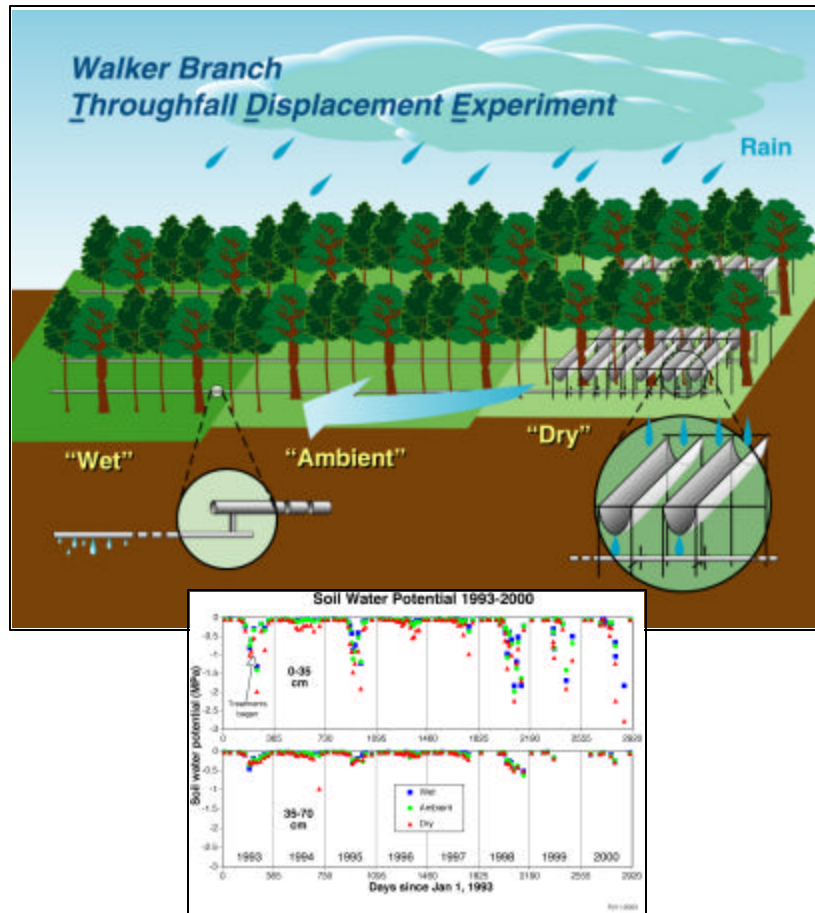# Walker Branch Throughfall Displacement Experiment Data Report: Site Characterization, System Performance, Weather, Species Composition, and Growth

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Walker Branch Throughfall Displacement Experiment Data Report: Site Characterization, System Performance, Weather, Species Composition, and Growth

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CONTENTS

LIST OF TABLES

ABBREVIATIONS

CDIAC   Carbon Dioxide Information Analysis Center

CEC   cation exchange capacity

CLR   canopy light ratio

dbh   diameter at breast height

FTP   file transfer protocol

LAI   leaf area index

NDP   numeric data package

PAR   photosynthetically active radiation

QA   quality assurance

RelLAI relative leaf area index

TDE   Throughfall Displacement Experiment

TDR   time-domain reflectometer

WBW   Walker Branch Watershed

ABSTRACT

Hanson, P. J., D. E. Todd, J. S. Riggs, M. E. Wolfe, and E. G. O'Neill. 2001. *Walker Branch Throughfall Displacement Experiment Data Report: Site Characterization, System Performance, Weather, Species Composition, and Growth.* ORNL/CDIAC-134, NDP-078A. Carbon Dioxide Information Analysis Center, U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, Tennessee, U.S.A. 158 pp. doi: 10.3334/CDIAC/vrc. ndp078

This numeric data package provides data sets, and accompanying documentation, on site characterization, system performance, weather, species composition, and growth for the Throughfall Displacement Experiment, which was established in the Walker Branch Watershed of East Tennessee to provide data on the responses of forests to altered precipitation regimes. The specific data sets include soil water content and potential, coarse fraction of the soil profile, litter layer temperature, soil temperature, monthly weather, daily weather, hourly weather, species composition of trees and saplings, mature tree and sapling annual growth, and relative leaf area index.

Fortran and SAS™ access codes are provided to read the ASCII data files. The data files and this documentation are available without charge on a variety of media and via the Internet from the Carbon Dioxide Information Analysis Center (CDIAC).

Keywords: forests, growth, leaf area index, litter, sapling, soil, soil temperature, soil water content, soil water potential, tree, weather

1. BACKGROUND INFORMATION

INTRODUCTION

Models of global climate change predict that increasing levels of greenhouse gases in the atmosphere will (1) cause an increase in average global temperatures and (2) alter regional levels of precipitation. It is also predicted that the incidence of drought will increase with a warming global climate. Forests throughout the southeastern United States, where evapotranspiration demand is high and is predicted to increase as temperatures rise, would be particularly vulnerable to declines in annual precipitation. Potential responses of U.S. forests to future drought associated with climate change include a reduction in net primary production and stand water use, along with increased mortality of seedlings and saplings (Hanson and Weltzin 2000).

To provide data on the responses of forests to altered precipitation regimes, the Throughfall Displacement Experiment (TDE) was established in the Walker Branch Watershed (WBW) of East Tennessee (latitude 35º 58' N, longitude 84º 17' W). Funding for the TDE was provided by the Program for Ecosystem Research (**http://www.er.doe.gov/production/ober/GC/per.html**) of the U.S. Department of Energy's Office of Biological and Environmental Research.

Remotely sensed imagery of the WBW is available from the National Aeronautics and Space Administration (**http://modis-land.gsfc.nasa.gov/val/coresite.asp?SiteID=28** and **http://modis. gsfc.nasa.gov/MODIS/LAND/VAL/prove/forest/prove.html**) and from the U.S. Geological Survey (**http://edcdaac.usgs.gov/pathfinder/walker/gsm011na.htm**).

A detailed description of the TDE is provided by Hanson et al. (1998) and Hanson et al. (2001), both of which are included in Appendix A of this report. Experimental manipulation of hydrologic inputs at the TDE is accomplished by intercepting throughfall in approximately 2000 subcanopy troughs (0.3 × 5 m) suspended above the forest floor on a "dry" treatment plot and transferring the throughfall across a control plot for distribution onto a "wet" treatment plot. Each plot is 80 × 80 m in size. The treatments result in a 33% decrease in precipitation reaching the forest floor on the dry plot and a corresponding increase in precipitation on the wet plot. Reductions in soil moisture on the dry plot are expected to be equivalent to the driest growing seasons of the 1980's drought, which resulted in reduced tree growth of some species.

The site was chosen because of its uniform slope, consistent soils, and a reasonably uniform distribution of vegetation. The physical and chemical characteristics of the typic Paleudult soils (Fullerton cherty silt loam) of the TDE site are summarized in Appendix B. The forest community is dominated by white oak, chestnut oak, and red maple, but it contains more than 25 tree species (Appendix C). The past 25 years of research on the Walker Branch Watershed provide an important reference database against which to judge the outcomes of this large-scale field experiment.

MEASUREMENT METHODS

Soil Water Content and Potential

Soil water content (%, v/v) was measured with a Soil Moisture Equipment Corp.® TRASE SYSTEM time-domain reflectometer (TDR) following the procedure of Topp and Davis (1985) as documented for soils with high coarse-fraction content (Drungil et al. 1989). Three hundred and ten sampling locations were installed at an 8×8-m spacing across the site, giving more than 100 soil water monitoring locations per plot. At each location two pairs of TDR waveguides were installed in a vertical orientation (0 to 0.35 and 0 to 0.7 m). The surface (0 to 0.35 m) TDR measurements coincide with the zone of maxium root density in these soils. TDR measurements were obtained biweekly during the growing season and approximately monthly during the dormant season. The TDR soil water content measurements were adjusted for the coarse fraction of these soils and converted to soil water potentials using laboratory-derived soil moisture retention curves for the A, A/E, and E/B horizons (Hanson et al. 1998).

Soil Rock Content

Soil was sampled from depths of 0 to 30 and 30 to 60 cm in ~10-cm-diameter cylindrical cores with a total volume of 2430.96 cm^3. The soil coarse fraction was determined by weighing the material retained by a 2-mm sieve. To convert coarse-fraction mass to volume all rock (i.e., chert) was assumed to have a mean density of 2.3 g cm^{-3}. This density was based on laboratory observations for chert taken from the TDE samples.

Weather and Radiation

Weather data are collected as hourly means and logged on LiCor® LI-1000 data loggers housed in instrument enclosures located at one upslope and one downslope location per treatment plot and one enclosure in the nearby clearing. Measurements of incoming rainfall, irradiance (LiCor® LI-200SA pyranometer), and photosynthetic photon flux density (LiCor® LI-191SA quantum sensor) were obtained in a nearby clearing until 1998 when above-canopy observations were added to the ambient plot tower. Clearing data were used to represent "above-canopy" conditions for the experimental site for the years 1993–1997. Mean incident shortwave radiation was measured with an Eppley® precision spectral pyranometer located 44 m above the forest canopy (these data are not available for 1993 and 1994). Two tipping bucket rain gauges with 3-m extension troughs attached are installed on each plot to evaluate the amount of throughfall reaching the forest floor. Sub-canopy air temperatures (2 stations per treatment plot) are measured with thermistors at approximately 1 m height in a location shielded from direct solar radiation. Wind data for 1993 through 1997 are from a height of 37 m on the the Oak

Ridge Ameriflux tower (10 m above the canopy). A value of 1.5 m s^{-1} is used to fill in for missing hours for those years in the hourly weather data. Wind data for 1998 through 2000 are from the ambient plot tower on the TDE experimental site and the anemometer is nearer to the canopy (4 m above the canopy).

Litter Temperature

Self-contained Onset Computer® data loggers were deployed within the Oi litter layer during extensive periods in 1997–1998 and 2000. In 1997–1998, StowAway XTI08 sensors in the dry (×4) and ambient (×4) plots were used. The XTI08 sensors employed an external thermistor positioned inside litter decomposition bags that were located in the Oi horizon leaf litter from March 15, 1997, through February 6, 1998. StowAway TidbiT sensors were placed directly in the Oi layer of the dry (×4) and wet (×4) plots from January 27, 2000, to December 14, 2000.

