

**SPATIOTEMPORAL VARIATIONS OF CONVECTIVE AVAILABLE POTENTIAL  
ENERGY IN BANGLADESH AND ITS EFFECT ON RAINFALL**

by

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The thesis titled “**SPATIOTEMPORAL VARIATIONS OF CONVECTIVE AVAILABLE POTENTIAL ENERGY IN BANGLADESH AND ITS EFFECT ON RAINFALL**”, submitted by **SAKIA SHABNAM KADER**, Roll No.: **0417143004**, Session: **April 2017** has been accepted as satisfactory in partial fulfillment of the requirement for the degree **MASTER OF PHILOSOPHY IN PHYSICS** on.....2025.

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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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Sakia Shabnam Kader

*Dedicated to,*

*My Beloved Parents*

*and*

*My Respected Teachers*

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## Abstract

Severe weather events in Bangladesh are closely linked to Convective Available Potential Energy (CAPE), a key indicator of atmospheric instability. This study investigates the long-term spatiotemporal distribution of CAPE and its relationship with rainfall over Bangladesh during 1990-2019, using ERA-interim 3-hourly reanalysis data. In addition, the Autoregressive Integrated Moving Average (ARIMA) model is employed to predict daily and monthly CAPE variations. The highest CAPE values are consistently observed in the southwestern region, with a gradual decrease toward the northern parts of the country. Daily average CAPE values vary widely, ranging from a minimum of 3 J/kg to a peak of 1761 J/kg. The annual diurnal variation shows CAPE peaks at 0600 UTC (840 J/kg) and a minimum at 1500 UTC (615 J/kg). Monthly analysis confirms that April has the highest average CAPE (1500 J/kg), while December has the lowest (7 J/kg). The seasonal comparisons reveal significant variability, with the pre-monsoon season exhibiting the greatest CAPE variation (~20%) and a statistically significant increasing trend ( $p < 0.05$ ). In contrast, the winter season shows the least variability, which is not statistically significant. The yearly analysis of CAPE revealed a notable and statistically significant upward trend over the study period ( $p < 0.05$ ). Correlation analysis indicates a positive relationship between monthly CAPE and rainfall ( $r = 0.34$ ). However, seasonal correlations are weak, with  $r$  values ranging from -0.12 to 0.14. This weak correlation between CAPE and rainfall suggests that CAPE alone is insufficient to explain rainfall variability, highlighting the important role of other atmospheric factors. The ARIMA model efficiently forecasts CAPE, especially at the monthly scale. This long-term climatological study of CAPE provides essential insights for monitoring severe convection and improving the prediction of extreme weather and climate change impacts in Bangladesh.