

# SU solar resource measurement station: Sonbesie metadata

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Date: 30 July 2013

## Introduction

A solar resource measurement station, known as Sonbesie, has been installed at Stellenbosch University. The system is intended for solar resource assessment research which directly relates to CSP, PV and CPV-developments. The Sonbesie system comprises a set of high quality radiometry and meteorological instruments (Figure 1).

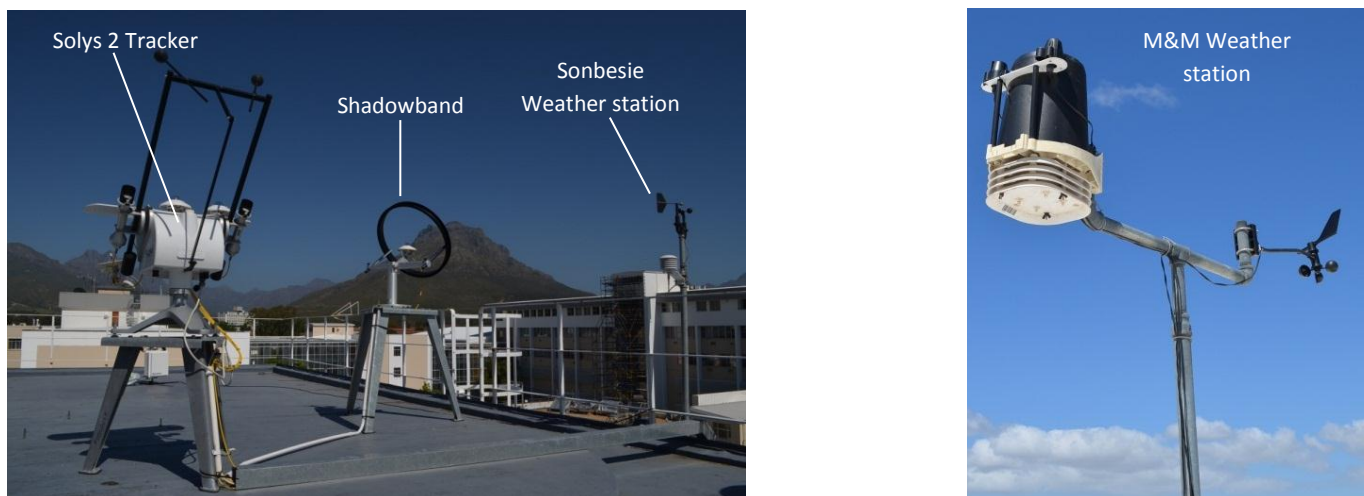


Fig. 1. Sonbesie instrumentation. From left to right: Solys2 tracker; CM 121 shadow ring; and Sonbesie weather station (approx. GPS: 33°9281'S, 18°8654'E). Far right: M&M weather station (approx. GPS: 33°9283'S, 18°8648'E).

## Instrumentation

The installation includes an automatic solar tracker, Kipp and Zonen (K&Z) Model Solys 2 dual-axis sun tracker, complete with a shading ball assembly and mounting plates.

The Solys 2 houses:

- one K&Z CHP1 pyrliometer (DNI measurements)
- one shaded K&Z CMP11 pyranometer (DHI measurements)
- one un-shaded K&Z CMP11 pyranometer (GHI measurements)
- one UVS-AB-T radiometer (UVA, UVB measurements)

A K&Z CM 121 shadow ring and CMP6 pyranometer configuration is installed to provide comparable DHI data.

Meteorological data is recorded by two separate systems: Sonbesie and M&M weather stations.

