SAFARI 2000 Micro-Pulse Lidar Cloud and Aerosol Data, Dry Season 2000

Abstract

Two Micro-Pulse Lidar (MPL) systems were deployed to Africa for the SAFARI 2000 experiment. One MPL was setup in Mongu, Zambia and the other was setup in Skukuza, South Africa. The primary focus of MPL work during SAFARI was to study the vertical distribution and optical properties of smoke from biomass burning in the region. See Figures 1 and 2.

The MPL system is a single channel (523nm), autonomous, eye-safe lidar originally developed at GSFC that is now available commercially. The MPL system is used to determine the vertical structure of clouds and aerosols in the atmosphere. MPL data are analyzed to produce optical properties such as extinction and optical depth profiles of the clouds and aerosols. The data for the 2 S2K sites were added to MPL-Net, a global network of micro-pulse lidar (MPL) systems.

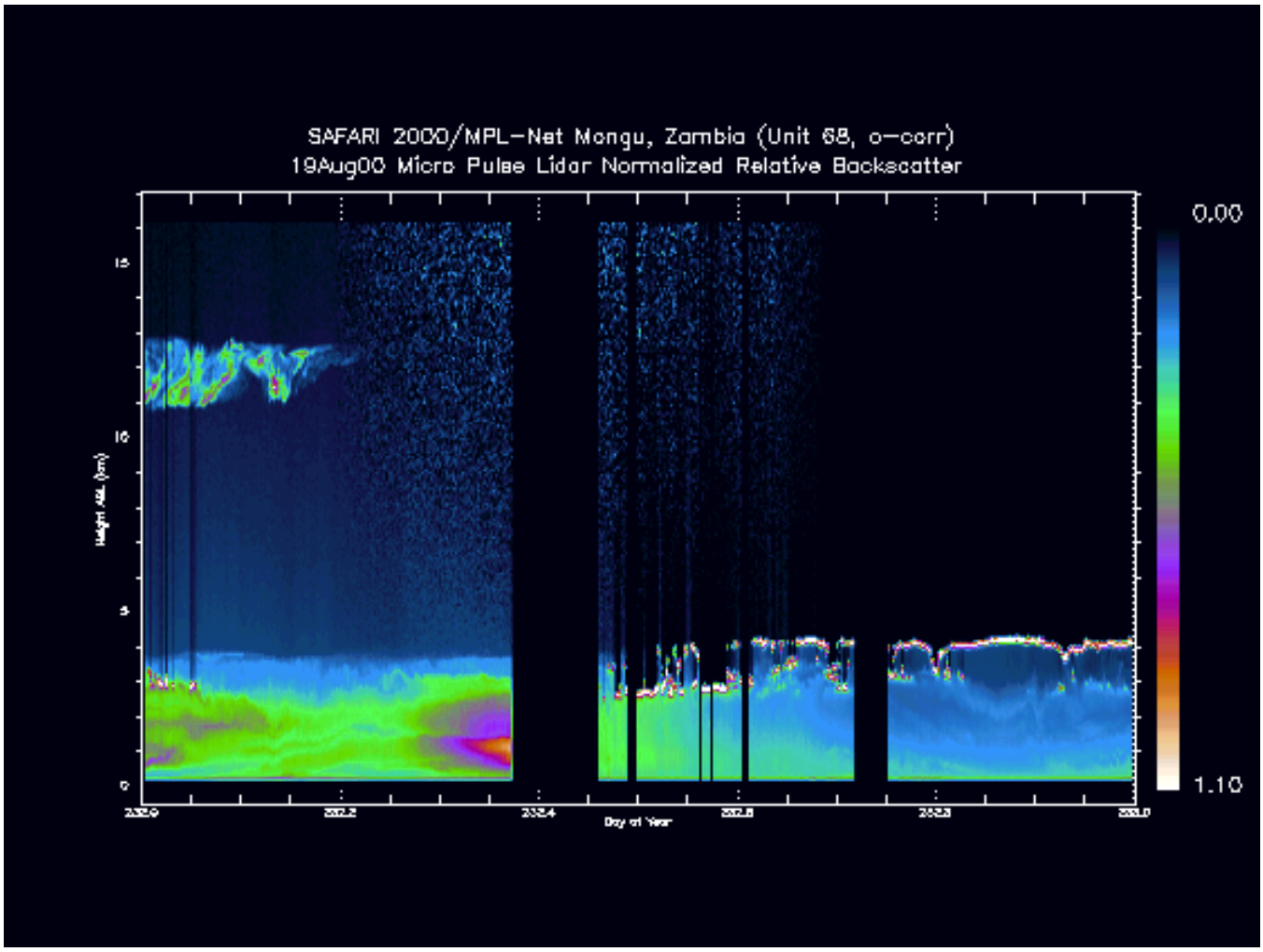

Figure 1. Daily quicklook image of data from Mongu site on August 31, 2000.

