SAFARI 2000 Leaf Area Measurements at the Mongu Tower Site, Zambia, 2000-2002

Abstract

Data from the LAI-2000 instrument were processed to determine the leaf area index (LAI) at the EOS Validation Core Site in Kataba Local Forest, approximately 20 km south of Mongu, Zambia. Measurements began in 2000 and continued into 2002 with measurements collected about every month. The LAI-2000 was carried along three parallel transects, each 750 m long and spaced 250 m apart. Each transect was divided into 25 m segments, and measurements were collected at the endpoints of each segment. Data from all transects were combined to provide a site-average LAI. Data were collected just before sunrise, just after sunset, or on uniformly cloudy days.

Background Information

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

Data Set Title: SAFARI 2000 Leaf Area Measurements at the 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., 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.

Data File Information

The data file is stored as an ASCII text file, in comma-separated-value (csv) format, with column headers.

Column Name	Definition	Units/Format
Date	The observation date	DD/MM/YY
START TIME	The starting time of data collection	HH:MM GMT
END TIME	The ending time of data collection	HH:MM GMT
NUM PTS	The number of data values collected	numeric
LAI	The average LAI	m^2/m^2
Notes	Further information about the data	ASCII

Sample Records

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Date,Start Time,End time,num points,LAI,Notes
10/09/00,4:33:47,6:02:30,93,0.78,
10/18/00,4:36:33,5:59:06,93,0.77,
10/31/00,,,,,Data not processed
11/16/00,,,,,Data not processed
```

LAI-2000 data were collected on the following dates:

10/09/00	07/25/01
10/18/00	08/11/01
10/31/00	09/12/01
11/16/00	10/02/01
11/17/00	10/06/01
11/28/00	10/18/01
01/05/01	10/30/01
02/07/01	11/19/01
03/12/01	12/18/01
04/14/01	01/24/02
05/18/01	03/15/02
06/13/01	04/13/02

Only data collected under good open sky conditions at both the beginning and end of data collection and covering two or three transects were processed.

Errors and Limitations:

Since the determination of LAI depends on light transmittance through the canopy, the measurements are sensitive to all materials in the canopy, both leaves and branches. As we can assume that change in branch area is small over the temporal coverage, then observed changes in LAI from the LAI-2000 are due to changes in leaf area.

Known Problems with the Data:

Several sets of data were collected under conditions that were too dark to give useful LAI values.

Quality Assessment Activities:

LAI values were compared with MODIS LAI products. The satellite and ground observations were in close agreement.

Site Description

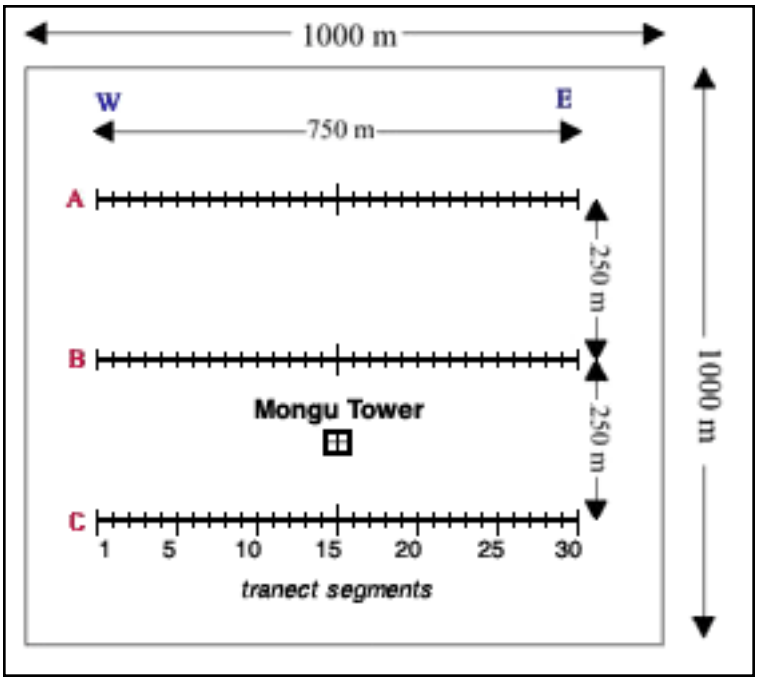
Surface observations were collected from the area surrounding the flux tower at the Kataba Local Forest, approximately 20 km south of Mongu in western Zambia. The tower was located at 15° 26.3' S., 23° 15.2' E, on a flat area adjacent to the Zambezi River flood plain. The land cover was miombo woodland on Kalahari Sand (Privette et al., 2002) or Kalahari woodland. Around the tower the woodland tree and shrub basal area measured at breast height averaged 8.19 m^2/ha with a standard deviation of 2.75 m^2/ha, for 42 samples, with canopy cover averaging 49.3% with a standard deviation of 10.6% (Scholes et al., 2002). There were five dominant species in the forest canopy: *Brachystegia spiciformis, Burkea africana, Guibourtia coleosperma, Brachystegia bakerana, and Ochna pulchra.* Average canopy height was about 12 m. Beneath the canopy there was a sparse understory of the grass *Pogonarthria squarrosa*, various shrubs and geoxylic suffrutices (*Copaifera baumiana, Paropsia brazzeana, Baphia massaiensis, Bauhinia petersiana,* and *Lannea gossweileri,* among others), moss, and leaf litter. The soil was a pale gray, deep, excessively well drained, fine sandy regosol of largely aeolian origin ('Kalahari sand') that showed almost no profile development with depth (Otter et al., 2002; Swap et al., 2002).