Sonbesie weather station houses:

- CS215 probe with 41303-5A radiation shield ( $T_{amb}$  & relative humidity (RH) measurements)
- RM Young wind sentry, Model 03001 (wind speed (WS), direction (WD) measurements)
- RM Young barometric pressure sensor, Model 61205V (barometric press (BP) measurements)

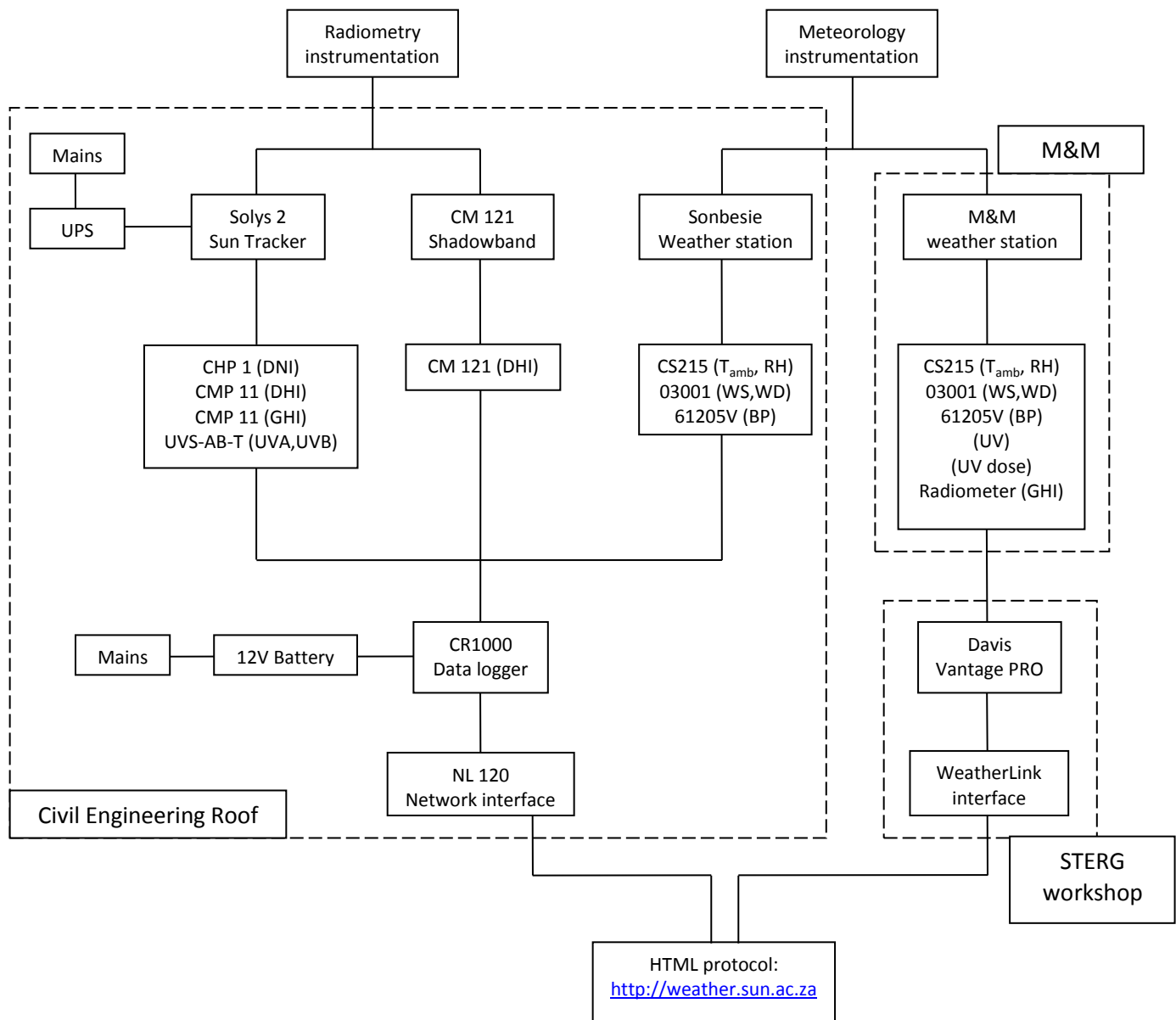
M&M weather station comprises a Vantage PRO Integrated Sensor Suite (ISS) which houses:

- Anemometer (WS, WD, wind chill measurements)
- Temperature/humidity sensor & radiation shield ( $T_{amb}$ , RH measurements)
- Rain collector (rain rate measurements)
- UV 6490 sensor (UV measurements)
- Solar radiation 6450 sensor (GHI measurements)
- Barometric pressure sensor (BP measurements)
- Dew point (DP) measurements
- Heat index (HI) measurements

Appendix A shows detailed specifications and calibration information for each instrument.

