

National Climatic Data Center

DATA DOCUMENTATION

FOR

DATA SET 9870 (DSI-9870)

UNITED STATES INCIDENT SOLAR RADIATION OBS - 15 MINUTE VALUES

January 3, 2003

National Climatic Data Center
151 Patton Ave.
Asheville, NC 28801-5001 USA

:

Table of Contents

Topic	Page Number
1. Abstract.....	3
2. Element Names and Definitions:	3
3. Start Date.....	10
4. Stop Date.....	10
5. Coverage.....	10
6. How to order data.....	10
7. Archiving Data Center.	10
8. Technical Contact.....	10
9. Known Uncorrected Problems.....	10
10. Quality Statement.....	10
11. Essential Companion Data Sets.....	11
12. References.....	11

⋮

1. **Abstract:** NCDC has a collection of US solar radiation data. DSI-9870 contains 15 minute values of incident solar radiation. Major parameters included are: Global horizontal irradiance (GBL), direct beam irradiance (NIP), diffuse irradiance (DIFF), Violet global irradiance (UVB) and photosynthetic active radiation (PARrsr). GBL and DIFF elements are measured using a precision spectral pyranometer. NIP is measured using a precision pyrliometer. UVB is measured using an Ultra Violet Biometer (Solar Light). PARrsr is measured using a silicon solid-state pyranometer under a rotating shadowband radiometer. In addition to these parameters, this data set also includes maximums and minimums of the 15 second values.

2. **Element Names and Definitions:** - Solar radiation data are archived by station sort (WBAN number) then date.

A. RECORDS

There are two types of records in the database - header and data. Header records precede each station's monthly data. The header records contain information about the site (latitude, longitude, elevation, etc.) and the year and month of the data. The data records are 15 minute average values sorted by time. Data are archived on 3480 cartridges as described below:

Record Length : Fixed 130 characters
 Blocked : 13000 characters
 Media : ASCII 18-Track IBM-Type 3480 cartridge
 Parity : Odd
 Label : ANSI Standard Labeled

B. FORMAT

(1) The Header Record is a fixed 130 character string.

LABEL	FIELD	WIDTH	POSITION
WBAN	WBAN Number	5	1-5
YR	Year of reports	4	6-9
MN	Month of reports	2	10-11
ID	Station identifier	3	12-14
WMO	WMO number	5	15-19
LAT	Latitude	5	20-24
LATHEM	Latitude hemisphere	1	25-25
LONG	Longitude	6	26-31
LONGHEM	Longitude hemisphere	1	32-32
ELEV	Elevation	5	33-37
TZSGN	Timezone Sign	1	38-38
TZ	Timezone	2	39-40
DV	Data version	1	41-41
RES	Reserved	85	42-126
SEQNUM	Sequence Number	4	127-130

Weather Bureau-Army-Navy Number (WBAN) - Site identification using WBAN. A unique five-digit number assigned to sites by NCDC.

Year (YR) - The year in which the data were observed. A four-digit number with values starting with 1994.

:
:

Month (MN) - The month in which the data were observed. Range of values from 01 to 12.

Station identifier (ID) - Three letter FAA call sign of the site.

WMO number (WMO) - Five-digit World Meteorological Organization number.

Latitude (LAT) - The site's latitude in thousandths of degrees.

Latitude hemisphere (LATHEM) - The hemisphere of the latitude, either "N" or "S".

Longitude (LONG) - The site's longitude in thousandths of degrees.

Longitude hemisphere (LONGHEM) - The hemisphere of the longitude, either "E" or "W".

Elevation (ELEV) - Height of the site to the nearest tenth of a meter (MSL). A "-" in the left most position indicates site is below MSL.

Timezone sign (TZSGN) - Indicates whether to add or subtract the hour in the time zone field from UTC to determine the local standard time of the site. Value can be either "-" or "+".

Timezone (TZ) - The time zone correction in number of hours to Local Standard Time from Universal Time Coordinate (UTC).

