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Evaluation of Some Atmospheric Transmittance Indices Over Nigeria

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Atmospheric transmittance, encompassing parameters such as the clearness index, cloudiness index, and transmitting index, plays a pivotal role in the transfer of electromagnetic energy in the atmosphere. This research aimed to enhance our understanding of solar energy availability by investigating these transmittance indices across specific locations in Nigeria's diverse climatic zones. By analyzing satellite hourly data from MERRA-2 spanning ten years, the diurnal and spatial distribution patterns of solar radiation parameters and transmittance indices were examined. The research identified distinct patterns in the radiation parameters and transmittance indices. In the morning hours, radiation parameters exhibited an increasing trend from coastal to inland locations, while the afternoon period showed a reverse pattern for diffuse solar radiation. Clearness and transmitting coefficient demonstrated consistent increases from the coast inland during both morning and afternoon hours, whereas the cloudiness index displayed an opposite pattern. Moreover, the transmittance indices showed a gradual reduction from west to east during the evening. Coastal regions experienced average annual values of 100W/m2 for diffuse solar radiation, 1443W/m2 for direct solar radiation, and 500W/m2 for global solar radiation, while Sahelian regions recorded 104W/m2, 2081W/m2, and 678W/m2, respectively. The clearness index ranged from 0.35 to 0.54, the cloudiness index ranged from 0.15 to 0.46, and the transmitting coefficient ranged from 0.19 to 0.45 across the studied locations. The observed distribution patterns provide valuable insights into solar energy availability within Nigeria's climatic zones. The contrasting patterns between morning and afternoon periods suggest variations in atmospheric conditions. Importantly, the study emphasizes the significance of the transmitting coefficient in characterizing atmospheric transmittance and its role in defining radiation transfer variables. In conclusion, this research contributes to existing knowledge by evaluating atmospheric transmittance indices and their distribution patterns in specific locations across Nigeria. The findings underscore the importance of considering the transmitting coefficient alongside other parameters to accurately assess solar energy availability. Understanding these indices and their variations is essential for the effective utilization and management of solar energy resources.