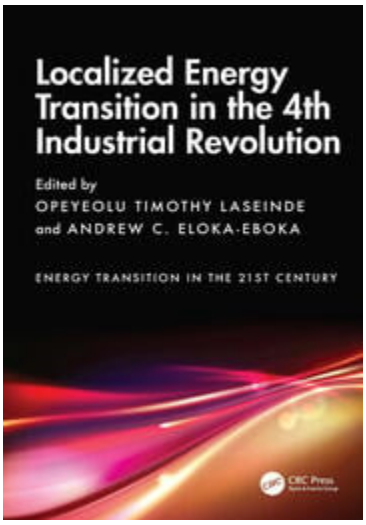

Chapter

In-Situ Based Observation and Reanalysis-Derived Wind Data for Offshore Wind Energy Potential Assessment in the Gulf of Guinea

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ABSTRACT

This study investigates offshore wind energy resources over five synoptic stations offshore in Nigeria, located within Guinea Gulf of Guinea (GoG). It utilizes buoy-station observations of wind from 1979 to

2015 to validate the use of high-resolution RegCM4 Regional Climate Model CORDEX-CORE simulations driven by ERA-Interim (ERA). It employs the Weibull distribution function to estimate parameters for the evaluation of offshore wind energy potential based on characteristics intrinsic to energy conversion in the study area. Mann–Kendal test was carried out to evaluate the statistical significance of the observed trends and inter-annual variability. A series of standardized criteria such as wind power density (WPD), coefficient of variation (CV), monthly variability index (MVI), accessibility, extreme wind speed, and distance to the coast were adopted to find the most appropriate sites for offshore wind energy exploitation over the study area. The results revealed that the ERA simulations have fairly good agreements and fit with the field observations of sea surface wind speed. Low and insignificant (at $p = 0.05$) negative model bias, MB ($-0.07 \leq MB \leq -0.28$ ms^{-1}), and percentage mean bias, PMB ($-2.12 \leq PMB \leq -7.06\%$) were obtained in 80% of the stations. The wind power potential in the GoG varied with the distance of the site from the coast. Agbami station showed the best potential for wind power resources with daily mean and annual total WPD of 2.50 ± 0.50 kW m^{-2} and 1.02 ± 0.17 MW m^{-2}, respectively. There were indications of abundant wind power availability and generation at the selected sites, going by the low variability and intermittency obtained in terms of trends, range, CV, MVI, and extreme wind speed episodes.

Previous ChapterNext Chapter