Statistical Analyses of External Weather Forcing Signals over Micronesia Area for Supporting Climate Resilience

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Abstract

Small island nations of Micronesia, including Guam and the Federated States of Micronesia, are on the frontlines of climate change, facing rising temperatures, shifting rainfall patterns, stronger typhoons, and sea-level rise. Recent analyses utilizing 17 climate change detection indices recommended by the World Meteorological Organization reveal statistically significant warming trends across the region. For example, Guam exhibits an increase of 0.036 °C/year in seasonal maximum daily temperatures during the dry season and 0.025 °C/year during the wet season. Parallel analyses across 13 FSM sites similarly indicate increasing temperature magnitudes with consistent seasonal extremes. Rainfall patterns demonstrate a more complex response, with strong trends in both total seasonal rainfall and in extreme rainfall events, particularly during July–September, which pose heightened risks for flooding, water quality degradation, and coral reef stress. Using the Mann–Kendall trend estimator and Sen's slope, the study highlights the spatial and temporal heterogeneity of these climate impacts, emphasizing their consequences for water resource security, ecosystem health, and public infrastructure. These findings underscore the urgent need for adaptive management strategies to bolster climate resilience across Micronesia, including improved monitoring, integrated watershed and coastal planning, and proactive community engagement. By deepening our understanding of seasonal and extreme climate trends, this research supports informed decision-making to safeguard island communities and their vital resources in the face of accelerating climate risks.

Keywords

Climate change, Micronesia, trend analysis, resilience, precipitation, temperature, extreme events, water resources.