JJMIE

Volume 17, Number 4, December. 2023
ISSN 1995-6665
Pages 605– 615
https://doi.org/10.59038/jjmie/170415

Jordan Journal of Mechanical and Industrial Engineering

Measurement and Assessment of Solar Energy in Zarqa Governorate - Jordan

Ali M. Jawarneh*, Ahmad K. AL-Migdady, Amer K. Ababneh, Hitham M. Tlilan, Mohammad Tarwaneh

Department of Mechanical Engineering,Faculty of Engineering, The HashemiteUniversity, Zarqa, 13115, Jordan.

Received 15 Aug 2023 *Accepted 20 Oct 2023*

Abstract

The purpose of the present work is to measure and assess the potential of solar energy in Zarqa governorate, Jordan. The solar radiation data along a whole one year obtained from Pyranometer which measures the global radiation over horizontal surfaces. Solar data in several different forms, over period of 5 minutes, hour-by-hour, daily and monthly data radiation have been presented. The highest irradiance of 1182 W/ m^2 was recorded on April 9, while the highest of an average irradiance of 632 was recorded on May 28. In June, the maximum hourly radiation of 3.87 MJ/m^2 was recorded in the fourth day at 12:00 PM. The highest daily total radiation of 31.14 MJ/m^2 occurred on June 15, but January 18 has the lowest daily radiation of 1.52 MJ/m^2.

Briefly, the yearly global solar radiation in Zarqa governorate is 7291 MJ/m^2 (2025.3 kwh/m^2) for the whole year with an average annual solar radiation per day of 20 MJ/m^2 (5.56 kwh/m^2). The total winter and summer solar energy are 1573 MJ/m^2 (437 kwh/m^2) 5718 MJ/m^2 (1588.3 kwh/m^2), respectively. More specifically, the average annual solar radiation per day is 24 MJ/m^2 (6.67 kwh/m^2) in summer and 13 MJ/m^2 (3.6 kwh/m^2) in winter for the horizontal surface. Resource assessment data is critical to the markets and the consumers of solar and other renewable energy technologies.

Keywords: Solar Energy, Irradiance, Pyranometer, Zarqa Governorate.

Nomenclature

G	irradiance (W/ m^2)
H	irradiation for a day (kJ/ m^2)
$\overline{H}$	a monthly average daily radiation (kJ/ m^2)
I	irradiation for an hour (kJ/m^2)

1. Introduction

Jordan lies between Latitude 28º4'-33º30' N and between Longitude 35 º -39 º E. The total area of Jordan is about 89,206 km^2, around 90% of which is desert and rural areas. The population of Jordan is about 11 million in 2023 with high growth rate. Almost 90% of the population lives in the north-west of Jordan, situated in areas which together constitute about 10% of the county's total land area. Jordan like other developing countries in general has to meet the energy challenges for achieving the requirements of the government strategy for a comprehensive and sustainable social and economic development. The lack of commercial energy resources in Jordan and dependence on crude oil and oil products imports, high population growth rate, an expected continuous high energy consumption growth rate of about (3% / year) and (6%) for the electricity consumption, all these yearly costs make the energy bill a big burden on the national economy. Part of the solution to this problem is to utilize Jordan's renewable energy resources like solar energy. The total installed capacity of electric power generating projects from renewable energy reached about 2445.7 MW[1].

Several studies have showed that the solar energy is promising in Jordan [2, 3, 4]. Jordan is one of the Sun-Belt countries according to the international classification since the average annual solar radiation per day is (3.8) kwh/m^2in winter to more than (8) kwh/m^2in summer. The yearly global solar radiation in Jordan ranges from (1700) kWh/m² in Jordan Valley to more than (2250) kWh/m² for Hill area which facilitates building investment projects utilizing solar energy for the generation of electricity [5, 6]. Fine contribution to study the visibility of some applications that are driven by solar energy in Jordan had been done by [7, 8, 9].Solar radiation data for Amman was measured by Hamdan [10], who found that the annual average daily total solar radiation was 20.4 MJ/m^2, while diffuse radiation was 4.5 MJ/m^2.Radiation data was measured over a 5-yr period for Izmir in Turkey by [11]. The ratios of the total daily diffuse to global radiation intensities for each month range from 0.38 to 0.45 averaged for the same period, with an average value of 0.41. A new model to evaluate the hourly solar radiation for composite climate was proposed by [12]. Hourly solar radiation estimated by constants obtained by new model for composite climate was fairly comparable with measured data. Beam and diffuse

* Corresponding author e-mail: jawarneh@hu.edu.jo.

radiation data were extracted analytically from measured data on a horizontal surface in Zarqa governorate, Jordan. Radiation data on a tilted surface with various slopes have also been deduced and analyzed by Jawarneh et al. [13]. The best harvesting of solar annual energy of 7771MJ/m^2 (2158.6 kwh/m^2) and 7754 MJ/m^2 (2154 kwh/m^2) occurred for surfaces with slopes of 20^o and 32^o, respectively. Mihailović et al. [14] used Kolmogorov complexity model to capture periodic patterns in solar irradiation data and Aksentijevic–Gibson complexity model to sense global spatial. An extensive and comprehensive review of deep learning-based solar irradiance forecasting models is presented by Kumari and Toshniwal [15].Tahir et al. [16] measured hourly global horizontal irradiance at different locations in Pakistan. Clearness index, solar zenith angle and periodicity factor were calculated and used to develop bias correction models. Khatib and Elmenreich [17] presented a model for predicting hourly solar radiation data using daily solar radiation averages. A brief history of solar resource data sets, followed by areas for future research is presented by Clifton et al. [18]. Solar system that utilizes the solar irradiation data has many application [19-22].

Zarqa city lies at latitude of 32^o 5' N and longitude of 36^{o}7' E with elevation of 555 m. Unfortunately, there are no solar data available in Zarqa region despite of more than 52% of industrial facilities lie within its zone in addition to energy-producing facilities such as the Jordan petroleum refinery and Al-Hussein thermal station.

Mapping of solar energy along the year is essential for the utilization solar energy applications. This includes photovoltaic applications, thermal- solar systems, solar desalination and passive solar architecture. Moreover, availability of solar data may be encouraging the existing energy units in Zarqa governorate to seek alternatives such as combined solar-thermal energy or hybrid system.

The main objective of this work is to measure and assess the characteristics of the solar radiation in Zarqa area and to introduce valuable solar data for people who are interested in this area. In this study, irradiance measurement is recorded every five minutes for a complete year.

2. Experimental setup and Procedure

The solar radiation data along a year were measured using Pyranometer which measures the global radiation on horizontal surfaces. It is mounted on the roof of the engineering college in The Hashemite University. It contains carefully calibrated thermoelectric elements fitted under a glass cover, which is open to the whole vault of the sky. The glass cover was cleaned periodically. A voltage proportional to the total incident light energy is produced and then recorded electronically. A weather data logger and a solar energy radiation data acquisition system were installed in the solar energy laboratory of the mechanical engineering department. The sensor is photodiode detector, the spectral response from 0.4 to 1.1 microns, the sensitivity is 100 mV/1000 W/m^2, and the accuracy is ±5%.

From the raw data stored for every one minute, the irradiation G data was recorded. Pyranometer measurements are recorded simply as the total energy incident on a horizontal surface (beam plus diffuse). Data are recorded every one minute and then averaged on five minutes, hourly, daily, and monthly basis.

3. Results and Discussion

The objective of the present measurement is to introduce four types of solar radiation data. These are irradiance G (W/ m^2), hourly radiation I (MJ/ m^2), daily radiation H (MJ/ m^2), and monthly average daily radiation $\overline{H}$ (MJ/ m^2).

The irradiance G data were recorded as shown in Fig. 1. May 10 was selected as an example of sample data. Values for G were recorded by integrated over period of 5 minutes. Irradiance G data along one year are very huge, and it could be difficult to show each irradiance for the whole hours of the year. For this reason, an average irradiance G_{avg}has been used which represents the summation of whole G's for a specific day divided by the total numbers of recorded G for that day. The average irradiance data G_{avg} and the peak irradiance$G_{max}$are shown in Fig.2. It is clear that the daily average and maximum irradiance are higher in summer time and lower in the winter. The highest irradiance of 1182 W/ m^{2}was recorded onApril 9, while the highest of an average irradiance of 632 was recorded on May 28 for the whole year.

Fig.3 shows hourly radiation I(MJ/m^2) on a horizontal surface versus 24 hours for May 10 as an instant. The hourly radiation I at a specific an hour is calculated by averaging the irradiance values at that hour. Values of hourly radiation data I for all days along one year are tabulated in Appendix 1. The maximum hourly radiation I_{max} (MJ/m^2) data are extracted from Appendix 1 and shown in Fig.4. In June, the maximum hourly radiation I_{max} of 3.87 MJ/m^2 was recorded in the fourth day at 12:00 PM (D4@12:00 PM).

Daily total radiation Hdata on a horizontal surface for all months are shown in Fig.5. The data are recorded by summing the total hourly radiation over the day. It is clear that in June and July the highest harvesting of solar energy occurred, then the harvesting decreases as the data departure from June and July. The highest daily total radiation of 31.14 MJ/m^2 occurred on June 15, but January 18 has thelowest radiation of 1.52 MJ/m^2.

Monthly average daily radiation $\overline{H}$ data for each month are shown in Fig. 6. This is done by averaging the daily total radiation for each month. The month of June has the highest monthly average daily radiation of 30 MJ/m^2, but the month of December shows the lowest monthly average daily solar radiation of 9.74 MJ/m^2.

