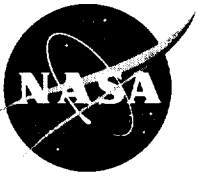


NASA/TM—2000–209891, Vol. 170



**Technical Report Series on the
Boreal Ecosystem-Atmosphere Study (BOREAS)**

Forrest G. Hall and Andrea Papagno, Editors

Volume 170

**BOREAS TE-12 Incoming PAR
Through the Forest Canopy Data**

*Elizabeth A. Walter-Shea and Mark A. Mesarch
University of Nebraska-Lincoln*

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

October 2000

Available from:

NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320
Price Code: A17

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Price Code: A10

BOREAS TE-12 Incoming PAR Through the Forest Canopy Data

Elizabeth A. Walter-Shea, Mark A. Mesarch

Summary

The BOREAS TE-12 team collected PAR data sets in support of its efforts to characterize and interpret information on shoot geometry, leaf optical properties, leaf water potential, and leaf gas exchange. The data were collected at the SSA-OBS site from 04-Jul-1996 to 25-Jul-1996. The data are stored in tabular ASCII files.

Table of Contents

- 1) Data Set Overview
- 2) Investigator(s)
- 3) Theory of Measurements
- 4) Equipment
- 5) Data Acquisition Methods
- 6) Observations
- 7) Data Description
- 8) Data Organization
- 9) Data Manipulations
- 10) Errors
- 11) Notes
- 12) Application of the Data Set
- 13) Future Modifications and Plans
- 14) Software
- 15) Data Access
- 16) Output Products and Availability
- 17) References
- 18) Glossary of Terms
- 19) List of Acronyms
- 20) Document Information

1. Data Set Overview

1.1 Data Set Identification

BOREAS TE-12 Incoming PAR Through the Forest Canopy Data

1.2 Data Set Introduction

The Terrestrial Ecology (TE)-12 team took measurements of incoming photosynthetically active radiation (PAR) as part of the BOREal Ecosystem-Atmosphere Study (BOREAS) at the Old Black Spruce (OBS) site in the Southern Study Area (SSA) from 04-Jul-1996 to 25-Jul-1996. PAR, in units of micro Einsteins per meter squared per second, from 0.4 to 0.7 microns, was measured in an array below the tree canopy, but above the understory. Ten LI-COR quantum sensors measured PAR, and minute averages are reported.

1.3 Objectives/Purpose

The objective of this research was to characterize the duration and magnitude of sun flecks under a boreal forest canopy.

1.4 Summary of Parameters

Minute averages of PAR, in units of micro Einstein per meter squared per minute.

1.5 Discussion

TE-12 took measurements of incoming PAR at SSA-OBS from 04-Jul-1996 to 25-Jul-1996. PAR, in units of micro Einsteins per meter squared per second, from 0.4 to 0.7 microns, was measured in an array below the tree canopy, but above the understory. Ten LI-COR quantum sensors measured PAR, and minute averages are reported.

1.6 Related Data Sets

TE-12 Shoot Geometry Data

TE-12 Leaf Gas Exchange Data

2. Investigator(s)

2.1 Investigator(s) Name and Title

Elizabeth A. Walter-Shea, Assoc. Professor

2.2 Title of Investigation

Radiation and Gas Exchange of Canopy Elements in a Boreal Forest

2.3 Contact Information

Contact 1:

Mark A. Mesarch
University of Nebraska
14 LW Chase Hall
Lincoln, NE 68583-0728
(402) 472-5904
(402) 472-0284
(402) 472-6614 (fax)
mmesarch1@unl.edu

Contact 2:

Elizabeth A. Walter-Shea
University of Nebraska
246 LW Chase Hall
Lincoln, NE 68583-0728
(402) 472-1553
(402) 472-6614 (fax)
ewalter-shea1@unl.edu

Contact 3:

Andrea Papagno
Raytheon ITSS
NASA GSFC
Code 923
Greenbelt, MD 20771
(301) 286-3134
(301) 286-0239 (fax)
Andrea.Papagno@gsfc.nasa.gov

3. Theory of Measurements

Fluxes need to be measured at understory levels to relate to environmental and state variables and explain the stand scale fluxes. At the understory level, upper canopy elements shade the understory partially, creating sun flecks. These sun flecks fluctuate over time, both spatially and in intensity. An array of hemisphere sensors was placed above the understory to measure a represented area of transmitted PAR. The time frame of the measurements, 1-minute averages, provided a time scale representative of a plant's photosynthetic processes' reaction time.