## Sonbesie architecture

The below diagram describes the Sonbesie system architecture.



# Download instructions for solar resource data at Stellenbosch University

1. Go to link <http://weather.sun.ac.za/>
2. The below page should pop-up, click on [Download data]

**Stellenbosch Weather**  
Location: 33°55'42.84" S, 18°51'55.08" E, Elevation: 119m

**Current Weather**  
Date: Tuesday, 30 July 2013  
Wind: 0.55 km/h, NE  
Rain: 0.2 mm  
Humidity: 88.2%  
Barometer: 1025hPa  
Trend: ---  
Last update: Today at 08:25 from 2 weather stations.

**Outside Temperature:**  
**5.8°C**  
Min: 3.94°C at 06:23  
Max: 7.6°C at 00:38

**Forecast**  
Tuesday, 30 July 2013  
Max: 19°C, Min: 6°C  
Partly Cloudy  
Wednesday, 31 July 2013  
Max: 25°C, Min: 11°C  
Clear  
Last Update: 8:20 from Wunderground.com

**Moon**  
Waning Crescent  
Illuminated: 45.2%, Age: 23 days  
Distance: 396'602 km  
Angular diameter: 0.50216°

**Stars**  
Leo - The Lion  
23 July - 22 August

**Sun**  
Sunrise: 07:36  
Sunset: 18:05  
Distance: 151'856'485 km  
Angular diameter: 0.52520°

**Tides**  
Visit <http://www.satides.co.za/> for information on ocean tides.

*"The trouble with weather forecasting is that it's right too often for us to ignore it and wrong too often for us to rely on it." - Patrick Young*

You are visiting from the Stellenbosch campus. IP = 146.232.145.169

3. Fill in the [Start date] and [End date] required. Please keep date range within one month, anything longer may not work. Under [Select the data you need] select at least one item (daily/hourly/minutely). At bottom of page tick [I agree] and enter a valid email address, then click [Download].

**Download Weather Data**  
Select the data you wish to download, fill in your details and click on "Download".  
Processing may take up to 5 minutes before the download starts. Afterwards you will have a zip-archive containing files with comma-separated values (CSV). You can open these with a program like Excel or Matlab.

**Select a date range for which you need the data**  
Please keep the date range within a few days. A bigger range will take too long due to server load and it will time out.

Start date:   
End date:

**Select the data you need**  
☐ M&M Weather Station (2008-09-03 to 2013-07-26)  
☐ E&E Weather Station (2010-04-01 to 2013-07-30)  
☐ Sonbesie Daily (Minimums and maximums)  
☐ Sonbesie Hour (Includes weather data)  
☒ Sonbesie Minute (Minutely solar data only)  
Sonbesie data available for 2010-05-24 to 2013-07-30

**Disclaimer**  
• This weather and solar data are made available under the **Public Domain Dedication and License version v1.0** whose full text can be found at <http://opendatacommons.org/licenses/pddl/1.0/> and [http://weather.sun.ac.za/ODC\\_PDDL.pdf](http://weather.sun.ac.za/ODC_PDDL.pdf)  
• The accuracy and completeness of the data can not be guaranteed.  
• Although it is not legally necessary to attribute the University of Stellenbosch, it will be appreciated.

