed scientific and policy interest, especially as climate warming accelerates dust frequency and stagnation events across Central Asia[2].

1. Methodology

This study synthesizes:

1. Satellite-derived aerosol optical depth (AOD) data from NASA and ESA missions[3].

2. Local ground monitoring data published by Uzbekistan's Hydrometeorological Service (UzHydromet)[4].

3. Peer-reviewed Central Asian air quality research from 2019–2025[5].

4. Regional climate model projections relevant to dust mobility and temperature trends[6].

Data were harmonized through cross-comparison methods commonly applied in environmental atmospheric science. No proprietary or classified datasets were used.

2. Current Air Quality Overview (November 2025)

2.1 PM2.5 Levels

As of November 2025, average PM2.5 concentrations across Uzbekistan remain significantly elevated.

Tashkent: 40–70 μg/m^3 during stagnant weather conditions[7]

Fergana Valley (Fergana, Namangan, Andijan): 60–95 μg/m^3[8]

Samarkand & Bukhara: 35–55 μg/m^3, influenced by cross-border dust events[9]

These values exceed WHO's recommended limit of 5 μg/m^3 annual average and 15 μg/m^3 daily exposure[10].

2.2 PM10 and Dust Influence

PM10 spikes continue to be driven by natural and anthropogenic dust sources. The drying of soils, agricultural land disruption, and mild drought conditions in 2025 magnify dust intrusions, particularly in central and western regions[11].

2.3 NO_2 and Vehicle Emissions

Road transportation remains a major contributor to NO_2 levels in Tashkent, where traffic density increased sharply following population growth and urban migration trends[12].

2.4 SO_2 and Industrial Sources

Industrial zones in Angren, Almalyk, and Muborak emit considerable SO_2 from metallurgical and energy facilities[13]. While modernization efforts are underway, emissions remain above EU benchmark levels.

3. Regional Distribution of Pollution

3.1 Tashkent Metropolitan Area

Tashkent consistently records the country's highest NO_2 and CO levels[14]. Winter inversion layers trap pollutants close to the ground, creating severe smog episodes.

3.2 Fergana Valley

Topographic enclosure intensifies pollutant retention. PM2.5 levels in autumn 2025 were among the highest in Central Asia[15].

3.3 Southern Industrial Belt

Cities like Qarshi, Muborak, and Shurtan show elevated SO_2 and particulate emissions due to gas processing and energy production facilities[16].

4. Health Impacts

4.1 Respiratory Illnesses

Studies indicate increased rates of asthma, chronic bronchitis, and pediatric respiratory infections in polluted regions[17].

4.2 Cardiovascular Effects

Long-term exposure to PM2.5 is linked with hypertension, heart disease, and higher stroke incidence—patterns consistent with global research but now increasingly observed in Uzbek epidemiological reports[18].

5. Climate Amplifiers

Central Asia is warming faster than the global average. Uzbekistan's 2023–2025 temperature anomalies intensified dust storms and stagnation events[19]. Reduced precipitation and soil moisture contributed to higher aerosol concentrations.

6. Government Measures and Policy Evaluation

Uzbekistan's government introduced new environmental reforms between 2023 and 2025, including:

Expansion of air monitoring stations[20]

Introduction of Euro-5 fuel standards[21]

Industrial emission modernization programs[22]

Public awareness campaigns on air quality[23]

While significant, these measures require scaling to address rapid urbanization and climatic pressures.

7. Recommendations

7.1 Expand Monitoring Network

Satellite data must be paired with more dense, high-resolution ground sensors to increase measurement accuracy.

7.2 Clean Transport Transition

Subsidizing electric and hybrid vehicles, upgrading bus fleets, and improving urban planning could significantly reduce urban NO_2.

7.3 Dust Mitigation

Afforestation, soil stabilization, and water-efficient agriculture can reduce dust emissions—strategies already piloted in parts of Karakalpakstan.

7.4 Industry Upgrades

Installing modern SO_2 scrubbers and particulate filters in industrial centers should be prioritized.

Conclusion

As of November 2025, Uzbekistan faces a complex air pollution landscape shaped by human activity, geographic constraints, and climate-induced dust intensification. PM2.5 levels remain the most dangerous pollutant, especially in Tashkent and the Fergana Valley. While governmental reforms represent real progress, more aggressive and comprehensive strategies are needed. Continued scientific assessment, policy innovation, and international collaboration are essential for improving air quality and protecting health.

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