4. Equipment

4.1 Sensor/Instrument Description

A LI-COR Quantum Sensor (LI-190SA) was used to detect sun flecks. A silicon photo diode with an enhanced response in the visible wavelengths was used to measure PAR, from 0.4 to 0.7 microns. A visible bandpass interference filter, in combination with color glass filters, was mounted in a cosine corrected head. Error calculations indicated that under sun-and-sky radiation, and under various natural or artificial light sources, the relative measurement errors are less than 5.0%. Therefore, this sensor can be used within or inverted over canopies and in greenhouses, controlled growth chambers, and confined laboratory conditions. Generally, this instrument measures hemispherical incoming radiation; however, when placed within a canopy, the instrument acts as a point source detector.

The quantum sensors were placed in an array surrounding a central point at varying distances from this central point. The table below describes the directions and distances from the central point for sensor.

<u>Sensor serial number</u>	<u>Direction</u>	<u>Distance (m)</u>
Q15566	North	15
Q9020	Northeast	16
Q15565	East	10
Q2738	East-Southeast	2.5
Q9123	Southeast	12
Q9022	South	12
Q7433	South-Southwest	1.7
Q7434	Southwest	5
Q10890	West	12
Q89085	Northwest	4.5

4.1.1 Collection Environment

Measurements were made onsite at the SSA-OBS site.

4.1.2 Source/Platform

Each LI-COR quantum sensor was attached to a LI-COR 2003S Mounting and Leveling Fixture. These fixtures are made of anodized aluminum with stainless steel leveling screws and a weatherproof spirit level. The fixture was attached to a wood block that was attached to the top of a pole, 0.6 m above the sphagnum surface. Once the wood block was attached to the pole, the leveling screws on the fixture were used to level the fixture holding the quantum sensor.

4.1.3 Source/Platform Mission Objectives

None given.

4.1.4 Key Variables

Incoming PAR under a tree canopy.

4.1.5 Principles of Operation

The LI-COR quantum sensor uses a silicon diode to convert sunlight to electrical energy (voltage).

4.1.6 Sensor/Instrument Measurement Geometry

The quantum sensors were placed in an array surrounding a central point at varying distances from this central point. The table below describes the directions and distances from the central point for sensor.

<u>Sensor serial number</u>	<u>Direction</u>	<u>Distance (m)</u>
Q15566	North	15
Q9020	Northeast	16
Q15565	East	10
Q2738	East-Southeast	2.5
Q9123	Southeast	12
Q9022	South	12
Q7433	South-Southwest	1.7
Q7434	Southwest	5
Q10890	West	12
Q89085	Northwest	4.5

Each LI-COR quantum sensor was attached to a LI-COR 2003S Mounting and Leveling Fixture. These fixtures are made of anodized aluminum with stainless steel leveling screws and a weatherproof spirit level. The fixture was attached to a wood block that was attached to the top of a pole 0.6 m above the sphagnum surface. Once the wood block was attached to the pole, the leveling screws on the fixture were used to level the fixture holding the quantum sensor.

4.1.7 Manufacturer of Sensor/Instrument

LI-COR, Inc.
Box 4425
Lincoln, NE 68504
(402) 467-3576

4.2 Calibration

4.2.1 Specifications

None given.

4.2.1.1 Tolerance

None given.

