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

Forrest G. Hall and Shelaine Curd, Editors

Volume 148
BOREAS TE-6 NPP for the Tower Flux, Carbon Evaluation, and Auxiliary Sites

S.T. Gower and J.G. Vogel

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

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BOREAS TE-6 NPP for the Tower Flux, Carbon Evaluation, and Auxiliary Sites

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BOREAS TE-6 NPP for the Tower Flux, Carbon Evaluation, and Auxiliary Sites

Stith T. Gower, Jason G Vogel

Summary

The BOREAS TE-6 team collected several data sets to examine the influence of vegetation, climate, and their interactions on the major carbon fluxes for boreal forest species. This data set contains estimates of the biomass produced by the plant species at the TF, CEV, and AUX sites in the SSA and NSA for a given year. Temporally, the data cover the years of 1985 to 1995. The plant biomass production (i.e., aboveground, belowground, understory, litterfall), spatial coverage, and temporal nature of measurements varied between the TF, CEV, and AUX sites as deemed necessary by BOREAS principal investigators. The data are stored in tabular ASCII files.

Table of Contents

1. Data Set Overview

1.1 Data Set Identification

BOREAS TE-06 NPP for the Tower Flux, Carbon Evaluation, and Auxiliary Sites

1.2 Data Set Introduction

The data provided are estimates of the accumulation of biomass by the plant species for a given year, or net primary productivity (NPP), at the BOReal Ecosystem-Atmosphere Study (BOREAS) Northern Study Area (NSA) and Southern Study Area (SSA) Tower Flux (TF), Carbon Evaluation (CEV), and Auxiliary (AUX) sites. Estimates for the aboveground and belowground biomass increment and detritus production and the understory biomass increment are found to varying degrees within these data sets for all sites.

These NPP data sets are part of the effort by the Terrestrial Ecology (TE)-06 team to develop carbon budgets for the various Canadian boreal forest types. NPP is both the result of and the precursor to a number of important dynamics within the boreal forest that determine whether this forest type is a sink or source of carbon dioxide in climate change scenarios.

1.3 Objective/Purpose

The objective of this study was to quantify the NPP for the TF, CEV, and AUX sites.

1.4 Summary of Parameters

Aboveground NPP(ANPP) stem increment, foliage increment, understory increment, litterfall, root NPP, overstory biomass increment.

1.5 Discussion

NPP is an estimate of the incremental production of biomass by plants in an ecosystem. Generally, NPP is the sum of overstory biomass increment, aboveground litterfall, and belowground detritus production. The data sets collected are part of the TE-06 team's effort to quantify the plant carbon sequestration as expressed by the production of biomass in a given year.

Diameter measurements were made for variable radius and fixed area plots at each site. Stem increment data and allometric equations were then used to quantify biomass for a given year, and the difference between years was considered ANPP. Litterfall was measured at the TF sites and the CEV sites with litter screens.

NPP estimates for the TF and CEV sites are of good quality because they were derived from site-specific allometric equations and direct measurements of litterfall. Foliage and litterfall estimates derived for the AUX sites may suffer from not being site specific allometric equations. From a spatial perspective, the TF site plots were located in areas that approximated the ANPP of the forest within the Wind-Aligned Blob (WAB), while the CEV and AUX plots were located to describe the ANPP within a 30- x 30-m area.

1.6 Related Data Sets

BOREAS TE-06 Biomass Estimates Data
BOREAS TE-06 Allometry Data

2. Investigator(s)

2.1 Investigator(s) Name and Title

Tom Gower, Professor
University of Wisconsin-Madison

2.2 Title of Investigation

Measurement and Scaling of Carbon Budgets for Contrasting Boreal Forest Sites

2.3 Contact Information

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3. Theory of Measurements

The accumulation of biomass, or NPP, is the net result of photosynthesis by a plant after plant respiration. These measurements were made to best quantify ANPP for the years 1993 and 1994 for the TF and CEV sites and 1994 and 1995 for the AUX sites. Historical overstory biomass increment estimates are provided, although accuracy becomes an increasing problem where historical data are concerned because of plot sampling methodology and allometric equation limitations.

4. Equipment

4.1 Sensor/Instrument Description

10 Basal Area Factor (BAF) prism, diameter tape, 50-m measuring tape, increment borer, Dual Axis Optical Micrometer (M-2001-D) Series with a Spalding B5 Digital Position Display System (7109-C225) that is used to measure the distance between tree rings, hydropneumatic elutriator system (separates roots from soil).

4.1.1 Collection Environment

Measurements were made under a variety of field conditions that had no effect on the quality of measurements.

4.1.2 Source/Platform

Not applicable.

4.1.3 Source/Platform Mission Objectives

Not applicable.

4.1.4 Key Variables

Not applicable.

4.1.5 Principles of Operation

The Dual Axis Optical Micrometer and Spalding B5 Digital Position Display System are two components of a system that allow an operator to view a tree's rings through a microscope, measure the distance between two rings, and then download the distance into a spreadsheet. This increment is then used to estimate overstory increment.

4.1.6 Sensor/Instrument Measurement Geometry

Not applicable.

4.1.7 Manufacturer of Sensor/Instrument
Dual Axis Optical Micrometer and Spalding B5 Digital Position Display System:

Gaertner Scientific
1201 Wrightwood Ave.
Chicago, IL 60614
(312) 281-5335

Hydropneumatic Elutriator System

Gillison's Variety Fabrication, Inc.
Benzonia, MI
Instrument Specifications found in Smucker et al., 1982

4.2 Calibration

4.2.1 Specifications
None given.

4.2.1.1 Tolerance
None given.

4.2.2 Frequency of Calibration
The micrometer was periodically checked for precision, but calibration was never needed.

4.2.3 Other Calibration Information
None given.

5. Data Acquisition Methods

Understory and overstory increment, fine root NPP, and litterfall estimates were made for the overstory and understory at the Old Black Spruce (OBS) (Picea mariana), Old Jack Pine (OJP) (Pinus banksiana), and Old Aspen (OA) (Populus tremuloides) TF sites. At the CEV sites, the understory and overstory increment and litterfall were measured. Only the overstory increment was measured at the AUX sites.

