University of Oregon
Solar Radiation Monitoring Laboratory

ASES Solar 2j017, Denver, CO

Structure of a Comprehensive Solar Radiation Dataset

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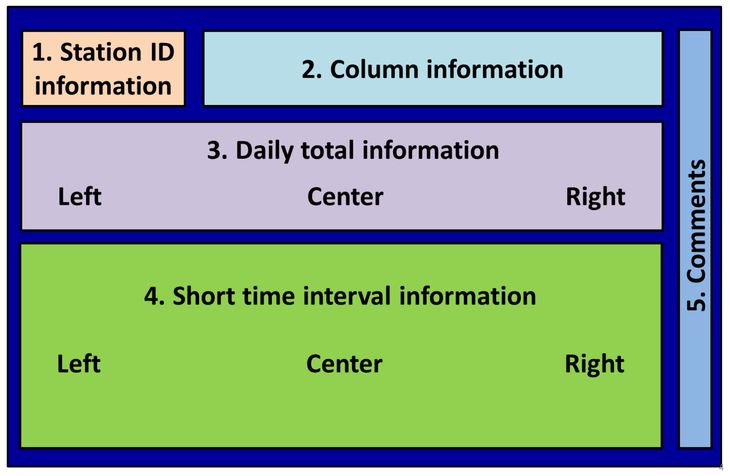
Previous format of the data

(a sample set of data from file *BUPO1510.txt*)

94170	2015	1000	0	2010	0	9300	0	3000	0
274	1	0	12	0	12	10.5	11	0	71
274	2	0	12	0	12	10.5	11	0	71
274	3	0	12	0	12	10.5	11	0	71
274	4	0	12	0	12	10.5	11	0	71
274	5	0	12	0	12	10.5	99	0	71
274	6	0	12	0	12	10.5	99	0	71
274	7	0	12	0	12	10.5	99	0	71
274	8	0	12	0	12	10.4	11	0	71
274	9	0	12	0	12	10.4	11	0	71
274	10	0	12	0	12	10.4	11	0	71
…	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…
274	1155	291	12	1	12	19.4	11	290	71
274	1156	297	13	1	12	19.4	11	296	71
274	1157	304	13	1	12	19.5	11	303	71
274	1158	311	12	1	12	19.5	11	310	71
274	1159	316	12	2	12	19.4	11	315	71
274	1200	318	12	2	12	19.4	11	317	71
274	1201	319	12	1	12	19.5	11	318	71
274	1202	320	12	1	22	19.5	11	319	72
274	1203	320	12	2	22	19.4	11	319	72
274	1204	324	12	5	12	19.5	11	321	71
…	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…

Outline of new file format



New file format

Station ID	94145	-	-	-	-	Type of M	GHI	GHI_Flag	DrHI_Calc	DrHI_Calc	DNI	DNI_F
Station Na	DIM	-	-	-	-	Element:	1000	-	2000	-	2010	-
Station Lo	Dillon_Mo	-	-	-	-	Instrumen	PSP(23973	-	NIP(27087	-	NIP(27087	-
Latitude:	45.20834	-	-	-	-	Instrumen	P23	-	NA	-	N13	-
Longitude	-112.638	-	-	-	-	Responsivi	8.6844	microV/(W	NA	-	7.2102	microV
Altitude (r	1590	-	-	-	-	Estimated	3.587	-	3.618	-	3.618	-
Time Zone	-7	-	-	-	-	Sample M	Avg	-	-	-	Avg	-
Time Inter	1	-	-	-	-	Units:	W/m^2	-	W/m^2	-	W/m^2	-
Year//Mor	2016//06	-	-	-	-	Column N	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-

Day of mo	Day of yea	Time Sunrise (HH::MM:SS)	Time Sunse	Time Solar	Daily Total	Daily Total	Daily Total	Daily Total	Daily Total	Daily Total	Daily Total	Daily
1	153	04::46:46	20::10:40	12::28:30	11.473	20.405	7.624	4.459	4.544	3.82	6.973	3.
2	154	04::46:16	20::11:29	12::28:40	11.493	20.422	5.923	4.978	1.46	5.377	2.103	4.
3	155	04::45:47	20::12:17	12::28:50	11.513	20.438	8.374	4.285	6.673	3.693	10.851	3.
4	156	04::45:21	20::13:03	12::29:01	11.531	20.476	8.809	4.248	8.023	3.686	12.348	3.

