Spatiotemporal Variations of Atmospheric Heat Fluxes in the Bay of Bengal and Bangladesh along with Their Correlations to Precipitation

by

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The thesis titled **"Spatiotemporal Variations of Atmospheric Heat Fluxes in the Bay of Bengal and Bangladesh along with Their Correlations to Precipitation"** submitted by **Mohammad Nasirul Hoque**, Roll No.: **1018143004P**, Session: **October, 2018** has been accepted as satisfactory in partial fulfillment of the requirement for the degree of **MASTER OF PHILOSOPHY IN PHYSICS** on 20 October, 2024.

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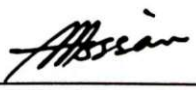
3. 

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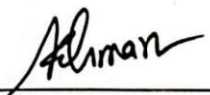
4. 

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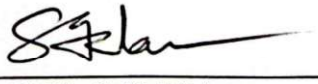
5. 

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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.

Mohammad Nasirul Hoque

Dedicated to

My Beloved Parents

&

Respected Teachers

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The Author

Abstract

Surface Latent Heat Flux (SLHF) and Surface Sensible Heat Flux (SSHF) play significant roles in the energy budget of the atmosphere-ocean-land system. In this study, the spatiotemporal variations of SLHF and SSHF and their correlations with precipitation over the Bay of Bengal (BoB) and the land area of Bangladesh have been analyzed. ERA-Interim three hourly, $0.5^0 \times 0.5^0$ gridded, reanalysis data for SLHF, SSHF, Convective Precipitation (CP) and Total Precipitation (TP) during the period 1990-2019 have been used. The highest SLHF was observed in December (395.32±32.31 W/m²) over the BoB and in May (284.52±14.47 W/m²) over Bangladesh. A significant difference between SLHF and SSHF over the BoB and Bangladesh was identified in this study. The maximum SLHF (351.80±24.02 W/m^2) was found over the BoB during the winter season, whereas the maximum SSHF (85.25±8.99 W/m^2) was noticed over Bangladesh during the pre-monsoon season. Besides this, the spatial distribution reveals that BoB experiences the highest amount of SLHF at deep sea during winter. Furthermore, a relatively small Bowen ratio was assessed over the BoB compared to Bangladesh. A moderate positive correlation (coefficient 0.55) was found over the BoB between SLHF and CP during the pre-monsoon season. Among the evaluated machine learning models, Random Forest regression demonstrated the highest accuracy in capturing atmospheric heat flux variability. The observed upward trend in SLHF over Bangladesh suggests an increase in atmosphere moisture, which may reduce climate stability. Mitigating this trend could involve greenhouse gas reduction through renewable energy adoption and advanced carbon capture technologies.