In the field, plots were established using either a 10 BAF prism or a measuring tape. The diameters of trees located within a plot were measured, and either a disk or a core was removed at the exact place a diameter measurement was made. In the lab, the distance between the tree rings was measured to the nearest 0.001 mm. The diameter for successive years was then calculated, and allometric equations were used to determine the biomass for that year. The difference in biomass was considered the overstory ANPP.

The other component of ANPP, litterfall, was measured at the TF and CEV sites by placing 40 60-m x 40-cm or 5 1-m x 1-m screens in the plots. The difference in the number of screens placed at the TF vs. CEV sites was a function of the area that we were attempting to describe the litterfall amount for; the 500-m WAB at the TF sites and a 30-m x 30-m area at the CEV sites. For two CEV sites, D9G4A and D9I1M, litterfall was estimated from the new foliage allometric equation developed for D9I1M, and therefore there are only estimates for the aspen foliage. The litter screen size used depended on the tree density; for greater density, smaller screens were used. The screens were collected in the fall and spring to determine 1 year of litterfall. The litterfall was separated by species foliage and the nonfoliage component.

Understory vegetation was sampled from a 2-m x 2-m or 1-m x 1-m subplot that was randomly located in each of the plots. The subplot size varied depending on plant density. All vegetation in the plot was clipped and stored in a cold room (3 °C) until it was processed. Samples were separated into three categories: ephemeral, new foliage and twig from perennial plants, and old foliage and twig from perennial plants. Samples were dried and weighed to the nearest 0.1 g. Understory NPP was calculated as the sum of the ephemeral, new twig, and new foliage tissues. Stem increment was measured for the shrub layer at the southern OA and the northern CEV aspen (in the same manner as above), but was not measured at other sites because the radial increment was too small.

Fine root NPP was also estimated using ingrowth cores. Cores were established on 28-Apr to 30-Apr-1994, at the jack pine and aspen stands at the SSA and the NSA and on 28-May to 04-Jun-1994 at the black spruce stands and all the NSA stands. The difference in sampling dates occurred because the soil was still frozen at the SSA black spruce and all stands at the NSA in late April 1994. Ice lenses were encountered in all stands at the time of sampling, suggesting that root growth had not yet begun by April in 1994. Ten cores (10 cm diameter * 30 cm depth) were taken from each plot, and the soil was separated by horizon and composited by plot. The composited soil from each horizon was thoroughly mixed on a tarp and sieved to pass through a 1-cm mesh screen. The sieved soil was thoroughly mixed by hand, and as many fine roots as possible were removed. The root-free soil was placed by horizon into each hole, and forest floor was replaced on top of the hole. It was impossible to sieve the thick organic layer at the black spruce stands; therefore, only the mineral soil was sieved, and the organic layer was replaced with commercially available sphagnum, which had been harvested in southeastern Manitoba. To mimic the hydrologic and chemical characteristics of the surrounding peat, water was collected from nearby free-standing pools and used to saturate each sphagnum core.

In June 1995 and 1996, five ingrowth cores per plot were sampled using a 5-cm-diameter x 30-cm-deep corer. Samples were stored in plastic bags at 3 °C until processed. Cores were washed with the hydropneumatic elutriator system (Gillison's Variety Fabrication, Inc., Benzonia, MI), and all live roots were collected. Roots were sorted and classified as herbaceous or woody. Samples were dried at 70 °C to a constant mass and weighed. Dried root tissue from each plot was composited, ground in a Wiley mill to pass through a 1-mm screen, and dry-ashed in a muffle furnace at 450 °C for 24 hours to determine ash content. Fine root NPP was calculated for each year by dividing fine root mass by the number of years the ingrowth cores were in the ground.

Not all measurements were made for all productivity components at all sites. The following is a description of the NPP what, when, and where for the TF, CEV, and AUX sites.

- TF= 1993 and 1994 overstory increment and litterfall. 1994 understory increment. 1994 and 1995 root/fine root production.
- CEV=1993 and 1994 overstory increment. 1994 litterfall and understory increment.
- AUX=1995 and 1994 overstory increment.

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

At the TF sites, four replicate plots were established immediately outside the footprint of the tower. The plots were located in areas that reasonably represented the vegetation within the WAB and should provide accurate stand level descriptions. The plot size varied from 7.5 x 7.5 m to 30 x 30 m depending upon tree density. The number of trees per plot ranged from 60 to 120. The CEV and AUX sites were sampled to describe the biomass within a 30- x 30-m area. The North American Datum of 1983 (NAD83) coordinates of the sites are:

