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Advancing the Understanding of Light Pollution: Comprehensive Analysis, Predictive Insights, and Multidisciplinary Impacts

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Abstract: *Amidst rapid urbanization and technological advancements, light pollution has emerged as a multifaceted environmental challenge, with profound implications for astronomical research, ecological integrity, and human health. This paper embarks on a comprehensive exploration of light pollution, employing the Random Forest algorithm to analyze and predict its levels using sky quality measurements from the Globe at Night initiative. Through a methodological fusion of data analytics and environmental science, we illuminate the intricate dynamics of light pollution's spatial and temporal patterns. Our findings underscore the necessity of a multidisciplinary approach in mitigating the adverse effects of artificial nocturnal light. By integrating case studies of effective light pollution reduction strategies and incorporating insights from urban planning, public health, and ecological conservation, we advocate for collaborative efforts towards sustainable lighting practices. This study not only advances the predictive modeling of light pollution but also catalyzes a global dialogue on the urgency of preserving the night sky, fostering biodiversity, and ensuring human well-being in the face of pervasive artificial lighting. Through this investigation, we aim to equip policymakers, researchers, and communities with actionable insights, promoting informed decision-making and policy development to address the pressing issue of light pollution in the modern world.*

Keywords: Light Pollution, Predictive Modeling, Random Forest Algorithm, Sky Quality Measurement (SQM), Environmental Impact, Astronomical Observations, Ecological Conservation, Human Health, Sustainable Lighting Practices, Multidisciplinary Approach

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