Data version (DV) - Atmospheric Research Laboratory's processing version.

Reserved (RES) - Reserved blanks

Sequence Number (SEQNUM) - Sequence number is a 4-digit sort key. All header records have a sequence number of 0000.

FIELD	1	2	3	4	5	6
ELEMENT	WBAN NUMBER	YEAR	MONTH	SITE ID	WMO NUMBER	LAT
#CHARAS	XXXXXX	XXXX	XX	XXX	XXXXX	XXXXXX
REC POS	1-5	6-9	10-11	12-14	15-19	20-24

FIELD	7	8	9	10	11	12
ELEMENT	LAT HEMIS	LONG	LONG HEMIS	ELEV	TIME SIGN	TIME ZONE
#CHARAS	X	XXXXXX	X	XXXXX	X	XX
REC POS	25-25	26-31	32-32	33-37	38-38	39-40

:
:

FIELD	13	14	15
ELEMENT	DATA VERSION	RESERVE	SEQ NUMBER
#CHARAS	X	X....X	XXXX
REC POS	41-41	42-126	127-130

(2) The Data Records are a fixed length 130 character string. Fields are right justified and zero filled. Missing data is represented with all "9". Radiation values are averaged over a 15-minute period from 1-2 second scans.

<u>LABEL</u>	<u>FIELD</u>	<u>WIDTH</u>	<u>POSITION</u>
WBAN	WBAN Number	5	1-5
YR	Year of report	4	6-9
MN	Month of report	2	10-11
DOY	Day of Year of report	3	12-14
DD	Day of Month of report	2	15-16
HR	Hour of report	2	17-18
MN	Ending Minute of report	2	19-20
GBL	Global irradiance	4	21-24
	Using precision spectral pyranometer		
IfG	Global flag	2	25-26
Sgbl	Global standard deviation	4	27-30
NIP	Direct beam irradiance	4	31-34
IfN	Direct flag	2	35-36
SNIP	Direct standard deviation	4	37-40
Diff	Diffuse irradiance	4	41-44
IfD	Diffuse flag	2	45-46
Sdif	Diffuse standard deviation	4	47-50
UVB	UVB global irradiance	4	51-54
Suvb	UVB standard deviation	4	55-58
PY	PY global irradiance	4	59-62
	using silicon cell pyranometer		
SPY	PY standard deviation	4	63-66
PARrsr	Photosynthetic active radiation	4	67-70
	using silicon cell pyranometer		
	under rsr		
SPAR	PARrsr standard deviation	4	71-74
PRSR	PRSR global irradiance	4	75-78
	using silicon cell pyranometer		
	under rsr		
SPRSR	PRSR standard deviation	4	79-82
PYmx	Maximum of PY	4	83-86
PARmx	Maximum of PARrsr	4	87-90
PRSRmx	Maximum of PRSR	4	91-94
Pymm	Minimum of PY	4	95-98
PARmm	Minimum of PARrsr	4	99-102
PRSRmm	Minimum of PRSR	4	103-106
RES1	Reserved 1 instrument	4	107-110
RES1S	Reserved 1 standard deviation	4	111-114
ZANGLE	Solar Zenith Angle	4	115-118
RES2	Reserved 2 instrument	4	119-122

:
:

RES2S	Reserved 2 standard deviation	4	123-126
SEQNUM	Sequence Number	4	127-130

Weather Bureau-Army-Navy Number (WBAN) - WBAN of the site. A unique five-digit number assigned to sites by NCDC.

Year (YR) - The year in which the data were observed. Range of values starting at 1994.

Month (MN) - The month in which the data were observed. Range of values is from 01 to 12.

Day of Year (DOY) - The universal day of the year in which the data were observed. Range of values is from 001 to 366.

Day of Month (DD) - The day of the month in which the data were observed. Range of values is from 01 to 31.