SITE	LATITUDE	LONGITUDE
NSA-9BS-9TETR	55.90802° N	98.51865° W
NSA-9BS-AUX01	55.76824° N	97.84024° W
NSA-9BS-AUX02	55.78239° N	97.80937° W
NSA-9BS-AUX03	55.83083° N	97.98339° W
NSA-9BS-AUX04	55.83455° N	97.98364° W
NSA-9BS-AUX05	55.83913° N	97.99325° W
NSA-9BS-AUX06	55.87968° N	98.18658° W
NSA-9BS-AUX07	55.88351° N	98.80225° W
NSA-9BS-AUX08	55.88371° N	98.82345° W
NSA-9BS-AUX09	55.89358° N	98.22621° W
NSA-9BS-AUX10	55.9061° N	97.70986° W
NSA-9BS-AUX12	55.91021° N	97.70281° W
NSA-9BS-AUX13	55.91506° N	98.44877° W
NSA-9BS-AUX14	55.9161° N	98.64022° W
NSA-9BS-AUX15	55.91689° N	98.37111° W
NSA-9JP-AUX01	55.55712° N	98.02473° W
NSA-9JP-AUX02	55.88173° N	99.03952° W
NSA-9JP-AUX03	55.89486° N	98.30037° W
NSA-9JP-AUX04	55.90456° N	98.28385° W
NSA-9JP-AUX05	55.90539° N	98.26269° W
NSA-9JP-AUX06	55.93219° N	98.6105 ° W
NSA-9JP-AUX07	55.93737° N	98.59568° W
NSA-9OA-9TETR	55.88691° N	98.67479° W
NSA-ASP-AUX02	55.56227° N	98.02635° W
NSA-ASP-AUX04	55.84757° N	98.04329° W
NSA-ASP-AUX05	55.88576° N	98.87621° W
NSA-ASP-AUX07	55.91856° N	98.37041° W
NSA-ASP-AUX08	55.97396° N	97.48565° W
NSA-ASP-AUX09	56.00339° N	97.3355 ° W
NSA-MIX-AUX02	55.88911° N	98.85662° W
NSA-OBS-FLXTR	55.88007° N	98.48139° W
NSA-OJP-FLXTR	55.92842° N	98.62396° W
SSA-9BS-AUX01	53.64877° N	105.29534° W
SSA-9BS-AUX02	53.90349° N	104.63785° W
SSA-9BS-AUX03	53.93021° N	105.13964° W
SSA-9BS-AUX04	53.94446° N	104.759 ° W
SSA-9BS-AUX05	53.99877° N	105.11805° W
SSA-9BS-AUX07	54.06199° N	105.92545° W
SSA-9JP-AUX02	53.86608° N	105.11175° W
SSA-9JP-AUX03	53.88211° N	105.03226° W

SSA-9JP-AUX04	53.88336° N	105.05115° W
SSA-9JP-AUX05	53.9088° N	104.74812° W
SSA-9JP-AUX06	53.91883° N	104.76401° W
SSA-9JP-AUX07	53.95882° N	104.77148° W
SSA-9JP-AUX08	53.96558° N	104.63755° W
SSA-9JP-AUX09	53.97576° N	104.73779° W
SSA-9JP-AUX10	54.11181° N	105.05107° W
SSA-9OA-FLXTR	53.62889° N	106.19779° W
SSA-ASP-AUX03	53.66879° N	104.6388 ° W
SSA-ASP-AUX05	53.74019° N	105.46929° W
SSA-MIX-9TETR	53.7254° N	105.20643° W
SSA-MIX-AUX01	53.80594° N	104.533 ° W
SSA-MIX-AUX02	53.9375° N	105.14246° W
SSA-MIX-AUX03	54.06535° N	105.92706° W
SSA-MIX-AUX04	54.066° N	105.92982° W
SSA-OBS-FLXTR	53.98717° N	105.11779° W
SSA-OJP-FLXTR	53.91634° N	104.69203° W

7.1.2 Spatial Coverage Map
Not available.

7.1.3 Spatial Resolution
The plot sizes varied from 7.5 x 7.5 m to 30 x 30 m depending upon tree density.

7.1.4 Projection
Not applicable.

7.1.5 Grid Description
Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage
- TF Sites: Overstory increment and litterfall were measured in 1993 and 1994. Understory increment was measured in 1994. Root/fine root production were measured in 1994 and 1995
- CEV Sites: Overstory increment was measured in 1993 and 1994. Litterfall and understory increment were measured in 1994.
- AUX Sites: Overstory increment was measured in 1994 and 1995.

Overstory increment numbers are also provided for 1985-92 and 1986-93 at the TF/CEV and AUX sites, respectively; however, the accuracy of these numbers likely decreases as one projects back in time (see Section 10.1).

7.2.2 Temporal Coverage Map
Not available.

7.2.3 Temporal Resolution
All NPP measurements based on plant dry matter accumulation are expressed on a yearly basis. The number of human hours it takes to make the measurements listed above for a given site could be estimated at being greater than 1,000 hours per tower site, per year.