Fig. 7 shows the total daily radiation on horizontal surface. This is done by summing all days for each month. The highest total daily radiation of 910.8 MJ/m^2 (253 kwh/m^2) was recorded on July, while December possesses the lowest value of 302.2 MJ/m^2 (84 kwh/m^2). If one takes the summation for all months then the total annual energy will be 7291 MJ/m^2 (2025.3 kwh/m^2) for the whole year. Fig. 7 shows also total winter energy of 1573 MJ/m^2 (437 kwh/m^2) for the horizontal surface, taken as the total energy for the months of January, February, March, and December which would represent the time of the year when most space heating would occur. Total summer energy also shown in Fig. 7 to be 5718 MJ/m^2 (1588.3 kwh/m^2) for the horizontal surface, taken as the total energy for the months of April to November, which would represent the time of the year when most space cooling would occur. The average annual solar radiation per day is 20 MJ/m^2 (5.56 kwh/m^2) for the horizontal surface. More specifically, the average annual solar radiation per day is 24 MJ/m^2 (6.67 kwh/m^2) in summer and 13 MJ/m^2 (3.6 kwh/m^2) in winter for the horizontal surface.

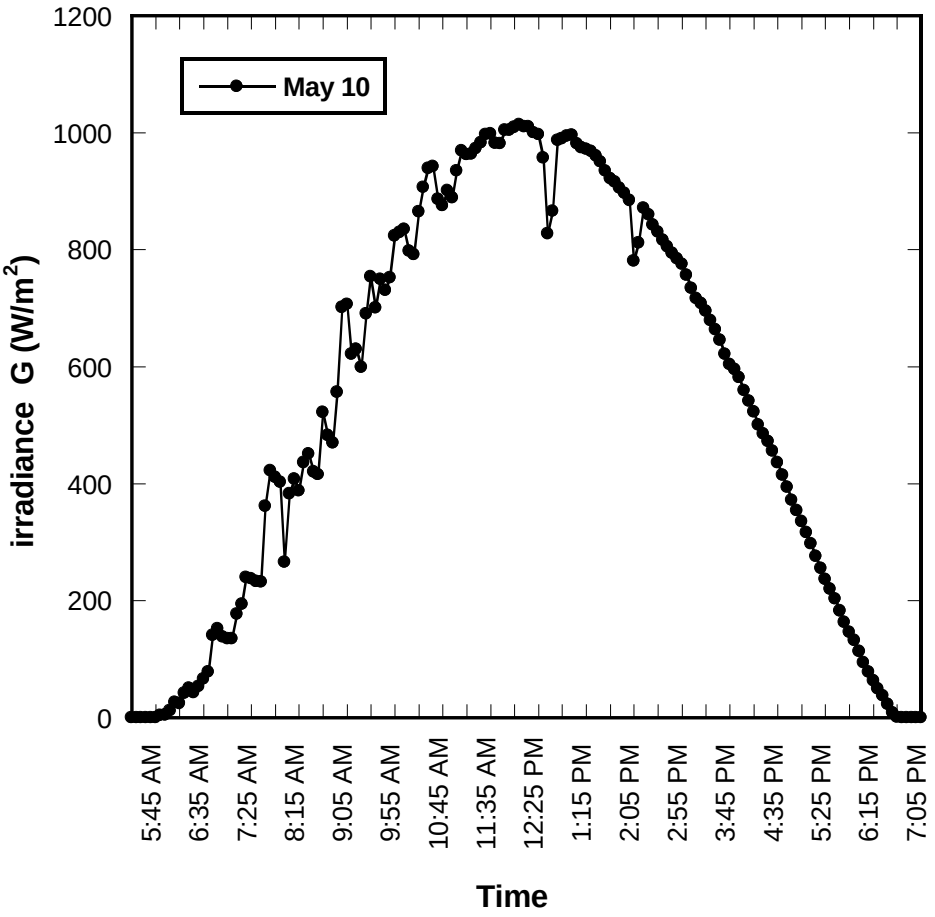

Figure 1. Irradiance on a horizontal surface vs time

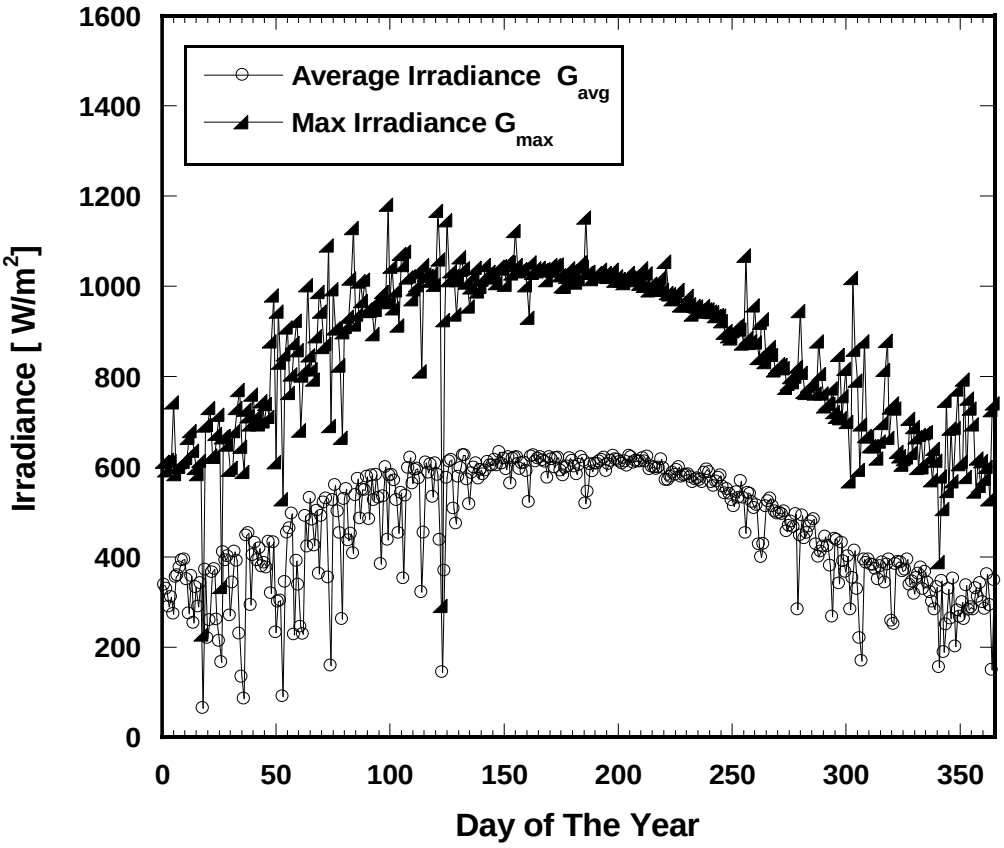

Figure 2. Average irradiance and peaks of irradiance throughout the year.