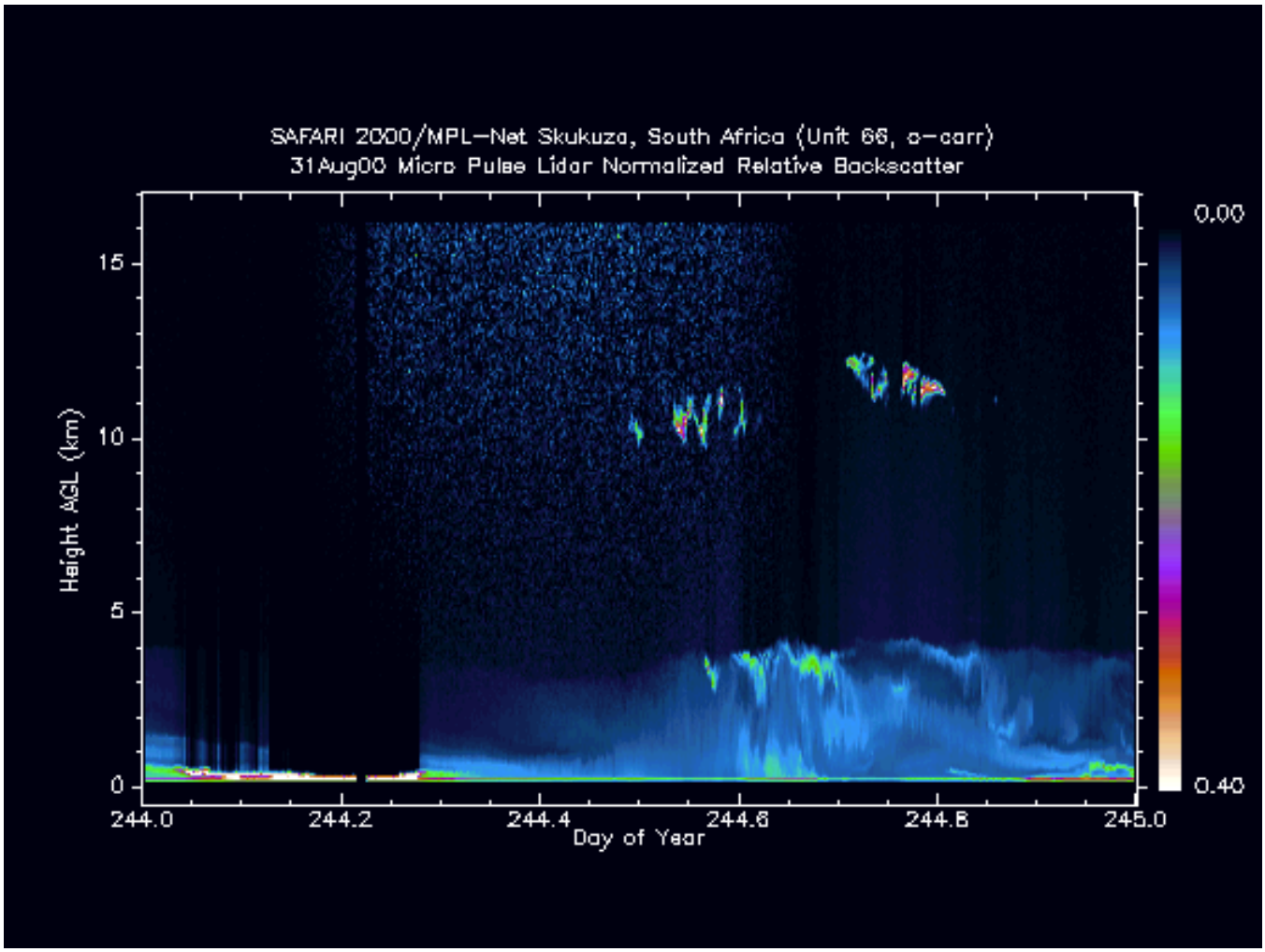

Figure 2. Daily quicklook image of data from Skukuza on August 31, 2000.

The primary goal of MPL-Net is to provide long-term data sets of cloud and aerosol vertical distribution at key sites around the world. The long-term data sets will be used to validate and help improve global and regional climate models, and also serve as ground-truth sites for NASA/EOS satellite programs such as the Geoscience Laser Altimeter System (GLAS) [Internet Link] on the **ICESat** spacecraft (launch date December 2002). MPL-Net is run by members of the GSFC Cloud and Aerosol Lidar Group (Code 912) [Internet Link] and is funded by NASA/EOS.

Background Information

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Project: SAFARI 2000
Data Set Title: SAFARI 2000 Micro-Pulse Lidar Cloud and Aerosol Data, Dry Season 2000

Sites: Skukuza, RSA and Mongu, Zambia

Data Set Citation: Welton, J., J. Spinhirne, and J. Campbell. SAFARI 2000 Micro-Pulse Lidar Cloud and Aerosol Data, Dry Season 2000. Data set. Available on-line [http://www.daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

Data File Information

Final Level 1.5a Results in ASCII format
These MPL data files were made by converting MPLNET project data files from NetCDF format to ASCII. The data are Level 1.5a MPLNET products, and are real-time data. They are not quality checked nor are they quality assured. Bad data can be screened based on examination of the MPL detector temperature (see below) -- further information on using these data and quality screening should be directed to Dr. Judd Welton (welton@virl.gsfc.nasa.gov). Data files for each MPL site are denoted by "Mongu" or "Skukuza" in the filename.

Level 1.5a (Real-time Single Layer Aerosol Properties, Not Quality Assured)
The level 1.5a data products include:

- Aerosol Layer Heights
- Layer Averaged Aerosol Extinction-to-Backscatter Ratio (S)
