SAFARI 2000 Surface Irradiance Measurements, Mongu Tower Site, Zambia, 2000-2002

Abstract

This data set contains the top-of-canopy irradiance in the shortwave (0.3-2.8 micron) and photosynthetically active radiation (PAR; 0.4-0.7 micron) wavebands collected with an Eppley Precision Spectral Pyranometer (PSP) and a Skye SKE510 pyranometer, respectively. The instruments were deployed at the top of the 30-m tower in the Kataba Local Forest approximately 20 km south of Mongu in Western Province, Zambia. The data include the hourly mean and maximum values from 0500-1600 GMT (7 a.m. - 6 p.m. local time) and cover the period from September 4, 2000 to December 31, 2002.

Background Information

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Project: SAFARI 2000
Southern Africa Validation of EOS (SAVE)

Data Set Title: SAFARI 2000 Surface Irradiance Measurements, Mongu Tower Site, Zambia, 2000-2002

Site: Mongu, Zambia
Westernmost Longitude: 22.027572
Easternmost Longitude: 24.277347
Northernmost Latitude: -14.934194
Southernmost Latitude: -16.866708

Data Set Citation:

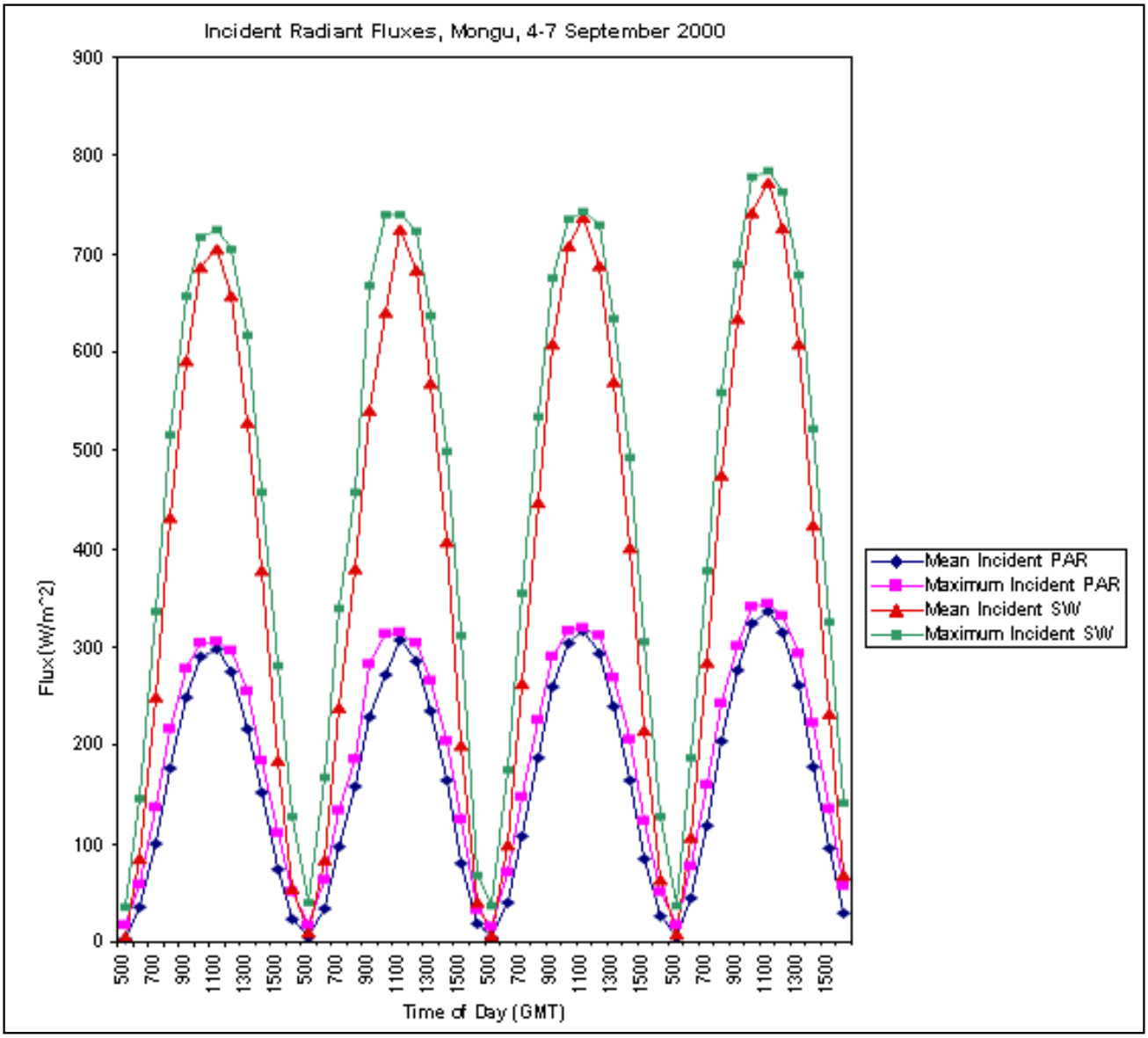
Privette J. L. and M. Mukelabai. 2005. SAFARI 2000 Surface Irradiance Measurements, Mongu Tower Site, Zambia, 2000-2002. Data set. Available on-line [http://daac.ornl.gov/] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