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
WOOD_NPP_1985
WOOD_NPP_1986
WOOD_NPP_1987
WOOD_NPP_1988
WOOD_NPP_1989
WOOD_NPP_1990
WOOD_NPP_1991
WOOD_NPP_1992
WOOD_NPP_1993
WOOD_NPP_1994
WOOD_NPP_1995
CONIFER_FOLIAGE_NPP_1985
CONIFER_FOLIAGE_NPP_1986
CONIFER_FOLIAGE_NPP_1987
CONIFER_FOLIAGE_NPP_1988
CONIFER_FOLIAGE_NPP_1989
CONIFER_FOLIAGE_NPP_1990
CONIFER_FOLIAGE_NPP_1991
CONIFER_FOLIAGE_NPP_1992
CONIFER_FOLIAGE_NPP_1993
CONIFER_FOLIAGE_NPP_1994
CONIFER_FOLIAGE_NPP_1995
COARSE_WOOD_ROOTS_NPP_1992
COARSE_WOOD_ROOTS_NPP_1993
COARSE_WOOD_ROOTS_NPP_1994
FINE_WOOD_ROOTS_NPP_1994
FINE_WOOD_ROOTS_NPP_1995
ASPEN_LITTER_1993
ASPEN_LITTER_1994
JACK_PINE_LITTER_1993
JACK_PINE_LITTER_1994
BLACK_SPRUCE_LITTER_1993
BLACK_SPRUCE_LITTER_1994
NON_FOLIAR_LITTER_1993
NON_FOLIAR_LITTER_1994
LARCH_LITTER_1993
LARCH_LITTER_1994
HAZEL_LITTER_1993
HAZEL_LITTER_1994
ALDER_LITTER_1993
ALDER_LITTER_1994
BIRCH_LITTER_1993
BIRCH_LITTER_1994
UN_ID_DECIDUOUS_LITTER_1993
```

UN_ID_DECIDUOUS_LITTER_1994
UN_ID_UNDERSTORY_LITTER_1994
REVISION_DATE
CRTFCN_CODE

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.
WOOD_NPP_1985	The increment of wood (stem+branch) added during 1985.
WOOD_NPP_1986	The increment of wood (stem+branch) added during 1986.
WOOD_NPP_1987	The increment of wood (stem+branch) added during 1987.
WOOD_NPP_1988	The increment of wood (stem+branch) added during 1988.
WOOD_NPP_1989	The increment of wood (stem+branch) added during 1989.
WOOD_NPP_1990	The increment of wood (stem+branch) added during 1990.
WOOD_NPP_1991	The increment of wood (stem+branch) added during 1991.
WOOD_NPP_1992	The increment of wood (stem+branch) added during 1992.
WOOD_NPP_1993	The increment of wood (stem+branch) added during 1993.
WOOD_NPP_1994	The increment of wood (stem+branch) added during 1994.
WOOD_NPP_1995	The increment of wood (stem+branch) added during 1995.
CONIFER_FOLIAGE_NPP_1985	The increment of total foliage (conifers only) added during 1985.
CONIFER_FOLIAGE_NPP_1986	The increment of total foliage (conifers only) added during 1986.
CONIFER_FOLIAGE_NPP_1987	The increment of total foliage (conifers only) added during 1987.
CONIFER_FOLIAGE_NPP_1988	The increment of total foliage (conifers only) added during 1988.
CONIFER_FOLIAGE_NPP_1989	The increment of total foliage (conifers only)

	added during 1989.
CONIFER_FOLIAGE_NPP_1990	The increment of total foliage (conifers only) added during 1990.
CONIFER_FOLIAGE_NPP_1991	The increment of total foliage (conifers only) added during 1991.
CONIFER_FOLIAGE_NPP_1992	The increment of total foliage (conifers only) added during 1992.
CONIFER_FOLIAGE_NPP_1993	The increment of total foliage (conifers only) added during 1993.
CONIFER_FOLIAGE_NPP_1994	The increment of total foliage (conifers only) added during 1994.
CONIFER_FOLIAGE_NPP_1995	The increment of total foliage (conifers only) added during 1995.
COARSE_WOOD_ROOTS_NPP_1992	The increment of coarse wood added to the coarse roots during 1992.
COARSE_WOOD_ROOTS_NPP_1993	The increment of coarse wood added to the coarse roots during 1993.
COARSE_WOOD_ROOTS_NPP_1994	The increment of coarse wood added to the coarse roots during 1994.
FINE_WOOD_ROOTS_NPP_1994	The increment of fine wood added during 1994.
FINE_WOOD_ROOTS_NPP_1995	The increment of fine wood added during 1995.
ASPEN_LITTER_1993	Mean value collected from Populus tremuloides litter baskets in 1993.
ASPEN_LITTER_1994	Mean value collected from Populus tremuloides litter baskets in 1994.
JACK_PINE_LITTER_1993	Mean value collected from Pinus banksia litter baskets in 1993.
