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ILLINOIS SOLAR WEATHER PROGRAM

by

L. Keith Hendrie, Climatologist

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Richard G. Semonin
Principal Investigator

Champaign, Illinois

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L. Keith Hendrie
Climatologist
Illinois State Water Survey

INTRODUCTION

Interest in alternative energy sources, and pressures to develop appropriate technology to utilize them, have increased with the rapid depletion of, and frequent cost increases for, environmentally-acceptable conventional fossil fuels. Solar radiation and wind energy have been widely proposed as alternatives, and have been suggested as potential buffers for the national energy crisis, at least until replacement energy resources are developed.

The main attractions of the solar and wind, energy sources are that they are renewable, adaptable over a wide scale of demands, and that their prior utilization in simple systems such as windmills and grain drying makes them more readily acceptable to the general public. Some of the current uses of solar radiation and wind for energy supplement purposes include space heating for homes, offices and animal shelters, grain and fruit drying, domestic and other small-scale water heating, pumping of water, and generation of electric power. Less well-recognized applications include air conditioning and space cooling, industrial process heating, natural lighting of buildings, and heating of outdoor facilities such as swimming pools and patios. Additionally, solar radiation and wind data are used in physically-based relationships to predict crop water loss by evapotranspiration, irrigation requirements, crop growth, evaporative loss from water surfaces, and snowmelt.

The kinetic energy available in atmospheric motion is usually converted to mechanical, potential or electrical energy by a wind turbine system or windmill. The radiant energy of the incoming solar flux comprises two components; the direct beam from the sun, and the diffuse component resulting from reflection and scattering by clouds and aerosols. Collection systems that are utilized to capture incoming solar energy are usually subdivided into two types and classified as active or passive systems, although some have characteristics of both types. Collector surfaces can be flat (capture both the direct and diffuse components) or curved to concentrate the beam (react mainly to the direct beam), they can be stationary or tracking, and they can be positioned with varying aspect and inclination to maximize or optimize the mean flux density of the energy received.

In active systems the radiant energy is generally transformed to thermal or chemical energy which is then usually transported by fluid motion to a storage point for later distribution and use. Passive (or direct) systems usually involve a transparent medium oriented appropriately to maximize the total receipt of solar radiation, and behind which is a large mass of a high thermal capacity material that acts as a net storage point during the day, and which slowly releases heat during the night.

Various types of solar collection systems and wind-driven generators are now being produced by several companies, and members of the public and industry are contemplating the economic viability of these devices to provide energy supplements. Soderholm (1982) and Wendland (1982) have provided studies of the economics of wind turbines for rural areas, and Endlich et al. (1981) have developed a computational approach to estimate wind characteristics at potential wind turbine sites. Paton et al. (1981) have published an atlas providing the broad spatial picture of the Midwest wind resource, Wendland (1981) outlined the commencement of a series of wind measurement sites in Illinois, and Hendrie and Wendland (1981) provided an initial discussion of the spatial distribution of the wind and solar energy potentials for Illinois.

Unfortunately both of these potential energy sources are quite sensitive to variationsin weather and climate. Hendrie (1981) showed the changes in incoming global radiation for the Argonne National Laboratory from 1950 to 1980, with a marked decrease evident for most months. While this trend is undoubtedly due in part to urban sprawl and the concommitant increase in atmospheric turbidity in the general Chicago area, it can also be partially explained by increases in cloudiness over the same time period (Changnon, 1981; Wendland and Semonin, 1982). Changes in cloudiness and atmospheric turbidity, along with other parameters, directly influence the receipt of solar energy at the surface, and the associated passage of weather systems and diurnal heating and cooling play a large part in causing the observed variations in surface wind speed. Consequently, to have a good understanding of the magnitude of these potential energy resources and their spatial distribution over Illinois, we need long-term meteorological data, including measurements of wind speed and solar radiation. Reliable and comparable long-term data on the necessary spatial scale are not currently available. Also there is little useful information on the impact of climatic variability upon solar and wind energy availability, even on the short time scale. As a result, climate-induced variations and often even differences due to changes in day-to-day weather have been ignored as variables in the determination of cost-benefit analyses used to evaluate many proposed technological developments related to alternative energy systems.

Additionally, both the solar and wind resource have temporal variability, both diurnally and seasonally. On average Midwest wind speeds are stronger and more persistent during daylight periods and during late winter and spring, suggesting that these time periods offer the greatest potential for the use of wind as an alternative energy source. Solar radiation income occurs only during daytime, and usually is greatest on a horizontal surface near noon and during summer. Additional variation in the solar flux results from the diurnal and seasonal directional variation of the direct beam component, and thus orientation of the collector surface is also important. Mathematical interpretations of these solar-terrestrial relationships are provided in Sellers (1965) and Robinson

(1966). A variety of models based upon these relationships have been developed to provide estimates of clear-day incoming solar radiation. Relationships have also been developed to provide the mean partitioning of global radiation into its direct and diffuse components (e.g. Liu and Jordan, 1960), the direct beam flux incoming to slopes of varying inclination and aspect (e.g. Garnier and Ohmura, 1968), and of total solar radiation on various slopes (e.g. Temps and Coulson, 1977; Revfiem, 1978, 1982). Jaffe and Erley (1980) use these types of model estimations in developing a set of guidelines for planning officials to assist in the provision of residential development with maximum solar exposure for energy supplement uses.

While computational estimates of the solar flux reaching the surface can be obtained using solar-terrestrial relationships, surface configuration, and average atmospheric conditions, the derived values are usually not good estimates of the actual flux. The influence of cloudiness, changing atmosphere turbidity, local weather effects, and longer term changes in climate combine to provide a further spatial and temporal variability to these expectations. Consequently, measurements of solar radiation are necessary to obtain a realistic picture of the pattern of solar receipt if a meaningful economic analysis is to be undertaken.

Based upon the mean monthly values provided in Hendrie (1981) and SERI (1981), the potential for economic utilization of solar radiation as an alternative energy source in Illinois appears quite promising, both in an agricultural and an urban/suburban context. On the other hand, Paton et al. (1981) suggests that relative to much of the country, the potential wind energy in Illinois is at best moderate, with the highest potential occurring in winter. Wendland (1982) found a SW-NE band across the center of the state to have the highest economic potential for the utilization of wind energy, and suggested that for this area 50-55% of a residential electrical demand could be realized, while some other areas would be as low as 25-30%. One benefit of wind energy may be as a supplement to solar energy at times of low solar income.

Optimization of the use of the renewable solar and wind energy resources requires a good grasp of their spatial and temporal potential, and this necessitates their continued monitoring with good quality instrumentation positioned at spatially coherent sites. Broad spatial and temporal patterns of solar radiat ion are provided in SERI(1981) and of wind energy in Paton et al. (1981) , but the detail necessary for sound economic decision-making in localized areas is not available. Prior to the initiation of Phase I of this study, Illinois like many other regions of the country, had little available reliable quantitative information upon which to base their assessments of these alternative energy strategies with any degree of certainty. While solar radiation was being monitored independently at a few places in Illinois, direction of operations at these sites lacked coordination, and the data were not of sufficiently compatible form to incorporate into one picture for a number of reasons. Often these measurements were made for only a relatively short period of time and with widely different objectives which bore strongly on the methodology adopted. In most cases the acquisition of data had commenced very recently, meaning that little value could be attributed to them as being representative of any mean value. Additionally, the type of instrumentation employed varied widely, resulting in a variety of differences in the sensor outputs related to the instrument characteristics, spectral response, mounting and exposure, and leading to incompatible data in many cases. The types of factors involved here can cause wide variations in calibrated output, often of the order of 10-20%, and under certain conditions much greater. These factors include differences in instrument response time, varying instrument sensitivity to temperature, spectral composition of the incoming radiation, azimuth, orientation and zenith angle, and also changing sensitivities when instruments are mounted in non-horizontal positions. The procedures adopted for instrument calibration (if performed) and maintenance also varied widely, and the nature of the exposure, particularly in the case of tilted sensors lacked consistency.

Overall, the only reliable long-term data were those from Argonne NL, and these contained a trend of decreasing values that may not be valid for other parts of the state. The State Water Survey began the development of the necessary basic monitoring network in Phase I of this study, and this report covers the second year of development of these measurement sites and progress made towards the provision of suitable solar radiation and wind data bases.

PROJECT AIMS
&
SUMMARY OF YEAR 1

Project Aims

The primary aims of the project are:

(1) to collect high-quality solar radiation data in order to develop an understanding of the mesoscale solar and wind climatologies for Illinois;

(2) to use these data to interpret the spatial and temporal variability in the solar and wind energy potentials for the state;

(3) to publish the collected data and make it available to interested agencies, research organizations and members of the public; and

(4) to incorporate these measurements with other historic data and related information such as sunshine records to extend the usable records back in time.

To ensure the best possible data set, it was considered necessary to use high quality sensors and recorders, to install these instruments at good data collection sites determined according to a consistent set of criteria, and to use a consistent methodology throughout. Additionally, these sites need to be maintained for a long-term program of monitoring.

Summary of Year 1 of Program

This program was initiated in September 1980 to establish an observational network to provide a high quality solar radiation and wind data-base on the temporal and spatial scales critical to the appropriate evaluation of solar and wind energy systems. With time and continued monitoring, these data will provide planners with information on climatological trends and variations in receipt of solar radiation and wind energy at the surface for meso-scale regions in Illinois. This is a spatial scale in keeping with that used in previous atmospheric experiments that have revealed variations in cloudiness and precipitation, oftenwith a persistence of months to years. Other previously collected comparable solar radiation and wind data have been considered to provide an initial examination of historical trends and variability in solar and wind energy received over this region of the Midwest.

During the first year (September 1980 to August 1981) six measurement sites were established at Bondville/Champaign, Brownstown, DeKalb, Dixon Springs, Monmouth, and Perry. Six Eppley 8-48 black and white pyranometers were purchased and calibrated for monitoring solar radiation. Six Eppley integrators and interfaced Digitec printers were purchased to record hourly summations of solar radiation. Six R.M. Young propane anemometers were refurbished, cross-compared, and calibrated with a constant speed motor designed for the purpose. These sensors were installed at the sites along with other meteorological equipment. Commencing in about May-July 1981 measurements of solar radiation, air temperature and humidity, precipitation, soil temperature, and soil moisture have been recorded at each site. Unfortunately the manufacturer supplying the wind data recording systems was unable to make delivery until the second year of the project.

In addition to the development of the six measurement sites, analyses were made of SOLMET solar radiation data and National Weather Service sunshine data for Midwest stations and estimates of monthly means of incoming solar radiation were evaluated and plotted for Illinois. Solar radiation data for Argonne National Laboratory for the period 1950-1980 was analyzed to determine spatial and temporal patterns.

Further details of the developments and progress achieved during this first year are detailed in Hendrie (1981) and Wendland (1981).

SITES

In a project of this nature it is very important to be careful in the selection of measurement sites so that they will most adequately fulfill the research goals within the specified timeframe, yet retain the longevity and stability desired of longterm networks. The criteria desired for the sites in this study were carefully evaluated and documented prior to requests being made for the use of potential locations. A total of 11 of 12 projected solar and wind monitoring sites have been at least partially instrumented to this time, and an additional 3 sites have been established to monitor other climatological parameters. Negotiations for the use of the twelfth location (Peoria) are almost successfully completed, and it is expected that this site will be equipped in November 1982. Negotiations have also commenced for an additional two supplementary sites, and it is expected that both will be successful. These sites are referred to collectively as the Illinois Climate Network (ICN), and the parameters monitored at each location include at least some of solar radiation, wind speed and direction, air temperature and humidity, precipitation, soil temperature, and soil moisture.

Selection of Measurement Sites

The criteria developed during the site selection process are listed below in their order of importance.

(1) The sites should be located so as to provide a reasonably homogeneous spatial coverage of the State. It was determined that data from the Argonne National Laboratory at Lemont would be compatible with the networks data, and permission was obtained for us to receive it, hence giving a thirteenth site. It was also decided that no attempt should be made to monitor solar radiation within Chicago since due to large local variations in cloudiness, atmospheric moisture and aerosol concentrations it is likely to be highly variable. Rather this should be studied independently in a future project.

(2) The pyranometers were to be mounted with their sensing surfaces positioned in a horizontal plane as is conventional in meteorological practice. Solar fluxes on surfaces of other orientation can be estimated from these data using appropriate empirical models. The instruments should be positioned at a height of at least 1 meter above the surface, but still be convenient for servicing.

(3) The pyranometers should be located preferably in an open space in a relatively flat area, and fairly unobstructed by buildings, trees and all other tall objects, particularly from the east through south to west. It is important that there be no shading of the sensor surface, and best if there is also little horizon obstruction. The limits imposed were that the top of any obstructions located from the east through south to west should have an angle of elevation from the sensor surface of

less than 5° (2.5 meters above instrument at 30 meters distance), and that the location would be definitely unsuitable if the angle of elevation of any obstruction exceeded 10° (5 meters above instrument at 30 meters distance).

(4) The site locations should be relatively accessible at all times of the year to facilitate Water Survey personnel in the initial installation of the delicate equipment, and in their routine visits for maintenance, calibration and checking of the instrumentation. However, the site should not be directly adjacent to high-use areas or traffic corridors where it may become subject to theft, vandalism and/or tampering.

(5) It would be beneficial to have experienced and sympathetic personnel living and/or working near the site. This would greatly enhance the security of the instrumentation and provide an "on-site" observer who could notify Water Survey personnel promptly in the event of such abnormalities as equipment malfunction, damage or theft, thereby reducing periods of data loss.

(6) It would be preferable to have a 115 V AC power source nearby to reduce distances through which cabling would have to be installed.

(7) It was also considered preferable to locate these sites at places where the data could be utilized to assist with on-going operations, research, education, or community needs.

It was decided to co-locate these sites with those for a wind energy study also initiated by the Water Survey in 1980/1 (Contract STIL-INR80.211; Wendland, 1981), and in addition to include equipment to monitor temperature, humidity, precipitation, soil temperature and soil moisture at the same location.

After careful consideration of site requirements, possible site locations, spatial coverage of the state, and any special data needs, a number of target locations were determined. It was decided that the most appropriate places to locate the initial sites would be at the University of Illinois College of Agriculture Research Centers. It was felt that they would provide a reasonably well-spaced network of sites giving a good state-wide coverage during the first year; have good instrument exposure, accessibility and long-term availability; offer good security against the threats of vandalism and theft; have experienced staff on location; and that the data would be useful to agricultural researchers. A proposal was submitted to the College of Agriculture and approval given to establish sites at 5 of their Research Centers. The Water Survey site at Bondville, about 5 miles SW of Champaign, was used as the sixth initial location. Additionally, arrangements were made with the Argonne National Laboratory to provide compatible data as a cooperative agency in the ICN. More details of the activities of the first year of the program (Contracts STIL-INR80.210 and STIL-INR80.211) are provided in Hendrie (1981) and Wendland (1981).

The selection of sites during the second year of the project was more difficult since they had to satisfy the criteria listed above and also complement the spatial pattern established during the first year. Finally a mix of Southern Illinois University agriculture research farms and other Colleges with agricultural and/or alternative energy programs were selected from the original target locations as providing the required potential sites. The negotiation stage also proved to be much more awkward than in the first year since individual agreements were required with each institution and the on-site staff nominated to supervise the equipment varied widely in skills and experience. An attempt was made to continue the agricultural relevance of the ICN sites established during the first year. The six sites selected and successfully negotiated during this period were at Belleville (SIU Agricultural Research Farm), Freegort (Highland Community College), Ina (Rend Lake College), Olney (Olney Central College), Peoria (Illinois Central College), and Springfield (Lincoln Land College). In addition, negotiations are in progress to develop sites at Carbondale (SIU Agricultural Research Farm) and St. Anne (University of Illinois Trust Farm). Sites of limited extent have also been instrumented at Oak Run and Topeka in 1981 and at the Salem DENR Research Farm in 1982.

The location of the sites developed to monitor solar radiation and wind is shown in Figure 1, and Table 1 provides detailed information of their location, including latitude and longitude, and height above mean sea-level (MSL). Initially the Bondville site was not equipped to monitor solar radiation, the pyranometer instead being installed on the Water Survey building in Champaign in order to recalibrate an actinograph used previously to provide estimates of solar radiation for Champaign, but now in need of considerable maintenance. The Champaign actinograph has been in continuous operation since July 1966, providing a potentially valuable relatively long-term record for evaluation. The simultaneous operation of the pyranometer and actinograph for a period of months at this location has allowed an assessment of the quality of the long-term actinograph data, and the pyranometer will shortly be relocated at the Bondville site.

As revealed by Figure 1, the present array of sites provides quite a good spatial coverage of Illinois with only two or three regions remaining that could benefit from supplementary locations.

Current Status of Sites

The operational ICN sites can be conveniently divided into three categories:

(1) Full Sites:

These are sites designed to monitor the flux of solar radiation on a horizontal surface, wind speed and direction at 10 meters, air temperature and humidity, precipitation, soil temperature at 10 cm, 20 cm, and 40 cm, and soil moisture in 20 cm depth intervals down to 2 meters. Currently some of these sites are fully operational, while others are still only partially operational due to delay in the provision of recording equipment by the manufacturer.

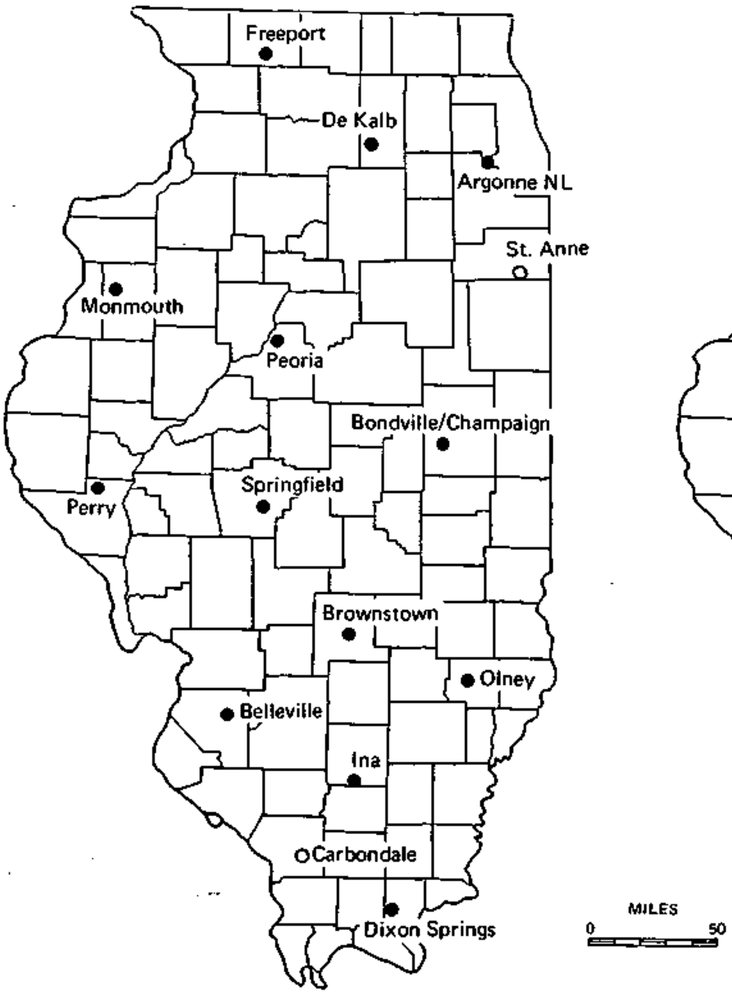

Figure 1: Location of the current Illinois Climate Network sites. Solid dots represent operational sites, open circles represent sites under negotiation.

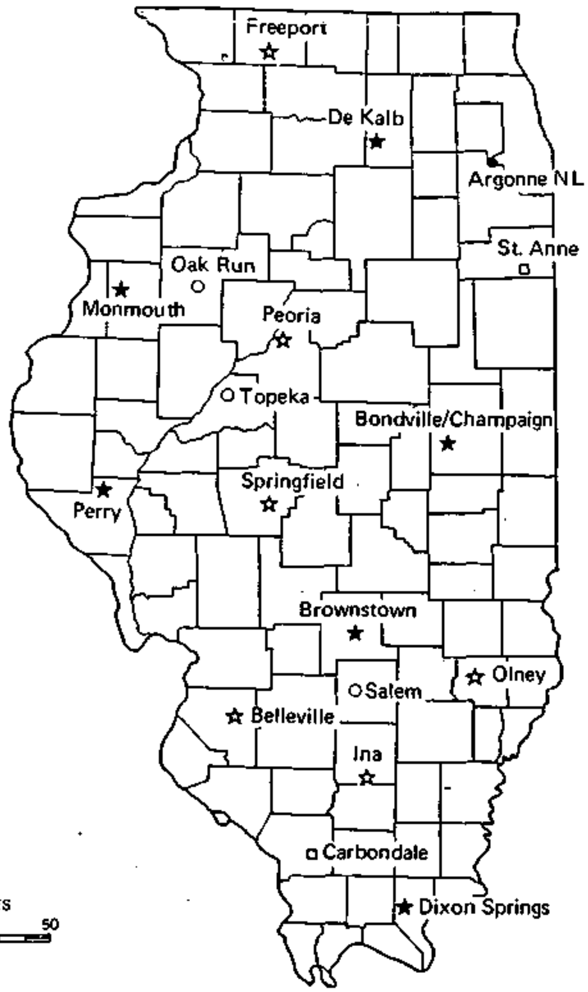

Figure 2: Current Status of the Illinois Climate Network sites. Solid stars = Full Sites, fully operational; open stars = Full Sites, partially operational (awaiting recorders) ; Solid dot = Cooperative Agency Site; Open circle = Limited Sites, operational; Open squares = sites under negotiation.

Table 1: Location, elevation (above mean sea level), and host affiliation of each site in the Illinois Climate Network,

Location	Site Code	Site No.	Latit. (N)	Long. (W)	Elev^n (m)	County	NOTES
(1) Full Sites (completed)							
BONDVILLE	BVL	01	40 03	88 22	213	Champaign	SWS Precip. Chem. Research site, about 4 miles south of Bondville.
BROWNSTOWN	BRW	03	38 57	88 57	177	Fayette	U of I Agricultural Research Farm, about 3 miles s of Brownstown.
CHAMPAIGN	SWS	81	40 07	88 14	219	Champaign	Illinois State Water Survey Bldg., Springfield & Sixth, Champaign.
DE KALB	DEK	05	41 51	88 51	265	DeKalb	U of I Agricultural Research Farm, about 5 miles NNE of Shabbona.
DIXON SPRINGS	DXS(B)	02	37 27	88 40	165	Pope	U of I Agricultural Research Center (bare soil moisture site), about 2 miles S of Glendale.
	DXS(G)	82	37 27	88 40	165	Pope	Grass covered soil moisture site at the same location.
MONMOUTH	MON	06	40 65	90 45	229	Warren	U of I Agricultural Research Farm, about 4 miles W of Monmouth.
PERRY	ORR	04	39 48	90 50	206	Pike	U of I Orr Agric. Research Center, about 5 miles WNW of Perry.
(2) Cooperative Agency Site:							
ARGONNE NL	ANL	07	41 42	87 58	221	Cook	At the Argonne National Laboratory, Lemont. Not run directly by the SWS, but data supplied to be included with other network data.
(3) Full Sites (Partially completed/under negotiation):							
BELLEVILLE	FRM	10	38 31	89 53	133	St. Clair	SIU Agricultural Research Farm, about 7 miles E of Belleville.
CARBONDALE	SIU	11	37 43	89 14	137	Jackson	At SIU, on the Forestry Tree Improvement Research Farm area, about 2 miles SW of Carbondale.
FREEPORT	FRE	13	42 17	89 40	265	Stephenson	At Highland Community College, by Physical Plant office. W edge of Freeport.
INA	RND	14	38 08	88 55	130	Jefferson	At Rend Lake College, within the water treatment plant fenced area, 2 miles SW of Ina.
OLNEY	OLN	12	38 44	88 06	134	Richland	At Olney Central College, on NW corner of campus, near gym.
PEORIA	ICC	08	40 42	89 32	207	Tazewell	At Illinois Central College, near demonstration solar home. East Peoria.
SPRINGFIELD	LLC	09	39 31	89 37	177	Sangamon	At Lincolnland Community College, between Physical plant and parking area, south edge of Springfield.
ST. ANNE	ANN	15	41 03	87 42	194	Kankakee	On newly acquired U of I Trust Farm land, 1 mile NE of Wichert; SE corner.
(4) Limited Sites (completed):							
OAK RUN	OAK	17	40 58	90 09	229	Knox	At Oak Run, 50 m NW of the water tower,
SALEM	TON	18	38 42	88 57	186	Marion	At DENR Research Farm, about 5 miles NNW of Salem,
TOPEKA	MTF	16	40 18	89 54	152	Mason	At Mason Tree Nursery, about 200 m SE from office, 2 miles SE of Topeka.

(2) Cooperative Agency Sites:

These sites are equipped with instrumentation providing data compatible with that of the ICN Full Sites, but operated and maintained by another agency which has agreed to provide the data to form part of the ICN data set.

(3) Limited Sites:

Parameters monitored at these sites form only a subset of those at Full Sites, and never include solar radiation and wind speed/ direction.

Figure 2 shows the location and status of each of the currently operational ICN sites, and the location of sites under negotiation. Table 2 provides a detailed listing of the parameters measured at each site, the frequency or time of integration of measurements, the beginning month of the observation in each case, and the instrumentation used.

Site Development Activities during the 1981/2 Contract Period

During the 1981/2 contract period, the first six sites (Bondville, Brownstown, DeKalb, Dixon Springs, Monmouth and Perry) were completed by the , installation of #483 Science Associates digital data systems for the monitoring of wind speed and direction. These recording systems had been ordered during the previous 12 month period, but final delivery had been considerably delayed while electronic malfunctions were isolated and corrected by the manufacturer, and subsequent checks and calibrations effected at the State Water Survey. The months during which these installations were made are listed in Table 2.

New sites were negotiated, surveyed, and equipped at the following locations:

Belleville	-	SIU Agricultural Research Farm
Freeport	-	Highland Communicty College
Ina	-	Rend Lake College
Olney	-	Olney Central College
Peoria	-	Illinois Central College
Springfield	-	Lincoln Land College

In each case a 10 meter tower and instrumentation as indicated in Table 2 was installed. However, again because of lengthy delays in the successful development and operation of the digital data acquisition systems ordered to record solar radiation and wind speed/direction, final completion of these sites will not take place until late in 1982.

Negotiations for the location of two supplementary measurement sites at Carbondale (SIU Agricultural Research Farm) and St. Anne (University of Illinois Trust Farm) are well underway. Successful outcomes are expected in the next month for Carbondale and by early 1983 for St. Anne. A Limited Site was established at the DENR Research Farm near Salem, and was equipped to measure air temperature and humidity, precipitation and soil moisture.

TABLE 2: PARAMETERS MEASURED AT EACH SITE, FREQUENCY AND BEGINNING MONTH OF OBSERVATIONS.

	(Global) Solar Radiation[1]	Wind Speed[2]	Wind Direction[2]	Air Temperature[3]	Relative Humidity[3]	Soil Temperature[4] 4"	8"	16"	Precipitation[5]	Soil Moisture[6]
Bondville/ Champaign	H 4/81	H 2/82	H 2/82	D 3/81	D 3/81	D 3/81	D 3/81	D 3/81	D 3/81	W 3/81
Brownstown	H 6/81	H 6/82	H 6/82	D 5/81	D 5/81	NWS Agnet	D 6/81	D 6/81	D 5/81	M/2 5/81
DeKalb	H 6/81	H 4/82	H 4/82	D 6/81	D 6/81	DeK Staff	D 6/81	D 6/81	D 6/81	M/2 6/81
Dixon Springs	H 5/81	H 4/82	H 4/82	--All measured on Dixon Springs instrumentation--						M/2 5/81
Monmouth	H 8/81	H 4/82	H 4/82	D 6/81	D 6/81	NWS Agnet	D 6/81	D 6/81	D 6/81	M/2 6/81
Perry	H 5/81	H 4/82	H 4/82	D 5/81	D 5/81	NWS Agnet	D 5/81	D 5/81	D 5/81	M/2 5/81
Argonne NL[7]	H 1950	H 1950	H 1950	H 1950	H 1950	-	-	-	H 1950	-
Belleville	AR	AR	AR	D 5/82	D 5/82	NWS Agnet	-	-	D 5/82	M/2 5/82
Carbondale	-	-	-	-	-	-	-	-	-	-
		Under negotiation:		expected to be instrumented Nov/Dec 1982.						
Freeport	AR	AR	AR	D 4/82	D 4/82	-	-	-	D 4/82	M/2 4/82
Ina	AR	AR	AR	D 8/82	D 8/82	-	-	-	D 8/82	M/2 8/82
Olney	AR	AR	AR	D 7/82	D 7/82	-	-	-	D 7/82	M/2 7/82
Peoria	AR	AR	AR	D 10/82	D 10/82	-	-	-	D 10/82	M/2 10/82
Springfield	AR	AR	AR	D 7/82	D 7/82	-	-	-	D 7/82	M/2 7/82
St. Anne	-	-	-	-	-	-	-	-	-	-
		Under negotiation:		expected to be instrumented spring 1983.						
Oak Run	-	-	-	-	-	-	-	-	D 6/81	M/2 6/81
Salem	-	-	-	D 10/82	D 10/82	-	-	-	D 10/82	M/2 10/82
Topeka	-	-	-	-	-	-	-	-	D 6/81	M/2 6/81

W = weekly; H = hourly; D = daily; M/2 = twice a month; AR = awaiting recorder (to be hourly).

