World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:18, No:04, 2024

Assessing Future Offshore Wind Farms in the Gulf of Roses: Insights from Weather Research and Forecasting Model Version 4.2

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Abstract : With the growing prevalence of wind energy there is a need, for modeling techniques to evaluate the impact of wind farms on meteorology and oceanography. This study presents an approach that utilizes the WRF (Weather Research and Forecasting)with that include a Wind Farm Parametrization model to simulate the dynamics around Parc Tramuntana project, a offshore wind farm to be located near the Gulf of Roses off the coast of Barcelona, Catalonia. The model incorporates parameterizations for wind turbines enabling a representation of the wind field and how it interacts with the infrastructure of the wind farm. Current results demonstrate that the model effectively captures variations in temeperature, pressure and in both wind speed and direction over time along with their resulting effects on power output from the wind farm. These findings are crucial for optimizing turbine placement and operation thus improving efficiency and sustainability of the wind farm. In addition to focusing on atmospheric interactions, this study delves into the wake effects within the turbines in the farm. A range of meteorological parameters were also considered to offer a comprehensive understanding of the farm's microclimate. The model was tested under different horizontal resolutions and farm layouts to scrutinize the wind farm's effects more closely. These experimental configurations allow for a nuanced understanding of how turbine wakes interact with each other and with the broader atmospheric and oceanic conditions. This modified approach serves as a potent tool for stakeholders in renewable energy, environmental protection, and marine spatial planning. environmental protection and marine spatial planning. It provides a range of information regarding the environmental and socio economic impacts of offshore wind energy projects.

Keywords : weather research and forecasting, wind turbine wake effects, environmental impact, wind farm parametrization, sustainability analysis
Conference Title : ICCWE 2024 : International Conference on Computational Wind Engineering
Conference Location : New York, United States
Conference Dates : April 22-23, 2024