Web Site: http://modarch.gsfc.nasa.gov/MODIS/LAND/VAL/terra/privette/

Data File Information

The data file "**mongu_pyranometer_2000-2002.csv**" contains average and maximum irradiance in the shortwave (0.3-2.8 micron) and photosynthetic (visible, 0.3-0.7 micron) wavebands from the Kataba Local Forest near Mongu, Zambia. The data are contained within a single ASCII text file, in comma-separated-value format, with associated date, time, and QA information. The data file is described below.

Column Name	Definition	Units/Format	Instrument	Range
Year	Year	YYYY	data logger	2000-2002
Day	Julian Day of Year	numeric	data logger	1-365
Time	Time at the end of the averaging period, in GMT	HHMM GMT	data logger	500-1600
Mean_PAR	Hourly Mean PAR Irradiance	W m^{-2}	Skye SKE510	0-600
Max_PAR	Hourly Maximum PAR Irradiance	W m^{-2}	Skye SKE510	0-600
Mean_Shortwave	Hourly Mean Shortwave Irradiance	W m^{-2}	Eppley PSP	0-1300
Max_Shortwave	Hourly Maximum Shortwave Irradiance	W m^{-2}	Eppley PSP	0-1300
Solar_Zenith_Angle	Solar Zenith Angle at the end of the averaging period	degrees (from nadir)	NA (calculated)	2.54-90.21
Solar_Azimuth_Angle	Solar Azimuth Angle at the end of the averaging period	degrees (from North)	NA (calculated)	9.3-349.64



Site Description

The Mongu tower site is located within the Kataba Local Forest approximately 20 km south of Mongu in Western Province, Zambia. Mongu is situated at an elevation of 1187 m near the Zambezi River with a seasonality defined by wet and dry cycles. The rainy season extends from about November to April and the dry season from about May to October. Temperature averages 30º C in the dry season and 26º C in the wet season. Annual rainfall averages 949 mm, occurring primarily in the wet season.

The vegetation cover in the Kataba Local Forest is Kalahari woodland (also known as Miombo woodland on Kalahari Sands) and is dominated by *Brachystegia spiciformis, Burkea africana, Guibourtia coleosperma, Brachystegia bakerana, and Ochna pulchra.* The Local Forest undergoes subsistence harvesting.

Measurements

The sensors were leveled on a platform connected to the tower top. Each had an unobscured view of the full sky dome. Although the pyranometer has a hemispherical field-of-view, cosine reduction limits the effective field-of-view to about 70 degrees from zenith. The daily data cover the hours 0500-1600 GMT (7 a.m. - 6 p.m. local time), and include hourly mean and maximum values. The data collection period extended from September 4, 2000 to December 31, 2002. A data logger sampled the sensors at 60-second intervals and recorded the maximum and mean values every 60 minutes throughout the day.

Instrumentation

The Skye SKE510 uses a blue enhanced planar diffused silicon detector and has a fairly even response from 400 to 700 nm. A special cosine correction head on the detector improves the sensor's response at low solar elevation angles. The Eppley PSP has a standard thermopile detector.

Skye Instruments SKE 51

Eppley Pyranometer (left) and the Skye SKE 510 (right) together on a platform on the Mongu Tower.

The Skye Instruments SKE 510 is a waterproof cosine corrected sensor, which measures energy in units of watts/ m^2 falling in the photosynthetic waveband 400-700 nm. The measurement of energy within this defined waveband is particularly useful when studies involve the use of other equipment, such as thermopiles, which measure energy. Also, the defined response curve means that the sensor may be used in conditions of mixed lighting, since strong "out of band" sources will be ignored and only energy within the 400-700 nm waveband will be measured. The sensor effectively has a response derived from measuring the difference in output between two solarimeters where one is filtered to be sensitive only to wavelengths greater than 700 nm.