JACK_PINE_LITTER_1994	Mean value collected from Pinus banksia litter baskets in 1994.
BLACK_SPRUCE_LITTER_1993	Mean value collected from Picea maria litter baskets in 1993.
BLACK_SPRUCE_LITTER_1994	Mean value collected from Picea maria litter baskets in 1994.
NON_FOLIAR_LITTER_1993	Mean value collected from Non-foliar litter, generally twigs and cones baskets in 1993.
NON_FOLIAR_LITTER_1994	Mean value collected from Non-foliar litter, generally twigs and cones baskets in 1994.
LARCH_LITTER_1993	Mean value collected from Larix larici litter baskets in 1993.
LARCH_LITTER_1994	Mean value collected from Larix larici litter baskets in 1994.
HAZEL_LITTER_1993	Mean value collected from Corylus cornuta litter baskets in 1993.
HAZEL_LITTER_1994	Mean value collected from Corylus cornuta litter baskets in 1994.
ALDER_LITTER_1993	Mean value collected from Alnus inca litter baskets in 1993.
ALDER_LITTER_1994	Mean value collected from Alnus inca litter baskets in 1994.
BIRCH_LITTER_1993	Mean value collected from Betula papyrifera litter baskets in 1993.
BIRCH_LITTER_1994	Mean value collected from Betula papyrifera litter baskets in 1994.
UN_ID_DECIDUOUS_LITTER_1993	Mean value collected from Unidentified deciduous

	litter baskets in 1993.
UN_ID_DECIDUOUS_LITTER_1994	Mean value collected from Unidentified deciduous litter baskets in 1994.
UN_ID_UNDERSTORY_LITTER_1994	Mean value collected from Unidentified understory litter baskets in 1994.
REVISION_DATE	The most recent date when the information in the referenced data base table record was revised.
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).

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]
WOOD_NPP_1985	[kilograms carbon][hectare^-1]
WOOD_NPP_1986	[kilograms carbon][hectare^-1]
WOOD_NPP_1987	[kilograms carbon][hectare^-1]
WOOD_NPP_1988	[kilograms carbon][hectare^-1]
WOOD_NPP_1989	[kilograms carbon][hectare^-1]
WOOD_NPP_1990	[kilograms carbon][hectare^-1]
WOOD_NPP_1991	[kilograms carbon][hectare^-1]
WOOD_NPP_1992	[kilograms carbon][hectare^-1]
WOOD_NPP_1993	[kilograms carbon][hectare^-1]
WOOD_NPP_1994	[kilograms carbon][hectare^-1]
WOOD_NPP_1995	[kilograms carbon][hectare^-1]
CONIFER_FOLIAGE_NPP_1985	[kilograms carbon][hectare^-1]
CONIFER_FOLIAGE_NPP_1986	[kilograms carbon][hectare^-1]
CONIFER_FOLIAGE_NPP_1987	[kilograms carbon][hectare^-1]
CONIFER_FOLIAGE_NPP_1988	[kilograms carbon][hectare^-1]
CONIFER_FOLIAGE_NPP_1989	[kilograms carbon][hectare^-1]
CONIFER_FOLIAGE_NPP_1990	[kilograms carbon][hectare^-1]
CONIFER_FOLIAGE_NPP_1991	[kilograms carbon][hectare^-1]
CONIFER_FOLIAGE_NPP_1992	[kilograms carbon][hectare^-1]
CONIFER_FOLIAGE_NPP_1993	[kilograms carbon][hectare^-1]
CONIFER_FOLIAGE_NPP_1994	[kilograms carbon][hectare^-1]
CONIFER_FOLIAGE_NPP_1995	[kilograms carbon][hectare^-1]
COARSE_WOOD_ROOTS_NPP_1992	[kilograms carbon][hectare^-1]
COARSE_WOOD_ROOTS_NPP_1993	[kilograms carbon][hectare^-1]
COARSE_WOOD_ROOTS_NPP_1994	[kilograms carbon][hectare^-1]
FINE_WOOD_ROOTS_NPP_1994	[kilograms carbon][hectare^-1]
FINE_WOOD_ROOTS_NPP_1995	[kilograms carbon][hectare^-1]
ASPEN_LITTER_1993	[kilograms carbon][hectare^-1]
ASPEN_LITTER_1994	[kilograms carbon][hectare^-1]
JACK_PINE_LITTER_1993	[kilograms carbon][hectare^-1]
JACK_PINE_LITTER_1994	[kilograms carbon][hectare^-1]
BLACK_SPRUCE_LITTER_1993	[kilograms carbon][hectare^-1]
BLACK_SPRUCE_LITTER_1994	[kilograms carbon][hectare^-1]
NON_FOLIAR_LITTER_1993	[kilograms carbon][hectare^-1]
NON_FOLIAR_LITTER_1994	[kilograms carbon][hectare^-1]