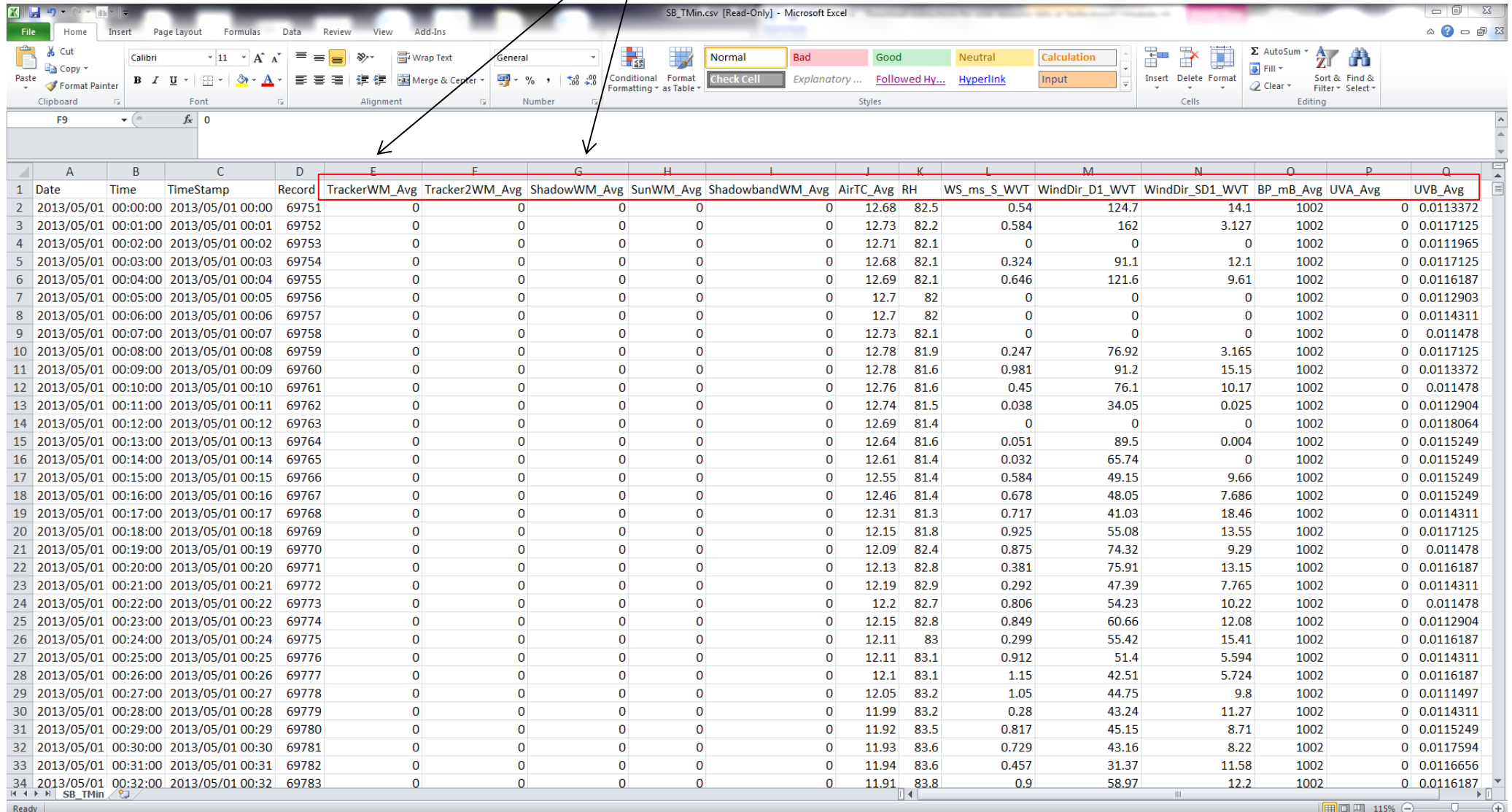
☒ I agree  
☐ I do not agree  
Email address:

4. Wait for data download, if it takes too long, it most likely timed-out, input smaller data range and try again.

## What does the data mean?

Data is downloaded in CSV format and can be opened with excel or similar software.

