THE FLUXNET-CANADA DATA MANAGEMENT PLAN

The Data Management and Policy Working Group

Alan Barr, Charmaine Hrynkiw, Andy Black, Fan Meng, Robert Grant, Josef Cihlar, Wenjun Chen

and

Steve Enns, Natasha Neumann

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1 INTRODUCTION

Fluxnet-Canada will produce, document, and archive its results in an integrated, long-term database that will be an important scientific legacy of the network. The Data Management Plan and Data Policy Document has been developed by the Data Policy and Management Working Group (DP&MWG) to ensure the success of the Fluxnet-Canada network by

- facilitating the sharing of information and data across the network:
- establishing clear protocols for data and metadata preparation and submission, including specifications for formatting and documentation and definition of standard quality assurance procedures,
- defining the structure and function of the Fluxnet-Canada Data Information System,
- establishing a clear Data Policy to ensure the quality, availability, and fairness of use for all network data,
- supporting and stimulating network-wide modeling and synthesis activities.

The Fluxnet-Canada network is committed to the complete and timely sharing of data. The following sections of this document will introduce the structure and mandate of the DP&MWG and Data Manager, details of the data archive system and expectations of submitted data, and the Fluxnet-Canada Data Policy.

2 THE FLUXNET-CANADA DATA POLICY AND MANAGEMENT WORKING GROUP

2.1 Membership

Investigators from each science discipline within Fluxnet-Canada have been chosen to represent their disciplines on the DP&MWG. The initial membership, as of May 2002, is:

Alan Barr, MSC, chair	Flux and Meteorology
Andy Black, UBC	Flux and Meteorology
Tony Trofymow, CFS	Site Characterization, Ecology,
Fan Meng, UNB	Ecology
Robert Grant, U of A	Modeling
Josef Cihlar, CCRS	Remote Sensing
Wenjun Chen, CCRS	Modeling and Remote Sensing
Charmaine Hrynkiw, MSC	Data Manager (Secretary)
Steve Enns, MSC	DIS Implementation

Later in 2003, two members were added, one resigned, and a new chair was appointed. The revised membership as of Jan 2004 is

Charmaine Hrynkiw, MSC	Data Manager, Chair
Alan Barr, MSC	Flux and Meteorology, FCRN PI
Andy Black, UBC	Flux and Meteorology

Pierre Bernier CFS	Ecology
Tony Trofymow, CFS	Site Characterization, Ecology
Fan Meng, UNB	Ecology
Robert Grant, U of A	Modeling
Jing Chen, U of T	Modeling and Remote Sensing
Wenjun Chen, CCRS	Modeling and Remote Sensing
Steve Enns, MSC	DIS Implementation

2.2 Mandate

The DP&MWG reports to the Fluxnet-Canada Science Committee and, under their leadership, is responsible to:

- Develop the Fluxnet-Canada Data Management Plan and revise it as necessary
- Review the Fluxnet-Canada Data Policy and revise it as appropriate
- Oversee the planning and implementation of the Fluxnet-Canada Data Information System
- Provide direction, guidance and support to the Fluxnet-Canada Data Manager or management team.
- Review quality and completeness of data submissions (bi-annually)
- Advise the Science Committee on DIS issues and recommend options for resolution

2.3 Data Manager

A full-time Data Manager, supported jointly by Fluxnet-Canada (60%) and Environment Canada (40%), will serve as the primary interface between Fluxnet-Canada scientists and the Fluxnet-Canada DIS. The Data Manager will:

- Provide advice and guidance to the Fluxnet-Canada Science Committee (through the DP&MWG) on data management issues
- Assist the DP&MWG in developing the Fluxnet-Canada Data Management Plan and designing the Fluxnet-Canada Data Information System
- Develop and maintain the Fluxnet-Canada Data Information System (DIS)
    - Implement and maintain both hardware and software components of the DIS
    - Manage the Fluxnet-Canada data archive:
        - Receive all data and metadata submissions
        - Evaluate the quality and completeness of all data submissions and ensures adherence to Fluxnet-Canada data protocols
        - Archive all scientific and project data and metadata, analysis results, and modeling results on the Fluxnet-Canada DIS
    - Manage data access and exchange, both within and outside the network
    - Prepare statistics on data submission, access, and usage for the Fluxnet-Canada Science Committee
- Work with the Fluxnet-Canada Network Manager to maintain the Fluxnet-Canada website

- Assist Fluxnet-Canada investigators in network-wide syntheses
- Provide information and advice to researchers in national and international scientific agencies, non-government organizations and industry on data management issues relating to Fluxnet-Canada
- Liaise with international data centers, representing Fluxnet-Canada on advisory committees and working groups relating to data management issues in order to establish international standards for access to and archiving of data
- Develop, prepare and present scientific and technical reports and articles on data archiving, access, quality control and data management relating to the Fluxnet-Canada data base for publication and for presentation at scientific conferences
- Serve as secretary of the Fluxnet-Canada Data Policy & Management Working Group and non-voting member of the Fluxnet-Canada Science Committee

2.4 Coordination with the Measurement Standardization Working Group

The DP&MWG will work closely with the Fluxnet-Canada Measurement Standardization Working Group (MSWG) to ensure a high level of measurement standardization. The MSWG will be responsible to ensure that each station measures a standard core of mandatory variables using common instruments and/or standard measurement protocols. The DP&MWG and MSWG will share the responsibility to develop protocols for data post-processing and quality assurance.

3 THE FLUXNET-CANADA DATA INFORMATION SYSTEM

The Fluxnet-Canada database will be incorporated into an Internet-based Data Information System (DIS) that includes both measured and modeled data. The DIS will reside at Environment Canada's National Hydrology Research Centre (NHRC) in Saskatoon, under the supervision of Fluxnet-Canada participant Alan Barr. The DIS will be developed based on the framework used by the BERMS project, with guidance and support from the Carbon Dioxide Information and Analysis Center (CDIAC), an international data centre that houses the FLUXNET and Ameriflux data archives. A seamless link will connect the CDIAC FLUXNET and Ameriflux data servers to the Fluxnet-Canada DIS. This link will raise the profile of the Fluxnet-Canada DIS internationally and promote the use of the Fluxnet-Canada data sets by the international scientific community.

The Fluxnet-Canada DIS will make all Fluxnet-Canada data freely and quickly available to Fluxnet-Canada investigators and their collaborators, and, after a two-year holdback, to the scientific community worldwide. The two-year holdback for non-participants has a three-fold purpose: to give those who collect the data and their collaborators within Fluxnet-Canada the first opportunity to publish results from the data; to ensure a high level of data scrutiny and quality control before public release; and to respect the data policies of existing programs within Fluxnet-Canada (e.g., BERMS).

During the holdback period, Fluxnet-Canada participants will make every effort to publicize their recent results in a timely fashion over the Fluxnet-Canada website. Non-participants who wish to collaborate with Fluxnet-Canada will be able to submit a Collaborative Research Proposal to the Fluxnet-Canada Science Committee; if approved, they will become formal collaborators and gain access to the most recent data before its public release. All data users, including Fluxnet Canada investigators, collaborators, and non-participants, will be bound by the fair-use guidelines in the Fluxnet-Canada Data Policy (Section 5).

The responsibility for data post-processing, quality assurance, formatting, documentation, and submission to the DIS will rest with the principal investigators (PI) of each Fluxnet-Canada project. The data management costs have been included in the budgets of each project. Fluxnet-Canada investigators will be required to submit their data sets, complete with documentation, to the DIS within one year of establishing a new field site and, thereafter, within six months of data acquisition. The initial data submissions will be given a certification code and a revision date. It will then be posted on the DIS for immediate distribution to the network. When corrections are made after the initial submission, the data will be resubmitted, given a revised certification code and revision date, and reposted. In preparing data and metadata for submission to the DIS, each PI will follow the standards and protocols as outlined in the Data Management Plan (this section and Appendix C).

3.1 DIS Function

The fundamental design of the Fluxnet-Canada DIS will be based on previous successful implementations in BOREAS and BERMS. Priorities of the design are:

- Accessibility from both a data access and "user friendliness" perspective. This includes data submission using simple data formats, quick verification, and collating with immediate availability of data upon acceptance into the archive. To realize this priority, the standard mode of operation will be Internet-based data submission and access.
- Security of the data integrity and physical security of the data itself. Data submissions will be subjected to a number of automated and manual checks to assure integrity. The physical data storage will be protected by multiple redundant systems, and be archived in a number of standard media types for future access.

3.2 DIS Architecture

3.2.1 Hardware

The DIS will consist of standard hardware components, many of which are already in place. The heart of the DIS will be a single Intel architecture server, with emphasis on storage capacity and delivery speed rather than processing power. Other components will include:

- Expandable storage

- Standard storage media reading capabilities including CD/DVD ROM and 4mm (DAT) tape. Other media reading capabilities (e.g. Exabyte tape) may be added in response to particular participant requirements.
- CD/DVD creation capabilities. CDs and DVDs will be the standard physical media output for intermediate archive products. Other media creation capabilities may also be added in response to particular participant requirements or special requests.
- Backup to tape and CD/DVD for physical security.
- A dedicated T1 Internet link to enable multiple users to be submitting and/or retrieving data simultaneously at a reasonable speed (A T1 link provides approximately 128Kb/sec, or 7.5Mb/minute transfer speed.)

If necessary, the server capacity will be expanded with additional storage, memory or faster processors. With storage expansions as required, a single server should be sufficient for the proposed 5-year Fluxnet-Canada life span.

3.2.2 Software

The DIS will use the Microsoft Windows 2000 Server Operating System to provide compatibility with existing infrastructure. Standard Internet services will be provided by Windows 2000, including web serving, email delivery and management, and FTP file transfer service. Whenever possible, routine tasks and the day-to-day operation of the system will be automated. For example, notifications of new data submissions and initial verification of the data will occur be proceed automatically, without the need for manual intervention. Proprietary processing software will be developed for these purposes as necessary. Other system maintenance chores such as backups and production of CD/DVD-ROM archives will be scheduled to proceed automatically.

3.2.3 File Organization

The data will be stored as ASCII text files, organized in a directory hierarchy to allow for a wide variety of specific data types. The hierarchy will be implemented as nested directories on the storage media. A simple example hierarchy may be visualized as follows:

FluxStationSite/DataType/DataSubType/data files, by day, month or year as appropriate.
eg: SK-OldAspen/Flux/NEP/SK-OA_FlxTwr_Flx3_2002-01-00.csv

FluxStationSite/DataType/MetaDocumentation
eg: SK-OldAspen/Flux/SK-OA_Met_metadoc.txt

where ***FluxStationSite*** identifies the location of the FluxStation, ***DataType*** identifies the data (e.g., Meteorology, Flux, Ecological Data, etc.), and ***DataSubType*** identifies a particular file type associated with the Data Type (e.g. Ancillary, NEP – is dependent on Data Type). ***Data files*** are individual ASCII files, typically named and organized by the date and time of their collection. Each subdirectory that contains data or metadata will include a descriptive 0_ReadMe.txt file that briefly describes the variables in these data files.

The same or similar hierarchical organization can be used both for the working, active archive system and for publication of data archive products such as CD/DVD-ROMs. (i.e. periodic "snapshots" of the archive can be copied to other media for distribution and storage without requiring extensive reorganization or reformatting).

3.3 Data Access

Access to the Fluxnet-Canada archive will be provided through direct ftp access as well as through seamless links to the Fluxnet-Canada, Ameriflux, and FLUXNET websites. The Fluxnet-Canada DIS will allow two levels of access, participant and public/guest. Fluxnet-Canada participants will have unrestricted access to the current, live archive. This access will be password protected and will require a participant account that is set up by the Data Manager.

- Public and guest non-participants will have access to the historic archive, which will be released annually following the two-year holdback. Public access will not require a password or account.

- The Data Manager as directed by the Science Committee will manage Fluxnet-Canada accounts for participant access.

If participants express a need for internet based services such as status and progress bulletin board pages and/or mailing lists, the Data Manager will make provisions for this.

Physical media products (typically CD/DVD-ROM) will be produced periodically by the Data Manager and distributed to all Fluxnet-Canada members. Additional physical media products may be produced in response to particular requests.

4 DATA FORMATS AND SUBMISSION

4.1 Data Formats

Both measured (e.g. tower-based or experimental) data and modeled results will be submitted to the DIS for archiving. Formats and standards guidelines for these two types of data are presented in the following two sections. Remotely sensed data formats will be discussed in section 4.1.3.

The Fluxnet-Canada DIS will use simple ASCII format text files as the basic data type. The organized and sorted collection of these files, along with corresponding metadata, will constitute the Fluxnet-Canada data archive. The advantages of simple ASCII text format files are as follows:

- Universality. Virtually all computing systems worldwide use ASCII coding of text and numerical data,
- True WYSIWYG (what you see is what you get) functionality. The data is always exactly as shown, no decoding is required to see or read the data.
- Easy implementation of input and output of data from any system. All collection and computing systems from data loggers to visualization and modeling systems are capable of producing ASCII text output.
- Software and hardware independence. The universality and easy implementation allow the data to be independent of particular hardware and software systems, thus maximizing the useful life of the data.

The disadvantages of simple ASCII format text files are largely related to computer performance and capacity:

- For a given hardware and software platform, such as an Intel-based PC running Windows XP, reading and writing of ASCII text files will generally be significantly slower than using a native binary or other encoded format.
- For a given platform, the ASCII text files will be significantly larger and thus consume more storage space than a native binary or other encoded format.

The advantages of the ASCII text format easily outweigh the disadvantages. A universally readable data format (i.e. independent of any particular computer hardware and software platform) is crucial, for both immediate implementation of the archive, and for long-term viability. The mandate of the Fluxnet-Canada DIS is to produce and maintain a data archive, rather than perform significant processing or analysis of the data, so processing performance will not be a significant issue. The scope of the Fluxnet-Canada archive does not indicate prohibitive data storage costs, so storage capacity will not be a significant issue.

The Data Management Plan (this document) will be available on the DIS to participants under the 0-Fluxnet-Canada directory. Participants may access this document to get information on data standards, submission and archiving. The data manager will make efforts to contact all Station PIs regarding data submission. The PIs are asked to respond to these requests in a timely manner, indicating when they expect to submit their data. The data manager will make an effort to assist the PI with getting their data into the Fluxnet-Canada format, but is not obligated to reformat any data files received.

4.1.1 Measured Data

4.1.1.1 Formats and Standards

Measured data will be submitted to the DIS as tab-, space- or comma-delimited ASCII text files, with descriptive headers. File names should follow the protocol defined below.

Data files should span the period of a calendar month or year to avoid large files, allow for an organised filing method, facilitate automated file use by other programs, and provide a consistent protocol between sites.

4.1.1.1.1 File Names

A measured data file is typically named with a semi-coded convention, for example,
Site-SubSite_DataType_Year-Mo-Dy.FileType
SK-OA_FlxTwr_Met2_1999-11-00.csv

- ***Site-SubSite*** uniquely identifies the location based on the flux station identifier (Stn), the site identifier (Site), and an optional sub-site identifier (SubSite), e.g., SK-OA_FlxTwr stands for Saskatchewan Old Aspen Main Flux Tower site, or BC-ODF_CpyTwr stands for British Columbia Old Douglas Fir Canopy Access Tower. See Appendix B for a list of standard site identifiers. If multiple sites are included within one file, the Site identifier should be set to MultipleSites.
- ***DataType*** identifies the data type, e.g., Flux, Met, LAI, etc. See Appendix B for a list of standard data types.
- ***Year-Mo-Dy*** uniquely identifies the data period, based on the Year (4 digit) – Mo (2 digit month) and Dy (2-digit day of month). If the file contains an entire year of data, Mo-Dy is set to 00-00. If the file contains an entire month of data, Dy is set to 00. If all dates are included within one file, the data period identifier should be set to AllDates.
- ***FileFormat*** indicates that the file is comma-delimted.

This naming convention allows for a single file is to be fairly self-contained – there is enough information to uniquely identify the source and type of the data and to imply a unique location in the archive hierarchy.

4.1.1.1.2 File Details

Duration: Measured data will be of two basic types: continuous time series data from automated measurement systems, such as climate and flux measurements, and sample data from manual measurements, such as site characterization data and many ecological measurements. For the continuous time series data, we recommend the use of monthly files with one data line for every period in the month. For the sample data, the data should be stored in annual or multi-year files, with data lines for periods with measurements only.

Headers. The first two lines of each data file are reserved as headers. The first line contains the variable names (column titles), following the Adjective_Parameter_Location_X (A_P_L_X) convention. The second line contains the units of measure, following the SI convention. See Appendix B for a list of network standard set of variable names and units. The variable names should be descriptive, with the individual A_P_L_X designations separated by underscores, e.g., CNR1_DownShortwaveRad_AbvCnpy_39m or SoilTemp_NW_2cm. The units should be enclosed in brackets and contain no special formatting characters. If the variable (column) is unitless (e.g., DataType or SiteID) the units should contain a constant value, e.g., (Met2), or be set to (n/a). Both variable names and units should be comma delimited. The variable names (column titles) for the time stamp and the station identifier are defined in the following two sections.

Columns one to six should be the same for all measured data files.

- The first column is reserved for a unique data type (Appendix B), and should have the title DataType. The actual data may be numeric or text.
- The second column is reserved for a unique site identifier (eg: SK-OA, see Appendix B), and should have the title Site. The actual data may be numeric or text.
- The third column is reserved for a unique subsite identifier (eg: FlxTwr) and should have the title SubSite. The actual data should be text.
- The fourth,fifth, and sixth columns are reserved for the time stamp, and should be titled Year, Day and End_Time. The units will be, respectively, (UTC), (UTC) and (UTC) (see Example, below).

Time. Time will be reported in UTC and should mark the END of the measurement or averaging period. It should be clearly labeled as End_Time. In the example below, the first data line represents values measured in the previous half-hour. Measurements at midnight will be reported as 2400 and not 0.

Missing Data. Missing data should be set to –999. Files containing time series data that are collected at regular intervals, e.g., every 30 min, should contain one data line for each period, with no missing lines. Periods that are completely missing should be included in the data files, with the appropriate data identifier, time stamp, and station identifier, but with all measured data set to –999.

4.1.1.1.3 Example

The following simple ASCII file is an example of the standard file format for flux or meteorological data:

```
…
DataType,Site,SubSite,Year,Day,End_Time,FourWay_NetRad_AbvCnpy,Adjusted_Net
Rad_AbvCnpy_31m,CertificationCode,RevisionDate
(n/a),(n/a),(n/a),(UTC),(UTC),(HrMn_UTC),(W/m2),(W/m2),(n/a),(dymoyear)
Met2,SK-OA,FlxTwr,1999,305,30,-1.3,-1.75,CPI,20031030
Met2,SK-OA,FlxTwr,1999,305,100,-1.43,-1.82,CPI,20031030
Met2,SK-OA,FlxTwr,1999,305,200,-5.93,-6.24,CPI,20031030
Met2,SK-OA,FlxTwr,1999,305,230,-7.66,-7.94,CPI,20031030
…
Met2,SK-OA,FlxTwr,1999,305,2400,-1.2,-1.74,CPI,20031030
```

Each line represents a time sample and each column a parameter or variable. Two header lines contain variable names and measurement units, respectively. All fields are comma delimited, with the first few columns containing the data type, site, year, date and time of the sample. The last two columns are reserved for Certification and Revision information. Certification Code will either be "CPI" or "PRE". "CPI" means that data have been checked by the principal investigator and "PRE" means that the data are preliminary. "RevisionDate" is the date when the data were last revised by the principal investigator. In the example above, Net Radiation is a mean of the values measured in the previous half-hour (0 to 30 min). This format follows standard data logger output, with header lines added.

4.1.1.1.4 Documentation

To facilitate data sharing or experiment reproduction, the Fluxnet-Canada data sets will be thoroughly documented following a condensed BOREAS model. One data document will be produced for each data type at each site. Where the data collection procedures have been standardized across multiple sites within a flux station, one data document will suffice for the multiple sites. The metadata documentation details for each data set are given in Appendix C, and include experiment details as well as data summaries.

In addition, each data file will have an associated format descriptor (read_me) file that outlines the file contents and data. An example, based on the data example in 4.1.1.1.3, is given below.

==

File: sk-oa_flx2_readme.txt

```
--------------------------------------
The files in this directory are quality controlled and
processed carbon, water and energy flux data originating
from the Saskatchewan Old Aspen Flux Tower site.

For more information on this data set, please refer to
0_metadata.doc and 0_KnownProblems.txt

File Names:
-----------
An Example of the file naming convention is as follows:
SK-OA_FlxTwr_Flx2_2000-06-00.csv

 - SK-OA:  is the Saskatchewan Old Aspen site.
 - FlxTwr:  is subsite where data was collected, in this
case the main fluxtower.
 - Flx2: Flx2 files include Heat Flux, Net Ecosystem
Exchange, Friction Velocity, CO2 Flux, CO2 Storage Change,
and CO2 Concentration data.
 - 2000-06-00:  year, month, day.  Where 06-00 indicates that
the entire month of June is contained in the data file.

Acknowledge:
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Andy Black University of British Columbia Vancouver, B.C.
V6T 1Z4 Canada Tel: 604-822-2730
Alan Barr National Hydrology Research Centre Saskatoon,SK
S7N 3H5 306-975-4324

Revision History:

Flx2 Data from June 2000 to Dec 2001 revised: 8-May-2003

Variable List Flx2:

1	DataType="Flx2"	(n/a)	Carbon, Water and Energy flux variables.
2	Site="SK-OA"	(n/a)	Saskatchewan Old Aspen site.
3	SubSite="FlxTwr"	(n/a)	Flux Tower sub-site.
4	Year	(UTC)	4 digit year.
5	Day	(UTC)	Day of Year.
6	End_Time	(UTC)	End of 30min time period, in hours and minutes UTC.
7	NetEcosystem Exchange	(umol /m2/s)	Net ecosystem exchange.
8	FourWay_Net Rad_AbvCnpy	(W/m2)	Derived by: (downwelling shortwave - upwelling shortwave)+(downwelling longwave - upwelling longwave).
9	LatentHeat Flux	(W/m2)	Latent heat flux (sum of eddy flux and storage flux).
10	SensibleHeat Flux	(W/m2)	Sensible heat flux (sum of eddy flux and storage flux).
11	AvgSoilHeat Flux_0cm	(W/m2)	Soil heat flux at ground surface.
12	BiomassHeat StorageChange	(W/m2)	Biomass heat flux rate of change.
13	Photosynthetic HeatFlux	(W/m2)	Photosynthetic heat flux.
14	Friction Velocity_ AbvCnpy_39m	(m/s)	Friction Velocity above canopy at 39m agl.
15	OneLevel_ CO2Storage	(umol /m2/s)	Carbon dioxide storage flux calculated from CO2 concentration at a single level

	Flux_39m		of 39m agl.
16	CO2Storage Flux_0to39m	(umol /m2/s)	Carbon dioxide storage flux calculated from CO2 profile measurements (0 to 39m agl).
17	LatentHeat Flux_AbvCnpy _39m	(W/m2)	Latent heat flux above canopy at 39m agl.
18	LatentHeat StorageFlux _0to39m	(W/m2)	Latent heat storage flux calculated from water vapour profile measurements (0 to 39m agl).
19	SensibleHeat Flux_AbvCnpy _39m	(W/m2)	Sensible heat flux above canopy at 39m agl.
20	SensibleHeat StorageFlux _0to39m	(W/m2)	Sensible heat storage flux calculated from air temperature profile measurements (0 to 39m agl).
21	Certification Code	(n/a)	CPI: checked by PI; PRE: preliminary.
22	RevisionDate	(dymo year)	Date data last revised by PI.

4.1.1.2 Site Characterization Data: Linkage to NFI Data System

The Fluxnet-Canada Measurement Standardization Working Group is currently exploring the possibility that the Fluxnet-Canada site characterization data be archived in the National Forest Inventory (NFI) data system of the Canadian Forest Service, in standard NFI format. The NFI data system is currently being developed and will be housed at the Pacific Forestry Centre. There are several advantages to storing a copy of the Fluxnet-Canada site characterization data in the NFI data system. The collection of site characterization data at Fluxnet-Canada sites will follow NFI protocols and standards, and so the NFI data system and formats are ideally suited for archiving this data. In many cases, it is CFS personnel who will be collecting and managing the site characterization data at Fluxnet-Canada, and they will be skilled in the use of the NFI data system. The NFI data system is based on a relational database, written in Oracle, so that the addition of the Fluxnet-Canada sites will enable intersite queries both among Fluxnet-Canada sites and also between Fluxnet-Canada sites and other NFI sites. The output of ascii, text reports of the data should be possible with minimal effort. The latter is an essential requirement, so that a duplicate, text copy of all site characterization data can also reside on the Fluxnet-Canada DIS. The output data will conform to the formats described above.

The NFI system has been proposed as a standard method for provinces and territories to submit ground plot attribute data. The goal is to have a reproducible data set, regardless of where or by whom it was collected.
The following list of ground plot attributes is a summary of what can be found in table format in the accompanying document: NFI_AppendixV_Sept24_021.doc.

NFI GROUND PLOT, SITE INFORMATION
|
|→PLOT DISURBANCE (multiple disturbances possible per ground plot)
|
|→PLOT ORIGIN (multiple origins possible per ground plot)
|
|→PLOT TREATMENT (multiple treatments per ground plot)
|
|→LARGE TREE PLOT, HEADER AND SUMMARY INFORMATION (one per ground plot)
|
| →LARGE TREE LIST (multiple large tree records possible per large tree plot)
|
| →DEFECTS AND PATHOLOGICAL INDICATORS (multiple damage or loss
| indicators possible per large tree) – Optional table
|
| →HEIGHT, AGE AND GROWTH INFORMATION (one record per large tree)
|
| →ANNUAL GROWTH INFORMATION (one record per large tree)
|
|→SMALL TREE PLOT, HEADER AND SUMMARY INFORMATION (one small tree plot per ground
| plot)
|
| →SMALL TREE LIST (multiple small tree records per small tree plot)
|
|→SHRUB AND HERB, HEADER AND SUMMARY INFORMATION (four microplots per ground
| plot)
|
| →SHRUB AND HERB, SPECIES INFORMATION (multiple species records per micro plot)
|
|→WOODY DEBRIS, HEADER AND SUMMARY INFORMATION (one per ground plot)
|
|→SOIL HEADER AND SITE INFORMATION (one per plot)
|
| →SOIL PIT FEATURES (multiple features possible per soil pit)
|
| →SOIL PIT HORIZON DESCRIPTION (one description per pit with multiple horizon records

| possible) – Optional table
|
| →SOIL HORIZON INFORMATION (multiple horizon records possible per soil pit)

4.1.2 Modelled Data

Fluxnet Model Intercomparison: Protocol

Model Parameterization

Soil and weather data for each site are provided. However there are always site-specific algorithms and parameters that depend on model formulation and so will be different for each model. Key algorithms and parameters are those for plant and soil C transformation. We should try to make a table in which the definitions, values and units of these algorithms and parameters are compared. A proposed example of this type of table follows:

	Model			
Algorithm or Parameter	BEPS-InTEC	C-CLASS	ecosys	IBIS
	CO2 Fixation			
Vmax				
Irradiance interception				
Light response of Vmax				
Temp. sensitivity of Vmax				
CO2 sensitivity of Vmax				
N sensitivity (if used) of Vmax				
Stomatal conductance				
Sensitivity of conductance to CO2 fixation, CO2 concentration, water stress				
	Autotrophic Respiration			
Maintenance co-eff't.				
Temp. sensitivity of maintenance co-eff't				
Growth co-eff't(s)				
	Heterotrophic Respiration			
C pools: plant residue				
SOC				
Respiration coeff'ts of C pools				
Temp. sensitivity of respiration coeff'ts				
Water sensitivity of respiration coeff'ts				
Evapotranspiration				

Net radiation (albedo, transmission, emissivity, LW)
LE (boundary layer and stomatal conductances - link to CO2 fixation, root water uptake, capacitance)
H (boundary layer conductance)
G (soil heat transfer, freeze-thaw)

This table would be used to support analysis of each model's performance in tracking CO2 and energy exchange under contrasting boundary conditions.

Model Initialization

Each model in an intercomparison will have its own initialization procedure. Some may best be initialized from scratch and run up to the present time, using the data for initial pool sizes as a check, and others will use the initial pool sizes to initialize the model. We need to describe each initialization procedure, and detail the site data used to initialize and drive each model (e.g. initial pool sizes, incoming LW radiation, measured LAI etc.).

Model Outputs

As many of the following model outputs as possible should be generated for the Walker Branch site (1998, 1999 and 2000), the Old Aspen Site (1997, 1998 and 1999) and the Old Jack Pine Site (2000):

Hourly or Half-Hourly

Year	Day	Hour	Rn	LE	H	G	CO2 (ecosystem)	CO2 (soil)
			--------W m-2---------------				-----?mol m-2 s-1-----	

Temp. of each Soil Layer
-----------deg. C-------------

Daily

Year	Day	ET	NEP	LAI	SWC of each Soil Layer
		mm d-1	g C m-2 d-1	m2 m-2	------m3 m-3---------

Yearly

Year	GPP	Ra(shoot)	Ra(root)	NPP(shoot)	NPP(root)	Rh	NEP
	-------------------------------------- g C m-2 y-1 --						

Wood Growth	Litterfall(shoot)	Litterfall(root)
---------------------------- g C m-2 y-1 ----------------------------		

ET E T Runoff Drainage
---------------------- mm y-1 ----------------

4.1.2.1 Formats and Standards

Modelled data will be submitted as comma-delimited ASCII text files. Model outputs will be generated for the following intervals: hourly or half-hourly, daily and yearly. Data files will span a period of one year per site.

Files will be named similar to the measured data file names. The file names will include:

- ***Year-Mo-Dy:*** identifies the data period.
- ***Site-SubSite:*** identifies the site and subsite where applicable.
- ***Model Initialization:*** indicates what the model was initialized with.
- ***DataType:*** may indicate a particular version or model initialization subtype.
- ***File Format:*** indicates whether file is csv, tab or space delimited.

eg: OA-FlxTwr_Pool-Hly_2003-00-00.csv

4.1.2.2 File Details

Where it is feasible to do so, model output should be submitted following the same file format protocols outlined for Measured Data. The first 6 columns and last two columns will be identical.

eg:

```
DataType,Site,SubSite,Year,Day,End_Time,FourWay_NetRad_AbvCnpy,Adjusted_Net
Rad_AbvCnpy_31m,CertificationCode,RevisionDate
(n/a),(n/a),(n/a),(UTC),(UTC),(HrMn_UTC),(W/m2),(W/m2),(n/a),(yyyymody)
Met2,SK-OA,FlxTwr,1999,305,30,-1.3,-1.75,CPI,20031030
Met2,SK-OA,FlxTwr,1999,305,100,-1.43,-1.82,CPI,20031030
Met2,SK-OA,FlxTwr,1999,305,200,-5.93,-6.24,CPI,20031030
Met2,SK-OA,FlxTwr,1999,305,230,-7.66,-7.94,CPI,20031030
```


4.1.2.3 Documentation

The main meta data document will be written using the outline provided in Appendix C.

It is recommended that short readme files should accompany each data file type, as outlined for measured data in section 4.1.1.1.4 Documentation. These short metadata files may include such things as (a) dataset summary, (b) description of file-naming convention (c) acknowledgement (d) revision history and (e) data/variable description

4.1.3 Remotely-Sensed Data

4.1.3.1 Formats and Standards

The remote sensing data and products will be archived in raw binary format to allow a range of users to import it without the need of proprietary software. Each binary file will include an ASCII header file indicating the spatial coverage (longitudes and latitudes of central and four corner pixels) , #rows, #columns, resolution (m), and data type (signed and unsigned bits per pixel, integer or float, etc). Although the Fluxnet Data Management Plan recommends that all data be provided in ASCII format, this is highly inefficient for image files that may already be >100Mb. (Provide a template)

The files will be named according to (a) product type, (b) Fluxnet site, and (c) satellite acquisition date. Binary data files will have the extension (.IMG) and ASCII header files will have (.HDR)

We can propose the following naming covention for the remote sensing products (Product_type—Fluxnet_Site—AquisitionDate). For example, file names for the three major remote sensing product types would appear as follows.

1. (a) ETM-REFLECTANCE_SK-OA_20010821.IMG, (b) ETM-REFLECTANCE_SK-OA_20010821.HDR
2. (a) LAI_SK-OA_20010821.IMG, (b) LAI_SK-OA_20010821.HDR
3. (a) LANDCOVER_SK-OA_20010821.IMG, (b) LANDCOVER_SK-OA_20010821.HDR

There are several elements that will be standard for each data file: Landsat Instrument, Fluxnet Site, Date of Aquisition, Time of Acquisition, Data Source, Spatial Coverage, Projection. Many of the elements would be specified in a separate metadata file

Type of Images:

In order of priority, the following data types are encouraged to be submitted to the database:

1. High resolution remote sensing images of tower sites (stationary or satellite sites). They can include the following data:

    (1) original channels
    (2) reflectance at the surface after sensor and atmospheric corrections
    (3) LAI
    (4) Landcover
    (5) Biomass

2. Moderate/coarse resolution images

(1) original channels
(2) reflectance at the surface after sensor and atmospheric corrections
(3) LAI
(4) Landcover
(5) Biomass
(6) Clumping index

3. Gridded soil, meteorological and other datasets

4.1.3.2 Documentation

Meta data documentation will be written following the outline provided in Appendix C.

As with modeled data above, it is also recommended that short readme files should accompany each data file type, as outlined for measured data in section 4.1.1.1.4 Documentation. These short metadata files may include such things as (a) dataset summary, (b) description of file-naming convention (c) acknowledgement (d) revision history and (e) data/variable description

4.2 Data Submission

The standard mode of data/metadata submission will be via the Internet using the ftp (File Transfer Protocol) system. The transfer itself will not require any pre-arrangement. The intent is that the system will always be "live" and ready to accept data. For special situations, such as particularly large datasets, physical media such as CD-ROMs and or tapes may be physically shipped to the DIS Data Manager.

The Data Manager will verify the transferred data. The data will checked for formatting compliance and basic integrity, and be given a certification date and code. This process will be as automated as is practical. Confirmation of data receipt and integrity will be made via email and/or the WEB. When the data fails the compliance and integrity checks, the Data Manager will notify the sender about problems. The data will not be certified or archived until the problems have been fixed.

Once certified and confirmed, the data will be archived, i.e., copied to the appropriate location in the live archive. This process will be as automated as is possible, with human intervention only as required. Email and/or web based notification or status messages will again be available. The archived data will be immediately available for retrieval from the archive via ftp and/or web-based access or automatic email delivery.

4.3 Data Processing

4.3.1 Flux and Meteorological Data

Discussions on Data Management during the summer of 2003 among key Fluxnet-Canada participants have resulted in the decision that there should be three types of meteorological and flux data files available in the archive. For Flux, there will be:

1. ***Ancillary:*** contains raw data used to derive Carbon, Water and Energy fluxes and ultimately Net Ecosystem Productivity information. Includes profile, tree bole and soil heat flux data.
2. ***Computed Fluxes:*** contains Carbon, Water and Energy flux data.
3. ***NEP:*** contains Net Ecosystem Productivity, Gross Ecosystem Productivity and Respiration information. The variables in this file will be **standard** for all sites.

For Meteorology, there will also be three types of files:

1. ***Ancillary:*** contains a subset of Meteorological variables that were used to derive and quality assure some variables in the Main directory. These are "extra" variables that may be useful to only a few people.
2. ***Main:*** contains the most complete sub set of meteorological variables where most have been corrected and some have been derived, but none have been gap-filled.
3. ***Summarized:*** contains data that have been summarized from the Main subset. Variables have been aggregated (eg: 4 tower top temperature measurements have become one) and gaps have been filled. This summarized subset is to be **standard** for all sites.

For a list of standardized names for variables in the above file types, see Appendix B Naming Conventions.

Appendix A: Fluxnet-Canada Data Policy

Network Data Principles

The success of the Fluxnet-Canada network is dependent upon the timely and unrestricted sharing of data and information. Fluxnet-Canada requires an early and continuing commitment to the maintenance, quality assurance, documentation, and distribution of its data sets. The creation of a long-term and high quality data archive will be an important scientific legacy of the Fluxnet-Canada network. The Fluxnet-Canada Data Policy has been developed based on the following principles:

- Within a reasonable period of time for post-processing and quality control, all data collected as part of Fluxnet-Canada must be made available to the Fluxnet-Canada network.
- Fluxnet-Canada investigators and their collaborators (including the Fluxnet-Canada network) should be given a reasonable period of time to analyze the data they collect, and to publish the results, before the same data are released to the scientific community worldwide.
- Data sets should be easily accessed, simply formatted, fully documented, and conform to national and international standards.
- Both measured and modelled data should be archived.
- All users of Fluxnet-Canada data must abide by the Fluxnet-Canada fair-use guidelines.

Data Submission Requirements

The responsibility for data post-processing, quality assurance, formatting, and documentation and submission will rest with the Principal Investigators (PI) of each Fluxnet-Canada project.

- The PI will be required to submit data and documentation to the central Fluxnet-Canada archive within eighteen months of establishing a site and within one year of collection thereafter. When post-submission corrections are made, the data will be resubmitted and given a revised certification date and code.
- Data will be submitted as flat ASCII files, in a standard prescribed format, and with complete documentation, as described in the Fluxnet-Canada Data Management Plan (to be developed by the Data Manager).
- The final data submission will adhere to network-wide protocols in respect to post-processing, quality assurance, data correction, and, where possible, filling of gaps as outlined by the MSWG.

Data Access Details

The Fluxnet-Canada database will be made available via an Internet-based Data Information System (DIS).

- The Fluxnet-Canada Data Manager will develop and maintain the Fluxnet-Canada DIS and act as the primary interface between Fluxnet-Canada scientists and the DIS.
- Fluxnet-Canada investigators and their collaborators will have unrestricted access to the complete Fluxnet-Canada database.
- The scientific community worldwide will be given Internet access to the database after a two-year holdback period. The data will be released one year at a time at the beginning of each calendar year, e.g., data from Jan-Dec 2001 will become publicly available on January 1, 2004.
- Prior to public release of the data, non-participants who wish to collaborate with Fluxnet-Canada may submit a Collaborative Research Proposal to the Fluxnet-Canada Science Committee; if approved, they will become formal collaborators with access to the complete database.
- Under exceptional circumstances, the author(s) of Fluxnet-Canada data may be granted, upon application to the Fluxnet-Canada Science Committee, an extension to the two-year holdback.

Fair-Use Guidelines

All data users, including Fluxnet-Canada participants and non-participants, must agree in writing to abide by the following fair-use guidelines.

- Data users must inform the PIs who collect the data (or their designates) of their specific data analysis plans, and confirm that these plans are not in conflict with the PI's own research and publication plans. The PI who collected the data has first right to publish results from these data and must agree to waive this right prior to another party publishing material based on these data. Publications or presentations must not use unpublished data without the prior agreement and proper acknowledgement of the PI.
- They must agree not to distribute the data to others.
- They must agree to give proper acknowledgement to the PI and the data collection team, including the offer of co-authorship when the data comprise a significant component of any publication. In addition, all publications that use Fluxnet-Canada data must acknowledge Fluxnet-Canada.
- They must absolve the PI and data collection team of any responsibility for inadvertent errors in the data that lead to wrongful analysis and improper decision-making.

Appendix B: Naming Conventions

Standardized Variable Names And Units

The goal for naming variables is to have clear and self-defining names, which may mean they will sometimes be rather long. Variables should be named using a adjective, parameter and location, separated by underscores ("_"). Here are some examples from BERMS:

1. BF3_DownPAR_AbvCnpy_36m. "BF3" is the instrument type, "DownPAR" is the parameter, "AbvCnpy" describes the location, and "36m" is the height of the instrument. For this example, there are other PAR variables measured by a LiCor instrument that need to be set apart from this one, including:
    a. LI_DownPAR_AbvCnpy_36m
    b. LI_DownPAR_BlwCnpy_S_4m
    c. LI_UpPAR_AbvCnpy_31m
2. SoilTemp_N_2cm
    a. It is not necessary to include an instrument type in this variable name because only one instrument type is deployed for soil temperatures. However, this variable is just one depth in a profile of soil temperatures at one location. Other similar variables include:
        i. SoilTemp_N_5cm, SoilTemp_N_10cm, SoilTemp_N_20cm, SoilTemp_N_50cm, SoilTemp_N_100cm.
3. SnowDepth_Cnpy, where "Cnpy" indicates that the sensor is deployed within the canopy. In this example, there is another snow depth sensor deployed in a clearing, therefore a location is required in the variable name to set these two measurements apart:
    a. SnowDepth_Clrg.
4. Pressure
    a. In this example, there is only one atmospheric pressure measurement at the site, therefore this variable name is succinct.

The following tables list standard variables names and units. Changeable text strings are in *italics*. It may be helpful to view actual files already posted on the FCDIS, particularly those for SK-OldAspen. Note that only the Summarized and NEP tables are standard lists of required variables. The other tables simply list variable names and not required measurements. For a list of required measurements, please refer to the Fluxnet-Canada Measurement Protocols document.

Meteorological Variables (3 separate files)

1. ANCILLARY (reported variables will vary by site)

[Adjective]	Parameter	Location	X	Units
	CompDownLongwaveRad	AbvCnpy	*Heightx*	(W/m2)
DownLongwave	Thermopile			(W/m2)
DownLongwave	BodyTemp			(degC)
DownLongwave	DomeTemp			(degC)
	CompUpLongwaveRad	AbvCnpy	*Heightx*	(W/m2)
UpLongwave	Thermopile			(W/m2)
UpLongwave	BodyTemp			(degC)
UpLongwave	DomeTemp			(degC)
	WindSpd	*AtPrecipGauge*		(m/s)
	AirTemp	*AtSnowdGauge-Locx*		(degC)
	Reference a/o Logger Temp			(degC)
	LoggerBattery			(Volts)

2. MAIN (reported variables will vary by site)

[Adjective]	Parameter	Location	X	Units
FourWay	NetRad	AbvCnpy	*x*-m or *x*-cm	(W/m2)
Instrument	NetRad	AbvCnpy	*x*-m or *x*-cm	(W/m2)
Instrument	GlobalShortwaveRad	AbvCnpy	*x*-m or *x*-cm	(W/m2)
Instrument	UpShortwaveRad	AbvCnpy	*x*-m or *x*-cm	(W/m2)
Instrument	DownLongwaveRad	AbvCnpy	*x*-m or *x*-cm	(W/m2)
Instrument	UpLongwaveRad	AbvCnpy	*x*-m or *x*-cm	(W/m2)
	DownPAR	AbvCnpy	*x*-m or *x*-cm	(umol/m2/s)
	DownDiffusePAR	AbvCnpy	*x*-m or *x*-cm	(umol/m2/s)
	UpPAR	AbvCnpy	*x*-m or *x*-cm	(umol/m2/s)
	DownPAR	BlwCnpy	*x*-m or *x*-cm	(umol/m2/s)
	DownPAR	BlwUndstry	*x*-m or *x*-cm	(umol/m2/s)

PRT or TC	AirTemp	AbvCnpy	*x*-m or *x*-cm	(degC)
Aspirated	AirTemp	AbvCnpy	*x*-m or *x*-cm	(degC)
	AirTemp	Cnpy	*x*-m or *x*-cm	(degC)
	AirTemp	BlwCnpy	*x*-m or *x*-cm	(degC)
	RelHum	AbvCnpy	*x*-m or *x*-cm	(%)
	RelHum	Cnpy	*x*-m or *x*-cm	(%)
	RelHum	BlwCnpy	*x*-m or *x*-cm	(%)
	WindSpd	AbvCnpy	*x*-m or *x*-cm	(m/s)
	WindDir	AbvCnpy	*x*-m or *x*-cm	(deg)
StdDev	WindDir	AbvCnpy	*x*-m or *x*-cm	(deg)
	SurfPress		*x*-m or *x*-cm	(kPa)
Geonor	CumPrec	*Location*		(mm)
TBRG	Rain	*Location*		(mm)
	SnowDepth	*Location*		(cm)
	WaterTableDepth			
	SoilTemp	*LocationA*	*Depth* x_1-x_i-cm	(degC)
	SoilTemp	*LocationB*	*Depth* x_1-x_i-cm	(degC)
	SnowTemp	*LocationA*	*Height* x_1-x_i-cm	(degC)
	SnowTemp	*LocationB*	*Height* x_1-x_i-cm	(degC)

3. SUMMARIZED (a gapfilled standard list all sites must report)

[Adjective]	Parameter	Location	X	Units
FourWay	NetRad	AbvCnpy	Heightx	(W/m2)
	GlobalShortwaveRad	AbvCnpy	Heightx	(W/m2)
	DownPAR	AbvCnpy	Heightx	(W/m2)
	AirTemp	AbvCnpy		(degC)
	RelHum	AbvCnpy		(%)
	SpecificHum	AbvCnpy		
	WindSpeed	AbvCnpy	Heightx	(m/s)
	SoilTemp		Depthx1-xi-cm	(degC)
Instrument	CumPrec			(mm)
	EventPrec			(mm)

Flux Variables (3 separate files)

1. ANCILLARY (reported variables will vary by site)

[Adjective]	Parameter	Location	X	Units
EddyCovariance	CO2		*Top*	(umol/m2/s)
	CO2		*Heightx₁-xᵢ*-m	(ppm)
	TreeTemp	*TreeA_Heightx agl*	*Position in bole-x_1-x_i*mm *from edge*	(degC)
	TreeTemp	*TreeB_Heightx agl*	*Position in bole-x_1-x_i*mm *from edge*	(degC)
	SoilTemp	*Location*	*Depthx_1-x_2*-cm	(degC)
	SoilHeatFlux	*Location*	*Depthx-*cm*Rep#1*	(W/m2)
	*Reference a/o Logger*Temp			(degC)
	LoggerBattery			(Volts)

2. COMPUTED FLUXES (reported variables will vary by site)

[Adjective]	Parameter	Location	X	Units
	NetEcosystemExchange			(umol/m2/s)
FourWay	NetRad	AbvCnpy		(W/m2)
	LatentHeatFlux			(W/m2)
	SensibleHeatFlux			(W/m2)
Avg	SoilHeatFlux	0cm		(W/m2)
	BiomassHeatStorageFlux			(W/m2)
	PhotosyntheticHeatFlux			(W/m2)
	FrictionVelocity	AbvCnpy		(m/s)
OneLevel	CO2StorageFlux		*Top*	(umol/m2/s)
	CO2StorageFlux		*Sfc to Top*	(umol/m2/s)
	LatentHeatFlux	AbvCnpy	*Top*	(W/m2)
	LatentHeatStorageFlux		*Sfc to Top*	(W/m2)
	SensibleHeatFlux	AbvCnpy	*Top*	(W/m2)
	SensibleHeatStorageFlux		*Sfc to Top*	(W/m2)

3. NEP (a gapfilled standard list all sites must report)

[Adjective]	Parameter	Location	X	Units
	NEP			(umol/m2/s)
	R			(umol/m2/s)
	GEP			(umol/m2/s)
GapFilled	NEP			(umol/m2/s)
GapFilled	R			(umol/m2/s)
GapFilled	GEP			(umol/m2/s)
Modelled	R			(umol/m2/s)
Modelled	GEP			(umol/m2/s)
EClosure	NEP			(umol/m2/s)
EClosure	R			(umol/m2/s)
EClosure	GEP			(umol/m2/s)
GapFilledEClosure	NEP			(umol/m2/s)
GapFilledEClosure	R			(umol/m2/s)
GapFilledEClosure	GEP			(umol/m2/s)
ModelledEClosure	R			(umol/m2/s)
ModelledEClosure	GEP			(umol/m2/s)
**PIPreferred	NEP			(umol/m2/s)
**PIPreferred	R			(umol/m2/s)
**PIPreferred	GEP			(umol/m2/s)
**GapFilledPIPref	NEP			(umol/m2/s)
**GapFilledPIPref	R			(umol/m2/s)
**GapFilledPIPref	GEP			(umol/m2/s)
**PIPrefModelled	R			(umol/m2/s)
**PIPrefModelled	R			(umol/m2/s)

**Optional

Ecological Variables
(standard list not defined – PIs to use their discretion)

Site Names and Identifiers
(may be subject to change if new sites added).

Station Identifier	Site Identifier	Directory Name on DIS	Site
AB	WPL	AB-WPeatland-TreedFen	Western Peatland
BC	DF49	BC-DFir1948	1949 Douglas-fir
BC	HDF89	BC-HarvestDFir1989	1989 Harvested Douglas-fir (pole sapling)
BC	HDF00	BC-HarvestDFir2000	2000 Harvested Douglas-fir (clearcut)
SK	OA	SK-OldAspen	Old Aspen
SK	OBS	SK-OldBlackSpruce	Old Black Spruce
SK	OJP	SK-OldJackPine	Old Jack Pine
SK	FEN	SK-Fen	Fen
SK	HJP02	SK-HarvestJP2002	2002 Harvested Jack Pine
SK	HJP94	SK-HarvestJP1994	1994 Harvested Jack Pine
SK	HJP75	SK-HarvestJP1975	1975 Harvested Jack Pine
SK	F98	SK-Fire1998	1998 Fire
SK	F89	SK-Fire1989	1989 Fire
SK	F80	SK-Fire1980	1980 Fire
ON	OMW	ON-GroundhogR	Groundhog River - Mature Mixed Wood
ON	EPL	ON-EPeatland-MerBleue	Eastern Peatland – Mer Bleue
QC	OBS	ON-MatureBSpruce	Mature Black Spruce
QC	HBSYY	ON-BSpruceJPineCut	19YY Harvested Black Spruce/Jack Pine
NB	OBF	NB-NashwaakL-01	Mature Balsam Fir
NB	NWL	NB-NashwaakL-02	25-35 y old thinned Balsam Fir
NB	CL	NB-CharlieL-01	20-25 y old thinned Balsam Fir

Data Types and Codes
(may be subject to change as data types are added or modified)

Type	Code	Description
Meteorology	Met1	30-min meteorological data – Ancillary
	Met2	30-min meteorological data – Main
	Met3	30-min meteorological data – Summarized
SoilMoisture	SM***x*** + QALevel	4 hly or 30min soil moisture data
Flux	Flx1	30-min flux data – Ancillary
	Flx2	30-min flux data – ComputedFluxes
	Flx3	30-min flux data – NEP
SoilResp	SR***x*** + QALevel	30-min soil respiration chamber data
SoilSurvey	SS***x*** + QALevel	
CarbonStocks	CS***xor*** + QALevel	
Vegetation	Veg***x*** + QALevel	
LAI	LAI***x*** + QALevel	
FoliarNutrients	FN***x*** + QALevel	
To be completed		

Appendix C: Fluxnet-Canada Metadata Documentation Guidelines

This is an outline of the required data set documentation for Fluxnet-Canada. It is a summarized version of the BOREAS model. The data documentation includes:

1. Data Set Overview
2. Investigator(s)
3. Theory of Measurements
4. Equipment
5. Site Description
6. Data Acquisition Methods
7. Observations
8. Data Description
9. Data Manipulations
10 Errors and Limitations
11. Software
12. References
13. Glossary of Terms and Acronyms
14. Document Information

Note: The text surrounded by square brackets ([..]) is an expanded instruction, or set of instructions, for the outline item which appears directly above it. Also, be aware that the metadata file will also be stored as a simple ASCII flat file. Special characters, maps, figures and other objects (including Microsoft Word equations), as well as special formats such as bold, underline and italics will not get translated when saving the file. If in doubt, please try saving your metadata file as a ".txt" file to determine if file integrity is maintained.

----

1. Data Set Overview

[This section is aimed toward the person searching for a data set. Descriptions should be succinct and clear, and acronyms should be spelled out.]

1.1 Data Set Identification

[Title or name for the data set, generally a short descriptive phrase, e.g. "BERMS Tower Flux Data From the Southern Study Area Old Aspen Site"]

1.2 Study Overview

[A short text describing the study/experiment, and its objective]

1.3 Data Set Introduction

[The nature of the data, including a summary of the key parameters/variables studied, and the primary instruments used. A full description will be given in section 7.]

1.4 Related Data Sets

[Note any similar or related data collected by the investigator, other investigators, or other data centres. Something like five or six related data sets is a good number to provide.]

----

2. Investigator(s)

2.1 Principal Investigator(s) Name and Title

[Identify the Principal Investigator(s) for this data set, including general affiliation if applicable]

2.2 Title of Investigation

[Official name of group taken from the Fluxnet-Canada Experiment Plan.]

2.3 Contact Information

[Identify and give full coordinates of the person(s) most knowledgeable about the actual collection and processing of the data sets. In many cases this will be a person (or persons), other than the Principal Investigator.]

Contact 1

Dr. Unknown
Affiliation
Address line 1
Address line 2
Telephone:
Fax:
Email:

Contact 2

Dr. Unknown
Affiliation
Address line 1
Address line 2
Telephone:
Fax:
Email:

2.4 Field and/or laboratory staff:

2.5 Acknowledgements :

----

3. Theory of Measurements

[Theoretical basis for the way in which the measurements were made (e.g. special procedures, characteristics of the instrument, etc.).]

----

4. Equipment

4.1.1 Sensor/Instrument Description

[This section provides a listing of the instrumentation and the characteristics of the instrumentation.]

4.1.2 Manufacturer of Sensor/Instrument

[Name, address, and telephone number of the company that produced the instrument. If the measuring device was built by the investigator, or specially customized, please specify.]

4.1.3 Principles of Operation

[Fundamental scientific basis for the way the instrument operates. This is a summary; where a full development is required, it should be placed in section 3.]

4.1.4 Source/Platform

[What the instrument(s) is(are) mounted on, e.g. tower, hand held, aircraft.]

4.1.5 Sensor/Instrument Measurement Geometry

[Describe the sensor location(s), orientation, and any other parameters that affect the collection or analysis of data, e.g. field of view, optical characteristics, height, etc.]

4.1.6 Collection Environment

[Under what environmental conditions were the data collected and the instrumentation operated. This includes descriptions of the types of sites visited and factors that may effect the measurements such as temperature range experienced during data collection.]

4.2 Calibration

[Describe how the measurements made by the device(s) are calibrated with known standards. Specific details should be given in the subsections below.]

4.2.1 Specifications

[Record any specifications that affect the calibration of the device, its operations, or the analysis of the data collected with it.]

4.2.1.1 Tolerance

[Describe the acceptable range of inputs and the precision of the output values.]

4.2.2 Frequency of Calibration

[Indicate how often the instrument is measured against a standard. Also indicate any other routine procedures required to maintain calibration or detect miscalibrations. Describe also the actual practice with this device.]

4.2.3 Other Calibration Information

[Give factory calibration coefficients, information about independent calibrations, history of modifications, etc.]

----

5 Site description

[Standard site description, should include site location in a well referenced coordinate system, site elevation, vegetation type, etc...]

6. Data Acquisition Methods

[Describe the procedures for acquiring this data in sufficient detail so that someone else with similar equipment could duplicate your measurements. Should be sufficient to include in the Methods section of a paper]

6.1 Methods of data acquisition

[How the instruments were actually installed and used to obtain the measurements and how the material was processed after the main measurements were obtained, e.g. analytical lab procedures to get nitrogen concentration following gas exchange measurements]

6.2 Sampling

6.2.1 Spatial Coverage/Geographic Location

[Give enough information to locate the measurement site with suitable precision. This may be a list of sites visited, or a geographic range in the case of aircraft measurements or satellite imagery, or plot coordinates in UTM, including a clear reference to the coordinate system.]

6.2.2 Spatial sampling

[Includes a description of spatial sampling: how many sites/samples; how were they selected, the coordinates (e.g. UTM) of the plots, how many replicates over space, etc...]

6.2.3 Temporal coverage

[The period(s) of time during which data was collected more or less continuously.]

6.2.4 Temporal sampling

[Includes a description of the temporal sampling scheme: when was the sampling carried out (time of day), at what frequency were the measurements taken, how long did the measurements take, etc...]

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7 . Observations

7.1 Procedural Notes

[Use this section to record observations made during actual data collection, which could bear on the analysis of the data, e.g. condition of site, peculiar procedures or operations, the presence of U.F.O.'s or bears, oddities in equipment function, etc.]

7.2 Field Notes

[If a large amount field notes exist, a reference to a separate file will be adequate.]

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8 . Data Description

[This section describes the data in the data set: what the data are, units, format, data characteristics.]

8.1 Data Organization

[Describe how your data is organized, e.g.: by site and/or month.]

8.2 Image andData Format

[Specify the format that the image or the data is (are) provided in.]

8.3 Numerical Data Characteristics

[Describe the types of data submitted. On separate lines, indicate each column number followed by its header, the variable description, the unit of measurement or format of presentation, the data source or sensor, and the variable range.]

Examples:

Column number: Colums header; variable description: unit of measurement or format of presentation: data source or sensor; variable range

1: DATE: day of year of measurement; whole numbers; CR10 clock; 1 to 366

2: HOUR: end of measurement period in coordinated universal time; hours and decimal hours; CR10 clock; 0 to 23.99

3: SOIL_TEMP: soil temperature; degrees C; soil temp probe; -40 to 25

It is very important to fill in as much of this information as possible. If you need extra space for an item, use footnotes at the end of the table.]

8.3.1 .6 Sample Data Record

[One or more sample records from a data file, including headers]

8.4 Image Data

[Describe the data submitted, with subsections 7.4.1 through 7.4.13 (below) being represented as columns in a tableExample:

Identifier:OBS02031HH.PIX

Date of Acquisition (UTC):31 January 2002
Time of Acquisition (UTC):16:13
Sensor / Mode:RADARSAT-1 SAR Standard Beam S1
Wavelength (nm) / Frequency (GHz):Standard
Platform Altitude (magl):N/A
Spatial Ground Resolution (m):30
Incidence Angle - Average:N/A
Incidence Angle - Minimum:20.0
Incidence Angle - Maximum:27.4
Polarization:HH
Gain Control:Automatic
Flight Azimuth:Ascending
Scene Centre:53.80206 N 104.61797 W

8.4.1 1 Image Identifier
[A unique image file name that the image will be archived as, e.g. OBS02031HH.PIX.]

8.4.2 2 Date of Acquisition
[As UTC.]

8.4.3 Time of Acquisition
[Time as UTC; to allow later users to reproduce such things as sun angle.]

8.4.4 Sensor
[Identify the imaging sensor and mode used.]

8.4.5 Wavelength
[The wavelength range or frequency used. If settings are fixed, the descriptor "standard" can be used.]