- Aerosol Backscatter, Extinction, and Optical Depth Profiles

The level 1.5a data products are determined by matching up coincident MPL and on-site sunphotometer (AERONET at sites) aerosol optical depth measurements. The level 1.5a data are only available when there is a sunphotometer measurement. The level 1.5a MPL-Net data is calculated using the AERONET level 1.5 aerosol optical depth as a constraint (for more info please see papers listed on our home page under publications). The typical time resolution of the MPL will be about 10-20 minutes, centered on the sunphotometer

observation time. HINT: MPL systems not operating at peak performance (due to old age or some other problem) will most likely require longer time averages in order to obtain good signal-to-noise, and low data product uncertainties.

MPL ASCII File Format

Files Ending with "_ext.dat"
Files ending with "_ext.dat" contain aerosol extinction (1/km) profiles and their uncertainties. These files are arranged as rows, with the first column containing the header for each row. The first row is altitude (km) above sea level. The follow on rows contain extinction and uncertainty profiles for times coincident with AERONET optical depth observations. The format of the file is:

```
Altitude_(km)                    1.1475     1.2225     1.2975     ......
232.236588_Extinction_1/km       2.99E-02   3.23E-02   3.48E-02   ......
232.236588_Extinction_Uncertainty 8.49E-03  8.53E-03   8.47E-03   ......
```

The altitude increment is 75 m as set by the MPL range resolution. The number in the extinction and uncertainty headers is the Day of Year and the decimal indicates fraction of day in UTC.

Files Ending with "_bks.dat"
Files ending with "_bks.dat" contain aerosol backscatter (1/km*sr) profiles and their uncertainties. These files are arranged exactly as the "_ext.txt" files, except the data are backscatter not extinction.