4.2.2 Frequency of Calibration

LI-COR quantum sensors were calibrated at the manufacturer in May 1996.

4.2.3 Other Calibration Information

Calibration coefficients for the sensors were in units of micro Einsteins per meter squared per second per millivolt.

<u>Sensor Number</u>	<u>Serial Number</u>	<u>Coefficient</u>
1	Q9020	-253.54
2	Q9022	-282.05
3	Q7434	-252.00
4	Q9123	-308.31
5	Q15566	-311.21
6	Q15565	-245.64
7	Q89085	-285.45
8	Q10890	-286.44
9	Q7433	-200.00
10	Q2734	-194.55

5. Data Acquisition Methods

The quantum sensors were placed in an array surrounding a central point at varying distances from this central point. The sensors were placed in the array to cover an area of approximately 600 m², which was representative of an area of understory under the canopy. The table below describes the directions and distances from the central point for sensor.

<u>Sensor serial number</u>	<u>Direction</u>	<u>Distance (m)</u>
Q15566	North	15
Q9020	Northeast	16
Q15565	East	10
Q2738	East-Southeast	2.5
Q9123	Southeast	12
Q9022	South	12
Q7433	South-Southwest	1.7
Q7434	Southwest	5
Q10890	West	12
Q89085	Northwest	4.5

Each LI-COR quantum sensor was attached to a LI-COR 2003S Mounting and Leveling Fixture. These fixtures are made of anodized aluminum with stainless steel leveling screws and a weatherproof spirit level. The fixture was attached to a wood block that was attached to the top of a pole, 0.6 m above the sphagnum surface. Once the wood block was attached to the pole the leveling screws on the fixture were used to level the fixture holding the quantum sensor. Data were measured every 5 seconds and reported as 1-minute averages.

6. Observations

6.1 Data Notes

None given.

6.2 Field Notes

None given.

7. Data Description

7.1 Spatial Characteristics

7.1.1 Spatial Coverage

The SSA measurement site and its associated North American Datum of 1983 (NAD83) coordinates are:

- SSA-OBS, site id G8I4T, Lat/Long: 53.98717_N, 105.11779_W, Universal Transverse Mercator (UTM) Zone 13, N: 5,982,100.5, E: 492,276.5.

7.1.2 Spatial Coverage Map

Not applicable.

7.1.3 Spatial Resolution

The maximum distance between any two quantum sensors was 27 meters. The entire array covered approximately 600 m².

7.1.4 Projection

Not applicable.

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

Data were collected at the OBS-SSA site From 04-Jul-1996 to 25-Jul-1996.

7.2.2 Temporal Coverage Map

Not available.

7.2.3 Temporal Resolution

Data were collected on most days from sunrise to sunset (approximately 4 a.m. to 10 p.m. local time). Measurements were made every 5 seconds and reported as 1-minute averages.

7.3 Data Characteristics

7.3.1 Parameter/Variable

The parameters contained in the data files on the CD-ROM are:

```
Column Name
-----
SITE_NAME
SUB_SITE
DATE_OBS
TIME_OBS
MEAN_DIR_DOWN_PPFD_SNSR1
MEAN_DIR_DOWN_PPFD_SNSR2
MEAN_DIR_DOWN_PPFD_SNSR3
MEAN_DIR_DOWN_PPFD_SNSR4
MEAN_DIR_DOWN_PPFD_SNSR5
MEAN_DIR_DOWN_PPFD_SNSR6
MEAN_DIR_DOWN_PPFD_SNSR7
MEAN_DIR_DOWN_PPFD_SNSR8
```


MEAN_DIR_DOWN_PPFD_SNSR9
 MEAN_DIR_DOWN_PPFD_SNSR10
 CRTFCN_CODE
 REVISION_DATE

7.3.2 Variable Description/Definition

The descriptions of the parameters contained in the data files on the CD-ROM are:

