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Solar radiation measurements in Algeria: case of Ghardaïa station as member of the enerMENA meteorological network

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Abstract

A comprehensive knowledge of available solar energy amount in a specific location is crucial for the successful development for solar energy policies and investment. Indeed, PV or CSP systems require reliable information on solar radiation measurements. This could be obtained from solar radiation data measured by meteorostations installed in different places of the site under consideration. In this paper, an overview of solar radiation measurements assessment in Ghardaïa region has been analysed. The choice of this site is based on its membership to the enerMENA meteorological network. The investigation of the data has exposed a huge solar potential where the average annual global solar radiation received on horizontal surface is about 2149 kWh/m² and the DNI about of 2305 kWh/m². The comparison with satellite derived data has provided an error of about 4.67% for the global radiation and 0.25% for DNI solar radiation.

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Keywords: enerMENA; global; DNI; Satellite derived data

1. Introduction

Renewable energies are considered as credible alternatives to the conventional sources. Currently, they contribute up to 10% of the world primary energy production. In this way, many countries have adopted strategies and visions for the development of these clean sources, in order to meet their energy needs and supplies. We can cite as an indication, the 2030 plan of Algeria and Tunisia for the production of 40% of their electricity needs from renewables, the 2020 plan of Morocco and Egypt for the production of 42% and 20%, respectively from clean energies [1,2].

Algeria is located in the center of the North Africa along the Mediterranean coast, between the latitudes of 19° and 38 ° North and longitudes of 8 ° West and 12 ° East. Its southern region comprises a large part of the Sahara (nearly 86% of the total area of the country). Its geographical position in the solar belt and favorable climatic

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conditions make it a strategic actor in the field of solar technology. The Algerian solar potential is the most important among the MENA countries (Figure 1) where the sunshine duration is about of 7.3 hours in the North, 8.3 hours in the highlands and more than 10 hours in the southern regions. In general, the sunshine duration of whole territory exceeds 3000 hours/year and can reach 3500 hours/year in the Sahara. High accuracy solar measurements are required in the most fields of solar research. Indeed, solar data are important not only for sites identification, but also for the choice of an appropriate technology. With the launch of many solar projects in the MENA region, it is necessary to carry out detailed studies of solar potential where the PV or CSP power plants will be installed. In this perspective that the enerMENA project takes place; this project is the initiative of the German Aerospace Center (DLR) and its solar energy research institute. It aims mainly to provide knowledge and experience to CSP professionals of the MENA region. Accordingly, DLR has installed a measurement network of ten stations covering five countries (Figure 2) to evaluate the solar energy conditions in these regions [3]. Since the exploitation of solar energy is influenced by the meteorological variables, the following parameters are measurable in the enerMENA networks: solar radiation components (global, diffuse and DNI), air temperature, humidity, atmospheric pressure, and wind speed. The various studies introduced so far on the solar energy in Algeria show a considerable potential for the exploitation of this clean energy. With the initiation of solar power plants in the recent years and the ambition to obtain a solar capacity of about 22 GW by 2030 [4, 5], the assessment of the solar potential is becoming increasingly important. However, several studies have been carried out over the entire Algerian territory [6-11].

Our attempt in this work is the assessment of Ghardaïa solar potential through the analysis of global and DNI solar radiation data. A comparison with satellite derived database is also illustrated.

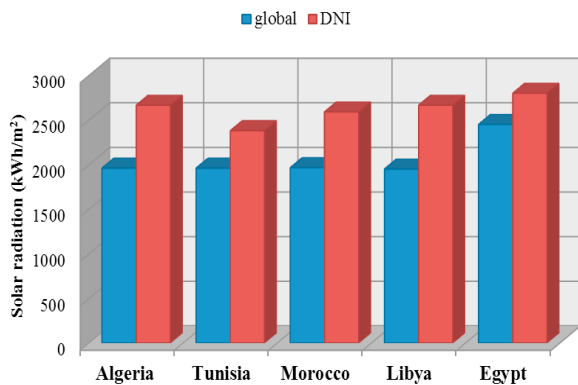


Fig. 1. Solar potential of MENA countries [1]



Fig. 2. enerMENA meteorological network and Ghardaïa station location [3]

2. Ghardaïa meteostation

Since its installation in 2012, Ghardaïa meteostation (latitude of 33.46° N, longitude of 3.78° E and altitude of 463 m) ensures the measurements of the solar radiation components (global, DNI and diffuse), in addition to the meteorological parameters (air temperature, humidity, wind speed, atmospheric pressure). Therefore, a database of more than four years, allowed us to get an overview on the local solar potential. The meteostation is equipped with CHP1 pyrhemeters for DNI measurement and CMP11 thermal pyranometers for diffuse (DHI) and global horizontal irradiance (GHI). All these instruments are mounted on Solys2 solar tracker with sun sensor (figure 3). A Campbell Scientific CR1000 data logger is used to collect the data daily as 1 minute and 10 minutes averages.



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