An explanation of each title, including, measurement, instrument, units and calibration information is given on the following page.



|    | A          | B        | C                | D      | E             | F              | G            | H         | I                | J         | K    | L           | M              | N               | O         | P       | Q         |
|----|------------|----------|------------------|--------|---------------|----------------|--------------|-----------|------------------|-----------|------|-------------|----------------|-----------------|-----------|---------|-----------|
| 1  | Date       | Time     | TimeStamp        | Record | TrackerWM_Avg | Tracker2WM_Avg | ShadowWM_Avg | SunWM_Avg | ShadowbandWM_Avg | AirTC_Avg | RH   | WS_ms_S_WVT | WindDir_D1_WVT | WindDir_SD1_WVT | BP_mB_Avg | UVA_Avg | UVB_Avg   |
| 2  | 2013/05/01 | 00:00:00 | 2013/05/01 00:00 | 69751  | 0             | 0              | 0            | 0         | 0                | 12.68     | 82.5 | 0.54        | 124.7          | 14.1            | 1002      | 0       | 0.0113372 |
| 3  | 2013/05/01 | 00:01:00 | 2013/05/01 00:01 | 69752  | 0             | 0              | 0            | 0         | 0                | 12.73     | 82.2 | 0.584       | 162            | 3.127           | 1002      | 0       | 0.0117125 |
| 4  | 2013/05/01 | 00:02:00 | 2013/05/01 00:02 | 69753  | 0             | 0              | 0            | 0         | 0                | 12.71     | 82.1 | 0           | 0              | 0               | 1002      | 0       | 0.0111965 |
| 5  | 2013/05/01 | 00:03:00 | 2013/05/01 00:03 | 69754  | 0             | 0              | 0            | 0         | 0                | 12.68     | 82.1 | 0.324       | 91.1           | 12.1            | 1002      | 0       | 0.0117125 |
| 6  | 2013/05/01 | 00:04:00 | 2013/05/01 00:04 | 69755  | 0             | 0              | 0            | 0         | 0                | 12.69     | 82.1 | 0.646       | 121.6          | 9.61            | 1002      | 0       | 0.0116187 |
| 7  | 2013/05/01 | 00:05:00 | 2013/05/01 00:05 | 69756  | 0             | 0              | 0            | 0         | 0                | 12.7      | 82   | 0           | 0              | 0               | 1002      | 0       | 0.0112903 |
| 8  | 2013/05/01 | 00:06:00 | 2013/05/01 00:06 | 69757  | 0             | 0              | 0            | 0         | 0                | 12.7      | 82   | 0           | 0              | 0               | 1002      | 0       | 0.0114311 |
| 9  | 2013/05/01 | 00:07:00 | 2013/05/01 00:07 | 69758  | 0             | 0              | 0            | 0         | 0                | 12.73     | 82.1 | 0           | 0              | 0               | 1002      | 0       | 0.011478  |
| 10 | 2013/05/01 | 00:08:00 | 2013/05/01 00:08 | 69759  | 0             | 0              | 0            | 0         | 0                | 12.78     | 81.9 | 0.247       | 76.92          | 3.165           | 1002      | 0       | 0.0117125 |
| 11 | 2013/05/01 | 00:09:00 | 2013/05/01 00:09 | 69760  | 0             | 0              | 0            | 0         | 0                | 12.78     | 81.6 | 0.981       | 91.2           | 15.15           | 1002      | 0       | 0.0113372 |
| 12 | 2013/05/01 | 00:10:00 | 2013/05/01 00:10 | 69761  | 0             | 0              | 0            | 0         | 0                | 12.76     | 81.6 | 0.45        | 76.1           | 10.17           | 1002      | 0       | 0.011478  |
| 13 | 2013/05/01 | 00:11:00 | 2013/05/01 00:11 | 69762  | 0             | 0              | 0            | 0         | 0                | 12.74     | 81.5 | 0.038       | 34.05          | 0.025           | 1002      | 0       | 0.0112904 |
| 14 | 2013/05/01 | 00:12:00 | 2013/05/01 00:12 | 69763  | 0             | 0              | 0            | 0         | 0                | 12.69     | 81.4 | 0           | 0              | 0               | 1002      | 0       | 0.0118064 |
| 15 | 2013/05/01 | 00:13:00 | 2013/05/01 00:13 | 69764  | 0             | 0              | 0            | 0         | 0                | 12.64     | 81.6 | 0.051       | 89.5           | 0.004           | 1002      | 0       | 0.0115249 |
| 16 | 2013/05/01 | 00:14:00 | 2013/05/01 00:14 | 69765  | 0             | 0              | 0            | 0         | 0                | 12.61     | 81.4 | 0.032       | 65.74          | 0               | 1002      | 0       | 0.0115249 |