Break in data

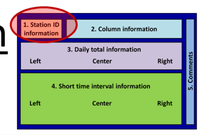
year.fracti	dayofyear	YYYY-MM-DD--HH:MM:SS	SZA	AZM	ETR (W/m	ETRn (W/r	GHI	GHI_Flag	DrHI_Calc	DrHI_Calc	DNI	DNI_F
2016.415	153.0007	2016-06-01--00:01:00	112.3565	353.0045	0	0	-1.18	12	-1.67	72	-1.67	
2016.415	153.0014	2016-06-01--00:02:00	112.3775	353.2539	0	0	-1.06	12	-1.82	72	-1.82	
2016.415	153.0021	2016-06-01--00:03:00	112.3978	353.5035	0	0	-0.79	12	-1.78	72	-1.78	
2016.415	153.0028	2016-06-01--00:04:00	112.4172	353.7531	0	0	-0.61	12	-1.49	72	-1.49	
2016.415	153.0035	2016-06-01--00:05:00	112.4359	354.0028	0	0	-0.36	12	-1.17	72	-1.17	
2016.415	153.0042	2016-06-01--00:06:00	112.4539	354.2526	0	0	-0.04	12	-1.1	72	-1.1	

Break in data

2016.417	153.4986	2016-06-01--11:58:00	23.87358	162.0287	1214.3	1327.91	888.06	12	593.42	72	648.94	
2016.417	153.4993	2016-06-01--11:59:00	23.81999	162.5855	1214.8	1327.91	869.69	12	569.92	72	622.99	
2016.417	153.5	2016-06-01--12:00:00	23.76803	163.1444	1215.29	1327.91	907.59	12	602.41	72	658.24	
2016.417	153.5007	2016-06-01--12:01:00	23.71772	163.7053	1215.75	1327.91	917.92	12	609.35	72	665.57	
2016.417	153.5014	2016-06-01--12:02:00	23.66907	164.2683	1216.21	1327.91	891.51	12	579.48	72	632.7	
2016.417	153.5021	2016-06-01--12:03:00	23.62208	164.8333	1216.64	1327.91	853.61	12	537.04	72	586.15	
2016.417	153.5028	2016-06-01--12:04:00	23.57677	165.4001	1217.06	1327.91	830.65	12	511.36	72	557.93	
2016.417	153.5035	2016-06-01--12:05:00	23.53315	165.9687	1217.47	1327.91	845.57	12	523.24	72	570.71	

More data not visible to the right.

1. Station ID information



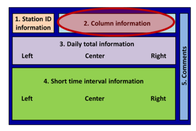
Example 1.

Station ID Number:	**94170**
Station Name:	**BUO**
Station Location:	**Burns_Oregon_USA**
Latitude:	**43.519197**
Longitude (+ East):	**-119.021623**
Altitude (m):	**1260**
Time Zone (+ East):	**-8**
Time Interval (Minutes):	**1**
Year//Month	**2016//12**

Example 2.

Station ID Number:	**94145**
Station Name:	**DIM**
Station Location:	**Dillon_Montana_USA**
Latitude:	**45.20834**
Longitude (+ East):	**-112.638**
Altitude (m):	**1590**
Time Zone (+ East):	**-7**
Time Interval (Minutes):	**1**
Year//Month	**2016//06**

2. Column Information



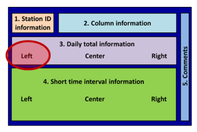
GHI example

Type of Measurement:	GHI	GHI_Flag	GHI_Calc	GHI_Calc Flag	GHI withNO	GHI_withNO Flag
Element:	1000	-	1001	-	1000_withNO	-
Instrument Serial Number:	PSP (23973F3)	-	Computed from DHI and DNI	-	PSP (23973F3)	-
Instrument Shorthand Name:	P23	-	NA	-	P23	-
Responsivity:	8.6844	$\frac{\text{microV}}{\text{W/m}^2}$	NA	-	8.6844	$\frac{\text{microV}}{\text{W/m}^2}$
Estimated Uncertainty (U95%):	3.587	-	6.003	-	3.587	-
Sample Method:	Avg	-	-	-	Avg	-
Units:	W/m^2	-	W/m^2	-	W/m^2	-
Column Notes:	Processed Column	-	Calculated Column	-	Measured Column	-

Working with the new data format

- New format can be viewed in Excel and notepad.
- Other computer languages can access the data
  - C, Python, Mathematica, etc.
  - Load, manipulate, sort, plot, export
- The new format can have information requiring considerable text and this information may be partially hidden when viewing in spreadsheets

3 (Left). Daily totals

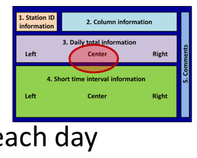


- General information about each day at site.
  - Independent of irradiance measurements at site

Day of month	Day of year	Time Sunrise (HH::MM:SS)	Time Sunset (HH::MM:SS)	Time Solar Noon (HH::MM:SS)	Daily Total Energy ETR (kW h/m²)	Daily Total Energy ETRn (kW h/m²)
1	153	04::46:46	20::10:40	12::28:30	11.473	20.405
2	154	04::46:16	20::11:29	12::28:40	11.493	20.422
3	155	04::45:47	20::12:17	12::28:50		
4	156	04::45:21	20::13:03	12::29:01		
5 …. 31						
year. Fraction of year	**Day of year . Fraction of day**	**YYYY-MM-DD--HH:MM:SS**	**SZA**	**AZM**		
Short time interval data below (Section 3)						
2016.415	153.0007	2016-06-01--00:01:00	112.3565	353.0045	0	0

Using a Double Colon :: or double dash -- Keeps Excel from reformatting dates and times