Column Name	Description
SITE_NAME	The identifier assigned to the site by BOREAS, in the format SSS-TTT-CCCCC, where SSS identifies the portion of the study area: NSA, SSA, REG, TRN, and TTT identifies the cover type for the site, 999 if unknown, and CCCCC is the identifier for site, exactly what it means will vary with site type.
SUB_SITE	The identifier assigned to the sub-site by BOREAS, in the format GGGGG-III III, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and III III is the identifier for sub-site, often this will refer to an instrument.
DATE_OBS	The date on which the data were collected.
TIME_OBS	The Greenwich Mean Time (GMT) when the data were collected.
MEAN_DIR_DOWN_PPFD_SNSR1	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 1.
MEAN_DIR_DOWN_PPFD_SNSR2	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 2.
MEAN_DIR_DOWN_PPFD_SNSR3	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 3.
MEAN_DIR_DOWN_PPFD_SNSR4	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 4.
MEAN_DIR_DOWN_PPFD_SNSR5	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 5.
MEAN_DIR_DOWN_PPFD_SNSR6	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 6.
MEAN_DIR_DOWN_PPFD_SNSR7	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 7.

MEAN_DIR_DOWN_PPF_D_SNSR8	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 8.
MEAN_DIR_DOWN_PPF_D_SNSR9	The one-minute mean direct downward photosynthetic photon flux density based on measurements taken below the tree canopy but above the understory using quantum sensor 9.
MEAN_DIR_DOWN_PPF_D_SNSR10	The one-minute mean direct downward

indicate that an attempt was made to determine the parameter value, but the analysis personnel determined that the parameter value was below the detection limit of the instrumentation.

Data Not Clctd -- This value indicates that no attempt was made to determine the parameter value. This usually indicates that BORIS combined several similar but not identical data sets into the same data base table but this particular science team did not measure that parameter.

Blank -- Indicates that blank spaces are used to denote that type of value.
 N/A -- Indicates that the value is not applicable to the respective column.
 None -- Indicates that no values of that sort were found in the column.

7.4 Sample Data Record

The following are wrapped versions of data record from a sample data file on the CD-ROM.

```
SITE_NAME,SUB_SITE,DATE_OBS,TIME_OBS,MEAN_DIR_DOWN_PPF_D_SNSR1,
MEAN_DIR_DOWN_PPF_D_SNSR2,MEAN_DIR_DOWN_PPF_D_SNSR3,MEAN_DIR_DOWN_PPF_D_SNSR4,
MEAN_DIR_DOWN_PPF_D_SNSR5,MEAN_DIR_DOWN_PPF_D_SNSR6,MEAN_DIR_DOWN_PPF_D_SNSR7,
MEAN_DIR_DOWN_PPF_D_SNSR8,MEAN_DIR_DOWN_PPF_D_SNSR9,MEAN_DIR_DOWN_PPF_D_SNSR10,
CRTFCN_CODE,REVISION_DATE
'SSA-OBS-FLXTR','9TE12-PAR01',04-JUL-96,2212,79.8,87.1,246.0,142.4,212.3,176.4,
84.3,222.6,1111.0,75.2,'CPI',17-MAR-99
'SSA-OBS-FLXTR','9TE12-PAR01',04-JUL-96,2213,71.6,80.5,198.6,113.1,299.6,112.5,
61.91,109.7,1106.0,70.5,'CPI',17-MAR-99
```

8. Data Organization

8.1 Data Granularity

The smallest unit of data tracked by the BOREAS Information System (BORIS) was the data collected at a given site on a given date.

8.2 Data Format(s)

The Compact Disk-Read-Only Memory (CD-ROM) files contain American Standard Code for Information Interchange (ASCII) numerical and character fields of varying length separated by commas. The character fields are enclosed with single apostrophe marks. There are no spaces between the fields.

Each data file on the CD-ROM has four header lines of Hyper-Text Markup Language (HTML) code at the top. When viewed with a Web browser, this code displays header information (data set title, location, date, acknowledgments, etc.) and a series of HTML links to associated data files and related data sets. Line 5 of each data file is a list of the column names, and line 6 and following lines contain the actual data.