Hour (HR) - The hour in which the data were observed in Local Standard Time. Range of values is from 00 to 24. The earliest hour-minute would be 0015 (where 00 is the hour and 15 is the minute) and the latest hour-minute would be 2400 (where 24 is the hour and 00 is the minute).

Minute (MN) - The ending minute of the 15 minute period in which solar values are averaged from 1-2 second scans. Values are either 00, 15, 30 or 45.

Global irradiance (GBL) - Global horizontal irradiance measured using a precision spectral pyranometer. Unit is Watts per square meter (W/m^2) in whole values. Waveband ranges from 0.4 - 2.3 micrometers.

Global flag (IfG) - See "Data Quality"

Global standard deviation (Sgbl) - Standard deviation of global horizontal irradiance measured with a precision spectral pyranometer.

Direct beam irradiance (NIP) - Direct beam irradiance measured using a precision pyrliometer. Unit is Watts per square meter (W/m^2) in whole values. Waveband ranges from 0.4 - 2.3 micrometers. Instrument is mounted on a sun tracker.

Direct flag (IfN) - See "Data Quality"

Direct standard deviation (SNIP) - Standard deviation of direct beam irradiance.

Diffuse irradiance (Diff) - Diffuse irradiance measured using a precision spectral pyranometer. Unit is Watts per square meter (W/m^2) in whole values. Waveband ranges from 0.4 - 2.3 micrometers. Instrument is mounted under a shadowband.

Diffuse flag (IfD) - See "Data Quality"

Diffuse standard deviation (Sdif) - Standard deviation of diffuse irradiance.

:
:

UVB global irradiance (UVB) - Ultra Violet global irradiance measure using an Ultra Violet Biometer (Solar Light). Unit is milliWatts per square meter (mW/m^2) of erythema effective irradiance in whole values. Waveband ranges from 290-320 nanometers.

UVB standard deviation (Suvb) - Standard deviation of Ultra Violet global irradiance.

PY Global irradiance - Global irradiance measured using a silicon solid-state pyranometer. Unit is Watts per square meter (W/m^2) in whole values. Waveband ranges from 0.4 - 1.1 micrometers.

PY standard deviation (SPY) - Standard deviation of PY.

Photosynthetic active radiation (PARrsr) - Photosynthetic active radiation measured using a silicon solid-state pyranometer under a rotating shadowband radiometer (rsr). Waveband is 0.4 - 0.7 micrometer, with the rsr at 0.2 revolutions per minute. Unit is microEinstein per second per square meter in whole values.

PARrsr standard deviation (SPAR) - Standard deviation of PARrsr

PRSR global irradiance (PRSR) - Global irradiance measured using a silicon solid state pyranometer under a rotating shadowband radiometer. Unit is Watts per square meter (W/m^2) in whole values. Waveband ranges from 0.4 - 1.1 micrometer.

PRSR standard deviation (SPRSR) - Standard deviation of PRSR

Maximum of PY (PYmx) - Maximum of the global irradiance using a silicon solid state pyranometer. Unit is Watts per square meter (W/m^2) in whole values.

Maximum of PARrsr (PARmx) - Maximum of photosynthetic active radiation using a silicon solid state pyranometer under a rotating shadowband. Unit is microEinstein per second per square meter in whole values.

Maximum of PRSR (PRSRmx) - Maximum of global irradiance using a silicon solid state pyranometer under a rotating shadowband. Unit is Watts per square meter (W/m^2) in whole values.

Minimum of PY (PYmm) - Minimum of the global irradiance using a silicon solid state pyranometer. Unit is Watts per square meter (W/m^2) in whole values.

Minimum of PARrsr (PARmm) - Minimum of photosynthetic active radiation using a silicon solid state pyranometer under a rotating shadowband. Unit is microEinstein per second per square meter in whole values.

Minimum of PRSR (PRSRmm) - Minimum of global irradiance using a silicon solid state pyranometer under a rotating shadowband. Unit is Watts per square meter (W/m^2) in whole values.

Reserved 1 instrument (RES1) - Reserved for additional instrument type depending on site.