3 (Center). Daily totals



- Total energy for each instrument for each day
- Each instrument presented in two columns format

Day of year		Daily Total Energy ETR (kWh/m²)	Daily Total Energy ETRn (kWh/m²)	GHI Daily Total Energy (kWh/m²)	GHI Flag Daily Total Uncertainty (U95%)	DNI Daily Total Energy (kWh/m²)	DNI Flag Daily Total Uncertainty (U95%)
153		11.473	20.405	7.624	4.459	6.973	3.701
154		11.493	20.422	5.923	4.978	2.103	4.699
155		11.513	20.438	8.374	4.285	10.851	3.649
156		11.531	20.476	8.809	4.248	12.348	3.641
157		11.548	20.493	7.89	4.536	8.209	3.768

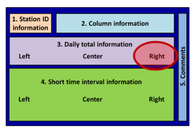
Left columns

Extraterrestrial totals (Left columns)

Daily total measured energy

Uncertainty in energy measurement

3 (Right). Daily totals Nighttime Offsets Values



- The average nighttime irradiance value is calculated for each day

Day of year	GHI_withNO Average Nighttime Value	GHI_withNO Flag Standard Deviation Nighttime	DNI_withNO Average Nighttime Value	DNI_withNO Flag Standard Deviation Nighttime
153	-7.49	1.06	1.10	0.42
154	-5.94	0.88	0.99	0.70
155	-5.82	0.83	0.64	0.75
156…				

- The nighttime offset is subtracted from the daytime values to "zero" the data set

GHI = GHI_withNO – NO

Data after nighttime offset has been subtracted.

Data before nighttime offset has been subtracted. Measured directly from sensor

Nighttime offset for the sensor during this night.

4 (Left). Short time interval

year. Fraction of year	Day of year . Fraction of day	YYYY-MM-DD--HH:MM:SS	SZA	AZM	ETR (W/m²)	ETRn (W/m²)
2016.086149	32.53056	2016-02-01--12:44:00	62.26446	179.8391	655.6	1408.7
2016.086151	32.53125	2016-02-01--12:45:00	62.26418	180.109	655.6	1408.7
2016.086153	32.53194	2016-02-01--12:46:00	62.26473	180.3789	655.59	1408.7

Time information (3 formats) **Sun location** **Extraterrestrial radiation**

4 (Center). Corrected irradiance

Need to compute the irradiance after the nighttime value has been subtracted.

YYYY-MM-DD--HH:MM:SS	GHI	GHI Flag	GHI withNO	GHI withNO Flag	Nighttime Offset
2016-06-01--00:01:00	-1.18	12	-8.43	11	-7.25
2016-06-01--00:02:00	-1.06	12	-8.31	11	-7.25
2016-06-01--00:03:00	-0.79	12	-8.04	11	-7.25
Break in data	Break in data	Break in data	Break in data	Break in data	Break in data
2016-06-01--11:59:00	867.25	12	860.00	11	-7.25
2016-06-01--12:00:00	907.59	12	900.34	11	-7.25
2016-06-01--12:01:00	917.92	12	910.67	11	-7.25

GHI = GHI_withNO – NO

867.25 = 860.00 – (-7.25)

Note the flag change from 11 to 12

4 (Right). Short time interval information

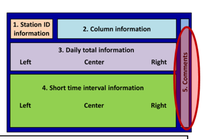
Data directly from sensors (nighttime offset not subtracted)

YYYY-MM-DD--HH:MM:SS	GHI withNO	GHI withNO Flag	DNI withNO	DNI withNO Flag	DfHI withNO	DfHI withNO Flag
2016-06-01--00:01:00	-8.43	11	-2.1	11	0.82	11
2016-06-01--00:02:00	-8.31	11	-2.25	11	1.01	11
2016-06-01--00:03:00	-8.04	11	-2.21	11	1.05	11
Break in data	Break in data	Break in data	Break in data	Break in data	Break in data	Break in data
2016-06-01--11:59:00	860.00	11	622.56	11	279.35	11
2016-06-01--12:00:00	900.34	11	657.81	11	284.43	11
2016-06-01--12:01:00	910.67	11	665.14	11	289.22	11

Time information (Left columns)

Quality control flags
11 means good data, nighttime offset is not subtracted

5. Comments



Space is designated to allow for notes

Row	
2	Contact Info: http://solardat.uoregon.edu
3	Elements described at: http://solardat.uoregon.edu/DataElementNumbers.html
4	Flag description at: http://solardat.uoregon.edu/QualityControlFlags.html
5	Data has been calibrated using the responsivity values listed
6	The phrase (_withNO) means the data has not had the nighttime offset subtracted
7	Data that has been (computed) was calculated from measured columns
8	Date file was created: 2017-3-3
9	Version used to create this file: Check data (2017-02-26).nb
10	-
11	Assorted Daily Values (Rows 12 - 42)
12-44	Room for day specific details as required.
45	Data_Begins_Next_Row
46 – END	Room for details for the specific minute as required