Soil Temperature

From 1993 through 1997 hourly soil temperatures were measured at two depths (10 and 35 cm) at 2 locations in each treatment plot. LiCor® LI-1000-15 soil temperature thermistors were installed vertically from the surface to the specified depth. Data were automatically logged on six independent LiCor LI-1000 data loggers housed in instrument enclosures located at one upslope and one downslope location per treatment plot. No differences among treatment plots or slope positions were observed for temperatures at these depths, and the data were pooled as hourly site averages. Starting in 1998, soil temperature observations were obtained from Campbell Scientific® Model 107 soil temperature thermistors installed horizontally into the walls of an excavated and subsequently refilled soil pit. The probes were distributed at four depths in each pit (~10 cm, ~30 cm, ~45 cm, and one deep probe in the 60 to 100-cm range). Data were logged as hourly means of 5-second (for 1993–1997 data) or 1-minute (1998 and thereafter) observations on a Campbell Scientific® CR10X data logger.

Tree Mortality and Growth

Prior to the experiment and at approximately annual intervals thereafter, all trees greater than 0.1 m in diameter at 1.3 m height (diameter at breast height, dbh) were identified to species (762 trees). Presence/mortality was recorded annually. Annual diameter measurements were conducted with diameter tapes at tagged locations on all trees.

Tree heights and crown widths were measured directly on approximately one-third of the trees or derived from allometric relationships from a subset of the measured data. *Quercus* spp. and *Acer* spp.

3

were the major canopy dominants; *Liriodendron tulipifera* L. was a canopy dominant on the lower slope positions; and *Nyssa sylvatica* Marsh. and *Oxydendrum arboreum* [L.] D. C. were the predominant species occupying mid-canopy locations. In March of 1994, stand basal area averaged 21 m^2 ha^{-1} with nearly identical basal area on each plot. By December 1999, mean basal area across all plots had increased to 22.8 m^2 ha^{-1}.

Quercus alba L., *Q. prinus* L., *Acer rubrum* L., *L. tulipifera* L., and *N. sylvatica* Marsh. trees greater than 0.2 m dbh were fitted with dendrometer bands (170 trees) for biweekly measurements of stem circumference during each growing season. A single dendrometer measurement consists of duplicate digital caliper measurements (0.01 mm resolution) of the distance between two reference holes in stainless steel dendrometer bands (25.4 mm wide $\times$ 0.2 mm thick) installed around the circumference of each tree (McLaughlin and Downing 1996). Measured changes in the circumference of each tree were combined with information on its initial stem diameter to obtain the change in stem basal area over time (mm^2 day^{-1} or mm^2 $year^{-1}$). Dendrometer bands were installed on the *Q. alba*, *Q. prinus*, and *A. rubrum* trees prior to the 1993 growing season, and bands for *L. tulipifera* and *N. sylvatica* were added in February of 1994. All dendrometer bands were installed during the dormant season, ahead of the initial growth measurements, to eliminate potential first-year bias in the dendrometer band measurements (Keeland and Sharitz 1993).

Sapling Growth and Mortality

Starting in 1996 all saplings in 27 plots (8×8 m) distributed across the TDE experimental area (9 plots per treatment) were observed for survival and diameter (measured with a caliper) at marked locations on the stems. The preferred target height for diameter measurements was 1.3 m unless the sapling was too small, in which case 1 m was used instead. Figure 1 shows the distribution (random within rows). Each small block is an 8×8-m plot. The 27 plots, each

8×8 m, yielded a total of 1728 m^2 of monitored area, which was 9% of the total TDE experimental area. The number of saplings (trees < 0.1 m dbh) across the TDE area averaged 3073 ha^{-1} in 1994 and 2112 ha^{-1} in 1999. Saplings contributed an additional 3 and 2.6 m^2 ha^{-1} to total stand basal area in 1994 and 1999, respectively. *Acer rubrum* L. and *Cornus florida* L. combined to make up 59 percent of all saplings and 53 percent of the sapling basal area.

In February and March of 1994, 10 transects for observations of sapling growth and mortality were established across the three plots from lower- to upper-slope positions. Although other species were considered for these measurements, only *A. rubrum* and *C. florida* were distributed across the TDE in sufficient numbers for inclusion. Saplings ranged from 10 to 60 mm dbh with the majority from 10 to 40 mm. Height measurements were not included because the crowns were broad without predominant main shoots and because height growth was minimal in the low-light understory environment of our closed canopy stand. Starting at the time of spring leafout each year, biweekly measurements of stem diameter at a permanently marked location on each sapling's main stem (typically between 1 and 1.5 m above the ground) were conducted until sapling growth had ceased for that year. Each stem caliper measurement was the mean of three replicate diameter measurements made with a digital caliper (0.01 mm resolution) from three different angles around the marked point of measurement. The mean of replicate measures
from different angles was required to minimize the impact of noncircular stem cross sections. Sapling stem diameters were converted to basal area to express mean daily sapling growth rates per plant in mm^2 day^{-1}, or integrated annual sapling growth in mm^2 year^{-1}. Incremental growth of saplings that died in a given year were included in the calculation of that year's mean growth rate but excluded in all subsequent estimates of annual growth. Additional randomly chosen saplings were added to the measurement pool after the 1994, 1995, and 1996 growing seasons (to make up for mortality losses), but no additional plants were added to this observation set after that time.
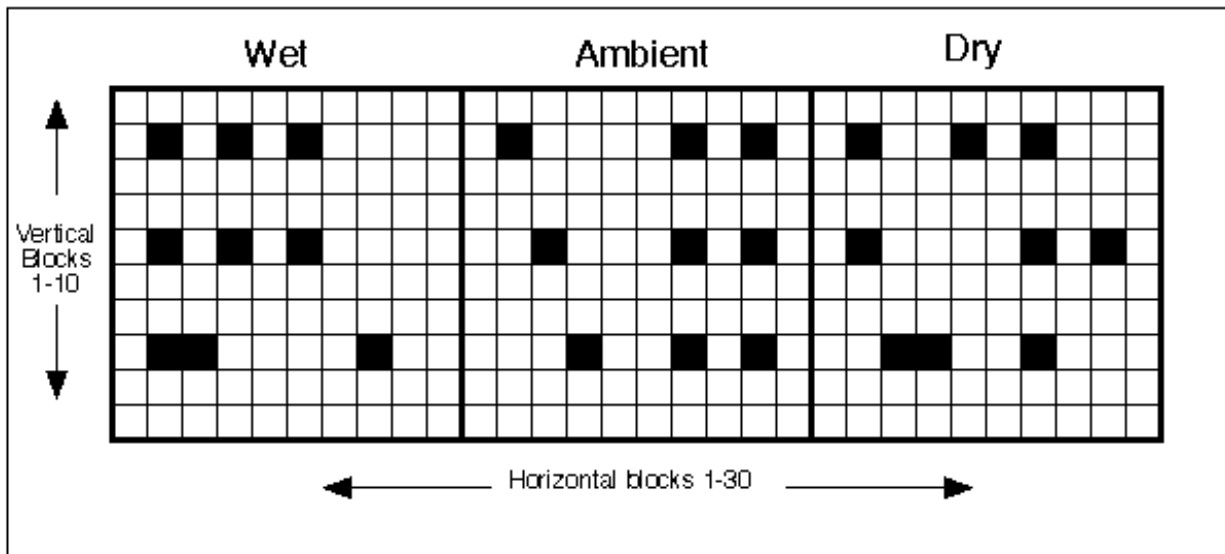
Figure 1. Distribution of plots for observation of survival and diameter of saplings at the TDE site.

5

Leaf Area Index

Seasonal patterns of stand leaf area development were determined from the ratio of understory to overstory light penetration. This canopy light ratio (CLR; Equation 1) was calculated as 1 minus the ratio of the daily sum of understory photosynthetically active radiation (PAR_u; PAR at 1.5 m) to the daily sum of overstory incident PAR (PAR_o):

$$CLR = 1 - (PAR_u/PAR_o) \qquad \text{Eq. 1}$$

Because of the presence of tree boles and branches, pre-leaf out and post-senescence baselines for the CLR were not zero. Therefore, to express the CLR on a 0–1 scale it was necessary to adjust the ratio for the light penetration during leafless periods as shown in Equation 2:

$$RelLAI = (Observed\ CLR - baseline)/(Maximum\ CLR - baseline) \qquad \text{Eq. 2}$$

where RelLAI is the relative leaf area index on the 0–1 scale for a given date. However, because the baseline ratio resulting from the presence of boles and branches changed with solar elevation, we found it necessary to use more than one baseline for the calculation of the seasonal pattern of RelLAI. Although the baseline CLR in the absence of leaves would vary continuously with solar elevation, we found that use of the pre-leafout baseline for days 80 through 180 and the post-senescence baseline for days 181 through 350 yielded an acceptable RelLAI pattern. It is important to note that the RelLAI values are representative of the development of leaf area, not leaf mass (i.e., they may overpredict the rate of annual leaf mass accumulation). Approximations of leaf mass development or a direct estimate of leaf are index (LAI) could also be made from the same data using a light extinction approach as described by Hutchinson and Baldocchi (1989).

Data Logging

Environmental data for the TDE were logged on Campbell Scientific® CR10X data loggers located on each of the treatment plots. All loggers were interfaced with a Campbell Scientific® MD9 coaxial multidrop interface, and data from all loggers were remotely accessed weekly via Campbell Scientific® COM200 modem and cellular telephone. As a backup to remote data downloads, the logged data were also stored in Campbell Scientific® SM192 nonvolatile circular memory with the capacity to hold approximately one month's data for the configuration used here. The loggers and associated instrumentation operated off three 12-volt, deep-cycle marine batteries wired in parallel. The batteries were trickle-charged from solar panels (Solarex® 55 watts @ 17.4 volts; with a metered Morningstar® PS30M photovoltaic controller, 30-amp PV current @ 12 volts) installed on towers

above the forest canopy. Sensors were connected to the CR10X data logger via a standard wiring panel and two Campbell Scientific® AN416 multiplexer modules.

An example data program for the CR10X data logger editor and the data logger download file for the TDE ambient plot and its instruments are included in this numeric data package (NDP) as files **tdeambi.csi** and **tdeambi.dld**, respectively. The example program includes two sampling tables. The majority of the instrumentation is queried once per minute and logged as hourly means or sums as a part of the first sampling table, and a second samling table is included to query heat dissipation matric potential sensors (Campbell Scientific® Model 229) twice a day (noon and midnight). Table 1 lists the measurement interval, logging interval, and type of sensors being logged on the TDE ambient plot as of December 2000.