:
:

For Oak Ridge (ORT), TN this field contains the Net allwave radiation. Net allwave is the incoming total hemispherical radiation minus the outgoing total hemispherical radiation. Unit is Watts per square meter (W/m²) in whole values. Waveband ranges from 0.25 - 60.0 micrometers (shortwave and longwave). Instrument is mounted 33 m over a forest canopy with a maximum tree height of 25m. Values reported are not corrected for wind effects thus are +/- 5%.

Reserved 1 standard deviation (RES1S) - Reserved for standard deviation of RES1 depending on site.

For Oak Ridge (ORT), TN this field contains the standard deviation of the Net allwave radiation.

Solar Zenith Angle (ZANGLE)

The Solar Zenith Angle is the angle in degrees between the sun and the perpendicular to the earth's surface. At sunrise it is 90 degrees, at noon it is a function of latitude, and at sunset it is again 90 degrees. Below the horizon value is 100. Values are to the nearest tenth of degree.

Reserved 2 (RES2) - Reserved.

Reserved 2 standard deviation (RES2S) - Reserved for standard deviation of RES2.

Sequence Number (SEQNUM) - Sequence number is a 4-digit sort key. The header record in every file has a sequence number of 0000. The first data record has a SEQNUM of 0001 and the SEQNUM increases by one for each successful data record.

FIELD	1	2	3	4	5	6
ELEMENT	WBAN NUMBER	YEAR	MONTH	DAY OF YEAR	DAY	HOURL
#CHARAS	XXXXX	XXXX	XX	XXX	XX	XX
REC POS	1-5	6-9	10-11	12-14	15-16	17-18

FIELD	7	8	9	10	11	12
ELEMENT	MINUTE	GLOBAL IR RAD	GLOBAL FLAG	GLOBAL STD DEV	DIRECT IRRAD	DIRECT FLAG
#CHARAS	XX	XXXX	XX	XXXX	XXXX	XX
REC POS	19-20	21-24	25-26	27-30	31-34	35-36

FIELD	13	14	15	16	17	18
ELEMENT	DIRECT STD DEV	DIFFUSE IRRAD	DIFFUSE FLAG	DIFFUSE STD DEV	UVB GBL IRRAD	UVB GBL STD DEV

:
:

#CHARAS	XXXX	XXXX	XX	XXXX	XXXX	XXXX
REC POS	37-40	41-44	45-46	47-50	51-54	55-58

FIELD	19	20	21	22	23	24
ELEMENT	GLOBAL PY	PY STD DEV	PARrsr	PAR STD DEV	PSRS	PSRS STD DEV
#CHARAS	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
REC POS	59-62	63-66	67-70	71-74	75-78	79-82

FIELD	25	26	27	28	29	30
ELEMENT	MAX OF PY	MAX OF PARrsr	MAX OF PRSR	MIN OF PY	MIN OF PARrsr	MIN OF PSRS
#CHARAS	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
REC POS	83-86	87-90	91-94	95-98	99-102	103-106

FIELD	31	32	33	34	32	35
ELEMENT	RESERVE 1 INSTR	RESERVE 1 SD	SOLAR Z ANGLE	RESERVE 1 INSTR	RESERVE 2 SD	SEQ NUMBER
#CHARAS	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
REC POS	107-110	111-114	115-118	119-122	123-126	127-130

C. INSTRUMENTS AND MEASUREMENTS REPORTED

Instrument	Measurement	Waveband	Units	Accuracy Uncrtnty	Comments
Precision spectral pyranometer	Global horizontal irradiance	0.4 - 2.3 micrometer	W/m ²	< 5%	Usually < 3%
Precision pyrhelimeter (Eppley)	Normal incident irradiance	0.4 - 2.3 micrometer	W/m ²	< 2%	Mounted on sun tracker
Precision spectral pyranometer	Diffuse horizontal irradiance	0.4 - 2.3 micrometer	W/m ²	< 5%	mounted under shadowband
Ultra Violet Biometer (Solar Light)	UVB Global irradiance	290-320 nanometer	mW/m ²	< 5%	erythema effective radiation
Pyranometer (LiCOR)	Global horizontal irradiance	0.4-1.1 micrometer	W/m ²	< = 5%	silicon solid state detector
Photosynthetic active	Global horizontal	0.4-0.7 micrometer	micro-Einstein	< = 5%	under rotating