```
LARCH_LITTER_1993               [kilograms carbon][hectare^-1]
LARCH_LITTER_1994               [kilograms carbon][hectare^-1]
HAZEL_LITTER_1993               [kilograms carbon][hectare^-1]
HAZEL_LITTER_1994               [kilograms carbon][hectare^-1]
ALDER_LITTER_1993               [kilograms carbon][hectare^-1]
ALDER_LITTER_1994               [kilograms carbon][hectare^-1]
BIRCH_LITTER_1993               [kilograms carbon][hectare^-1]
BIRCH_LITTER_1994               [kilograms carbon][hectare^-1]
UN_ID_DECIDUOUS_LITTER_1993     [kilograms carbon][hectare^-1]
UN_ID_DECIDUOUS_LITTER_1994     [kilograms carbon][hectare^-1]
UN_ID_UNDERSTORY_LITTER_1994    [kilograms carbon][hectare^-1]
REVISION_DATE                   [DD-MON-YY]
CRTFCN_CODE                     [none]
```

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]
WOOD_NPP_1985                   [Laboratory Equipment]
WOOD_NPP_1986                   [Laboratory Equipment]
WOOD_NPP_1987                   [Laboratory Equipment]
WOOD_NPP_1988                   [Laboratory Equipment]
WOOD_NPP_1989                   [Laboratory Equipment]
WOOD_NPP_1990                   [Laboratory Equipment]
WOOD_NPP_1991                   [Laboratory Equipment]
WOOD_NPP_1992                   [Laboratory Equipment]
WOOD_NPP_1993                   [Laboratory Equipment]
WOOD_NPP_1994                   [Laboratory Equipment]
WOOD_NPP_1995                   [Laboratory Equipment]
CONIFER_FOLIAGE_NPP_1985        [Laboratory Equipment]
CONIFER_FOLIAGE_NPP_1986        [Laboratory Equipment]
CONIFER_FOLIAGE_NPP_1987        [Laboratory Equipment]
CONIFER_FOLIAGE_NPP_1988        [Laboratory Equipment]
CONIFER_FOLIAGE_NPP_1989        [Laboratory Equipment]
CONIFER_FOLIAGE_NPP_1990        [Laboratory Equipment]
CONIFER_FOLIAGE_NPP_1991        [Laboratory Equipment]
CONIFER_FOLIAGE_NPP_1992        [Laboratory Equipment]
CONIFER_FOLIAGE_NPP_1993        [Laboratory Equipment]
CONIFER_FOLIAGE_NPP_1994        [Laboratory Equipment]
CONIFER_FOLIAGE_NPP_1995        [Laboratory Equipment]
COARSE_WOOD_ROOTS_NPP_1992      [Laboratory Equipment]
COARSE_WOOD_ROOTS_NPP_1993      [Laboratory Equipment]
COARSE_WOOD_ROOTS_NPP_1994      [Laboratory Equipment]
FINE_WOOD_ROOTS_NPP_1994        [Laboratory Equipment]
FINE_WOOD_ROOTS_NPP_1995        [Laboratory Equipment]
ASPEN_LITTER_1993               [Laboratory Equipment]
ASPEN_LITTER_1994               [Laboratory Equipment]
JACK_PINE_LITTER_1993           [Laboratory Equipment]
JACK_PINE_LITTER_1994           [Laboratory Equipment]
BLACK_SPRUCE_LITTER_1993        [Laboratory Equipment]
BLACK_SPRUCE_LITTER_1994        [Laboratory Equipment]
```

```
NON_FOLIAR_LITTER_1993         [Laboratory Equipment]
NON_FOLIAR_LITTER_1994         [Laboratory Equipment]
LARCH_LITTER_1993              [Laboratory Equipment]
LARCH_LITTER_1994              [Laboratory Equipment]
HAZEL_LITTER_1993              [Laboratory Equipment]
HAZEL_LITTER_1994              [Laboratory Equipment]
ALDER_LITTER_1993              [Laboratory Equipment]
ALDER_LITTER_1994              [Laboratory Equipment]
BIRCH_LITTER_1993              [Laboratory Equipment]
BIRCH_LITTER_1994              [Laboratory Equipment]
UN_ID_DECIDUOUS_LITTER_1993    [Laboratory Equipment]
UN_ID_DECIDUOUS_LITTER_1994    [Laboratory Equipment]
UN_ID_UNDERSTORY_LITTER_1994   [Laboratory Equipment]
REVISION_DATE                  [BORIS Designation]
CRTFCN_CODE                    [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	NSA-9BS-9TETR	SSA-OJP-FLXTR	None	None	None	None
SUB_SITE	9TE06-NPP01	9TE06-NPP01	None	None	None	None
WOOD_NPP_1985	39	2368	None	None	None	Blank
WOOD_NPP_1986	40	2731.56	None	None	None	None
WOOD_NPP_1987	51	2598.31	None	None	None	None
WOOD_NPP_1988	54.86	2541	None	None	None	None
WOOD_NPP_1989	47.34	2263	None	None	None	None
WOOD_NPP_1990	49.2	2627	None	None	None	None
WOOD_NPP_1991	49.12	2354	None	None	None	None
WOOD_NPP_1992	52.21	2411	None	None	None	None
WOOD_NPP_1993	51.77	2769.9	None	None	None	None
WOOD_NPP_1994	54.7	4641	None	None	None	None
WOOD_NPP_1995	40.45	5078.61	None	None	None	Blank
CONIFER_FOLIAGE_NPP_1985	0	149	None	None	None	Blank
CONIFER_FOLIAGE_NPP_1986	0	362.99	None	None	None	None
CONIFER_FOLIAGE_NPP_1987	0	261.89	None	None	None	None
CONIFER_FOLIAGE_NPP_1988	0	241.32	None	None	None	None
CONIFER_FOLIAGE_NPP_1989	0	244.01	None	None	None	None
CONIFER_FOLIAGE_NPP_1990	0	230.47	None	None	None	None
CONIFER_FOLIAGE_NPP_1991	0	232.61	None	None	None	None
CONIFER_FOLIAGE_NPP_1992	0	172.63	None	None	None	None
CONIFER_FOLIAGE_NPP_1993	0	218.39	None	None	None	None

CONIFER_FOLIAGE_NPP_ 1994	0	335.63	None	None	None	None
CONIFER_FOLIAGE_NPP_ 1995	0	188.27	None	None	None	Blank
COARSE_WOOD_ROOTS_ NPP_1992	88	209	None	None	None	Blank
COARSE_WOOD_ROOTS_ NPP_1993	97	209	None	None	None	Blank
COARSE_WOOD_ROOTS_ NPP_1994	107	256	None	None	None	Blank
FINE_WOOD_ROOTS_NPP_ 1994	141	461	None	None	None	Blank
FINE_WOOD_ROOTS_NPP_ 1995	214	460	None	None	None	Blank
ASPEN_LITTER_1993	0	947	None	None	None	Blank
ASPEN_LITTER_1994	0	1450	None	None	None	Blank
JACK_PINE_LITTER_ 1993	0	377	None	None	None	Blank
JACK_PINE_LITTER_ 1994	0	385	None	None	None	Blank
BLACK_SPRUCE_LITTER_ 1993	0	263	None	None	None	Blank
BLACK_SPRUCE_LITTER_ 1994	0	449	None	None	None	Blank
NON_FOLIAR_LITTER_ 1993	59	320	None	None	None	Blank
NON_FOLIAR_LITTER_ 1994	0	308	None	None	None	Blank
LARCH_LITTER_1993	0	81	None	None	None	Blank
LARCH_LITTER_1994	0	73	None	None	None	Blank
HAZEL_LITTER_1993	0	11	None	None	None	Blank
HAZEL_LITTER_1994	0	406	None	None	None	Blank
ALDER_LITTER_1993	0	1	None	None	None	Blank
ALDER_LITTER_1994	0	7	None	None	None	Blank
BIRCH_LITTER_1993	0	7	None	None	None	Blank
BIRCH_LITTER_1994	0	15	None	None	None	Blank
UN_ID_DECIDUOUS_ LITTER_1993	0	0	None	None	None	Blank
UN_ID_DECIDUOUS_ LITTER_1994	0	30	None	None	None	Blank
UN_ID_UNDERSTORY_ LITTER_1994	0	709	None	None	None	Blank
REVISION_DATE	24-OCT-97	13-NOV-97	None	None	None	None
CRTFCN_CODE	CPI	CPI	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 records from a sample data file on the CD-ROM.