[1]Eppley 8-48 pyranometers - recorded on (1) Eppley #411 Integrators and Digitec 6100 Printers, (2) Science Associates #483 Digital Data Recorders, or (3) Science Associates #920 Data Acguisition Systems.

[2]R. M. Young Gill Propvane Anemometers - recorded digitally on (1) Science Associates #483 Digital Data Recorders, or (2) Science Associates #920 Data Acquisition Systems.

[3]Belfort Hygrothermographs - weekly charts.

[4]Soil Thermographs - weekly charts.

[5]Belfort Weighing Rain Gage - weekly charts.

[6]Chicago Nuclear Surface and Depth Neutron Probes.

[7]Instrumentation is slightly different, but comparable.

Detailed Description of Instrumented Sites

The following is a detailed description of the actual ICN instrumented sites which presently are at least partially completed. For the remainder of this report they shall be referred to as Bondville, Brownstown, Champaign, DeKalb, Dixon Springs, Monmouth, Perry, Argonne NL, Belleville, Freeport, Ina, Olney, Peoria, Springfield, Oak Run, Salem and Topeka.

(1) Bondville:

The pyranometer has not yet been transferred to this site from Champaign, but all other equipment has been installed. The site is located in Champaign County about 4.2 miles south of Bondville on University of Illinois land under the control of Electrical Engineering, and surrounded by a University Trust Farm cropped in soybeans in 1981 and corn in 1982. The actual site is near the east edge of a 240m × 120m grassed area with a very slight north-facing slope (<2°). The nearest obstruction is a farmhouse and barn of about 12 m height at about 200 m to the ENE.

(2) Brownstown:

This site is located in Fayette County on the University of Illinois Brownstown Agricultural Research Center, about 3 miles south of Brownstown. There is a very slight S facing slope (<2°), and apart from a wooded area from the ESE to the SSW and at 300 m there is no obstruction. A large pond lies well to the south and between the wooded area and instrument site. The adjacent area was used as experimental crop land; wheat and irrigated corn and soybeans in both 1981 and 1982.

(3) Champaign:

At the moment a pyranometer is situated on a stand on the penthouse on the eastern end of the Water Resources Building occupied by the Water Survey on the corner of Springfield and Sixth Streets, Champaign. The exposure is excellent with only a few buildings and odd trees any higher than the sensor, and these are all at considerable distances. The instrument has been placed here temporarily to permit calibration of the previously installed actinograph for which some years of uncalibrated data are available. The instrument is to be reestablished at Bondville on flat land cropped in soybeans or corn as soon as a satisfactory calibration has been completed.

(4) DeKalb:

This site is located in DeKalb County at the University of Illinois Northern Agricultural Research Center between Shabbona and DeKalb and has a resident farm manager. The site has a slight east-facing slope (<3°) and is open in all directions except for a coniferous windbreak of about 12 m height at about 100m to the NW and. the farm manager's residence of about 10 m height at about 100 m distance to the WNW. The immediate surroundings are grassed verges and agricultural experiment plots planted in corn in 1981 and 1982.

(5) Dixon Springs:

This site has been incorporated in the meteorological enclosure of the University of Illinois Dixon Springs Agricultural Research Experimental Station, between Glendale and Dixon Springs, Pope County in an undulating, partially wooded area typical of southern Illinois. Several University of Illinois staff members live on the property quite close to the instrumented site which is located near the top of a knoll with a shallow-west-facing slope. The nearest obstructions are a timbered area and house to the east and a house and isolated trees to the north. The area is quite open from the SW through W to the N.

(6) Monmouth:

This site is located in Warren County on the recently acquired University of Illinois Northwestern Agricultural Research and Development Center about 4 miles west of Monmouth. There is an agronomist supervising the Center and a farm foreman who resides on the property. There is no detectable slope at the instrumented site, although there is a shallow SW to NE oriented gully about 100 m to the SE. The only obstruction within 600 m is an unused cattle-shed of about 6 m height at about 50 m to the NE. The surrounding land was cropped in soybeans in 1981 and partially in each of corn and soybeans in 1982.

(7) Perry:

This site is located in Pike County at the University of Illinois Orr Agricultural Research Center between Perry and Fishook, and has a resident farm manager whose home is adjacent to the site. The instruments are located on an upland area dissected by a NE to SW oriented gully of about 10 m depth to the NW of the site, and with an east-facing slope of about 5°. The site is open in all directions, with the only obstructions being the farm manager's residence of about 7 m height at 100 m distance to the NW and the Center's office, implement shed and new classroom/laboratory complex over 250 m to the ENE, with a pond lying between them and the site. The immediately adjacent area serves as the Center's meteorological site and an experimental plot planted in corn in both 1981 and 1982.

(8) Argonne NL:

This site is operated by the Argonne National Laboratory just north of Lemont and the Illinois and Michigan Canal, in western Cook County. The pyranometer monitoring solar radiation is located on the top of a tower of about 8-10 m height, and has an unobstructed exposure. The anemometers are located on a tower in the middle of an adjacent cleared field.

(9) Belleville:

The Belleville site is located in St. Clair County on the SIU Agricultural Research Farm about 3 miles east of Belleville and immediately south of Scott Air Force Base. There is a non-resident farm manager present at the farm every week day, and the entrance is' locked in his absence. The instruments are located in a grassed area with a slight east-facing slope (<3°) and 200 m west of the farm office and two bunkers of about 10 m height. The closest obstructions are a small hut of about 3 m height at about 50 m to the ENE, a storage shed of about 4 m height at about 70 m to the WSW, and a series of about 10 well-separated small pine trees, each of about 3-4 m height and at about 70 m away in an arc from the SW through W to N.

(10) Freeport:

The Freeport site is located in Stephenson County at Highland Community College on the western edge of Freeport. The instrumentation is sited on a grassed area with a NW facing slope of about 5° between the Physical Plant buildings and the southern entrance road to the campus. This location is quite open from the NE through N to SE, but is somewhat obstructed by the Physical Plant storage sheds, workshops and office with heights up to 15 m at 80-100 m to the NE, and by a shed, trees and a house with heights up to 15-18 m at 150-200 m to the east. A house with a height of about 5 m is about 120 m to the WSW.

(11) Ina:

This site is located on the southern fringe of Jefferson County at Rend Lake College, adjacent to Interstate 57'. The instruments are situated in the SW corner of the fences (2 m chain-lock) and locked area of the college water treatment plant about 1/2 mile NW of the main campus buildings. The area has a very slight west-facing slope (<2°) and is quite open, with only the fence and stirring tank (about 2 1/2 m high and 20m NE of the tower) providing obstructions. The soil moisture tube is located well within an adjacent soybean field about 200 m to the SE of the tower.

(12) Olney:

This site is located in Richland County on the property of Olney Central College which is near the NW edge of the town of Olney. The instrumentation is sited near the NW corner of the campus on an expansive grassed area that has little college use. There is no discernable slope. The main obstruction is the main campus building complex of about 15 m height to the SE, and with its closest point being at a distance of about 150 m. The only other obstruction is a low hedge of bushes of about 1-2 m height, bordering the college property and at its closest being about 20 m to the north and 30 to the west. Beyond the college property is cropped farmland.

(13) Peoria:

The Peoria site is situated in Tazewell County on the plain above and to the east of the Illinois River, and just NE of East Peoria. It is located on the property of Illinois Central College about 1/4 - 1/2 mile from the river valley bluffs and separated from them by a forested strip. The instruments are sited in a large grassed area that includes a baseball diamond, gymnasium and demonstration solar home (which also serves to house the recording equipment). There is a slight NE facing slope of less than 5°. The only obstructions are the solar home of about 5 m height at about 60 m distance to SW, the gymnasium building of about 10 m height at 150-200 m to the NE (downslope), and the trees lining the bluffs at about 200 m to the W. The soil moisture tube is located separately near agricultural test plots on the N edge of the college property.

(14) Springfield:

This site is located on the property of Lincoln Land College in Sangamon County near the southern edge of Springfield, east of Interstate 55, and just west of Lake Springfield. The instrumentation is situated on a broad grassed area near the SE corner of the campus, and has a slight (3-5°) SE facing slope. The nearest obstructions are a W-E line of trees of about 15 m height at about 200-250 m to the south, the college physical plant building of about 10 m height at a distance of about 150 m to the ENE, and the gymnasium of about 13 m height at about 150-200 m to the north. The slightly taller main buildings on campus are well to the NW of the instrumentation. The soil moisture tube is located separately about 50 m S of the main college entrance, and just to the W of Shepherds Road on the E edge of a test crop area. In 1982 the land was cropped in corn.

(15) Oak Run:

The Limited Site at Oak Run is in Knox County, about 15 miles east of Galesburg, and comprises only a recording raingage and soil moisture access tube. They are located near the crest of a W-E ridge extending into Spoon Valley Lake from the west. The soil moisture tube is situated in an uncut grassed lot of land about 50 m NW from the Oak Run water tower. There is a S-facing slope of about 5° at this point.

(16) Salem:

The Limited Site is located in Marion County, about 5 miles NW of Salem on the DENR Research Farm. The parameters monitored at this site are in temperature and humidity, soil moisture, and precipitation. There is a general W facing slope of about 3-5°, although the area is somewhat undulating.-

(17) Topeka:

Soil moisture and precipitation are monitored at this Limited Site located at the Marion State Tree Nursery in Marion County, about 10 miles east of Havana. The equipment is sited in a sandy area in the SE portion of the Nursery, with a SW facing slope of about 5°.

Soil types and soil moisture monitoring

Soil moisture in the upper 2 meters of soil at each of the sites is monitored regularly using surface and depth neutron probes. At each location soil moisture is measured in only one specific soil type that has been carefully selected as being representative of the agricultural soils in the area. The observations are expected to be fairly representative of soil moisture values for the important agricultural soils of that region, but not necessarily of all soil types there. This is particularly true for other areas of very

Table 3. Description of soil at each of the soil moisture observations sites.

Site	Soil Type	Abbreviate Description
BONDVILLE	Flanagan/Elburn	Dark-colored, moderately well-drained silt loam, <2°slope over silty-clay-loam, B horizon at about 80 cm. Over loess/till.
BROWNSTOWN	Cisne	Poorly drained, grayish-brown silty clay loam, claypan at about 50 cm.
DeKALB	Flanagan/Drummer	Nearly level, poorly drained, very dark silt-loam-clay with heavy silt-clay-loam B horizon at 60-80 cm.
DIXON SPRINGS	Grantsburg	4-7° slope moderately well-drained silt loam, fragipan at 50 cm, yellow-brown clay-loam below. Over sandstone.
MONMOUTH	Muscatine	Very dark colored, silty loam, well moderately drained, lighter more clayey B horizon at 60 cm
PERRY	Clarkesdale	Dary gray, silty loam, moderate drainage, silty-clay B horizon at 50 cm.
BELLEVILLE	Weir Silt-loam	Dark silt-loam, moderately drained, light brown B horizon at 70-80 cm
FREEPORT	Dubuque	Dark-medium colored silt-loam over bedrock (limestone ?) moderate-slow drainage
INA	Cisne	Poorly drained, grayish-brown silty-loam, grayish B horizon at about 50 cm.
OLNEY	Bluford Silt-loam	Light-colored gray-brown, poorly drained, gray and brown B horizon with much clay.
PEORIA	Clinton	Dark grayish-brown silty-loam, 3-6° slope, moderate drainage.

Table 3 (cont'd)

SPRINGFIELD	Ipava	Dark gray, silty-loam, moderately well drained, little slope, slightly lighter colored B horizon at about 50-70 cm.
OAK RUN	Rozetta	Dark grayish brown silt-loam, some clay in A horizon - much clay in B (43 cm), moderately-poorly drained.
SALEM	Bluford Silt-loam	Gray-brown silty-loam, moderate drainage, lighter colored B horizon at about 50-60 cm with higher clay content.
TOPEKA	Sandy-loam Plainfield/Onarga	Deep sandy-loam, little textural change to 200 cm, very well drained.

different soil types, however, the measured values should still be useful as indices of soil moisture changes there. Table 3 lists the soil types monitored according to Fehrenbacher, et al. (1967) and a brief description to aid in the interpretation of soil moisture at those sites relative to that of a different soil at a nearby site.

Measurements of soil moisture are made twice per month from March to September inclusive, and once per month during the remainder of the year. Readings are taken at the surface and at 20 cm intervals of depth down to 2 meters. These values are converted to soil moisture in 20 m slabs as % volume and water equivalent depth (mm) and plant available water and soil moisture deficit are computed using estimations of field capacity and wilting point values for that soil.

INSTRUMENTATION

Instrumentation: Purchase and Calibration

(1) Solar radiation sensors:

A further seven Eppley 8-48 or black and white pyranometers were purchased from The Eppley Laboratories during the second year of this project. They are the same model as, and have comparable outputs to the six pyranometers installed at ICN sites during the first year. In addition one Eppley PSP (Precision Spectral Pyranometer) was obtained to be used as a reference and calibration instrument for checking the network sensors. As with the first set of pyranometers purchased, these instruments have been checked and their calibrations cross-compared with instruments of known response. Cross-comparisons and laboratory maintenance of each of the network sensors is planned to be repeated at regular intervals of 6 to 12 months using the newly obtained reference instrument.

The net result of these tests and adjustments, is that given no other malfunctioning, the output signals will provide solar radiation values within ±3% of actual values under most circumstances. Only at fairly low intensities is the signal error likely to exceed this value, and fluxes of this order are of little value as an energy source. Consequently we can have high confidence in the data being provided by the network.

(2) Wind speed and direction sensors:

A total of 14 R.M. Young Gill Propane anemometers have now been totally overhauled, equipped with new bearings and brushes, and prepared for installation in the field. One sensor "has been selected as a calibration standard, and has been set aside for retention at the SWS laboratories to be used for cross-comparison tests only. All 14 sensors have now been cross-compared with the standard instrument for both wind speed and direction, and their output has also been checked using a constant speed motor designed for the purpose. Using the results from these tests, relationships have been developed for individual sensors so that all outputs can be standardized. Cross-comparisons and outputs using the constant speed motor are planned to be performed on a 6-12 month basis for each of the sensors in the field.

(3) Data recording systems:

The first six sites developed (Bondville, Brownstown, DeKalb, Dixon Springs, Monmouth, and Perry) were equipped during year 1 with Eppley 411-6140 Integrators interfaced with Digitec 6100 recorders to provide hourly integrations and printouts of incident solar radiation. These integrator-recorder systems were precalibrated at the Eppley Laboratory, and were checked using constant millivolt input sources at the Water Survey. They were found to have been adjusted precisely, and no further preliminary adjustments were effected.

The deployment of the wind recording systems was delayed due to circuitry development problems experienced by the manufacturer. These 6 recorders (Science Associates #483) were delivered during this second year of the program. State' Water Survey personnel performed extensive calibration and performance checks on this equipment, and made appropriate adjustments so that their recorded outputs were standardized. They were installed at the first 6 ICN sites between February and May 1982.

The main operating problems encountered with these systems have been related to integrated circuitry failure under intense thunderstorm conditions, and breaks in a cable to the printer that has been positioned poorly in the original design. Water Survey staff are correcting this design flaw, and have conducted trouble-shooting and repair exercises when necessary. Overall, the recorders have been operational for about 90% of the time, and we hope this percentage will increase as staff become more proficient in problem evaluation.

Additionally, during year 2 six microprocessor controlled digital recording systems, each to be with a printer and cassette recorder, were ordered for installation at the proposed 6 additional sites (Belleville, Freeport, Ina, Olney, Peoria, Springfield). These recorders, designated as Science Associated 920-3 Digital Data Acquisition Systems, were designed to record wind speed, wind direction, and the incoming solar flux. They will also be able to handle additional electrical input signals. They are controlled by an RCA 1800 Microsystem and will provide a programmed output to include (for preset time periods) the mean and maximum fluxes of solar radiation, mean wind speeds, variance in wind speed, maximum gusts, and a wind rose of percentage of time with wind direction from each of the 8 cardinal directions.

Unfortunately, due to unexpected development problems, the delivery of these systems by the manufacturer has been considerably delayed beyond the projected timetable. Also, the first system delivered to the State Water Survey failed to pass the testing procedures, and was returned for circuitry and program amendments. This improved unit is due to be returned to the State Water Survey very shortly for retesting. Upon acceptance of this unit, the remaining 5 will be completed and forwarded to us in a short time period. Once delivered these units will also be tested, and if found satisfactory, will be immediately deployed at network sites. Initial testing of the first unit leaves us with high expectations of their ability to perform the required functions once the appropriate changes are effected.

(4) Other equipment:

Precipitation, air temperature and humidity, soil temperature, and soil moisture equipment was refurbished and installed at the 6 new sites. Recording of these parameters has continued at each site from the dates provided in Table 2.

Instrumentation: Installation and Performance

(1) General installation:

The 6 Science Associates #483 Digital Recorders purchased during Phase I for the recording of wind speed and direction were installed at the first 6 sites during the period February to June, 1982. The actual dates of onset of records at the individual sites are provided in Table 2.

The installation of equipment at the 6 new sites commenced in April, 1982, following a period of final site selection, contract negotiation with the chosen host institution, fabrication of support structures and recorder shelters, and cable preparations. As for the initial sites, in all cases signal cables were kept as short as possible (maximum of 10 meters) to keep resistance at a minimum, and shielded cable used to avoid interference to the signals by other electromagnetic fluxes. Power cables installed were trenched, with 12 gage cable used if less than 15 meters long or 10 gage if longer. Circuit breakers and lightning arrestors were installed at each site.

Two systems were used for the support of the pyranometers. The first method utilized a horizontal steel plate attached to the top of a pole and positioned at a height of 1.75 meters. This was used at Carbondale where it was beneficial to locate the pyranometer away from the anemometer tower to improve the conditions of instrument exposure to achieve the necessary standards adopted. The second method utilized a horizontal steel plate attached to the end of a 3 meter horizontal boom which was bolted at a height of 1.75 meters on the anemometer tower with necessary support struts. The horizontal boom was pointed towards the south from the tower. This system was installed at Belleville, Freeport, Ina, Olney, Peoria, and Springfield.

Standard insulated recorder shelters (as for the first 6 sites) consisting of a 1 m × 0.6 m × 0.5 m painted box lined with R11 styrafoam insulation and equipped with ventilation ports and thermally controlled fans and light bulbs to maintain internal temperatures well within the operating range of the' recording systems, were installed at all new sites with the exception of Carbondale and Peoria. At Carbondale the recording rquipment will be housed in an adjacent instrument and pump shed, while at Peoria the recording systems will be housed in the nearby Illinois Central College Demonstration Solar Home where it will be on view to visitors.

(2) Solar system performance:

The first site completed was Champaign, with the first set of useable solar radiation data being recorded on May 8, 1981. All sites had been completed and were providing solar radiation usable solar data by June 24, 1981. Table 4 provides a summary of the performance of this equipment at each site. Overall performance initially was satisfactory to good, with improving performance as initial problems were solved and on-site personnel became familiar with maintenance and checking procedures. Overall, by the end of 1981 acceptable solar data were

Table 4. Record of period of monitoring of solar radiation at each of the six sites instrumented and problems encountered during 1981.

Site Name	Date of final Installation	Time (CST), Date of First Good Record	# days operation	% days no data loss	% hours of acceptable data	Problems Encountered
Brownstown	June 4	18 hrs, June 23	192	87.5	92.0	faulty cable permitting electrical interference to signal occasional power outage due to electrical storms
Champaign	May 8	17 hrs, May 8	238	100.0	100.0	internal damage to sensor due to moisture - repair & recalibration required (under warrant
DeKalb	June 15	19 hrs, June 15	200	94.5	95.1	power outage during electrical storms coupled with lack of daily inspection of recorder
Dixon Springs	June 3	19 hrs, June 3	212	88.2	93.8	extensive damage to electronic components of integrator & recorder resulting from nearby lightning strike occasional power outage due to electrical storms
Monmouth	June 24	15 hrs, June 24	107	82.3	84.3	recorder: failure to electronic component - repaired sensor: internal damage due to moisture - repaired & recalibrated (under warranty)
Perry	June 18	17 hrs, June 18	197	72.1	86.8	frequent power interruption due to power outage during electrical storms; frequent power shutdown during construction of major new facility, now completed
Network Total			1146	88.3	92.8	

available for 92.8% of all possible hours, with 88.3% of all days being without any data loss. Hourly data for 1981 for Champaign are provided in Appendix B, and daily data for all sites for 1981 in Appendix A.

In general the Eppley 8-48 pyranometers have performed very reliably, requiring only that their glass dome be cleaned regularly with methyl alcohol, and that their silica gel be refurbished occasionally. The only problem occurred early in the data collection period when moisture that had condensed on the external body of the instrument was ingested to the interior, rapidly expending the silica gel, and saturating the air inside the instrument. As the air in the dome cooled due to radiative loss at night, this moisture condensed on the inside of the dome and ran down onto the sensor surface, staining it, and thereby changing its sensitivity to the incoming solar flux. These damaged instruments were returned to the Eppley Laboratory, R. I. for correction of the fault, repainting of the sensor surface, and recalibration.

The Eppley integrator-printer systems have also performed quite well with only one annoying internal feature: that being, that whenever there is a power failure or disruption (even for a few seconds), they turn off, resetting their clocks and integrators, and requiring manual resetting before they will again print data. This one poor feature has resulted in well over half of the data loss that has occurred to date. The other large data losses have resulted mainly from electronic failure of integrated circuits during thunderstorms.

(3) Wind system performance:

The R. M. Young Gill propane anemometers have performed well since installation with only one problem, this being the shearing during an ice storm of the vertical shaft permitting the rotation of the directional vane. The Science Associates #483 Digital Recorders have performed moderately well with retrievable, acceptable data being available for over 98% of the total hours of their operation, and with the recorders being operable for about 90% of the time overall since their installation at the network sites. These recorders are not susceptible to the problem of being shut down by each loss of power as is the case with the Eppley integrators. They have, however, experienced more down-time due to failure of their component integrated circuits during intense thunderstorm activity. It is expected that as State Water Survey personnel become more experienced in the troubleshooting of electronic failures of these recorders that the loss of data due to down-time will be considerably reduced. Appendix C provides daily wind speed and direction data for Bondville for the period February to September, 1982.

(4) Host site personnel:

Personnel on the Agricultural Research farms hosting ICN sites have been very cooperative in their response to the project, competent in their care of the equipment, and willing to assist whenever requested. Also, the involved administrative personnel of the University of Illinois and Southern Illinois University Colleges of Agriculture have provided solid support throughout. Similarly the personnel selected to oversee instrumentation located at ICN sites hosted by Colleges have provided cooperative and consistent support and are quickly developing the necessary skills to tend the instrumentation.

DATA
COLLECTION, REDUCTION
& DISCUSSION

Data Collection, Reduction, and Publication

Observations from each of the ICN sites are recorded continuously for all parameters except soil moisture. The analog signals received from the solar radiation and wind sensors are electronically digitized and then integrated over selected time periods. At the end of each integration period cumulative totals of solar radiation (Wm^{-2}) and wind run (1/20's mile), and averages of wind direction (degrees) are printed on paper tape. The Eppley integrator-printers are set for one hour periods, and reset at midnight, while the Science Associates #483 Digital Data Systems are set for 20-minute intervals.

Data tapes and charts for each site are forwarded to the State Water[3] Survey weekly where they are edited for problems and loss of otherwise unacceptable data. These edited data are then entered onto disc files on the University of Illinois CYBER 175 computer. Programs have been developed to appropriately calibrate and check these data following input. They are then verified against the original data tapes before being made available to users.

FORTRAN programs have been developed to appropriately process these data files and to provide for each site tabular listings of hourly data by days for each month, or by days in months for a calendar year. Daily and monthly totals, and maxima and minima values are also calculated and printed. The solar radiation output can be in any one or more of 3 sets of units; Wm^{-2} and MJm^{-2}, cal cm^{-2} and kcal cm^{-2}, or BTU ft^{-2}, thus being immediately useful to a wide range of potential users without the need for unit conversions. The wind data are available in mph or ms^{-1} (speed), and degrees or the 8 major compass directions (direction). Table 5 provides the temporal and unit formats available for the different parameters recorded.

Examples of the solar radiation outputs provided by this technique are given in Appendices A and B, while Appendix C lists wind data. Appendix A provides the 1981 daily solar radiation data for all of the ICN sites monitoring solar in all three types of unit formats, while Appendix B provides the 1981 Champaign hourly solar data in units of WM^{-2}. To convert values in these tables to other units, the conversion factors provided in Table 6 can be utilized. Appendix C lists the Bondville daily wind data as mean speed and direction for the period from February 22 (onset of record) to September 19, 1982.

Discussion of Data

The only data that will be discussed in this section are the 1981 solar radiation data for all sites and the wind data for Bondville for the time period

Table 5. The temporal and units frequency of published and available Illinois Climate Network Data.
Note: X = currently available; TBA = to become available in the future.

	Means or Totals				Max/Min	Units	Notes
	Hourly	Daily	Monthly	2-Weekly	Daily		
Solar radiation	X	X	X			W m^{-2}, MJ m^{-2} cal cm^{-1} BTU ft^{-1}	global, horizontal surface
Wind speed	X	X	X		X	mph, ms^{-1}	at height of 10 m
Wind direction	X	X	X			degrees, 8 main compass directions	at height of 10 m
Air temperature	TBA	X	X		X	C, F	at 1½ m in weather shelter
Relative humidity	TBA	X	X		X	%	at 1½ m in weather shelter, unaspirated
Precipitation	TBA	X	X			mm, inches	weighting-bucket rain gage
Soil temperature	TBA	X	X		X	C, F	at 10, 20, 40 cm (4", 8", 16")
Soil moisture				X		% by volume mm (water equivalent)	at surface, and in 20 cm (8") layers

Table 6. Useful unit conversion factors for solar radiation values.

	TO CONVERT	TO	MULTIPLY BY
ENERGY	BTU	kWh	2.931×10^{-4}
	BTU	kcal	2.520×10^{-1}
	BTU	J	1.055×10^{3}
	kWh	kcal	8.600×10^{2}
	kWh	MJ	3.600
	kcal	J	4.186×10^{3}
ENERGY DENSITY	BTU ft^{-2}	kcal cm^{-2}	2.712×10^{-4}
	BTU ft^{-2}	MJ m^{-2}	1.141×10^{-2}
	BTU ft^{-2}	kJ m^{-2}	1.141×10
	kcal cm^{-2}	kWh m^{-2}	8.600×10^{6}
	kcal cm^{-2}	MJ m^{-2}	4.186×10^{5}
	kWh m^{-2}	MJ m^{-2}	3.600
	kWh m^{-2}	kJ m^{-2}	3.600×10^{3}
ENERGY FLUX (Power)	BTU h^{-1}	kW	2.931×10^{-4}
	BTU h^{-1}	kcal min^{-1}	4.200×10^{-3}
	BTU h^{-1}	W ($=Js^{-1}$)	2.931×10^{-1}
	kW	kcal min^{-1}	1.433×10
	kcal min^{-1}	W	6.977×10
ENERGY FLUX DENSITY	BTU ft^{-2} h^{-1}	W m^{-2}	3.155
	BTU ft^{-2} h^{-1}	kJ m^{-2} h^{-1}	1.141
	BTU ft^{-2} h^{-1}	MJ m^{-2} d^{-1}	2.739×10^{-2}
	BTU ft^{-2} h^{-1}	ly h^{-1}	2.726×10^{-2}
	BTU ft^{-2} h^{-1}	ly d^{-1}	6.542×10^{-1}
	ly h^{-1}	W m^{-2}	1.163×10
	ly h^{-1}	kJ m^{-2} h^{-1}	4.186×10
	ly h^{-1}	MJ m^{-2} d^{-1}	1.005
	ly h^{-1}	cal cm^{-2} h^{-1}	1.000
	TO DERIVE	FROM	DIVIDE BY

listed above. Other data will be published in separate data reports and listings to follow.

(1) Solar Radiation: Distribution and variation over Illinois:

As of yet insufficient solar data have been received from the network stations to develop any reliable mean values, but some indications of spatial and temporal variability are beginning to form. Figures 3A and 3B provide mean values of daily solar radiation for each month ($MJm^{-2}d^{-l}$) estimated for Illinois by Hendrie (1981). Figure 4 provides the comparable mean daily data for the whole year. Once sufficient data from the ICN sites become available, these relatively simple patterns will almost certainly be modified, and with the more reliable data some of the changes could become quite significant. However, at the moment these are the best mean values available, and the patterns do fit fairly closely to those of SERI(1981).

These figures show a latitudinal gradient in solar radiation to exist for all months, with the highest values in the south. Additionally, in all months, and to a much greater degree in the warmer months, a west to east decrease in the solar flux occurs in response to increasing cloudiness as you move eastward from the Mississippi River. Consequently the overall maximum values occur in the southwest of the state and the minimum values occur in the northeast. This region of minimum incident solar radiation is reinforced by the increased cloudiness experienced there and the urban and industrial influence of the greater Chicago area.