9. Data Manipulations

9.1 Formulae

None.

9.1.1 Derivation Techniques and Algorithms

Not applicable.

9.2 Data Processing Sequence

None given.

9.2.1 Processing Steps

None given.

9.2.2 Processing Changes

None given.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

None given.

9.3.2 Calculated Variables

None given.

9.4 Graphs and Plots

None given.

10. Errors

10.1 Sources of Error

The manufacturer estimates that the LI-COR quantum sensor will measure within +/- 5.0 percent relative error of the true incoming PAR.

10.2 Quality Assessment

10.2.1 Data Validation by Source

None given.

10.2.2 Confidence Level/Accuracy Judgment

None given.

10.2.3 Measurement Error for Parameters

None given.

10.2.4 Additional Quality Assessments

None given.

10.2.5 Data Verification by Data Center

Data were examined for general consistency and clarity.

11. Notes

11.1 Limitations of the Data

None given.

11.2 Known Problems with the Data

None given.

11.3 Usage Guidance

None given.

11.4 Other Relevant Information

None given.

12. Application of the Data Set

This data set can be used to study the incoming PAR of the boreal forest.

13. Future Modifications and Plans

None given.

14. Software

14.1 Software Description

None given.

14.2 Software Access

None given.

15. Data Access

The incoming PAR data are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information

For BOREAS data and documentation please contact:

ORNL DAAC User Services
Oak Ridge National Laboratory
P.O. Box 2008 MS-6407
Oak Ridge, TN 37831-6407
Phone: (423) 241-3952
Fax: (423) 574-4665
E-mail: ornl_daac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics
<http://www-eosdis.ornl.gov/>.

15.3 Procedures for Obtaining Data

Users may obtain data directly through the ORNL DAAC online search and order system [<http://www-eosdis.ornl.gov/>] and the anonymous FTP site [<ftp://www-eosdis.ornl.gov/data/>] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products

None given.

16.2 Film Products

None given.

16.3 Other Products

These data are available on the BOREAS CD-ROM series.

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

LI-COR Radiation Sensors. 1991. Pub. No. 8609-56. LI-COR, Inc., Lincoln, NE.

17.2 Journal Articles and Study Reports

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. 2000. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM.

Sellers, P. and F. Hall. 1994. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1994-3.0, NASA BOREAS Report (EXPLAN 94).

Sellers, P. and F. Hall. 1996. Boreal Ecosystem-Atmosphere Study: Experiment Plan. Version 1996-2.0, NASA BOREAS Report (EXPLAN 96).

Sellers, P., F. Hall, and K.F. Huemmrich. 1996. Boreal Ecosystem-Atmosphere Study: 1994 Operations. NASA BOREAS Report (OPS DOC 94).

Sellers, P., F. Hall, and K.F. Huemmrich. 1997. Boreal Ecosystem-Atmosphere Study: 1996 Operations. NASA BOREAS Report (OPS DOC 96).

Sellers, P., F. Hall, H. Margolis, B. Kelly, D. Baldocchi, G. den Hartog, J. Cihlar, M.G. Ryan, B. Goodison, P. Crill, K.J. Ranson, D. Lettenmaier, and D.E. Wickland. 1995. The boreal ecosystem-atmosphere study (BOREAS): an overview and early results from the 1994 field year. *Bulletin of the American Meteorological Society*. 76(9):1549-1577.

Sellers, P.J., F.G. Hall, R.D. Kelly, A. Black, D. Baldocchi, J. Berry, M. Ryan, K.J. Ranson, P.M. Crill, D.P. Lettenmaier, H. Margolis, J. Cihlar, J. Newcomer, D. Fitzjarrald, P.G. Jarvis, S.T. Gower, D. Halliwell, D. Williams, B. Goodison, D.E. Wickland, and F.E. Guertin. 1997. BOREAS in 1997: Experiment Overview, Scientific Results and Future Directions. *Journal of Geophysical Research* 102(D24): 28,731-28,770.