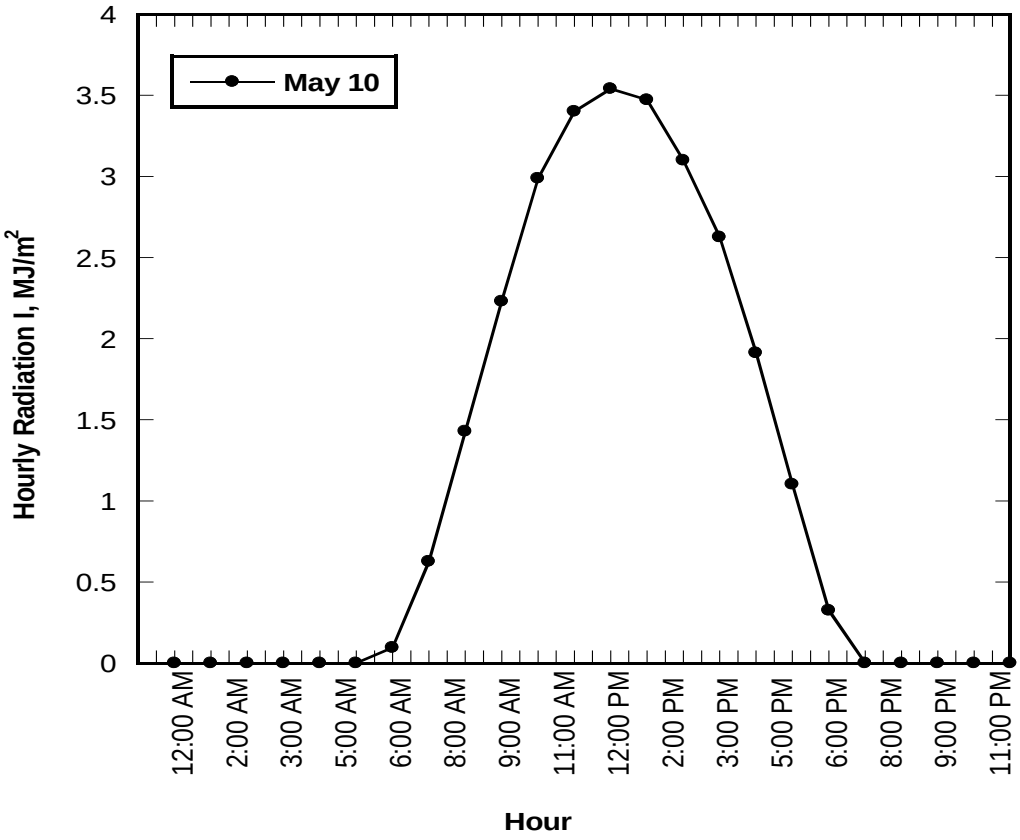

Figure 3. Hourly total radiation on a horizontal surface

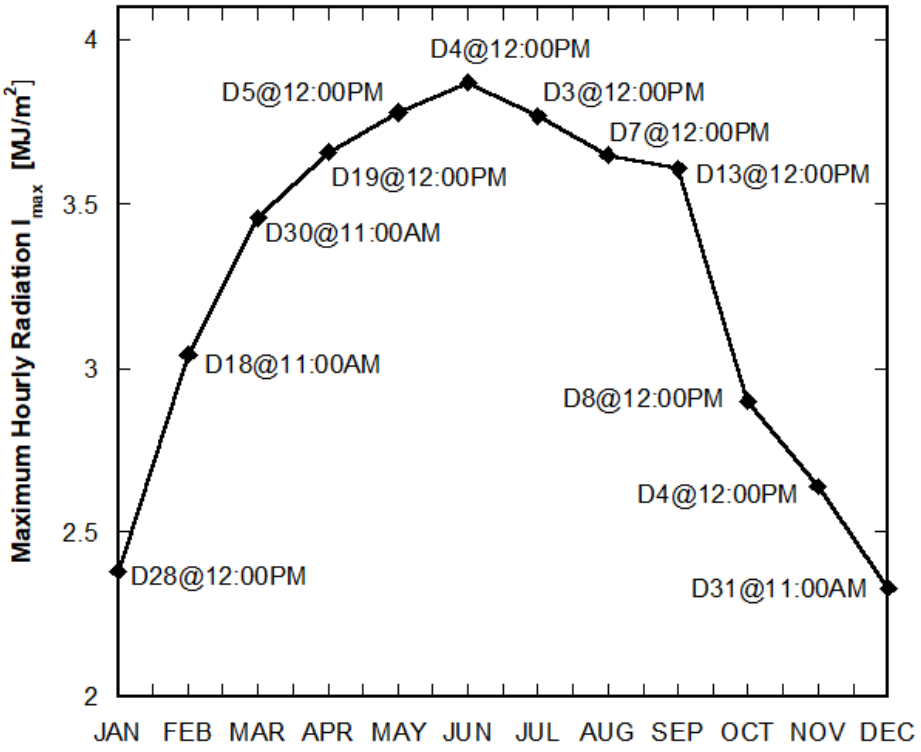

Figure 4. Maximum hourly radiation

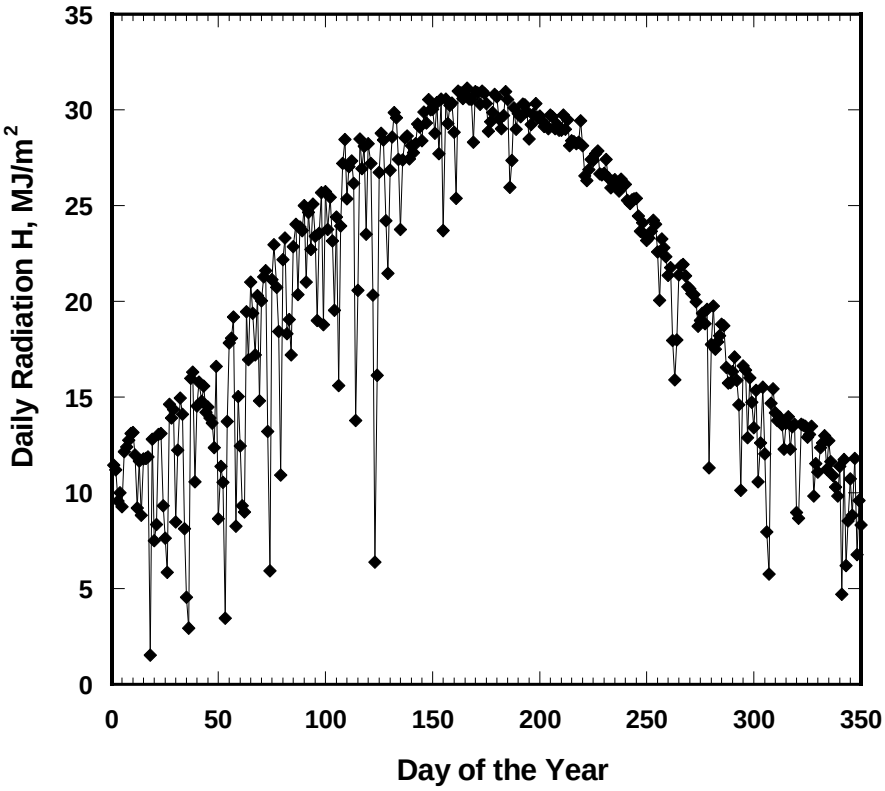

Figure 5. Daily total radiation on a horizontal surface

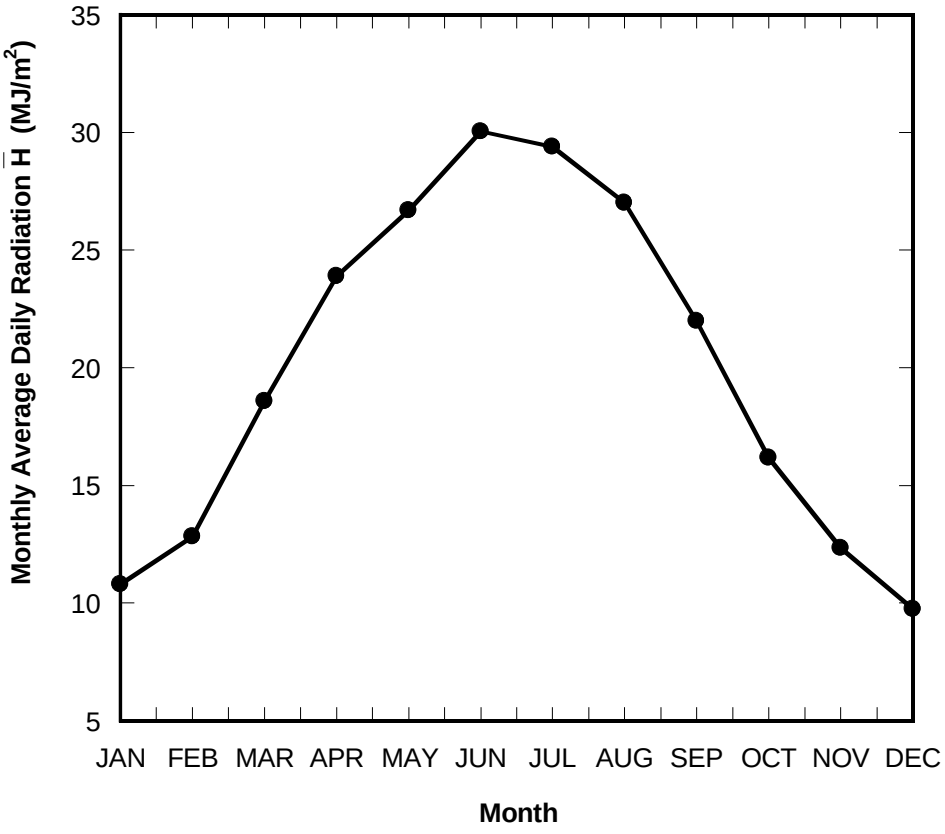

Figure 6. Monthly Average Daily total radiation on a horizontal surface

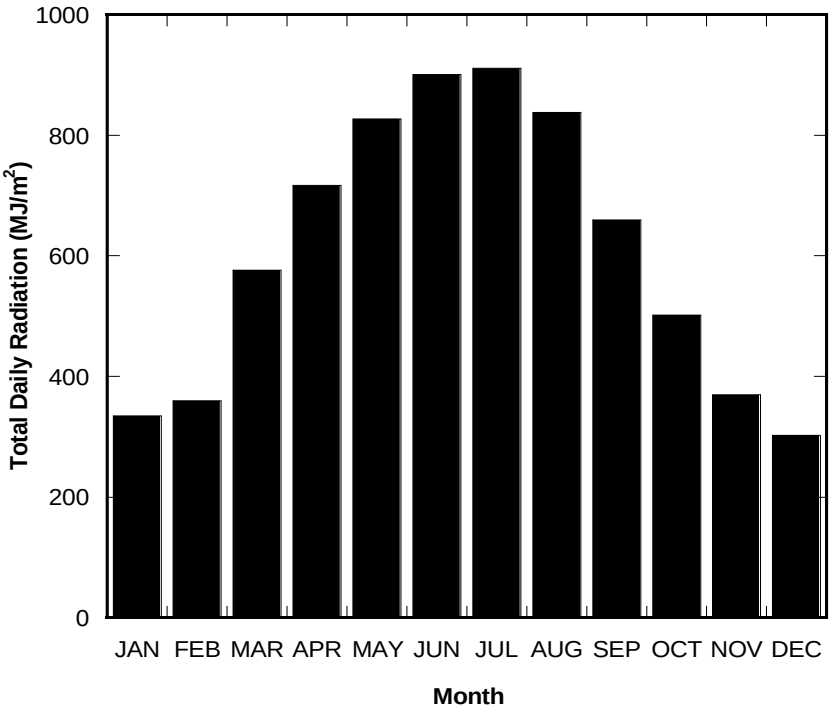

Figure 7. Total Daily Radiation on a horizontal surface

Since the measurements of total radiation (beam plus diffuse) were done on a horizontal surface, then measurements are required for direct and diffuse radiation. In addition, measurements of solar radiation on inclined planes are important in determining the input to solar collectors, PV cells, and passive heating and cooling systems. Beam and diffuse radiation and data for inclined surfaces including the reflected radiation can be deduced from the available data on a horizontal surface.

Conclusions

Solar data in Zarqa governorate in several different forms have been presented, for each five minutes, hour-by-hour, daily and monthly data radiation. The yearly global solar radiation in Zarqa governorate is found to be 7291 MJ/m^2 (2025.3 kwh/m^2) and the average annual solar radiation per day is 20 MJ/m^2 (5.56 kwh/m^2). More specifically, the average annual solar radiation per day is 24 MJ/m^2 (6.67 kwh/m^2) in summer and 13 MJ/m^2 (3.6 kwh/m^2) in winter. These values are promising and indicating a high potential of solar energy in this region.

Data Availability Statement:

The data and materials that support the results or analyses presented in this paper are freely available upon request.

References

[1] Ministry of energy and mineral resources. Annual Report 2021. Amman

[2] Durisch W , J Keller , W Bulgheroni , LKeller , H Fricker, Solar irradiation measurements in Jordan and comparisons with California and Alpine data, *Applied Energy*, 52(2–3),1995,111–124.

[3] Badran O, Study in industrial applications of solar energy and the range of its utilization in Jordan. *Renewable Energy*, 24(3–4), 2001, 485–90.

[4] Hrayshat E , M Al-Soud, Potentials of solar energy development for water pumping in Jordan. *Renew Energy* 29, 2004,1393–1399.