Files Ending with "_para.dat"
Files ending with "_para.dat" contain parameters other than aerosol backscatter and extinction. These files are arranged as columns, and contain a header row with the following column titles:

```
Day_of_Year_(UTC)
Latitude
Longitude
AERONET_AOT_523nm_(+-0.01)
Extinction-to-Backscatter_(sr)
Extinction-to-Backscatter_Uncertainty
AERONET_Angstrom_Exponent
AERONET_Angstrom_Coeff
AERONET_PolyFitCoeff1
```

```
AERONET_PolyFitCoeff2
AERONET_PolyFitCoeff3
AERONET_Airmass
AERONET_Water
MPL_Detector_Temperature_(C)
```

Day_of_Year_(UTC) is the same format as the other files. Latitude and Longitude are in decimal format.

The AERONET_AOT_523nm value was calculated using the 2nd order polynomial fit described below, and the AERONET AOT values at each wavelength. The Extinction-to-Backscatter terms are the extinction-to-backscatter ratio (sr) and its uncertainty (also known as the lidar ratio). The AERONET Angstrom terms are the exponent and coefficient from an Angstrom power law fit to all the wavelengths. The AERONET_PolyFitCoeff terms are the coefficients from a fit of the following equation:

$$\ln(\tau) = a_1 + a_2 \ln(\lambda) + a_3 [\ln(\lambda)]^2$$

where a_1 is PloyFitCoeff1, etc. AERONET_Water is the water vapor in cm.

The MPL_Detector_Temperature_(C) is the temperature of the instrument. Data may have errors at times when the temperature was far different from the temperature when the instrument was calibrated. The Skukuza MPL was calibrated at a temperature of 25 C, and the Mongu MPL was calibrated at 28 C. Further questions on screening bad data should be directed to Dr. Judd Welton (welton@virl.gsfc.nasa.gov).

MPL for SAFARI 2000

Two MPL systems were deployed to Africa for the SAFARI 2000 experiment. One MPL was setup in Mongu, Zambia and the other was setup in Skukuza, South Africa. The primary focus of MPL work during SAFARI was to study the vertical distribution and optical properties of smoke from biomass burning in the region.

