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NACP Site: Terrestrial Biosphere Model Output Data in Original Format

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Revision Date:

Summary:

This data set contains the original model output data submissions from the 24 terrestrial biosphere models (TBM) that participated in the North American Carbon Program (NACP) Site-Level Synthesis. The model teams generated estimates for, but not limited to, a minimum of six variables, including gross primary productivity (GPP), net ecosystem exchange (NEE), leaf area index (LAI), ecosystem respiration (Re), latent heat flux (LE), and sensible heat flux (H) for each of 47 selected eddy covariance flux tower sites across North America. Participating modeling teams followed the NACP Site Synthesis Protocol ([site_synthesis_protocol_v7.pdf](#)), which covers procedures, plans, and infrastructure for the site-level analyses. File format and units conversions of several data submissions were made by the MAST-DC to produce NetCDF files of consistent content and structure for all 24 TBM outputs. The model outputs are structured as described in Appendix A: Model Output Variables, of the Site Synthesis Protocol.

In addition, MAST-DC processed these original model submissions to derive uniquely processed and formatted data files for model inter-comparison and evaluation ([NACP Site: Terrestrial Biosphere Model and Aggregated Flux Data in Standard Format](#)). This related data set provides GPP, NEE, LAI, Re, LE, and sensible heat (H) model output variables at the native half-hourly time step, and in daily, monthly, and annual aggregations. The related data set also contains gap-filled observations and total uncertainty estimates at the same time steps.

Some caveats about the original model output data:

- Generally there is one output file per model per site, although some models have separate files for each year.
- Note that not all models produced output estimates for all flux tower sites, therefore, site inclusion varies.
- Some models produced output estimates for additional variables which are included only in their data files.
- File sizes vary based on the individual modeling team's submissions.

There are 24 compressed (*.zip) files with this data set -- one file for each model. When expanded, the .zip files contain model output data files for flux tower sites in NetCDF and some in text formats.

Data and Documentation Access:

Get Data: http://daac.ornl.gov/cgi-bin/dsvviewer.pl?ds_id=1192

Related Data Products:

NACP Site: Tower Meteorology, Flux Observations with Uncertainty, and Ancillary Data [<http://dx.doi.org/10.3334/ORNLDAAC/1178>]

NACP Site: Terrestrial Biosphere Model and Aggregated Flux Data in Standard Format [<http://dx.doi.org/10.3334/ORNLDAAC/1183>]

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1. Data Set Overview:

Project: North American Carbon Program (NACP)

The NACP (Denning et al., 2005; Wofsy and Harriss, 2002) is a multidisciplinary research program to obtain scientific understanding of North America's carbon sources and sinks and of changes in carbon stocks needed to meet societal concerns and to provide tools for decision makers. Successful execution of the NACP has required an unprecedented level of coordination among observational, experimental, and modeling efforts regarding terrestrial, oceanic, atmospheric, and human components. The project has relied upon a rich and diverse array of existing observational networks, monitoring sites, and experimental field studies in North America and its adjacent oceans. It is supported by a number of different federal agencies through a variety of intramural and extramural funding mechanisms and award instruments.

MAST-DC organized several synthesis activities to evaluate and inter-compare biosphere model outputs and observation data at local to continental scales for the time period of 2000 through 2005. The synthesis activities have included three component studies, each conducted on different spatial scales and producing numerous data products: (1) site-level synthesis that examined process-based model estimates and observations at over 30 AmeriFlux and Fluxnet-Canada tower sites across North America; (2) a regional, mid-continent intensive study centered in the agricultural regions of the United States and focused on comparing inventory-based estimates of net carbon exchange with those from atmospheric inversions; and (3) a regional and continental synthesis evaluating model estimates against each other and available inventory-based estimates across North America. A number of other NACP syntheses are underway, including ones focusing on non-CO₂ greenhouse gases, the impact of disturbance on carbon exchange, and coastal carbon dynamics. The ORNL DAAC is the archive for the NACP synthesis data products.

This data set is part of the NACP Site Synthesis which is divided into three separate sub-data components: model driver data and observations (Data Set 1), the processed model output (Data Set 2), and the original model output (Data Set 3). This is Data Set 3. It provides the original model output for 47 eddy covariance flux tower sites in North America submitted by 24 modeling teams.

Authors:

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Robert B. Cook			cookrb@ornl.gov
Ryan Anderson	BIOME_BGC (BioGeochemical Cycles)	BIOME-BGC	ryan.anderson@ntsg.umd.edu
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Robert Grant	Ecosys terrestrial ecosystem model	ecosys	Robert.Grant@afhe.ualberta.ca
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	Local Terrestrial Ecosystem Carbon		

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Erandi Lokupitiya	coupled Simple Biosphere (SiB) - crop phenology model (SiBcrop)	SiBcrop	erandi@atmos.colostate.edu
Yiqi Luo	Terrestrial ECOSystem (TECO) model	TECO	yluo@ou.edu
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Note: See Table 2 in Schaefer et al. (2012) for a summary of model characteristics and references.

2. Data Description:

This data set contains original output from 24 terrestrial biosphere models for six (or more) variables for each flux tower site: GPP, NEE, LAI, Re, LE, and sensible heat flux (H). File format and units conversions of several data submissions were made by the MAST-DC to produce NetCDF files of consistent content and structure for all 24 TBM outputs. The model outputs are structured as described in Appendix A: Model Output Variables, of the Site Synthesis Protocol.

2.1. Spatial Coverage

Site: North America

Site Boundaries:(All latitude and longitude given in decimal degrees)

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
North America	-170	-50	84	10

2.2. Spatial Resolution

Point (lat/lon) centered on flux tower

2.3. Temporal Coverage

1990-2007

2.4. Temporal Resolution

Hourly or daily (The native time resolution of the input observations.)

2.5. Data File Information

There are 24 compressed (*.zip) files with this data set -- one file for each model. When expanded, the .zip files contain model output data files for the flux tower sites.

Generally there is one file per model per site, although several models also have separate files for each year. The model output site inclusion and specific variable content varies with different modeling teams. File sizes vary also. The model outputs are structured as described in Appendix A: Model Output

Variables, of the Site Synthesis Protocol.

Note that if a modeling team did not submit estimates for a particular variable or variables, as listed in Appendix A: Model Output Variables, when the MAST-DC performed file format and units conversions, all of the values for the missing variable were set to missing (-999.0). This ensures that the NetCDF file structure is consistent across models and sites, but resulted in many variable fields with all missing values.

Table 1. Data Files. There are 24 compressed (*.zip) files with this data set -- one file for each model. When expanded, the .zip files contain model output data files for flux towers sites.

COMPRESSED FILE NAMES
Agro-IBIS.zip
BEPS.zip
BIOME-BGC.zip
Can-IBIS.zip
CLM4.zip
CLM4VIC.zip
CN-CLASS.zip
DLEM.zip
DNDC.zip
ECLUEEDCM.zip
ECOSYS.zip
ED2.zip
EPIC.zip
ISAM.zip
ISOLSM.zip
LPJ.zip
LoTEC.zip
ORCHIDEE.zip
SSiB2.zip
SiB3.zip
SiBCASA.zip
SiBCrop.zip
TECO.zip
TRIPLEX.zip

Table 2. Companion Files

FILE NAME	DESCRIPTION
site_information_basic.csv	Basic information about each flux tower site (site code, name, PI, affiliation, email, address, references, priority, biome, etc.)
site_information_extended.pdf	Summarizes site code, name, PI, affiliation, email, address, references, priority, biome, etc.
site_location_summary.csv	Summarizes all site location information required as input to all models: latitude, longitude, elevation, instrument height, biome, start and stop years, time zone shift to local standard time, and the flux time averaging period
site_synthesis_protocol_v7.pdf	Describes standardized site synthesis protocol
site_synthesis_documentation.pdf	Additional documentation for the three NACP Site Synthesis data sets

3. Data Application and Derivation:

This data product contributes to a multidisciplinary research program to obtain scientific understanding of North America's carbon sources and sinks and of changes in carbon stocks needed to meet societal concerns and to provide tools for decision makers. The data were generated as part of a NACP site-level synthesis to evaluate and inter-compare models and observation measurements across North America.

The site-level NACP data set was used to assess how well models simulated carbon process across vegetation types and environmental conditions at 47 eddy covariance flux tower sites in North America. This data set includes the original model data submissions from 24 terrestrial biosphere models.

4. Quality Assessment:

The original model output submitted by modeling teams is archived with only format and units conversions. It is strongly recommended that users work closely with the modeling teams when using these data to ensure accurate analysis.

5. Data Acquisition Materials and Methods:

5.1 Participating Flux Tower Sites

Participating eddy flux covariance towers in the Site Synthesis were divided into a Priority 1 and a Priority 2 list. The Priority 1 sites represent a broad range of vegetation types and geographic regions to test each model's performance under the fullest range of expected conditions across North America. No more than three Priority 1 sites were chosen to represent each of the major biome types in North America as defined by the IGBP biome classification.

The Priority 1 list represents the minimum number of tower sites required to evaluate model performance in North America. The Priority 2 list expands the site selection to include towers required for specialized analyses. Each participating site provided data as input to models and for comparison with model output, as described below.

An additional 11 flux tower sites that lacked ancillary and biological data were identified as third-priority sites (see Figure 1) but were not used as part of the model-data comparison.

For each site we used the unique FLUXNET code CC-XXX, where CC is a two-letter country code and XXX is a three-letter site code. The site codes are a unique identifier for each site and a convenient naming convention for all model input and output files.

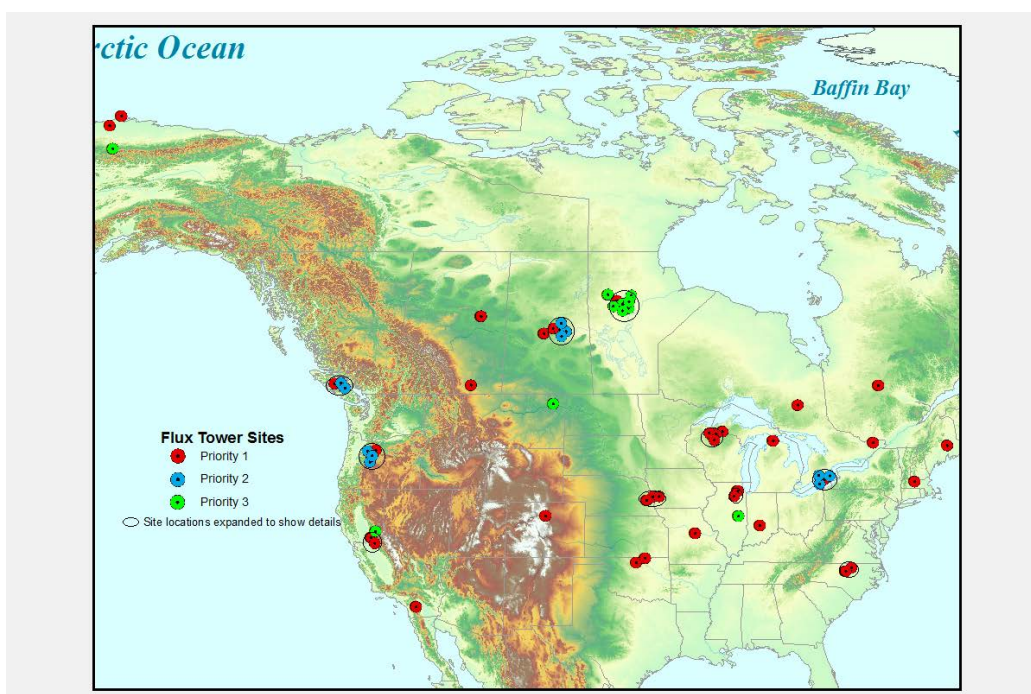


Figure 1. Flux Tower Site Locations: First-priority sites (36 sites) and Second-priority sites (11 chronosequence sites) were used for the model-data comparison. The third-priority sites (11 sites) were not used as part of the model-data comparison.

Table 3. NACP Site-Level Synthesis - First-priority sites (36 sites). These sites have forcing and flux with uncertainty data but not all sites provided ancillary data.

FLUXNET Site Code	Full Name	Period of Record ¹	Flux w/ Uncertainty Data	Ancillary Data	State/Prov	Type ²
US-ARM	ARM – Southern Great Plains	2000-2006	yes	yes	OK	CRO
US-Ne1	Mead – Irrigated maize	2001-2006	yes	yes	NE	CRO
US-Ne2	Mead – Irrigated maize/soybean	2001-2006	yes	yes	NE	CRO
US-Ne3	Mead – Rainfed maize/soybean	2001-2006	yes	yes	NE	CRO
US-IB1	Fermi Lab – Maize/soybean rotation	2005-2007	yes	yes	IL	CRO
CA-Let	Lethbridge Grassland	1997-2006	yes	yes	AB	GRA

US-Var	Vaira Ranch	2001-2007	yes	yes	CA	GRA
US-Shd	Shidler	1997-2001	yes	yes	OK	GRA
US-IB2	Fermi Lab – Prairie	2004-2007	yes	yes	IL	GRA
CA-Oas	BERMS – Old Aspen	1997-2006	yes	yes	SK	DBF
US-Ha1	Harvard Forest – EMS Tower	1991-2006	yes	yes	MA	DBF
US-Dk2	Duke Forest – Hardwood	2003-2005	yes	yes	NC	DBF
US-UMB	University of Michigan Biological Station (UMBS)	1998-2006	yes	yes	MI	DBF
US-MMS	Morgan Monroe State Forest	1999-2006	yes	yes	IN	DBF
US-WCr	Willow Creek	1998-2006	yes	no	WI	DBF
US-MOz	Missouri Ozark	2004-2007	yes	yes	MO	DBF
CA-Man	BOREAS – Northern Study Area, Old Black Spruce	1994-2006	yes	yes	MB	ENFB
CA-Obs	BERMS – Old Black Spruce	2000-2006	yes	yes	SK	ENFB
CA-Ojp	BERMS – Old Jack Pine	2000-2006	yes	yes	SK	ENFB
CA-Qfo	Quebec – Mature Black Spruce	2004-2006	yes	yes	QB	ENFB
CA-Ca1	Campbell River – Mature Douglas-fir	1998-2006	yes	yes	BC	ENFT
US-Dk3	Duke Forest – Loblolly Pine	1998-2005	yes	yes	NC	ENFT
US-Ho1	Howland Forest – Main Tower	1996-2004	yes	yes	ME	ENFT
US-Me2	Metolius – Intermediate-aged Ponderosa Pine	2002-2007	yes	yes	OR	ENFT
US-NR1	Niwot Ridge	1998-2007	yes	yes	CO	ENFT
CA-TP4	Turkey Point – Mature	2002-2007	yes	yes	ON	ENFT
US-PFa	Park Falls / WLEF	1997-2005	yes	yes	WI	MF
US-Syv	Sylvania Wilderness Area	2001-2006	yes	yes	MI	MF
CA-Gro	Groundhog River Station	2004-2006	yes	yes	ON	MF
US-Ton	Tonzi Ranch	2001-2007	yes	yes	CA	WSA
US-SO2	Sky Oaks – Old	1998-2006	yes	yes	CA	SHR
US-Brw	Barrow	1998-2006	yes	yes	AK	TUN
US-Atq	Atkasuk	1999-2006	yes	yes	AK	TUN
CA-Mer	Eastern Peatland – Mer Bleue	1999-2006	yes	yes	ON	WET
US-Los	Lost Creek	2000-2006	yes	no	WI	WET
CA-WP1	Western Peatland – LaBiche River	2003-2007	yes	no	AB	WET

Table 4. NACP Site-Level Synthesis - Second-priority sites (11 chronosequence sites). All second-priority sites have forcing data but not all sites have flux with uncertainty data and none provided ancillary data.

