SAFARI 2000 Canopy Structural Measurements, Kalahari Transect, Wet Season 2001

Abstract

This data set contains leaf area index (LAI), leaf inclination angle, and canopy dimension data from study sites along the Kalahari Transect in southwest Botswana. The data were collected during the 2001 wet season field campaign of the SAFARI 2000 at a total of seven plots of 200 x 150 meter dimensions; two plots each at Tshane and Mabuasehube, and three plots at Tsabong. The data set consists of measurements of leaf angle for plot dominant woody species, LAI calculated from overstory and understory photosynthetically active radiation (PAR) measurements, and canopy dimension data (i. e., crown height, crown width, and height to crown) for grass and woody vegetation, for use in the parameterization of plant canopy reflectance models.

Background Information

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Project: SAFARI 2000

Data Set Title: SAFARI 2000 Canopy Structural Measurements, Kalahari Transect, Wet Season 2001

Site: Kalahari District, Southern Africa
Westernmost Longitude: 21.83
Easternmost Longitude: 22.32944
Northernmost Latitude: -24.16
Southernmost Latitude: -25.75

Data Set Citation:

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Web Site: http://www.ties.salford.ac.uk/

Data File Information

Data files contain records of LAI, leaf inclination angle, and canopy dimensions (i.e., crown height, crown width, and height to crown) from three study sites along the Kalahari Transect. Data availability is summarized in the table below. Additional notes and exceptions can be found in the lower section of this document in the **Data Notes Table**.

Data Availability Table

Site/Plot	LAI	Canopy Dimensions				
		Grewia flava	*Acacia mellifera*	*Boschia albitrunca*	*Acacia erioloba*	*Acacia leuderitzii*
Tshane						
Plot 1	x		x			x
Plot 2	x		x			x
Mabuasehube						
Plot 1	x	x	x	x		
Plot 2	x	x	x		x	
Tsabong						
Plot 1	x	x	x			x
Plot 2	x	x	x		x	x
Plot 3	x	x	x			

Site/Plot	Leaf Angle				
	Grewia flava	*Acacia mellifera*	*Boschia albitrunca*	*Acacia erioloba*	*Acacia leuderitzii*
Tshane					
Plot 1		x			x
Plot 2					
Mabuasehube					
Plot 1					
Plot 2	x			x	

Tsabong					
Plot 1					
Plot 2	x				x
Plot 3	x	x			

The LAI data files contain header information at the top, followed by the main body of 10 data columns, defined below.

Variables in LAI Data Records Table

Column	Definition	Units/format
Time	Time of data collection (local time)	hh:mm:ss
Plot Code	Site indicator	ASCII
Sample Number	The sample number of the measurement. If the measurements are made along a 200 m transect at 10 m intervals, the sample numbers will be 1-21.	numeric
Transmitted	The amount of photosynthetically active radiation (PAR) transmitted through the canopy.	µmol m-2 s-1
Spread	PAR is measured at 64 photodiodes located along the length of the SunScan 1 m probe. A single value of LAI is calculated from an average of all 64. The spread is the coefficient of variation of the PAR levels recorded at each of the 64 photodiodes.	dimensionless
Incident	The amount of PAR incident on the top of the canopy.	µmol m-2 s-1
Beam Fraction	The fraction of direct radiation in the total incident radiation.	dimensionless
Zenith Angle	The solar zenith angle, calculated from the SunScan software.	degrees
LAI	The leaf area index, defined as the one-sided green leaf area per unit ground area. The LAI is calculated from an average of all 64 PAR values.	dimensionless
Notes	Overstory measurement indicator. A cell with an 'o' indicates a measurement of the overstory LAI. A cell that is empty indicates the measurement is of the understory LAI.	NA

Data File Naming Convention

The file naming convention for LAI data files is **site_datatype_plotdimension_transect_plotid.csv**, such that LAI data collected in Tshane, Plot 1 (200 x 150 m), along the "A" transect, is named **tshane_lai_200_a_p1.csv**. Straight line measurement transects were established within the field plots.

There is just one canopy dimension file per plot, containing measurements of 10-20 individual trees for each of the dominant species at the site. The data columns are as follows: species, tree height, crown height, height-to-crown, and crown width. All canopy dimension measurements are in meters.

The leaf inclination angle distribution files contain a few header lines at the top, followed by the data records in two columns: species and leaf angle. Because of the time consuming nature of the leaf angle data collection, these data are not available at all plots. See the first table above for availability.

Study Sites

Three study sites were visited, where data were obtained from a total of seven field plots. The dimensions of the field plots were 200 m x 150 m, within which a 60 m x 60 m sub-plot was situated. The Tshane site was farthest north and LAI data have previously been collected at this site by other SAFARI 2000 investigators (Privette et al., 2002). Two field plots were sited at Tshane, referred to as p1 and p2. Mabuasehube is a game reserve within which two field plots were sited, p1 and p2. Farthest south was the Tsabong site, where three field plots were sited, p1, p2, and p3. The soil type at all of the sites are the Kalahari Sands.

Location and General Characteristics of the Field Plots

Site/Plot	Latitude Longitude	Characteristics	LAI	Tree Height	Time Period Visited
Tshane					
Plot 1	24.16591 S 21.89090 E	Low tree/shrub savanna *(Acacia)* Overstory vegetation cover: 16% Understory vegetation cover: 17% Light cattle grazing takes place	0.08-3.51	0.87-9.40m	28-Feb and 02-Mar, 2001

Plot 2	24.16439 S 21.88253 E	Low tree/shrub savanna *(Acacia)* Overstory vegetation cover: 20% Understory vegetation cover: 23% Light cattle grazing takes place	0.08-4.45	1.14-9.13m	01-Mar-2001
Mabuasehube					
Plot 1	24.91528 S 21.97547 E	Savanna grassland Overstory vegetation cover: 7% Understory vegetation cover: 18% Game reserve, light grazing by ungulates	0.01-2.03	0.60-4.41m	03-Mar-2001
Plot 2	25.00645 S 22.05572 E	Savanna grassland Overstory vegetation cover: 5% Understory vegetation cover: 17% Game reserve, light grazing by ungulates	0.05-1.72	0.61-9.08m	04-Mar-2001
Tsabong					
Plot 1	25.74148 S 22.31466 E	Shrub savanna *(Acacia mellifera* and *Grewia flava)* Overstory vegetation cover: 18% Understory vegetation cover: 12% Once intensively grazed, now only very light grazing; little biomass in the understorey	0.10-2.81	1.38-10.38m	06-Mar-2001

Plot 2	25.63758 S 22.27852 E	Low tree/shrub savanna (*Acacia leuderitzii* and *Grewia flava)* Overstory vegetation cover: 6% Understory vegetation cover: 16% Located inside a wildlife management area; light grazing by ungulates	0.02-3.59	0.78-8.72m	07-Mar-2001
Plot 3	25.74508 S 22.32332 E	Shrub savanna *(Acacia mellifera* and *Grewia flava)* Overstory vegetation cover: 8% Understory vegetation cover: 12% Once intensively grazed, now only very light grazing; little biomass in the understorey	0.09-5.23	1.55-8.40m	08-Mar-2001

LAI Measurements

Sampling Framework

A nested sampling framework was adopted to collect these data. Measurements of LAI were made along five straight line transects (ABCDE) within a 200 m x 150 m plot. There were three straight line transects (ABC) of 200 meters in length, each parallel to one another and separated by 75 meters. Measurements were taken at 10 meter intervals, yielding 21 samples per transect. Within the center of this 200 m x 150 m plot, a 60 m x 60 m sub-plot was situated. Transects D and E extended from the corners of this 60 m x 60 m sub-plot, each 85 meters long, sampling every 5 meters, thus yielding 18 samples per transect. In total, 99 measurements of LAI were obtained from each plot. The start and end points of each transect were recorded with a GPS unit. Measurements were made approximately one hour either side of solar noon whenever this was possible. The data files record the exact time at which measurements were taken.

Instrumentation

Measurements of LAI were made with a SunScan plant canopy analysis system (Delta-T Devices, Cambridge, U.K.). This instrument records direct and diffuse photosynthetically

active radiation (PAR) at the top of the canopy using a beam fraction sensor (BFS). PAR beneath the canopy is measured simultaneously with a one meter long probe held horizontally beneath the canopy. Because of the height of the vegetation at Tshane and Tsabong, the BFS was not placed above the canopy directly; rather, it was placed in an opening as near as possible to where the measurement was to be taken.

Measurement Notes

While measuring LAI at the Tsabong plots, the BFS began to malfunction. Measurements of top of canopy PAR were then made without the BFS. Direct PAR above the canopy was recorded by the probe itself, before being placed underneath the canopy (sequential mode). Fortunately, light conditions were very stable when measurements were made in this way. The LAI measurements at Tsabong plot 3, transects C, D, and E, were made without the BFS, while measurements made along transects A and B were lost completely due to the BFS malfunction. Some measurements made at the other two Tsabong plots were also lost because of the BFS malfunction. For an explanation of the effect of this on the format of the data files, see the table below. The leaf angle distribution parameter was set to 1, this represents a spherical leaf angle distribution. The leaf absorption parameter was set to 0.85.

Data Notes Table

Site/Plot	Measurement	Data Notes
Tshane		
Plot 1	LAI 200 m	All data were obtained using the instrument in simultaneous mode.
	LAI 60 m	Two measurements on transects D and one on transect E were made erroneously. This was noticed in the field, so a replacement measurement was made. This explains the interrupted sequence in the 'samp' column of the data files. Only one of the erroneous measurements on transect D was replaced, such that there are 17 samples instead of 18. All data were obtained using the instrument in simultaneous mode.
	Leaf Angle Dist	Species codes in the filenames are: *Acacia leuderitzii* - al, *Acacia mellifera* - am
Plot 2	LAI 200 m	All data were obtained using the instrument in simultaneous mode.

	LAI 60 m	Two measurements on transect D were made erroneously. This was noticed in the field, so replacement measurements were made. This explains the interrupted sequence in the 'samp' column of the data files. All data were obtained using the instrument in simultaneous mode.
Mabuasehube		
Plot 1	LAI 200 m	One measurement on transect C was made erroneously. This was noticed in the field, so a replacement measurement was made. This explains the interrupted sequence in the 'samp' column of the data file. All data were obtained using the instrument in simultaneous mode.
	LAI 60 m	All data were obtained using the instrument in simultaneous mode.
Plot 2	LAI 200 m	All data were obtained using the instrument in simultaneous mode.
	LAI 60 m	All data were obtained using the instrument in simultaneous mode.
	Leaf Angle Dist	Species codes in the filenames are: *Acacia erioloba* - ae, *Grewia flava* - gf
Tsabong		
Plot 1	LAI 200 m	Some measurements from transect C have been removed because of instrument malfunction. This explains the interrupted sequence in the 'samp' column of the data files. All data were obtained using the instrument in simultaneous mode.
	LAI 60 m	One measurement from transect D has been removed because of instrument malfunction. This explains the interrupted sequence in the 'samp' column of the data file. All data were obtained using the instrument in simultaneous mode.
Plot 2	LAI 200 m	Seven measurements from transect A and three measurements from transect B have been removed because of instrument malfunction. This explains the interrupted sequence in the 'samp' column of the data files. All data were obtained using the instrument in simultaneous mode.
	LAI 60 m	Six measurements from transect D and 15 measurements from transect E have been removed because of instrument malfunction. This explains the interrupted sequence in the 'samp' column of the data files. All data were obtained using the instrument in simultaneous mode.

	Leaf Angle Dist	Species codes in the filenames are: *Acacia leuderitzii* - al, *Grewia flava* - gf
Plot 3	LAI 200 m	No measurements are available from transects A and B because of instrument malfunction. Data from transect C were obtained using the instrument in sequential mode.
	LAI 60 m	All data were obtained using the instrument in sequential mode.
	Leaf Angle Dist	Species codes in the filenames are: *Acacia mellifera* - am, *Grewia flava* - gf

Canopy Dimension Data

Measurements of tree height, crown height, height-to-crown, and crown width were made for 10 to 20 individual trees of the dominant species at each field plot. Measurements were concentrated within the 60 m x 60 m sub-plot, although occasionally measurements were made farther afield than this, but within the bounds of the 200 m x 150 m rectangular plot, to better cover the naturally occurring range of data. Measurements of tree height and height-to-crown were made by either directly using a tape measure, or using simple trigonometry. Crown height was calculated by subtracting height to crown from tree height. Crown width was measured directly using tape measures. If vegetation was clumped, as was sometimes the case, then clumps of the same species were treated as one individual. The longest axis was measured first and then a second axis, approximately orthogonal to the first, was also measured. Crown width was then calculated as the average of these two measurements.

Leaf Inclination Data

Leaf inclination angle measurements were made at all three sites using a clinometer (azimuthal symmetry was assumed). Measurements were made at random and approximately 100 measurements were made on individuals of the most common species at each site. These were: *Acacia leuderitzii* (al), *Acacia mellifera* (am), *Acacia erioloba* (ae), and *Grewia flava* (gf). Time constraints limited the collection of leaf inclination angle measurements. Thus, these data are not available at all plots. See table above for availability.

Site Photography

Several photographs in JPEG format are provided of each plot to provide an idea of site conditions. The photographs can be viewed on the S2K Photo Gallery pages. Sample photographs are shown below.

Tshane site, plot 1.

Mabuasehube site, plot 1.

Tsabong site, plot 2.

Additional Sources of Information

This work was sponsored by The Royal Society and The Remote Sensing and Photogrammetry Society.

Additional related data sets collected during the Kalahari Transect Wet Season Field Campaign 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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