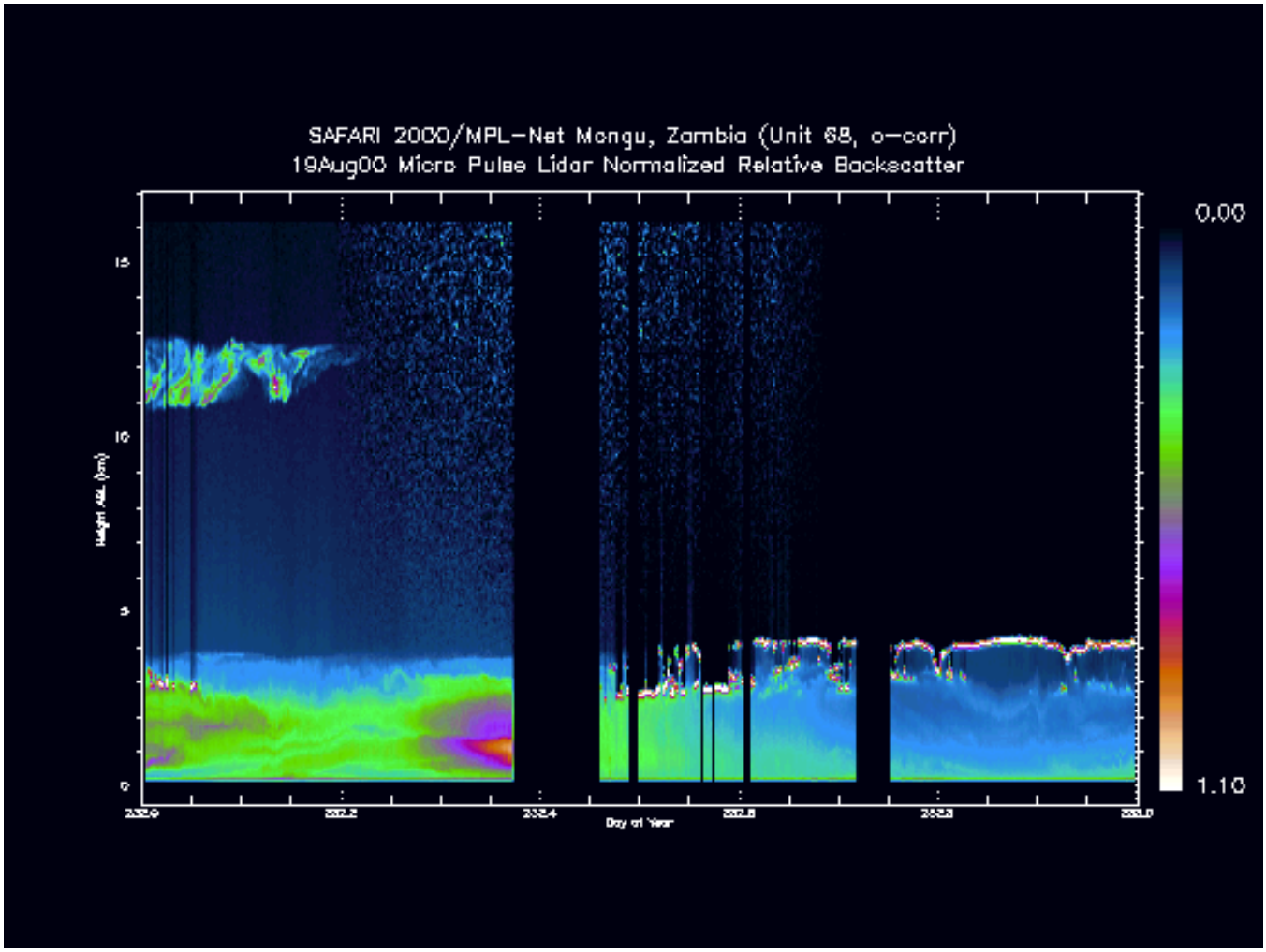
Mongu

The Mongu MPL was set up at the Meteorological Department building near the small airport in Mongu, Zambia.

Coordinates: 15° 15.26' S, 23° 9.03' E
Elevation: 1.025 km asl

Instrument Specifications:

System	68
Start Date	08/18/00
End Date	09/18/00
Vertical Resolution	75 m
Temporal Resoluiton	60 s
Notes	System running 24/7... Occasional loss of power on Sundays... system has backup power battery.



Daily quicklook image of data from Mongu site on August 31, 2000.

