SAFARI 2000 AOT and Column Water Vapor, Kalahari Transect, Wet Season 2000

Abstract

The data presented here include the aerosol optical thickness (AOT) and column water vapor measurements taken at sites along the Kalahari Transect using a Microtops sun photometer. Data were collected every 30 minutes at 4 sites that were visited during the SAFARI 2000 Kalahari Wet Season Campaign between March 3, 2000 and March 18, 2000. AOT values are provided at 340, 440, 675, 870, and 936 nm wavelengths. An estimate of the Angstrom Coefficient is also provided to allow the estimation of AOT at other wavelengths.

The purpose of this data collection was primarily for documentation of the conditions at each site and to aid in the correction of remote sensing data, validation of Earth Observation System (EOS) products such as MODIS and MISR aerosol products, and for modeling of canopy productivity.

Background Information

Investigators:

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

Data Set Title: SAFARI 2000 AOT and Column Water Vapor, Kalahari Transect, Wet Season 2000

Site: Kalahari Transect

Westernmost Longitude: 21.72° E
Easternmost Longitude: 25.50° E
Northernmost Latitude: 18.65° S
Southernmost Latitude: 24.17° S

Data Set Citation:

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

Data File Information

This data set contains the aerosol optical depth and column water vapor measurements made at Kalahari Transect sites in Botswana. The data are organized into two files corresponding to the two instruments used. In many cases, the instruments were used nearly simultaneously at the same point for redundancy. The sites visited were Pandamatenga, Maun (Okavango Delta), Okwa River Crossing, and Tshane. AOT measurements were made every half hour during cloud-free periods of the campaign at the following wavelengths: 340, 440, 675, 870, and 936 nm. An estimate of the Angstrom Coefficient (alpha) is also provided to allow estimation of AOT at other wavelengths. The associated time of day and geographic locations are also provided.

The data files contain numerical and character fields of varying length separated by commas. The metadata information are contained in file header, followed by the data arranged as one row per measurement. The columns in each rows are as follows.

Column Name	Column Description	Units/Format
year	Year of data collection	yyyy
month	Month of data collection	mm
day	Day of data collection	dd
hour	Hour of data measurement (UTC)	hh
minute	Minute of data measurement (UTC)	mn
second	Second of data measurement (UTC)	ss
Lat	Latitude location of data measurement	degrees
Lon	Longitude location of data measurement	degrees
AOT340	Aerosol optical thickness, 340 nm wavelength	dimensionless
AOT440	Aerosol optical thickness, 440 nm wavelength	dimensionless
AOT675	Aerosol optical thickness, 675 nm wavelength	dimensionless
AOT870	Aerosol optical thickness, 870 nm wavelength	dimensionless
AOT936	Aerosol optical thickness, 936 nm wavelength	dimensionless
WV	Columnar Water Vapor	cm
ALPHA	Angstrom Coefficient	dimensionless

Study Sites

The Kalahari Transect is marked by fairly constant arenosol soils, typically tens of meters deep (the Kalahari sands). The Transect's vegetation includes near-continuous Kalahari woodlands (Miombo woodland on sand) to the north and increasingly sparser woodlands and savannas southward. All field sites were on the southern African plateau with elevations of about 1000 meters. All sites in Botswana

exhibited signs of light grazing. The region 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 generally semi-deciduous, responding to the seasonal variation in rainfall. Summary information is available in Otter et al. (2002), Dowty et al. (2000) and Scholes et al. (2002).

Sites	Latitude	Longitude
Maun	19° 55' 22" S	23° 35' 40" E
Pandamentanga	18° 39' 19" S	25° 30' 01" E
Ghanzi/Okwa River Crossing	22° 24' 33" S	21° 42' 47" E
Tshane	24° 09' 51" S	21° 53' 34" E

Theory of Measurements

The instrument determines the airmass between the ground and sun based on latitude, longitude, date and time of day. It uses a modified version of Beer's Law, together with the measured radiances, to estimate the AOT.

