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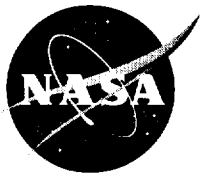

Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall and Andrea Papagno, Editors

Volume 165

BOREAS TE-11 Sap Flow Data

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BOREAS TE-11 Sap Flow Data

Bernard Saugier

Summary

The BOREAS TE-11 team collected several data sets in support of its efforts to characterize and interpret information on the sap flow, gas exchange, and lichen photosynthesis of boreal vegetation and meteorological data of the area studied. This data set contains measurements of sap flow conducted at the SSA-OJP site in the growing seasons of 1993 and 1994. The data are stored in ASCII files.

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1. Data Set Overview

1.1 Data Set Identification

BOREAS TE-11 Sap Flow Data

1.2 Data Set Introduction

The Terrestrial Ecology (TE)-11 team took measurements of sap flow at the BOReal Ecosystem-Atmosphere Study (BOREAS) Southern Study Area (SSA) Old Jack Pine (OJP) site during the growing seasons of 1993 and 1994 using hand-made probes.

1.3 Objective/Purpose

The purposes of the work were to:

- Measure the average sap flow velocity in six trees.
- Calculate the sap flow from the velocity and the sapwood area.

1.4 Summary of Parameters

Sap flow measurements were taken at the SSA-OJP site on Julian days 236 to 245 in 1993 and Julian days 118 to 259 in 1994. Stand transpiration is computed in mm/hour for each of the measured trees. Sapwood area on TE-11's site was taken as 12.3 m^2/ha. This figure may change according to new biometric data.

1.5 Discussion

The TE-11 team's aim is to compare these data with a micrometeorological (micromet) estimate of tree transpiration (H_2O flux above the forest minus H_2O flux above the soil). If the comparison is good, these data will be used to fill out gaps that occurred when the micromet measurements were not operating.

1.6 Related Data Sets

BOREAS TE-11 Leaf Gas Exchange Measurements

2. Investigator(s)

2.1 Investigator(s) Name and Title

Bernard Saugier
Professor

2.2 Title of Investigation

Seasonal Variations of Net Photosynthesis and Transpiration at the Tree Level

2.3 Contact Information

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3. Theory of Measurements

Two cylindrical probes were inserted perpendicular to the tree trunk; one was continuously heated, while the other was not. Each probe contained a copper-constantan junction. The two constantan wires were connected together, and the voltage between the two copper wires was measured proportional to the temperature difference between the two probes. It was then transformed into an averaged sap velocity using a formula that was independent of the tree species. Then, sap flow was calculated as the product of sap velocity by the sapwood area.

From these measurements, stand sapwood area was 12.3 m^2/ha for a basal area of 22.5 m^2/ha. The diameter of the probes was 2 mm; the length of the probes was 20 mm (usually). Resistance of the constantan wire was about 10 ohms. The temperature difference between the probes was about 12 °C during the night, and it decreased during the day.

4. Equipment

4.1 Sensor/Instrument Description

The probes were made by Andre Granier, a coinvestigator, who went to the site in 1993 and in April 1994 to install the probes. They were connected to a CR10 data logger, downloaded to a portable PC.

4.1.1 Collection Environment

None given.

4.1.2 Source/Platform

None given.

4.1.3 Source/Platform Mission Objectives

None given.

4.1.4 Key Variables

Sap flow velocity, temperature difference, resistance, sap flow area.

4.1.5 Principles of Operation

Two cylindrical probes were inserted perpendicular to the tree trunk; one was continuously heated, while the other was not. Each probe contained a copper-constantan junction. The two constantan wires were connected together, and the voltage between the two copper wires was measured proportional to the temperature difference between the two probes. It was then transformed into an averaged sap velocity using a formula that was independent of the tree species. Finally, sap flow was calculated as the product of sap velocity by the sapwood area.

4.1.6 Sensor/Instrument Measurement Geometry

None given.

4.1.7 Manufacturer of Sensor/Instrument

CR10 Data Logger
Campbell Scientific, Inc.
815 West 1800 North
Logan, UT 84321-1784
(435) 753-2342
(435) 750-9540 (fax)
support@campbellsci.com

The probes were made by Andre Granier, a coinvestigator.

4.2 Calibration

No calibration was required in principle. The test will be the comparison with the micromet measurements (see above).

4.2.1 Specifications

None given.

4.2.1.1 Tolerance

None given.

4.2.2 Frequency of Calibration

None given.

4.2.3 Other Calibration Information

None given.

5. Data Acquisition Methods

A Campbell Scientific, Inc., CR10 data logger was used for the acquisition and storage of data. Six channels were used in 1994.

6. Observations

6.1 Data Notes

None given.

6.2 Field Notes

The TE-11 team had fun and had no problems with this technique, which worked very well unattended for long periods. The only problem was with sensor 1, as mentioned in Section 10.1.

7. Data Description

7.1 Spatial Characteristics

The six trees were about 20 m away from the TE scaffolding towers, in the direction of the micromet tower. The following table gives, for each tree, its circumference (C) at breast height (h) in mm and its approximate height in m.

Tree Number	Circumference (mm)	Height (m)
1	256	10.50
2	331	11.25
3	362	13.25
4	368	12.75
5	435	13.50
6	521	14.70

7.1.1 Spatial Coverage

At SSA-OJP. The six trees were about 20 m away from the TE scaffolding towers, in the direction of the micromet tower.

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

- OJP, site id G2L3T, Lat/Long: 53.91634° N, 104.69203° W, UTM Zone 13, N: 5974257.5, E: 520227.7.

7.1.2 Spatial Coverage Map

Not available.

7.1.3 Spatial Resolution

None given.

7.1.4 Projection

None given.

7.1.5 Grid Description

None given.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

Measurements were taken every 15 minutes, from day 236 to day 245, in 1993, and measurements were taken every 30 minutes, from day 118 to day 259, in 1994.

In 1994, the first data were not reliable because the sensors took some time to reach equilibrium and because alternating freezing and thawing gave strange results. In 1994, data were taken from day 120 and may not be very good until day 125.

7.2.2 Temporal Coverage Map

None given.

7.2.3 Temporal Resolution

None given.

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
TREE_ID
SPECIES
SAPFLOW_RATE
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-IIIII, where GGGGG is the group associated with the sub-site instrument, e.g. HYD06 or STAFF, and IIIII 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.
TREE_ID	Identifier of the mapped tree or plant stem.
SPECIES	Botanical (Latin) name of the species (Genus species).
SAPFLOW_RATE	The sap flow rate of the sample tree.
CRTFCN_CODE	The BOREAS certification level of the data. Examples are CPI (Checked by PI), CGR (Certified by Group), PRE (Preliminary), and CPI-??? (CPI but questionable).
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.

7.3.3 Unit of Measurement

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

Column Name	Units
SITE_NAME	[none]
SUB_SITE	[none]
DATE_OBS	[DD-MON-YY]
TIME_OBS	[HHMM GMT]
TREE_ID	[none]
SPECIES	[none]
SAPFLOW_RATE	[millimeters][hour^-1]
CRTFCN_CODE	[none]
REVISION_DATE	[DD-MON-YY]

7.3.4 Data Source

The sources of the parameter values contained in the data files on the CD-ROM are:

Column Name	Data Source
SITE_NAME	[BORIS Designation]
SUB_SITE	[BORIS Designation]
DATE_OBS	[Human Observer]
TIME_OBS	[Human Observer]
TREE_ID	[Human Observer]
SPECIES	[Human Observer]
SAPFLOW_RATE	[Laboratory Equipment]
CRTFCN_CODE	[BORIS Designation]
REVISION_DATE	[BORIS Designation]

7.3.5 Data Range

The following table gives information about the parameter values found in the data files on the CD-ROM.

Column Name	Minimum Data Value	Maximum Data Value	Missng Data Value	Unrel Data Value	Below Detect Limit	Data Not Cllctd
SITE_NAME	SSA-OJP-FLXTR	SSA-OJP-FLXTR	None	None	None	None
SUB_SITE	9TE11-SAP01	9TE11-SAP01	None	None	None	None
DATE_OBS	25-AUG-93	16-SEP-94	None	None	None	None
TIME_OBS	0	2345	None	None	None	None
TREE_ID	1	6	None	None	None	None
SPECIES	N/A	N/A	None	None	None	None
SAPFLOW_RATE	0	1.228	-999	None	None	None
CRTFCN_CODE	CPI	CPI	None	None	None	None
REVISION_DATE	14-SEP-98	14-SEP-98	None	None	None	None

Minimum Data Value -- The minimum value found in the column.
Maximum Data Value -- The maximum value found in the column.
Missng Data Value -- The value that indicates missing data. This is used to indicate that an attempt was made to determine the parameter value, but the attempt was unsuccessful.
Unrel Data Value -- The value that indicates unreliable data. This is used to indicate an attempt was made to determine the parameter value, but the value was deemed to be unreliable by the analysis personnel.
Below Detect Limit -- The value that indicates parameter values below the instruments detection limits. This is used to 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 Cllctd -- 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,TREE_ID,SPECIES,SAPFLOW_RATE,CRTFCN_CODE,
REVISION DATE
```

10. Errors

10.1 Sources of Error

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory

20. Document Information

20.1 Document Revision Date

Date written: 06-Jan-1994
Last updated: 04-Aug-1999

20.2 Document Review Date(s)

BORIS Review: 28-Jul-1998
Science Review: 12-Aug-1998

20.3 Document ID

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When using these data, please contact B. Saugier (see Section 2.3) as well as citing relevant papers in Section 17.2.

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

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