[5] Jordan Meteorological Department: Jordan Annual Climate Bulletin, JMD, Amman, Jordan, 2000.

[6] Jordan Meteorological Department: Jordan Annual Climate Bulletin, JMD, Amman, Jordan, 1999.

[7] Eyad S Hrayshat, Viability of solar photovoltaics as an electricity generation source for Jordan, Renewable Energy 34 (2009) 2133–2140.

[8] Kablan M.M, Forecasting the demand on solar water heating systems and their energy savings potential during the period 2001–2005 in Jordan, Energy Conversion and Management 44 (2003) 2027–2036.

[9] Yaser Anagreh, Ahmad Bataineh, Renewable energy potential assessment in Jordan, Renewable and Sustainable Energy Reviews 15 (2011) 2232–2239.

[10] Hamdan MA. Solar radiation data for Amman. Appl Energy (1994);47:87–96.

[11] Ulgen and A. Hepbasli, Estimation of solar radiation parameters for Izmir, Turkey, International Journal of Energy Research; 2002, 26(9), pg. 807-823.

[12] Jamil M., Ahmad and Tiwari G. N., Evaluation and comparison of hourly solar radiation models, International Journal of Energy Research; 2008, 33(5), pg. 538-552.

[13] Jawarneh A.M, Al-Tarawneh M, Ababneh A.K, Tlilan H, "Solar Energy Availability on Horizontal and Tilted Surfaces: a Case Study", International Review of Mechanical Engineering, vol. 6, no. 4, 2012, pp. 901-917.

[14] Dragutin T. Mihailović, Aleksandar Aksentijevic & Anja Mihailović, "mapping regularities in the solar irradiance data using complementary complexity measures", Stochastic Environmental Research and Risk Assessment volume 35, pages1257–1272 (2021).

[15] Pratima Kumari and Durga Toshniwal ," Deep learning models for solar irradiance forecasting: A comprehensive review", Journal of Cleaner Production, Volume 318, 10 October 2021, 128566.

[16] Zia ul Rehman Tahir, Muhammad Asim, Muhammad Azhar, Ghulam Murtaza Amjad, Muhammad Junaid Ali, "Hourly global horizontal irradiance data of three stations in Punjab, Pakistan", Data in Brief, 38 (2021) 107371.

[17] Tamer Khatib and Wilfried Elmenreich, "A Model for hourly solar radiation data generation from daily solar radiation data using a generalized regression artificial neural network", International Journal of Photoenergy, Volume 2015, ID 968024.

[18] Andrew Clifton, Bri-Mathias Hodge,Caroline Draxl,Jake Badger,Aron Habte, "Wind and solar resource data sets", WIREs Energy Environ 2018, 7:e276. doi: 10.1002/wene.276.

[19] Ali M. Jawarneh, Faris M. AL-Oqla, Anas Abu Jadoo, "Transient behavior of non-toxic natural and hybrid multi-layer desiccant composite materials for water extraction from atmospheric air", Environmental Science and Pollution Research, Sep 2021;28(33):45609-45618. EPub. 19 April 2021. https://doi.org/10.1007/s11356-021-13995-3.

[20] A. AL-Migdady, Ali. M. Jawarneh, A. K. Ababneh, H. N. Dalgamoni "Numerical investigation of the cooling performance of PCM-based heat sinks integrated with metal foam insertion", Jordan Journal of Mechanical and Industrial engineering, JJMIE, June 2021, 15(2), pp. 191-197.

[21] Etier I., Al-Labadi M.N., Ali. M. Jawarneh, Hammad B., Kannan N, "Real time analysis model of single action tracker, duel axis solar tracker and fixed mounting of the photovoltaic system", Journal of Green Engineering, 2020, 10(11), pp. 12439–12455.

[22] Ababneh A, Jawarneh A.M, Jaber S, "Direct vaporization of organic fluid in parabolic trough collector for solar power generation", International Review of Mechanical Engineering, Vol 13, No 9 (2019), pp. 493-503.

APPENDIX 1. Hourly data radiation on a horizontal surface *I* [MJ/m^2] for the whole year

JAN	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31
Hour	I (MJ/m^2)																														
7:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
8:00 AM	0.06	0.04	0.20	0.23	0.19	0.15	0.22	0.29	0.21	0.21	0.27	0.14	0.01	0.23	0.23	0.21	0.21	0.00	0.26	0.23	0.01	0.17	0.27	0.22	0.13	0.05	0.27	0.30	0.30	0.31	0.26
9:00 AM	0.21	0.16	0.93	1.02	0.88	0.82	1.01	0.83	1.04	1.03	1.01	0.44	0.78	0.95	0.55	0.98	0.90	0.00	1.10	0.59	0.21	0.96	1.04	0.78	1.29	0.23	1.09	1.00	1.07	0.97	0.91
10:00 AM	0.55	0.49	1.41	1.45	1.45	1.52	1.49	1.60	1.62	1.62	1.58	0.99	1.59	1.48	1.19	1.19	1.54	0.01	1.58	1.19	0.76	1.59	1.63	1.21	1.38	0.79	1.70	1.67	1.68	1.71	1.43
11:00 AM	0.76	0.59	1.84	1.96	1.40	1.91	1.87	1.99	2.01	2.01	1.84	1.67	1.87	1.23	1.95	1.95	1.95	0.03	2.02	1.74	1.71	2.01	1.99	1.32	1.09	1.00	2.16	2.19	2.07	1.95	1.74
12:00 PM	1.17	0.93	1.99	2.11	1.44	2.09	2.10	2.14	2.18	2.18	1.97	1.65	1.96	1.39	2.11	1.42	1.95	0.20	2.27	1.29	1.54	2.20	2.19	1.38	0.43	0.92	2.37	2.38	2.31	1.56	1.67
1:00 PM	1.28	1.42	1.02	1.26	1.41	2.02	2.06	2.08	2.12	2.12	2.01	2.04	2.08	1.79	2.01	2.07	1.91	0.62	2.21	0.57	1.72	2.18	2.16	1.53	0.91	0.97	2.34	2.30	2.27	1.15	2.02
2:00 PM	1.60	1.63	0.56	1.21	1.25	1.73	1.76	1.78	1.82	1.83	1.67	1.18	1.70	0.87	1.74	1.84	1.78	0.47	2.08	0.87	1.01	1.89	1.56	1.64	1.54	0.99	2.06	2.02	2.04	0.62	1.86
3:00 PM	1.83	1.89	1.02	0.60	0.63	1.24	1.26	1.31	1.32	1.33	1.11	0.77	1.20	0.59	1.25	1.34	0.97	0.15	0.73	0.57	0.85	1.39	1.29	0.84	0.44	0.60	1.54	1.40	1.54	0.17	1.37
4:00 PM	1.94	1.98	0.55	0.16	0.56	0.61	0.60	0.65	0.68	0.69	0.49	0.31	0.45	0.26	0.65	0.70	0.56	0.05	0.41	0.40	0.40	0.58	0.84	0.30	0.37	0.25	0.87	0.57	0.87	0.02	0.81
5:00 PM	2.05	2.06	0.04	0.01	0.05	0.08	0.02	0.09	0.10	0.11	0.04	0.02	0.04	0.04	0.10	0.10	0.11	0.00	0.14	0.06	0.13	0.05	0.14	0.09	0.05	0.03	0.22	0.09	0.19	0.00	0.18

FEB	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28
Hour	I (MJ/m^2)																											
7:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.02	0.03	0.01	0.01	0.32	0.29	0.53	0.42	0.33	0.07	0.43	0.80	0.70	0.75	0.25	0.22
8:00 AM	0.33	0.33	0.33	0.12	0.20	0.39	0.40	0.49	0.15	0.40	0.28	0.42	0.46	0.38	0.43	0.47	0.15	1.13	1.12	1.53	0.82	0.14	0.85	1.52	1.52	1.56	0.07	0.77
9:00 AM	1.11	1.15	1.11	0.75	0.37	1.22	1.26	0.67	1.37	1.20	0.83	1.18	1.26	1.06	1.18	1.24	0.41	1.63	0.97	1.37	1.05	0.09	1.36	2.16	2.17	2.21	0.48	2.17
10:00AM	1.73	1.76	1.70	0.71	0.18	1.86	1.91	1.46	1.84	1.86	1.39	1.81	1.66	1.59	1.65	1.84	1.33	2.40	0.71	0.83	1.50	0.31	1.61	2.58	2.57	2.65	1.16	2.80
11:00AM	2.18	1.75	1.11	0.93	0.90	2.30	2.34	1.73	2.17	2.28	2.00	2.28	2.10	2.23	2.10	2.21	2.13	3.04	1.46	2.63	0.63	1.23	1.70	2.83	2.72	2.86	2.97	2.53
12:00PM	2.41	2.21	1.33	0.66	0.54	2.48	2.54	1.58	2.31	2.47	2.54	2.48	2.49	2.36	2.35	2.43	2.64	2.94	1.01	1.45	1.29	0.71	2.20	2.42	2.68	2.81	0.80	1.59
1:00 PM	2.36	2.09	0.64	0.50	0.45	2.50	2.50	1.44	2.42	2.43	2.50	2.43	1.99	2.20	2.23	2.36	2.32	1.99	1.07	1.69	2.28	0.26	2.33	2.28	2.26	2.50	1.18	2.26
2:00 PM	2.11	2.10	0.82	0.43	0.15	2.21	2.24	1.62	1.93	2.22	2.24	2.15	1.76	1.98	1.86	1.85	1.59	1.67	1.04	0.85	1.78	0.36	1.72	1.76	1.74	1.97	0.72	1.91
3:00 PM	1.59	1.60	0.38	0.25	0.10	1.70	1.71	0.94	1.27	1.65	1.73	1.58	1.32	1.45	1.24	0.92	0.99	1.16	0.57	0.38	0.73	0.19	1.24	0.94	1.18	1.30	0.54	0.67
4:00 PM	0.92	0.89	0.64	0.15	0.04	1.02	1.07	0.49	0.83	1.02	0.96	0.94	0.86	0.93	0.74	0.31	0.47	0.31	0.16	0.17	0.14	0.06	0.21	0.43	0.50	0.53	0.08	0.09
5:00 PM	0.22	0.21	0.08	0.05	0.01	0.30	0.34	0.14	0.25	0.27	0.31	0.30	0.28	0.25	0.11	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.04	0.02	0.02	0.02	0.00	0.00

