NACP Regional: National Greenhouse Gas Inventories and Aggregated Gridded Model Data

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Revision Date: August 21, 2013

Summary:

This data set provides two products that were derived from the recently published North American Carbon Program (NACP) Regional Synthesis 1-degree terrestrial biosphere model (TBM) and inverse model (IM) outputs (Gridded 1-deg Observation Data and Biosphere and Inverse Model Outputs, Wei et al., 2013).

The first product is the aggregation of the standardized gridded 1-degree TBM and IM outputs to the Greenhouse Gas (GHG) inventory zones as defined for North America (United States, Canada, and Mexico). Depending on the data availability, the monthly/yearly Net Ecosystem Exchange (NEE), Net Primary Production (NPP), Total Vegetation Carbon (VegC), Heterotrophic Respiration (Rh), and Fire Emissions (FE) outputs from the 22 TBM and 7 IM models were aggregated from the 1-degree resolution gridded format to the inventory zones and then, further divided into Forest Lands, Crop Lands, and Other Lands sectors within each inventory zone based on the 1-km resolution GLC2000 land cover map (GLC2000, 2003).

The second product is the North American national GHG inventories on the scale of inventory zones which contain estimated land-atmosphere exchange of CO2 (NEE) in forest lands, crop lands, and other lands sectors. NEE estimates were synthesized from inventory-based data on productivity, ecosystem carbon stock change, and harvested product stock change, and additional information from national-level GHG inventories of the United States, Canada, and Mexico including EPA (2011) and Environment Canada (2011).

An additional summary file of annual mean NEE (2000-2006) is provided for both land sectors and reporting zones in North America and was created by combining the aggregated model output and the national GHG database and is provided.

The aggregated monthly and yearly model output data and the national GHG inventories data are available in comma separated value (*.csv) format files.

Also provided are detailed inventory zone spatial data as an ESRI Shapefile. Included are zone names, boundaries, and zone and land cover type area attributes. For mapping convenience, the inventory zones shapefile was merged with 1-km forest, crop, and other lands masks to create a 1-km resolution reference data file that was converted to GeoTIFF format. The GeoTIFF defines to which inventory zone and land cover type each 1-km grid cell belongs.

This document provides detailed information about the content, format, and processing procedures of these two data products. Detailed descriptions of the TBMs and IMs can be found in a separate companion document: NACP Regional Synthesis - Description of Observations and Models.

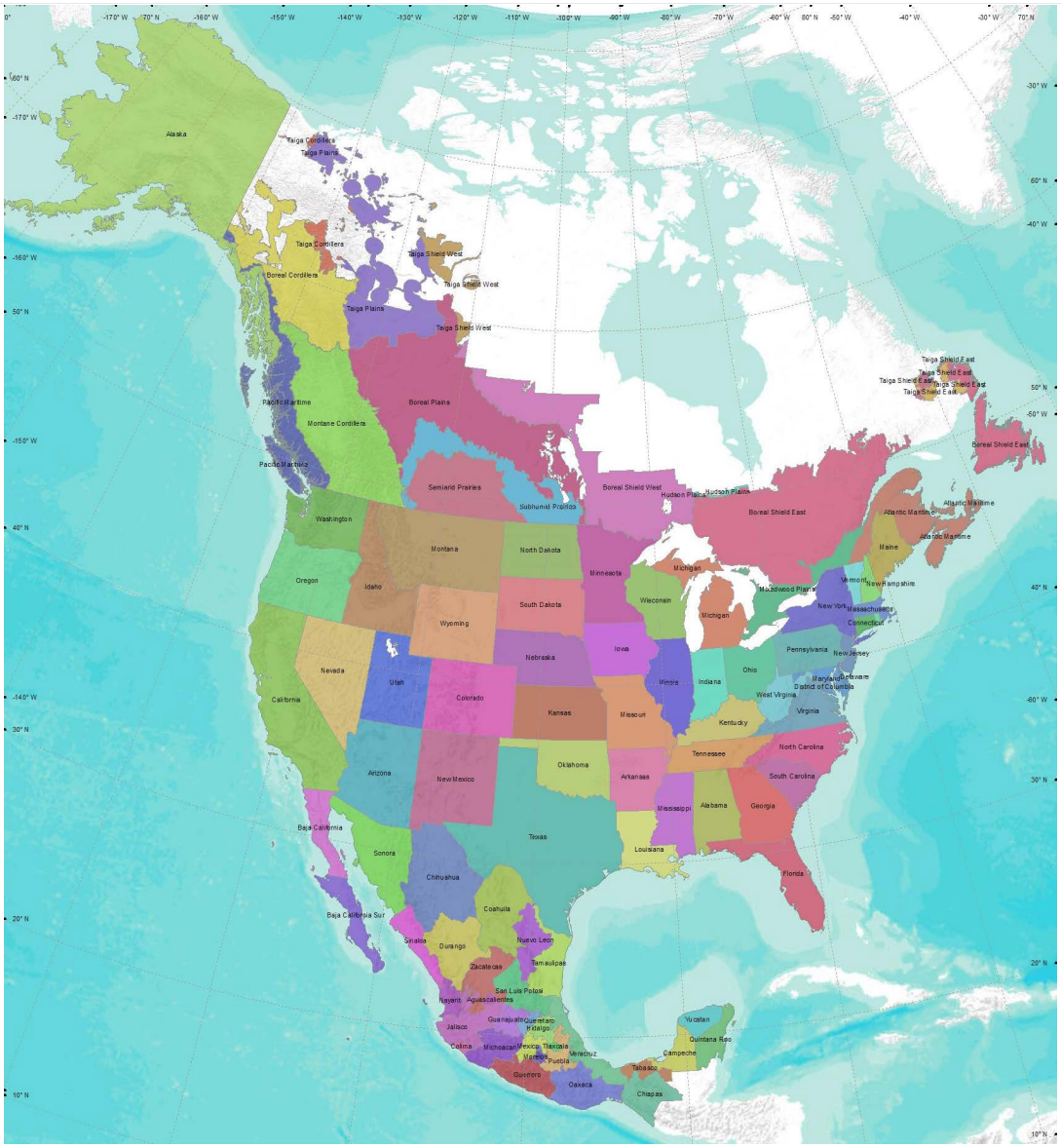

Figure 1. North American inventory zones map.

This data set is related to two other processed regional data sets (i.e., NACP Regional: Gridded 1-deg Observation Data and Biosphere and Inverse Model Outputs; and NACP Regional: Supplemental Gridded Observations, Biosphere and Inverse Model Outputs); and to the originally-submitted NACP Regional: Original Observation Data and Biosphere and Inverse Model Outputs. The data set was also used in the model-inventory comparison activities of the NACP Regional Synthesis.

This data set was compiled by the Modeling and Synthesis Thematic Data Center (MAST-DC). MAST-DC was a component of the NACP (www.nacarbon.org) designed to support NACP by providing data products and data management services needed for modeling and synthesis activities. The overall objective of MAST-DC was to provide data management support to NACP investigators and agencies performing modeling and synthesis activities. The products were used in the model-inventory comparison activities of the NACP Regional Synthesis.

Data and Documentation Access:

Get Data: http:daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=1179

Companion Documentation for this Data Set:

- Regional-Description_of_Observations_and_Models.pdf
- Regional-Standardized_Inventory_Zones.pdf
- NACP_Model_Metadata_Survey_Results.pdf
- NACP_Model_Characteristics.pdf

Model Characteristics Overview and References: NACP_Model_Characteristics.pdf

Related Data Products:

NACP Regional: Original Observation Data and Biosphere and Inverse Model Outputs
NACP Regional: Gridded 1-deg Observation Data and Biosphere and Inverse Model Outputs [http:daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=1157]
NACP Regional: Supplemental Gridded Observation, Biosphere and Inverse Model Outputs [http:daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=1158]

Data Citation:

Cite this data set as follows:

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Table of Contents:

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 program 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.

NACP and 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 analyses 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 were conducted, including ones focusing on non-CO2 greenhouse gases, the impact of disturbance on carbon exchange, and coastal carbon dynamics. The Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) is the archive for the NACP synthesis data products.

NACP Regional Synthesis

This data set contains part of the third NACP synthesis product described above: regional analyses. The data products were compiled and used in model-inventory comparison activities.

Table 1. Contributors

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		Montana		GPP/NPP

Table 2 lists all of the models and their corresponding output variables that were aggregated to inventory zones, along with their temporal coverage and resolution. For selected models and output variables, other variables were used to derive the data. For example, the aggregated Veg variable of model CLM-CASA was derived from LEAFC+WOODC+FROOTC, which was comparable to variable TOTVEGC of model CLM-CN or variable TotLivBiom of model MC1. A cell marked with "n/a" means a variable is neither directly available nor derivable from other variables for a model.

Table 2. List of Model and Variables Aggregated to Inventory Zones

Model			Temporal Coverage*	Temporal Resolution	Variables				
					NEE	NPP	Veg	Rh	FE
Terrestrial Biosphere Models	CLM-CASA	i01.54 i01.54_q15 i01.55 i01.55_q15	2000-2004	monthly	NEE	NPP	(LEAFC + WOODC + FROOTC)	HR	n/a
	CLM-CN	i01.56 i01.57_q15	2000-2004	monthly	NEE	NPP	TOTVEGC	HR	n/a
	ORCHIDEE		2001-2007	monthly	CO2FLUX	NPP	n/a	HET_RESP	n/a
	SiB3		2000-2005	monthly	NEE	n/a	n/a	n/a	n/a
	CASA-Transcom		2002-2003	monthly	NEE	n/a	n/a	n/a	n/a
	CASA GFed2		2000-2005	monthly	NEEF	n/a	n/a	n/a	CFire (derived from NEEF-NEE)
	NASA-CASA		2001-2004	monthly	(-1 * NEP)	NPP	n/a	(NPP – NEP)	n/a
	MC1		2000-2007	monthly	NEE + BioCons	NPP	TotLivBiom	RespH	BioCons
	TEM6		2000-2006	monthly	NCE	NPP	VEGC	RH	(NCE - NEE)
	DLEM		2000-2005	monthly	NEE	NPP	TotLivBiom	Rh	n/a
	VEGAS		2000-2007	monthly	NEE	NPP	cvege	Rh	cfire
	EC-MOD		2001-2006	monthly	NEE	n/a	n/a	n/a	n/a
	MOD17-plus		2000-2004	monthly	(GPP – Reco)	n/a	n/a	n/a	n/a
	ISAM		2000-2007	monthly	NEE	NPP	n/a	resp	n/a
	BEPS		2000-2004	monthly	(-1 * NEP)	NPP	n/a	(NPP - NEP)	n/a
	LPJmL		2000-2006	monthly, yearly	NEE (monthly), ANEEF (annually, derived from ANEE+FIRE)	NPP	VEGC (annually)	RH	FIRE (annually)
	Can-IBIS		2000-2005	monthly,yearly	NEE (derived from -1*NEP)	NPP	CBiomass (annually)	Rh	n/a
Inverse Models	UToronto		2001-2003	monthly	NEE	n/a	n/a	n/a	n/a
	CarbonTracker		2000-2007	monthly	NEE	n/a	n/a	n/a	n/a
	LCSE-no1 (Peylin)		2002-2004	monthly	NEE	n/a	n/a	n/a	n/a
	JENA (Rodenbeck)		2000-2007	monthly	NEE	n/a	n/a	n/a	n/a
	Michigan-Geostatistical		2000-2001	monthly	NEE	n/a	n/a	n/a	n/a
	CSU-no1 (MLEF-PCTM)		2003-2004	monthly	NE	n/a	n/a	n/a	n/a
	LSCE-no2 (Chevalier)		2000-2006	monthly	NEE	n/a	n/a	n/a	n/a

Note: * Only data in and after year 2000 were included in aggregation.

Table 3. Data Product Summary

Data Set Category	Sub Category	Variables	File Formats
Model Outputs Aggregated to Inventory Zones	Terrestrial Biosphere Model (TBM) Outputs	5 (NEE, NPP, VegC, Rh, FE)	Comma-Separated-Value (.csv)
	Inverse Model (IM) Outputs	1 (NEE)	
GHG Inventory Data	National GHG inventories and the estimation of land-atmosphere exchange of CO2 (NEE) by reporting zone and land sector	9 (forest area, live biomass C, soil organic matter/non-live, non-soil C, fire CO2 emissions, C removal as harvested products, NPP, HR, C emissions in processing of harvested products, NEE)	
NEE (2000-2006) Summary Data	Annual mean NEE (2000-2006) by sectors and zones in North America	1 (NEE)	

2. Data Description:

Aggregated Model Output

This data set contains two major categories of data:

(1) standardized gridded biosphere model and inverse model outputs aggregated to the inventory zones defined for North America (United States, Canada, and Mexico) and further divided into Forest Lands, Crop Lands, and Other Lands sectors for each inventory zone based on the 1-km resolution GLC2000 land cover map; and

(2) North American national GHG inventories, which contain estimated land-atmosphere exchange of CO2 (NEE) in Forest Lands, Crop Lands, and Other Lands sectors synthesized from inventory-based data on productivity, ecosystem carbon stock change and harvested product stock change.

An additional summary file of annual mean NEE (2000-2006) by both land sectors and reporting zones in North America was created by combining the aggregated model output and the national GHG database and is provided.

The aggregated monthly/yearly model output data and the national GHG inventories data are stored in comma separated value (*.csv) format.

Spatial Data Connection

All the above data files are non-spatial data, but they can be linked to the two auxiliary spatial data files described below for further spatial analysis and mapping purposes. NAZonesFine.shp is a Shapefile that provides detailed inventory zones information, including zone names, boundaries, and associated zone attributes at a spatial scale of 1:15,000,000. NA_Reporting_Zones_Sectors.tif is a 1-km resolution reference zone and sector mask data file in GeoTIFF format that defines to which reporting zone and sector each 1-km grid cell belongs. It was created by merging the North American reporting zones shapefile with land sector masks.

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. Coordinate Reference System

The Coordinate Reference System (CRS) of both auxiliary spatial data files is WGS 84. Below is its definition in the format of Open Geospatial Consortium Well Know Text (OGC WKT) format:

GEOGCS["WGS 84",
DATUM["WGS_1984",
SPHEROID["WGS 84",6378137,298.257223563,
AUTHORITY["EPSG","7030"]],

AUTHORITY["EPSG","6326"]],
PRIMEM["Greenwich",0,
AUTHORITY["EPSG","8901"]],
UNIT["degree",0.01745329251994328,
AUTHORITY["EPSG","9122"]],
AUTHORITY["EPSG","4326"]]

2.3. Spatial Resolution

The spatial scale for the inventory zone shapefile **NAZonesFine.shp** is 1:15,000,000. The spatial resolution for the reference zone & sector mask data file is 0.0089285714 degree, or about 1-km.

2.4. Temporal Coverage

Varies (range: 2000-2007)

2.5. Temporal Resolution

Monthly or yearly

2.6. Data File Information

2.6.1. Aggregated Model Output

For each TBM and IM model, a compressed file (*model.zip*) contains the aggregated output data files, organized by variable, with one data file for each of the monthly and yearly time periods in and after 2000. The output variables and temporal range for each model are listed in Table 2.

Table 4. Terrestrial Biosphere Model Output Data Files

TBM Output Data Files	IM Output Data Files
TBM_BEPS_InventoryZone.zip	IM_CSU-no1_Zone.zip
TBM_CASA-GFEDv2_InventoryZone.zip	IM_CarbonTracker_Zone.zip
TBM_CASA-Transcom_InventoryZone.zip	IM_JENA_Zone.zip
TBM_CLM-CASA_55_Zonal_Monthly.zip	IM_LCSE-no1_Zone.zip
TBM_CLM-CASA_i54_InventoryZone.zip	IM_LCSE-no2_Zone.zip
TBM_CLM-CASA_i54q15_InventoryZone.zip	IM_Michigan-Geostatistical_Zone.zip
TBM_CLM-CASA_i55q15_InventoryZone.zip	IM_UToronto_Zone.zip
TBM_CLM-CN_56_Zonal_Monthly.zip	
TBM_CLM-CN_57q15_Zonal_Monthly.zip	
TBM_CLM-CN_Zonal_Monthly.zip	
TBM_Can-IBIS_InventoryZone.zip	
TBM_DLEM_Zonal_Monthly.zip	
TBM_EC-MOD_Zonal_Monthly.zip	
TBM_ISAM_Zonal_Monthly.zip	
TBM_LPJmL_Zonal_Monthly.zip	
TBM_MC1_Zonal_Monthly.zip	
TBM_MOD17-plus_Zonal_Monthly.zip	
TBM_NASA-CASA_Zonal_Monthly.zip	
TBM_ORCHIDEE_Zonal_Monthly.zip	
TBM_SiB3-plus_Zonal_Monthly.zip	
TBM_TEM6_Zonal_Monthly.zip	
TBM_VEGAS2_Zonal_Monthly.zip	

When a compressed file (*model.zip*) is expanded, the data files are organized by variable and named as follows:

Annual time-step data files are named as: *model_variable*_YYYY.csv

Monthly time-step data files are named as: *model_variable*_YYYYMM.csv

Example of Expanded Model Output File: TBM_CLM-CN_Zonal_Monthly.zip

TBM_CLM-CN_Zonal_Monthly/ (there is a subdirectory for each output variable)

NEE/

CLMCN_NEE_2000.csv (annual file, YYYY)

…

CLMCN_NEE_2004.csv

CLMCN_NEE_200001.csv (monthly file, YYYYMM)

…

CLMCN_NEE_200412.csv

NPP/

Rh/

Veg or VegC/

FE/

NEEF/

Note that IM model files only contain NEE data files.

Model Output File Contents:

For each variable, the following information is provided at each annual and monthly time step: a sum and area-weighted average for each zone, the sum of each variable by land cover type (forest, crop, other) for each zone, and the area-weighted average of each variable by land cover type (forest, crop, other) for each zone.

Table 5. Annual Data File Contents:

Column Name	Units	Description
OBJECTID		Unique ID of each reporting zone. It can be used to link back to the reporting zone polygons for mapping and spatial analysis. Also, Zone_ID
Zone_		Name of reporting zone. Also, Zone_Name
SUM_*variable**	kgC/year	Sum of variable for forest, crop, and other land cover types for zone. Sum of next three columns.
SUM_*variable*_F	kgC/year	Sum of variable for forest land cover type for zone.
SUM_*variable*_C	kgC/year	Sum of variable for crop land cover type for zone.
SUM_ variable_O	kgC/year	Sum of variable for all other land cover types for zone.
AVG_*variable*	kgC/m2/year	Area-weighted average of variable for forest, crop, and other land cover types for zone.
AVG_*variable*_F	kgC/m2_of_forest_area/year	Area-weighted average of variable for forest land cover type for zone.
AVG_*variable*_C	kgC/m2_of_crop_area/year	Area-weighted average of variable for crop land cover type for zone.
AVG_variable_O	kgC/m2_of_other_area/year	Area-weighted average of variable for all other land cover types for zone.
MODEL_NAME		Model abbreviation/acronym
PERIOD	YYYY	Year reported.

variable* = NEE, NPP, Rh, VegC, FE, NEEF

***Note that VegC was reported as a single monthly estimate of biomass -- not the sum of more frequent estimates.

Example Data Records: BEPS_NEE_2000.csv

```
OBJECTID,Zone_,SUM_NEE,SUM_NEE_F,SUM_NEE_C,SUM_NEE_O,AVG_NEE,AVG_NEE_F,
AVG_NEE_C,AVG_NEE_O,MODEL_NAME,PERIOD
1,"Aguascalientes",1348576487.9333,354109096.48465,124316331.60469,870151059.8416,0.241047345,0.241495992,
0.258280493,0.238592579,"BEPS","2000"
2,"Alabama",-3469663161.320003,-52290465.266001,-2545006998.444,-872365697.6271,-0.025819, -0.000519,
-0.102347,-0.099634,"BEPS","2000"
3,"Alaska",1557942057.51001,4226545721.485,-503947616.85851,-2164656047.252998,0.001032567, 0.010325192,
```

```
-0.033816,-0.001996,"BEPS","2000"
…
37,"Kentucky",-6286697580.731999,-503608786.5066,-5536245211.075,-246843583.1518,-0.060367, -0.008801,
-0.124193,-0.105449,"BEPS","2000"
56,"New Jersey",-4621521636.3857,-3553303595.4253,-403854192.2452,-664363848.7137,-0.234434, -0.267431,
-0.179307,-0.159149,"BEPS","2000"
72,"San Luis Potosi",23016515438.107,7922971766.1432,10299937853.608,4793605818.3542,0.359743892,
0.493990662,
1.169769434,0.122484361,"BEPS","2000"
```

Table 6. Monthly Data File Contents:

Column Name	Units	Description
OBJECTID		Unique ID of each reporting zone. It can be used to link back to the reporting zone polygons for mapping and spatial analysis. Also, Zone_ID
Zone_		Name of reporting zone. Also, Zone_Name
SUM_*variable**	kgC/month	Sum of variable for forest, crop, and other land cover types for zone. Sum of next three columns.
SUM_*variable*_F	kgC/month	Sum of variable for forest land cover type for zone.
SUM_*variable*_C	kgC/month	Sum of variable for crop land cover type for zone.
SUM_*variable*_O	kgC/month	Sum of variable for all other land cover types for zone.
AVG_*variable*	kgC/m2/month	Area-weighted average of variable for forest, crop, and other land cover types for zone.
AVG_*variable*_F	kgC/m2_of_forest_area/month	Area-weighted average of variable for forest land cover type for zone.
AVG_*variable*_C	kgC/m2_of_crop_area/month	Area-weighted average of variable for crop land cover type for zone.
AVG_*variable*_O	kgC/m2_of_other_area/month	Area-weighted average of variable for all other land cover types for zone.
MODEL_NAME		Model abbreviation/acronym

variable* = NEE, NPP, Rh, VegC, FE, NEEF

***Note that VegC was reported as a single monthly estimate of biomass -- not the sum of more frequent estimates.

Example Data Records: LPJmL_NPP_200412.csv

```
OBJECTID,Zone_,SUM_NEE,SUM_NEE_F,SUM_NEE_C,SUM_NEE_O,AVG_NEE,AVG_NEE_F,
AVG_NEE_C,AVG_NEE_O,MODEL_NAME,PERIOD
1,"Aguascalientes",-188405989.211,-50187718.2739,-16245868.144,-121972402.793,
-0.033676, -0.034227,-0.033753,-0.033444
2,"Alabama",2700373282.88,2079147028.96,447472522.485,173753731.432,
0.020094261,0.020634001, 0.017995067,0.01984454
3,"Alaska",-2039038892.45,-629978804.87,-58795085.4363,-1350265002.14,
-0.001351,-0.001539, -0.003945,-0.001245
…
95,"Wyoming",-596649117.106,-226724409.814,-6400282.72015,-363524424.572,
-0.002346,-0.003803,-0.002213,-0.001895
96,"Yucatan",-297105626.192,-222049975.169,-59293206.5953,-15762444.4289,
-0.007848, -0.007363,-0.008712,-0.017647
97,"Zacatecas",-1712269243.9,-304987190.751,-29052579.5864,-1378229473.57,
-0.022886,-0.023377,-0.030178,-0.022665
```

2.6.2. GHG Inventories and NEE

GHG inventories, which contain estimated land-atmosphere exchange of CO2 (NEE) in Forest Lands, Crop Lands, and Other Lands sectors synthesized from inventory-based data on productivity, ecosystem carbon stock change and harvested product stock change, and additional information from national-level GHG inventories of the United States, Canada, and Mexico.

For ease of comparison, the descriptions below of the *.csv data files are grouped by Forest Lands, Crop Lands, and Other Lands rather than by country.