:
:

radiation (LiCOR)	irradiance	, RSR .2RPM	/s/m ²		shadowband
Pyranometer (LiCOR)	Global horizontal irradiance	0.4-1.1 micrometer	W/m ²	< = 5%	under rotating shadowband
REDS Q*7.1 net radiometer	Net allwave radiation	0.25-60.0 micrometer	W/m ²	< = 5%	measured at 33m at ORT

C. Sort - 15 minute solar radiation records are sorted by station sort (WBAN number) and date.

3. **Start Date:** 19941199
4. **Stop Date:** Ongoing.
5. **Coverage:** Continental United States
6. **How to Order Data:**

Ask NCDC's Climate Services about the cost of obtaining this data set.
 Phone: 828-271-4800
 FAX: 828-271-4876
 e-mail: NCDC.Orders@noaa.gov

7. **Archiving Data Center:**

National Climatic Data Center
 Federal Building
 151 Patton Avenue
 Asheville, NC 28801-5001
 Phone: (828) 271-4800.

8. **Technical Contact:**

National Climatic Data Center
 Federal Building
 151 Patton Avenue
 Asheville, NC 28801-5001
 Phone: (828) 271-4800.

9. **Known Uncorrected Problems:** None.

10. **Quality Statement:** At NOAA's Atmospheric Research Laboratory in Oak Ridge, Tennessee, the data processes through a quality control procedure and daily plotting of time series. The passed 15-minute mean values are also tested against the Solar Energy Research Institute (SERI, but now National Renewable Energy Laboratory) Quality Control (SERI QC) software. The SERI QC generates flags for global, normal incident, and diffuse global radiation. This quality control primarily flags data that departs from expected limits and boundaries. Flagging convention follows:

<u>Flag</u>	<u>Description</u>
00	Untested (raw data)
01	Passed one-component test; data fall within max-min limits

:
:

of K_t , K_n , or K_d

02 Passed two-component test; data fall within 0.03 of the Gompertz boundaries

03 Passed three-component test; data come within \pm 0.03 of satisfying $K_t = K_n + K_d$

04 Passed visual inspection: not used by SERI_QC1

05 Failed visual inspection: not used by SERI_QC1

06 Value estimated; passes all pertinent SERI_QC tests

07 Failed one-component test; lower than allowed minimum

08 Failed one-component test; higher than allowed maximum

09 Passed three-component test but failed two-component test by 0.05

10-93 Failed two- or three- component tests in one of four ways.

To determine the test failed and the manner of failure (high or low), examine the remainder of the calculation $(\text{flag}+2)/4$.

<u>Rem</u>	<u>Failure</u>
0	Parameter too low by three-component test ($K_t = K_n + K_d$)
1	Parameter too high by three component test ($K_t = K_n + K_d$)
2	Parameter too low by two-component test (Gompertz boundary)
3	Parameter too high by two-component test (Gompertz boundary)

The magnitude of the test failure (distance in K-units) is determined from: $d = (\text{INT}(\text{flag} + 2)/4)100$.

<u>Flag</u>	<u>Description</u>
94-97	Data fails into physically impossible region where $K_n > K_t$ by K-space distances of 0.05 to 0.10 (94), 0.10 to 0.15 (95), 0.15 to 0.20 (96), and \geq 0.20 (97).
98	Not used
99	Missing data

11. **Essential Companion Datasets:** None.

12. **References:**

National Solar Radiation Database (1961-1990), User's Manual, National Renewable Energy Laboratory, 1617 Cole Boulevard, Golden CO 80401.

:
: