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El Hadri Y.[1]
Berlinskyi N.[1]
Slizhe M.[1]

THE WIND POWER DENSITY DISTRIBUTION IN MOROCCO`S MARRAKESH - SAFI REGION IN 2021-2050

[1] Odessa State Environmental University

Анотація

Метою дослідження є визначення особливостей просторового розподілу питомої потужності вітрового потоку на висоті 50 м у 2021-2050 рр. в регіоні Марракеш - Сафі Королівства Марокко. Оцінка вітрових характеристик була виконана на основі розрахунків середньомісячних значень швидкості вітру на висоті 10 м регіональних кліматичних моделей проекту CORDEX-Africa. Визначення вітрового класу території виконувалось на основі величини питомої потужності вітрового потоку на висоті 50 м. Аналіз результатів моделювання показав, що в прибережних районах збережуться сприятливі для розвитку вітроенергетики умови. За величиною питомої потужності вітрового потоку значними вітровими запасами буде володіти територія, яка лежить уздовж узбережжя від мису Сім до південної межі регіону, а район розміщення електростанцій Essaouira-Amogdoul і Tarfayer за прогнозами моделей буде мати клас, який характеризується видатними вітровими ресурсами.

Ключові слова: CORDEX-Африка, питома потужність вітрового потоку, регіональні кліматичні моделі, Марокко, Марракеш – Сафі.

Abstract

The purpose of the study is to determine the features of the spatial distribution of the wind power density in Marrakesh - Safi region in 2021-2050 to determine the wind class of the area in the coming decades. To assess the future state of climate in Marrakesh − Safi region, the results of calculations of regional climate models (RCM) of the CORDEX-Africa project for the period 2021-2050 were used. Then, based on the wind speed rows, the values of the wind power density at a height of 50 m. The analysis of simulation results showed that in the coastal areas of the region favorable conditions in terms of wind energy development will remain, and the highest wind power density are predicted on the Atlantic coast between Cap Sim and Cap Tafelny. By the size of the specific power of the wind flow, significant wind resources will have the territory lying along the coast from Cap Sim to the southern border of the region, and in the area of the power plants Essaouira-Amogdoul and Tarfayer models predict the conditions corresponding to the outstanding wind power class.

Keywords: CORDEX-Africa; Wind Power Density; RCM; Morocco, Marrakesh – Safi.

Introduction

Today, Morocco has a tendency to increase its energy consumption, as a result of industrial development, demographic growth and changes in people's living standards. By 2040, Morocco's population is expected to reach 40 million, mostly in urban areas [1]. The impact of climate change is already leading to the movement and migration of people across the country. This will entail an additional environmental impact in Morocco. In addition, in recent decades there was a need to quickly address the urgent environmental problems associated with increased levels of greenhouse gas emissions into the atmosphere. In this context, the timely assessment of possible changes in the potential of wind energy in Morocco is an urgent issue that will ensure its energy security in the future. Today, it is possible to obtain such information by modelling future climate conditions using climate models. The Moroccan Government has developed the National Energy Strategy, which includes the Moroccan Integrated Wind Energy Program [2]. One of the priorities of this program is to increase the share of renewable technologies in the country's energy sector [3, 4]. Marrakesh – Safi region covers an area of 38445 km² and is located on the Atlantic coast of Morocco. Currently, the region has two large wind farms: Essaouira-Amogdoul and Tarfayer, which are included to the Moroccan Integrated Wind Program.

The purpose of the study is to determine the features of the spatial distribution of the wind power density (*Ne*) at 50 m height in Marrakesh – Safi region in 2021-2050 for to determine the wind class of the

area in the coming decades.

To assess the future state of climate in Marrakesh – Safi region, the results of calculations of regional climate models (RCM) of the CORDEX-Africa project for the period 2021-2050 were used [5, 6]. Model calculation was performed taking into account the greenhouse gas concentration trajectory of RCP 4.5. 11 climate models were used for the calculation. As a result of simulation for the period 2021-2050, mean monthly values of wind speed ($m \cdot s^{-1}$) on the basis of which *Ne* was calculated [7]. The wind power density is a climate characteristic that allows an assessment of the wind potential of a specific area [8], as well as providing a justification for using the layout and design of wind turbines.

Results and discussion

Analysis of *Ne* at a height of 50 m showed (Fig. 1) that the eastern half of the region will be characterized as a territory with poor wind power class (up to 200 $W \cdot m^{-2}$). An area with good class (more

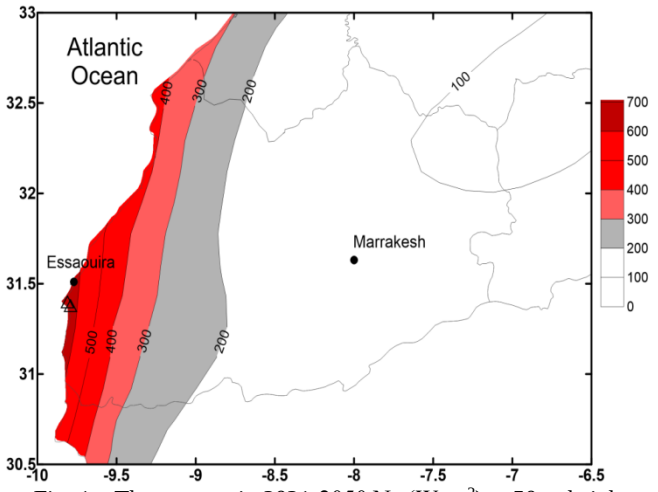

Fig. 1 – The average in 2021-2050 Ne ($W \cdot m^{-2}$) at 50 m height

than 400 $W \cdot m^{-2}$) will be a strip lying along the coast from Cap Sim to the southern border of the region, where its width will reach approximately 40 km. The highest wind potential the model is predicted on the coast between Essaouira and Cap Tafelny, where the wind farms Essaouira-Amogdoul and Tarfayer are located (more than 600 $W \cdot m^{-2}$).

Conclusions

By value of the wind power density at a height of 50 m good wind class will have territory, which located along the coast from Cap Sim to the southern border of the region. The area in which the Essaouira-Amogdoul and Tarfayer wind farms is located will have the outstanding wind power class. Thus, in 2021-2050 on the territory of Marrakesh − Safi region, we can expect favorable conditions for the placement of large wind turbines with a nominal capacity of up to 10 MW, which if connections can form larger wind farms.

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Ель Хадрі Юссеф – PhD, ст. викладач кафедри океанології та морського природокористування, Одеський державний екологічний університет, e-mail: magribinets@ukr.net;
Берлінський Миколай Анатолійович - д.геогр.н., проф., зав. кафедри океанології та морського природокористування, Одеський державний екологічний університет;
Сліже Марія Олегівна - к.геогр.н., диспетчер деканату факультету комп'ютерних наук, управління та адміністрування, Одеський державний екологічний університет

El Hadri Youssef - PhD, senior lecturer of department of oceanography and marine nature management, e-mail: magribinets@ukr.net;
Berlinsky Mykola Anatoliiovych - DSc (Geography), professor, head of department of oceanography and marine nature management;
Slizhe Mariia – PhD, faculty of computer science, management and administration dean's office dispatcher