Table 7. National GHG Inventory Data Files

FILE NAMES	

COMPRESSED FILE NAMES	UNCOMPRESSED DATA FILE NAMES
Inventory_CAN.zip	Inventory_CAN_Crop.csv
	Inventory_CAN_Forest.csv
	Inventory_CAN_Other.csv
Inventory_MEX.zip	Inventory_MEX_Forest.csv
	Inventory_MEX_Other.csv
Inventory_USA.zip	Inventory_USA_Crop.csv
	Inventory_USA_Forest.csv
	Inventory_USA_Other.csv

2.6.3. Attributes of Forest Lands GHG Inventories and NEE_F

Canada Forest Lands: Table 8 lists the major components of GHG inventories and the estimation of land-atmosphere exchange of CO_2 (NEE_F) by Canada reporting zone in forest lands sector.

Table 8. Attributes of Canada Forest Lands GHG Inventories

Attribute	Attribute Column Name	Units	Description
Zone ID	Zone_ID		Unique ID of each reporting zone. It can be used to link back to the reporting zone polygons for mapping and spatial analysis.
SectorZone ID	SectorZone_ID		Unique ID of each reporting zone and land sector combination. It can be used to link back to reference land sector mask data for mapping and spatial analysis.
Zone Name	Zone_Name		Name of reporting zone.
Forest Area	Forest_Area	km^2	Area of forest in each reporting zone.
ΔLiveC	dLiveC	TgC yr-1	Carbon stock change in live biomass pools
ΔDOM	dDOM	TgC yr-1	Carbon stock changes in soil organic matter and in non-live, non-soil pools (standing dead, litter, coarse woody debris)
Fire (C)	FireC	TgC yr-1	Fire emissions (carbon in all forms)
H_R	HCRemoved	TgC yr-1	Total C removed from the stand as harvests in the Managed Forest sector of each reporting zone
NPP	NPP	TgC yr-1	Net Primary Productivity
Rh	Rh	TgC yr-1	Heterotrophic Respiration
Fire (CO_2)	FireCO2	TgC yr-1	Fire emissions (carbon in CO2 only)
H_E	HCEmitted	TgC yr-1	The amount of C emitted from the processing of harvested products within the forest sector = $-0.3*H_R$
NEE_F	NEE	TgC yr-1	$\Delta LiveC + \Delta DOM - (Fire\ (C) - Fire\ (CO_2)) + H_R + H_E = NPP + Rh + Fire\ (CO_2) + H_E$

U.S. Forest Lands: Table 9 lists the major components of GHG inventories and the estimation of land-atmosphere exchange of CO_2 (NEE_f) by US States in forest lands sector.

Table 9. Attributes of US Forest Lands GHG Inventories

Attribute	Attribute Column Name	Units	Description
Zone ID	Zone_ID		Unique ID of each reporting zone. It can be used to link back to the reporting zone polygons for mapping and spatial analysis.
SectorZone ID	SectorZone_ID		Unique ID of each reporting zone and land sector combination. It can be used to link back to reference land sector mask data for mapping and spatial analysis.
Zone Name	Zone_Name		Name of reporting zone.
Forest Area	Forest_Area	km^2	Area of forest in each reporting zone.
ΔLiveC	dLiveC	TgC yr-1	Carbon stock change in live biomass pools
ΔDOM	dDOM	TgC yr-1	Carbon stock changes in soil organic matter and in non-live, non-soil pools (standing dead, litter, coarse woody debris)

H_R	HCRemoved	TgC yr-1	Total C removed from the stand as harvested products in each reporting zone
H_E	HCEmitted	TgC yr-1	The amount of C emitted from the processing of harvested products within the forest sector = -0.3*H_R
NEE_F	NEE	TgC yr-1	NEE_F = ΔLive + ΔDOM + H_R + H_E

Mexico Forest Lands: Table 10 lists the major components of GHG inventories and the estimation of land-atmosphere exchange of CO_2 (NEE_f) by Mexico States in forest lands sector.

Table 10. Attributes of Mexico Forest Lands GHG Inventories

Attribute	Attribute Column Name	Units	Description
Zone ID	Zone_ID		Unique ID of each reporting zone. It can be used to link back to the reporting zone polygons for mapping and spatial analysis.
SectorZone ID	SectorZone_ID		Unique ID of each reporting zone and land sector combination. It can be used to link back to reference land sector mask data for mapping and spatial analysis.
Zone Name	Zone_Name		Name of reporting zone.
Forest Area	Forest_Area	km^2	Area of forest in each reporting zone.
$\Delta Live_{LUC}$	Biomass_Conversion	TgC yr-1	Carbon stock change in live biomass pools due to forest land use conversion
$\Delta Soil_{LUC}$	dSoilC	TgC yr-1	Carbon stock change in soil organic matter pools due to forest land use conversion
$\Delta Live_{ABND}$	Abandonment	TgC yr-1	Carbon stock change in live biomass pools due to biomass increment on forest land regenerating after agricultural abandonment
$\Delta Live_{MNGD}$	Fuelwood+Uptake	TgC yr-1	Carbon stock change in live biomass pools due to biomass increment and fuelwood harvest in managed forest land
Total NEE	Total_NEE	TgC yr-1	Total Net Ecosystem Exchange from forest land

2.6.4. Attributes of Crop Lands GHG Inventories and NEE_c

Canada Crop Lands: Table 11 lists the major components of GHG inventories and the estimation of land-atmosphere exchange of CO_2 (NEE_c) by Canada reporting zone in crop lands sector.

Table 11. Attributes of Canada Crop Lands GHG Inventories

Attribute	Attribute Column Name	Units	Description
Zone ID	Zone_ID		Unique ID of each reporting zone. It can be used to link back to the reporting zone polygons for mapping and spatial analysis.
SectorZone ID	SectorZone_ID		Unique ID of each reporting zone and land sector combination. It can be used to link back to reference land sector mask data for mapping and spatial analysis.
Zone Name	Zone_Name		Name of reporting zone.
Crop Area	Crop_Area	km^2	Area of crop in each reporting zone.
NPP	NPP	TgC yr-1	Crop Net Primary Productivity
H_R	Harvest	TgC yr-1	Total C removed as harvested crop products in each reporting zone
ΔSOILC	dSoilC	TgC yr-1	Carbon stock change in soil organic matter pools in agricultural land
NEE_C	NEE	TgC yr-1	NEE = H_R + ΔSOILC

US Crop Lands: Table 12 lists the major components of GHG inventories and the estimation of land-atmosphere exchange of CO_2 (NEE_c) by US States in crop lands sector.

