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Kernel Density Estimation of Tropical Cyclone Frequencies in the North Atlantic Basin

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ABSTRACT

Previous research has identified specific areas of frequent tropical cyclone activity in the North Atlantic basin. This study examines long-term and decadal spatio-temporal patterns of Atlantic tropical cyclone frequencies from 1944 to 2009, and analyzes categorical and decadal centroid patterns using kernel density estimation (KDE) and centographic statistics. Results corroborate previous research which has suggested that the Bermuda-Azores anticyclone plays an integral role in the direction of tropical cyclone tracks. Other teleconnections such as the North Atlantic Oscillation (NAO) may also have an impact on tropical cyclone tracks, but at a different temporal resolution. Results expand on existing knowledge of the spatial trends of tropical cyclones based on storm category and time through the use of spatial statistics. Overall, location of peak frequency varies by tropical cyclone category, with stronger storms being more concentrated in narrow regions of the southern Caribbean Sea and Gulf of Mexico, while weaker storms occur in a much larger area that encompasses much of the Caribbean Sea, Gulf of Mexico, and Atlantic Ocean off of the east coast of the United States. Additionally, the decadal centroids of tropical cyclone tracks have oscillated over a large area of the Atlantic Ocean for much of recorded history. Data collected since 1944 can be analyzed confidently to reveal these patterns.

KEYWORDS

Atlantic Tropical Cyclone Frequencies, Decadal Centroid Patterns, Kernel Density Estimation (KDE), Centographic Statistics, Bermuda-Azores Anticyclone, Teleconnections

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