8.4.6 Platform Altitude
[The height of the sensor above the ground surface (m). If the altitude is fixed, such as for satellite platforms, N/A may be used.]

8.4.7 Ground Spatial Resolution
[The smallest resolvable unit on the ground (m).]

8.4.8 .7 Incidence Angle - Average
[The average angle from vertical.]

8.4.9 .8 Incidence Angle - Minimum
[The minimum angle from vertical.]

8.4.10 Incidence Angle - Maximum
[The maximum angle from vertical.]

8.4.11 Polarization
[The polarization set on the sensor.]

8.4.12 Gain Control
[Automatic or manual gain control.]

8.4.13 Flight Azimuth
[Identify the direction of travel of the platform. For satellite-based platforms, Ascending or Descending is sufficient.]

8.4.14 Scene Centre
[Give the scene centre in lat/long format.]

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9 . Data Manipulations
[This section describes the steps by which the data were processed to their final form.]

9.1 Post Processing and Calculated Variables
[Specify all post-treatment of data, including data processing steps and calculations. Include relevant equations with definitions of terms and units.]

9.2 Special Corrections/Adjustments
[List any 'special' corrections/adjustments made to portions but not all of the data to make it compatible with the data set as a whole.]

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10 . Errors and Limitations
[This section describes an error analysis for the data.]

10.1 Sources of Error
[Describe what factors of the instrument or environment may introduce errors in the observations.]

10.2 Quality Assessment

10.2.1 Data Validation by Source
[Describe all efforts to validate the data by the submitter, e.g. comparisons with data from other investigators.]

10.2.2 Confidence Level/Accuracy Judgment
[Subjective discussion of data quality.]

10.2.3 Measurement Error for Parameters
[Quantitative error estimates.]

10.2.4 Additional Quality Assessments
[May include visual review of plots, etc.]

10.3 . Limitations and Representativeness
[Provide warnings on the use of the data, e.g. data were collected under drought conditions relations between variables may be different when things are wet, as well as known problems. Discuss how representative your data is, eg: of the landscape, climate, footprint, etc.]

10.4 Known Problems with the Data

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11 . Software

11.1 Software Description
[Describe all software that was used to process the data.]

11.2 Software Access
[Describe any software that may be available for use by someone who may want to perform further processing of the data. Also describe where a user can get it -- commercial source, Web site, FTP archive, e-mail to author, etc.]

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12 . References

12.1 Platform/Sensor/Instrument/Data Processing Documentation
[List any published documentation relevant to the data collected, such as manufacturer's instruction manuals, government technical manuals, user's guides, etc.]

12.2 Journal Articles and Study Reports
[List technical reports and scientific publications that concern the methods, instruments, or data described in this document. Publications by the Principal Investigator or investigating group that would help a reader understand or analyze the data are particularly important.]

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13. Glossary of Terms and Acronyms
[Define discipline-related jargon and the wealth of scientific notations/symbols that may be used in the text, as well all "local" acronyms. Items from the following list may

be included.
BERMS - Boreal Ecosystem Research and Monitoring Sites
BOREAS - BOReal Ecosystem-Atmosphere Study
PANP - Prince Albert National Park]

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14 . Document Information

14.1 Document Revision Date
[Use yyyy-mm-dd-mmm format]

14.2 Document Author

14.3 Keywords
[Include a list of appropriate key words to assist in searching for information.]
Fluxnet-Canada Data Metadata Template, Revised 2003-09-07 1

Appendix D: Memorandum of Agreement between Fluxnet-Canada and Environment Canada

Background

The January 2002 Fluxnet-Canada Research Network Proposal to NSERC/CFCAS involves close cooperation between university and government network participants. As part of this co-operation, Environment Canada has agreed to play a leading role in data management for the Fluxnet-Canada network and to share the costs of data management. The terms of this co-operation are outlined in Research Network Proposal (section 2.3.12: 'Data Management and Data Policy' and the Data Information System Budget).

Fluxnet-Canada, as represented by the Network Director
and
Environment Canada, as represented by the Chief of the Climate Processes and Earth Observations Division of the Meteorological Service of Canada

Hereafter referred to as the "Parties",

Wishing to broaden the scope of scientific cooperation and exchange between university and government network participants; and

Desiring to ensure effective administration of data management aspects of the Fluxnet-Canada research initiative; and

Being committed to the efficient storage, management, and analysis of scientific data of mutual benefit and benefit to other researchers;

Believing that availability and accessibility of the Fluxnet-Canada data sets will help to ensure the widespread usefulness and lasting legacy of the Network,

Have agreed as follows:

1. Environment Canada will provide data management services to Fluxnet-Canada, as described in the January 2002 Fluxnet-Canada Research Network Proposal. The applicable sections are attached as Appendices A (Data Management and Data Policy) and B (Data Information System Budget).
2. The Fluxnet-Canada Data Information System will reside at Environment Canada's National Hydrological Research Centre, in Saskatoon, under the supervision of Fluxnet-Canada participant Alan Barr.
3. Environment Canada will provide the services of an employee of the Climate Research Branch of the Meteorological Service of Canada (MSC) as Data

Manager to the Network; it will also provide reasonable additional technical or computer support, by other MSC employees in Saskatoon.

4. The Parties will cooperate in the preparation of data protocols and in arrangements for data presentation, storage, archiving, metadata development, and retrieval.
5. The Parties will participate in regular Network meetings dealing with data management issues, to share information and to cooperate in the preparation of texts for the Network's annual reports to the funding agencies.
6. Nothing in this Agreement should be taken to construe an employer-employee relationship.

Financial and Practical Arrangements

7. Both Parties agree to provide support to the Fluxnet-Canada Data Information System in cash or in-kind, as outlined in the Data Information System Budget (Appendix B: Climate Research Branch, Environment Canada – Support for the Fluxnet-Canada Data Information System).
8. Environment Canada agrees to provide computer and technical support (DIS Server and associated hardware), annual operating costs, a portion of the salary costs of the data manager, advice and links to Environment Canada and other public databases.
9. Fluxnet-Canada agrees to transfer funds to Environment Canada in partial compensation for additional costs of computer, technical and professional support for data management services to the network, in accordance with the Data Information System Budget (Appendix B, Data Information System Proposed Expenditures – Direct Research Costs). The amount of such compensation will be based on an all-inclusive fee of $39,000 per annum.
10. Environment Canada will invoice the Fluxnet-Canada National Management Office for $19,500 at the beginning of each fiscal year (April) and an additional $19,500 half way through the fiscal year (October). The invoices will initiate the transfer of funds from the Fluxnet-Canada National Management Office to the Climate Research Branch of Environment Canada.
11. Both parties agree that access to the data, as outlined in the January 2002 Fluxnet-Canada Research Network Proposal and the Fluxnet-Canada Data Policy, will be free of charge.

Confidentiality

12. Both parties agree to conform to the terms of the Research Network Proposal with regard to confidentiality and non-disclosure of data for the time period stipulated in the proposal and agreed to by the Board of Directors for the Network; they further agree to the principle that information should be available to the larger scientific and professional community in a timely and open manner.

Amendments

13. The Agreement can be modified at any time on mutual consent of both Parties in writing.

14. Either Party can withdraw from this Agreement on two months' written notice. The withdrawing Party will cooperate in a smooth transfer of relevant information and files to the other Party or that Party's designated representative, to maintain the integrity and availability of data.

Duration

15. The term of this Agreement shall be April 2002 to March 2005. Both Parties are amenable to a possible extension to March 2007.

Signed

On behalf of Fluxnet-Canada

____
Name

Date: ____________________

On behalf of Environment Canada

____
Name

Date:_____________________