Table 12. Attributes of US Crop Lands GHG Inventories

	Attribute		

Attribute	Column Name	Units	Description
Zone ID	Zone_ID		Unique ID of each reporting zone. It can be used to link back to the reporting zone polygons for mapping and spatial analysis.
SectorZone ID	SectorZone_ID		Unique ID of each reporting zone and land sector combination. It can be used to link back to reference land sector mask data for mapping and spatial analysis.
Zone Name	Zone_Name		Name of reporting zone.
Crop Area	Crop_Area	km^2	Area of crop in each reporting zone.
NPP	NPP	TgC yr-1	Crop Net Primary Productivity
H_R	Harvest	TgC yr-1	Total C removed as harvested crop products in each reporting zone
ΔSOILC	dSoilC	TgC yr-1	Carbon stock change in soil organic matter pools in agricultural land
NEE_C	NEE	TgC yr-1	NEE = H_R + ΔSOILC

2.6.5. Attributes of Other Lands GHG Inventories and NEE_o

Canada Other Lands: Table 13 lists the major components of GHG inventories and the estimation of land-atmosphere exchange of CO_2 (NEE_o) by Canada reporting zone in other lands sector.

Table 13. Attributes of Canada Other Lands GHG Inventories

Attribute	Attribute Column Name	Units	Description
Zone ID	Zone_ID		Unique ID of each reporting zone. It can be used to link back to the reporting zone polygons for mapping and spatial analysis.
SectorZone ID	SectorZone_ID		Unique ID of each reporting zone and land sector combination. It can be used to link back to reference land sector mask data for mapping and spatial analysis.
Zone Name	Zone_Name		Name of reporting zone.
A_O	Other_Area	km^2	Area represented in the Other Lands sector: the Total Reporting Zone Area minus Inventory Forest Area minus Inventory Crop Area
Pop_H	Population	10^3	Human population (thousand persons) in each reporting zone estimated by overlaying reporting zone boundaries on census units containing year 2006 population estimates from Statistics Canada (www.statcan.gc.ca)
C_H	Human_Crop_Consumption	TgC yr-1	Human crop consumption and CO_2 emissions from human respiration estimated using per capita consumption (61.6 kg C yr-1) and respiration (54.0) rates from the U.S. data ([West et al., 2009])
E_H	Human_CO2_Respiration	TgC yr-1	
E_L-CH_4	Livestock_CH4_Emissions	TgC yr-1	Livestock (cattle and swine) methane emissions from Statistics Canada 2006 Census of Agriculture
E_L	Livestock_CO2_Emissions	TgC yr-1	Estimated livestock CO_2 emissions; the column total is equal to the national total HR adjusted for the net crop harvest export out of the country (27%*), minus national total human crop consumption and total C emitted as CH_4 from livestock; the column total is distributed proportional to C emitted as CH_4 from livestock in each reporting zone; *national-level crop harvest imports vs. exports is based on cash value, from the Canadian Socio-Economic Information Management System (Statistics Canada)
E_F	Forest_Product_CO2_Emissions	TgC yr-1	Estimated CO_2 emissions from decay of forest products; the column total is equal to the national total emissions from HWPE which is distributed proportional to human population in each reporting zone
			NEE for grasslands estimated by multiplying the average grassland sink per area from the U.S. data (2.1

NEE_G	NEE_Grasslands	TgC yr-1	g C m-2 yr-1) by the "other" land area in each reporting zone
NEE_S	NEE_Settlements	TgC yr-1	NEE for settled areas estimated by multiplying the average settlements sink per capita from the U.S. data (95.6 kg C per capita yr-1) by the human population in each reporting zone
NEE_O	Total_NEE_Other_Lands	TgC yr-1	$NEE_O = E_H + E_L + E_F + NEE_G + NEE_S$

U.S. Other Lands: Table 14 lists the major components of GHG inventories and the estimation of land-atmosphere exchange of CO_2 (NEE_o) by US States in other lands sector.

Table 14. Attributes of US Other Lands GHG Inventories

Attribute	Attribute Column Name	Units	Description
Zone ID	Zone_ID		Unique ID of each reporting zone. It can be used to link back to the reporting zone polygons for mapping and spatial analysis.
SectorZone ID	SectorZone_ID		Unique ID of each reporting zone and land sector combination. It can be used to link back to reference land sector mask data for mapping and spatial analysis.
Zone Name	Zone_Name		Name of reporting zone.
A_O	Other_Area	km^2	Area represented in the Other Lands sector: the Total Reporting Zone Area minus Inventory Forest Area minus Inventory Crop Area (average area years 2000 - 2006)
Pop_H	Population	10^3	Human population (thousand persons) is the average state population between 2000 and 2006, estimates from U.S. Census Bureau [2009]
C_H	Human_Crop_Consumption	TgC yr-1	For human consumption of crop products , there is a consistent respiration-to-consumption multiplier (1.14) across all age/gender classes in Table 1 of West et al., [2009], which was applied to the data on human respiration.
E_H	Human_CO2_Respiration	TgC yr-1	
E_L-CH_4	Livestock_CH4_Emissions	TgC yr-1	Livestock methane emissions from enteric fermentation from the USDA Greenhouse Gas Inventory [2008]
E_L	Livestock_CO2_Emissions	TgC yr-1	Estimated livestock CO_2 emissions; the column total is equal to the national total crop harvest (HR from Table A5), adjusted for the net crop harvest export out of the country (HCPIMP – HCPEXP = -46.7 TgC yr-1between 2000 and 2006*), minus national total human crop consumption and total C emitted as CH_4 from livestock; the column total is distributed proportional to C emitted as CH_4 from livestock in each reporting zone; *national-level crop harvest imports vs. exports is based on volume converted to dry-weight biomass carbon using data in USDA Economic Research Service (2010)."Foreign Agricultural Trade of the United States (FATUS)" [2010] http://www.ers.usda.gov/data/fatus/
E_F	Forest_Product_CO2_Emissions	TgC yr-1	Estimated CO2 emissions from decay of forest products; the column total is equal to the national total emissions from HWP; the column total is distributed proportional to human population in each reporting zone
NEE_G	NEE_Grasslands	TgC yr-1	NEE for grasslands estimated by distributing the annual, national-level grassland sink estimates from the U.S. Environmental Protection Agency Greenhouse Gas Inventory [2010] proportional to the area of the Other Land sector in each reporting zone
NEE_S	NEE_Settlements	TgC yr-1	NEE for settled areas estimated by distributing the annual, national-level settlements / other sink estimates from the U.S. Environmental Protection Agency Greenhouse Gas Inventory [2010] proportional to the human population in each reporting zone
NEE_O	Total_NEE_Other_Lands	TgC yr-1	$NEE_O = E_H + E_L + E_F + NEE_G + NEE_S$

Mexico Other Lands: Table 15 lists the major components of GHG inventories and the estimation of land-atmosphere exchange of CO_2 (NEE_0) by Mexico States in other lands sector.