| 17 | 2013/05/01 | 00:15:00 | 2013/05/01 00:15 | 69766  | 0             | 0              | 0            | 0         | 0                | 12.55     | 81.4 | 0.584       | 49.15          | 9.66            | 1002      | 0       | 0.0115249 |
| 18 | 2013/05/01 | 00:16:00 | 2013/05/01 00:16 | 69767  | 0             | 0              | 0            | 0         | 0                | 12.46     | 81.4 | 0.678       | 48.05          | 7.686           | 1002      | 0       | 0.0115249 |
| 19 | 2013/05/01 | 00:17:00 | 2013/05/01 00:17 | 69768  | 0             | 0              | 0            | 0         | 0                | 12.31     | 81.3 | 0.717       | 41.03          | 18.46           | 1002      | 0       | 0.0114311 |
| 20 | 2013/05/01 | 00:18:00 | 2013/05/01 00:18 | 69769  | 0             | 0              | 0            | 0         | 0                | 12.15     | 81.8 | 0.925       | 55.08          | 13.55           | 1002      | 0       | 0.0117125 |
| 21 | 2013/05/01 | 00:19:00 | 2013/05/01 00:19 | 69770  | 0             | 0              | 0            | 0         | 0                | 12.09     | 82.4 | 0.875       | 74.32          | 9.29            | 1002      | 0       | 0.011478  |
| 22 | 2013/05/01 | 00:20:00 | 2013/05/01 00:20 | 69771  | 0             | 0              | 0            | 0         | 0                | 12.13     | 82.8 | 0.381       | 75.91          | 13.15           | 1002      | 0       | 0.0116187 |
| 23 | 2013/05/01 | 00:21:00 | 2013/05/01 00:21 | 69772  | 0             | 0              | 0            | 0         | 0                | 12.19     | 82.9 | 0.292       | 47.39          | 7.765           | 1002      | 0       | 0.0114311 |
| 24 | 2013/05/01 | 00:22:00 | 2013/05/01 00:22 | 69773  | 0             | 0              | 0            | 0         | 0                | 12.2      | 82.7 | 0.806       | 54.23          | 10.22           | 1002      | 0       | 0.011478  |
| 25 | 2013/05/01 | 00:23:00 | 2013/05/01 00:23 | 69774  | 0             | 0              | 0            | 0         | 0                | 12.15     | 82.8 | 0.849       | 60.66          | 12.08           | 1002      | 0       | 0.0112904 |
| 26 | 2013/05/01 | 00:24:00 | 2013/05/01 00:24 | 69775  | 0             | 0              | 0            | 0         | 0                | 12.11     | 83   | 0.299       | 55.42          | 15.41           | 1002      | 0       | 0.0116187 |
| 27 | 2013/05/01 | 00:25:00 | 2013/05/01 00:25 | 69776  | 0             | 0              | 0            | 0         | 0                | 12.11     | 83.1 | 0.912       | 51.4           | 5.594           | 1002      | 0       | 0.0114311 |
| 28 | 2013/05/01 | 00:26:00 | 2013/05/01 00:26 | 69777  | 0             | 0              | 0            | 0         | 0                | 12.1      | 83.1 | 1.15        | 42.51          | 5.724           | 1002      | 0       | 0.0116187 |
| 29 | 2013/05/01 | 00:27:00 | 2013/05/01 00:27 | 69778  | 0             | 0              | 0            | 0         | 0                | 12.05     | 83.2 | 1.05        | 44.75          | 9.8             | 1002      | 0       | 0.0111497 |
| 30 | 2013/05/01 | 00:28:00 | 2013/05/01 00:28 | 69779  | 0             | 0              | 0            | 0         | 0                | 11.99     | 83.2 | 0.28        | 43.24          | 11.27           | 1002      | 0       | 0.0114311 |
| 31 | 2013/05/01 | 00:29:00 | 2013/05/01 00:29 | 69780  | 0             | 0              | 0            | 0         | 0                | 11.92     | 83.5 | 0.817       | 45.15          | 8.71            | 1002      | 0       | 0.0115249 |
| 32 | 2013/05/01 | 00:30:00 | 2013/05/01 00:30 | 69781  | 0             | 0              | 0            | 0         | 0                | 11.93     | 83.6 | 0.729       | 43.16          | 8.22            | 1002      | 0       | 0.0117594 |
| 33 | 2013/05/01 | 00:31:00 | 2013/05/01 00:31 | 69782  | 0             | 0              | 0            | 0         | 0                | 11.94     | 83.6 | 0.457       | 31.37          | 11.58           | 1002      | 0       | 0.0116656 |
| 34 | 2013/05/01 | 00:32:00 | 2013/05/01 00:32 | 69783  | 0             | 0              | 0            | 0         | 0                | 11.91     | 83.8 | 0.9         | 58.97          | 12.2            | 1002      | 0       | 0.0116187 |