17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None.

19. List of Acronyms

ASCII - American Standard Code for Information Interchange
BOREAS - BOReal Ecosystem-Atmosphere Study
BORIS - BOREAS Information System
CD-ROM - Compact Disk-Read-Only Memory
DAAC - Distributed Active Archive Center
DOY - Julian Day of Year
EOS - Earth Observing System
EOSDIS - EOS Data and Information System
GIS - Geographic Information System
GMT - Greenwich Mean Time
GSFC - Goddard Space Flight Center
HTML - HyperText Markup Language
IFC - Intensive Field Campaign
MIX - Mixed Wood
NAD83 - North American Datum of 1983
NASA - National Aeronautics and Space Administration
NOAA - National Oceanic and Atmospheric Administration
NSA - Northern Study Area
OA - Old Aspen
OBS - Old Black Spruce
ORNL - Oak Ridge National Laboratory
PANP - Prince Albert National Park
PAR - Photosynthetically Active Radiation
RSS - Remote Sensing Science
SSA - Southern Study Area
TE - Terrestrial Ecology
TF - Tower Flux
URL - Uniform Resource Locator
UTM - Universal Transverse Mercator

20. Document Information

20.1 Document Revision Date

Written: 06-Jan-1999

Last Updated: 17-Sep-1999

20.2 Document Review Date(s)

BORIS Review: 11-Mar-1999

Science Review:

20.3 Document ID

20.4 Citation

When using these data, please acknowledge E.A. Walter-Shea and M.A. Mesarch, both of UNL, and include citations of relevant papers in Section 17.2.

If using data from the BOREAS CD-ROM series, also reference the data as:

Walter-Shea, E.A., "Radiation and Gas Exchange of Canopy Elements in a Boreal Forest." In *Collected Data of The Boreal Ecosystem-Atmosphere Study*. Eds. J. Newcomer, D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers. CD-ROM. NASA, 2000.

Also, cite the BOREAS CD-ROM set as:

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. *Collected Data of The Boreal Ecosystem-Atmosphere Study*. NASA. CD-ROM. NASA, 2000.

20.5 Document Curator

20.6 Document URL

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE October 2000	3. REPORT TYPE AND DATES COVERED Technical Memorandum		
4. TITLE AND SUBTITLE Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS) BOREAS TE-12 Incoming PAR Through the Forest Canopy Data			5. FUNDING NUMBERS 923 RTOP: 923-462-33-01	
6. AUTHOR(S) Elizabeth A. Walter-Shea and Mark A. Mesarch Forrest G. Hall and Andrea Papagno, Editors				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS (ES) Goddard Space Flight Center Greenbelt, Maryland 20771			8. PERFORMING ORGANIZATION REPORT NUMBER 2000-03136-0	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS (ES) National Aeronautics and Space Administration Washington, DC 20546-0001			10. SPONSORING / MONITORING AGENCY REPORT NUMBER TM—2000—209891 Vol. 170	
11. SUPPLEMENTARY NOTES E.A. Walter-Shea and M.A. Mesarch: University of Nebraska-Lincoln; A. Papagno: Raytheon ITSS, NASA Goddard Space Flight Center, Greenbelt, Maryland				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Unclassified—Unlimited Subject Category: 43 Report available from the NASA Center for AeroSpace Information, 7121 Standard Drive, Hanover, MD 21076-1320. (301) 621-0390.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The BOREAS TE-12 team collected PAR data sets in support of its efforts to characterize and interpret information on shoot geometry, leaf optical properties, leaf water potential, and leaf gas exchange. The data were collected at the SSA-OBS site from 04-Jul-1996 to 25-Jul-1996. The data are stored in tabular ASCII files.				
14. SUBJECT TERMS BOREAS, terrestrial ecology, PAR.			15. NUMBER OF PAGES 15	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL	