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## Assessment of large-scale wind energy potential in the emerging city of Duqm (Oman)

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### ABSTRACT

Duqm is an emerging port city for both industrial and tourism applications. Energizing such city requires careful utilization of all available resources. Due to its geographical location, Duqm can harness the wind energy through developing grid connected wind farm. Therefore, a proper wind energy assessment using high temporal and spatial data is required before any financial investment. This paper investigates the assessment of a large-scale wind energy potential in the emerging city of Duqm (Oman). The initial wind assessment is conducted by the mean of dynamical downscaling Ensemble Numerical Weather Prediction Models. Multi-criteria decision support system was used to analysis the land suitability for wind energy applications. 25 MW wind farm is also simulated using WASP to estimate the annual energy production and the wake losses.

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### Contents

1. Introduction	438
2. Method and datasets	441
2.1. Stage 1: nested ensemble numerical weather prediction (NWP) model's approach	441
2.2. Stage 2: wind farm siting using multi-criteria analysis and classification system under Fuzzy logic and geographical information system (GIS) environment	443
2.3. Stage 3: wind farm performance simulation using WASP	443
3. Wind resources mapping	443
4. Wind farm modeling	446
5. Conclusions	446
References	446

## 1. Introduction

Duqm is an emerging port town on the Arabian Sea, in the central-eastern part of the Sultanate of Oman (Fig. 1). Duqm is experiencing a spectacular development, growing from 5100 in 2008 to over 11,200 inhabitants in 2010, and the population is expected to reach 100,000 by 2020. Duqm is also planned to become an industrial and tourism hub [33]. This ambitious project will need greatly increasing energy supply in the next 20 years. Because of its geographical location, Duqm can utilize different

sources of renewable energy. Earlier in 2008, the government has decided to ensure the power supply for Duqm project, through clean coal power plant. The government argues this choice to the shortage of the national gas resources, and the reasonable price of clean coal. In 2010, the clean coal power plant, had faces several criticizes, mainly related to environmental issues, the dependency of coal importation and the lack of interest to the availability of renewables options. The government has decided to end the coal-fired power plant project and to generate electricity from gas-fired power plant. However, gas power plant is not the best sustainable option for the future due to the shortage in the national natural gas resource in Oman.

Several researches studies, has shown that Oman has a high ratio of "sky clearness" and receives daily solar radiation ranging

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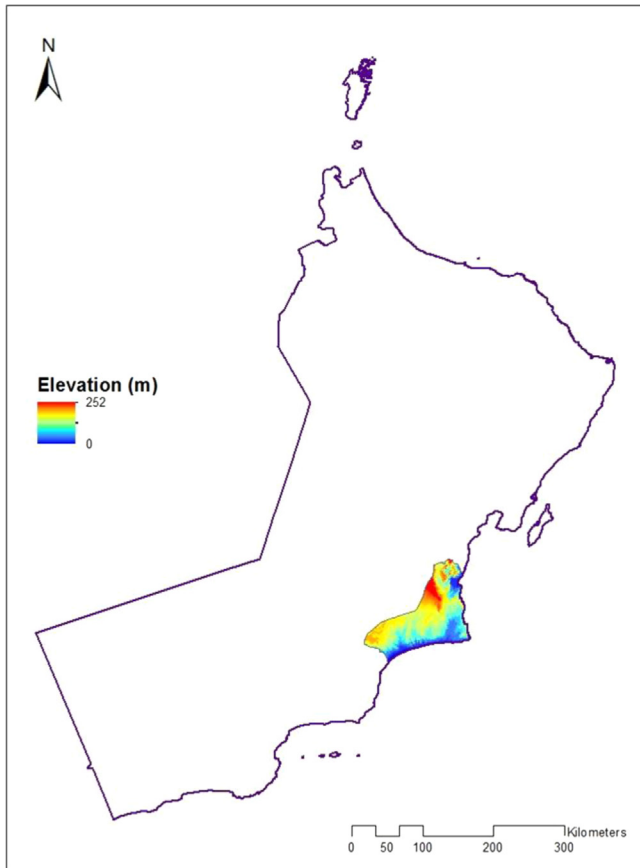


Fig. 1. Localization of the study area.