MAR	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31
Hour	I (MJ/m^2)																														
5:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
6:00 AM	0.06	0.02	0.12	0.08	0.07	0.10	0.12	0.10	0.13	0.09	0.24	0.18	0.10	0.02	0.00	0.28	0.31	0.13	0.33	0.14	0.16	0.44	0.10	0.43	0.27	0.39	0.47	0.43	0.12	0.51	0.51
7:00 AM	0.37	0.02	0.57	0.82	0.84	0.98	0.88	0.63	0.81	0.13	0.83	0.98	0.84	0.44	0.27	1.15	1.20	0.67	1.20	0.59	0.81	1.01	1.19	0.96	0.73	1.26	1.34	1.38	1.07	1.36	1.40
8:00 AM	1.00	0.13	0.86	1.65	1.65	1.76	1.64	1.46	1.63	1.51	1.66	1.77	1.85	1.37	1.01	1.77	2.00	1.43	2.00	0.78	1.95	1.98	1.25	1.69	1.91	2.07	2.12	2.40	2.23	2.15	2.22
9:00 AM	1.15	0.55	1.10	2.25	1.70	2.42	2.17	1.99	2.38	1.84	2.26	2.43	2.47	1.65	0.96	2.60	2.61	2.30	2.40	0.94	2.58	2.59	2.25	2.43	2.55	2.67	2.74	2.97	2.70	2.77	2.75
10:00 AM	1.61	1.07	0.46	2.69	2.13	2.85	2.63	2.41	2.88	2.10	2.97	2.88	2.89	1.14	0.91	2.85	3.04	3.00	2.38	1.40	2.95	3.08	2.51	3.13	2.53	3.09	3.13	2.84	3.25	3.16	3.24
11:00 AM	2.13	1.83	0.34	2.87	2.97	3.03	2.77	2.65	3.07	3.29	2.93	3.09	3.11	1.57	0.64	3.04	3.24	2.74	2.27	0.80	2.98	3.26	2.89	2.81	2.69	3.25	3.34	2.22	3.33	3.46	3.40
12:00 PM	1.61	1.73	1.57	2.74	3.08	2.97	2.79	2.56	3.04	2.31	2.51	3.01	3.07	2.80	0.68	3.16	3.12	3.16	2.56	1.36	3.15	3.21	2.27	2.98	1.52	3.11	3.26	2.67	3.29	3.43	3.32
1:00 PM	1.89	1.84	1.96	2.41	1.97	2.67	2.54	2.22	2.48	1.20	2.64	2.70	2.77	2.40	0.18	2.55	2.77	2.82	2.19	1.74	2.83	2.86	2.14	1.23	1.98	2.29	2.92	2.35	2.96	2.28	3.01
2:00 PM	1.10	1.47	1.34	2.00	1.48	2.15	2.00	1.51	1.93	0.91	2.17	2.15	2.25	0.96	0.42	1.84	2.29	2.26	1.48	1.20	2.28	2.35	2.24	1.52	1.43	2.12	2.38	1.27	2.41	2.08	2.44
3:00 PM	1.24	0.52	0.60	1.34	0.75	1.43	1.30	1.14	1.38	1.15	1.20	1.41	1.52	0.64	0.41	1.52	1.57	1.44	1.12	1.35	1.58	1.62	1.15	1.16	1.16	1.66	1.54	1.42	1.57	1.62	1.70
4:00 PM	0.29	0.15	0.07	0.56	0.31	0.61	0.50	0.50	0.56	0.26	0.61	0.62	0.68	0.21	0.42	0.32	0.73	0.69	0.46	0.55	0.80	0.82	0.28	0.60	0.34	0.81	0.75	0.37	0.81	0.79	0.84
5:00 PM	0.00	0.00	0.01	0.03	0.02	0.04	0.03	0.06	0.03	0.00	0.01	0.04	0.05	0.00	0.01	0.08	0.08	0.10	0.03	0.06	0.11	0.12	0.07	0.11	0.11	0.12	0.06	0.05	0.13	0.07	0.17

APR	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30
Hour	I (MJ/m^2)																													
5:00 AM	0.03	0.01	0.01	0.01	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:00 AM	0.54	0.63	0.42	0.60	0.52	0.45	0.03	0.04	0.02	0.04	0.06	0.06	0.04	0.02	0.10	0.02	0.10	0.12	0.14	0.10	0.13	0.18	0.18	0.13	0.04	0.20	0.21	0.25	0.06	0.24
7:00 AM	1.21	1.49	1.26	1.45	0.96	1.34	0.66	0.76	0.74	0.75	0.79	0.71	0.48	0.32	0.82	0.66	0.92	0.89	0.97	0.79	0.85	0.97	0.76	0.63	0.37	0.89	1.04	0.93	0.55	1.03
8:00 AM	1.72	2.27	2.00	2.24	2.15	1.92	1.52	1.62	1.54	1.58	1.66	1.52	1.19	0.74	1.64	0.94	1.41	1.70	1.83	1.59	1.75	1.80	1.58	1.46	0.71	1.80	1.62	1.81	0.93	1.86
9:00 AM	2.68	2.94	2.63	2.82	2.59	1.93	2.31	2.38	1.88	2.31	2.43	2.30	1.91	1.92	2.40	2.05	1.52	2.41	2.55	2.39	2.53	2.51	2.50	1.25	1.30	2.57	2.50	2.57	1.23	2.58
10:00 AM	2.80	3.27	3.03	3.24	3.18	2.39	2.88	2.93	2.15	2.93	2.93	2.91	2.56	2.42	2.87	1.17	2.18	3.03	3.13	2.94	3.13	3.12	3.13	2.27	1.69	3.12	2.89	3.15	2.20	3.12
11:00 AM	3.15	3.26	3.19	3.39	3.35	2.79	2.81	3.32	3.01	3.33	3.28	3.25	3.18	2.70	2.59	0.52	3.12	3.34	3.53	3.33	3.47	3.50	3.57	1.98	1.66	3.51	3.04	3.49	3.20	3.46
12:00 PM	2.17	3.18	3.13	3.30	3.03	2.11	2.46	3.45	2.00	3.46	3.34	3.36	3.33	3.06	2.72	3.17	3.37	3.57	3.66	3.44	3.54	3.59	3.55	1.61	2.41	3.66	3.54	3.63	3.64	3.57
1:00 PM	2.83	2.94	2.82	2.96	2.72	2.51	2.71	3.36	2.14	3.39	3.32	3.34	3.30	2.35	3.31	1.90	3.00	3.46	3.55	3.31	3.27	3.45	3.19	1.86	3.34	3.56	3.50	3.49	3.42	3.48
2:00 PM	2.25	2.39	2.26	2.39	2.36	1.72	2.96	2.99	2.47	2.63	2.38	2.97	2.86	1.93	3.17	2.18	2.98	3.13	3.20	2.94	2.99	3.06	2.82	1.33	3.17	3.22	3.15	3.15	2.91	3.04
3:00 PM	1.16	1.42	1.46	1.68	1.69	0.90	2.41	2.21	1.28	2.44	2.41	2.40	2.14	2.19	2.58	1.79	2.49	2.55	2.65	2.27	2.48	2.37	2.45	0.76	2.60	2.64	2.55	2.56	2.51	2.59
4:00 PM	0.41	0.77	0.44	0.89	0.73	0.51	1.71	1.74	1.02	1.69	0.78	1.65	1.41	1.23	1.84	0.82	1.75	1.77	1.92	1.45	1.75	1.65	1.57	0.37	1.90	1.92	1.63	1.83	1.84	1.87
5:00 PM	0.09	0.07	0.09	0.13	0.09	0.37	0.93	0.83	0.48	0.94	0.33	0.80	0.68	0.58	0.29	0.32	0.91	0.99	1.07	0.67	0.93	0.93	0.75	0.13	1.10	1.08	1.03	0.98	0.92	1.07
6:00 PM	0.00	0.00	0.00	0.00	0.00	0.04	0.19	0.06	0.05	0.22	0.03	0.17	0.09	0.07	0.07	0.05	0.22	0.25	0.25	0.13	0.21	0.21	0.14	0.01	0.29	0.31	0.24	0.26	0.13	0.32

MAY	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31
Hour	I (MJ/m^2)																														
5:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.01	0.00
6:00 AM	0.25	0.20	0.02	0.10	0.20	0.21	0.28	0.15	0.19	0.10	0.26	0.38	0.33	0.29	0.18	0.24	0.30	0.29	0.32	0.27	0.32	0.29	0.36	0.41	0.10	0.43	0.43	0.47	0.49	0.47	0.39
7:00 AM	1.00	0.93	0.17	0.26	0.59	1.10	1.08	0.94	0.76	0.63	1.07	1.22	1.15	1.03	0.81	0.95	1.06	1.09	1.06	1.07	1.08	1.03	1.14	1.15	0.82	1.20	1.22	1.27	1.27	1.27	1.16
8:00 AM	1.73	1.28	0.19	1.05	1.68	1.92	1.91	1.74	1.80	1.43	1.87	2.00	1.99	1.85	1.57	1.75	1.89	1.94	1.88	1.86	1.88	1.84	1.95	2.00	1.89	1.99	2.02	2.06	2.07	2.06	1.95
9:00 AM	2.24	1.83	0.50	2.07	2.46	2.63	2.60	2.36	2.66	2.23	2.59	2.72	2.70	2.58	2.32	2.48	2.62	2.66	2.60	2.59	2.51	2.56	2.66	2.69	2.53	2.70	2.69	2.75	2.77	2.75	2.63
10:00 AM	2.58	2.06	0.58	2.00	2.73	3.17	3.19	3.07	2.96	2.99	3.17	3.26	3.25	3.14	2.90	3.06	3.18	3.21	3.15	3.12	3.04	3.10	3.20	3.21	3.15	3.24	3.21	3.26	3.30	3.28	3.14
11:00 AM	3.05	2.83	0.43	2.51	3.47	3.52	3.53	3.39	3.07	3.40	3.48	3.59	3.59	3.54	3.29	3.44	3.53	3.55	3.44	3.47	3.18	3.46	3.54	3.55	3.52	3.59	3.50	3.59	3.64	3.63	3.48
12:00 PM	3.66	2.95	0.46	2.76	3.78	3.63	3.65	2.77	2.47	3.54	3.19	3.71	3.72	3.61	3.36	3.55	3.66	3.69	3.55	3.58	3.60	3.47	3.65	3.68	3.66	3.70	3.60	3.73	3.75	3.71	3.59
1:00 PM	3.64	2.89	0.52	1.21	2.89	3.52	3.43	2.22	2.65	3.47	3.56	3.53	3.58	3.48	3.08	3.45	3.50	3.22	3.24	3.44	3.47	3.37	3.47	3.50	3.54	3.56	3.48	3.56	3.59	3.65	3.44
2:00 PM	3.14	2.03	0.79	1.73	2.92	3.14	3.23	2.10	2.42	3.10	3.21	3.24	3.26	2.74	2.94	3.14	3.14	3.19	2.93	3.07	2.86	3.16	3.10	2.97	3.02	3.18	2.93	3.30	2.56	2.84	3.05
3:00 PM	2.61	1.57	1.11	1.42	2.56	2.62	2.61	2.19	1.42	2.63	2.68	2.69	2.67	2.28	2.19	2.50	2.55	2.61	2.47	2.48	2.55	2.63	2.69	2.69	2.62	2.71	2.69	2.77	2.77	2.76	2.55
4:00 PM	1.91	1.06	1.11	0.63	1.96	1.89	1.87	1.81	0.67	1.91	1.98	1.98	1.93	1.40	0.69	1.66	1.81	1.84	1.58	1.77	1.82	1.82	1.92	1.71	1.98	2.03	2.01	2.07	2.10	2.03	1.88
5:00 PM	1.09	0.62	0.47	0.33	1.14	1.09	0.84	1.07	0.35	1.10	1.16	1.17	1.11	1.10	0.33	0.92	1.01	1.04	0.90	1.07	1.15	1.12	1.20	1.19	1.18	1.19	1.19	1.29	1.31	1.21	1.13
6:00 PM	0.31	0.09	0.05	0.07	0.37	0.33	0.19	0.39	0.05	0.33	0.38	0.38	0.33	0.37	0.12	0.25	0.29	0.33	0.31	0.33	0.31	0.36	0.38	0.34	0.38	0.38	0.34	0.38	0.37	0.36	0.36

JUN	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30
Hour	I (MJ/m^2)																													
5:00 AM	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.02	0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.00	0.02	0.02	0.02	0.02	0.01	0.01	0.00	0.00	0.01	0.02	0.01	0.00
6:00 AM	0.48	0.47	0.50	0.24	0.47	0.45	0.49	0.49	0.41	0.19	0.47	0.47	0.48	0.51	0.52	0.47	0.49	0.28	0.49	0.53	0.49	0.52	0.48	0.44	0.38	0.37	0.47	0.49	0.39	0.39
7:00 AM	1.27	1.26	1.29	1.16	1.27	1.20	1.28	1.27	1.18	0.78	1.26	1.29	1.28	1.31	1.32	1.25	1.26	0.97	1.29	1.29	1.29	1.32	1.27	1.23	1.11	0.98	1.26	1.14	1.23	1.17
8:00 AM	2.09	2.03	2.08	1.80	2.07	1.99	2.07	2.05	1.95	1.54	1.99	2.08	2.05	2.09	2.11	2.02	2.06	1.66	2.08	2.09	2.08	2.11	2.07	2.02	1.87	1.97	2.02	2.20	2.02	1.98
9:00 AM	2.79	2.76	2.74	2.85	2.75	2.63	2.75	2.74	2.64	2.22	2.76	2.75	2.72	2.80	2.79	2.73	2.76	2.44	2.76	2.76	2.75	2.79	2.76	2.70	2.57	2.60	2.70	2.74	2.71	2.66
10:00 AM	3.31	3.26	3.28	3.51	3.30	3.17	3.26	3.26	3.17	2.78	3.30	3.27	3.24	3.25	3.32	3.26	3.31	3.00	3.29	3.30	3.25	3.33	3.28	3.22	3.10	3.08	3.23	3.24	3.25	3.17
11:00 AM	3.66	3.62	3.63	3.61	3.65	3.51	3.59	3.58	3.47	3.14	3.62	3.60	3.58	3.62	3.64	3.59	3.62	3.35	3.62	3.64	3.57	3.63	3.63	3.52	3.46	3.41	3.54	3.59	3.57	3.50
12:00 PM	3.75	3.76	3.65	3.87	3.75	3.66	3.72	3.72	3.45	3.21	3.77	3.70	3.72	3.67	3.73	3.72	3.72	3.56	3.74	3.75	3.69	3.75	3.76	3.67	3.57	3.58	3.65	3.73	3.70	3.66
1:00 PM	3.52	3.32	3.56	3.63	3.57	3.29	3.49	3.59	3.41	3.14	3.64	3.57	3.55	3.55	3.53	3.57	3.55	3.53	3.62	3.50	3.53	3.56	3.52	3.57	3.48	3.48	3.50	3.56	3.61	3.56
2:00 PM	2.93	2.17	3.23	3.01	3.18	3.12	3.05	3.27	3.14	2.83	3.31	3.33	3.24	3.16	3.32	3.22	3.15	3.21	3.29	3.27	3.04	3.10	3.31	3.32	3.14	3.18	2.80	3.27	3.31	3.04
3:00 PM	2.82	1.41	2.74	2.70	2.73	2.67	2.77	2.74	2.68	2.33	2.85	2.89	2.79	2.85	2.85	2.77	2.72	2.64	2.81	2.82	2.69	2.83	2.83	2.81	2.62	2.78	2.73	2.83	2.80	2.57
4:00 PM	2.10	2.04	2.10	2.10	2.12	2.01	2.09	2.02	1.90	1.74	2.19	2.17	2.18	2.21	2.21	2.16	2.15	2.01	2.17	2.13	2.11	2.19	2.16	2.12	1.95	2.13	2.17	2.19	2.19	2.10
5:00 PM	1.31	1.26	1.39	1.36	1.33	1.23	1.32	1.26	1.08	1.08	1.42	1.41	1.39	1.43	1.42	1.43	1.38	1.27	1.41	1.40	1.39	1.44	1.39	1.32	1.21	1.39	1.35	1.42	1.43	1.31
6:00 PM	0.36	0.36	0.37	0.36	0.35	0.35	0.33	0.34	0.34	0.38	0.34	0.34	0.33	0.32	0.34	0.34	0.33	0.35	0.34	0.34	0.36	0.36	0.35	0.36	0.39	0.40	0.40	0.38	0.41	0.41
7:00 PM	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.02	0.03	0.03	0.03	0.03	0.04	0.03

JUL	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31
Hour	I (MJ/m^2)																														
5:00 AM	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:00 AM	0.33	0.32	0.45	0.48	0.27	0.19	0.41	0.30	0.33	0.34	0.37	0.39	0.36	0.31	0.32	0.37	0.38	0.32	0.32	0.31	0.31	0.29	0.24	0.28	0.30	0.28	0.27	0.24	0.23	0.28	0.25
7:00 AM	1.07	1.08	1.26	1.30	0.77	0.84	1.16	0.93	1.11	1.09	1.15	1.16	1.15	1.00	1.06	1.13	1.15	1.09	1.10	1.06	1.04	1.03	1.01	1.04	1.08	1.04	1.02	0.98	0.97	1.06	0.98
8:00 AM	1.87	1.88	2.05	2.06	1.67	1.13	1.70	1.42	1.89	1.88	1.93	1.93	1.94	1.59	1.85	1.90	1.94	1.87	1.90	1.86	1.82	1.81	1.82	1.85	1.89	1.82	1.82	1.79	1.79	1.86	1.78
9:00 AM	2.57	2.58	2.73	2.70	2.25	2.11	2.85	2.60	2.61	2.57	2.60	2.63	2.63	1.57	2.47	2.62	2.64	2.56	2.60	2.58	2.52	2.54	2.53	2.56	2.61	2.52	2.51	2.49	2.50	2.57	2.53
10:00 AM	3.11	3.12	3.27	3.23	3.07	2.74	3.21	3.14	3.15	3.13	3.17	3.23	3.15	3.23	3.06	3.14	3.18	3.13	3.14	3.13	3.09	3.11	3.06	3.14	3.16	3.10	3.10	3.06	3.07	3.10	3.10
11:00 AM	3.46	3.47	3.62	3.57	2.80	3.38	3.53	3.49	3.52	3.50	3.54	3.57	3.52	3.50	3.39	3.49	3.55	3.49	3.51	3.51	3.47	3.48	3.44	3.51	3.51	3.48	3.47	3.45	3.45	3.52	3.45
12:00 PM	3.61	3.64	3.77	3.65	3.22	3.62	3.68	3.63	3.64	3.66	3.68	3.72	3.67	3.67	3.63	3.66	3.71	3.63	3.65	3.64	3.61	3.61	3.65	3.68	3.66	3.64	3.64	3.64	3.60	3.68	3.59
1:00 PM	3.51	3.51	3.59	3.52	2.91	3.54	3.54	3.52	3.52	3.56	3.50	3.56	3.57	3.54	3.45	3.52	3.56	3.52	3.47	3.52	3.53	3.53	3.57	3.58	3.56	3.53	3.57	3.58	3.52	3.65	3.52
2:00 PM	3.11	3.16	3.21	3.16	2.25	3.14	3.17	3.17	3.26	3.25	3.26	3.19	3.12	3.16	3.16	3.13	3.27	3.18	3.23	3.15	3.07	3.11	3.14	3.15	3.16	3.04	3.19	3.13	3.16	3.20	3.13
3:00 PM	2.69	2.80	2.84	2.78	2.65	2.75	2.77	2.74	2.83	2.74	2.90	2.76	2.72	2.78	2.77	2.77	2.82	2.78	2.77	2.70	2.71	2.74	2.67	2.78	2.74	2.70	2.74	2.71	2.71	2.82	2.71
4:00 PM	2.01	2.20	2.22	2.18	2.16	2.09	2.17	2.16	2.15	2.11	2.24	2.16	2.12	2.18	2.16	2.11	2.17	2.14	2.12	2.06	2.09	2.09	2.05	2.17	2.11	2.06	2.07	2.04	2.08	2.13	2.07
5:00 PM	1.23	1.49	1.49	1.44	1.43	1.38	1.42	1.41	1.35	1.34	1.45	1.43	1.44	1.41	1.42	1.39	1.41	1.38	1.33	1.36	1.33	1.31	1.28	1.41	1.33	1.30	1.31	1.30	1.34	1.31	1.31
6:00 PM	0.42	0.44	0.43	0.45	0.46	0.44	0.47	0.47	0.45	0.46	0.49	0.51	0.52	0.54	0.48	0.53	0.53	0.50	0.52	0.54	0.52	0.53	0.55	0.58	0.54	0.51	0.53	0.53	0.54	0.53	0.55
7:00 PM	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01

