

Seasonal Dynamics and Long-Term Trends of Aerosol Optical Depth and Particulate Matter Using Multi-Source Analysis: A Case Study of Jaipur, Rajasthan

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35
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Text Views



Abstract

Document Sections

- » Introduction
- » Study Area
- » Methodology
- » Results and Discussions
- » Implications for Air Quality and Policy

Show Full Outline ▾

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[References](#)

[Keywords](#)

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Abstract:

Aerosols and particulate matter (PM) play a significant role in altering atmospheric composition and radiative balance through complex physical and chemical processes. Understanding their optical and mass characteristics is essential for evaluating both climate forcing and air quality. In the present study, ground-based measurements of particulate matter (PM 2.5 and PM 10) obtained from the Central Pollution Control Board (CPCB) were compared with satellite-retrieved Aerosol Optical Depth (AOD) at 500 nm from the AErosol RObotic NETwork (AERONET) over Jaipur, India. The analysis covers the period from April 2018 to November 2024 and aims to examine the interrelationship between AOD and PM concentrations under varying seasonal conditions. Results indicate that both AOD and PM levels reach their maximum during the pre-monsoon season, while relatively high values are also recorded in winter months due to stagnant meteorological conditions. The lowest AOD values occur during spring, corresponding to cleaner atmospheric conditions. A gradual decline in AOD and PM levels during successive winters suggests a possible reduction in biomass burning and industrial emissions. The observed strong correlation between AOD and PM underscores the reliability of AOD as a proxy for surface aerosol loading.

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