ASSESSMENT OF PARTICULATE MATTER 2.5 MICRONS AND PARTICLE BACK TRAJECTORIES ANALYSIS IN DHAKA USING HYSPLIT MODEL

by

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The thesis titled **"ASSESSMENT OF PARTICULATE MATTER 2.5 MICRONS AND PARTICLE BACK TRAJECTORIES ANALYSIS IN DHAKA USING HYSPLIT MODEL"** submitted by **Mehbuba Khan Momo**, Roll No.: **0423142516**, Session: **April-2023**, has been accepted as satisfactory in partial fulfillment of the requirement for the degree of **MASTER OF SCIENCE (M.Sc.) IN PHYSICS** on 3 February 2026.

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It is hereby declared that this thesis or any part of it has not been submitted elsewhere for the award of any degree or diploma.

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Dedicated to

My Beloved Partner, Parents

&

Respected Teachers

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Abstract

This study investigated the spatial and temporal variations of PM2.5 concentrations and their transport pathways in Dhaka, over the period 2016–2023. Daily PM2.5 data from the US Embassy in Dhaka, meteorological variables from ERA5 reanalysis, and rainfall data from GSMaP were analyzed to assess the influence of atmospheric conditions on aerosol dispersion. The daily PM2.5 concentrations ranged from 23 ± 9.88 to 228 ± 37.07 μg/m³, exhibit distinct diurnal peaks at midnight (107 ± 16.46 μg/m³ at 00 LST) and afternoon (63 ± 7.83μg/m³ at 15 LST). Monthly averages of PM2.5 were found highest in January (197 ± 21.12 μg/m³) and lowest in July (31 ± 3.40 μg/m³). Seasonal analysis revealed the highest PM2.5 levels in winter (181 ± 14 μg/m³) and the lowest during the monsoon (37 ± 6 μg/m³), influenced by precipitation, humidity, and wind patterns. The yearly mean concentration was 89 ± 11.55 μg/m³, with an overall upward trend across the study period. Back trajectory analysis using the HYSPLIT model indicated that high PM2.5 events were primarily associated with air masses from the northwest, including the Indo-Gangetic Plain, while monsoonal winds from the Bay of Bengal contributed to lower PM2.5 concentrations. Correlation analysis revealed moderate to strong negative relationships with temperature (r = -0.70), relative humidity (r = -0.62), and wind speed (r = -0.50), but a low association with rainfall (r = -0.21). Wind rose diagrams at multiple pressure levels (925, 850, 500, and 200 hPa) highlighted seasonal shifts in prevailing winds, demonstrating stronger westerlies at upper levels and southwesterlies dominance near the surface during the monsoon. The Air Quality Index (AQI) indicated that ~27% of days fell in the 'Unhealthy for sensitive' range (AQI 101-150) and ~25% of days fell in the 'Unhealthy' range (AQI 151–200), while 'Good' air quality days accounted for only 1%, reflecting persistent exposure of Dhaka's population to elevated pollution. These findings provide a comprehensive understanding of PM2.5 variability, transport mechanisms, and health risks in Bangladesh, highlighting the need for effective pollution mitigation strategies.