Skukuza

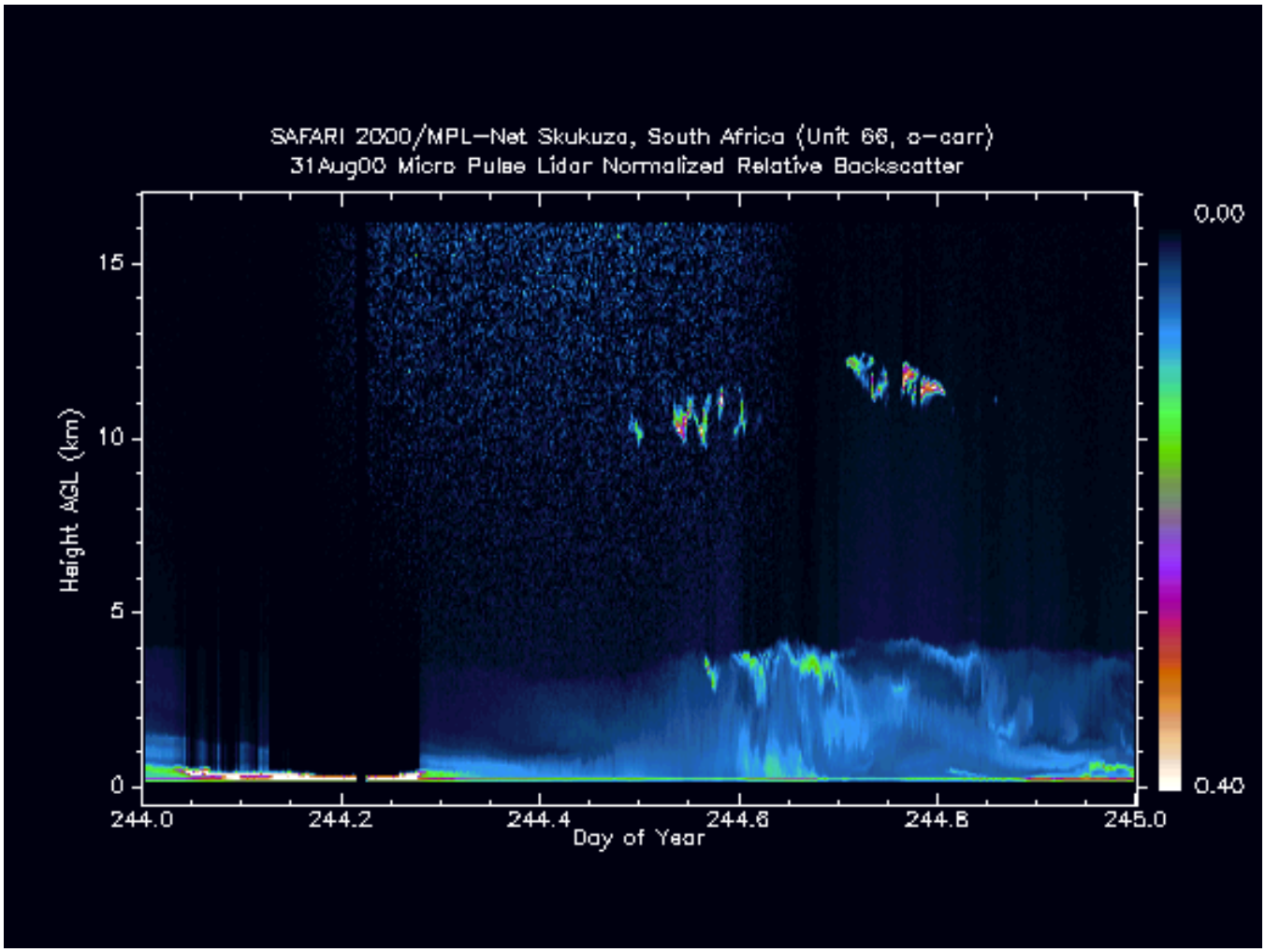
The MPL in Skukuza was operated at the Skukuza Airport in the Kruger National Park, Republic of South Africa.

Coordinates: 24° 58.32' S, 31° 35.1' E

Elevation: 0.150 km asl

Instrument Specifications:

System	68
Start Date	08/17/00
End Date	09/22/00
Vertical Resolution	75 m
Temporal Resoluiton	60 s
Notes	System ran 24/7... occasional minor power interruptions... system has backup power battery. Last two days of data were garbage due to condensation on transmitting window.



Daily quicklook image of data from Skukuza on August 31, 2000.

Instrument

Micro-Pulse Lidar (MPL) is a conventional time-gated, incoherent detection lidar approach able to profile all significant atmospheric cloud and aerosol structure using a compact, fully eye-safe instrument. Eye-safety, which allows for unattended full-time long-term operation, is accomplished by transmitting low power pulses. These pulses use an expanded beam (10 micro-Joules with a 0.2 m exit-aperture width and 1.2E-6 beam divergence), with a pulse repetition frequency much higher than standard lidar systems (2.5 kHz). Signal acquisition is handled by detecting the number of photons, providing a more accurate and problem free means of handling low level signals relative to analog detection.

Two MPL systems were deployed to southern Africa for the SAFARI 2000 experiment. One MPL was setup in Mongu, Zambia and the other was setup in Skukuza, South Africa. The primary focus of MPL work during SAFARI was to study the vertical distribution and optical properties of smoke from biomass burning in the region.

Standard System Specifications

Wavelength	0.523 µm
Laser Power	1.0 W
Output Energy	~ 10 µj
Pulse Repetition Frequency	2500 Hz
"Transceiver" Aperture	0.2 m
Beam Divergence	~ 50 µrad
Vertical Resolution	30 m - 300 m
"Transceiver" Field-of-View	~ 100 µrad

Additional Sources of Information

Point of Contact

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