The site experiences a hot continental climate with a pronounced wet and dry seasonality. Nearly all of the rain occurs from November to April, while typically no rainfall occurs from June to September. The vegetation is deciduous, responding to the seasonal variation in rainfall.

Data Collection:

Measurements of LAI were made along three parallel east-west running transects, each 750-m long. The northern-most transect was labeled A, the middle transect B, and the southern-most transect was named C. The tower was located midway between the centers of the B and C transects. The transects were separated by 250 m. Each transect was divided up into 25-m long segments, numbered 1 to 30. The length and spacing of the transects were chosen to sample an area large enough to be representative of a 1 km MODIS pixel.

When measuring LAI, the LAI-2000 was first taken to an open area where unobstructed measurements of the sky were made. Then, the transects were walked with a measurement made every 25 m at the ends of the segments. After these measurements were made a second set of open sky measurements were collected. A lens cap with 90 degrees of cover (270 degrees uncovered) was used for all measurements.



Data Processing:

The raw LAI-2000 data were processed using the software provided with the instrument in the mode where the sky observations at the start and end of a set of measurements were interpolated for each under-tree measurement. All LAI observations were averaged together to get a site-average LAI.

Theory

This study examined LAI through the seasons. The LAI-2000 measures the intensity of blue light in five upward-looking concentric conical rings. Measurements made under the forest canopy were compared with open-sky measurements to determine transmittance for each of the five viewing angles. Effective leaf area was calculated from the transmittance in the different view angles based on the assumption of a random distribution of leaves (Welles and Norman, 1991). Measurements were collected near sunrise or sunset to have nearly uniform sky illumination. Open-sky measurements were collected before and after the transect measurements. This approach was chosen as it allows repeated consistent measurements of the same locations, without disturbing the canopy. This made possible LAI measurements to be collected throughout the growing season to examine the phenology of LAI for this site.

Instrumentation

The LAI-2000 measures the intensity of blue light in five upward-looking concentric conical rings (Wells and Norman, 1991).

Sensor or Instrument Measurement Geometry:

In operation, the LAI-2000 is held level at a marked spot along a transect while the sensors measured light levels in conical scans. The sensor head was placed at ground level during data acquisition. Before and after the transect data were collected, measurements of open sky were made.

Manufacturer of Sensor or Instrument:

LAI-2000
LI-COR, Inc.
Lincoln, Nebraska
USA

Additional Sources of Information

Some LAI-2000 data are available for the Skukuza, South Africa site. Please contact the investigators for information on this data set.

Global Positioning System (GPS) coordinates for the grid transect end points were collected at the Kalahari Transect sites and can be found in the file GPS_Coords_transect_endpts.txt.

Related Data Sets:

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.

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:

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Welles, J. M. and J. M. Norman. 1991. Instrument for indirect measurement of canopy architecture. Agronomy Journal, 83(5): 818-825.

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Revision Date: Tuesday, January 11, 2005