```
SITE_NAME,SUB_SITE,WOOD_NPP_1985,WOOD_NPP_1986,WOOD_NPP_1987,WOOD_NPP_1988,
WOOD_NPP_1989,WOOD_NPP_1990,WOOD_NPP_1991,WOOD_NPP_1992,WOOD_NPP_1993,
WOOD_NPP_1994,WOOD_NPP_1995,CONIFER_FOLIAGE_NPP_1985,CONIFER_FOLIAGE_NPP_1986,
CONIFER_FOLIAGE_NPP_1987,CONIFER_FOLIAGE_NPP_1988,CONIFER_FOLIAGE_NPP_1989,
CONIFER_FOLIAGE_NPP_1990,CONIFER_FOLIAGE_NPP_1991,CONIFER_FOLIAGE_NPP_1992,
CONIFER_FOLIAGE_NPP_1993,CONIFER_FOLIAGE_NPP_1994,CONIFER_FOLIAGE_NPP_1995,
COARSE_WOOD_ROOTS_NPP_1992,COARSE_WOOD_ROOTS_NPP_1993,
COARSE_WOOD_ROOTS_NPP_1994,FINE_WOOD_ROOTS_NPP_1994,FINE_WOOD_ROOTS_NPP_1995,
ASPEN_LITTER_1993,ASPEN_LITTER_1994,JACK_PINE_LITTER_1993,JACK_PINE_LITTER_1994,
BLACK_SPRUCE_LITTER_1993,BLACK_SPRUCE_LITTER_1994,NON_FOLIAR_LITTER_1993,
NON_FOLIAR_LITTER_1994,LARCH_LITTER_1993,LARCH_LITTER_1994,HAZEL_LITTER_1993,
HAZEL_LITTER_1994,ALDER_LITTER_1993,ALDER_LITTER_1994,BIRCH_LITTER_1993,
BIRCH_LITTER_1994,UN_ID_DECIDUOUS_LITTER_1993,UN_ID_DECIDUOUS_LITTER_1994,
UN_ID_UNDERSTORY_LITTER_1994,REVISION_DATE,CRTFCN_CODE
'NSA-9BS-9TETR','9TE06-NPP01',1041.0,1075.0,1059.0,980.0,936.0,1020.0,1076.0,
1103.0,1268.0,1278.0,,149.0,153.0,151.0,139.0,133.0,145.0,153.0,156.0,179.0,
180.0,,,,,,,,0.0,,14.0,,244.0,,80.0,,0.0,,0.0,,,,,,30.0,37.0,13-NOV-97,'CPI'
'NSA-9BS-AUX01','9TE06-NPP01',,871.74,808.35,793.74,794.32,848.18,782.67,846.9,
1039.4,940.02,897.84,,70.2,65.17,64.04,64.06,68.48,63.2,68.44,84.11,76.07,72.66,
,,,,,,,,,,,,,,,,,,,,,,,,24-OCT-97,'CPI'
'NSA-9BS-AUX02','9TE06-NPP01',,672.78,685.46,722.64,680.7,742.1,691.51,743.9,
981.58,907.79,720.27,,54.35,55.37,58.38,54.99,60.02,55.93,60.22,79.55,73.55,58.4,
,,,,,,,,,,,,,,,,,,,,,,,,24-OCT-97,'CPI'
```

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

9.1.1 Derivation Techniques and Algorithms

Tree biomass is calculated from a diameter measurement and an allometric equation and then scaled to the hectare level using a plot scaling factor that reflects the tree's representative size in relation to the plot size (Dilworth and Bell, 1979). Allometric equations are generally developed on a log-log basis to correct for nonhomogeneous variance (see BOREAS TE-06 Allometry Data documentation).

Biomass by component

(Kg/ HA) = (INVLOG(a + b (LOG (diameter)))) * PLOT SCALING FACTOR

Tree increment (multiplied by 2 and corrected for a tree bark thickness of 0.1 cm) is then subtracted from or added to the original diameter measurement (depending on when the tree diameter was measured and tree core taken) to develop an estimate of another year's diameter.

1993 diameter = 1994 measured diameter - 1993 measured increment

Biomass is then calculated for two consecutive years, and the difference between the two is considered the overstory increment.

Overstory Increment = 1994 Biomass by component - 1993 Biomass by component

For determining litterfall mass by component at the tower sites, screens are averaged by plot and scaled to the hectare level. The stand average is then determined and added to the overstory biomass increment.

9.2 Data Processing Sequence

9.2.1 Processing Steps

None given.

9.2.2 Processing Changes

None given.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

Not applicable.

9.3.2 Calculated Variables

See Section 9.1.1.

9.4 Graphs and Plots

Not applicable.

10. Errors

10.1 Sources of Error

The greatest potential source of error other researchers need to be aware of for the TF sites is not from the data collection or calculation but from differences in vegetation between where other researchers may have worked and where the TE-06 team located its plots. Researchers should contact Tom Gower if they feel plot location may be affecting any corroboration between their estimates and these. The variability for fine root production is high for these estimates, as is the case for most estimates of fine root production. It is likely that this variation is a reflection of the variability within boreal forests. The estimates for overstory root increment are based on generalized equations and are not all species specific, but problems surrounding this usage are likely minimal (Santantonio et al., 1977)

For the AUX sites, difficulty surrounding the efficacy of non-site-specific allometric equations in estimating biomass and overstory biomass increment values occurs at a number of sites. Estimating overstory biomass increment from non-site-specific equations for wood and branch increment is problematic when the diameters of the trees measured are smaller or larger than the diameters of the trees that were harvested to develop the allometric equation. For this reason, the biomass for trees at the AUX and CEV sites that had a diameter that was either too large or small for the TF allometric equations was estimated from the Singh (1982) equations.

10.2 Quality Assessment

The data provided are of generally good quality with the above considerations taken into account.

10.2.1 Data Validation by Source

It is not possible to validate the data without developing new allometric equations and/or installing new plots. A check was performed using published allometric equations (Singh, 1982) and there was generally good agreement for total biomass increment at all sites, but poor agreement for foliage increment, which is not unexpected.

10.2.2 Confidence Level/Accuracy Judgment

Confidence level for the TF sites is high for the data submitted and slightly less so for some AUX sites. Researchers should note Section 10.1.

10.2.3 Measurement Error for Parameters

Not applicable.

10.2.4 Additional Quality Assessments

Not applicable.

10.2.5 Data Verification by Data Center

Data were examined for general consistency and clarity.

11. Notes

11.1 Limitations of the Data

The CEV and AUX increment estimates are limited to a 30- x 30-m area surrounding a point located using a Global Positioning System (GPS). The location of these points can be found in the STAFF directory of BORIS.

11.2 Known Problems with the Data

The overstory increment numbers provided for 1985-92 and 1986-93 at the TF/CEV and AUX sites likely decrease in accuracy as one projects back in time (see Section 10.1).

11.3 Usage Guidance

None.

11.4 Other Relevant Information

None.

12. Application of the Data Set

NPP is both the result of and the precursor to a number of important dynamics within the boreal forest that may determine whether this forest type is a sink or source of carbon dioxide in future climate change scenarios. The estimates provided by this effort also provide a means of validation for models that develop carbon budgets for these forests.

13. Future Modifications and Plans

Estimates for the 1996 overstory increment and litterfall data may be available; please contact the investigator (see Section 2.1).

14. Software

14.1 Software Description

None given.

14.2 Software Access

None given.

15. Data Access

The TE-06 NPP 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: ornldaac@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.

16.2 Film Products

None.

16.3 Other Products

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

17. References

17.1 Platform/Sensor/Instrument/Data Processing Documentation

None.

17.2 Journal Articles and Study Reports

Chen, J.M., P.M. Rich, S.T. Gower, J.M. Norman, and S. Plummer. 1997. Leaf area index of boreal forests: Theory, techniques, and measurements. Journal of Geophysical Research 102(D24): 29,429-29,443.

Dilworth, J.R. and J.F. Bell. 1979. Variable probability sampling-variable plot and three-P. O.S.U. Book Stores, Inc. Corvallis, Oregon.

Gower, S.T., J.G. Vogel, J.M. Norman, C.J. Kucharik, S.J. Steele, and T.K. Stow. 1997. Carbon distribution and aboveground net-primary production in aspen, jack pine, and black spruce stands in Saskatchewan and Manitoba, Canada. Journal of Geophysical Research 102(D24):29,029-29,041.

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.

Santantonio, D., R.K. Hermann, and W.S. Overton. 1977. Root biomass studies in forest ecosystems. Pedobiologia. 17:1-31.

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.

Singh, T. 1982. Biomass equations for Ten Major Tree Species of the Prairie Provinces. Information Report NOR-X-242, Northern Forest Research Centre, Canadian Forestry Service, Environment Canada, Edmonton.

Smucker, A.J., S.L. McBurney, and A.K. Srivastava. 1982. Quantitative separation of roots from compacted soil profiles by the hydropneumatic elutriation system. Agron. J. 74:500-503.

Steele, S.J., S.T. Gower, J.G. Vogel, and J.M. Norman. 1997. Root mass, net primary production and turnover in aspen, jack pine and black spruce forests in Saskatchewan and Manitoba, Canada. Tree Physiol. (in press).

17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None given.

19. List of Acronyms

```
ANPP    - Aboveground NPP
ASCII   - American Standard Code for Information Interchange
AUX     - Auxiliary site
BOREAS  - BOReal Ecosystem-Atmosphere Study
BORIS   - BOREAS Information System
CD-ROM  - Compact Disk-Read-Only Memory
CEV     - Carbon Evaluation site
DAAC    - Distributed Active Archive Center
EOS     - Earth Observing System
EOSDIS  - EOS Data and Information System
GIS     - Geographic Information System
GPS     - Global Positioning System
GSFC    - Goddard Space Flight Center
HTML    - HyperText Markup Language
NPP     - Net Primary Productivity
NSA     - Northern Study Area
OA      - Old Aspen
OBS     - Old Black Spruce
OJP     - Old Jack Pine
ORNL    - Oak Ridge National Laboratory
PANP    - Prince Albert National Park
SSA     - Southern Study Area
TE      - Terrestrial Ecology
TF      - Tower Flux site
URL     - Uniform Resource Locator
WAB     - Wind-Aligned Blob
```

20. Document Information

20.1 Document Revision Date

Written: 14-Apr-1997
Last Updated: 26-Jul-1999

20.2 Document Review Date(s)

BORIS Review: 12-Jun-1997
Science Review: 26-Jun-1998

20.3 Document ID

20.4 Citation

Researchers using the data from the TF sites should cite Gower et al., 1997, as well as citations of relevant papers in Section 17.2.

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

Gower, T., "Measurement and Scaling of Carbon Budgets for Contrasting Boreal Forest Sites." 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:

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The BOREAS TE-6 team collected several data sets to examine the influence of vegetation, climate, and their interactions on the major carbon fluxes for boreal forest species. This data set contains estimates of the biomass produced by the plant species at the TF, CEV, and AUX sites in the SSA and NSA for a given year. Temporally, the data cover the years of 1985 to 1995. The plant biomass production (i.e., aboveground, belowground, understory, litterfall), spatial coverage, and temporal nature of measurements varied between the TF, CEV, and AUX sites as deemed necessary by BOREAS principal investigators. The data are stored in tabular ASCII files.

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