The 1981 solar data for Illinois varied somewhat from these estimated values, although in general the monthly means of daily values showed both the same seasonal pattern and the SW to NE decreasing trend for individual months. Table 7 provides a comparison of the 1981 monthly values with the estimated long-term means for each of the ICN sites. In general there was a significantly lower incidence solar flux during the summer months, slightly lower values during fall although with considerable spatial variability, and significantly higher values in December. Interestingly the sky condition records for the summer for the Champaign site showed no significant differences from normal, but the summer precipitation values were all much higher than normal, suggesting that the cloud cover was much less transparent to solar radiation than usual. The December precipitation and sky condition records mirror the solar radiation data, with significantly less cloudy skys than normal.

Individual daily values varied widely, with typical summer (June-August) clear day maxima solar flux densities ranging from 31.0 MJm^{-2} in the south to 29.2 MJm^{-2} in the north, and summer minima ranging from 7.5 MJm^{-2} in the south to 4.0 MJm^{-2} in the north. Comparable December ranges for clear day maxima were from 12.4 MJm^{-} in the south to 9.4 MJm^{-2} in the north, but minimum values for all sites were fairly uniform at 0.9-1.0 MJm^{-2}. Values for the intermediate months lay between these seasonal extremes, but typically revealed more spatial variability.

Tables 8 and 9 provide two ways of viewing the data for probabilities of the occurrence of solar income achieving different thresholds. It should be

Figure 3A.

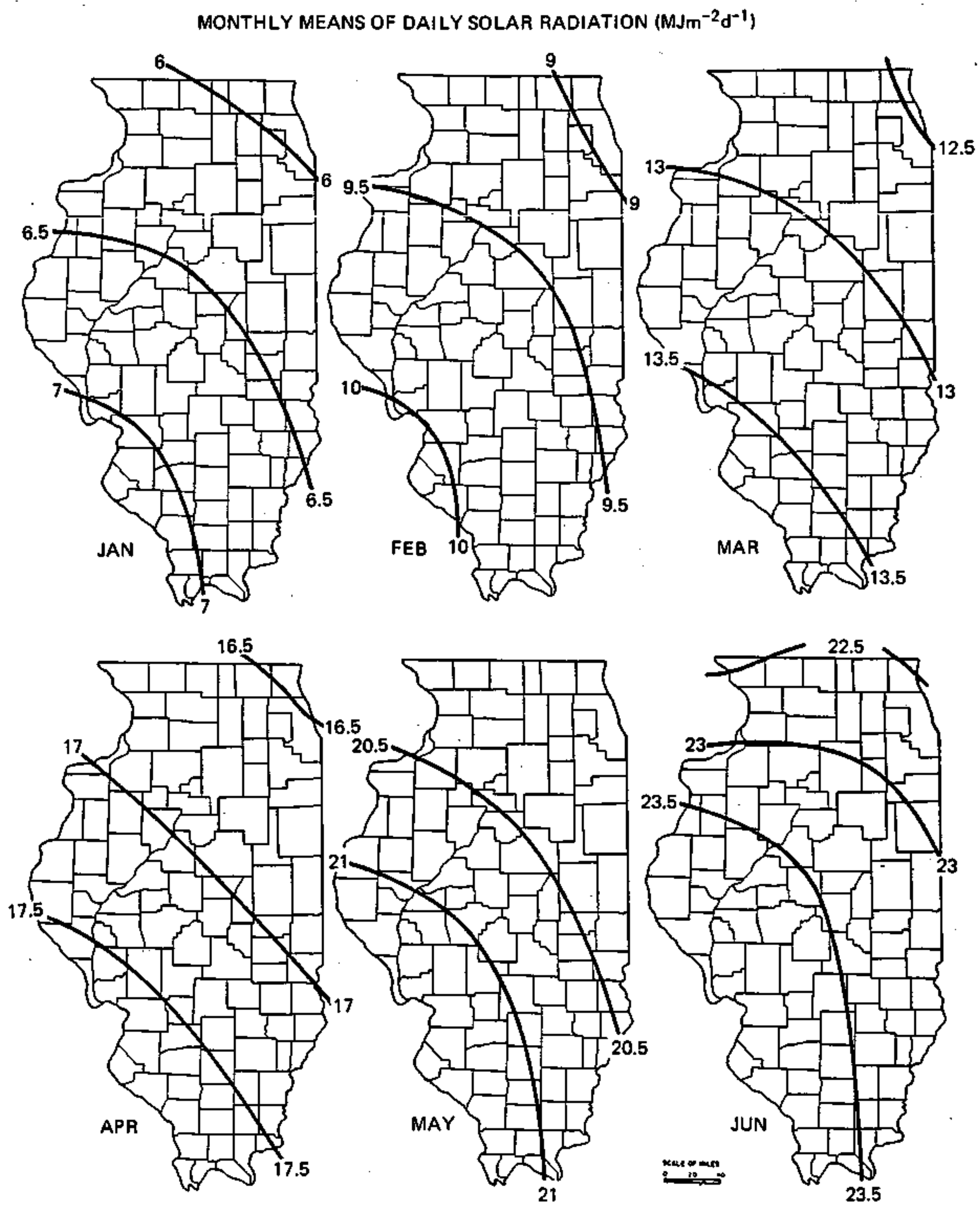
MONTHLY MEANS OF DAILY SOLAR RADIATION (MJm⁻²d⁻¹)
6
6
6.5
6.5
7
7
JAN
9
9
9.5
9.5
10
10
FEB
12.5
13
13
13.5
13.5
MAR
16.5
16.5
17
17
17.5
17.5
APR
20.5
20.5
21
21
MAY
22.5
23
23
23.5
23.5
JUN

Figure 3B.

MONTHLY MEANS OF DAILY SOLAR RADIATION ($MJm^{-2}d^{-1}$)

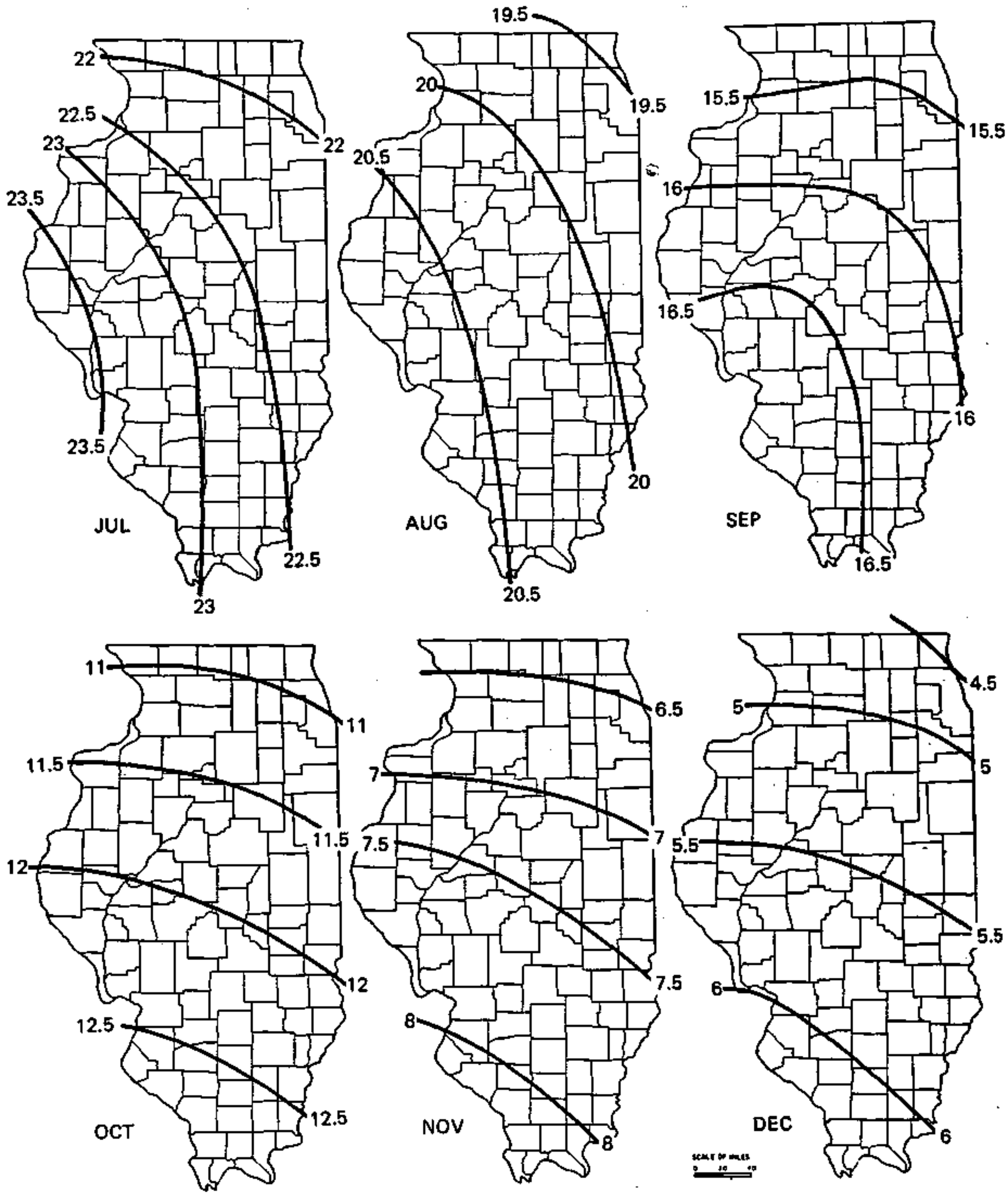

Figure 4.

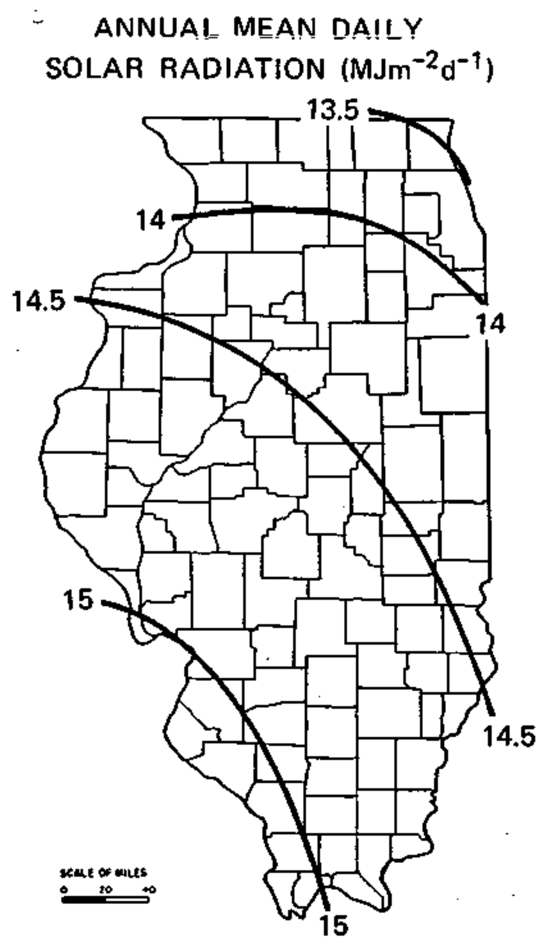
ANNUAL MEAN DAILY
SOLAR RADIATION (MJm-2d-1)
13.5
14
14.5
14
14.5
15
15
SCALE OF MILES
0 20 40

Table 7. Comparison of global solar radiation measured during 1981 to the estimated long-term mean values for the same sites.

SITE	% difference of measured value from estimated mean value							
	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
CHAMPAIGN	-16	-11	-15	-7	-4	-1	-5	+17
BROWNSTOWN	ND	-6	-12	0	-4	-4	-1	+23
DE KALB	ND	+3	-18	-7	-2	-6	+7	+10
DIXON SPRINGS	ND	-9	-13	-9	+10	-2	+2	+23
MONMOUTH	ND	ND	ND	ND	-4	+10	-3	+14
PERRY	ND	-4	-15	-12	-1	-11	+3	+17

TABLE 8. PERCENTAGE OF DAYS IN EACH MONTH OF 1981 WHEN THE TOTAL DAILY GLOBAL SOLAR RADIATION EXCEEDED VALUES OF 5, 10, 15, 20 and 25 MJ m^{-2}.

		MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
(1)	> 5 MJ m^{-2} d^{-1}								
	Champaign	85	100	100	98	94	84	62	69
	Brownstown	-	100	100	100	100	83	69	72
	DeKalb	-	100	95	100	94	82	69	51
	Dixon Springs	-	100	100	100	100	88	73	75
	Monmouth	-	-	-	-	87	97	70	66
	Perry	-	100	100	100	96	83	76	75
(2)	> 10 MJ m^{-2} d^{-1}								
	Champaign	68	91	83	94	83	65	27	18
	Brownstown	-	100	88	100	94	71	39	24
	DeKalb	-	100	78	91	84	61	33	0
	Dixon Springs	-	90	92	95	90	70	52	31
	Monmouth	-	-	-	-	82	70	35	7
	Perry	-	100	94	91	88	52	42	17
(3)	> 15 MJ m^{-2} d^{-1}								
	Champaign	59	76	67	69	70	29	0	0
	Brownstown	-	82	77	84	55	29	0	0
	DeKalb	-	92	63	79	69	23	0	0
	Dixon Springs	-	75	81	80	87	39	0	0
	Monmouth	-	-	-	-	69	40	0	0
	Perry	-	92	76	76	80	18	0	0
(4)	> 20 MJ m^{-2} d^{-1}								
	Champaign	50	61	51	47	17	0	0	0
	Brownstown	-	68	58	59	29	0	0	0
	DeKalb	-	72	47	38	16	0	0	0
	Dixon Springs	-	53	51	49	41	4	0	0
	Monmouth	-	-	-	-	9	0	0	0
	Perry	-	66	54	49	15	0	0	0
(5)	> 25 MJ m^{-2} d^{-1}								
	Champaign	29	35	32	13	0	0	0	0
	Brownstown	-	41	31	0	0	0	0	0
	DeKalb	-	55	20	6	0	0	0	0
	Dixon Springs	-	37	20	0	0	0	0	0
	Monmouth	-	-	-	-	0	0	0	0
	Perry	-	46	31	0	0	0	0	0

Table 9. Various percentile values of daily total incoming solar radiation (MJ m^{-2} d^{-1}) at ICN sites during each month of measurement, 1981.

	Percentile	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Champaign	10	10.1	7.8	10.6	7.3	3.3	2.0	2.3
	25	15.7	12.9	12.9	12.6	8.7	3.7	3.8
	50	22.0	20.5	19.7	17.6	12.3	7.1	6.5
	75	26.8	26.1	22.7	19.3	15.1	10.4	9.4
	90	29.8	27.0	25.5	20.7	18.0	12.1	10.2
Brownstown	10	13.2	9.0	13.8	11.3	2.6	1.8	1.9
	25	15.6	16.0	18.3	13.4	7.7	4.3	4.5
	50	24.0	21.8	20.7	15.3	12.9	8.3	8.4
	75	25.7	25.3	23.3	20.2	15.7	11.8	9.9
	90	29.5	27.4	24.7	22.1	18.0	12.6	10.9
DeKalb	10	16.9	7.0	11.2	7.1	2.7	2.5	1.9
	25	18.3	12.2	15.8	12.5	7.3	3.9	3.0
	50	25.6	19.5	18.2	16.8	11.7	6.3	5.3
	75	27.6	24.1	22.2	19.3	13.7	10.9	8.6
	90	29.0	26.5	23.0	20.9	17.0	11.7	9.0
Dixon Springs	10	10.1	11.5	11.5	10.5	4.4	1.4	2.4
	25	15.1	16.1	16.0	17.2	8.2	3.9	5.0
	50	21.9	20.1	19.9	19.0	14.1	10.2	7.8
	75	26.4	24.4	21.3	21.1	17.1	12.2	10.6
	90	30.0	26.8	22.6	21.6	18.6	13.4	11.3
Monmouth	10	-	-	-	3.9	6.2	1.2	2.1
	25	-	-	-	13.3	9.2	3.7	3.2
	50	_	_	_	18.0	13.2	7.4	6.8"
	75	-	-	-	19.1	16.4	10.8	8.6
	90	-	-	-	19.9	17.9	12.0	9.4
Perry	10	15.7	12.3	10.4	7.4	4.1	2.7	2.1
	25	17.8	15.2	15.0	15.8	6.2	5.4	5.3
	50	22.9	20.7	19.8	17.3	10.5	8.7	7.4
	75	27.2	25.8	21.9	19.6	14.3	11.2	9.2
	90	28.8	26.5	23.4	20.7	16.9	12.5	10.6

cautioned that these tables are based upon only 7 months of data (June-December, 1981), and for a limited spatial array of sites. As more data accumulate, and more sites are established with solar radiation measurements, these probabilities will in all likelihood change considerably, and then will be able to be plotted on maps with justification. Table 8 lists for each site the percentage of days in each month in 1981 when the total global radiation incoming onto a horizontal surface exceeded selected thresholds set at 5 $MJm^{-2} d^{-1}$ increments. These data are most useful if it is necessary to determine the probability at a given location of a particular preset threshold irradiance being achieved during different times of the year. Table 9 lists for each site the actual values of incident total solar radiation ($MJm^{-2}d^{-1}$) on a horizontal surface for various percentile levels. This type of data array reveals more detail of the variance within each month than does the data in Table 8. It is more useful in providing an input towards the establishment of thresholds for which there is a reasonable expectation of occurrence at given locations, and accordingly towards the designing of appropriate facilities and equipment.

As more data become available more reliable long-term means will be computed, an improved understanding of the temporal and meso-scale spatial patterning of incoming solar radiation over Illinois will be achieved, and the interim probabilities and percentiles documented above will be updated.

(2) Wind Speed and Direction:

The only wind data currently both entered into computer files and verified are those for the Bondville site, and they form the basis of this discussion. The mean daily wind speeds and prevailing directions for Bondville for February to September, 1982 are detailed in Appendix C. Prior to the establishment of the ICN sites, the main sources of wind data for Illinois were the National Weather Service first order stations (Cairo, Chicago, Evansville (IN), Peoria, Rockford, Springfield, St. Louis (MO)) and the State Water Survey at Champaign. Wendland (1981, 1982) produced mean monthly wind speeds (mph) and prevailing directions for each of these locations based upon the period 1970-1980, and these values are reproduced in the top section of Table 10. Additionally, he used these values (Wendland, 1982) to determine for each site the wind power availability for electrical power generation and estimates of cost paybacks for the purchase and operation of wind turbines.

The ICN is now at a point where we can commence comparisons of these mean values with ICN data collected from sensitive and standardized sensors at a standard height (10m) and with good exposures. Of particular interest are those areas indicated by Wendland as having a low windpower potential, and where an urban influence may have been exerted upon the data, such as for Champaign. Table 10 provides monthly mean wind speeds and the fastest hours of wind each month for the Champaign and Bondville sites for the period February to September, 1982. Fairly obviously there is a considerable difference in wind speeds at the two sites, with much higher values at Bondville which is located in a setting typical of potential rural wind turbine sites in central-east Illinois. Estimates of long-term mean monthly wind speeds for Bondville have been included in Table 10.

TABLE 10. MEAN MONTHLY WIND SPEED (MPH) AND PREVAILING DIRECTION.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
(1) Mean Values 1970-1980:												
Cairo	SW 9.8	NE 9.8	SW 10.6	SW 10.2	SW 8.2	SW 7.4	SW 6.5	NE 6.2	NE 7.0	S 7.3	S 9.1	S 9.3
Chicago	W 11.5	W 11.5	W 11.9	W 11.8	SSW 10.4	SW 9.5	SW 8.4	SW 8.2	S 9.0	S 9.9	SSW 11.3	W 11.2
Evansville	SSW 9.4	NW 9.7	WNW 10.4	SSW 9.9	SSW 8.1	SW 7.3	SW 6.3	SW 5.9	SSW 6.5	NW 7.0	NW 8.8	NW 9.1
Peoria	S 11.2	WNW 11.5	WNW 12.3	S 12.2	S 10.3	S 9.2	S 8.0	S 7.8	S 8.6	S 9.5	S 11.1	S 11.0
Rockford	WNW 10.4	WNW 10.6	ESE 11.6	WNW 11.7	ENE 10.6	SSW 9.3	SSW 8.1	SSW 7.9	SSW 8.6	SSW 9.5	WNW 10.4	WNW 10.4
Springfield	NW 12.9	NW 12.9	NW 14.0	S 13.5	SSW 11.6	SSW 10.0	SSW 8.5	SSW 8.0	SSW 9.1	S 10.5	S 12.7	S 12.8
St. Louis	NW 10.4	NW 10.8	WNW 11.8	WNW 11.4	S 9.4	S 8.7	S 7.8	S 7.5	S 7.9	S 8.7	S 9.9	WNW 10.3
Champaign	SW 8.3	S 8.3	S 8.7	S 8.6	S 7.1	SW 6.1	SW 5.0	SW 4.9	SW 5.3	SW 6.3	S 7.9	S 8.2
(2) 1982 Values:												
Champaign	-- --	NE 6.6	NW 8.3	NW 7.6	S 4.7	SW 5.3	SW 4.8	SW 4.0	S 4.0	-- --	-- --	-- --
Bondville	-- --	NE 11.3	NW 13.8	S 13.7	S 10.8	NE 8.4	S 6.1	S 5.5	SE 6.0	-- --	-- --	-- --
(3) Estimated Mean Values:												
Bondville	--	13.0	14.2	14.7	13.2	9.2	6.3	6.4	7.3	--	--	--
(4) Fastest Hour of Wind, 1982:												
Champaign	--	10	25	30	20	16	13	13	11	--	--	--
Bondville	--	19.3	37.9	44.7	27.1	25.0	15.8	18.2	16.4	--	--	--

A more detailed analysis of the wind statistics at Bondville is provided in Tables 11 and 12. Again it must be stressed that these data are for an 8-month period only, and as such give only tentative estimates of long-term conditions. Table 11 lists for each month the percentage of hours of wind speed in 5 mph intervals. From these data it can be seen that the strongest winds occurred in the spring months and the weakest in the summer. Assuming a low cut-off of 5 mph at a height of 10m, at least 50% of the hours of each month, and over 90% for some months, would have been sufficiently windy to operate a turbine. Estimation of the windspeed at turbine height can be made using a power law relationship of the form

$$u_T = u_{10} \, (h_T/h_{10})^{\alpha}$$

where u_T = estimated wind speed (ms^{-1}) at turbine height

u_T = seasonal wind speed (ms^{-1}) at 10 cm

h_T = turbine height (m)

h_{10} = anemometer height = 10 m

α = power function; relates wind speed at various heights

The value of a depends largely upon atmospheric stability, and appropriate values can very widely. Using profiled data from a meteorological tower at the Illinois Power Company's Clinton Power Station site, reasonable mean values of a for the east-central Illinois region are 0.10 for daytime hours and 0.143 for nightime. Conversion of the kinetic energy of moving air to power by a turbine can be approximated by the following relationship:

$$P_T = 0.5 \, A_T \, \rho \, (u_T)^3$$

where P_T = power generated (watts)

A_T = cross-sectional area of turbine perpendicular to the air movement (m^2)

ρ = density of air (~ 1.225 kg m^{-3})

Table 12 provides a listing for Bondville of the percentage of the hours of each month with the wind direction in each of the 8 major compass directions.

As more data becomes available with time, and additional sites commence monitoring wind data, these statistics will be reviewed and updated. Eventually reliable long-term mean values and probabilities of occurrence of various categories of wind speed will be computed and made available.

Table 11. Percentage of hours of wind in each of 5 mph wind speed intervals for each month. Bondville, February to September, 1982.

Wind Speed (mph)	Percentage of hours of month in each wind speed class. 0.0 to 4.9	5.0 to 9.9	10.0 to 14.9	15.0 to 19.9	20.0 to 24.9	25.0 to 29.9	30.0 to 34.4	35.0 to 39.9	40.0 and Over
February	7	50	35	9	0	0	0	0	0
March	8	27	29	21	11	3	2	1	0
April	8	29	27	18	8	5	3	1	2
May	13	43	23	12	8	1	0	0	0
June	24	44	21	9	2	1	0	0	0
July	43	43	13	1	0	0	0	0	0
August	50	44	6	1	0	0	0	0	0
September	44	43	11	1	0	0	0	0	0
2/22-9/19	27	39	19	9	4	1	1	0+	0+

Table 12. Percentage of hours of wind having directions in the 8 major compass directions for each month. Bondville, February to September, 1982.

Month	Hrs	Percentage of hours of wind in month in each of 8 major directions. N	NE	E	SE	S	SW	W	NW
February	121	7	52	15	6	15	4	0	1
March	691	10	11	14	11	14	10	12	19
April	686	9	7	19	9	19	10	11	17
May	613	4	6	11	15	29	16	13	6
June	647	13	16	5	10	16	15	11	16
July	691	7	12	9	14	24	15	11	9
August	744	6	15	16	12	16	13	11	12
September	456	5	9	10	20	19	13	10	15
2/22-9/19	4679	8	12	12	12	19	13	11	13

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REFERENCES

Changnon, S. A. 1981. Midwestern cloud, sunshine and temperature trends since 1901: Possible evidence of jet contrail effects. J. Applied Meteor., 20, 496-508.

Endlich, R. M.; F. L. Ludwig; C. M. Bhumralkar; and M. A. Estoque 1981. A practical method for estimating wind characteristics at potential wind energy conversion sites. SRI International, Menlo Park, CA., PNL-3808, 167 pp.

Fehrenbacher, J. B. ; G. 0. Walker; and H. L. Wascher 1967. Soils of Illinois, University of Illinois College of Agriculture and USDA Soil Conservation Service, Bulletin 725, 47 pp.

Garnier, B. J. and A. Ohmura 1968. A method of calculating the direct shortwave radiation income of slopes. J. Applied Meteor., 7, 796-800.

Hay, J. E. 1982. An assessment of the uncertainty in measurements of solar radiation. Solar Energy, 29(4), 271-278.

Hendrie, L. K. 1981. Illinois Solar Weather Program, Illinois State Water Survey, Contract Report 276, 42 pp.

Hendrie, L. K. and W. M. Wendland. 1981. Illinois Solar and Wind Climate, Illinois State Water Survey, Mis. Pub. 61, 82 pp.

Jaffe, M. and D. Erley 1980. Protecting solar access for residential development. A guidebook for planning officials. The American Planning Association, Chicago. Contract Report H-2573, 154 pp.

Liu, B.Y.H. and R. C. Jordan, 1960. The interrelationship and characteristic distribution of direct, -diffuse and total radiation. Solar Energy, 4, 1-19.

Paton, D. L., A. Bass, D. G. Smith, D. L. Elliott, W. R. Barchet, and R. L. George, 1981: Wind Energy Resource Atlas Vol. 3, The Great Lakes Region. Battelle Pacific Northwest Lab., Richland, WA, 170 pp.

Revfeim, K.J.A. 1978. A simple procedure for estimating global daily radiation on any surface. J. Applied Meteor., 17, 1126-1131.

Revfeim, K.J.A. 1982. Simplified relationships for estimating solar radiation incident on any flat surface. Solar Energy, 28(6), 509-517.

Robinson, N. (ed.) 1966. Solar radiation. Elsevier, New York, pp.

Sellers, W. D. 1965. Physical Climatology, University of Chicago Press, Chicago, pp.

Soderholm, L. H. 1982. Economics of wind energy for heating rural structures. Trans. ASAE, , 1392-1395.

Solar Energy Research Institute. 1981. Solar radiation energy resource atlas of the United States. U.S. Dept. of Energy, SERI/SP-642-1037, October 1981, 167 pp and appendices.

Temps, R. C. and K. L. Coulson. 1977. Solar radiation incident upon slopes of different orientations. Solar Energy, 19(2), 179-184.

Wendland, W. M. 1981. Illinois Windpower Program. Illinois State Water Survey, Contract Report 266, 20 pp.

Wendland, W. M. 1982. Windpower as an electrical energy source in Illinois. J. Appl. Meteor., 21, 423-428.

Wendland, W. M., and R. G. Semonin. 1982. Effect of contrail cirrus on surface weather conditions in the Midwest - Phase II. Illinois State Water Survey, SWS Contract Report 298, 95 pp.

APPENDIX A

Daily totals of solar radiation (MJm^{-2}, cal cm^{-2}, 3TU ft^{-2}) for 1981 for Brownstown, Champaign, DeKalb, Dixon Springs, Monmouth and Perry.

The following tables in Appendix A provide the daily total solar radiation (direct plus diffuse) received on a horizontal surface at the Brownstown, Champaign, DeKalb, Dixon Springs, Monmouth and Perry sites from the onset of data collection to the end of 1981. The tables are provided in 3 unit formats, being in order MJm^{-2}, kcal cm^{-2}, and BTU ft^{-2}.

There are two columns for each month, the first containing the daily solar radiation total in the appropriate units, and the second the number of hours (#H) of acceptable data used to generate the first value. The symbol M represents unavailable/missing data. The five rows at the bottom of each matrix provide the monthly total solar radiation (M TOT), the number of complete days of data (# DAYS) available, the average daily receipt of solar radiation (DAY AV) for that month, the maximum daily value (D MAX), and the minimum daily value (D MIN).

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

BROWNSTOWN, ILLINOIS
88 57'W, 38 57'N
177 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = MJ/M2

MONTH

DAY	JANUARY MJ/M2	#H	FEBRUARY MJ/M2	#H	MARCH MJ/M2	#H	APRIL MJ/M2	#H	MAY MJ/M2	#H
1	M	0	M	0	M	0	M	0	M	0
2	M	0	M	0	M	0	M	0	M	0
3	M	0	M	0	M	0	M	0	M	0
4	M	0	M	0	M	0	M	0	M	0
5	M	0	M	0	M	0	M	0	M	0
6	M	0	M	0	M	0	M	0	M	0
7	M	0	M	0	M	0	M	0	M	0
8	M	0	M	0	M	0	M	0	M	0
9	M	0	M	0	M	0	M	0	M	0
10	M	0	M	0	M	0	M	0	M	0
11	M	0	M	0	M	0	M	0	M	0
12	M	0	M	0	M	0	M	0	M	0
13	M	0	M	0	M	0	M	0	M	0
14	M	0	M	0	M	0	M	0	M	0
15	M	0	M	0	M	0	M	0	M	0
16	M	0	M	0	M	0	M	0	M	0
17	M	0	M	0	M	0	M	0	M	0
18	M	0	M	0	M	0	M	0	M	0
19	M	0	M	0	M	0	M	0	M	0
20	M	0	M	0	M	0	M	0	M	0
21	M	0	M	0	M	0	M	0	M	0
22	M	0	M	0	M	0	M	0	M	0
23	M	0	M	0	M	0	M	0	M	0
24	M	0	M	0	M	0	M	0	M	0
25	M	0	M	0	M	0	M	0	M	0
26	M	0	M	0	M	0	M	0	M	0
27	M	0	M	0	M	0	M	0	M	0
28	M	0	M	0	M	0	M	0	M	0
29	M	0			M	0	M	0	M	0
30	M	0			M	0	M	0	M	0
31	M	0			M	0			M	0
M TOT	M		M		M		M		M	
# DAYS	0		0		0		0		0	
DAY AV	M		M		M		M		M	
D MAX	M		M		M		M		M	
D MIN	M		M		M		M		M	

DAY	JUNE MJ/M2	#H	JULY MJ/M2	#H	AUGUST MJ/M2	#H	SEPTEMBER MJ/M2	#H	OCTOBER MJ/M2	#H	NOVEMBER MJ/M2	#H	DECEMBER MJ/M2	#H
1	M	0	19.68	24	23.86	24	9.92	24	16.06	24	5.79	24	2.27	24
2	M	0	22.45	24	21.50	24	6.52	24	19.70	24	8.31	24	6.76	24
3	M	0	16.92	24	17.75	24	11.02	24	18.05	24	10.65	24	5.00	24
4	M	0	9.05	24	21.27	24	14.32	15	5.14	24	7.19	24	4.51	24
5	M	0	M	0	14.37	24	M	0	14.54	24	4.13	24	8.51	24
6	M	0	M	0	22.28	24	M	0	14.36	24	13.40	24	8.61	24
7	M	0	16.95	16	23.42	24	11.28	18	17.52	24	12.89	24	7.44	24
8	M	0	25.55	24	18.05	24	22.23	24	18.03	24	8.55	24	8.10	24
9	M	0	23.48	24	24.72	24	22.08	24	15.08	24	5.52	24	2.16	24
10	M	0	28.14	24	13.93	24	22.06	24	2.61	24	13.28	24	9.89	24
11	M	0	28.32	24	23.89	24	15.05	24	16.55	24	12.23	24	9.56	24
12	M	0	24.22	24	22.76	24	20.21	24	5.96	24	11.75	24	10.60	24
13	M	0	24.99	24	19.20	24	14.12	24	12.41	24	12.18	24	8.30	24
14	M	0	24.50	24	19.22	24	11.32	24	3.10	15	11.87	24	6.08	24
15	M	0	14.13	24	12.97	24	13.26	24	1.01	10	6.09	24	8.59	24
16	M	0	18.93	24	13.15	24	15.30	24	7.70	24	5.79	24	3.21	24
17	M	0	25.27	24	19.04	24	14.40	24	2.69	24	11.79	24	9.07	24
18	M	0	18.37	24	24.89	24	15.40	24	M	0	10.74	24	11.22	24
19	M	0	11.72	24	21.83	24	20.43	24	4.92	11	4.37	24	11.66	24
20	M	0	19.48	16	24.76	24	20.15	24	15.71	24	2.12	24	10.77	24
21	M	0	23.90	17	24.40	24	14.26	22	13.15	24	6.19	24	1.49	24
22	M	0	25.37	24	20.09	24	18.58	24	1.65	24	11.83	24	1.63	24
23	1.33	7	7.85	24	20.68	24	20.25	24	14.53	24	1.55	24	10.30	24
24	21.35	24	16.90	24	20.65	24	12.21	24	16.46	24	1.19	24	9.04	24
25	24.02	24	20.93	24	16.06	14	16.96	24	10.14	24	2.93	24	9.61	24
26	30.38	24	4.85	18	M	0	11.90	24	1.82	24	3.85	24	4.45	24
27	25.55	24	15.02	24	M	0	1.47	8	12.82	24	9.99	24	6.10	24
28	15.91	24	8.49	24	M	0	14.42	15	11.54	24	4.35	24	3.35	24
29	25.73	24	21.18	24	M	0	13.88	24	12.25	24	9.42	24	10.99	24
30	12.48	24	26.72	24	M	0	17.59	24	12.93	24	1.14	24	10.63	24
31			27.32	24	1.65	11			10.37	24			.75	24
M TOT	155.41		505.48		488.66		364.84		319.78		231.06		220.68	
# DAYS	7		25		24		23		27		30		31	
DAY AV	22.20		20.22		20.36		15.86		11.84		7.70		7.12	
D MAX	30.38		28.32		24.85		22.23		19.70		13.40		11.66	
D MIN	12.48		7.85		12.97		6.52		1.65		1.14		.75	

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

CHAMPAIGN, ILLINOIS
88 57'W, 40 03'N
219 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = MJ/M2

MONTH

DAY	JANUARY MJ/M2	#H	FEBRUARY MJ/M2	#H	MARCH MJ/M2	#H	APRIL MJ/M2	#H	MAY MJ/M2	#H	JUNE MJ/M2	#H	JULY MJ/M2	#H	AUGUST MJ/M2	#H	SEPTEMBER MJ/M2	#H	OCTOBER MJ/M2	#H	NOVEMBER MJ/M2	#H	DECEMBER MJ/M2	#H
1	M	0	M	0	M	0	M	0	M	0	12.07	24	18.95	24	24.23	24	8.85	24	17.07	24	5.33	24	1.48	24
2	M	0	M	0	M	0	M	0	M	0	16.33	24	23.48	24	20.64	24	4.07	24	19.29	24	4.66	24	3.49	24
3	M	0	M	0	M	0	M	0	M	0	19.13	24	21.14	24	11.11	24	3.72	24	18.26	24	9.34	24	3.81	24
4	M	0	M	0	M	0	M	0	M	0	28.09	24	5.01	24	21.00	24	16.02	24	9.66	24	5.94	24	7.70	24
5	M	0	M	0	M	0	M	0	M	0	17.26	24	10.84	24	4.02	24	20.20	24	13.13	24	6.77	24	8.77	24
6	M	0	M	0	M	0	M	0	M	0	24.21	24	26.12	24	14.81	24	17.76	24	13.40	24	12.66	24	6.52	24
7	M	0	M	0	M	0	M	0	M	0	29.63	24	23.97	24	22.67	24	11.85	24	18.22	24	12.39	24	5.20	24
8	M	0	M	0	M	0	M	0	.30	8	21.67	24	27.06	24	14.88	24	22.73	24	17.72	24	7.06	24	2.08	24
9	M	0	M	0	M	0	M	0	7.32	24	24.17	24	26.78	24	20.53	24	21.05	24	16.34	24	9.36	24	6.53	24
10	M	0	M	0	M	0	M	0	1.90	24	20.33	24	29.67	24	11.38	24	22.41	24	6.07	24	12.42	24	9.37	24
11	M	0	M	0	M	0	M	0	5.05	24	8.57	24	27.89	24	24.34	24	16.93	24	16.64	24	11.76	24	8.83	24
12	M	0	M	0	M	0	M	0	22.30	24	12.01	24	22.62	24	22.47	24	17.99	24	14.82	24	11.43	24	8.87	24
13	M	0	M	0	M	0	M	0	7.27	24	10.13	24	25.22	24	19.79	24	17.63	24	12.24	24	10.10	24	5.32	24
14	M	0	M	0	M	0	M	0	2.13	24	22.01	24	19.58	24	9.94	24	8.09	24	3.17	24	11.11	24	4.46	24
15	M	0	M	0	M	0	M	0	27.52	24	23.34	24	10.71	24	12.92	24	17.76	24	4.05	24	8.14	24	7.90	24
16	M	0	M	0	M	0	M	0	26.30	24	13.90	24	7.06	24	18.34	24	15.49	24	14.24	24	3.99	24	2.92	24
17	M	0	M	0	M	0	M	0	8.47	24	29.95	24	25.53	24	26.06	24	8.21	24	1.90	24	11.21	24	5.70	24
18	M	0	M	0	M	0	M	0	3.68	24	30.01	24	18.94	24	26.09	24	15.48	24	6.35	24	8.09	24	9.95	24
19	M	0	M	0	M	0	M	0	25.24	24	8.90	24	8.55	24	25.45	24	18.71	24	15.96	24	3.86	24	10.40	24
20	M	0	M	0	M	0	M	0	29.57	24	24.49	24	19.87	24	25.61	24	19.21	24	15.04	24	2.72	24	10.47	24
21	M	0	M	0	M	0	M	0	29.31	24	10.05	24	15.18	24	23.48	24	18.73	24	10.41	24	2.89	24	1.18	24
22	M	0	M	0	M	0	M	0	24.41	24	26.73	24	26.28	24	22.90	24	17.75	24	3.42	24	8.29	24	2.55	24
23	M	0	M	0	M	0	M	0	16.03	24	29.91	24	14.91	24	21.86	24	20.10	24	9.99	24	.75	24	10.05	24
24	M	0	M	0	M	0	M	0	15.39	24	21.17	24	19.54	24	21.36	24	15.03	24	15.13	24	2.87	24	11.54	24
25	M	0	M	0	M	0	M	0	23.76	24	26.31	24	13.67	24	19.29	24	12.37	24	12.21	24	1.38	24	9.19	24
26	M	0	M	0	M	0	M	0	10.20	24	27.82	24	7.91	24	12.29	24	12.67	24	2.26	24	3.22	24	5.44	24
27	M	0	M	0	M	0	M	0	19.89	24	26.85	24	12.85	24	10.12	24	19.71	24	9.26	24	5.57	24	2.88	24
28	M	0	M	0	M	0	M	0	26.35	24	18.33	24	7.61	24	10.98	24	19.77	24	10.91	24	3.90	24	6.23	24
29	M	0			M	0	M	0	23.01	24	26.63	24	22.43	24	19.66	24	6.83	24	13.61	24	9.70	24	9.99	24
30	M	0			M	0	M	0	12.06	24	10.98	24	27.00	24	18.06	24	17.07	24	12.44	24	1.57	24	9.46	24
31	M	0			M	0			29.20	24			26.23	24	18.76	24			8.68	24			1.50	24
M TOT	M		M		M		M		396.35		620.97		592.59		575.04		464.17		361.91		208.48		199.78	
# DAYS	0		0		0		0		23		30		31		31		30		31		30		31	
DAY AV	M		M		M		M		17.23		20.70		19.12		18.55		15.47		11.67		6.95		6.44	
D MAX	M		M		M		M		29.57		30.01		29.67		26.09		22.73		19.29		12.66		11.54	
D MIN	M		M		M		M		1.90		8.57		5.01		4.02		3.72		1.90		.75		1.18	

LKH 5/81

DE KALB, ILLINOIS
88 51'W, 41 51'N
265 M ABOVE MSL

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = MJ/M2

MONTH

DAY	JANUARY MJ/M2	#H	FEBRUARY MJ/M2	#H	MARCH MJ/M2	#H	APRIL MJ/M2	#H	MAY MJ/M2	#H	JUNE MJ/M2	#H	JULY MJ/M2	#H	AUGUST MJ/M2	#H	SEPTEMBER MJ/M2	#H	OCTOBER MJ/M2	#H	NOVEMBER MJ/M2	#H	DECEMBER MJ/M2	#H
1	M	0	M	0	M	0	M	0	M	0	M	0	M	0	26.80	24	4.97	24	11.67	24	4.73	24	1.09	24
2	M	0	M	0	M	0	M	0	M	0	M	0	M	0	9.12	24	12.84	24	19.17	24	3.36	24	2.09	24
3	M	0	M	0	M	0	M	0	M	0	M	0	M	0	19.79	24	15.54	24	17.33	24	11.14	24	2.61	24
4	M	0	M	0	M	0	M	0	M	0	M	0	M	0	22.26	24	21.99	24	11.13	24	3.68	24	8.73	24
5	M	0	M	0	M	0	M	0	M	0	M	0	M	0	5.58	24	17.77	24	7.76	24	6.16	24	4.19	24
6	M	0	M	0	M	0	M	0	M	0	M	0	M	0	16.15	24	17.59	24	15.13	24	11.97	24	7.12	24
7	M	0	M	0	M	0	M	0	M	0	M	0	M	0	15.39	24	7.80	24	18.08	24	12.15	24	6.51	24
8	M	0	M	0	M	0	M	0	M	0	M	0	M	0	18.14	24	21.42	24	16.44	24	9.98	24	1.34	24
9	M	0	M	0	M	0	M	0	M	0	M	0	0.00	5	18.32	24	20.03	24	11.94	24	11.89	24	4.72	24
10	M	0	M	0	M	0	M	0	M	0	M	0	29.15	24	19.48	24	21.71	24	11.68	24	11.43	24	9.18	24
11	M	0	M	0	M	0	M	0	M	0	M	0	20.47	24	22.68	24	18.15	24	12.02	24	11.35	24	8.77	24
12	M	0	M	0	M	0	M	0	M	0	M	0	23.84	24	21.88	24	19.21	24	15.33	24	10.93	24	7.75	24
13	M	0	M	0	M	0	M	0	M	0	M	0	14.25	24	21.87	24	17.97	24	10.40	24	10.97	24	3.56	24
14	M	0	M	0	M	0	M	0	M	0	M	0	18.08	24	6.97	24	16.66	24	1.69	24	8.11	24	2.60	24
15	M	0	M	0	M	0	M	0	M	0	.07	6	7.85	24	22.35	24	15.86	24	4.71	24	5.03	24	7.59	24
16	M	0	M	0	M	0	M	0	M	0	17.87	24	19.47	24	17.41	24	15.75	24	13.01	24	5.81	24	4.77	24
17	M	0	M	0	M	0	M	0	M	0	30.90	24	24.87	24	26.24	24	11.55	24	1.90	24	10.55	24	5.90	24
18	M	0	M	0	M	0	M	0	M	0	25.14	24	20.46	24	22.24	24	9.67	24	3.98	24	5.53	24	9.37	24
19	M	0	M	0	M	0	M	0	M	0	26.01	24	14.35	24	26.00	24	20.06	24	15.96	24	1.25	24	9.35	24
20	M	0	M	0	M	0	M	0	M	0	18.33	24	21.59	24	23.38	24	19.45	24	13.19	24	5.29	24	8.58	24
21	M	0	M	0	M	0	M	0	M	0	10.20	24	13.05	24	22.29	24	11.42	24	1.68	24	7.39	24	1.71	24
22	M	0	M	0	M	0	M	0	M	0	26.20	24	26.09	24	19.04	24	16.75	24	8.52	24	6.32	24	2.89	24
23	M	0	M	0	M	0	M	0	M	0	26.02	24	17.18	24	20.66	24	19.66	24	8.50	24	1.09	24	8.92	24
24	M	0	M	0	M	0	M	0	M	0	17.69	24	21.45	24	19.76	24	14.02	24	8.66	24	9.81	24	8.73	24
25	M	0	M	0	M	0	M	0	M	0	28.74	24	9.63	24	15.81	24	3.98	24	2.45	22	3.12	24	8.41	24
26	M	0	M	0	M	0	M	0	M	0	27.59	24	5.81	24	13.68	24	2.89	24	5.17	24	2.70	24	3.40	24
27	M	0	M	0	M	0	M	0	M	0	27.59	24	3.95	24	13.35	24	19.29	24	11.98	24	3.91	24	4.63	24
28	M	0	M	0	M	0	M	0	M	0	24.51	24	9.10	24	13.35	24	19.26	24	10.15	24	4.83	24	2.96	24
29	M	0			M	0	M	0	M	0	22.14	24	26.99	24	16.77	24	6.70	24	12.32	24	8.85	24	6.27	24
30	M	0			M	0	M	0	M	0	M	0	25.57	24	17.40	24	15.87	24	11.67	24	2.42	24	4.20	24
31	M	0			M	0			M	0			27.58	24	18.10	24			5.74	24			1.47	24
M TOT	M		M		M		M		M		329.01		400.76		571.25		455.84		316.89		211.79		169.31	
# DAYS	0		0		0		0		0		14		22		31		30		30		30		31	
DAY AV	M		M		M		M		M		23.50		18.22		18.43		15.19		10.56		7.06		5.46	
D MAX	M		M		M		M		M		30.90		29.15		26.80		21.99		19.17		12.15		9.37	
D MIN	M		M		M		M		M		10.20		3.95		5.58		2.89		1.68		1.09		1.09	

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

DIXON SPRINGS, ILLINOIS
88 40'W, 37 27'N
165 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = MJ/M2

MONTH

DAY	JANUARY MJ/M2	#H	FEBRUARY MJ/M2	#H	MARCH MJ/M2	#H	APRIL MJ/M2	#H	MAY MJ/M2	#H	JUNE MJ/M2	#H	JULY MJ/M2	#H	AUGUST MJ/M2	#H	SEPTEMBER MJ/M2	#H	OCTOBER MJ/M2	#H	NOVEMBER MJ/M2	#H	DECEMBER MJ/M2	#H
1	M	0	M	0	M	0	M	0	M	0	M	0	20.69	24	23.18	24	13.16	24	10.90	24	4.61	24	7.51	24
2	M	0	M	0	M	0	M	0	M	0	M	0	26.74	24	22.32	24	5.86	24	20.55	24	11.77	24	7.89	24
3	M	0	M	0	M	0	M	0	M	0	.09	6	22.26	24	13.53	24	21.13	24	19.27	24	10.13	24	5.17	24
4	M	0	M	0	M	0	M	0	M	0	18.47	24	20.05	24	23.33	24	17.90	24	5.48	24	3.23	20	4.00	24
5	M	0	M	0	M	0	M	0	M	0	14.31	24	2.17	9	20.59	24	18.66	24	14.84	24	6.15	24	9.64	24
6	M	0	M	0	M	0	M	0	M	0	M	0	13.08	24	16.24	24	19.65	24	13.04	24	14.64	24	8.34	24
7	M	0	M	0	M	0	M	0	M	0	M	0	21.70	24	11.25	24	17.27	24	15.20	24	14.13	24	7.65	24
8	M	0	M	0	M	0	M	0	M	0	25.34	17	28.30	24	20.09	24	22.72	24	18.61	24	11.93	24	10.99	24
9	M	0	M	0	M	0	M	0	M	0	18.82	24	26.98	24	24.74	24	21.31	24	13.79	24	2.05	24	5.13	24
10	M	0	M	0	M	0	M	0	M	0	10.32	24	8.86	11	15.56	14	23.19	24	4.36	24	12.92	24	10.56	24
11	M	0	M	0	M	0	M	0	M	0	18.41	24	M	0	2.09	9	20.98	24	15.57	24	13.57	24	4.36	24
12	M	0	M	0	M	0	M	0	M	0	16.68	24	M	0	22.63	24	21.64	24	6.34	24	12.78	24	10.76	24
13	M	0	M	0	M	0	M	0	M	0	18.27	24	2.49	8	20.44	24	14.71	24	11.38	24	11.62	24	7.35	24
14	M	0	M	0	M	0	M	0	M	0	22.38	24	20.89	24	22.04	24	9.42	24	3.14	24	12.24	24	8.40	24
15	M	0	M	0	M	0	M	0	M	0	21.86	24	19.67	24	12.40	24	7.88	24	6.20	24	7.37	24	9.27	24
16	M	0	M	0	M	0	M	0	M	0	9.02	24	14.35	24	17.94	24	13.15	22	4.78	14	5.02	24	6.68	24
17	M	0	M	0	M	0	M	0	M	0	30.95	24	17.97	24	15.90	24	13.94	22	M	0	13.04	24	5.02	24
18	M	0	M	0	M	0	M	0	M	0	29.78	24	16.27	24	21.64	24	17.13	24	M	0	12.15	24	11.12	24
19	M	0	M	0	M	0	M	0	M	0	4.67	18	24.27	24	10.12	24	19.20	24	17.69	24	2.72	24	12.40	24
20	M	0	M	0	M	0	M	0	M	0	22.56	24	22.63	16	19.18	24	21.46	24	17.06	24	1.56	24	11.80	24
21	M	0	M	0	M	0	M	0	M	0	8.08	23	M	0	21.21	24	20.74	24	13.81	15	10.47	24	.69	24
22	M	0	M	0	M	0	M	0	M	0	13.82	24	4.13	9	16.70	24	19.01	24	1.76	16	11.32	24	.93	24
23	M	0	M	0	M	0	M	0	M	0	29.62	24	8.64	24	21.26	24	21.21	24	17.13	24	1.39	24	3.38	24
24	M	0	M	0	M	0	M	0	M	0	26.25	24	10.47	20	20.32	24	16.98	24	17.10	24	1.38	24	6.30	24
25	M	0	M	0	M	0	M	0	M	0	26.70	24	19.05	24	19.38	24	18.42	24	8.83	24	6.81	24	10.50	24
26	M	0	M	0	M	0	M	0	M	0	30.62	24	22.43	24	12.32	23	16.81	24	1.50	24	2.73	24	3.29	24
27	M	0	M	0	M	0	M	0	M	0	26.03	24	17.41	24	7.48	24	20.34	24	15.03	24	10.22	24	9.90	24
28	M	0	M	0	M	0	M	0	M	0	26.50	24	9.06	24	15.22	24	20.46	24	11.00	24	6.67	24	6.04	24
29	M	0			M	0	M	0	M	0	25.19	24	15.46	24	19.92	24	18.59	24	14.09	24	6.02	24	11.17	24
30	M	0			M	0	M	0	M	0	14.58	24	24.68	24	20.61	24	18.55	24	14.08	24	.90	24	11.44	24
31	M	0			M	0			M	0			26.11	24	17.31	24			10.14	24			1.42	24
M TOT	M		M		M		M		M		471.14		436.07		516.97		504.37		322.32		238.35		229.11	
# DAYS	0		0		0		0		0		22		22		28		28		26		29		31	
DAY AV	M		M		M		M		M		21.42		19.82		18.46		18.01		12.40		8.22		7.39	
D MAX	M		M		M		M		M		30.95		28.30		24.74		23.19		20.55		14.64		12.40	
D MIN	M		M		M		M		M		9.02		8.64		7.48		5.86		1.50		.90		.69	

LKH 5/81

MONMOUTH, ILLINOIS
90 45'W, 40 65'N
229 M ABOVE MSL

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

YEAR: 1981

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

UNITS: DAILY AND MONTHLY = MJ/M2

MONTH

DAY	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	MJ/M2	#H	MJ/M2	#H	MJ/M2	#H	MJ/M2	#H	MJ/M2	#H	MJ/M2	#H	MJ/M2	#H	MJ/M2	#H	MJ/M2	#H	MJ/M2	#H	MJ/M2	#H	MJ/M2	#H
1	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	17.74	24	2.92	24	1.00	24
2	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	16.96	24	3.99	24	8.00	24
3	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	11.55	24	5.82	24	.27	9
4	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	16.75	24	3.05	24	.04	8
5	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	6.22	24	5.98	24	9.32	24
6	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	14.69	24	12.33	24	6.20	24
7	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	17.90	24	12.48	24	8.44	24
8	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	17.28	24	7.79	24	6.53	24
9	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	15.21	24	12.14	24	2.27	24
10	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	10.00	24	11.82	24	9.04	24
11	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	15.48	24	11.50	24	6.78	24
12	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	8.92	24	10.72	24	6.05	24
13	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	6.66	24	10.79	24	2.39	24
14	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	0.00	6	10.44	24	4.02	24
15	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	2.30	10	5.44	24	4.86	24
16	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	13.16	24	10.29	24	3.24	24
17	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	14.07	14	8.28	16	10.96	24	7.67	24
18	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	15.94	24	M	0	8.98	24	10.17	24
19	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	19.84	24	M	0	1.18	24	10.56	24
20	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	19.01	24	M	0	3.41	24	7.94	24
21	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	17.98	24	M	0	5.59	24	2.07	24
22	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	20.36	24	4.65	11	8.61	24	1.67	24
23	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	18.40	24	0.00	6	1.18	24	9.16	24
24	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	11.12	24	M	0	2.70	11	9.41	24
25	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	3.97	24	M	0	1.04	24	8.42	24
26	M	0	M	0	M	0	M	0	M	0	M	0	M	0	M	0	3.57	24	M	0	1.28	24	7.77	24
27	M	0	M	0	M	0	M	0	M	0	M	0	M	0	1.39	9	19.36	24	M	0	5.27	24	3.11	24
28	M	0	M	0	M	0	M	0	M	0	M	0	M	0	.92	9	19.07	24	M	0	7.04	24	.86	10
29	M	0			M	0	M	0	M	0	18.17	16	M	0	M	0	14.06	24	.82	9	8.94	24	M	0
30	M	0			M	0	M	0	M	0	.01	5	M	0	M	0	16.35	24	11.29	24	1.34	24	.05	8
31	M	0			M	0			M	0			M	0	M	0			4.89	24			2.08	24
M TOT	M		M		M		M		M		0.00		0.00		0.00		199.04		206.72		202.31		158.17	
# DAYS	0		0		0		0		0		0		0		0		13		16		29		26	
DAY AV	M		M		M		M		M		-1		-1		-1		15.31		12.92		6.98		6.08	
D MAX	M		M		M		M		M		0.00		0.00		0.00		20.36		18.96		12.48		10.56	
D MIN	M		M		M		M		M		0.00		0.00		0.00		3.57		4.89		1.04		1.00	

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

PERRY, ILLINOIS
90 50'W, 39 48'N
206 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = MJ/M2

MONTH

DAY	JANUARY MJ/M2	#H	FEBRUARY MJ/M2	#H	MARCH MJ/M2	#H	APRIL MJ/M2	#H	MAY MJ/M2	#H	JUNE MJ/M2	#H	JULY MJ/M2	#H	AUGUST MJ/M2	#H	SEPTEMBER MJ/M2	#H	OCTOBER MJ/M2	#H	NOVEMBER MJ/M2	#H	DECEMBER MJ/M2	#H
1	M	0	M	0	M	0	M	0	M	0	M	0	18.16	24	24.97	24	8.74	24	18.43	24	2.85	24	.51	24
2	M	0	M	0	M	0	M	0	M	0	M	0	19.22	24	10.01	21	19.60	24	18.83	24	3.90	24	6.68	24
3	M	0	M	0	M	0	M	0	M	0	M	0	19.47	24	11.48	24	16.68	24	14.27	24	7.96	24	.31	9
4	M	0	M	0	M	0	M	0	M	0	M	0	3.95	21	22.82	24	19.54	24	13.95	24	6.81	24	7.17	24
5	M	0	M	0	M	0	M	0	M	0	M	0	8.48	24	15.10	24	18.65	24	.14	7	6.81	24	6.20	24
6	M	0	M	0	M	0	M	0	M	0	M	0	26.69	24	16.74	24	20.62	24	15.95	17	12.74	24	7.05	24
7	M	0	M	0	M	0	M	0	M	0	M	0	23.12	24	21.51	24	2.82	24	17.46	24	12.77	24	8.31	24
8	M	0	M	0	M	0	M	0	M	0	M	0	25.29	24	6.23	17	22.08	24	16.81	24	4.67	24	.11	8
9	M	0	M	0	M	0	M	0	M	0	M	0	6.54	10	22.03	24	19.17	23	14.32	24	8.68	24	.67	11
10	M	0	M	0	M	0	M	0	M	0	M	0	25.04	17	9.62	24	21.71	24	9.01	24	12.09	24	9.22	24
11	M	0	M	0	M	0	M	0	M	0	M	0	.69	8	6.39	10	18.47	24	15.29	24	11.52	24	7.66	24
12	M	0	M	0	M	0	M	0	M	0	M	0	24.06	17	.09	6	15.43	24	9.05	24	10.75	24	7.89	24
13	M	0	M	0	M	0	M	0	M	0	M	0	26.49	24	.53	7	17.23	24	6.49	24	1.11	9	1.99	24
14	M	0	M	0	M	0	M	0	M	0	M	0	17.77	15	15.70	14	14.84	24	1.02	24	7.97	14	2.43	24
15	M	0	M	0	M	0	M	0	M	0	M	0	8.11	16	14.98	20	18.10	16	3.29	24	4.86	24	5.50	24
16	M	0	M	0	M	0	M	0	M	0	M	0	20.66	24	7.28	24	15.09	17	10.08	24	10.30	24	2.11	24
17	M	0	M	0	M	0	M	0	M	0	M	0	23.11	16	21.68	24	16.23	24	7.39	24	11.39	24	0.00	7
18	M	0	M	0	M	0	M	0	M	0	3.05	8	8.53	16	23.67	23	17.14	24	2.37	9	9.71	24	10.38	24
19	M	0	M	0	M	0	M	0	M	0	17.80	24	9.42	6	21.01	24	20.08	24	15.69	17	1.07	24	10.67	24
20	M	0	M	0	M	0	M	0	M	0	14.04	24	18.30	10	23.94	24	19.59	24	14.91	24	1.83	24	8.65	24
21	M	0	M	0	M	0	M	0	M	0	8.60	18	21.92	17	23.10	24	18.66	24	4.13	24	8.72	24	2.75	24
22	M	0	M	0	M	0	M	0	M	0	13.34	12	13.41	24	21.36	24	16.29	24	7.93	24	10.74	24	1.72	24
23	M	0	M	0	M	0	M	0	M	0	28.42	24	14.88	24	18.66	22	17.38	24	2.59	17	.04	8	10.87	24
24	M	0	M	0	M	0	M	0	M	0	20.35	24	12.33	24	15.10	24	7.40	24	9.80	20	M	0	9.98	24
25	M	0	M	0	M	0	M	0	M	0	27.08	24	15.95	24	19.84	24	7.36	24	4.62	24	M	0	7.68	24
26	M	0	M	0	M	0	M	0	M	0	29.17	24	M	0	12.11	24	4.04	10	5.98	24	M	0	8.73	24
27	M	0	M	0	M	0	M	0	M	0	20.08	24	M	0	8.72	23	14.09	14	14.01	24	M	0	6.91	24
28	M	0	M	0	M	0	M	0	M	0	27.21	24	.02	5	.14	7	18.94	24	10.89	24	M	0	5.27	24
29	M	0			M	0	M	0	M	0	25.41	24	23.41	24	18.82	24	14.49	24	13.45	24	M	0	11.52	24
30	M	0			M	0	M	0	M	0	17.41	24	26.10	24	3.78	19	17.27	24	11.96	24	.17	11	9.35	24
31	M	0			M	0			M	0			25.92	24	17.70	9			5.25	24			2.18	24
M TOT	M		M		M		M		0.00		226.97		319.57		328.51		407.25		268.85		160.16		179.38	
# DAYS	0		0		0		0		0		10		16		18		25		25		20		27	
DAY AV	M		M		M		M		-1		22.70		19.97		18.25		16.29		10.75		8.01		6.64	
D MAX	M		M		M		M		0.00		29.17		26.69		24.97		22.08		18.83		12.77		11.52	
D MIN	M		M		M		M		0.00		14.04		8.48		7.28		2.82		1.02		1.07		.51	

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

BROWNSTOWN, ILLINOIS
88 57'W, 38 57'N
177 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = CAL/CM2

MONTH

DAY	JANUARY CAL/CM	#H	FEBRUARY CAL/CM	#H	MARCH CAL/CM	#H	APRIL CAL/CM	#H	MAY CAL/CM	#H
1	M	0	M	0	M	0	M	0	M	0
2	M	0	M	0	M	0	M	0	M	0
3	M	0	M	0	M	0	M	0	M	0
4	M	0	M	0	M	0	M	0	M	0
5	M	0	M	0	M	0	M	0	M	0
6	M	0	M	0	M	0	M	0	M	0
7	M	0	M	0	M	0	M	0	M	0
8	M	0	M	0	M	0	M	0	M	0
9	M	0	M	0	M	0	M	0	M	0
10	M	0	M	0	M	0	M	0	M	0
11	M	0	M	0	M	0	M	0	M	0
12	M	0	M	0	M	0	M	0	M	0
13	M	0	M	0	M	0	M	0	M	0
14	M	0	M	0	M	0	M	0	M	0
15	M	0	M	0	M	0	M	0	M	0
16	M	0	M	0	M	0	M	0	M	0
17	M	0	M	0	M	0	M	0	M	0
18	M	0	M	0	M	0	M	0	M	0
19	M	0	M	0	M	0	M	0	M	0
20	M	0	M	0	M	0	M	0	M	0
21	M	0	M	0	M	0	M	0	M	0
22	M	0	M	0	M	0	M	0	M	0
23	M	0	M	0	M	0	M	0	M	0
24	M	0	M	0	M	0	M	0	M	0
25	M	0	M	0	M	0	M	0	M	0
26	M	0	M	0	M	0	M	0	M	0
27	M	0	M	0	M	0	M	0	M	0
28	M	0	M	0	M	0	M	0	M	0
29	M	0			M	0	M	0	M	0
30	M	0			M	0	M	0	M	0
31	M	0			M	0			M	0
M TOT	M		M		M		M		M	
# DAYS	0		0		0		0		0	
DAY AV	M		M		M		M		M	
D MAX	M		M		M		M		M	
D MIN	M		M		M		M		M	

DAY	JUNE CAL/CM	#H	JULY CAL/CM	#H	AUGUST CAL/CM	#H	SEPTEMBER CAL/CM	#H	OCTOBER CAL/CM	#H	NOVEMBER CAL/CM	#H	DECEMBER CAL/CM	#H
1	M	0	470.1	24	570.1	24	237.0	24	383.7	24	138.4	24	54.3	24
2	M	0	536.3	24	513.5	24	155.7	24	470.7	24	198.5	24	161.4	24
3	M	0	404.3	24	424.1	24	263.3	24	431.1	24	254.5	24	119.5	24
4	M	0	216.3	24	508.1	24	342.0	15	122.7	24	171.8	24	107.8	24
5	M	0	M	0	343.2	24	M	0	347.4	24	98.7	24	203.4	24
6	M	0	M	0	532.4	24	M	0	343.2	24	320.1	24	205.8	24
7	M	0	405.0	16	559.5	24	269.5	18	418.7	24	307.9	24	177.9	24
8	M	0	610.5	24	431.3	24	531.2	24	430.7	24	204.3	24	193.5	24
9	M	0	560.8	24	590.6	24	527.4	24	360.4	24	131.8	24	51.7	24
10	M	0	672.4	24	332.8	24	527.1	24	62.4	24	317.3	24	236.3	24
11	M	0	676.6	24	570.7	24	359.5	24	395.4	24	292.1	24	228.4	24
12	M	0	578.5	24	543.8	24	482.9	24	142.3	24	280.6	24	253.3	24
13	M	0	597.0	24	458.7	24	337.3	24	296.4	24	290.9	24	198.3	24
14	M	0	585.3	24	459.1	24	270.4	24	74.1	15	283.5	24	145.3	24
15	M	0	337.5	24	310.0	24	316.8	24	24.1	10	145.4	24	205.3	24
16	M	0	452.1	24	314.3	24	365.4	24	183.9	24	138.2	24	76.7	24
17	M	0	603.7	24	455.0	24	344.0	24	64.2	24	281.7	24	216.6	24
18	M	0	438.8	24	593.8	24	368.0	24	M	0	256.6	24	268.1	24
19	M	0	279.9	24	521.6	24	498.1	24	117.7	11	104.4	24	278.7	24
20	M	0	465.3	16	591.4	24	481.5	24	375.4	24	50.7	24	257.2	24
21	M	0	570.9	17	582.9	24	340.6	22	314.2	24	147.9	24	35.5	24
22	M	0	606.0	24	479.9	24	443.9	24	39.3	24	282.5	24	39.0	24
23	31.7	7	187.5	24	494.0	24	483.7	24	347.0	24	37.0	24	246.1	24
24	510.0	24	403.7	24	493.3	24	291.7	24	393.1	24	29.4	24	216.0	24
25	573.7	24	500.1	24	383.7	14	405.3	24	242.4	24	70.0	24	229.5	24
26	725.9	24	115.9	18	M	0	284.2	24	43.5	24	92.0	24	106.2	24
27	610.3	24	358.8	24	M	0	35.2	8	306.3	24	238.6	24	145.7	24
28	380.1	24	202.7	24	M	0	344.4	15	275.7	24	104.0	24	80.0	24
29	614.6	24	506.0	24	M	0	331.5	24	292.7	24	225.0	24	262.7	24
30	298.2	24	638.3	24	M	0	420.3	24	309.0	24	27.3	24	253.9	24
31			652.7	24	39.3	11			247.7	24			18.0	24
M TOT	3.7		12.1		11.7		8.7		7.6		5.5		5.3	
# DAYS	7		25		24		23		27		30		31	
DAY AV	530.4		483.0		486.4		379.0		282.9		184.0		170.1	
D MAX	725.9		676.6		593.8		531.2		470.7		320.1		278.7	
D MIN	298.2		187.5		310.0		155.7		39.3		27.3		18.0	

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

CHAMPAIGN, ILLINOIS
88 57'W, 40 03'N
219 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = CAL/CM2

MONTH

DAY	JANUARY CAL/CM	#H	FEBRUARY CAL/CM	#H	MARCH CAL/CM	#H	APRIL CAL/CM	#H	MAY CAL/CM	#H	JUNE CAL/CM	#H	JULY CAL/CM	#H	AUGUST CAL/CM	#H	SEPTEMBER CAL/CM	#H	OCTOBER CAL/CM	#H	NOVEMBER CAL/CM	#H	DECEMBER CAL/CM	#H
1	M	0	M	0	M	0	M	0	M	0	288.5	24	452.7	24	578.8	24	211.5	24	407.9	24	127.3	24	35.3	24
2	M	0	M	0	M	0	M	0	M	0	390.1	24	560.9	24	493.1	24	97.2	24	460.8	24	111.3	24	83.3	24
3	M	0	M	0	M	0	M	0	M	0	456.9	24	505.1	24	265.5	24	88.9	24	436.1	24	223.2	24	91.0	24
4	M	0	M	0	M	0	M	0	M	0	671.2	24	119.6	24	501.7	24	382.7	24	230.7	24	141.9	24	183.9	24
5	M	0	M	0	M	0	M	0	M	0	412.4	24	258.9	24	96.2	24	482.7	24	313.7	24	161.7	24	209.4	24
6	M	0	M	0	M	0	M	0	M	0	578.4	24	624.0	24	353.7	24	424.2	24	320.0	24	302.4	24	155.7	24
7	M	0	M	0	M	0	M	0	M	0	707.8	24	572.6	24	541.6	24	283.2	24	435.3	24	296.1	24	124.3	24
8	M	0	M	0	M	0	M	0	7.1	8	517.7	24	646.6	24	355.4	24	542.9	24	423.3	24	168.7	24	49.6	24
9	M	0	M	0	M	0	M	0	174.9	24	577.3	24	639.7	24	490.5	24	502.9	24	390.4	24	223.5	24	156.1	24
10	M	0	M	0	M	0	M	0	45.5	24	485.8	24	708.8	24	271.9	24	535.3	24	145.0	24	296.7	24	223.8	24
11	M	0	M	0	M	0	M	0	120.7	24	204.8	24	666.4	24	581.5	24	404.4	24	397.4	24	281.0	24	210.9	24
12	M	0	M	0	M	0	M	0	532.7	24	286.9	24	540.3	24	536.9	24	429.8	24	354.2	24	273.1	24	211.9	24
13	M	0	M	0	M	0	M	0	173.7	24	242.0	24	602.5	24	472.8	24	421.1	24	292.5	24	241.3	24	127.1	24
14	M	0	M	0	M	0	M	0	50.9	24	525.8	24	467.7	24	237.5	24	193.3	24	75.7	24	265.4	24	106.6	24
15	M	0	M	0	M	0	M	0	657.4	24	557.5	24	255.9	24	308.6	24	424.2	24	96.7	24	194.5	24	188.7	24
16	M	0	M	0	M	0	M	0	628.3	24	332.1	24	168.7	24	438.1	24	370.1	24	340.1	24	95.4	24	69.8	24
17	M	0	M	0	M	0	M	0	202.3	24	715.6	24	609.9	24	622.5	24	196.1	24	45.4	24	267.7	24	136.1	24
18	M	0	M	0	M	0	M	0	88.0	24	716.9	24	452.5	24	623.2	24	359.7	24	151.8	24	193.3	24	237.8	24
19	M	0	M	0	M	0	M	0	602.9	24	212.6	24	204.2	24	608.0	24	447.0	24	381.3	24	92.3	24	248.5	24
20	M	0	M	0	M	0	M	0	706.4	24	585.2	24	474.7	24	611.7	24	458.8	24	359.4	24	65.0	24	250.1	24
21	M	0	M	0	M	0	M	0	700.2	24	240.2	24	362.7	24	560.9	24	447.6	24	248.8	24	69.1	24	28.1	24
22	M	0	M	0	M	0	M	0	583.1	24	638.5	24	627.9	24	547.1	24	424.0	24	81.0	24	199.2	24	61.0	24
23	M	0	M	0	M	0	M	0	382.9	24	714.5	24	356.1	24	522.3	24	480.2	24	238.7	24	17.9	24	240.2	24
24	M	0	M	0	M	0	M	0	367.8	24	505.7	24	466.3	24	510.3	24	359.0	24	361.5	24	68.5	24	275.7	24
25	M	0	M	0	M	0	M	0	567.5	24	628.5	24	326.6	24	460.7	24	295.6	24	291.7	24	32.9	24	219.7	24
26	M	0	M	0	M	0	M	0	243.6	24	664.6	24	188.9	24	293.6	24	302.7	24	54.1	24	76.9	24	129.9	24
27	M	0	M	0	M	0	M	0	475.1	24	641.3	24	306.9	24	241.8	24	470.8	24	221.3	24	133.0	24	68.9	24
28	M	0	M	0	M	0	M	0	629.5	24	438.0	24	181.8	24	262.4	24	472.4	24	260.7	24	93.2	24	148.9	24
29	M	0			M	0	M	0	549.8	24	636.1	24	535.9	24	469.8	24	163.1	24	325.2	24	231.7	24	238.7	24
30	M	0			M	0	M	0	288.0	24	262.2	24	644.9	24	431.5	24	407.8	24	297.2	24	37.6	24	226.0	24
31	M	0			M	0			697.7	24			626.6	24	448.2	24			207.4	24			35.8	24
M TOT	M		M		M		M		9.5		14.8		14.2		13.7		11.1		8.6		5.0		4.8	
# DAYS	0		0		0		0		23		30		31		31		30		31		30		31	
DAY AV	M		M		M		M		411.7		494.5		456.7		443.2		369.6		278.9		166.0		154.0	
D MAX	M		M		M		M		706.4		716.9		708.8		623.2		542.9		460.8		302.4		275.7	
D MIN	M		M		M		M		45.5		204.8		119.6		96.2		88.9		45.4		17.9		28.1	

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

DE KALB, ILLINOIS
88 51'W, 41 51'N
265 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = CAL/CM2

MONTH

DAY	JANUARY CAL/CM	#H	FEBRUARY CAL/CM	#H	MARCH CAL/CM	#H	APRIL CAL/CM	#H	MAY CAL/CM	#H	JUNE CAL/CM	#H	JULY CAL/CM	#H	AUGUST CAL/CM	#H	SEPTEMBER CAL/CM	#H	OCTOBER CAL/CM	#H	NOVEMBER CAL/CM	#H	DECEMBER CAL/CM	#H
1	M	0	M	0	M	0	M	0	M	0	M	0	M	0	640.3	24	118.8	24	278.9	24	113.1	24	26.1	24
2	M	0	M	0	M	0	M	0	M	0	M	0	M	0	217.8	24	306.7	24	458.0	24	80.2	24	49.9	24
3	M	0	M	0	M	0	M	0	M	0	M	0	M	0	472.8	24	371.3	24	414.0	24	266.2	24	62.4	24
4	M	0	M	0	M	0	M	0	M	0	M	0	M	0	531.7	24	525.4	24	265.9	24	87.9	24	208.6	24
5	M	0	M	0	M	0	M	0	M	0	M	0	M	0	133.3	24	424.5	24	185.3	24	147.1	24	100.0	24
6	M	0	M	0	M	0	M	0	M	0	M	0	M	0	385.8	24	420.3	24	361.4	24	286.0	24	170.2	24
7	M	0	M	0	M	0	M	0	M	0	M	0	M	0	367.7	24	186.4	24	431.9	24	290.2	24	155.4	24
8	M	0	M	0	M	0	M	0	M	0	M	0	M	0	433.4	24	511.6	24	392.9	24	238.3	24	32.1	24
9	M	0	M	0	M	0	M	0	M	0	M	0	0.0	5	437.8	24	478.5	24	285.4	24	284.1	24	112.8	24
10	M	0	M	0	M	0	M	0	M	0	M	0	696.5	24	465.5	24	518.6	24	279.1	24	273.1	24	219.4	24
11	M	0	M	0	M	0	M	0	M	0	M	0	488.9	24	541.9	24	433.7	24	287.1	24	271.1	24	209.4	24
12	M	0	M	0	M	0	M	0	M	0	M	0	569.6	24	522.8	24	458.9	24	366.1	24	261.2	24	185.1	24
13	M	0	M	0	M	0	M	0	M	0	M	0	340.3	24	522.4	24	429.2	24	248.4	24	262.1	24	85.1	24
14	M	0	M	0	M	0	M	0	M	0	M	0	431.9	24	166.5	24	398.1	24	40.3	24	193.7	24	62.2	24
15	M	0	M	0	M	0	M	0	M	0	1.6	6	187.5	24	534.0	24	378.8	24	112.4	24	121.4	24	181.3	24
16	M	0	M	0	M	0	M	0	M	0	426.9	24	465.0	24	415.9	24	376.3	24	310.8	24	138.7	24	113.9	24
17	M	0	M	0	M	0	M	0	M	0	738.3	24	594.1	24	626.9	24	276.0	24	45.3	24	252.1	24	140.9	24
18	M	0	M	0	M	0	M	0	M	0	600.5	24	488.8	24	531.3	24	231.0	24	95.1	24	132.0	24	223.9	24
19	M	0	M	0	M	0	M	0	M	0	621.5	24	342.7	24	621.0	24	479.2	24	381.2	24	29.9	24	223.4	24
20	M	0	M	0	M	0	M	0	M	0	438.0	24	515.7	24	558.6	24	464.6	24	314.8	24	126.3	24	204.9	24
21	M	0	M	0	M	0	M	0	M	0	243.6	24	311.8	24	532.6	24	272.8	24	40.2	24	176.6	24	40.9	24
22	M	0	M	0	M	0	M	0	M	0	627.8	24	623.3	24	430.9	24	400.2	24	203.7	24	151.0	24	69.1	24
23	M	0	M	0	M	0	M	0	M	0	621.6	24	410.3	24	493.6	24	469.6	24	203.0	24	26.0	24	210.6	24
24	M	0	M	0	M	0	M	0	M	0	422.7	24	512.5	24	472.0	24	334.9	24	206.8	24	234.3	24	208.6	24
25	M	0	M	0	M	0	M	0	M	0	686.6	24	230.1	24	377.6	24	95.1	24	58.6	22	74.5	24	200.8	24
26	M	0	M	0	M	0	M	0	M	0	659.2	24	138.8	24	326.7	24	69.1	24	123.6	24	64.6	24	81.3	24
27	M	0	M	0	M	0	M	0	M	0	659.0	24	94.4	24	318.9	24	460.8	24	286.1	24	93.4	24	110.5	24
28	M	0	M	0	M	0	M	0	M	0	585.5	24	217.3	24	318.8	24	460.2	24	242.4	24	115.5	24	70.7	24
29	M	0			M	0	M	0	M	0	529.0	24	644.8	24	400.5	24	160.1	24	294.3	24	211.3	24	149.8	24
30	M	0			M	0	M	0	M	0	M	0	610.8	24	415.6	24	379.2	24	278.8	24	57.8	24	100.3	24
31	M	0			M	0			M	0			658.8	24	432.5	24			137.2	24			35.2	24
M TOT	M		M		M		M		M		7.9		9.6		13.6		10.9		7.6		5.1		4.0	
# DAYS	0		0		0		0		0		14		22		31		30		30		30		31	
DAY AV	M		M		M		M		M		561.4		435.2		440.2		363.0		252.3		168.7		130.5	
D MAX	M		M		M		M		M		738.3		696.5		640.3		525.4		458.0		290.2		223.9	
D MIN	M		M		M		M		M		243.6		94.4		133.3		69.1		40.2		26.0		26.1	

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

DIXON SPRINGS, ILLINOIS
88 40'W, 37 27'N
165 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = CAL/CM2

MONTH

DAY	JANUARY CAL/CM	#H	FEBRUARY CAL/CM	#H	MARCH CAL/CM	#H	APRIL CAL/CM	#H	MAY CAL/CM	#H
1	M	0	M	0	M	0	M	0	M	0
2	M	0	M	0	M	0	M	0	M	0
3	M	0	M	0	M	0	M	0	M	0
4	M	0	M	0	M	0	M	0	M	0
5	M	0	M	0	M	0	M	0	M	0
6	M	0	M	0	M	0	M	0	M	0
7	M	0	M	0	M	0	M	0	M	0
8	M	0	M	0	M	0	M	0	M	0
9	M	0	M	0	M	0	M	0	M	0
10	M	0	M	0	M	0	M	0	M	0
11	M	0	M	0	M	0	M	0	M	0
12	M	0	M	0	M	0	M	0	M	0
13	M	0	M	0	M	0	M	0	M	0
14	M	0	M	0	M	0	M	0	M	0
15	M	0	M	0	M	0	M	0	M	0
16	M	0	M	0	M	0	M	0	M	0
17	M	0	M	0	M	0	M	0	M	0
18	M	0	M	0	M	0	M	0	M	0
19	M	0	M	0	M	0	M	0	M	0
20	M	0	M	0	M	0	M	0	M	0
21	M	0	M	0	M	0	M	0	M	0
22	M	0	M	0	M	0	M	0	M	0
23	M	0	M	0	M	0	M	0	M	0
24	M	0	M	0	M	0	M	0	M	0
25	M	0	M	0	M	0	M	0	M	0
26	M	0	M	0	M	0	M	0	M	0
27	M	0	M	0	M	0	M	0	M	0
28	M	0	M	0	M	0	M	0	M	0
29	M	0			M	0	M	0	M	0
30	M	0			M	0	M	0	M	0
31	M	0			M	0			M	0
M TOT	M		M		M		M		M	
# DAYS	0		0		0		0		0	
DAY AV	M		M		M		M		M	
D MAX	M		M		M		M		M	
D MIN	M		M		M		M		M	

DAY	JUNE CAL/CM	#H	JULY CAL/CM	#H	AUGUST CAL/CM	#H	SEPTEMBER CAL/CM	#H	OCTOBER CAL/CM	#H	NOVEMBER CAL/CM	#H	DECEMBER CAL/CM	#H
1	M	0	494.4	24	553.9	24	314.3	24	260.4	24	110.1	24	179.3	24
2	M	0	638.9	24	533.2	24	140.1	24	491.0	24	281.2	24	188.6	24
3	2.2	6	531.8	24	323.3	24	504.8	24	460.5	24	243.2	24	123.4	24
4	441.3	24	479.0	24	557.4	24	427.7	24	130.9	24	77.2	20	95.6	24
5	341.8	24	51.8	9	491.9	24	445.8	24	354.5	24	146.8	24	230.4	24
6	M	0	312.5	24	388.1	24	469.3	24	311.4	24	349.7	24	199.4	24
7	M	0	518.4	24	268.7	24	412.5	24	363.2	24	337.6	24	182.8	24
8	605.4	17	676.0	24	479.9	24	542.9	24	444.6	24	285.0	24	262.4	24
9	449.7	24	644.6	24	591.0	24	509.1	24	329.4	24	48.9	24	122.5	24
10	246.5	24	211.6	11	371.6	14	554.0	24	104.1	24	308.8	24	252.2	24
11	439.7	24	M	0	50.0	9	501.2	24	372.0	24	324.1	24	104.2	24
12	398.5	24	M	0	540.5	24	517.0	24	151.4	24	305.3	24	257.0	24
13	436.4	24	59.5	8	488.4	24	351.3	24	271.9	24	277.7	24	175.6	24
14	534.7	24	499.2	24	526.5	24	225.2	24	75.0	24	292.3	24	200.7	24
15	522.2	24	469.9	24	296.2	24	188.3	24	148.0	24	176.1	24	221.4	24
16	215.5	24	342.8	24	428.5	24	314.3	22	114.2	14	120.0	24	159.5	24
17	739.3	24	429.2	24	379.9	24	333.0	22	M	0	311.6	24	120.0	24
18	711.4	24	388.7	24	517.1	24	409.1	24	M	0	290.3	24	265.8	24
19	111.5	18	579.8	24	241.8	24	458.7	24	422.7	24	65.0	24	296.2	24
20	539.0	24	540.7	16	458.1	24	512.8	24	407.5	24	37.2	24	281.9	24
21	193.1	23	M	0	506.6	24	495.5	24	330.0	15	250.1	24	16.6	24
22	330.1	24	98.7	9	398.9	24	454.1	24	42.1	16	270.5	24	22.2	24
23	707.7	24	206.5	24	507.9	24	506.6	24	409.3	24	33.2	24	80.7	24
24	627.1	24	250.2	20	485.5	24	405.6	24	408.5	24	32.9	24	150.5	24
25	638.0	24	455.1	24	463.0	24	440.0	24	211.1	24	162.6	24	251.0	24
26	731.6	24	535.8	24	294.2	23	401.6	24	35.8	24	65.1	24	78.7	24
27	621.8	24	415.8	24	178.6	24	485.9	24	359.1	24	244.2	24	236.5	24
28	633.1	24	216.4	24	363.6	24	488.8	24	262.7	24	159.3	24	144.3	24
29	601.8	24	369.3	24	475.9	24	444.1	24	336.7	24	143.8	24	266.8	24
30	348.4	24	589.6	24	492.5	24	443.1	24	336.3	24	21.5	24	273.4	24
31			623.9	24	413.5	24			242.4	24			34.0	24
M TOT	11.3		10.4		12.4		12.0		7.7		5.7		5.5	
# DAYS	22		22		28		28		26		29		31	
DAY AV	511.6		473.5		441.1		430.3		296.2		196.4		176.6	
D MAX	739.3		676.0		591.0		554.0		491.0		349.7		296.2	
D MIN	215.5		206.5		178.6		140.1		35.8		21.5		16.6	

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

MONMOUTH, ILLINOIS
90 45'W, 40 65'N
229 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = CAL/CM2

MONTH

DAY	JANUARY CAL/CM	#H	FEBRUARY CAL/CM	#H	MARCH CAL/CM	#H	APRIL CAL/CM	#H	MAY CAL/CM	#H	JUNE CAL/CM	#H
1	M	0	M	0	M	0	M	0	M	0	M	0
2	M	0	M	0	M	0	M	0	M	0	M	0
3	M	0	M	0	M	0	M	0	M	0	M	0
4	M	0	M	0	M	0	M	0	M	0	M	0
5	M	0	M	0	M	0	M	0	M	0	M	0
6	M	0	M	0	M	0	M	0	M	0	M	0
7	M	0	M	0	M	0	M	0	M	0	M	0
8	M	0	M	0	M	0	M	0	M	0	M	0
9	M	0	M	0	M	0	M	0	M	0	M	0
10	M	0	M	0	M	0	M	0	M	0	M	0
11	M	0	M	0	M	0	M	0	M	0	M	0
12	M	0	M	0	M	0	M	0	M	0	M	0
13	M	0	M	0	M	0	M	0	M	0	M	0
14	M	0	M	0	M	0	M	0	M	0	M	0
15	M	0	M	0	M	0	M	0	M	0	M	0
16	M	0	M	0	M	0	M	0	M	0	M	0
17	M	0	M	0	M	0	M	0	M	0	M	0
18	M	0	M	0	M	0	M	0	M	0	M	0
19	M	0	M	0	M	0	M	0	M	0	M	0
20	M	0	M	0	M	0	M	0	M	0	M	0
21	M	0	M	0	M	0	M	0	M	0	M	0
22	M	0	M	0	M	0	M	0	M	0	M	0
23	M	0	M	0	M	0	M	0	M	0	M	0
24	M	0	M	0	M	0	M	0	M	0	M	0
25	M	0	M	0	M	0	M	0	M	0	M	0
26	M	0	M	0	M	0	M	0	M	0	M	0
27	M	0	M	0	M	0	M	0	M	0	M	0
28	M	0	M	0	M	0	M	0	M	0	M	0
29	M	0			M	0	M	0	M	0	434.1	16
30	M	0			M	0	M	0	M	0	.3	5
31	M	0			M	0			M	0		
M TOT	M		M		M		M		M		0.0	
# DAYS	0		0		0		0		0		0	
DAY AV	M		M		M		M		M		-1	
D MAX	M		M		M		M		M		0.0	
D MIN	M		M		M		M		M		0.0	

DAY	JULY CAL/CM	#H	AUGUST CAL/CM	#H	SEPTEMBER CAL/CM	#H	OCTOBER CAL/CM	#H	NOVEMBER CAL/CM	#H	DECEMBER CAL/CM	#H
1	M	0	M	0	M	0	423.7	24	69.7	24	23.8	24
2	M	0	M	0	M	0	452.9	24	95.4	24	191.0	24
3	M	0	M	0	M	0	276.0	24	139.0	24	6.5	9
4	M	0	M	0	M	0	400.3	24	72.8	24	.9	8
5	M	0	M	0	M	0	148.7	24	142.8	24	222.7	24
6	M	0	M	0	M	0	351.0	24	294.5	24	148.2	24
7	M	0	M	0	M	0	427.7	24	298.2	24	201.7	24
8	M	0	M	0	M	0	412.8	24	186.1	24	156.0	24
9	M	0	M	0	M	0	363.4	24	289.9	24	54.3	24
10	M	0	M	0	M	0	239.0	24	282.4	24	216.0	24
11	M	0	M	0	M	0	369.8	24	274.7	24	161.9	24
12	M	0	M	0	M	0	213.1	24	256.1	24	144.6	24
13	M	0	M	0	M	0	159.2	24	257.8	24	56.9	24
14	M	0	M	0	M	0	0.0	6	249.4	24	96.1	24
15	M	0	M	0	M	0	54.9	10	130.0	24	116.2	24
16	M	0	M	0	M	0	314.3	24	245.7	24	77.4	24
17	M	0	M	0	336.1	14	197.7	16	261.8	24	183.3	24
18	M	0	M	0	380.9	24	M	0	214.6	24	243.0	24
19	M	0	M	0	473.9	24	M	0	28.1	24	252.2	24
20	M	0	M	0	454.2	24	M	0	81.4	24	189.6	24
21	M	0	M	0	429.6	24	M	0	133.4	24	49.5	24
22	M	0	M	0	486.4	24	111.2	11	205.6	24	39.9	24
23	M	0	M	0	439.6	24	0.0	6	28.1	24	218.9	24
24	M	0	M	0	265.6	24	M	0	64.6	11	224.9	24
25	M	0	M	0	94.9	24	M	0	24.9	24	201.2	24
26	M	0	M	0	85.4	24	M	0	30.5	24	185.5	24
27	M	0	33.3	9	462.6	24	M	0	125.9	24	74.2	24
28	M	0	21.9	9	455.6	24	M	0	168.2	24	20.6	10
29	M	0	M	0	335.8	24	19.7	9	213.6	24	M	0
30	M	0	M	0	390.6	24	269.7	24	32.1	24	1.3	8
31	M	0	M	0			116.9	24			49.7	24
M TOT	0.0		0.0		4.8		4.9		4.8		3.8	
# DAYS	0		0		13		16		29		26	
DAY AV	-1		-1		365.8		308.7		166.7		145.3	
D MAX	0.0		0.0		486.4		452.9		298.2		252.2	
D MIN	0.0		0.0		85.4		116.9		24.9		23.8	

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

PERRY, ILLINOIS
90 50'W, 39 48'N
206 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = CAL/CM2

MONTH

DAY	JANUARY CAL/CM	#H	FEBRUARY CAL/CM	#H	MARCH CAL/CM	#H	APRIL CAL/CM	#H	MAY CAL/CM	#H
1	M	0	M	0	M	0	M	0	M	0
2	M	0	M	0	M	0	M	0	M	0
3	M	0	M	0	M	0	M	0	M	0
4	M	0	M	0	M	0	M	0	M	0
5	M	0	M	0	M	0	M	0	M	0
6	M	0	M	0	M	0	M	0	M	0
7	M	0	M	0	M	0	M	0	M	0
8	M	0	M	0	M	0	M	0	M	0
9	M	0	M	0	M	0	M	0	M	0
10	M	0	M	0	M	0	M	0	M	0
11	M	0	M	0	M	0	M	0	M	0
12	M	0	M	0	M	0	M	0	M	0
13	M	0	M	0	M	0	M	0	M	0
14	M	0	M	0	M	0	M	0	M	0
15	M	0	M	0	M	0	M	0	M	0
16	M	0	M	0	M	0	M	0	M	0
17	M	0	M	0	M	0	M	0	M	0
18	M	0	M	0	M	0	M	0	M	0
19	M	0	M	0	M	0	M	0	M	0
20	M	0	M	0	M	0	M	0	M	0
21	M	0	M	0	M	0	M	0	M	0
22	M	0	M	0	M	0	M	0	M	0
23	M	0	M	0	M	0	M	0	M	0
24	M	0	M	0	M	0	M	0	M	0
25	M	0	M	0	M	0	M	0	M	0
26	M	0	M	0	M	0	M	0	M	0
27	M	0	M	0	M	0	M	0	M	0
28	M	0	M	0	M	0	M	0	M	0
29	M	0			M	0	M	0	M	0
30	M	0			M	0	M	0	M	0
31	M	0			M	0			M	0
M TOT	M		M		M		M		0.0	
# DAYS	0		0		0		0		0	
DAY AV	M		M		M		M		-1	
D MAX	M		M		M		M		0.0	
D MIN	M		M		M		M		0.0	

DAY	JUNE CAL/CM	#H	JULY CAL/CM	#H	AUGUST CAL/CM	#H	SEPTEMBER CAL/CM	#H	OCTOBER CAL/CM	#H	NOVEMBER CAL/CM	#H	DECEMBER CAL/CM	#H
1	M	0	433.8	24	596.6	24	208.9	24	440.9	24	68.2	24	12.2	24
2	M	0	459.2	24	239.1	21	468.3	24	449.9	24	93.1	24	159.5	24
3	M	0	465.2	24	274.3	24	398.4	24	340.8	24	190.2	24	7.3	9
4	M	0	94.3	21	545.2	24	466.8	24	333.3	24	162.6	24	171.2	24
5	M	0	202.6	24	360.7	24	445.6	24	3.4	7	162.6	24	148.0	24
6	M	0	637.6	24	399.9	24	492.7	24	381.1	17	304.5	24	168.7	24
7	M	0	552.2	24	513.9	24	67.4	24	417.2	24	305.0	24	198.4	24
8	M	0	604.3	24	148.8	17	527.5	24	401.6	24	111.6	24	2.7	8
9	M	0	156.3	10	526.3	24	458.1	23	342.2	24	207.4	24	16.1	11
10	M	0	598.2	17	229.9	24	518.6	24	215.4	24	288.8	24	220.3	24
11	M	0	16.6	8	152.7	10	441.2	24	365.2	24	275.1	24	183.1	24
12	M	0	574.9	17	2.2	6	368.6	24	216.2	24	256.9	24	188.4	24
13	M	0	632.7	24	12.6	7	411.5	24	154.8	24	26.6	9	47.6	24
14	M	0	424.6	15	375.1	14	354.5	24	24.3	24	190.4	14	58.1	24
15	M	0	193.9	16	357.9	20	432.3	16	78.7	24	116.0	24	131.3	24
16	M	0	493.6	24	173.8	24	360.6	17	240.9	24	246.1	24	50.5	24
17	M	0	552.1	16	517.8	24	387.7	24	176.7	24	272.0	24	0.0	7
18	72.8	8	203.7	16	565.6	23	409.5	24	56.5	9	231.9	24	247.9	24
19	425.2	24	225.1	6	501.8	24	479.6	24	374.7	17	25.5	24	254.9	24
20	335.3	24	437.1	10	572.0	24	468.1	24	356.2	24	43.7	24	206.7	24
21	205.5	18	523.7	17	551.8	24	445.7	24	98.6	24	208.4	24	65.6	24
22	318.7	12	320.3	24	510.3	24	389.3	24	189.6	24	256.5	24	41.2	24
23	678.9	24	355.4	24	445.7	22	415.3	24	61.9	17	.9	8	259.6	24
24	496.3	24	294.6	24	360.7	24	176.8	24	234.1	20	M	0	233.3	24
25	647.0	24	381.1	24	473.9	24	175.9	24	110.3	24	M	0	183.4	24
26	696.9	24	M	0	289.4	24	96.6	10	142.8	24	M	0	208.6	24
27	479.6	24	M	0	208.3	23	336.5	14	334.6	24	M	0	155.0	24
28	650.1	24	.4	5	3.4	7	452.5	24	260.2	24	M	0	125.8	24
29	607.0	24	559.2	24	449.7	24	346.2	24	321.4	24	M	0	275.3	24
30	415.8	24	623.4	24	90.3	19	412.6	24	285.7	24	4.0	11	223.3	24
31			619.3	24	422.8	9			125.5	24			52.1	24
M TOT	5.4		7.6		7.8		9.7		6.4		3.9		4.3	
# DAYS	10		16		18		25		25		20		27	
DAY AV	542.2		477.2		436.0		389.2		256.9		191.3		158.7	
D MAX	696.9		637.6		596.6		527.5		449.9		305.0		275.3	
D MIN	335.3		202.6		173.8		67.4		24.3		25.5		12.2	

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

BROWNSTOWN, ILLINOIS
88 57'W, 38 57'N
177 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = BTU/FT2

MONTH

DAY	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H
1	M	0	M	0	M	0	M	0	M	0	M	0	1732	24	2101	24	873	24	1414	24	510	24	200	24
2	M	0	M	0	M	0	M	0	M	0	M	0	1976	24	1892	24	573	24	1734	24	731	24	595	24
3	M	0	M	0	M	0	M	0	M	0	M	0	1490	24	1563	24	970	24	1589	24	938	24	440	24
4	M	0	M	0	M	0	M	0	M	0	M	0	797	24	1872	24	1260	15	452	24	633	24	397	24
5	M	0	M	0	M	0	M	0	M	0	M	0	M	0	1265	24	M	0	1280	24	363	24	749	24
6	M	0	M	0	M	0	M	0	M	0	M	0	M	0	1962	24	M	0	1264	24	1179	24	758	24
7	M	0	M	0	M	0	M	0	M	0	M	0	1492	16	2062	24	993	18	1543	24	1134	24	655	24
8	M	0	M	0	M	0	M	0	M	0	M	0	2250	24	1589	24	1957	24	1587	24	753	24	713	24
9	M	0	M	0	M	0	M	0	M	0	M	0	2067	24	2176	24	1943	24	1328	24	485	24	190	24
10	M	0	M	0	M	0	M	0	M	0	M	0	2478	24	1226	24	1942	24	229	24	1169	24	871	24
11	M	0	M	0	M	0	M	0	M	0	M	0	2493	24	2103	24	1325	24	1457	24	1076	24	841	24
12	M	0	M	0	M	0	M	0	M	0	M	0	2132	24	2004	24	1780	24	524	24	1034	24	933	24
13	M	0	M	0	M	0	M	0	M	0	M	0	2200	24	1690	24	1243	24	1092	24	1072	24	731	24
14	M	0	M	0	M	0	M	0	M	0	M	0	2157	24	1692	24	996	24	273	15	1044	24	535	24
15	M	0	M	0	M	0	M	0	M	0	M	0	1243	24	1142	24	1167	24	88	10	536	24	756	24
16	M	0	M	0	M	0	M	0	M	0	M	0	1666	24	1158	24	1346	24	677	24	509	24	282	24
17	M	0	M	0	M	0	M	0	M	0	M	0	2225	24	1676	24	1268	24	236	24	1039	24	798	24
18	M	0	M	0	M	0	M	0	M	0	M	0	1617	24	2188	24	1356	24	M	0	945	24	988	24
19	M	0	M	0	M	0	M	0	M	0	M	0	1031	24	1922	24	1799	24	433	11	384	24	1027	24
20	M	0	M	0	M	0	M	0	M	0	M	0	1715	16	2180	24	1774	24	1383	24	186	24	949	24
21	M	0	M	0	M	0	M	0	M	0	M	0	2104	17	2148	24	1255	22	1159	24	545	24	130	24
22	M	0	M	0	M	0	M	0	M	0	M	0	2233	24	1768	24	1636	24	144	24	1041	24	143	24
23	M	0	M	0	M	0	M	0	M	0	116	7	691	24	1820	24	1782	24	1279	24	136	24	906	24
24	M	0	M	0	M	0	M	0	M	0	1879	24	1488	24	1818	24	1075	24	1449	24	104	24	796	24
25	M	0	M	0	M	0	M	0	M	0	2114	24	1843	24	1414	14	1493	24	893	24	258	24	846	24
26	M	0	M	0	M	0	M	0	M	0	2675	24	427	18	M	0	1047	24	160	24	339	24	391	24
27	M	0	M	0	M	0	M	0	M	0	2249	24	1322	24	M	0	129	8	1129	24	879	24	537	24
28	M	0	M	0	M	0	M	0	M	0	1401	24	747	24	M	0	1269	15	1016	24	383	24	294	24
29	M	0			M	0	M	0	M	0	2265	24	1864	24	M	0	1222	24	1079	24	829	24	968	24
30	M	0			M	0	M	0	M	0	1099	24	2352	24	M	0	1549	24	1139	24	100	24	935	24
31	M	0			M	0			M	0			2405	24	144	11			912	24			66	24
M TOT	M		M		M		M		M		13685		44511		43030		32127		28159		20346		19432	
# DAYS	0		0		0		0		0		7		25		24		23		27		30		31	
DAY AV	M		M		M		M		M		1955		1780		1792		1396		1042		678		626	
D MAX	M		M		M		M		M		2675		2493		2188		1957		1734		1179		1027	
D MIN	M		M		M		M		M		1099		691		1142		573		144		100		66	

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

CHAMPAIGN, ILLINOIS
88 57'W, 40 03'N
219 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = BTU/FT2

MONTH

DAY	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H
1	M	0	M	0	M	0	M	0	M	0	1063	24	1668	24	2133	24	779	24	1503	24	469	24	130	24
2	M	0	M	0	M	0	M	0	M	0	1437	24	2067	24	1617	24	358	24	1698	24	410	24	307	24
3	M	0	M	0	M	0	M	0	M	0	1684	24	1861	24	978	24	327	24	1607	24	822	24	335	24
4	M	0	M	0	M	0	M	0	M	0	2473	24	440	24	1849	24	1410	24	850	24	523	24	677	24
5	M	0	M	0	M	0	M	0	M	0	1520	24	954	24	354	24	1779	24	1156	24	595	24	771	24
6	M	0	M	0	M	0	M	0	M	0	2131	24	2299	24	1303	24	1563	24	1179	24	1114	24	573	24
7	M	0	M	0	M	0	M	0	M	0	2608	24	2110	24	1996	24	1043	24	1604	24	1091	24	458	24
8	M	0	M	0	M	0	M	0	25	8	1908	24	2383	24	1309	24	2001	24	1560	24	621	24	182	24
9	M	0	M	0	M	0	M	0	644	24	2128	24	2357	24	1807	24	1853	24	1438	24	823	24	575	24
10	M	0	M	0	M	0	M	0	167	24	1790	24	2612	24	1002	24	1973	24	534	24	1093	24	824	24
11	M	0	M	0	M	0	M	0	444	24	754	24	2456	24	2143	24	1490	24	1464	24	1035	24	777	24
12	M	0	M	0	M	0	M	0	1963	24	1057	24	1991	24	1979	24	1584	24	1305	24	1006	24	781	24
13	M	0	M	0	M	0	M	0	640	24	992	24	2220	24	1742	24	1552	24	1078	24	889	24	468	24
14	M	0	M	0	M	0	M	0	197	24	1938	24	1723	24	875	24	712	24	278	24	978	24	392	24
15	M	0	M	0	M	0	M	0	2423	24	2054	24	943	24	1137	24	1563	24	356	24	716	24	695	24
16	M	0	M	0	M	0	M	0	2315	24	1223	24	621	24	1614	24	1364	24	1253	24	351	24	257	24
17	M	0	M	0	M	0	M	0	745	24	2637	24	2248	24	2294	24	722	24	167	24	986	24	501	24
18	M	0	M	0	M	0	M	0	324	24	2642	24	1667	24	2297	24	1362	24	559	24	712	24	876	24
19	M	0	M	0	M	0	M	0	2222	24	783	24	752	24	2240	24	1647	24	1405	24	340	24	915	24
20	M	0	M	0	M	0	M	0	2603	24	2155	24	1749	24	2254	24	1691	24	1324	24	239	24	921	24
21	M	0	M	0	M	0	M	0	2581	24	885	24	1336	24	2067	24	1649	24	917	24	254	24	103	24
22	M	0	M	0	M	0	M	0	2149	24	2353	24	2314	24	2016	24	1562	24	301	24	730	24	224	24
23	M	0	M	0	M	0	M	0	1411	24	2633	24	1312	24	1925	24	1769	24	879	24	65	24	885	24
24	M	0	M	0	M	0	M	0	1355	24	1864	24	1720	24	1881	24	1323	24	1332	24	252	24	1016	24
25	M	0	M	0	M	0	M	0	2091	24	2316	24	1203	24	1698	24	1089	24	1075	24	121	24	809	24
26	M	0	M	0	M	0	M	0	897	24	2449	24	696	24	1082	24	1115	24	199	24	283	24	478	24
27	M	0	M	0	M	0	M	0	1751	24	2363	24	1131	24	891	24	1735	24	815	24	490	24	253	24
28	M	0	M	0	M	0	M	0	2320	24	1614	24	670	24	967	24	1741	24	960	24	343	24	548	24
29	M	0			M	0	M	0	2026	24	2344	24	1975	24	1731	24	601	24	1198	24	854	24	880	24
30	M	0			M	0	M	0	1061	24	966	24	2377	24	1590	24	1503	24	1095	24	138	24	833	24
31	M	0			M	0			2571	24			2309	24	1651	24			764	24			131	24
M TOT	M		M		M		M		34902		54682		52182		50637		40874		31869		18358		17592	
# DAYS	0		0		0		0		23		30		31		31		30		31		30		31	
DAY AV	M		M		M		M		1517		1822		1683		1633		1362		1028		611		567	
D MAX	M		M		M		M		2603		2642		2612		2297		2001		1698		1114		1016	
D MIN	M		M		M		M		167		754		440		354		327		167		65		103	

LKH 5/81

DE KALB, ILLINOIS
88 51'W, 41 51'N
265 M ABOVE MSL

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = BTU/FT2

MONTH

DAY	JANUARY BTU/FT	#H	FEBRUARY BTU/FT	#H	MARCH BTU/FT	#H	APRIL BTU/FT	#H	MAY BTU/FT	#H	JUNE BTU/FT	#H	JULY BTU/FT	#H	AUGUST BTU/FT	#H	SEPTEMBER BTU/FT	#H	OCTOBER BTU/FT	#H	NOVEMBER BTU/FT	#H	DECEMBER BTU/FT	#H
1	M	0	M	0	M	0	M	0	M	0	M	0	M	0	2360	24	437	24	1028	24	416	24	96	24
2	M	0	M	0	M	0	M	0	M	0	M	0	M	0	802	24	1130	24	1688	24	295	24	183	24
3	M	0	M	0	M	0	M	0	M	0	M	0	M	0	1742	24	1368	24	1526	24	981	24	230	24
4	M	0	M	0	M	0	M	0	M	0	M	0	M	0	1959	24	1936	24	980	24	323	24	769	24
5	M	0	M	0	M	0	M	0	M	0	M	0	M	0	491	24	1564	24	683	24	542	24	368	24
6	M	0	M	0	M	0	M	0	M	0	M	0	M	0	1422	24	1549	24	1332	24	1054	24	627	24
7	M	0	M	0	M	0	M	0	M	0	M	0	M	0	1355	24	686	24	1592	24	1069	24	572	24
8	M	0	M	0	M	0	M	0	M	0	M	0	M	0	1597	24	1885	24	1448	24	878	24	118	24
9	M	0	M	0	M	0	M	0	M	0	M	0	0	5	1613	24	1763	24	1051	24	1047	24	415	24
10	M	0	M	0	M	0	M	0	M	0	M	0	2567	24	1715	24	1911	24	1028	24	1006	24	808	24
11	M	0	M	0	M	0	M	0	M	0	M	0	1802	24	1997	24	1598	24	1058	24	M	24	771	24
12	M	0	M	0	M	0	M	0	M	0	M	0	2099	24	1927	24	1691	24	1349	24	962	24	682	24
13	M	0	M	0	M	0	M	0	M	0	M	0	1254	24	1925	24	1582	24	915	24	966	24	313	24
14	M	0	M	0	M	0	M	0	M	0	M	0	1592	24	613	24	1467	24	148	24	713	24	229	24
15	M	0	M	0	M	0	M	0	M	0	6	6	691	24	1968	24	1396	24	414	24	447	24	668	24
16	M	0	M	0	M	0	M	0	M	0	1573	24	1714	24	1533	24	1386	24	1145	24	511	24	419	24
17	M	0	M	0	M	0	M	0	M	0	2721	24	2189	24	2310	24	1017	24	167	24	929	24	519	24
18	M	0	M	0	M	0	M	0	M	0	2213	24	1801	24	1958	24	851	24	350	24	486	24	825	24
19	M	0	M	0	M	0	M	0	M	0	2290	24	1263	24	2289	24	1766	24	1404	24	110	24	823	24
20	M	0	M	0	M	0	M	0	M	0	1614	24	1900	24	2058	24	1712	24	1160	24	465	24	755	24
21	M	0	M	0	M	0	M	0	M	0	897	24	1149	24	1963	24	1005	24	148	24	650	24	150	24
22	M	0	M	0	M	0	M	0	M	0	2314	24	2297	24	1588	24	1475	24	750	24	556	24	254	24
23	M	0	M	0	M	0	M	0	M	0	2291	24	1512	24	1819	24	1730	24	748	24	95	24	776	24
24	M	0	M	0	M	0	M	0	M	0	1558	24	1889	24	1739	24	1234	24	762	24	863	24	768	24
25	M	0	M	0	M	0	M	0	M	0	2530	24	848	24	1391	24	350	24	215	22	274	24	740	24
26	M	0	M	0	M	0	M	0	M	0	2429	24	511	24	1204	24	254	24	455	24	238	24	299	24
27	M	0	M	0	M	0	M	0	M	0	2428	24	348	24	1175	24	1698	24	1054	24	344	24	407	24
28	M	0	M	0	M	0	M	0	M	0	2158	24	801	24	1175	24	1696	24	893	24	425	24	260	24
29	M	0			M	0	M	0	M	0	1949	24	2376	24	1476	24	589	24	1084	24	778	24	552	24
30	M	0			M	0	M	0	M	0	M	0	2251	24	1531	24	1397	24	1027	24	213	24	369	24
31	M	0			M	0			M	0			2428	24	1594	24			505	24			129	24
M TOT	M		M		M		M		M		28972		36289		50303		40140		27904		18650		14908	
# DAYS	0		0		0		0		0		14		22		31		30		30		30		31	
DAY AV	M		M		M		M		M		2069		1604		1622		1338		930		621		480	
D MAX	M		M		M		M		M		2721		2567		2360		1936		1688		1069		825	
D MIN	M		M		M		M		M		897		348		491		254		148		95		96	

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

DIXON SPRINGS, ILLINOIS
88 40'W, 37 27'N
165 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = BTU/FT2

MONTH

DAY	JANUARY BTU/FT	#H	FEBRUARY BTU/FT	#H	MARCH BTU/FT	#H	APRIL BTU/FT	#H	MAY BTU/FT	#H	JUNE BTU/FT	#H	JULY BTU/FT	#H	AUGUST BTU/FT	#H	SEPTEMBER BTU/FT	#H	OCTOBER BTU/FT	#H	NOVEMBER BTU/FT	#H	DECEMBER BTU/FT	#H
1	M	0	M	0	M	0	M	0	M	0	M	0	1822	24	2041	24	1158	24	959	24	405	24	660	24
2	M	0	M	0	M	0	M	0	M	0	M	0	2354	24	1965	24	516	24	1809	24	1036	24	695	24
3	M	0	M	0	M	0	M	0	M	0	7	6	1960	24	1191	24	1860	24	1697	24	896	24	454	24
4	M	0	M	0	M	0	M	0	M	0	1626	24	1765	24	2054	24	1576	24	482	24	284	20	352	24
5	M	0	M	0	M	0	M	0	M	0	1259	24	190	9	1813	24	1643	24	1306	24	541	24	849	24
6	M	0	M	0	M	0	M	0	M	0	M	0	1151	24	1430	24	1729	24	1147	24	1288	24	734	24
7	M	0	M	0	M	0	M	0	M	0	M	0	1910	24	990	24	1520	24	1338	24	1244	24	673	24
8	M	0	M	0	M	0	M	0	M	0	2231	17	2491	24	1768	24	2000	24	1638	24	1050	24	967	24
9	M	0	M	0	M	0	M	0	M	0	1657	24	2375	24	2178	24	1076	24	1214	24	180	24	451	24
10	M	0	M	0	M	0	M	0	M	0	908	24	779	11	1369	14	2042	24	383	24	1138	24	929	24
11	M	0	M	0	M	0	M	0	M	0	1620	24	M	0	184	9	1847	24	1371	24	1194	24	383	24
12	M	0	M	0	M	0	M	0	M	0	1469	24	M	0	1992	24	1905	24	557	24	1125	24	947	24
13	M	0	M	0	M	0	M	0	M	0	1608	24	219	8	1800	24	1294	24	1002	24	1023	24	647	24
14	M	0	M	0	M	0	M	0	M	0	1970	24	1839	24	1940	24	829	24	276	24	1077	24	739	24
15	M	0	M	0	M	0	M	0	M	0	1924	24	1732	24	1091	24	694	24	545	24	648	24	815	24
16	M	0	M	0	M	0	M	0	M	0	794	24	1263	24	1579	24	1158	22	420	14	442	24	589	24
17	M	0	M	0	M	0	M	0	M	0	2725	24	1582	24	1400	24	1227	22	M	0	1148	24	442	24
18	M	0	M	0	M	0	M	0	M	0	2622	24	1432	24	1905	24	1508	24	M	0	1070	24	979	24
19	M	0	M	0	M	0	M	0	M	0	410	18	2136	24	891	24	1690	24	1558	24	239	24	1091	24
20	M	0	M	0	M	0	M	0	M	0	1986	24	1993	16	1688	24	1890	24	1501	24	137	24	1039	24
21	M	0	M	0	M	0	M	0	M	0	711	23	M	0	1867	24	1826	24	1216	15	921	24	61	24
22	M	0	M	0	M	0	M	0	M	0	1216	24	363	9	1470	24	1673	24	155	16	996	24	81	24
23	M	0	M	0	M	0	M	0	M	0	2608	24	761	24	1972	24	1867	24	1508	24	122	24	297	24
24	M	0	M	0	M	0	M	0	M	0	2311	24	922	20	1789	24	1495	24	1505	24	121	24	554	24
25	M	0	M	0	M	0	M	0	M	0	2351	24	1677	24	1706	24	1621	24	777	24	599	24	925	24
26	M	0	M	0	M	0	M	0	M	0	2696	24	1974	24	1084	23	1480	24	131	24	239	24	290	24
27	M	0	M	0	M	0	M	0	M	0	2291	24	1532	24	658	24	1791	24	1323	24	899	24	871	24
28	M	0	M	0	M	0	M	0	M	0	2333	24	797	24	1340	24	1801	24	968	24	587	24	531	24
29	M	0			M	0	M	0	M	0	2218	24	1361	24	1754	24	1637	24	1241	24	530	24	983	24
30	M	0			M	0	M	0	M	0	1284	24	2173	24	1815	24	1633	24	1239	24	79	24	1007	24
31	M	0			M	0			M	0			2299	24	1524	24			893	24			125	24
M TOT	M		M		M		M		M		41487		38399		45523		44414		28303		20989		20174	
# DAYS	0		0		0		0		0		22		22		28		28		26		29		31	
DAY AV	M		M		M		M		M		1885		1745		1625		1586		1091		723		650	
D MAX	M		M		M		M		M		2725		2491		2178		2042		1809		1288		1091	
D MIN	M		M		M		M		M		794		761		658		516		131		79		61	

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

MONMOUTH, ILLINOIS
90 45'W, 40 65'N
229 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = BTU/FT2

MONTH

DAY	JANUARY BTU/FT	#H	FEBRUARY BTU/FT	#H	MARCH BTU/FT	#H	APRIL BTU/FT	#H	MAY BTU/FT	#H	JUNE BTU/FT	#H
1	M	0	M	0	M	0	M	0	M	0	M	0
2	M	0	M	0	M	0	M	0	M	0	M	0
3	M	0	M	0	M	0	M	0	M	0	M	0
4	M	0	M	0	M	0	M	0	M	0	M	0
5	M	0	M	0	M	0	M	0	M	0	M	0
6	M	0	M	0	M	0	M	0	M	0	M	0
7	M	0	M	0	M	0	M	0	M	0	M	0
8	M	0	M	0	M	0	M	0	M	0	M	0
9	M	0	M	0	M	0	M	0	M	0	M	0
10	M	0	M	0	M	0	M	0	M	0	M	0
11	M	0	M	0	M	0	M	0	M	0	M	0
12	M	0	M	0	M	0	M	0	M	0	M	0
13	M	0	M	0	M	0	M	0	M	0	M	0
14	M	0	M	0	M	0	M	0	M	0	M	0
15	M	0	M	0	M	0	M	0	M	0	M	0
16	M	0	M	0	M	0	M	0	M	0	M	0
17	M	0	M	0	M	0	M	0	M	0	M	0
18	M	0	M	0	M	0	M	0	M	0	M	0
19	M	0	M	0	M	0	M	0	M	0	M	0
20	M	0	M	0	M	0	M	0	M	0	M	0
21	M	0	M	0	M	0	M	0	M	0	M	0
22	M	0	M	0	M	0	M	0	M	0	M	0
23	M	0	M	0	M	0	M	0	M	0	M	0
24	M	0	M	0	M	0	M	0	M	0	M	0
25	M	0	M	0	M	0	M	0	M	0	M	0
26	M	0	M	0	M	0	M	0	M	0	M	0
27	M	0	M	0	M	0	M	0	M	0	M	0
28	M	0	M	0	M	0	M	0	M	0	M	0
29	M	0			M	0	M	0	M	0	1600	16
30	M	0			M	0	M	0	M	0	0	5
31	M	0			M	0			M	0		
M TOT	M		M		M		M		M		0	
# DAYS	0		0		0		0		0		0	
DAY AV	M		M		M		M		M******************************			
D MAX	M		M		M		M		M		0	
D MIN	M		M		M		M		M		0	

DAY	JULY BTU/FT	#H	AUGUST BTU/FT	#H	SEPTEMBER BTU/FT	#H	OCTOBER BTU/FT	#H	NOVEMBER BTU/FT	#H	DECEMBER BTU/FT	#H
1	M	0	M	0	M	0	1561	24	257	24	87	24
2	M	0	M	0	M	0	1669	24	351	24	704	24
3	M	0	M	0	M	0	1017	24	512	24	23	9
4	M	0	M	0	M	0	1475	24	268	24	3	8
5	M	0	M	0	M	0	548	24	526	24	820	24
6	M	0	M	0	M	0	1293	24	1085	24	546	24
7	M	0	M	0	M	0	1576	24	1099	24	743	24
8	M	0	M	0	M	0	1521	24	686	24	575	24
9	M	0	M	0	M	0	1339	24	1068	24	200	24
10	M	0	M	0	M	0	880	24	1041	24	796	24
11	M	0	M	0	M	0	1363	24	1012	24	596	24
12	M	0	M	0	M	0	785	24	944	24	532	24
13	M	0	M	0	M	0	586	24	950	24	209	24
14	M	0	M	0	M	0	0	6	919	24	354	24
15	M	0	M	0	M	0	202	10	479	24	428	24
16	M	0	M	0	M	0	1158	24	905	24	285	24
17	M	0	M	0	1238	14	728	16	964	24	675	24
18	M	0	M	0	1404	24	M	0	790	24	895	24
19	M	0	M	0	1746	24	M	0	103	24	929	24
20	M	0	M	0	1674	24	M	0	300	24	699	24
21	M	0	M	0	1583	24	M	0	491	24	182	24
22	M	0	M	0	1792	24	409	11	757	24	147	24
23	M	0	M	0	1620	24	0	6	103	24	806	24
24	M	0	M	0	978	24	M	0	238	11	828	24
25	M	0	M	0	349	24	M	0	91	24	741	24
26	M	0	M	0	314	24	M	0	112	24	683	24
27	M	0	122	9	1705	24	M	0	464	24	273	24
28	M	0	80	9	1679	24	M	0	620	24	75	10
29	M	0	M	0	1237	24	72	9	787	24	M	0
30	M	0	M	0	1439	24	994	24	118	24	4	8
31	M	0	M	0			430	24			183	24
M TOT	0		0		17527		18203		17814		13928	
# DAYS	0		0		13		16		29		26	
DAY AV					1348		1137		614		535	
D MAX	0		0		1792		1669		1099		929	
D MIN	0		0		314		430		91		87	

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

PERRY, ILLINOIS
90 50'W, 39 48'N
206 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

YEAR: 1981

UNITS: DAILY AND MONTHLY = BTU/FT2

MONTH

DAY	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H	BTU/FT	#H
1	M	0	M	0	M	0	M	0	M	0	M	0	1598	24	2199	24	770	24	1624	24	251	24	45	24
2	M	0	M	0	M	0	M	0	M	0	M	0	1692	24	881	21	1726	24	1658	24	343	24	589	24
3	M	0	M	0	M	0	M	0	M	0	M	0	1714	24	1010	24	1468	24	1256	24	700	24	26	9
4	M	0	M	0	M	0	M	0	M	0	M	0	347	21	2009	24	1720	24	1228	24	599	24	631	24
5	M	0	M	0	M	0	M	0	M	0	M	0	746	24	1329	24	1642	24	12	7	599	24	545	24
6	M	0	M	0	M	0	M	0	M	0	M	0	2350	24	1474	24	1816	24	1404	17	1122	24	621	24
7	M	0	M	0	M	0	M	0	M	0	M	0	2035	24	1894	24	248	24	1537	24	1124	24	731	24
8	M	0	M	0	M	0	M	0	M	0	M	0	2227	24	548	17	1944	24	1430	24	411	24	9	8
9	M	0	M	0	M	0	M	0	M	0	M	0	576	10	1940	24	1688	23	1261	24	764	24	59	11
10	M	0	M	0	M	0	M	0	M	0	M	0	2204	17	847	24	1911	24	793	24	1064	24	812	24
11	M	0	M	0	M	0	M	0	M	0	M	0	61	8	563	10	1626	24	1346	24	1014	24	674	24
12	M	0	M	0	M	0	M	0	M	0	M	0	2118	17	7	6	1358	24	796	24	946	24	694	24
13	M	0	M	0	M	0	M	0	M	0	M	0	2332	24	46	7	1516	24	570	24	97	9	175	24
14	M	0	M	0	M	0	M	0	M	0	M	0	1565	15	1382	14	1306	24	89	24	701	14	213	24
15	M	0	M	0	M	0	M	0	M	0	M	0	714	16	1319	20	1593	16	290	24	427	24	484	24
16	M	0	M	0	M	0	M	0	M	0	M	0	1819	24	640	24	1329	17	887	24	906	24	186	24
17	M	0	M	0	M	0	M	0	M	0	M	0	2035	16	1908	24	1429	24	651	24	1002	24	0	7
18	M	0	M	0	M	0	M	0	M	0	268	8	750	16	2084	23	1509	24	208	9	854	24	913	24
19	M	0	M	0	M	0	M	0	M	0	1567	24	829	6	1849	24	1767	24	1381	17	93	24	939	24
20	M	0	M	0	M	0	M	0	M	0	1236	24	1611	10	2108	24	1725	24	1313	24	161	24	761	24
21	M	0	M	0	M	0	M	0	M	0	757	18	1930	17	2033	24	1642	24	363	24	768	24	241	24
22	M	0	M	0	M	0	M	0	M	0	1174	12	1180	24	1381	24	1434	24	698	24	945	24	151	24
23	M	0	M	0	M	0	M	0	M	0	2502	24	1309	24	1642	22	1530	24	228	17	3	8	957	24
24	M	0	M	0	M	0	M	0	M	0	1792	24	1085	24	1329	24	651	24	862	20	M	0	878	24
25	M	0	M	0	M	0	M	0	M	0	2384	24	1404	24	1746	24	648	24	406	24	M	0	676	24
26	M	0	M	0	M	0	M	0	M	0	2568	24	M	0	1066	24	356	10	526	24	M	0	768	24
27	M	0	M	0	M	0	M	0	M	0	1767	24	M	0	767	23	1240	14	1233	24	M	0	608	24
28	M	0	M	0	M	0	M	0	M	0	2396	24	1	5	12	7	1667	24	959	24	M	0	463	24
29	M	0			M	0	M	0	M	0	2237	24	2061	24	1657	24	1275	24	1184	24	M	0	1014	24
30	M	0			M	0	M	0	M	0	1532	24	2298	24	332	19	1521	24	1053	24	14	11	822	24
31	M	0			M	0			M	0			2282	24	1558	9			462	24			192	24
M TOT	M		M		M		M		0		19986		28140		28928		35861		23674		14103		15795	
# DAYS	0		0		0		0		0		10		16		18		25		25		20		27	
DAY AV	M		M		M		M**********				1998		1758		1607		1434		946		705		585	
D MAX	M		M		M		M		0		2568		2350		2199		1944		1658		1124		1014	
D MIN	M		M		M		M		0		1236		746		640		248		89		93		45	

APPENDIX B

Hourly global radiation data (Wm^{-2}) for Champaign, 1981.

The following tables in Appendix B provide the hourly record of total solar radiation received on a horizontal surface at the Champaign site from the commencement of measurement on May 8, 1981 to the end of 1981. Daily and monthly totals, means, and extreme values are also included, and the data can be presented in three unit formats so as to be immediately useful to a wide spectrum of users. The tables presented have provided hourly values in units of W/m^2 and daily data in MJ/m^2. Alternative formats with units of cal/cm^2 or BTU/ft^2 are available upon request. The unit conversion table in the text (Table 6) can also be used to provide desired units.

The general format is the same in all cases, with each page providing the data for one month. The body of each table provides hourly data for each day of the month in units of W/m^2. The right hand columns list daily totals (TOTD) in MJ/m^2, and the number of hours of acceptable data for each day (#H). The rows across below the hourly data matrix provide monthly mean, maximum and minimum values of solar radiation received for each hour period, labeled as AV, MAX, MIN, respectively and each in units of W/m^2, and the number of days in the month (#D) for which there was acceptable data for that hour period. The row entitled TOT provides the total solar radiation received through the whole month for the hour period in MJ/m^2. The small table at the bottom provides corresponding values for the whole month, using only days with a full 24 hours of acceptable data, and in the units specified within the table.

The Champaign record provides a good example of uninterrupted data, allowing the highest confidence in daily and monthly totals and monthly means and extremes. The maximum daily values for each month are typical of a clear day solar energy receipt on a horizontal surface, while the monthly average value tends to be representative of the energy receipt on most days of the month.

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ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

CHAMPAIGN, ILLINOIS
88 57'W, 40 03'N
219 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

MAY, 1981

UNITS: HOURLY = W/M2, DAILY (TOTD & TOT) AND MONTHLY = MJ/M2

HOUR (CST) ENDING AT

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	TOTD	#H
1	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0
2	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0
3	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0
4	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0
5	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0
6	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0
7	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	0
8	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	66	14	2	0	0	0	0	0	.30	8
9	0	0	0	0	2	34	123	139	46	375	464	396	198	61	34	87	54	17	4	0	0	0	0	0	7.32	24
10	0	0	0	0	0	4	10	27	26	31	71	69	62	62	67	42	36	17	4	1	0	0	0	0	1.90	24
11	0	0	0	0	0	13	34	53	67	50	66	97	76	111	214	312	169	99	42	0	0	0	0	0	5.05	24
12	0	0	0	0	6	107	309	485	711	838	896	835	565	603	437	193	111	83	15	0	0	0	0	0	22.30	24
13	0	0	0	0	1	16	47	119	249	230	364	390	204	119	157	57	45	19	3	0	0	0	0	0	7.27	24
14	0	0	0	0	0	3	13	21	30	56	78	53	98	69	98	28	19	21	5	0	0	0	0	0	2.13	24
15	0	0	0	0	4	37	152	449	689	856	962	979	924	817	573	517	431	207	47	0	0	0	0	0	27.52	24
16	0	0	0	0	8	103	295	507	676	760	815	749	776	805	711	535	344	173	48	0	0	0	0	0	26.30	24
17	0	0	0	0	2	36	125	136	227	505	492	218	146	175	141	80	47	17	5	0	0	0	0	0	8.47	24
18	0	0	0	0	0	4	16	62	89	114	123	190	104	73	83	74	42	29	18	2	0	0	0	0	3.68	24
19	0	0	0	0	3	14	52	269	379	799	826	797	852	920	805	612	409	216	57	0	0	0	0	0	25.24	24
20	0	0	0	0	8	113	302	503	680	824	917	952	944	882	768	611	423	227	59	0	0	0	0	0	29.57	24
21	0	0	0	0	9	109	295	497	670	810	903	945	942	880	766	610	424	226	57	0	0	0	0	0	29.31	24
22	0	0	0	0	9	112	296	489	602	806	902	851	651	582	528	473	297	138	44	0	0	0	0	0	24.41	24
23	0	0	0	0	1	32	124	204	267	179	190	625	867	822	704	141	60	215	21	0	0	0	0	0	16.03	24
24	0	0	0	0	8	83	184	456	392	774	723	145	128	604	349	238	102	56	32	2	0	0	0	0	15.39	24
25	0	0	0	0	8	111	296	504	668	811	672	846	678	609	472	425	292	166	42	0	0	0	0	0	23.76	24
26	0	0	0	0	7	53	77	114	210	255	343	394	387	315	316	194	83	52	32	0	0	0	0	0	10.20	24
27	0	0	0	0	6	63	166	361	297	592	497	598	659	585	559	506	371	204	57	3	0	0	0	0	19.99	24
28	0	0	0	0	11	111	290	482	654	788	793	874	919	797	524	456	387	186	48	0	0	0	0	0	26.35	24
29	0	0	0	0	9	48	125	361	587	693	642	728	879	728	609	519	350	98	17	0	0	0	0	0	23.01	24
30	0	0	0	0	2	25	48	156	270	426	380	320	437	457	348	230	136	91	23	0	0	0	0	0	12.06	24
31	0	0	0	0	12	123	313	515	691	824	912	952	939	879	767	617	303	204	59	2	0	0	0	0	29.20	24
AV	0	0	0	0	5	58	160	300	399	538	566	565	540	519	436	328	208	115	30	.0	0	0	0	0		
MAX	0	0	0	0	12	123	313	515	711	856	962	979	944	920	805	617	431	227	59	3	0	0	0	0		
MIN	0	0	0	0	0	3	10	21	26	31	66	53	62	61	34	28	19	14	2	0	0	0	0	0		
#D	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	24	24	24	24	24	24	24	24		
TOT	0.0	0.0	0.0	0.0	.4	4.9	13.3	24.9	33.0	44.6	46.9	46.8	44.8	43.0	36.1	27.2	18.0	10.0	2.7	.0	0.0	0.0	0.0	0.0		

MONTHLY VALUES (FOR DAYS OF COMPLETE DATA ONLY)

TOTAL FOR MONTH	396.4 MJ/M2	DAILY AVER	17.23 MJ/M2
		DAILY MAX	29.57 MJ/M2
# COMPLETE DAYS	23	DAILY MIN	1.90 MJ/M2

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ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

CHAMPAIGN, ILLINOIS
88 57'W, 40 03'N
219 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

JUNE, 1981

UNITS: HOURLY = W/M2, DAILY (TOTD & TOT) AND MONTHLY = MJ/M2

HOUR (CST) ENDING AT

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	TOTD	#H
1	0	0	0	0	8	60	139	314	514	418	147	211	417	266	348	250	168	62	30	2	0	0	0	0	12.07	24
2	0	0	0	0	4	28	82	189	524	440	388	683	751	388	470	220	230	114	25	0	0	0	0	0	16.33	24
3	0	0	0	0	5	35	99	288	582	717	639	566	543	478	410	439	310	158	41	3	0	0	0	0	19.13	24
4	0	0	0	0	6	113	302	483	588	727	894	945	934	866	737	559	363	222	62	3	0	0	0	0	28.09	24
5	0	0	0	0	5	90	96	157	277	431	543	490	530	684	629	280	301	210	68	4	0	0	0	0	17.26	24
6	0	0	0	0	12	99	263	463	660	711	756	771	657	619	474	476	419	260	78	7	0	0	0	0	24.21	24
7	0	0	0	0	10	114	305	521	687	821	911	940	934	910	776	539	457	246	56	3	0	0	0	0	29.63	24
8	0	0	0	0	10	88	278	472	631	615	866	851	844	369	139	323	325	197	11	0	0	0	0	0	21.67	24
9	0	0	0	0	17	125	289	480	627	692	910	553	782	814	741	468	149	51	10	3	2	0	0	0	24.17	24
10	0	0	0	0	11	81	72	107	114	255	647	916	678	794	716	630	361	183	76	7	0	0	0	0	20.33	24
11	0	0	0	0	11	79	125	201	318	380	188	187	148	252	272	72	42	80	23	3	0	0	0	0	8.57	24
12	0	0	0	0	4	26	60	10	8	88	84	56	509	696	661	600	251	210	68	5	0	0	0	0	12.01	24
13	0	0	0	0	3	26	147	113	199	251	258	335	340	457	325	242	29	39	44	6	0	0	0	0	10.13	24
14	0	0	0	0	6	100	152	156	423	559	855	780	719	676	509	525	390	206	53	5	0	0	0	0	22.01	24
15	0	0	0	1	11	110	290	414	500	764	826	654	376	653	660	615	353	233	29	1	2	0	0	0	23.34	24
16	0	0	0	0	3	22	62	115	189	196	392	398	268	481	609	443	326	267	84	6	0	0	0	0	13.90	24
17	0	0	0	0	16	136	332	530	716	774	848	905	904	845	795	652	473	286	102	6	0	0	0	0	29.95	24
18	0	0	0	0	14	134	324	519	687	824	913	958	945	883	721	621	443	256	88	6	0	0	0	0	30.01	24
19	0	0	0	0	3	27	87	129	116	165	189	389	85	225	123	263	386	213	68	4	0	0	0	0	8.90	24
20	0	0	0	0	8	99	268	462	642	777	867	854	736	647	504	557	329	40	10	4	0	0	0	0	24.49	24
21	0	0	0	0	1	36	109	94	86	240	156	104	132	255	380	515	359	236	86	4	0	0	0	0	10.05	24
22	0	0	0	0	4	120	280	439	671	821	888	847	841	757	702	477	276	238	55	8	0	0	0	0	26.73	24
23	0	0	0	0	14	134	320	510	673	806	895	937	928	874	768	619	451	273	100	6	0	0	0	0	29.91	24
24	0	0	0	0	2	2	18	221	512	727	816	851	658	458	569	555	411	76	4	0	0	0	0	0	21.17	24
25	0	0	0	0	8	55	182	330	275	668	887	846	925	870	783	653	461	257	101	7	0	0	0	0	26.31	24
26	0	0	0	0	13	124	310	498	663	794	872	889	934	873	655	500	240	258	98	6	1	0	0	0	27.82	24
27	0	0	0	0	12	119	300	491	658	789	903	816	637	741	685	531	428	255	86	6	0	0	0	0	26.85	24
28	0	0	0	0	4	32	81	190	185	191	164	508	874	827	721	582	414	232	82	6	0	0	0	0	18.33	24
29	0	0	0	0	9	95	234	433	600	748	820	871	871	822	722	508	402	220	37	4	0	0	0	0	26.63	24
30	0	0	0	0	6	34	61	77	104	235	291	341	454	228	267	396	322	176	50	6	1	0	0	0	10.98	24
AV	0	0	0	0	8	78	188	313	447	554	627	648	645	623	562	470	328	191	57	4	0	0	0	0		
MAX	0	0	0	1	17	136	332	530	716	824	913	958	945	910	795	653	473	286	102	8	2	0	0	0		
MIN	0	0	0	0	1	2	18	10	8	88	84	56	85	225	123	72	29	39	4	0	0	0	0	0		
#D	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30		
TOT	0.0	0.0	0.0	.0	.9	8.4	20.4	33.9	48.3	59.8	67.7	70.0	69.7	67.3	60.7	50.8	35.5	20.7	6.2	.5	.0	0.0	0.0	0.0		

MONTHLY VALUES (FOR DAYS OF COMPLETE DATA ONLY)

TOTAL FOR MONTH 621.0 MJ/M2

COMPLETE DAYS 30

DAILY AVER 20.70 MJ/M2
DAILY MAX 30.01 MJ/M2
DAILY MIN 8.57 MJ/M2

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SENSOR: EPPLEY 8-48 PYRANOMETER

JULY, 1981

UNITS: HOURLY = W/M2, DAILY (TOTD & TOT) AND MONTHLY = MJ/M2

HOUR (CST) ENDING AT

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	TOTD	#H
1	0	0	0	0	4	69	216	332	481	651	390	624	454	468	575	456	288	186	64	6	0	0	0	0	18.95	24
2	0	0	0	0	6	77	208	284	403	695	724	795	944	817	553	536	324	81	69	6	0	0	0	0	23.48	24
3	0	0	0	0	9	91	256	327	611	717	781	772	639	419	378	328	330	168	43	4	0	0	0	0	21.14	24
4	0	0	0	0	1	20	42	64	85	140	295	179	256	187	65	36	11	6	3	1	0	0	0	0	5.01	24
5	0	0	0	0	5	19	29	138	160	233	203	299	257	297	577	438	199	100	50	6	0	0	0	0	10.84	24
6	0	0	0	0	9	96	267	450	609	736	827	827	726	829	668	492	408	228	77	6	0	0	0	0	26.12	24
7	0	0	0	0	8	87	241	390	585	724	795	727	619	672	588	508	452	196	60	6	0	0	0	0	23.97	24
8	0	0	0	0	8	98	274	434	568	710	818	877	874	834	738	565	393	240	81	6	0	0	0	0	27.06	24
9	0	0	0	0	7	86	249	440	612	745	802	865	819	819	704	580	411	271	25	2	1	0	0	0	26.78	24
10	0	0	0	0	8	103	291	489	666	803	895	935	934	867	780	634	460	273	97	6	0	0	0	0	29.67	24
11	0	0	0	0	8	106	288	480	651	790	898	921	892	893	736	459	306	241	72	7	0	0	0	0	27.89	24
12	0	0	0	0	5	69	205	343	542	649	626	887	745	550	449	511	382	221	92	6	0	0	0	0	22.62	24
13	0	0	0	0	3	55	216	404	577	649	780	871	840	813	690	529	416	135	37	1	0	0	0	0	25.22	24
14	0	0	0	0	2	14	139	313	343	384	660	790	554	605	493	520	377	209	33	2	0	0	0	0	19.58	24
15	0	0	0	0	0	11	46	19	153	261	308	287	250	365	251	484	306	161	70	4	0	0	0	0	10.71	24
16	0	0	0	0	5	61	115	169	200	230	193	181	102	145	185	135	102	91	44	4	0	0	0	0	7.06	24
17	0	0	0	0	4	72	239	411	553	613	842	882	861	786	718	503	349	205	51	3	0	0	0	0	25.53	24
18	0	0	0	0	4	63	195	355	522	633	541	603	565	431	536	410	246	88	18	1	0	0	0	0	18.94	24
19	0	0	0	0	1	4	8	93	75	90	41	216	287	460	433	452	81	106	24	3	0	0	0	0	8.55	24
20	0	0	0	0	2	20	78	293	355	579	731	772	802	597	574	394	151	77	78	9	0	0	0	0	19.87	24
21	0	0	0	0	5	55	85	100	238	255	227	424	648	550	535	433	403	200	55	4	0	0	0	0	15.18	24
22	0	0	0	0	4	73	238	432	591	741	825	874	859	821	660	540	386	213	40	4	0	0	0	0	26.28	24
23	0	0	0	0	6	54	117	170	203	194	379	678	648	805	469	173	130	82	31	2	0	0	0	0	14.91	24
24	0	0	0	0	4	45	138	320	582	675	681	634	758	579	320	361	161	132	31	7	0	0	0	0	19.54	24
25	0	0	0	0	5	43	139	165	166	192	314	332	594	490	439	400	341	144	32	1	0	0	0	0	13.67	24
26	0	0	0	0	1	10	40	66	26	66	338	426	188	244	209	182	164	173	61	2	0	0	0	0	7.91	24
27	0	0	0	0	0	3	7	8	42	275	363	420	693	621	482	367	224	53	10	1	0	0	0	0	12.85	24
28	0	0	0	0	0	10	31	36	141	259	535	462	165	126	147	89	47	43	15	0	0	0	0	0	7.61	24
29	0	0	0	0	3	83	255	465	596	684	562	670	663	644	512	458	337	230	69	0	0	0	0	0	22.43	24
30	0	0	0	0	3	78	244	441	619	721	805	859	856	833	723	604	418	231	62	2	0	0	0	0	27.00	24
31	0	0	0	0	3	72	243	436	604	717	797	840	831	789	719	574	393	211	56	1	0	0	0	0	26.23	24
AV	0	0	0	0	4	56	165	286	405	510	579	642	623	592	514	424	290	161	49	3	0	0	0	0		
MAX	0	0	0	0	9	106	291	489	666	803	898	935	944	893	780	634	460	273	97	9	1	0	0	0		
MIN	0	0	0	0	0	3	7	8	26	66	41	179	102	126	65	36	11	6	3	0	0	0	0	0		
#D	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31		
TOT	0.0	0.0	0.0	0.0	.5	6.3	18.5	31.9	45.2	56.9	64.7	71.7	69.6	66.1	57.4	47.3	32.4	18.0	5.6	.4	.0	0.0	0.0	0.0		

MONTHLY VALUES (FOR DAYS OF COMPLETE DATA ONLY)

TOTAL FOR MONTH 592.6 MJ/M2

COMPLETE DAYS 31

DAILY AVER 19.12 MJ/M2
DAILY MAX 29.67 MJ/M2
DAILY MIN 5.01 MJ/M2

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

CHAMPAIGN, ILLINOIS
88 57'W, 40 03'N
219 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

AUGUST, 1981

UNITS: HOURLY = W/M2, DAILY (TOTD & TOT) AND MONTHLY = MJ/M2

HOUR (CST) ENDING AT

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	TOTD	#H
1	0	0	0	0	3	62	216	401	555	721	706	839	722	738	633	528	379	187	39	1	0	0	0	0	24.23	24
2	0	0	0	0	2	39	194	382	507	659	561	765	734	707	557	309	184	121	12	0	0	0	0	0	20.64	24
3	0	0	0	0	0	25	64	60	80	196	238	455	440	631	350	238	147	104	59	0	0	0	0	0	11.11	24
4	0	0	0	0	0	43	197	457	381	509	706	673	614	663	540	505	333	178	34	1	0	0	0	0	21.00	24
5	0	0	0	0	2	47	113	181	244	65	24	3	50	129	42	133	40	33	11	1	0	0	0	0	4.02	24
6	0	0	0	0	1	23	106	117	204	292	380	286	569	622	590	469	323	98	32	1	0	0	0	0	14.81	24
7	0	0	0	0	1	36	165	399	517	666	736	842	839	497	593	416	385	161	44	0	0	0	0	0	22.67	24
8	0	0	0	0	2	41	182	153	232	468	508	407	579	444	510	248	158	172	27	1	0	0	0	0	14.88	24
9	0	0	0	0	1	49	212	415	613	697	748	507	679	672	483	351	261	8	7	0	0	0	0	0	20.53	24
10	0	0	0	0	1	42	200	436	448	248	322	223	295	237	119	359	123	85	24	0	0	0	0	0	11.38	24
11	0	0	0	0	1	37	150	405	606	742	812	906	755	812	686	385	249	181	32	1	0	0	0	0	24.34	24
12	0	0	0	0	0	33	140	317	538	697	796	834	814	674	529	413	283	147	27	1	0	0	0	0	22.47	24
13	0	0	0	0	0	32	147	341	527	640	742	704	648	536	569	285	208	102	15	1	0	0	0	0	19.79	24
14	0	0	0	0	1	11	81	139	155	149	179	254	505	316	52	405	337	152	26	0	0	0	0	0	9.94	24
15	0	0	0	0	0	15	30	55	127	111	114	260	522	648	699	445	367	166	28	1	0	0	0	0	12.92	24
16	0	0	0	0	0	18	105	102	245	505	660	626	567	721	595	491	287	139	33	0	0	0	0	0	18.34	24
17	0	0	0	0	0	37	215	425	604	758	798	854	818	851	737	555	382	177	27	0	0	0	0	0	26.06	24
18	0	0	0	0	1	43	221	411	540	748	814	921	905	847	744	477	376	173	25	0	0	0	0	0	26.09	24
19	0	0	0	0	0	41	201	414	593	752	782	899	927	849	786	474	254	83	24	0	0	0	0	0	25.45	24
20	0	0	0	0	0	44	212	412	595	732	834	884	889	828	665	523	337	145	13	0	0	0	0	0	25.61	24
21	0	0	0	0	1	35	190	384	573	718	803	864	831	594	596	477	304	135	17	0	0	0	0	0	23.48	24
22	0	0	0	0	0	23	119	319	406	703	753	833	840	776	678	455	323	118	15	0	0	0	0	0	22.90	24
23	0	0	0	0	0	24	148	336	516	668	642	785	784	705	604	469	273	108	11	0	0	0	0	0	21.86	24
24	0	0	0	0	0	23	138	305	502	672	693	721	890	574	559	414	301	131	11	0	0	0	0	0	21.36	24
25	0	0	0	0	0	48	121	63	160	438	787	898	806	672	584	433	270	71	6	0	0	0	0	0	19.29	24
26	0	0	0	0	0	10	84	270	480	574	606	612	170	32	172	219	135	46	4	0	0	0	0	0	12.29	24
27	0	0	0	0	0	4	23	65	115	230	559	707	478	524	56	28	21	2	0	0	0	0	0	0	10.12	24
28	0	0	0	0	0	5	31	74	83	142	172	592	613	371	457	265	162	78	6	0	0	0	0	0	10.98	24
29	0	0	0	0	0	10	146	319	522	565	680	806	769	544	384	443	199	66	9	0	0	0	0	0	19.66	24
30	0	0	0	0	0	10	129	278	503	507	492	630	751	640	548	319	158	50	2	0	0	0	0	0	18.06	24
31	0	0	0	0	0	13	88	311	491	431	735	729	574	668	611	429	94	33	3	1	0	0	0	0	18.76	24
AV	0	0	0	0	0	29	140	282	408	516	592	655	657	597	507	385	246	111	20	0	0	0	0	0		
MAX	0	0	0	0	3	62	221	457	613	758	834	921	927	851	786	555	385	187	59	1	0	0	0	0		
MIN	0	0	0	0	0	4	23	55	80	65	24	3	50	32	42	28	21	2	0	0	0	0	0	0		
#O	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31		
TOT	0.0	0.0	0.0	0.0	.1	3.3	15.7	31.5	45.5	57.6	66.2	73.1	73.4	66.7	56.6	43.1	27.6	12.4	2.2	.0	0.0	0.0	0.0	0.0		

MONTHLY VALUES (FOR DAYS OF COMPLETE DATA ONLY)

TOTAL FOR MONTH	575.0 MJ/M2	DAILY AVER	18.55 MJ/M2
		DAILY MAX	26.09 MJ/M2
# COMPLETE DAYS	31	DAILY MIN	4.02 MJ/M2

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

CHAMPAIGN, ILLINOIS
88 57'W, 40 03'N
219 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

SEPTEMBER, 1981

UNITS: HOURLY = W/M2, DAILY (TOTD & TOT) AND MONTHLY = MJ/M2

HOUR (CST) ENDING AT

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	TOTD	#H
1	0	0	0	0	0	13	56	124	241	154	154	324	414	292	325	206	121	33	2	0	0	0	0	0	8.85	24
2	0	0	0	0	0	7	28	62	76	105	125	128	121	213	159	69	29	7	1	0	0	0	0	0	4.07	24
3	0	0	0	0	0	3	22	65	82	130	149	126	99	120	117	49	42	29	1	0	0	0	0	0	3.72	24
4	0	0	0	0	0	4	55	130	153	496	751	519	614	558	442	442	199	83	4	0	0	0	0	0	16.02	24
5	0	0	0	0	0	17	143	340	525	618	768	659	734	664	491	367	203	79	4	0	0	0	0	0	20.20	24
6	0	0	0	0	0	11	88	172	270	626	738	863	602	452	492	310	233	72	3	0	0	0	0	0	17.76	24
7	0	0	0	0	0	8	73	296	525	629	599	454	375	162	92	51	17	6	1	0	0	0	0	0	11.85	24
8	0	0	0	0	0	19	167	363	549	695	733	835	831	739	577	439	279	85	2	0	0	0	0	0	22.73	24
9	0	0	0	0	0	17	198	316	502	456	647	773	833	725	622	443	241	71	3	0	0	0	0	0	21.05	24
10	0	0	0	0	0	14	150	346	532	673	772	818	805	738	611	443	250	70	2	0	0	0	0	0	22.41	24
11	0	0	0	0	0	16	152	336	503	602	721	517	446	446	314	372	211	65	1	0	0	0	0	0	16.93	24
12	0	0	0	0	0	11	89	261	474	608	718	731	751	382	460	292	180	40	1	0	0	0	0	0	17.99	24
13	0	0	0	0	0	9	129	278	451	618	722	664	612	529	401	251	181	51	1	0	0	0	0	0	17.63	24
14	0	0	0	0	0	7	67	124	101	48	139	203	342	528	393	235	37	22	1	0	0	0	0	0	8.09	24
15	0	0	0	0	0	3	57	289	463	470	624	703	726	632	368	362	198	37	0	0	0	0	0	0	17.76	24
16	0	0	0	0	0	2	44	161	496	642	698	568	259	301	505	404	169	53	1	0	0	0	0	0	15.49	24
17	0	0	0	0	0	7	113	217	172	194	439	388	214	222	186	69	45	13	1	0	0	0	0	0	8.21	24
18	0	0	0	0	0	10	134	320	516	645	635	509	584	358	362	130	73	22	1	0	0	0	0	0	15.48	24
19	0	0	0	0	0	7	97	252	403	549	663	767	707	632	508	375	200	38	0	0	0	0	0	0	18.71	24
20	0	0	0	0	0	6	98	279	455	599	694	737	718	650	532	360	175	32	0	0	0	0	0	0	19.21	24
21	0	0	0	0	0	7	112	300	407	626	716	746	693	638	507	305	140	7	0	0	0	0	0	0	18.73	24
22	0	0	0	0	0	8	128	238	181	285	684	772	756	685	564	395	200	34	0	0	0	0	0	0	17.75	24
23	0	0	0	0	0	8	125	308	487	627	719	760	740	673	547	376	184	29	0	0	0	0	0	0	20.10	24
24	0	0	0	0	0	6	75	182	392	471	577	636	639	652	298	178	61	7	0	0	0	0	0	0	15.03	24
25	0	0	0	0	0	2	32	148	439	282	525	476	424	500	295	225	77	12	0	0	0	0	0	0	12.37	24
26	0	0	0	0	0	4	17	207	390	469	414	615	273	440	466	171	23	1	0	0	0	0	0	0	12.67	24
27	0	0	0	0	0	4	117	306	488	622	720	738	730	657	536	363	171	22	0	0	0	0	0	0	19.71	24
28	0	0	0	0	0	8	123	315	492	626	713	747	731	658	531	361	170	18	0	0	0	0	0	0	19.77	24
29	0	0	0	0	0	0	3	1	14	21	11	118	335	459	493	305	120	16	0	0	0	0	0	0	6.83	24
30	0	0	0	0	0	2	74	227	409	546	647	688	667	591	468	292	120	11	0	0	0	0	0	0	17.07	24
AV	0	0	0	0	0	8	93	232	372	471	573	586	559	509	422	288	144	35	1	0	0	0	0	0		
MAX	0	0	0	0	0	19	198	363	549	695	772	863	833	739	622	443	279	85	4	0	0	0	0	0		
MIN	0	0	0	0	0	0	3	1	14	21	11	118	99	120	92	49	17	1	0	0	0	0	0	0		
#D	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30		
TOT	0.0	0.0	0.0	0.0	0.0	.9	10.1	25.1	40.3	50.9	62.0	63.3	60.4	55.1	45.6	31.1	15.7	3.8	.1	0.0	0.0	0.0	0.0	0.0		

MONTHLY VALUES (FOR DAYS OF COMPLETE DATA ONLY)

TOTAL FOR MONTH 464.2 MJ/M2

COMPLETE DAYS 30

DAILY AVER 15.47 MJ/M2
DAILY MAX 22.73 MJ/M2
DAILY MIN 3.72 MJ/M2

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

CHAMPAIGN, ILLINOIS
88 57'W, 40 03'N
219 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

OCTOBER, 1981

UNITS: HOURLY = W/M2, DAILY (TOTD & TOT) AND MONTHLY = MJ/M2

HOUR (CST) ENDING AT

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	TOTD	#H
1	0	0	0	0	0	0	39	131	441	587	657	561	721	646	510	289	140	11	0	0	0	0	0	0	17.07	24
2	0	0	0	0	0	4	109	299	478	616	704	741	721	652	523	347	150	14	0	0	0	0	0	0	19.29	24
3	0	0	0	0	0	3	100	285	467	606	701	725	680	622	501	290	84	7	0	0	0	0	0	0	18.26	24
4	0	0	0	0	0	0	12	21	84	178	305	413	617	569	278	158	42	5	0	0	0	0	0	0	9.66	24
5	0	0	0	0	0	2	20	178	338	478	567	596	353	508	432	161	13	1	0	0	0	0	0	0	13.13	24
6	0	0	0	0	0	2	17	125	341	233	559	543	589	534	416	269	85	8	0	0	0	0	0	0	13.40	24
7	0	0	0	0	0	3	94	279	450	591	678	715	687	621	498	314	125	7	0	0	0	0	0	0	18.22	24
8	0	0	0	0	0	2	97	277	444	573	660	694	672	602	479	313	104	5	0	0	0	0	0	0	17.72	24
9	0	0	0	0	0	1	33	216	380	451	704	626	671	600	444	303	106	4	0	0	0	0	0	0	16.34	24
10	0	0	0	0	0	0	10	39	78	120	219	263	280	244	180	169	80	4	0	0	0	0	0	0	6.07	24
11	0	0	0	0	0	0	71	246	414	543	634	667	640	577	451	277	98	3	0	0	0	0	0	0	16.64	24
12	0	0	0	0	0	0	27	126	241	446	621	654	641	567	436	265	90	4	0	0	0	0	0	0	14.82	24
13	0	0	0	0	0	0	47	193	340	421	525	475	378	475	337	144	63	3	0	0	0	0	0	0	12.24	24
14	0	0	0	0	0	0	10	27	88	87	95	91	125	141	116	81	18	1	0	0	0	0	0	0	3.17	24
15	0	0	0	0	0	0	10	39	72	121	175	206	237	168	61	28	6	1	0	0	0	0	0	0	4.05	24
16	0	0	0	0	0	0	54	206	385	522	597	623	553	465	338	166	44	2	0	0	0	0	0	0	14.24	24
17	0	0	0	0	0	0	5	9	42	83	83	56	54	55	77	46	17	1	0	0	0	0	0	0	1.90	24
18	0	0	0	0	0	0	27	197	215	248	322	288	237	137	51	30	13	0	0	0	0	0	0	0	6.35	24
19	0	0	0	0	0	0	58	225	397	533	623	658	636	558	424	249	70	2	0	0	0	0	0	0	15.96	24
20	0	0	0	0	0	0	51	208	377	508	597	625	602	526	396	228	60	1	0	0	0	0	0	0	15.04	24
21	0	0	0	0	0	0	19	139	248	432	444	410	554	416	151	65	14	1	0	0	0	0	0	0	10.41	24
22	0	0	0	0	0	0	1	11	28	54	93	151	184	158	125	112	33	1	0	0	0	0	0	0	3.42	24
23	0	0	0	0	0	0	46	200	375	460	452	465	229	226	183	98	39	2	0	0	0	0	0	0	9.99	24
24	0	0	0	0	0	0	43	203	378	515	605	637	619	539	404	211	49	0	0	0	0	0	0	0	15.13	24
25	0	0	0	0	0	0	43	199	359	351	449	579	570	451	275	99	17	0	0	0	0	0	0	0	12.21	24
26	0	0	0	0	0	0	4	19	50	152	118	87	89	50	40	14	6	0	0	0	0	0	0	0	2.26	24
27	0	0	0	0	0	0	7	22	57	119	261	457	551	449	385	213	52	0	0	0	0	0	0	0	9.26	24
28	0	0	0	0	0	0	21	167	334	445	540	452	379	349	170	130	44	0	0	0	0	0	0	0	10.91	24
29	0	0	0	0	0	0	19	163	328	494	539	579	562	493	366	199	39	0	0	0	0	0	0	0	13.61	24
30	0	0	0	0	0	0	25	154	313	439	501	517	544	463	349	127	24	0	0	0	0	0	0	0	12.44	24
31	0	0	0	0	0	0	14	79	204	232	316	437	415	382	210	104	19	0	0	0	0	0	0	0	8.68	24
AV	0	0	0	0	0	0	36	150	282	375	463	483	477	427	309	177	56	2	0	0	0	0	0	0		
MAX	0	0	0	0	0	4	109	299	478	616	704	741	721	652	523	347	150	14	0	0	0	0	0	0		
MIN	0	0	0	0	0	0	1	9	28	54	83	56	54	50	40	14	6	0	0	0	0	0	0	0		
#D	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31		
TOT	0.0	0.0	0.0	0.0	0.0	.1	4.1	16.9	31.5	41.9	51.7	54.0	53.2	47.7	34.6	19.8	6.3	.3	0.0	0.0	0.0	0.0	0.0	0.0		

MONTHLY VALUES (FOR DAYS OF COMPLETE DATA ONLY)

TOTAL FOR MONTH 361.9 MJ/M2

COMPLETE DAYS 31

DAILY AVER 11.67 MJ/M2
DAILY MAX 19.29 MJ/M2
DAILY MIN 1.90 MJ/M2

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

CHAMPAIGN, ILLINOIS
88 57'W, 40 03'N
219 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

NOVEMBER, 1981

UNITS: HOURLY = W/M2, DAILY (TOTD & TOT) AND MONTHLY = MJ/M2

HOUR (CST) ENDING AT

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	TOTD	#H
1	0	0	0	0	0	0	5	47	121	191	197	276	250	199	111	66	17	0	0	0	0	0	0	0	5.33	24
2	0	0	0	0	0	0	5	24	67	113	200	198	249	223	120	80	15	0	0	0	0	0	0	0	4.66	24
3	0	0	0	0	0	0	6	40	111	147	311	495	517	454	322	166	26	0	0	0	0	0	0	0	9.34	24
4	0	0	0	0	0	0	18	71	136	189	239	249	245	190	189	84	40	0	0	0	0	0	0	0	5.94	24
5	0	0	0	0	0	0	6	106	330	272	233	218	362	108	99	121	25	0	0	0	0	0	0	0	6.77	24
6	0	0	0	0	0	0	17	141	304	430	521	555	538	465	339	176	30	0	0	0	0	0	0	0	12.66	24
7	0	0	0	0	0	0	17	138	299	425	514	548	530	456	331	160	25	0	0	0	0	0	0	0	12.39	24
8	0	0	0	0	0	0	13	58	163	313	475	444	253	137	52	48	5	0	0	0	0	0	0	0	7.06	24
9	0	0	0	0	0	0	2	55	147	259	346	405	411	442	334	171	27	0	0	0	0	0	0	0	9.36	24
10	0	0	0	0	0	0	15	132	293	426	515	551	534	466	331	163	24	0	0	0	0	0	0	0	12.42	24
11	0	0	0	0	0	0	11	125	283	411	491	524	505	431	311	154	21	0	0	0	0	0	0	0	11.76	24
12	0	0	0	0	0	0	11	115	270	398	480	513	494	428	303	147	16	0	0	0	0	0	0	0	11.43	24
13	0	0	0	0	0	0	11	106	296	298	319	324	543	436	306	146	21	0	0	0	0	0	0	0	10.10	24
14	0	0	0	0	0	0	10	111	271	353	491	519	483	383	307	143	15	0	0	0	0	0	0	0	11.11	24
15	0	0	0	0	0	0	9	115	157	238	332	490	412	224	191	84	9	0	0	0	0	0	0	0	8.14	24
16	0	0	0	0	0	0	3	19	79	67	272	271	81	98	131	79	9	0	0	0	0	0	0	0	3.99	24
17	0	0	0	0	0	0	5	106	257	381	474	509	492	423	303	144	19	0	0	0	0	0	0	0	11.21	24
18	0	0	0	0	0	0	6	67	177	334	263	345	363	347	230	106	10	0	0	0	0	0	0	0	8.09	24
19	0	0	0	0	0	0	2	51	159	182	242	224	135	48	17	11	2	0	0	0	0	0	0	0	3.86	24
20	0	0	0	0	0	0	0	20	44	71	116	107	155	122	84	31	6	0	0	0	0	0	0	0	2.72	24
21	0	0	0	0	0	0	0	12	43	125	171	171	112	91	48	25	6	0	0	0	0	0	0	0	2.89	24
22	0	0	0	0	0	0	4	82	136	280	466	414	255	235	285	133	14	0	0	0	0	0	0	0	8.29	24
23	0	0	0	0	0	0	2	22	34	32	39	25	18	16	12	7	1	0	0	0	0	0	0	0	.75	24
24	0	0	0	0	0	0	0	10	80	152	116	122	165	80	50	19	3	0	0	0	0	0	0	0	2.87	24
25	0	0	0	0	0	0	0	12	29	42	55	64	70	53	33	19	5	0	0	0	0	0	0	0	1.38	24
26	0	0	0	0	0	0	2	30	48	168	236	200	95	37	15	60	3	0	0	0	0	0	0	0	3.22	24
27	0	0	0	0	0	0	3	78	224	343	269	209	154	129	91	42	4	0	0	0	0	0	0	0	5.57	24
28	0	0	0	0	0	0	0	18	55	111	171	163	136	146	191	87	6	0	0	0	0	0	0	0	3.90	24
29	0	0	0	0	0	0	2	55	207	337	416	460	442	378	267	118	12	0	0	0	0	0	0	0	9.70	24
30	0	0	0	0	0	0	0	18	53	81	70	59	70	37	31	16	2	0	0	0	0	0	0	0	1.57	24
AV	0	0	0	0	0	0	6	66	162	238	301	321	302	242	181	93	13	0	0	0	0	0	0	0		
MAX	0	0	0	0	0	0	19	141	330	430	521	555	543	466	339	176	40	0	0	0	0	0	0	0		
MIN	0	0	0	0	0	0	0	10	29	32	39	25	18	16	12	7	1	0	0	0	0	0	0	0		
#D	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30		
TOT	0.0	0.0	0.0	0.0	0.0	0.0	.7	7.1	17.5	25.8	32.5	34.7	32.6	26.2	19.6	10.1	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

MONTHLY VALUES (FOR DAYS OF COMPLETE DATA ONLY)

TOTAL FOR MONTH 208.5 MJ/M2

COMPLETE DAYS 30

DAILY AVER 6.95 MJ/M2
DAILY MAX 12.66 MJ/M2
DAILY MIN .75 MJ/M2

LKH 5/81

ILLINOIS STATE WATER SURVEY
ILLINOIS SOLAR ENERGY PROGRAM

CHAMPAIGN, ILLINOIS
88 57'W, 40 03'N
219 M ABOVE MSL

GLOBAL SHORTWAVE RADIATION
ON A HORIZONTAL SURFACE
SENSOR: EPPLEY 8-48 PYRANOMETER

DECEMBER, 1981

UNITS: HOURLY = W/M2, DAILY (TOTD & TOT) AND MONTHLY = MJ/M2

HOUR (CST) ENDING AT

DAY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	TOTD	#H
1	0	0	0	0	0	0	0	15	60	42	68	99	30	69	20	6	2	0	0	0	0	0	0	0	1.48	24
2	0	0	0	0	0	0	0	13	33	59	50	79	206	319	152	52	6	0	0	0	0	0	0	0	3.49	24
3	0	0	0	0	0	0	2	15	76	123	233	169	167	147	103	21	2	0	0	0	0	0	0	0	3.01	24
4	0	0	0	0	0	0	0	13	82	313	396	416	314	334	183	78	9	0	0	0	0	0	0	0	7.70	24
5	0	0	0	0	0	0	0	34	160	293	413	407	448	374	238	64	4	0	0	0	0	0	0	0	8.77	24
6	0	0	0	0	0	0	0	43	159	204	353	345	271	225	153	48	9	0	0	0	0	0	0	0	6.52	24
7	0	0	0	0	0	0	0	24	72	126	143	216	250	262	234	108	10	0	0	0	0	0	0	0	5.20	24
8	0	0	0	0	0	0	0	9	22	70	66	98	83	60	91	72	6	0	0	0	0	0	0	0	2.08	24
9	0	0	0	0	0	0	0	47	181	311	401	402	259	134	59	18	3	0	0	0	0	0	0	0	6.53	24
10	0	0	0	0	0	0	2	48	187	318	402	447	435	376	265	113	9	0	0	0	0	0	0	0	9.37	24
11	0	0	0	0	0	0	1	28	141	303	388	414	423	365	258	123	8	0	0	0	0	0	0	0	8.83	24
12	0	0	0	0	0	0	2	52	187	309	393	412	404	357	226	113	9	0	0	0	0	0	0	0	8.87	24
13	0	0	0	0	0	0	0	22	71	122	218	270	327	239	156	48	5	0	0	0	0	0	0	0	5.32	24
14	0	0	0	0	0	0	0	12	67	152	351	310	142	97	67	36	5	0	0	0	0	0	0	0	4.46	24
15	0	0	0	0	0	0	0	59	134	272	309	347	395	336	225	103	14	0	0	0	0	0	0	0	7.90	24
16	0	0	0	0	0	0	0	15	64	103	87	172	246	44	48	29	4	0	0	0	0	0	0	0	2.92	24
17	0	0	0	0	0	0	0	15	146	207	213	270	246	249	152	78	6	0	0	0	0	0	0	0	5.70	24
18	0	0	0	0	0	0	0	39	182	328	427	474	468	408	287	136	16	0	0	0	0	0	0	0	9.95	24
19	0	0	0	0	0	0	0	52	219	361	443	480	471	411	295	140	17	0	0	0	0	0	0	0	10.40	24
20	0	0	0	0	0	0	0	61	235	402	455	492	468	425	229	131	10	0	0	0	0	0	0	0	10.47	24
21	0	0	0	0	0	0	0	4	14	36	46	68	60	45	29	22	3	0	0	0	0	0	0	0	1.18	24
22	0	0	0	0	0	0	0	17	129	139	140	190	41	26	17	8	2	0	0	0	0	0	0	0	2.55	24
23	0	0	0	0	0	0	0	39	204	297	423	473	473	415	302	148	19	0	0	0	0	0	0	0	10.05	24
24	0	0	0	0	0	0	0	24	242	433	529	549	516	434	309	150	20	0	0	0	0	0	0	0	11.54	24
25	0	0	0	0	0	0	0	35	172	270	435	455	467	381	206	123	10	0	0	0	0	0	0	0	9.19	24
26	0	0	0	0	0	0	0	23	76	164	236	212	358	212	151	69	9	0	0	0	0	0	0	0	5.44	24
27	0	0	0	0	0	0	0	6	29	61	115	178	160	127	78	41	6	0	0	0	0	0	0	0	2.88	24
28	0	0	0	0	0	0	0	9	33	125	215	293	360	383	243	63	8	0	0	0	0	0	0	0	6.23	24
29	0	0	0	0	0	0	0	41	200	304	411	467	441	425	310	154	23	0	0	0	0	0	0	0	9.99	24
30	0	0	0	0	0	0	0	12	139	335	404	396	506	408	281	128	19	0	0	0	0	0	0	0	9.46	24
31	0	0	0	0	0	0	0	5	43	120	90	56	49	24	21	6	2	0	0	0	0	0	0	0	1.50	24
AV	0	0	0	0	0	0	0	26	121	216	285	311	305	261	173	78	8	0	0	0	0	0	0	0		
MAX	0	0	0	0	0	0	2	61	242	433	529	549	516	434	310	154	23	0	0	0	0	0	0	0		
MIN	0	0	0	0	0	0	0	4	14	36	46	56	30	24	17	6	2	0	0	0	0	0	0	0		
#D	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31		
TOT	0.0	0.0	0.0	0.0	0.0	0.0	.0	3.0	13.5	24.1	31.9	34.8	34.1	29.2	19.4	8.7	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

MONTHLY VALUES (FOR DAYS OF COMPLETE DATA ONLY)

TOTAL FOR MONTH 199.8 MJ/M2

COMPLETE DAYS 31

DAILY AVER 6.44 MJ/M2
DAILY MAX 11.54 MJ/M2
DAILY MIN 1.18 MJ/M2

APPENDIX C

Daily wind direction and speed (mph) at 10m for the Bondville site, February-September, 1982.

Table Cl provides daily prevailing wind direction and daily mean wind speed (mph) at a height of 10 meters at the Bondville site. These data were derived from mean hourly wind speeds and directions using a Gill propane anemometer.

The table provides three columns of information for each month; the first (#HRS) being the number of hours of acceptable record for that day. the second (DIR) being the prevailing wind direction for the day (using the 8 cardinal points on the compass), and the third (SPD MPH) being the mean daily wind speed (mph). The row across the bottom of the table gives the monthly prevailing wind direction and the monthly mean wind speeds (mph) for the period.

TABLE CI. MEAN DAILY WIND SPEED (MPH) AT HEIGHT OF 10 METERS AND PREVAILING WIND DIRECTION AT BONDVILLE (40° 03'N, 88° 22'W). THESE DATA WERE DERIVED FROM MEAN HOURLY WIND SPEEDS, AND THE NUMBER OF HOURS OF ACCEPTABLE DATA (# HRS) UTILIZED FOR EACH DAY ARE ALSO INDICATED IN THE TABLE. M = MISSING.

1982

	FEBRUARY			MARCH			APRIL			MAY		
	# HRS	DIR	SPD MPH	# HRS	DIR	SPD MPH	S HRS	DIR	SPD MPH	# HRS	DIR	SPD MPH
1	0	M	M	24	W	9.4	24	S	8.5	24	N	6.3
2	0	M	M	24	NE	16.5	24	S	25.8	24	SE	5.3
3	0	M	M	22	E	18.3	24	W	38.0	24	S	9.2
4	0	M	M	0	NW	M	24	NW	13.7	24	S	16.5
5	0	M	M	16	NW	7.2	24	E	19.4	7	S	15.7
6	0	M	M	24	NW	7.9	24	N	14.2	0	M	M
7	0	M	M	24	N	14.4	24	E	10.1	0	M	M
8	0	M	M	24	SW	16.0	24	E	10.2	0	M	M
9	0	M	M	24	SE	10.9	24	NW	11.3	0	M	M
10	0	M	M	17	S	17.3	24	W	12.6	17	S	15.2
11	0	M	M	9	SW	7.9	24	NE	6.3	24	SW	13.8
12	0	M	M	10	S	27.2	22	S	21.0	14	S	11.9
13	0	M	M	24	W	16.5	24	N	11.8	24	S	15.6
14	0	M	M	24	E	10.4	24	E	8.4	24	S	16.3
15	0	M	M	24	SE	16.4	24	S	15.2	24	S	11.8
16	0	M	M	24	SW	18.9	24	S	16.8	24	SW	9.5
17	0	M	M	24	E	7.3	24	NW	20.3	24	SE	11.2
18	0	M	M	24	NE	10.6	24	S	9.1	24	SW	10.5
19	0	M	M	24	E	18.1	24	S	11.2	24	SW	11.4
20	0	M	M	24	NW	6.2	24	NW	18.2	24	W	10.9
21	0	M	M	24	W	17.6	24	NW	7.1	24	S	10.3
22	0	S	M	24	W	9.5	3	NW	4.9	24	W	10.0
23	7	NE	15.3	24	SW	9.0	11	SW	13.4	24	W	7.4
24	2	E	13.8	24	W	9.9	24	S	11.9	24	NE	5.3
25	10	NE	12.2	24	NW	15.8	24	S	9.5	24	E	7.2
26	24	NE	9.1	24	NW	16.7	24	SE	11.2	24	S	9.6
27	24	NE	11.4	24	NE	8.7	24	N	18.5	24	W	9.9
28	24	NE	6.1	24	S	8.3	24	E	14.5	24	W	7.4
29				24	S	14.6	24	E	12.0	24	SW	15.7
30				24	S	30.1	24	W	5.5	24	NW	6.5
31				24	NW	16.3				24	W	10.9
MTH		NE	11.3		NW	13.8		S	13.7		S	10.8

	JUNE			JULY			AUGUST			SEPTEMBER		
	# HRS	DIR	SPD MPH	# HRS	DIR	SPD MPH	# HRS	DIR	SPD MPH	# HRS	DIR	SPD MPH
1	24	NW	11.6	24	SE	4.6	24	S	5.1	24	W	7.3
2	24	S	5.7	13	SE	7.2	24	W	5.0	24	NW	9.3
3	24	NE	14.6	0	M	M	24	SW	6.7	24	NW	7.0
4	24	NE	11.1	12	NE	4.2	24	SW	6.4	24	SE	3.3
5	24	N	7.0	24	S	6.7	24	E	6.4	24	S	6.0
6	24	SE	8.9	24	S	10.1	24	E	5.4	24	SE	3.9
7	24	S	8.5	24	W	6.2	24	S	4.8	24	NE	4.9
8	24	SE	6.4	24	NW	4.1	24	W	5.8	24	E	4.0
9	24	W	6.6	24	SE	5.4	24	NW	6.7	24	SE	5.4
10	24	NW	12.5	24	S	10.2	24	NW	2.9	24	S	7.7
11	24	W	5.1	24	W	9.6	24	NE	5.6	24	S	7.4
12	24	SW	5.6	24	W	4.6	24	E	4.1	24	S	7.3
13	24	N	7.3	24	S	5.8	24	SE	4.9	24	SE	5.6
14	24	S	9.1	24	S	6.6	24	SE	4.2	24	SW	5.1
15	24	SW	13.0	24	S	6.6	24	S	4.1	24	NW	6.2
16	24	N	11.2	24	S	8.0	24	NE	4.9	24	NE	5.1
17	24	SW	6.0	24	S	9.4	24	NE	5.5	24	SW	7.4
18	24	SW	7.8	24	S	6.3	24	E	3.9	24	NW	5.9
19	24	NW	10.2	17	SW	5.2	24	SW	7.2	24	W	4.3
20	24	W	13.3	24	E	4.3	24	W	6.8	0	M	M
21	24	NW	7.5	24	SE	6.2	24	NE	5.2	0	M	M
22	24	N	7.5	24	NE	8.1	24	S	8.1	0	M	M
23	24	SE	4.4	24	NE	8.1	24	W	3.5	0	M	M
24	24	S	6.6	24	E	4.3	24	SE	7.4	0	M	M
25	6	S	6.5	24	W	2.6	24	NW	5.3	0	M	M
26	0	M	M	24	S	3.5	24	S	4.9	0	M	M
27	0	M	M	24	W	4.3	24	NE	5.4	0	M	M
28	16	SE	3.6	24	NE	8.8	24	NE	6.8	0	M	M
29	24	W	5.8	24	N	3.1	24	S	6.9	0	M	M
30	24	NE	10.4	24	NW	5.1	24	W	6.0	0	M	M
31				24	NW	3.7	24	SE	3.4			
MTH		NE	8.4		S	6.1		S	5.5		SE	6.0