Table 1. Environmental sensors attached to the TDE ambient plot CR10X data logger as of December 2000

Sensor	Units	Number of sensors	Measurement interval	Logging interval
Time stamp				
Year	y	n/a	1 h	hourly
Day	d	n/a	1 h	hourly
Time	hh:mm	n/a	1 h	hourly
Fractional day of year	d	n/a	1 h	hourly
Battery voltage	v	n/a	1 h	hourly
Above-canopy sensors				
Pyranometer (LiCor® LI-200SA)	W m^{-2} s^{-1}	1	1 min	hourly mean
Wind speed (Campbell Scientific® 014A)	m s^{-1}	1	1 min	hourly mean
Rainfall (Campbell Scientific® TE525MM)	mm	1	continuous	hourly sum
Quantum (LiCor® LI-191SA)	Fmol m^{-2} s^{-1}	2	1 min	hourly mean
Air temperature/relative humidity (Rotronics® 101)	deg C/%	1	1 min	hourly mean
Understory sensors				
Understory rainfall[a] (Campbell Scientific® TE525MM)	mm	1	continuous	hourly sum
Quantum (LiCor® LI-191SA)	Fmol m^{-2} s^{-1}	1	1 min	hourly mean
Air temperature/relative humidity (Rotronics® 101)[a]	deg C/%	1	1 min	hourly mean
Soil and litter sensors				
Soil temperature (Campbell Scientific® 107)	deg C	4	1 min	hourly mean
Soil water content (Campbell Scientific® 615)	% v/v	8	1 min	hourly mean
Litter water content (DC half-bridge)[a]	g g^{-1}	8	1 min	hourly mean
Soil matric potential	MPa	8	12 h	twice daily
Plant measurements				
Sapflow[a]	deg C	8	1 min	hourly mean

Sensor	Units	Number of sensors	Measurement interval	Logging interval
Sapflow voltage[a] (Dynamax® thermal dissipation sap velocity probe)	V	1	1 min	hourly mean

[a]data not included in this numeric data package.

This NDP provides datasets, and accompanying documentation, on site characterization, system performance, weather, species composition, and growth. Related NDPs are planned on physiology, decomposition, and nutrient cycling.

2. APPLICATIONS OF THE DATA

These data are useful for quantifying certain responses of temperate forest ecosystems (litter and soil water content, growth, mortality) to changes in precipitation patterns. Other datasets from the TDE will be useful for quantifying other aspects of ecosystem response (e.g., physiology, decomposition, nutrient cycling).

Data from the TDE have been used in published studies of the effects of altered water regimes on forest root systems (Joslin et al. 2000) and sapling and large-tree growth and mortality (Hanson et al. 2001), and a wide variety of process-based studies (see Appendix D for TDE publications).

3. DATA LIMITATIONS AND RESTRICTIONS

Users should be aware of limitations to the data as a result of suspect values. The quality-assurance checks performed by CDIAC, and the results of those checks, are described in Section 4.

In the weather files, some reported values of relative humidity (in files **mweather.dat**, **dweather.dat**, **hw9399.dat**, and **hw00.dat**) exceed 100%; this is physically impossible. However, it is not yet known how these values arose nor how to adjust the data.

Some values of relative leaf area (in file **rellai.dat**) were suspiciously low, such as the value of 0.44 on day 289 in 1998. Most such values occur in the fall; a lower sun angle may contribute to these low values. A curve-fitting approach may be appropriate to analyze the patterns of leaf senescence.

Hourly weather data were checked by the data contributors for errors and missing data. If bad or missing data were found, approximate replacement data were obtained from other weather data sources in the area, if possible, to provide the most complete data set.

If TDE shortwave radiation data are needed for model input, the values for SWISIS should be used instead of the LiCor® pyranometer data. Both are in good agreement for most years, but the TDE pyranometer data for 1998 and 2000 do not agree very well with the SWISIS data (mean of 5 observations) distributed across the reservation.

The issue of pseudo-replication in the experimental design is addressed by Hanson et al. (1998) and Hanson et al. (2001) (Appendix A).

In addition to the above considerations, users should be aware that there is some evidence of minor effects of the experimental infrastructure (specifically, the precipitation-collection equipment) on the microclimate of the "dry" treatment plot.

4. QUALITY-ASSURANCE CHECKS AND DATA-PROCESSING ACTIVITIES PERFORMED BY CDIAC

An important part of the data packaging process at CDIAC involves the quality assurance (QA) of data before distribution. To guarantee data of the highest possible quality, CDIAC performs extensive QA checks, examining the data for completeness, reasonableness, and accuracy.

Comma-delimited files provided by the data contributors were imported into Microsoft Excel® for QA checks (and, ultimately, converted to space-delimited ascii files for archiving). Files were renamed when necessary, for consistency. Variable names were made consistent across files, for simplicity of documentation and analysis.

The file soiltemp.txt provided by the data contributor was divided into two files, **st9398.dat** (data from 1993 through 1998) and **st9900.dat** (data from 1999 through 2000). Sixteen tdr*.txt files (one set for each of two depths, 35 and 70 cm, and for each year from 1993 through 2000) were combined into one **tdr.dat** file. For consistency with other files, in file **tdr.dat** integer values 1, 2, and 3 for the variable TREAT were replaced by character values W, A, and D, respectively; and values 1, 2, and 3 for the variable SLOPE were replaced by values B, M, and U, respectively. Eight monthly and eight daily weather files (one monthly and one daily file for each year from 1993 through 2000) were combined into a single **mweather.dat** file and a single **dweather.dat** file, respectively. Seven hourly weather files (for the years 1993 through 1999) were combined into a single **hw9399.dat** file.

The format of all values was checked for improper entries.

Several files (e.g., **atree.dat**) were reformatted by adding variables for year, depth, etc., but eliminating variables that were a combination of year, depth, etc., and another variable (e.g., growth), thereby reducing the total number of variables, resulting in a "narrower" but "longer" file.

For all variables in all files, the range of values was checked for impossible or suspiciously large or small values, such MONTH >12 or values of water potential (e.g., variable A35WP in file **sw.dat**) >0 MPa. Values of relative humidity apparently exceeding 100% are discussed in Section 3.

Comparisons and X-Y scattergrams were used to check for outliers and impossible or unlikely combinations. For example, file **mweather.dat** was inspected to ensure that, for air temperature, relative humidity, and soil temperature, the minimum did not exceed the mean, which in turn did not exceed the maximum; no observations failed this test. Scattergrams were plotted and visually examined to check the correlation between PYRAN and QUAN; and ATMIN and STMIN, ATMEAN and STMEAN, and ATMAX and STMAX (minimum, mean, and maximum air and soil temperatures) in file **mweather.dat**; no obvious outliers were detected.

The following lists the specific data-quality checks by file:

File **sw.dat**
    range checks for all variables
    scattergrams: DOY v RDOY, RDOY v DATE

Result: No suspect data were identified.

File **nine.dat**
    range checks for all variables
    scattergrams: DOY v RDOY

Result: No suspect data were identified.

File **tdr.dat**
    range checks for all variables

Result: No suspect data were identified.

File **rocks.dat**
    range checks for all variables

Result: No suspect data were identified.

File **littert.dat**
    range checks for all variables
    scattergram: FDOY v DOY

Result: No suspect data were identified.

File **st9398.dat** and **st9900.dat**
    range checks for all variables

Result: No suspect data were identified.

File **mweather.dat**
    range checks for all variables
    comparisons: ATMIN # ATMEAN # ATMAX, RHMIN # RHMEAN # RHMAX, STMIN #
     STMEAN # STMAX
    scattergrams: PYRAN v QUAN, ATMIN v STMIN, ATMEAN v STMEAN, ATMAX v
     STMAX

Result: No suspect data were identified (other than some values of RHMIN, RHMEAN, and RHMAX
>100%).

File **dweather.dat**
    range checks for all variables
    comparisons: ATMIN # ATMEAN # ATMAX, RHMIN # RHMEAN # RHMAX, STMIN #
     STMEAN # STMAX
    scattergrams: PYRAN v QUAN, RADMEAN v QUAN, ATMIN v STMIN, ATMEAN v
     STMEAN, ATMAX v STMAX

Result: No suspect data were identified (other than some values of RHMIN, RHMEAN, and RHMAX
>100%).

File **hw9399.dat**
    range checks for all variables
    comparisons: UQUAN # QUAN

Result: Some values of RH >100%; 1502 occurrences of UQUAN > QUAN were detected (with values of UQUAN minus QUAN ranging from 1 to 366 µmol m^{-2} s^{-1}, typically during periods of low light conditions), tentatively attributed by the data contributor to random error in the sensors or data loggers; these data were not adjusted.

File **hw00.dat**

    range checks for all variables

    comparisons: UQUAN # QUAN

    scattergrams: PYRAN v QUAN, UQUAN v QUAN, HOY v DFOY, AT v ST

Result: Some values of RH >100%; 97 occurrences of UQUAN > QUAN were detected (with values of UQUAN minus QUAN ranging from 1 to 6 µmol m^{-2} s^{-1}), as with file **hw9399.dat**.

File **comptree.dat**
    range checks for all variables
    check for duplicate values of ID
    check SPC values against list of species

Result: No suspect data were identified.

File **compsap.dat**
    range checks for all variables

Result: No suspect data were identified.

File **atree.dat**
    range checks for all variables
    check for duplicate values of ID
    check SPC values against list of species

Result: No suspect data were identified.

File **asapling.dat**
    range checks for all variables
    check for duplicate values of ID
    check SPC values against list of species

Result: No suspect data were identified.

File **rellai.dat**
    range checks for all variables
    Relative LAI values between 0 and 1

Result: All years had some values of relative LAI that were outside the range of 0.00 to 1.00 (minimum of -0.33 in 1994 and maximum of 1.05 in 1998); per instruction from the data contributor, these were set to missing. A few anomalously low values, such as 0.44 on day 289 in 1998, were detected; per instruction from the data contributor, these were not changed.