Instrument

The Microtops II instrument is a hand-held multi-band sun photometer capable of measuring the total ozone column and optionally the water vapor column (also called precipitable water) as well as aerosol optical thickness at 1020 nm.

Principles of Operation

From: Microtops II User's Guide (v. 1.40):

The instrument is equipped with 5 optical collimators, accurately aligned, with a full field of view of 2.5° and internal baffles eliminating

internal reflections. Each channel is fitted with a narrow-band interference filter and a photodiode suitable for the particular wavelength range. All collimators are encapsulated in a cast aluminum optical block for stability. A sun target and a pointing assembly is permanently attached to the optical block and laser-aligned to ensure accurate alignment with the optical channels. When the image of the sun is centered at the cross-hairs of the sun target then all optical channels are looking directly at the solar disk. A small amount of circumsolar radiation is also being captured but it makes little contribution to the signal. The radiation captured by the collimators and then bandpass filtered falls onto the photodiodes producing an electrical current proportional to the radiant power intercepted by the photodiodes. The precipitable water column is determined based on measurements at 940 nm (water absorption peak) and 1020 nm (no absorption by water). The aerosol optical thickness at 1020 nm is calculated based on the extraterrestrial radiation at that wavelength, corrected for the sun-earth distance, and the ground level measurement of the radiation at 1020 nm.

Manufacturer of Sensor or Instrument

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Calibration

The data were compared to AERONET CIMEL data collected on February 22, 2000 in Greenbelt, MD for cross-calibration purposes. The data were processed using a procedure develop by C. Pietras for the NASA Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) group.

Quality Assessment

Error Sources

Errors may result from partial clouds (e.g., thin cirrus). High grade filters are embedded in a solid cast aluminum housing which assures accurate, stable optical alignment. Low noise electronics and a 20 bit A/D converter ensure high linearity, resolution and dynamic range.

Known Problems with the Data

There are a few cases where NaN (Not a Number) and Inf (Infinite number) are reported in the columns. Those cases should be ignored.

Additional Sources of Information

Related Data Sets

"SAFARI 2000 AERONET Ground-based Aerosol Data from Mongu, Zambia" archived at ORNL DAAC.

Additional related data sets collected during the Kalahari Transect Wet Season Field Campaign are archived at ORNL DAAC. A list of these data sets is available at: http://www.daac.ornl.gov/S2K/safari.html.

References

Dowty, P., P. Frost, D. Lesolle, G. Midgly, M. Mukelabai, L. Otter, J. Privette, J. Ramontsho, R. Scholes, S. Ringrose, and Y. Wang. 2000. Summary of the SAFARI 2000 wet season field campaign along the Kalahari Transect. EOS Earth Observer, 12(3): 29-34. [http://eospso.gsfc.nasa.gov/eos_observ/5_6_00/5_6_00.pdf].

Otter, L. B., R. J. Scholes, P. Dowty, J. L. Privette, K. Caylor, S. Ringrose, M. Mukelabai, P. Frost, O. Totolo, and E. M. Veenendaal.

2002. The SAFARI 2000 wet season campaigns. S. African J. Sci., 98(3/4): 131-137.

Privette, J. L., R. B. Myneni, Y. Knyazikhin, M. Mukelabai, Y. Tian, Y. Wang, G. Roberts, and S. Leblanc. 2002. Early spatial and temporal validation of MODIS LAI in the Southern Africa Kalahari, Remote Sens. Environ., 83: 232-243.

Privette, J. L., Y. Tian, G. Roberts, R. J. Scholes, Y. Wang, K. Caylor, and M. Mukelabai. 2004. Structural characterization and relationships in Kalahari woodlands and savannas. Global Ch. Biol., 10(3): 281-291, March 2004.

Scholes, R. J., P. R. Dowty, K. Caylor, P. G. H. Frost, D. A. B. Parsons, J. Ramontsho, and H. H. Shugart. 2002. Trends in savanna structure and composition on an aridity gradient in the Kalahari. Journal of Vegetation Science 13(3): 419-428.

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