Table 15. Attributes of Mexico Other Lands GHG Inventories

Attribute	Attribute Column Name	Units	Description
Zone ID	Zone_ID		Unique ID of each reporting zone. It can be used to link back to the reporting zone polygons for mapping and spatial analysis.
SectorZone ID	SectorZone_ID		Unique ID of each reporting zone and land sector combination. It can be used to link back to reference land sector mask data for mapping and spatial analysis.
Zone Name	Zone_Name		Name of reporting zone.
A_O	Forest_Area	km^2	Area of forest in each reporting zone.
$\Delta Live_{LUC}$	Biomass_Conversion	TgC yr-1	Carbon stock change in live biomass pools due to non-forest land use conversion
$\Delta Soil_{LUC}$	dSoilC	TgC yr-1	Carbon stock change in soil organic matter pools due to non-forest land use conversion
$\Delta Live_{ABND}$	Abandonment	TgC yr-1	Carbon stock change in live biomass pools due to biomass increment on non-forest land regenerating after agricultural abandonment
$\Delta Live_{MNGD}$	Fuelwood+Uptake	TgC yr-1	Carbon stock change in live biomass pools due to biomass increment and fuelwood emissions in managed non-forest land
Total NEE	Total_NEE	TgC yr-1	Total Net Ecosystem Exchange from forest land

2.7. Annual Mean NEE (2000-2006) by Sectors and Zones in North America

Annual mean NEE (2000-2006) summary data by both land sectors and reporting zones in North America (NEE_Zones_Sectors_Mean_2000-2006.csv) was created by combining the aggregated model output and the national GHG database. This NEE summary data can be used for model-inventory comparison purpose directly or be linked with the reference raster data (NA_Reporting_Zones_Sectors.tif) for mapping purpose. Table 16 describes the fields included in the NEE summary data.

Table 16. Attributes of NEE summary data

Attribute	Attribute Column Name	Units	Description
Sector Zone ID	Zone_ID		Unique ID for each sector-zone combination in the pattern of “NXY”, see section 4 for details
Sector	Sector		Sector type: forest, crop, or other
Zone Name	Zone_Name		Name of reporting zone
Country	Country		Country
NEE from Forward Model	NEE_Forward	g C m-2 yr-1	Annual mean NEE (2000-2006) from mean of multiple forward models
NEE from Inverse Model	NEE_Inverse	g C m-2 yr-1	Annual mean NEE (2000-2006) from mean of multiple inverse models
NEE from GHG Inventory	NEE_Inventory	g C m-2 yr-1	Annual mean NEE (2000-2006) from national GHG database

Example Data Records: NEE_Zones_Sectors_Mean_2000-2006.csv

```
Sector_Zone_ID,Sector,Zone_Name,Country,NEE_Forward,NEE_Inverse,NEE_Inventory
101,Forest Land,Aguascalientes,Mexico,4.80,16.52,13.78
102,Forest Land,Alabama,United States,-62.36,-114.35,-138.29
103,Forest Land,Alaska,United States,-10.36,-4.85,-59.48
…
395,Other Land,Wisconsin,United States,-71.98,-99.84,313.25
396,Other Land,Wyoming,United States,0.48,-34.85,11.98
397,Other Land,Yucatan,Mexico,-46.67,-1.12,-26.39
398,Other Land,Zacatecas,Mexico,3.67,-5.90,-8.69
```

2.8. Auxiliary Files

Detailed inventory zones information, including zone names, boundaries, and associated zone attributes are defined in ESRI Shapefile NAZonesFine.shp. File NAZonesFine.shp is described in Section 3 of the companion file, Regional-Standardized Inventory Zones.pdf. The following inventory zones attributes are included in the shapefile:

- Zone (string): Name of the state or reporting zone
- Country (string): The country to which the zone belongs
- SUM_Area (double): Area of the state or reporting zone (in square meters)
- SUM_AreaF (double): Area of forest land cover type within each Zone (in square meters)
- SUM_AreaC (double): Area of crop land cover type within each Zone (in square meters)
- SUM_AreaO (double): Area of “other” land cover type within each Zone (in square meters)

File NA_Reporting_Zones_Sectors.tif is described in Section 4 of the companion file, Regional-Standardized Inventory Zones.pdf. For the purpose of creating spatial maps as shown in Fig. 5 of Hayes et al. (2012), the North American reporting zones shapefile was merged with masks to create a 1km resolution reference raster data file (NA_Reporting_Zones_Sectors.tif) to describe which reporting zone and sector each 1km grid cell belongs to. The values in the reference raster data are 3-digit numbers following the pattern of “NXY”. If “N” is 1, it means the grid cell belongs to the forest land sector. Value “2” and “3” indicate the crop and “other” land sectors, repectively. “XY” is a 2-digit number representing the ID of reporting zones, as listed in Table 19 below. For example, a grid cell with value 141 means that 1km grid cell belongs to the forest sector and Maryland, U.S.

Table 17. Auxiliary Files

COMPRESSED FILE NAME	FILE NAME	DESCRIPTION
NAZonesFine.zip	NAZonesFine.shp	Detailed inventory zones information, including zone names, boundaries, and associated zone attributes at a spatial scale of 1:15,000,000
NA_Reporting_Zones_Sectors.zip		North American reporting zones shapefile merged with 1-km forest, crop, and other lands masks to create a 1-km resolution reference raster data file to describe to which reporting zone and sector each 1-km grid cell belongs.

