ANALYSIS OF TOTAL SOLAR RADIATION FLOWS ON THE TERRITORY OF UKRAINE

Larysa Nedostrelova, Associate Professor, PhD

Odesa I. I. Mechnikov National University, Ukraine

The main problems that humanity has entered the 21st century with are energy and ecology. The rapid industrial development of a group of countries in the Northern Hemisphere has been driven by intensive growth in the production of electrical and thermal energy. Over the past 150 years, since the mid-19th century, the Earth's population has increased fivefold, while energy production has increased 21 times. According to expert assessments by the International Energy Agency, global primary energy production will continue to grow at an average annual rate of 1.7% until 2030, reaching 15,300 million tons. At the same time, it is estimated that more than 90% of this energy production growth will be ensured by fossil fuels. The ever-increasing consumption of fossil fuels leads to rising CO_2 emissions and other greenhouse gases in the atmosphere, raising serious concerns about their potential impact on the planet's climate.

The use of solar energy not only helps preserve the Earth's climate but also reduces countries' dependence on imported hydrocarbons. The amount of solar energy that reaches the Earth's surface in one week exceeds the total energy reserves of oil, gas, coal, and uranium combined. Humanity currently utilizes only one ten-thousandth of this energy. Scientists are confident that if humans used at least 1% of solar energy, the energy crisis would be a thing of the past.

Solar energy is steadily securing a strong position in global energy production. The attractiveness of solar energy is due to several factors. Solar energy is available at every point on our planet, with the radiation flux density varying by no more than a factor of two. Therefore, it is appealing to all countries, aligning with their interests in energy independence. Solar energy is an environmentally friendly energy source that can be used on an ever-growing scale without negative impacts on the environment. Solar energy is an almost inexhaustible energy source that will remain available for millions of years.

Currently, thanks to the development of solar installation designs, the operation of which is economically feasible in certain physical-geographical regions, the prospects for using the radiant energy of the Sun have become more specific. However, this, in turn, requires researchers to conduct a detailed investigation of the energy resources of specific regions of the globe to determine their energy potential.

The use of solar energy primarily depends on the geographical location of a territory, while the efficiency of solar installations depends on the level of solar radiation. Therefore, it is necessary to analyze the feasibility of utilizing solar radiation in different regions of Ukraine, depending on their geographical location, cloud cover, and the time of year.

Alternative energy is primarily aimed at addressing two important issues – environmental safety and energy efficiency. The issue of energy efficiency of alternative fuels is even more relevant for Ukraine than for the rest of the world. The efficiency of solar installations is primarily influenced by the level of solar energy, which, in turn, depends on the geographical location of the territory. The operation mode of solar energy installations (SEI) is determined by a set of heliophysical parameters for utilizing the energy potential, considering the necessary specialized characteristics that take into account the chronological continuous course of solar radiation and its random variability over time, associated with various atmospheric phenomena.

To determine the potential solar energy resources of a particular area, justify the technical and design indicators of different solar systems, assess their economic efficiency of their operation during different seasons of the year and times of the day in a certain location, a set of indicators is required, namely: the possible total amount of direct, diffuse, and global solar radiation; the number of sunshine hours (duration of sunshine); average cloud cover levels; the number of clear and overcast days.

The purpose of the work. Identification of the features of the distribution of total solar radiation fluxes in the regions of Ukraine over different climatic periods. To achieve the goal, meteorological stations in different regions of the country were selected: Kovel – northwestern Ukraine, Odesa – southwestern Ukraine, Poltava – central Ukraine, Pokoshychi – northern Ukraine.

In general, the annual indicators for three periods, do not differ significantly, except for the data from the Kovel station. Here, the annual sum of total solar radiation under clear-sky conditions was the highest in 1951–1963 and gradually decreased from period to period. In Poltava, on the contrary, the annual sums increased from the first to the third period. At the Pokoshychi and Odesa stations, a certain oscillatory pattern is observed, with a minimum in the second period. Under average cloudiness conditions, a similar distribution of total radiation is observed at the stations, except for Poltava. Here, the annual sums increased from the first to the third period. Analysis of total radiation fluxes in Ukraine over different climatic periods under different sky conditions shows that maximum amounts are typical for Odesa, while minimum values are observed in Kovel.

Annual distributions have a clearly defined character with a peak in June or July. An exception is the Kovel station, where, during the period 1991–2020, a certain wave pattern was detected in the summer season, with a minimum in July and maximum in June and August. The sums of total radiation vary under different sky conditions in different regions: in summer, these variations range from 10% to 30%, while in winter, these indicators can change by 1.5 to 2.5 times (especially during the period 1991–2020). Overall, annual amounts of total radiation are lower during the climatic norm period of 1961–1990.