AUG	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31
Hour	I (MJ/m^2)																														
6:00 AM	0.25	0.23	0.22	0.20	0.20	0.20	0.23	0.16	0.17	0.07	0.13	0.15	0.16	0.15	0.15	0.14	0.12	0.12	0.13	0.11	0.10	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.05	0.06	0.05
7:00 AM	1.01	0.98	0.96	0.93	0.93	0.96	1.03	0.91	0.88	0.78	0.79	0.86	0.88	0.87	0.87	0.84	0.79	0.82	0.86	0.80	0.80	0.76	0.81	0.84	0.74	0.79	0.81	0.80	0.69	0.74	0.73
8:00 AM	1.82	1.77	1.77	1.73	1.74	1.80	1.83	1.74	1.61	1.06	1.64	1.68	1.70	1.68	1.68	1.61	1.59	1.62	1.65	1.60	1.60	1.55	1.64	1.65	1.56	1.59	1.61	1.60	1.48	1.52	1.54
9:00 AM	2.54	2.49	2.49	2.45	2.45	2.50	2.54	2.47	2.45	2.34	2.36	2.40	2.40	2.43	2.39	2.36	2.32	2.35	2.41	2.34	2.31	2.29	2.39	2.38	2.32	2.34	2.34	2.35	2.26	2.32	2.29
10:00 AM	3.12	3.06	3.06	2.98	3.03	3.04	3.13	3.02	3.05	2.88	2.93	2.95	2.97	3.00	2.99	2.93	2.90	2.92	2.97	2.93	2.89	2.89	2.94	2.93	2.91	2.90	2.88	2.92	2.81	2.90	2.86
11:00 AM	3.49	3.39	3.45	3.41	3.41	3.40	3.49	3.38	3.26	3.35	3.26	3.31	3.32	3.36	3.37	3.30	3.28	3.28	3.34	3.30	3.25	3.27	3.30	3.27	3.26	3.28	3.26	3.27	3.23	3.23	3.21
12:00 PM	3.64	3.55	3.60	3.56	3.55	3.56	3.65	3.55	3.06	3.50	3.45	3.47	3.49	3.52	3.53	3.43	3.43	3.43	3.50	3.39	3.37	3.42	3.43	3.39	3.36	3.42	3.40	3.40	3.36	3.35	3.34
1:00 PM	3.62	3.44	3.51	3.49	3.50	3.46	3.59	3.46	3.15	3.37	3.24	3.42	3.40	3.45	3.47	3.35	3.37	3.34	3.41	3.34	3.27	3.34	3.31	3.27	3.26	3.33	3.29	3.30	3.25	3.20	3.22
2:00 PM	3.26	2.98	3.09	3.16	3.18	3.09	3.26	3.14	3.10	3.04	3.09	3.10	3.11	3.13	3.14	3.03	3.05	3.03	3.11	2.99	2.94	3.03	2.98	2.93	2.91	3.02	3.01	3.03	2.92	2.87	2.91
3:00 PM	2.76	2.53	2.66	2.68	2.66	2.64	2.79	2.65	2.50	2.49	2.60	2.62	2.59	2.62	2.66	2.50	2.53	2.53	2.61	2.49	2.45	2.51	2.46	2.41	2.39	2.50	2.51	2.49	2.37	2.36	2.36
4:00 PM	2.09	1.99	1.97	2.02	1.95	1.96	2.09	1.99	1.88	1.91	1.89	1.94	1.87	1.94	2.00	1.83	1.85	1.87	1.92	1.82	1.74	1.82	1.78	1.79	1.74	1.81	1.80	1.76	1.71	1.57	1.68
5:00 PM	1.33	1.24	1.21	1.23	1.18	1.22	1.29	1.22	1.09	1.14	1.12	1.14	1.11	1.15	1.20	1.05	1.08	1.08	1.17	1.06	0.98	1.02	0.98	0.98	0.99	1.05	1.02	0.94	0.92	0.84	0.90
6:00 PM	0.55	0.47	0.43	0.48	0.44	0.48	0.47	0.42	0.36	0.39	0.37	0.37	0.37	0.39	0.42	0.31	0.32	0.32	0.36	0.31	0.24	0.29	0.26	0.26	0.26	0.28	0.24	0.22	0.21	0.14	0.20
7:00 PM	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SEP	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30
Hour	I (MJ/m^2)																													
6:00 AM	0.04	0.05	0.04	0.03	0.03	0.02	0.03	0.03	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:00 AM	0.72	0.75	0.65	0.62	0.61	0.54	0.57	0.64	0.57	0.65	0.65	0.61	0.43	0.59	0.59	0.49	0.54	0.49	0.41	0.51	0.49	0.51	0.53	0.50	0.46	0.45	0.45	0.43	0.38	0.40
8:00 AM	1.54	1.57	1.49	1.40	1.41	1.46	1.38	1.27	1.42	1.46	1.49	1.40	0.90	1.38	1.39	1.29	1.13	1.29	1.01	1.13	1.07	1.31	1.31	1.31	1.26	1.24	1.24	1.21	1.10	1.24
9:00 AM	2.28	2.29	2.22	2.14	2.23	2.10	2.11	2.11	2.16	2.21	2.22	2.11	1.15	2.18	2.13	2.07	2.11	2.04	1.85	1.96	1.43	2.03	2.03	2.05	1.99	1.95	1.95	1.93	1.87	1.92
10:00 AM	2.84	2.86	2.80	2.71	2.73	2.70	2.68	2.68	2.74	2.80	2.77	2.69	1.96	2.77	2.68	2.64	2.62	2.62	2.42	1.89	2.43	2.58	2.61	2.61	2.56	2.49	2.49	2.50	2.45	2.48
11:00 AM	3.20	3.21	3.17	3.08	3.12	3.06	3.02	3.15	3.08	3.21	3.13	3.03	3.06	3.06	3.03	2.98	2.52	2.90	2.78	2.00	2.99	2.89	2.96	2.97	2.93	2.86	2.84	2.83	2.85	2.83
12:00 PM	3.36	3.34	3.31	3.21	3.23	3.18	3.16	3.14	3.24	3.26	3.24	3.12	3.61	3.17	3.13	3.15	2.82	3.04	2.96	1.31	3.06	2.97	3.05	3.09	3.04	2.86	2.95	2.96	2.95	2.92
1:00 PM	3.25	3.25	3.19	3.11	3.12	3.09	3.04	2.99	3.10	3.15	3.13	2.95	2.68	3.06	3.01	3.00	3.14	2.92	2.45	1.95	2.85	2.83	2.92	2.95	2.92	2.73	2.85	2.81	2.80	2.73
2:00 PM	2.91	2.93	2.85	2.74	2.82	2.77	2.71	2.73	2.75	2.79	2.78	2.63	2.51	2.70	2.66	2.66	2.70	2.61	1.50	1.91	1.00	2.46	2.57	2.60	2.56	2.49	2.44	2.28	2.44	2.33
3:00 PM	2.39	2.39	2.26	2.20	2.28	2.15	2.18	2.25	2.21	2.27	2.24	2.05	1.68	2.15	2.09	2.11	2.04	2.03	1.21	1.77	0.94	1.95	2.02	2.04	1.95	1.96	1.87	1.93	1.90	1.77
4:00 PM	1.71	1.67	1.58	1.52	1.60	1.53	1.50	1.51	1.52	1.56	1.53	1.36	1.28	1.45	1.39	1.36	1.19	1.29	0.76	1.17	1.24	1.28	1.29	1.29	1.18	1.23	1.16	1.16	1.19	1.05
5:00 PM	0.93	0.91	0.76	0.76	0.80	0.76	0.72	0.74	0.74	0.76	0.75	0.59	0.69	0.68	0.65	0.56	0.51	0.51	0.57	0.30	0.48	0.54	0.53	0.49	0.44	0.49	0.41	0.38	0.40	0.31
6:00 PM	0.19	0.18	0.13	0.12	0.13	0.12	0.10	0.08	0.10	0.10	0.10	0.04	0.08	0.08	0.06	0.04	0.03	0.03	0.04	0.00	0.03	0.02	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.00