Eppley Precsion Spectral Pyranometer (PSP)

The Precision Spectral Pyranometer is a World Meteorological Organization First Class Radiometer designed for the measurement of sun and sky radiation, totally or in defined broad wavelength bands. It comprises a circular multi-junction wire-wound Eppley thermopile which has the ability to withstand severe mechanical vibration and shock. Its receiver is coated with Parson's black lacquer (non-wavelength selective absorption). This instrument is supplied with a pair of removable precision ground and polished hemispheres of Schott optical glass. Both hemispheres are made of clear WG295 glass which is uniformly transparent to energy between 0.285 to 2.8 µm. For special applications, other Schott glasses and Infrasil II quartz hemispheres are available.

Manufacturers:

Skye Insturments, Ltd.
21 Ddole Enterprise Park
Llandrindad Wells
Powys Ld1 6DF
United Kingdom
http://www.skyeinstruments.com/

The Eppley Laboratory, Inc.
12 Sheffield Avenue, PO Box 419
Newport, Rhode Island 02840 USA
Tel: 401-847-1020
Fax: 401-847-1031
http://www.eppleylab.com/

Specifications:

Skye SKE
(source: online datasheet)
S/N 3362
sensitivity = 1 V / 100 W m^{-2}

Eppley PSP
(source: tag on sensor)
S/N 13146F3
sensitivity = 8.58E-6 V / W m^{-2}

Data Processing Steps

1. Only complete days (0-24 h) are ingested into processing.
2. Data are time-adjusted for the period between September and November, 2000, when the data logger clock was one hour off. Those cases are flagged with '1' in the QA field.
3. The data are calibrated.
4. Based on the time, date, and location, the solar angles are determined from a model-generated look-up table.
5. QA checks are run.

Error Sources

The sensors were not cleaned periodically. In the wet season this probably had little effect. In the dry season, dust tends to build up on the sensors. The sensors were cleaned upon deployment in September 2000, and again in June and September 2001, and in June 2002.

Known Problems with the Data

After 2000, the Skye data should be used with great caution due to calibration drift. Specifically, the instrument became progressively less sensitive with time, and this trend is obvious in the data. Post-deployment calibration information may be available from the PI at a later date. If so, that data may be used to correct the bias. Otherwise, users might wish to try an ad hoc correction, such as normalizing the annual 98 percentile peak values against each other over the three years.

Additional Sources of Information

These data were obtained primarily for EOS validation and energy budget modeling. The data may also be combined with associated albedometer data from Kataba Forest to replace some periods of pyranometer instrument problems. A derived, cloud-cleared data set is available separately from the PI.

Related Data Sets:

The Mongu site was visited by many others during the Kalahari Transect field campaign in March-April of 2000. Related data sets include:

Privette J. L., M. Mukelabai, N. Hanan, and Z. Hao. 2005. SAFARI 2000 Surface Albedo and Radiation Fluxes at Mongu and Skukuza, 2000-2002. Data set. Available on-line [http://daac.ornl.gov/] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

Privette, J. L., M. M. Mukelabai, and K. F. Huemmrich. 2005. SAFARI 2000 FPAR TRAC Data for Mongu, Zambia, 1999-2002. Data set. Available on-line [http://daac.ornl.gov/] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

Privette, J. L., M. M. Mukelabai, and K. F. Huemmrich. 2005. SAFARI 2000 Leaf Area Measurements at the Mongu Tower Site, Zambia, 2000-2002. Data set. Available on-line [http://daac.ornl.gov/] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

Additional related data sets collected at the Mongu site during SAFARI 2000 are archived by ORNL DAAC. A list of these data sets is available at: http://www.daac.ornl.gov/S2K/safari.html.

References:

Privette J. L., M. Mukelabai, Z. Hao, and C. B. Schaaf. 2004. Validation of the MODIS albedo product in African savannas and woodlands. J. Geophys. Res., submitted.

Privette, J. L., R. B. Myneni, Y. Knyazikhin, M. Mukufute, G. Roberts, Y. Tian, Y. Wang, and S.

G. Leblanc. 2002. Early spatial and temporal validation of MODIS LAI product in Africa. Remote Sensing of Environment, 83(1-2): 232-243.

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