FLUXNET Site Code	Full Name	Period of Record ¹	Flux w/ Uncertainty Data	Ancillary Data	State/Prov	Type ²
CA-SJ1	BERMS – Jack Pine, 1994 harvest	2002-2005	yes	no	SK	ENFB
CA-SJ2	BERMS – Jack Pine, 2002 harvest	2003-2006	yes	no	SK	ENFB
CA_SJ3	BERMS – Jack Pine, 1975 harvest	2004-2005	yes	no	SK	ENFB
CA-Ca2	Campbell River – Douglas-fir clearcut	2001-2006	yes	no	BC	ENFT
CA-Ca3	Campbell River –	2002-	yes	no	BC	ENFT

	Douglas-fir juvenile	2006				
US-Me3	Metolius – Ponderosa Pine, young #2	2004-2005	yes	no	OR	ENFT
US-Me4	Metolius – Ponderosa Pine, old-growth	1996-2000	no	no	OR	ENFT
US-Me5	Metolius – Ponderosa Pine, Young #1	1999-2002	yes	no	OR	ENFT
CA-TP1	Turkey Point – Young	2003-2007	no	no	ON	ENFT
CA-TP2	Turkey Point – Seedling	2003-2007	no	no	ON	ENFT
CA-TP3	Turkey Point – Middle-aged	2003-2007	no	no	ON	ENFT

Notes (apply to both tables):

¹Start-end years in the gap-filled weather data. Partial years (from flux data record) have been extended to complete years of surface weather data to simplify model forcing. ²Types were assigned for convenience in this project, to identify combination of vegetation type and climate zone as an aid in site selection. These type names are not intended to match the IGBP classification assigned in other databases. Class: CRO = crop; GRA = grassland; ENFB = evergreen needleleaf forest – boreal; ENFT = evergreen needle leaf forest – temperate; DBF = deciduous broadleaf forest; MF = mixed (deciduous/evergreen) forest; WSA = woody savanna; SHR = shrubland; TUN = tundra; and WET = wetland. An additional 11 flux tower sites, which lack ancillary and biological data templates, were identified as third-priority sites (see Figure 4) but were not used as part of the model-data comparison.

5.2 Site Synthesis Protocol

Participating modeling teams followed the NACP Site Synthesis Protocol ([site_synthesis_protocol_v7.pdf](#)), which covers procedures, plans, and infrastructure for the site-level analyses. MAST-DC provided each modeling team with standardized model input data for each flux tower site. The input data included: gap-filled, locally observed weather; remotely-sensed phenology; land use history; and site description data. The input data are described and provided in a related data set, NACP Site: Tower Meteorology, Flux Observations with Uncertainty, and Ancillary Data ([10.3334/ORNDAAC/1178](#)). To ensure consistency, each modeling team followed standard model setup and spinup procedures (see the [NACP Site Synthesis Protocol](#)). All models used their standard values for various biophysical parameters except LoTEC, which used optimized parameter values obtained through data assimilation (Ricciuto et al., 2011).

5.3 Model Output

This data set contains the original model output data submissions from the 24 terrestrial biosphere models (TBM) that participated in the North American Carbon Program (NACP) Site-Level Synthesis. The model teams generated estimates for a minimum of six variables, including gross primary productivity (GPP), net ecosystem exchange (NEE), leaf area index (LAI), ecosystem respiration (Re), latent heat flux (LE), and sensible heat flux (H) for each of 47 selected eddy covariance flux tower sites across North America. Participating modeling teams followed the NACP Site Synthesis Protocol ([Site_Synthesis_Protocol_v7.pdf](#)) which covers procedures, plans, and infrastructure for the site-level analyses. File format and units conversions of several data submissions were made by the MAST-DC to produce NetCDF files of consistent content and structure for all 24 TBM outputs. The model outputs are structured as described in Appendix A: Model Output Variables, of the Site Synthesis Protocol.

Some caveats about the original model output data:

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- Note that not all models produced output estimates for all flux tower sites, therefore, site inclusion varies.
- Some models produced output estimates for additional variables which are included only in their data files.
- File sizes vary based on the individual modeling team's submissions.

In addition, MAST-DC processed these original model submissions to derive uniquely processed and formatted data files for model inter-comparison and evaluation ([NACP Site: Terrestrial Biosphere Model and Aggregated Flux Data in Standard Format](#)). This related data set provides GPP, NEE, LAI, Re, LE, and sensible heat (H) model output variables at the native half-hourly time step, and in daily, monthly, and annual aggregations. The related data set also contains gap-filled observations and total uncertainty estimates at the same time steps.

6. Data Access:

This data set is available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

Data Archive Center:

Contact for Data Center Access Information:

E-mail: uso@daac.ornl.gov

Telephone: +1 (865) 241-3952

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