OCT	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31
Hour	I (MJ/m^2)																														
6:00 AM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:00 AM	0.33	0.32	0.33	0.33	0.35	0.30	0.33	0.35	0.26	0.30	0.29	0.29	0.30	0.26	0.40	0.15	0.21	0.21	0.18	0.17	0.17	0.18	0.14	0.19	0.15	0.14	0.09	0.17	0.12	0.07	0.15
8:00 AM	1.09	1.04	1.09	1.11	1.18	0.84	1.13	1.16	0.93	1.06	1.05	1.08	1.15	1.08	0.91	0.64	0.92	0.95	0.98	0.72	0.70	0.98	0.91	0.97	0.88	0.91	0.42	0.94	0.85	1.14	0.97
9:00 AM	1.76	1.79	1.81	1.81	1.89	1.15	1.84	1.89	1.67	1.78	1.75	1.81	1.88	1.80	1.45	1.25	1.63	1.66	1.59	1.45	1.10	1.66	1.60	1.02	1.58	1.57	1.12	1.64	1.36	1.64	1.43
10:00 AM	2.32	2.36	2.38	2.35	2.47	1.91	2.16	2.44	2.25	2.31	2.32	2.40	2.41	2.32	1.98	2.17	2.19	2.23	2.22	1.92	1.60	2.19	2.14	2.24	2.12	2.08	2.13	1.96	1.40	1.98	2.32
11:00 AM	2.67	2.72	2.74	2.71	2.79	1.40	2.47	2.76	2.54	2.61	2.67	2.73	2.72	2.64	2.61	2.47	2.47	2.55	2.51	2.42	0.95	2.27	2.46	2.47	2.43	2.43	2.47	2.32	1.69	2.11	2.53
12:00 PM	2.78	2.81	2.85	2.77	2.85	1.19	2.65	2.90	2.67	2.73	2.79	2.81	2.80	2.70	2.05	2.55	2.49	2.63	2.53	2.47	1.94	2.59	2.54	1.66	2.52	2.23	2.09	2.37	1.44	2.71	2.06
1:00 PM	2.66	2.67	2.71	2.59	2.70	0.43	2.51	2.76	2.68	2.55	2.63	2.67	2.54	2.50	2.24	2.27	2.39	2.47	2.22	2.04	1.29	2.43	2.39	1.56	2.34	2.35	2.46	2.11	1.22	1.99	2.39
2:00 PM	2.22	2.30	2.36	2.16	2.31	1.34	1.54	2.37	1.84	2.12	2.23	2.25	2.17	1.81	1.95	1.93	2.03	2.07	1.83	1.90	1.17	2.04	1.99	1.53	1.93	1.83	1.66	1.84	1.01	0.57	1.73
3:00 PM	1.65	1.71	1.77	1.71	1.72	1.46	1.51	1.79	1.64	1.50	1.57	1.67	1.65	0.90	1.32	1.46	1.40	1.47	1.25	0.85	0.71	1.45	1.42	0.85	1.35	0.96	0.63	1.31	0.84	0.23	1.29
4:00 PM	0.94	0.99	1.03	1.00	1.02	1.13	1.26	1.05	0.82	0.75	0.79	0.92	0.90	0.45	0.70	0.69	0.51	0.75	0.49	0.58	0.50	0.74	0.71	0.36	0.63	0.15	0.25	0.62	0.61	0.17	0.59
5:00 PM	0.28	0.28	0.29	0.31	0.32	0.15	0.33	0.28	0.18	0.18	0.13	0.20	0.20	0.10	0.13	0.19	0.10	0.11	0.08	0.09	0.03	0.12	0.10	0.04	0.09	0.09	0.06	0.06	0.03	0.00	0.06
6:00 PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOV	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30
Hour	I (MJ/m^2)																													
7:00 AM	0.09	0.11	0.13	0.07	0.05	0.06	0.08	0.07	0.09	0.01	0.04	0.04	0.06	0.02	0.01	0.08	0.01	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.03	0.03	0.01	0.01	0.01
8:00 AM	0.82	0.93	0.76	0.87	0.88	0.46	0.69	0.70	0.51	0.22	0.72	0.67	0.74	0.74	0.66	0.67	0.37	0.56	0.64	0.60	0.57	0.57	0.57	0.52	0.35	0.26	0.49	0.48	0.48	0.28
9:00 AM	1.51	1.41	0.97	1.57	1.58	1.44	1.37	1.34	1.21	0.57	1.44	1.37	1.36	1.43	1.28	1.03	1.19	1.34	1.35	1.30	1.26	1.27	1.29	1.21	1.00	0.64	1.22	1.19	1.19	0.70
10:00 AM	2.01	1.05	0.86	2.05	2.11	2.01	1.90	1.75	1.91	1.82	1.52	1.91	1.89	1.95	1.69	1.31	1.37	1.82	1.86	1.83	1.73	1.80	1.82	1.71	1.61	1.26	1.46	1.72	1.72	1.38
11:00 AM	2.00	1.16	0.67	2.54	2.36	2.32	2.22	2.23	2.22	2.15	2.05	2.26	2.26	2.23	2.17	1.71	0.86	2.21	2.19	2.15	2.10	2.13	2.14	2.01	1.88	1.76	2.00	2.04	2.01	1.98
12:00 PM	1.49	0.90	0.41	2.64	2.33	2.37	2.31	2.29	2.27	2.15	2.34	2.32	1.49	2.49	2.21	1.37	1.95	2.35	2.26	2.22	2.12	2.21	2.22	1.72	2.02	2.14	2.29	2.13	2.05	2.07
1:00 PM	1.31	1.28	0.47	2.15	2.30	2.17	2.13	2.15	2.06	2.01	2.17	2.09	1.42	2.13	2.15	1.28	0.75	2.14	2.11	2.08	2.00	1.87	2.08	1.32	1.79	1.98	1.95	1.99	1.99	1.96
2:00 PM	1.30	0.80	1.11	1.14	1.89	1.74	1.63	1.72	1.65	1.70	1.76	1.70	1.40	1.38	1.74	0.90	0.59	1.38	1.63	1.69	1.64	1.61	1.71	1.22	1.56	1.58	1.52	1.61	1.76	1.56
3:00 PM	1.03	0.26	0.35	1.01	1.30	1.14	1.07	1.17	1.11	1.15	1.15	1.14	1.13	0.75	1.18	0.42	1.13	1.25	1.05	1.13	1.05	1.09	1.14	0.12	1.11	1.03	1.02	1.04	1.27	0.96
4:00 PM	0.45	0.06	0.05	0.59	0.58	0.46	0.37	0.50	0.49	0.50	0.44	0.45	0.49	0.31	0.48	0.20	0.44	0.52	0.43	0.46	0.42	0.46	0.48	0.00	0.19	0.41	0.40	0.40	0.51	0.30
5:00 PM	0.01	0.01	0.00	0.04	0.05	0.03	0.02	0.02	0.03	0.04	0.03	0.02	0.02	0.02	0.02	0.00	0.00	0.03	0.02	0.02	0.02	0.02	0.03	0.00	0.00	0.01	0.01	0.01	0.01	0.00

DEC	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31
Hour	I (MJ/m^2)																														
7:00 AM	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8:00 AM	0.48	0.45	0.32	0.03	0.30	0.35	0.25	0.36	0.21	0.24	0.32	0.14	0.30	0.06	0.18	0.30	0.28	0.11	0.26	0.38	0.14	0.23	0.24	0.23	0.23	0.26	0.06	0.21	0.01	0.14	0.19
9:00 AM	1.16	1.18	0.69	0.40	0.94	1.00	0.66	1.08	0.85	1.13	1.01	0.37	1.03	0.11	0.66	1.07	0.85	0.26	0.96	0.78	0.90	0.94	0.91	0.84	0.92	0.76	0.40	0.95	0.92	0.24	0.80
10:00 AM	1.70	1.37	1.33	1.41	1.05	1.49	0.83	1.58	1.52	0.32	1.53	1.43	1.55	0.50	1.09	1.55	1.35	0.85	1.50	1.30	1.54	1.30	1.43	1.40	1.48	1.38	0.71	1.50	1.19	0.72	1.45
11:00 AM	2.05	1.69	1.92	1.82	1.45	1.80	0.95	1.90	0.85	0.47	1.87	1.69	1.90	1.03	1.59	0.93	1.70	1.63	1.83	1.51	1.80	1.28	1.80	1.76	1.84	1.77	1.58	1.85	1.74	1.44	2.33
12:00 PM	1.95	1.73	1.89	1.96	2.08	1.91	1.03	2.02	0.98	1.67	1.94	1.98	2.03	1.60	1.79	1.26	1.76	1.59	1.98	1.74	1.74	1.66	1.92	1.95	2.00	1.88	1.96	1.98	1.84	0.73	2.01
1:00 PM	2.17	2.04	1.82	1.87	1.72	1.82	0.68	1.93	0.66	1.71	1.79	1.15	1.91	1.52	1.15	1.83	1.93	1.88	1.75	1.59	1.73	0.80	1.85	1.63	1.91	1.73	1.85	1.92	1.75	0.47	2.15
2:00 PM	1.65	1.68	1.54	1.45	1.46	1.56	0.22	1.64	0.51	1.71	1.30	1.09	1.59	1.15	1.59	1.22	1.31	1.10	1.39	1.47	2.01	1.59	1.52	1.44	1.60	1.56	1.51	1.75	1.04	0.41	1.64
3:00 PM	1.10	1.09	1.00	1.01	0.61	1.10	0.08	1.06	0.36	0.78	0.81	0.90	1.03	0.62	1.08	0.13	0.63	0.19	1.09	0.40	0.40	1.11	1.02	0.76	1.05	0.64	0.95	1.04	0.37	0.47	0.71
4:00 PM	0.45	0.39	0.38	0.34	0.17	0.34	0.00	0.16	0.27	0.49	0.18	0.08	0.43	0.18	0.42	0.05	0.26	0.01	0.44	0.22	0.22	0.56	0.41	0.25	0.44	0.10	0.44	0.40	0.30	0.12	0.50
5:00 PM	0.02	0.02	0.01	0.00	0.05	0.01	0.00	0.01	0.00	0.03	0.00	0.00	0.02	0.00	0.03	0.00	0.01	0.00	0.02	0.00	0.00	0.04	0.02	0.01	0.02	0.00	0.03	0.01	0.01	0.02	0.04