

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

by

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Session: April'2023

MASTER OF SCIENCE IN PHYSICS




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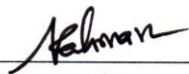
FEBRUARY 2026


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**

Acknowledgements

The completion of this thesis was not a linear journey. It required endurance, consistency, and clarity of purpose, qualities that were sustained through the guidance of Almighty Allah. His support enabled me to continue this work during both productive and challenging phases, and I remain deeply grateful for that guidance.

I would like to express my sincere appreciation to my supervisor, Professor Dr. Md. Rafi Uddin, Department of Physics, Bangladesh University of Engineering and Technology (BUET), whose guidance extended beyond routine supervision. His critical insight, thoughtful direction, and willingness to engage in detailed discussions played a decisive role in shaping the direction and depth of this research. I am particularly thankful for his patience and trust, which allowed me the academic space to grow as a researcher.

I am profoundly grateful to Professor Dr. Mohammad Abu Sayem Karal, Head, Department of Physics, BUET, for allowing me to conduct this research and constructive feedback throughout the journey. I would like to express my sincere gratitude to Professor Dr. Nasreen Akter, Department of Physics, BUET, for her kind guidance in developing my knowledge, problem-solving ability, critical thinking, and research-related skills, as well as for providing valuable suggestions for my research. I would like to thank A.T.M. Shafiul Azam, Assistant Professor, Department of Physics, BUET, for his valuable suggestions and comments, which helped me complete this research work. I would also like to express my sincere gratitude and heartfelt thanks to all the esteemed members of the examination board at BUET for their time, effort, and valuable insights. I would like to thank CASR, BUET for providing the funds for this study.

I owe a profound debt of gratitude to my parents and family members, whose unwavering support, prayers, and sacrifices formed the foundation of this achievement. I am especially grateful to my husband, Habib Ullah Milon, for his patience, emotional strength, and understanding during the demanding periods of this work.

Finally, I would like to extend my thanks to everyone who contributed, directly or indirectly, to the completion of this thesis. Their support, in both visible and unseen ways, is sincerely appreciated.

Abstract

This study investigated the spatial and temporal variations of PM_{2.5} concentrations and their transport pathways in Dhaka, over the period 2016–2023. Daily PM_{2.5} 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 PM_{2.5} concentrations ranged from 23 ± 9.88 to 228 ± 37.07 $\mu\text{g}/\text{m}^3$, exhibit distinct diurnal peaks at midnight (107 ± 16.46 $\mu\text{g}/\text{m}^3$ at 00 LST) and afternoon (63 ± 7.83 $\mu\text{g}/\text{m}^3$ at 15 LST). Monthly averages of PM_{2.5} were found highest in January (197 ± 21.12 $\mu\text{g}/\text{m}^3$) and lowest in July (31 ± 3.40 $\mu\text{g}/\text{m}^3$). Seasonal analysis revealed the highest PM_{2.5} levels in winter (181 ± 14 $\mu\text{g}/\text{m}^3$) and the lowest during the monsoon (37 ± 6 $\mu\text{g}/\text{m}^3$), influenced by precipitation, humidity, and wind patterns. The yearly mean concentration was 89 ± 11.55 $\mu\text{g}/\text{m}^3$, with an overall upward trend across the study period. Back trajectory analysis using the HYSPLIT model indicated that high PM_{2.5} 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 PM_{2.5} 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 PM_{2.5} variability, transport mechanisms, and health risks in Bangladesh, highlighting the need for effective pollution mitigation strategies.