| <b>Title</b>     | <b>Measurement</b>                  | <b>Instrument</b>                          | <b>Units</b>     | <b>Calibration date</b> |
|------------------|-------------------------------------|--|------------------|-------------------------|
| TrackerWM_Avg    | Direct Normal Irradiance (DNI)      | K&Z CHP1 pyrliometer                       | W/m <sup>2</sup> | 18 July 2012            |
| Tracker2WM_Avg   | Direct Normal Irradiance (DNI)      | K&Z CHP1 pyrliometer                       | W/m <sup>2</sup> | Unknown                 |
| *ShadowWM_Avg    | Diffuse Horizontal Irradiance (DHI) | K&Z CMP11 pyranometer (shaded)             | W/m <sup>2</sup> | 28 Jul 2011             |
| *SunWM_Avg       | Global Horizontal Irradiance (GHI)  | K&Z CMP11 pyranometer (un-shaded)          | W/m <sup>2</sup> | 28 Jul 2011             |
| ShadowbandWM_Avg | Diffuse Horizontal Irradiance (DHI) | K&Z CMP6 pyranometer (Shadowband)          | W/m <sup>2</sup> | 16 Dec 2009             |
| AirTC_Avg        | Air temperature                     | CS215 probe with 41303-5A radiation shield | °C               | Unknown                 |
| RH               | Relative humidity                   | CS215 probe with 41303-5A radiation shield | %                | Unknown                 |
| WS_ms_S_WVT      | Wind speed                          | R.M. Young wind sentry (Model 03001)       | m/s              | Unknown                 |
| WindDir_SD1_WVT  | Wind direction                      | R.M. Young wind sentry (Model 03001)       | °                | Unknown                 |
| BP_mB_Avg        | Barometric pressure                 | R.M. Young sensor (Model 61205V)           | mB               | Unknown                 |
| UVA_Avg          | UVA                                 | K&Z UVS-AB-T radiometer                    | W/m <sup>2</sup> | 24 Oct 2012             |
| UVB_Avg          | UVB                                 | K&Z UVS-AB-T radiometer                    | W/m <sup>2</sup> | 24 Oct 2012             |

\* ShadowWM\_Avg & SunWM\_Avg prior to 6 February 2012 represented data recorded from K&Z CMP6 pyranometers.