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6. HOW TO OBTAIN THE DATA AND DOCUMENTATION

This database (NDP-078A) is available free of charge from CDIAC. The files are available, via the Internet, from CDIAC's Web site (**http://cdiac.esd.ornl.gov**) or from CDIAC's anonymous FTP (file transfer protocol) area (**cdiac.esd.ornl.gov**) as follows:

1. FTP to cdiac.esd.ornl. gov (128.219.24.36).
2. Enter "ftp" as the user id.

3. Enter your electronic mail address as the password (e.g., fred@zulu. org).
4. Change to the directory "pub/ndp078a" (i.e., use the command "cd pub/ndp078a").
5. Set ftp to get ASCII files by using the ftp "ascii" command.
6. Retrieve the ASCII database documentation file by using the ftp "get ndp078a.txt" command.
7. Retrieve the ASCII data files by using the ftp "mget *.dat" and "mget tedambi.*" commands.
8. Exit the system by using the ftp "quit" command.

For **non-Internet data acquisitions** (e.g., floppy diskette or CD-ROM), or for additional information, contact:

Carbon Dioxide Information Analysis Center
Oak Ridge National Laboratory
P. O. Box 2008
Oak Ridge, Tennessee 37831-6335, U. S. A.

Telephone: 1-865-574-3645
Telefax: 1-865-574-2232
Email: cdiac@ornl.gov

7. LISTING OF FILES PROVIDED

This database consists of 19 ASCII files: this text documentation file (**ndp078a.txt**, File 1) and 18 data files (Table 2).

Table 2. Files in this numeric data package

File number	File name	File size (bytes)	File description
1	ndp078a.txt	98k	Descriptive file (i.e., this document)
2	tdeambi.csi	16k	Example data program for the CR10X data logger editor for the TDE ambient plot and its instruments
3	tdeambi.dld	4k	Example data logger download file for the TDE ambient plot and its instruments
4	sw.dat	13k	Mean soil water content and potential (1993–2000), by date, treatment, and depth
5	nine.dat	14k	Mean soil water content and potential for the 0- to 35-cm depth increment (1993–2000), by date, treatment and slope position
6	tdr.dat	2.1M	Gridded soil water content
7	rocks.dat	12k	Coarse fraction for the 0- to 30- and 30- to 60-cm portions of the soil profile
8	littert.dat	824k	Litter layer temperature
9	st9398.dat	1.9M	Soil temperature for 1993–1998
10	st9900.dat	1.9M	Soil temperature for 1999–2000
11	mweather.dat	7k	Monthly weather data
12	dweather.dat	265k	Daily weather data
13	hw9399.dat	4.6M	Hourly weather data for 1993–1999
14	hw00.dat	678k	Hourly weather data for 2000
15	comptree.dat	68k	Species composition: Trees (>10-cm dbh)
16	compsap.dat	27k	Species composition: Saplings (<10-cm dbh and >1 m tall)
17	atree.dat	53k	Mature tree annual growth
18	asapling.dat	88k	Sapling annual growth
19	rellai.dat	37k	Seasonal patterns of relative leaf area index

8. DESCRIPTION OF THE DOCUMENTATION FILE

ndp078a.txt (File 1)

This file is identical to this document.

9. DESCRIPTION, FORMAT, AND PARTIAL LISTINGS OF THE ASCII DATA FILES

Table 3 describes the format and contents of the ASCII data file **sw.dat (File 4)** distributed with this numeric data package.

Table 3. Contents and format of sw.dat (File 4)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
DATE	Character	18	1	18	n/a	Measurement date (month, day, year)
RDOY	Integer	5	19	23	d	Running day of the year (days since January 1, 1993)
DOY	Integer	4	24	27	d	Day of the year (1 = 1 January, 365 or 366 = 31 December)
W35WC	Real	5	28	32	% v/v	Mean 'wet' plot water content of the 0- to 35-cm depth increment
A35WC	Real	5	33	37	% v/v	Mean 'ambient' plot water content of the 0- to 35-cm depth increment
D35WC	Real	5	38	42	% v/v	Mean 'dry' plot water content of the 0- to 35-cm depth increment
W35WP	Real	6	43	48	MPa	Mean 'wet' plot water potential of the 0- to 35-cm depth increment
A35WP	Real	6	49	54	MPa	Mean 'ambient' plot water potential of the 0- to 35-cm depth increment

18

Table 3 (continued)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
D35WP	Real	6	55	60	MPa	Mean 'dry' plot water potential of the 0- to 35-cm depth increment
W70WC	Real	5	61	65	% v/v	Mean 'wet' plot water content of the 0- to 70-cm depth increment
A70WC	Real	5	66	70	% v/v	Mean 'ambient' plot water content of the 0- to 70-cm depth increment
D70WC	Real	5	71	75	% v/v	Mean 'dry' plot water content of the 0- to 70-cm depth increment
W3570WC	Real	5	76	80	% v/v	Mean 'wet' plot water content of the 35- to 70-cm depth increment
A3570WC	Real	5	81	85	% v/v	Mean 'ambient' plot water content of the 35- to 70-cm depth increment
D3570WC	Real	5	86	90	% v/v	Mean 'dry' plot water content of the 35- to 70-cm depth increment
W3570WP	Real	6	91	96	MPa	Mean 'wet' plot water potential of the 35- to 70-cm depth increment
A3570WP	Real	6	97	102	MPa	Mean 'ambient' plot water potential of the 35- to 70-cm depth increment

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
D3570WP	Real	6	103	108	MPa	Mean 'dry' plot water potential of the 35- to 70-cm depth increment

The missing-value indicators in this file are -9.9 for variables A35WC, D35WC, W70WC, A70WC, D70WC, W3570WC, A3570WC, and D3570WC; and -9.99 for variables A35WP, D35WP, W3570WP, A3570WP, and D3570WP.

First two data records:

```
  January 14, 1993   14  14 25.5 25.4 24.8 -0.04 -0.04 -0.04 26.2 26.6 26.5
27.7 28.6 29.0 -0.02 -0.02 -0.02
 February 24, 1993   55  55 26.6 25.6 25.1 -0.03 -0.04 -0.04 26.0 25.8 26.4
26.3 26.8 28.5 -0.03 -0.03 -0.02
```

Last two data records:

```
  November 1, 2000 2862 306  6.6 -9.9  5.6 -1.83 -9.99 -2.77 -9.9 -9.9 -9.9
-9.9 -9.9 -9.9 -9.99 -9.99 -9.99
 December 15, 2000 2906 350 23.0 23.4 22.4 -0.05 -0.05 -0.06 23.8 22.4 21.9
24.6 21.4 21.4 -0.04 -0.06 -0.06
```

Table 4 describes the format and contents of the ASCII data file **nine.dat (File 5)** distributed with this numeric data package.

Table 4. Contents and format of nine.dat (File 5)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
YEAR	Integer	5	1	5	y	Year
DOY	Integer	4	6	9	d	Day of the year (1 = 1 January, 365 or 366 = 31 December)
RDOY	Integer	5	10	14	d	Running day of the year (days since January 1, 1993)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
WBWC	Real	5	15	19	% v/v	Mean water content of the 0- to 35-cm depth increment of the bottom wet plot location
WMWC	Real	5	20	24	% v/v	Mean water content of the 0- to 35-cm depth increment of the middle wet plot location

Table 4 (continued)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
WUWC	Real	5	25	29	% v/v	Mean water content of the 0- to 35-cm depth increment of the upper wet plot location
ABWC	Real	5	30	34	% v/v	Mean water content of the 0- to 35-cm depth increment of the bottom ambient plot location
AMWC	Real	5	35	39	% v/v	Mean water content of the 0- to 35-cm depth increment of the middle ambient plot location
AUWC	Real	5	40	44	% v/v	Mean water content of the 0- to 35-cm depth increment of the upper ambient plot location
DBWC	Real	5	45	49	% v/v	Mean water content of the 0- to 35-cm depth increment of the bottom dry plot location
DMWC	Real	5	50	54	% v/v	Mean water content of the 0- to 35-cm depth increment of the middle dry plot location

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
DUWC	Real	5	55	59	% v/v	Mean water content of the 0- to 35-cm depth increment of the upper dry plot location
WBWP	Real	7	60	66	MPa	Mean water potential of the 0- to 35-cm depth increment of the bottom wet plot location

Table 4 (continued)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
WMWP	Real	7	67	73	MPa	Mean water potential of the 0- to 35-cm depth increment of the middle wet plot location
WUWP	Real	7	74	80	MPa	Mean water potential of the 0- to 35-cm depth increment of the upper wet plot location
ABWP	Real	7	81	87	MPa	Mean water potential of the 0- to 35-cm depth increment of the bottom ambient plot location
AMWP	Real	7	88	94	MPa	Mean water potential of the 0- to 35-cm depth increment of the middle ambient plot location
AUWP	Real	7	95	101	MPa	Mean water potential of the 0- to 35-cm depth increment of the upper ambient plot location
DBWP	Real	7	102	108	MPa	Mean water potential of the 0- to 35-cm depth increment of the bottom dry plot location
DMWP	Real	7	109	115	MPa	Mean water potential of the 0- to 35-cm depth increment of the middle dry plot location
DUWP	Real	7	116	122	MPa	Mean water potential of the 0- to 35-cm depth increment of the upper dry plot location

The missing-value indicators in this file are -9.9 for variables WBWC, WMWC, WUWC, ABWC, AMWC, AUWC, DBWC, DMWC, and DUWC; and -9.999 for variables WBWP, WMWP, WUWP, ABWP, AMWP, AUWP, DBWP, DMWP, and DUWP.

First two data records:

```
 1993  14    14 26.5 25.9 24.4 26.2 24.6 25.4 24.2 25.5 24.7 -0.037 -0.039
-0.043 -0.037 -0.045 -0.036 -0.044 -0.038 -0.039
 1993  55    55 27.1 26.7 26.5 26.7 24.5 25.4 24.9 25.6 25.1 -0.035 -0.035
-0.033 -0.035 -0.045 -0.036 -0.040 -0.037 -0.037
```

Last two data records:

```
 2000 306 2862  8.1 -9.9  5.0 -9.9 -9.9 -9.9  6.2 -9.9  4.9 -1.162 -9.999
-3.641 -9.999 -9.999 -9.999 -2.104 -9.999 -3.632
 2000 350 2906 24.7 22.1 22.3 24.3 23.1 22.9 20.6 22.0 19.9 -0.046 -0.063
-0.058 -0.047 -0.054 -0.050 -0.073 -0.060 -0.077
```

Table 5 describes the format and contents of the ASCII data file **tdr.dat (File 6)** distributed with this numeric data package.

Table 5. Contents and format of tdr.dat (File 6)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
YEAR	Integer	5	1	5	y	Year
DOY	Integer	4	6	9	d	Day of the year (1 = 1 January, 365 or 366 = 31 December)
DEPTH	Integer	3	10	12	cm	Depth interval (35 = 0–35 cm, 70 = 0–70 cm)
TREAT	Character	2	13	14	n/a	Treatment (W = wet, A = ambient, D = dry)
SLOPE	Character	2	15	16	n/a	Slope position (U = upper, M = middle, B = bottom)
Y	Integer	3	17	19	arbitrary units	Y coordinate position up/down the slope
X	Integer	3	20	22	arbitrary units	X coordinate position across the slope
YM	Integer	3	23	25	m	Y coordinate position up/down the slope
XM	Integer	4	26	29	m	X coordinate position across the slope
SWC	Real	5	30	34	% v/v	Soil water content

The missing-value indicator in this file is -9.9 for variable SWC.

First two data records:

```
 1993  14 35W B   1  1  0   0 17.8
 1993  14 35W B   1  2  0   8 26.6
```

Last two data records:

```
 2000 350 70D U  10 30 72 232 22.0
 2000 350 70D U  10 31 72 240 22.7
```

Table 6 describes the format and contents of the ASCII data file **rocks.dat (File 7)** distributed with this numeric data package.

Table 6. Contents and format of rocks.dat (File 7)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
TREAT	Character	2	1	2	n/a	Treatment (W = wet, A = ambient, D = dry)
SLOPE	Character	2	3	4	n/a	Slope position (U = upper, M = middle, B = bottom)
Y	Integer	3	5	7	arbitrary units	Y coordinate position up/down the slope
X	Integer	3	8	10	arbitrary units	X coordinate position across the slope
CFMASS30	Integer	5	11	15	g	Mass of rocks (mostly chert) at depth of 0–30 cm
CFVOL30	Real	6	16	21	cm^3	Volume of the rocks at depth of 0–30 cm
CFPCT30	Real	5	22	26	% v/v	Percent coarse fraction by volume at depth of 0–30 cm
CFMASS60	Integer	5	27	31	g	Mass of rocks (mostly chert) at depth of 30–60 cm
CFVOL60	Real	6	32	37	cm^3	Volume of the rocks at depth of 30–60 cm
CFPCT60	Real	5	38	42	% v/v	Percent coarse fraction by volume at depth of 30–60 cm

The missing-value indicators in this file are -999 for variables CFMASS30 and CFMASS60, -99.9 for variables CFVOL30 and CFVOL60, and -9.9 for variables CFPCT30 and CFPCT60.

First two data records:

```
W B   2  1 -999 -99.9 -9.9 -999 -99.9 -9.9
W B   2  2  475 206.5  8.5  697 303.0 12.5
```

Last two data records:

```
D U  10 30  651 283.0 11.6  734 319.1 13.1
D U  10 31 -999 -99.9 -9.9 -999 -99.9 -9.9
```

Table 7 describes the format and contents of the ASCII data file **littert.dat (File 8)** distributed with this numeric data package.

Table 7. Contents and format of littert.dat (File 8)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
YEAR	Integer	5	1	5	y	Year
DOY	Integer	4	6	9	month	Day of the year (1 = 1 January, 365 or 366 = 31 December)
DFOY	Real	7	10	16	d	Day fraction of the year
TREAT	Character	2	17	18	n/a	Treatment (W = wet, A = ambient, D = dry)
LITTERT	Real	6	19	24	deg C	Litter temperature

The missing-value indicator in this file is -9.9 for variable LITTERT.

First two data records:

```
 1997  21  21.66 A  12.2
 1997  21  21.70 A   9.9
```

Last two data records:

```
 2000 349 349.50 D   6.9
 2000 349 349.54 D   7.4
```

Table 8 describes the format and contents of the ASCII data file **st9398.dat (File 9)** distributed with this numeric data package.

Table 8. Contents and format of st9398.dat (File 9)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
YEAR	Integer	5	1	5	y	Year
MOY	Integer	3	6	8	month	Month of the year (1 = January, ..., 12 = December)
DOY	Integer	4	9	12	d	Day of the year (1 = 1 January, 365 or 366 = 31 December)
DFOY	Real	7	13	19	d	Day fraction of the year
HOY	Integer	5	20	24	h	Hour of the year
ST10	Real	6	25	30	deg C	Soil temperature at depth = 10 cm
ST35	Real	6	31	36	deg C	Soil temperature at depth = 35 cm

The missing-value indicators in this file are -99.9 for variables ST10 and ST35.

First two data records:

```
1993  1   1   1.00    1   7.0   7.0
1993  1   1   1.04    2   7.0   7.0
```

Last two data records:

```
1998 12 366 366.92 8783 -99.9 -99.9
1998 12 366 366.96 8784 -99.9 -99.9
```

Table 9 describes the format and contents of the ASCII data file **st9900.dat (File 10)** distributed with this numeric data package.

Table 9. Contents and format of st9900.dat (File 10)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
YEAR	Integer	5	1	5	y	Year
MOY	Integer	3	6	8	month	Month of the year (1 = January, ..., 12 = December)
DOY	Integer	4	9	12	d	Day of the year (1 = 1 January, 365 or 366 = 31 December)
DFOY	Real	7	13	19	d	Day fraction of the year
HOY	Integer	5	20	24	h	Hour of the year
ST10	Real	8	25	32	deg C	Soil temperature at depth = 10 cm
ST27	Real	8	33	40	deg C	Soil temperature at depth = 27 cm
STW6	Real	6	41	46	deg C	Soil temperature for wet plot, depth = 6 cm
STW31	Real	6	47	52	deg C	Soil temperature for wet plot, depth = 31 cm
STW55	Real	6	53	58	deg C	Soil temperature for wet plot, depth = 55 cm
STW72	Real	6	59	64	deg C	Soil temperature for wet plot, depth = 72 cm
STA7	Real	6	65	70	deg C	Soil temperature for ambient plot, depth = 7 cm
STA32	Real	6	71	76	deg C	Soil temperature for ambient plot, depth = 32 cm
STA59	Real	6	77	82	deg C	Soil temperature for ambient plot, depth = 59 cm
STA100	Real	6	83	88	deg C	Soil temperature for ambient plot, depth = 100 cm
STD9	Real	6	89	94	deg C	Soil temperature for dry plot, depth = 9 cm
STD30	Real	6	95	100	deg C	Soil temperature for dry plot, depth = 30 cm
STD45	Real	6	101	106	deg C	Soil temperature for dry plot, depth = 45 cm
STD63	Real	6	107	112	deg C	Soil temperature for dry plot, depth = 63 cm

The missing-value indicators in this file are -9.999 for variables ST10 and ST27, and -9.99 for variables STW6, STW31, STW55, STW72, STA7, STA32, STA59, STA100, STD9, STD30, STD45, and STD63.

First two data records:

```
 1999  1   1   1.00    1  6.1571  7.4550 -9.99 -9.99 -9.99 -9.99 -9.99 -9.99 -
9.99 -9.99 -9.99 -9.99 -9.99 -9.99
 1999  1   1   1.04    2  6.0109  7.3718 -9.99 -9.99 -9.99 -9.99 -9.99 -9.99 -
9.99 -9.99 -9.99 -9.99 -9.99 -9.99
```

Last two data records:

```
 2000 12 366 366.92 8783 -9.9999 -9.9999  3.10  5.50  6.90  7.40  4.20  7.00
8.20  9.70  3.90  5.80  6.80  7.60
 2000 12 366 366.96 8784 -9.9999 -9.9999  3.00  5.50  6.90  7.40  4.10  7.00
8.20  9.70  3.80  5.80  6.80  7.60
```

Table 10 describes the format and contents of the ASCII data file **mweather.dat (File 11)** distributed with this numeric data package.

Table 10. Contents and format of mweather.dat (File 11)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
YEAR	Integer	5	1	5	y	Year
MONTH	Integer	3	6	8	month	Month (1 = January, ..., 12 = December)
QUAN	Integer	5	9	13	mol m^{-2}	Integrated incident photosynthetically active radiation (PAR)
PYRAN	Integer	4	14	17	MW m^{-2}	Integrated incident total radiation
RAIN	Integer	4	18	21	mm	Monthly total rain (sum of hourly values)
ATMIN	Real	6	22	27	deg C	Monthly 1-h minimum air temperature
ATMEAN	Real	5	28	32	deg C	Monthly 1-h mean air temperature
ATMAX	Real	5	33	37	deg C	Monthly 1-h maximum air temperature
RHMIN	Real	5	38	42	%	Monthly 1-h minimum relative humidity
RHMEAN	Real	5	43	47	%	Monthly 1-h mean relative humidity
RHMAX	Real	6	48	53	%	Monthly 1-h maximum relative humidity
STMIN	Real	5	54	58	deg C	Monthly 1-h minimum soil temperature (15-cm depth)
STMEAN	Real	5	59	63	deg C	Monthly 1-h mean soil temperature (15-cm depth)
STMAX	Real	5	64	68	deg C	Monthly 1-h maximum soil temperature (15-cm depth)
WIND	Real	6	69	74	m/s	Mean daily wind speed

The missing-value indicator in this file is -9.99 for variable WIND.

First two data records:

```
1993  1  384 186 101  -3.3  5.5 16.5 21.5 76.8 101.5  5.0  6.1  7.5 -9.99
1993  2  488 241  50 -11.7  3.8 20.0 16.5 67.9 101.6  6.0  7.8  9.5 -9.99
```

Last two data records:

```
2000 11  439 232 104  -6.5  8.0 25.1 15.0 68.4 100.0  6.7 12.2 17.8  1.40
2000 12  376 189  75 -12.4 -0.5 11.5 31.7 71.2  99.8  3.2  6.7 10.0  1.60
```

Table 11 describes the format and contents of the ASCII data file **dweather.dat (File 12)** distributed with this numeric data package.

Table 11. Contents and format of dweather.dat (File 12)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
YEAR	Integer	5	1	5	y	Year
DOY	Integer	4	6	9	d	Day of the year (1 = 1 January, ..., 365 or 366 = 31 December)
QUAN	Real	6	10	15	mol m^{-2}	Integrated incident photosynthetically active radiation (PAR)
PYRAN	Real	6	16	21	MW m^{-2}	Integrated incident total radiation
RADMEAN	Real	10	22	31	W m^{-2}	Mean daily radiation
RAIN	Integer	6	32	37	mm	Monthly total rain (sum of hourly values)
ATMIN	Real	6	38	43	deg C	Monthly 1-h minimum air temperature
ATMEAN	Real	6	44	49	deg C	Monthly 1-h mean air temperature
ATMAX	Real	5	50	54	deg C	Monthly 1-h maximum air temperature
RHMIN	Real	6	55	60	%	Monthly 1-h minimum relative humidity

Table 11 (continued)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
RHMEAN	Real	6	61	66	%	Monthly 1-h mean relative humidity
RHMAX	Real	6	67	72	%	Monthly 1-h maximum relative humidity
STMIN	Real	5	73	77	deg C	Monthly 1-h minimum soil temperature (15-cm depth)
STMEAN	Real	5	78	82	deg C	Monthly 1-h mean soil temperature (15-cm depth)
STMAX	Real	5	83	87	deg C	Monthly 1-h maximum soil temperature (15-cm depth)
WIND	Real	5	88	92	m/s	Mean hourly wind speed

The missing-value indicator in this file is -9.9 for variable WIND.

First two data records:

```
 1993   1  8.04   3.61    66.8359   1.0   1.6    4.8   9.7   65.2   74.9   84.3   6.9
6.9  7.0 -9.9
 1993   2  8.04   3.61    66.8359   0.0   1.6    4.9   9.7   65.2   75.0   84.3   6.7
6.8  6.9 -9.9
```

Last two data records:

```
 2000 365  8.90   4.70    57.0000   0.0 -10.5   -8.2 -6.3   63.0   71.1   83.3   3.7
4.0  4.7  2.1
 2000 366 14.30   7.60    85.0000   0.0  -8.7   -6.3 -3.3   57.3   72.6   85.4   3.2
3.6  3.9  1.4
```

Table 12 describes the format and contents of the ASCII data files **hw9399.dat (File 13)** and **hw00.dat (File 14)** distributed with this numeric data package.

Table 12. Contents and format of hw9399.dat (File 13) and hw00.dat (File 14)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
YEAR	Integer	5	1	5	y	Year
MOY	Integer	3	6	8	month	Month of the year (1 = January, ..., 12 = December)
DOY	Integer	4	9	12	d	Day of the year (1 = 1 January, ..., 365 or 366 = 31 December)
DFOY	Real	7	13	19	d	Day fraction of the year
HOY	Integer	5	20	24	h	Hour of the year
QUAN	Integer	5	25	29	$\mu mol\ m^{-2}\ s^{-1}$	Mean incident photosynthetically active radiation (PAR)
PYRAN	Integer	5	30	34	$W\ m^{-2}$	Mean incident hourly radiation
UQUAN	Integer	5	35	39	$\mu mol\ m^{-2}\ s^{-1}$	Mean hourly understory (1.5 m above ground level) PAR
AT	Real	6	40	45	deg C	Hourly mean air temperature
RH	Real	6	46	51	%	Hourly mean relative humidity
RAIN	Real	5	52	56	mm	Hourly rainfall
WIND	Real	5	57	61	m/s	Mean hourly wind speed
ST	Real	5	62	66	deg C	Mean 1-h soil temperature (10- to 15-cm depth)
VPD	Real	7	67	73	kPa	Mean vapor pressure deficit

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
SWISIS	Integer	5	74	78	W m^{-2}	Mean incident shortwave radiation

The missing-value indicators in file **hw9399.dat** are -99 for variables QUAN, UQUAN, and SWISIS; -9.9 for variables WIND and ST; -99.9 for variable AT; and -9.999 for variable VPD.

First two data records in file **hw9399.dat**:

```
 1993  1   1   1.00    0    0    0  -99   2.6  71.2  0.0 -9.9  7.0  0.213  -99
 1993  1   1   1.04    1    0    0  -99   2.4  71.8  0.0  2.6  7.0  0.206  -99
```

Last two data records in file **hw9399.dat**:

```
 1999 12 365 365.96 8759    0    0    0  11.2  65.9  0.0  2.5  9.7  0.454    0
 1999 12 365 366.00 8760    0    0    0  11.4  64.6  0.0  2.5  9.8  0.454    0
```

There are no missing values in file **hw00.dat**.

First two data records in file **hw00.dat**:

```
 2000  1   1   1.04    1    0    0    0  11.1  66.1  0.0  2.3  9.4  0.449    0
 2000  1   1   1.08    2    0    0    0  10.4  69.0  0.0  2.1  9.3  0.392    0
```

Last two data records in file **hw00.dat**:

```
 2000 12 366 366.96 8783    0    0    0  -5.6  70.3  0.0  1.6  3.6  0.120    0
 2000 12 366 367.00 8784    0    0    0  -5.9  73.8  0.0  1.7  3.6  0.104    0
```

Table 13 describes the format and contents of the ASCII data file **comptree.dat (File 15)** distributed with this numeric data package.

Table 13. Contents and format of comptree.dat (File 15)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
ID	Real	7	1	7	n/a	Arbitrary individual tree identification number
SPC	Character	8	8	15	n/a	Species code (see listing of codes and species names in Appendix C)
TREAT	Character	2	16	17	n/a	Treatment (W = wet, A = ambient, D = dry)
SLOPE	Character	2	18	19	n/a	Slope position (U = upper, M = middle, B = bottom)
Y	Integer	3	20	22	arbitrary units	Y coordinate position up/down the slope
X	Integer	3	23	25	arbitrary units	X coordinate position across the slope
YM	Real	5	26	30	m	Y coordinate position up/down the slope
XM	Real	6	31	36	m	X coordinate position across the slope
D010693	Real	6	37	42	cm	Diameter at height = 1.3 m on 1 June 1993
D010694	Real	6	43	48	cm	Diameter at height = 1.3 m on 1 June 1994
D011294	Real	6	49	54	cm	Diameter at height = 1.3 m on 1 December 1994

Table 13 (continued)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
D010695	Real	6	55	60	cm	Diameter at height = 1.3 m on 1 June 1995
D010796	Real	6	61	66	cm	Diameter at height = 1.3 m on 1 July 1996
D010797	Real	6	67	72	cm	Diameter at height = 1.3 m on 1 July 1997
D010998	Real	6	73	78	cm	Diameter at height = 1.3 m on 1 September 1998
D011299	Real	6	79	84	cm	Diameter at height = 1.3 m on 1 December 1999
D290101	Real	6	85	90	cm	Diameter at height = 1.3 m on 29 January 2001

Trees that died during the experiment are represented as missing in the years after death occurred. Trees that reached (or approached) the 10 cm dbh cutoff during the experiment are represented as missing until the year they attained tree status.

The missing-value indicator in this file is -99.9 for variables D010693, D010694, D011294, D010695, D010796, D010797, D010998, D011299, and D290101.

First two data records:

```
   30.0AR      W U  8  2 61.6  11.9 -99.9 -99.9   9.9   9.9  10.9  11.4  12.1
12.7  13.5
   32.0AR      A B  2 16 15.1 122.5 -99.9 -99.9  10.4  10.4  11.5  12.3  12.9
13.1  13.7
```

Last two data records:

```
 6019.0CF      D B  1 24  2.5 189.6 -99.9 -99.9 -99.9 -99.9   9.8  10.1  11.3
10.3  10.4
 6020.0OA      D B  1 23  0.8 182.4 -99.9 -99.9 -99.9 -99.9  12.1  12.2  12.5
12.8  12.9
```

Table 14 describes the format and contents of the ASCII data file **compsap.dat (File 16)** distributed with this numeric data package.

Table 14. Contents and format of compsap.dat (File 16)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
ORDER	Real	6	1	6	n/a	Arbitrary individual tree identifier
SPC	Character	9	7	15	n/a	Species code (see listing of codes and species names in Appendix C)
TREAT	Character	2	16	17	n/a	Treatment (W = wet, A = ambient,D = dry)
SLOPE	Character	2	18	19	n/a	Slope position (U = upper, M = middle, B = bottom)
Y	Integer	2	20	21	arbitrary units	Y coordinate position up/down the slope
X	Integer	3	22	24	arbitrary units	X coordinate position across the slope
PLOTID	Integer	3	25	27	n/a	Number of the sapling within an individual plot
D1996	Real	6	28	33	cm	Diameter at height = 1.3 m in year 1996
D1997	Real	6	34	39	cm	Diameter at height = 1.3 m in year 1997
D1998	Real	6	40	45	cm	Diameter at height = 1.3 m in year 1998
D1999	Real	6	46	51	cm	Diameter at height = 1.3 m in year 1999

The missing-value indicators in this file are -9.99 for variables D1996, D1997, D1998, and D1999.

First two data records:

```
   1.0AR        W U  9  2  1  2.12  2.32 -9.99 -9.99
   2.0AR        W U  9  2  2  2.96  2.95 -9.99 -9.99
```

Last two data records:

```
 597.0QV        D B  3 27 13  4.17  4.18  4.40  4.44
 598.0Carya     D B  3 27 14  1.52  1.50  1.60  1.61
```

Table 15 describes the format and contents of the ASCII data file **atree.dat (File 17)** distributed with this numeric data package.

Table 15. Contents and format of atree.dat (File 17)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
YEAR	Integer	5	1	5	y	Year
ID	Integer	5	6	10	n/a	Arbitrary individual tree identification number
SPC	Character	3	11	13	n/a	Species code (see listing of codes and species names in Appendix C)
TREAT	Character	2	14	15	n/a	Treatment (W = wet, A = ambient, D = dry)
SLOPE	Character	2	16	17	n/a	Slope position (U = upper, M = middle, B = bottom)
Y	Integer	3	18	20	arbitrary units	Y coordinate position up/down the slope
X	Integer	3	21	23	arbitrary units	X coordinate position across the slope
GROWTH	Integer	6	24	29	mm^2/y	Basal area growth rate

The missing-value indicator in this file is -9999 for variable GROWTH.

First two data records:

```
1993    51AR A M   5 12  2673
1993    52AR A M   5 12  2462
```

Last two data records:

```
2000 2992QA A M   6 13  1576
2000 2996QP W M   5  9  2157
```

Table 16 describes the format and contents of the ASCII data file **asapling.dat (File 18)** distributed with this numeric data package.

Table 16. Contents and format of asapling.dat (File 18)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
YEAR	Integer	4	1	4	y	Year
ID	Character	8	5	12	n/a	Arbitrary individual tree identification number
SPC	Character	3	13	15	n/a	Species code (see listing of codes and species names in Appendix C)
TREAT	Character	2	16	17	n/a	Treatment (W = wet, A = ambient, D = dry)
SLOPE	Character	2	18	19	n/a	Slope position (U = upper, M = middle, B = bottom)
Y	Integer	3	20	22	arbitrary units	Y coordinate position up/down the slope
X	Integer	3	23	25	arbitrary units	X coordinate position across the slope
GROWTH	Real	7	26	32	mm^2/y	Basal area growth rate

The missing-value indicator in this file is -9.999 for variable GROWTH.

First two data records:

```
1994 3001   AR W U  10  1  0.122
1994 3002   AR A U  10 11  0.090
```

Last two data records:

```
2000 4027a  CF A M   6 14 -9.999
2000 5015a  CF W B   3  8 -9.999
```

Table 17 describes the format and contents of the ASCII data file **rellai.dat (File 19)** distributed with this numeric data package.

Table 17. Contents and format of rellai.dat (File 19)

Variable	Variable type	Variable width	Starting column	Ending column	Units	Definition and comments
YEAR	Integer	5	1	5	y	Year
DOY	Integer	4	6	9	d	Day of the year (1 = 1 January, ..., 365 = 31 December)
RELLAI	Real	6	10	15	n/a	Fractional LAI (leaf area index)

The missing-value indicator in this file is -9.99 for variable RELLAI.

First two data records:

```
1992  85 -9.99
1992  86 -9.99
```

Last two data records:

```
2000 349 -9.99
2000 350 -9.99
```

10. SAS® AND FORTRAN CODES TO ACCESS THE DATA

The following is SAS® code to read file **sw.dat**:

```
/*** retrieval routine to read sw.dat ***/

data sw ;

infile '/home/cdp/ndp078a/sw.dat' ;
input DATE $ 1-18 RDOY 19-23 DOY 24-27 W35WC 28-32 A35WC 33-37 D35WC 38-42
      W35WP 43-48 A35WP 49-54 D35WP 55-60 W70WC 61-65 A70WC 66-70 D70WC 71-75
      W3570WC 76-80 A3570WC 81-85 D3570WC 86-90 W3570WP 91-96 A3570WP 97-102
      D3570WP 103-108 ;

run ;
```

The following is Fortran code to read file **sw.dat**:

```
C *** Fortran program to read the NDP-078a file "sw.dat"
C
      INTEGER RDOY, DOY
      REAL W35WC, A35WC, D35WC, W35WP, A35WP, D35WP, W70WC,
     +     A70WC, D70WC, W3570WC, A3570WC, D3570WC, W3570WP,
     +     A3570WP, D3570WP
      CHARACTER DATE*18
C
      OPEN (UNIT=1, FILE='sw.dat')
C
   10 READ (1,100,END=99) DATE, RDOY, DOY, W35WC, A35WC, D35WC,
     + W35WP, A35WP, D35WP, W70WD, A70WC, D70WC, W3570WC, A3570WC,
     + D3570WC, W3570WP, A3570WP, D3570WP
  100 FORMAT (A18,I5,I4,3F5.1,3F6.2,6F5.1,3F6.2)
C
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```

The following is SAS® code to read file **nine.dat**:

```
/*** retrieval routine to read nine.dat ***/

data nine ;

infile '/home/cdp/ndp078a/nine.dat' ;
input YEAR 1-5 DOY 6-9 RDOY 10-14 WBWC 15-19 WMWC 20-24 WUWC 25-29
      ABWC 30-34 AMWC 35-39 AUWC 40-44 DBWC 45-49 DMWC 50-54 DUWC 55-59
      WBWP 60-66 WMWP 67-73 WUWP 74-80 ABWP 81-87 AMWP 88-94
      AUWP 95-101 DBWP 102-108 DMWP 109-115 DUWP 116-122 ;

run ;
```

The following is Fortran code to read file **nine.dat**:

```
C *** Fortran program to read the NDP-078a file "nine.dat"
C
      INTEGER YEAR, DOY, RDOY
      REAL WBWC, WMWC, WUWC, ABWC, AUWC, DBWC, DMWC, DUWC,
     +     WBWP, WMWP, WUWP, ABWP, AMWP, AUWP, DBWP, EMWP,
     +     DUWP
C
      OPEN (UNIT=1, FILE='nine.dat')
C
   10 READ (1,100,END=99) YEAR, DOY, RDOY, WBWC, WMWC, WUWC,
     + ABWC, AMWC, AUWC, DBWC, DMWC, DUWC, WBWP, WMWP, WUWP,
     + ABWP, AMWP, AUWP, DBWP, DMWP, DUWP
  100 FORMAT (I5,I4,I5,9F5.1,9F7.3)
C
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```

The following is SAS® code to read file **tdr.dat**:

```
/*** retrieval routine to read tdr.dat ***/

data tdr ;

infile '/home/cdp/ndp078a/tdr.dat' ;
input YEAR 1-5 DOY 6-9 DEPTH 10-12 TREAT $ 13-14 SLOPE $ 15-16 Y 17-19
      X 20-22 YM 23-25 XM 26-29 SWC 30-34 ;

run ;
```

The following is Fortran code to read file **tdr.dat**:

```
C *** Fortran program to read the NDP-078a file "tdr.dat"
C
      INTEGER YEAR, DOY, DEPTH, Y, X, YM, XM
      REAL SWC
      CHARACTER TREAT*2, SLOPE*2
C
      OPEN (UNIT=1, FILE='tdr.test')
C
   10 READ (1,100,END=99) YEAR, DOY, DEPTH, TREAT, SLOPE,
     + Y, X, YM, XM, SWC
  100 FORMAT (I5,I4,I3,2A2,3I3,I4,F5.1)
C
```

```
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```

The following is SAS® code to read file **rocks.dat**:

```
/*** retrieval routine to read rocks.dat ***/

data rocks ;

infile '/home/cdp/ndp078a/rocks.dat' ;
input TREAT $ 1-2 SLOPE $ 3-4 Y 5-7 X 8-10
      CFMASS30 11-15 CFVOL30 16-21 CFPCT30 22-26
      CFMASS60 27-31 CFVOL60 32-37 CFPCT60 38-42 ;

run ;
```

The following is Fortran code to read file **rocks.dat**:

```
C *** Fortran program to read the NDP-078a file "rocks.dat"
C
      INTEGER Y, X, CFMASS30, CFMASS60
      REAL CFVOL30, CFPCT30, CFVOL60, CFPCT60
      CHARACTER TREAT*2, SLOPE*2
C
      OPEN (UNIT=1, FILE='rocks.dat')
C
   10 READ (1,100,END=99) TREAT, SLOPE, Y, X, CFMASS30,
     + CFVOL30, CFPCT30, CFMASS60, CFVOL60, CFPCT60
  100 FORMAT (2A2,2I3,2(I5,F6.1,F5.1))
C
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```

The following is SAS® code to read file **littert.dat**:

```
/*** retrieval routine to read littert.dat ***/

data littert ;

infile '/home/cdp/ndp078a/littert.dat' ;
input YEAR 1-5 DOY 6-9 DFOY 10-16 TREAT $ 17-18 LITTERT 19-24  ;
```

```
run ;
```

The following is Fortran code to read file **littert.dat**:

```
C *** Fortran program to read the NDP-078a file "littert.dat"
C
      INTEGER YEAR, DOY
      REAL DFOY
      CHARACTER TREAT*2
C
      OPEN (UNIT=1, FILE='littert.dat')
C
   10 READ (1,100,END=99) YEAR, DOY, DFOY, TREAT, LITTERT
  100 FORMAT (I5,I4,F7.2,A2,F6.1)
C
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```

The following is SAS® code to read file **st9398.dat**:

```
*** retrieval routine to read st9398.dat ***/

data st9398 ;

infile '/home/cdp/ndp078a/st9398.dat' ;
input YEAR 1-5 MOY 6-8 DOY 9-12 DFOY 13-19 HOY 20-24
      ST10 25-30 ST35 31-36  ;

run ;
```

The following is Fortran code to read file **st9398.dat**:

```
C *** Fortran program to read the NDP-078a file "st9398.dat"
C
      INTEGER YEAR, MOY, DOY, HOY
      REAL DFOY, ST10, ST35
C
      OPEN (UNIT=1, FILE='st9398.dat')
C
   10 READ (1,100,END=99) YEAR, MOY, DOY, DFOY, HOY, ST10, ST35
  100 FORMAT (I5,I3,I4,F7.2,I5,2F6.1)
C
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```

The following is SAS® code to read file **st9900.dat**:

```
/*** retrieval routine to read st9900.dat ***/

data st9900 ;

infile '/home/cdp/ndp078a/st9900.dat' ;
input YEAR 1-5 MOY 6-8 DOY 9-12 DFOY 13-19 HOY 20-24
      ST10 25-32 ST27 33-40 STW6 41-46 STW31 47-52
      STW55 53-58 STW72 59-64 STA7 65-70 STA32 71-76
      STA59 77-82 STA100 83-88 STD9 89-94 STD30 95-100
      STD45 101-106 STD63 107-112 ;

run ;
```

The following is Fortran code to read file **st9900.dat**:

```
C *** Fortran program to read the NDP-078a file "st9900.dat"
C
      INTEGER YEAR, MOY, DOY, HOY
      REAL DFOY, ST10, ST27, STW6, STW31, STW55, STW72,
     + STA7, STA32, STA59, STA100, STD9, STD30, STD45, STD63
C
      OPEN (UNIT=1, FILE='st9900.dat')
C
   10 READ (1,100,END=99) YEAR, MOY, DOY, DFOY, HOY, ST10, ST27,
     + STW6, STW31, STW55, STW72, STA7, STA32, STA59, STA100,
     + STD9, STD30, STD45, STD63
  100 FORMAT (I5,I3,I4,F7.2,I5,2F8.4,12F6.2)
C
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```

The following is SAS® code to read file **mweather.dat**:

```
/*** retrieval routine to read mweather.dat ***/

data mweather ;

infile '/home/cdp/ndp078a/mweather.dat' ;
input YEAR 1-5 MONTH 6-8 QUAN 9-13 PYRAN 14-17 RAIN 18-21
      ATMIN 22-27 ATMEAN 28-32 ATMAX 33-37 RHMIN 38-42
      RHMEAN 43-47 RHMAX 48-53 STMIN 54-58 STMEAN 59-63
      STMAX 64-68 WIND 69-74;
```

53

```
run ;
```

The following is Fortran code to read file **mweather.dat**:

```
C *** Fortran program to read the NDP-078a file "mweather.dat"
C
      INTEGER YEAR, MONTH, QUAN, PYRAN, RAIN
      REAL ATMIN, ATMEAN, ATMAX, RHMIN, RHMEAN, RHMAX,
     + STMIN, STMEAN, STMAX, WIND
C
      OPEN (UNIT=1, FILE='mweather.dat')
C
   10 READ (1,100,END=99) YEAR, MONTH, QUAN, PYRAN, RAIN,
     + ATMIN, ATMEAN, ATMAX, RHMIN, RHMEAN, RHMAX, STMIN,
     + STMEAN, STMAX, WIND
  100 FORMAT (I5,I3,I5,2I4,F6.1,4F5.1,F6.1,3F5.1,F6.2)
C
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```

The following is SAS® code to read file **dweather.dat**:

```
/*** retrieval routine to read dweather.dat ***/

data dweather ;

infile '/home/cdp/ndp078a/dweather.dat' ;
input YEAR 1-5 DOY 6-9 QUAN 10-15 PYRAN 16-21 RADMEAN 22-31
      RAIN 32-37 ATMIN 38-43 ATMEAN 44-49 ATMAX 50-54 RHMIN 55-60
      RHMEAN 61-66 RHMAX 67-72 STMIN 73-77 STMEAN 78-82
      STMAX 83-87 WIND 88-92 ;

run ;
```

The following is Fortran code to read file **dweather.dat**:

```
C *** Fortran program to read the NDP-078a file "dweather.dat"
C
      INTEGER YEAR, DOY, RAIN
      REAL QUAN, PYRAN, RADMEAN, ATMIN, ATMEAN, ATMAX, RHMIN,
     + RHMEAN, RHMAX, STMIN, STMEAN, STMAX, WIND
C
      OPEN (UNIT=1, FILE='dweather.dat')
C
   10 READ (1,100,END=99) YEAR, DOY, QUAN, PYRAN, RADMEAN,
     + RAIN, ATMIN, ATMEAN, ATMAX, RHMIN, RHMEAN, RHMAX, STMIN,
     + STMEAN, STMAX, WIND
  100 FORMAT (I5,I4,2F6.2,F10.4,3F6.1,F5.1,3F6.1,4F5.1)
C
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```

The following is SAS® code to read file **hw9399.dat**:

```
/*** retrieval routine to read hw9399.dat ***/

data  hw9399 ;

infile '/home/cdp/ndp078a/hw9399.dat' ;
input YEAR 1-5 MOY 6-8 DOY 9-12 DFOY 13-19 HOY 20-24
      QUAN 25-29 PYRAN 30-34 UQUAN 35-39 AT 40-45
      RH 46-51 RAIN 52-56 WIND 57-61 ST 62-66
      VPD 67-73 SWISIS 74-78;

run ;
```

The following is Fortran code to read file **hw9399.dat**:

```
C *** Fortran program to read the NDP-078a file "hw9399.dat"
C
      INTEGER YEAR, MOY, DOY, HOY, QUAN, PYRAN, UQUAN, SWISIS
      REAL DFOY, AT, RH, RAIN, WIND, ST, VPD
C
      OPEN (UNIT=1, FILE='hw9399.dat')
C
   10 READ (1,100,END=99) YEAR, MOY, DOY, DFOY, HOY, QUAN,
     + PYRAN, UQUAN, AT, RH, RAIN, WIND, ST, VPD, SWISIS
  100 FORMAT (I5,I3,I4,F7.2,4I5,2F6.1,3F5.1,F7.3,I5)
C
```

```
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```

The following is SAS® code to read file **hw00.dat**:

```
/*** retrieval routine to read hw00.dat ***/

data  hw00 ;

infile '/home/cdp/ndp078a/hw00.dat' ;
input YEAR 1-5 MOY 6-8 DOY 9-12 DFOY 13-19 HOY 20-24
      QUAN 25-29 PYRAN 30-34 UQUAN 35-39 AT 40-45
      RH 46-51 RAIN 52-56 WIND 57-61 ST 62-66
      VPD 67-73 SWISIS 74-78;

run ;
```

The following is Fortran code to read file **hw00.dat**:

```
C *** Fortran program to read the NDP-078a file "hw00.dat"
C
      INTEGER YEAR, MOY, DOY, HOY, QUAN, PYRAN, UQUAN, SWISIS
      REAL DFOY, AT, RH, RAIN, WIND, ST, VPD
C
      OPEN (UNIT=1, FILE='hw00.dat')
C
   10 READ (1,100,END=99) YEAR, MOY, DOY, DFOY, HOY, QUAN,
     + PYRAN, UQUAN, AT, RH, RAIN, WIND, ST, VPD, SWISIS
  100 FORMAT (I5,I3,I4,F7.2,4I5,2F6.1,3F5.1,F7.3,I5)
C
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```

The following is SAS® code to read file **comptree.dat**:

```
/*** retrieval routine to read comptree.dat ***/

data  comptree ;

infile '/home/cdp/ndp078a/comptree.dat' ;
input ID 1-7 SPC $ 8-15 TREAT $ 16-17 SLOPE $ 18-19 Y 20-22 X 23-25
```

```
        YM 26-30 XM 31-36 D010693 37-42 D010694 43-48 D011294 49-54
        D010695 55-60 D010796 61-66 D010797 67-72 D010998 73-78
        D011299 79-84 D290101 85-90 ;

run ;
```

The following is Fortran code to read file **comptree.dat**:

```
C *** Fortran program to read the NDP-078a file "comptree.dat"
C
      INTEGER Y, X
      REAL ID, YM, XM, D010693, D010694, D011294, D010695,
     + D010796, D010797, D010998, D011299, D290101
      CHARACTER SPC*8, TREAT*2, SLOPE*2
C
      OPEN (UNIT=1, FILE='comptree.dat')
C
   10 READ (1,100,END=99) ID, SPC, TREAT, SLOPE, Y, X, YM,
     + XM, D010693, D010694, D011294, D010695, D010796,
     + D010797, D010998, D011299, D290101
  100 FORMAT (F7.1,A8,2A2,2I3,F5.1,10F6.1)
C
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```

The following is SAS® code to read file **compsap.dat**:

```
/*** retrieval routine to read compsap.dat ***/

data  compsap ;

infile '/home/cdp/ndp078a/compsap.dat' ;
input ORDER 1-6 SPC $ 7-15 TREAT $ 16-17 SLOPE $ 18-19 Y 20-21 X 22-24
      PLOTID 25-27 D1996 28-33 D1997 34-39 D1998 40-45 D1999 46-51 ;

run ;
```

The following is Fortran code to read file **compsap.dat**:

```
C *** Fortran program to read the NDP-078a file "compsap.dat"
C
      INTEGER ORDER, Y, X, PLOTID
      REAL D1996, D1997, D1998, D1999
      CHARACTER SPC*9, TREAT*2, SLOPE*2
C
      OPEN (UNIT=1, FILE='compsap.dat')
C
   10 READ (1,100,END=99) ORDER, SPC, TREAT, SLOPE, Y, X,
     + PLOTID, D1996, D1997, D1998, D1999
  100 FORMAT (F6.1,A9,2A2,I2,2I3,4F6.2)
C
```

```
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```

The following is SAS® code to read file **atree.dat**:

```
/*** retrieval routine to read atree.dat ***/

data  atree ;

infile '/home/cdp/ndp078a/atree.dat' ;
input YEAR 1-5 ID 6-10 SPC $ 11-13 TREAT $ 14-15 SLOPE $ 16-17 Y 18-20 X 21-23
      GROWTH 24-29 ;

run ;
```

The following is Fortran code to read file **atree.dat**:

```
C *** Fortran program to read the NDP-078a file "atree.dat"
C
      INTEGER YEAR, ID, Y, X, GROWTH
      CHARACTER SPC*3, TREAT*2, SLOPE*2
C
      OPEN (UNIT=1, FILE='atree.dat')
C
   10 READ (1,100,END=99) YEAR, ID, SPC, TREAT, SLOPE,
     + Y, X, GROWTH
  100 FORMAT (2I5,A3,2A2,2I3,I6)
C
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```

The following is SAS® code to read file **asapling.dat**:

```
/*** retrieval routine to read asapling.dat ***/

data  asapling ;

infile '/home/cdp/ndp078a/asapling.dat' ;
input YEAR 1-4 ID $5-12 SPC $ 13-15 TREAT $ 16-17 SLOPE $ 18-19 Y 20-22
      X 23-25 GROWTH 26-32 ;
```

```
run ;
```

The following is Fortran code to read file **asapling.dat**:

```fortran
C *** Fortran program to read the NDP-078a file "asapling.dat"
C
      INTEGER YEAR, Y, X
      REAL GROWTH
      CHARACTER ID*7, SPC*3, TREAT*2, SLOPE*2
C
      OPEN (UNIT=1, FILE='asapling.dat')
C
   10 READ (1,100,END=99) YEAR, ID, SPC, TREAT, SLOPE,
     + Y, X, GROWTH
  100 FORMAT (I4,A8,A3,2A2,2I3,F7.3)
C
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```

The following is SAS® code to read file **rellai.dat**:

```sas
/*** retrieval routine to read rellai.dat ***/

data  rellai ;

infile '/home/cdp/ndp078a/rellai.dat' ;
input YEAR 1-5 DOY 6-9 RELLAI 10-15 ;

run ;
```

The following is Fortran code to read file **rellai.dat**:

```fortran
C *** Fortran program to read the NDP-078a file "rellai.dat"
C
      INTEGER YEAR, DOY
      REAL RELLAI
C
      OPEN (UNIT=1, FILE='rellai.dat')
C
   10 READ (1,100,END=99) YEAR, DOY, RELLAI
  100 FORMAT (I5,I4,F6.2)
C
      GO TO 10
   99 CLOSE (UNIT=1)
      STOP
      END
```