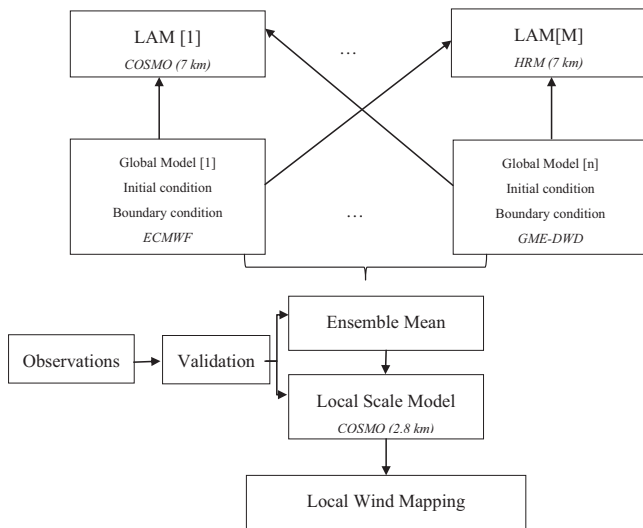


Fig. 2. Diagram of the nested ensemble NWP models approach for dynamical downscaling of wind.

from 5500–6,000 Wh/m<sup>2</sup> a day in July to 2500–3000 Wh/m<sup>2</sup> a day in January, giving it one of the highest solar energy densities in the world [8,16,9,17,13]. However, harnessing of solar energy in Oman, which is characterized by harsh hot climate, is facing great challenges related to the abundance of mineral dust in the lower layer of atmosphere and the scarcity of fresh water resources [11,12].

Wind energy could be a good alternative to overcome the climatological constraints of the hot arid area, and to provide sustainable clean energy for the expected escalating energy

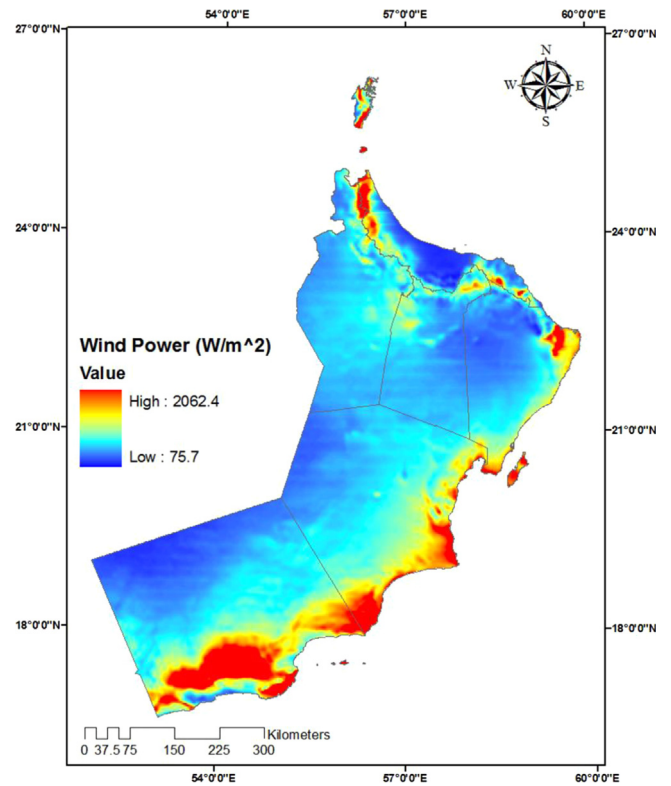


Fig. 3. Wind power density at 80 m above the ground for the whole country.

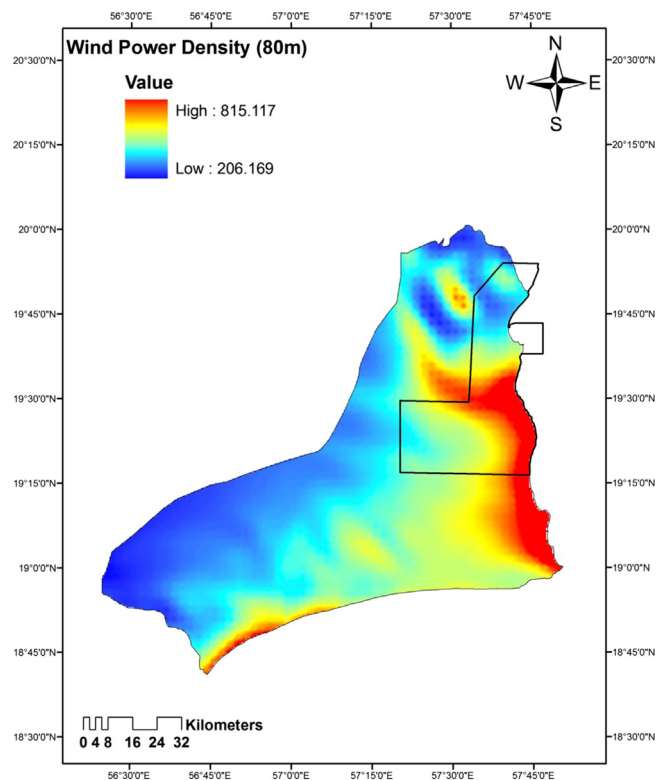


Fig. 4. Wind power density (W/m<sup>2</sup>) at 80 m above the ground.

demand of the emerging city of Duqm. But even for wind energy, the contamination agent by dust accumulation still remains a complex environmental problem. The dust accumulation on the

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