2.9. Companion File Information

Table 18. Companion Files

FILE NAME	DESCRIPTION
Regional-Description_of_Observations_and_Models.pdf	Overview of observation measurement data and biosphere and inverse models, including descriptions, sources, contacts, and a comprehensive reference list
NACP_Model_Characteristics.pdf	Overview of process descriptions in participating ecosystem or forward models and boundary conditions and driver data used in participating ecosystem or forward models with a comprehensive reference list
NACP_Model_Metadata_Survey_Results.pdf	Metadata for Forward (Ecosystem) Model Intercomparison: Site Model Data Comparison and Regional Model Data Comparison: Survey Results
Regional-Standardized_Inventory_Zones.pdfs	Provides a description of the aggregation process, inventory zones, and mapping methods.

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 an NACP regional and continental synthesis to evaluate and inter-compare models and observation measurements across North America.

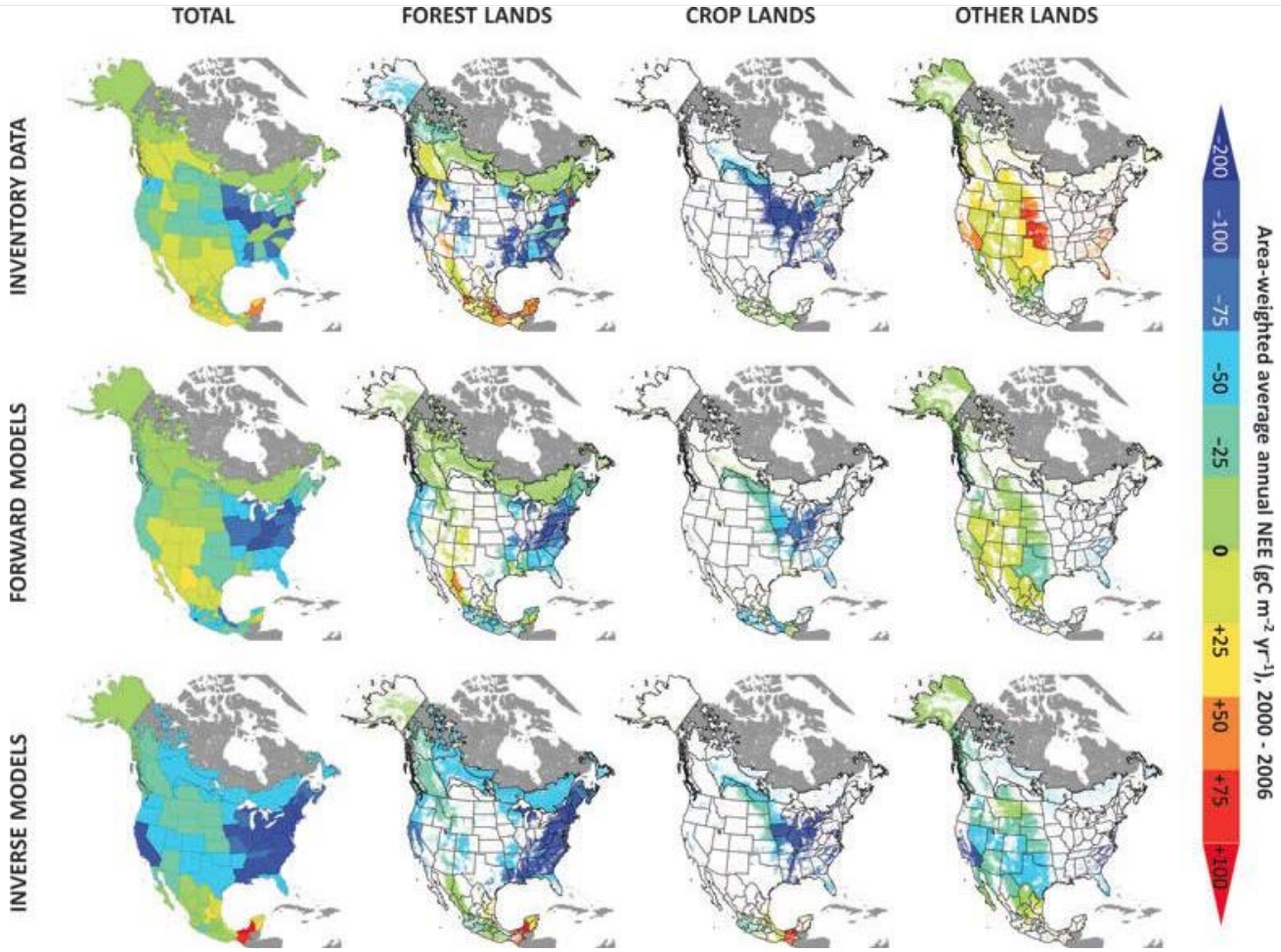

Figure 2. Mean area-weighted average annual NEE (g C m-2 yr-1), 2000–2006 for the Forest Lands, Crop Lands and Other Lands sectors, along with all land (total), in each reporting zone, from inventory-based estimates against mean results from the sets of terrestrial biosphere (forward) models and inverse models. (source: Figure 5 in Hayes, et al., 2012)

4. Quality Assessment:

This study (1) created a set of modeled carbon flux variables (NEE, NPP, VegC, Rh, and Fire Emissions) at the inventory-zone scale by aggregating model results at 1-degree spatial resolution and (2) developed an approach for estimating NEE using inventory-based information over North America for a recent 7-year period (ca. 2000–2006). The approach notably retains information on the spatial distribution of NEE, or the vertical exchange between land and atmosphere of all non-fossil fuel sources and sinks of CO2, while accounting for lateral transfers of forest and crop products as well as eventual emissions.

The GHG inventory-based results were derived from, and so are generally consistent with, recent inventory-based updates of the carbon budgets reported for Canada forests, U.S. forests and agriculture, and the agriculture and forest sector in Mexico. The new information provided in this study comes from the combination of those national- and sector-specific estimates into a continental-scale analysis, while using a novel conceptual model to estimate land-atmosphere exchange of CO2 at the sub-national scale. As a result, the inventory-based data and the methodology used in this study suggest considerable spatial variability in NEE estimates across sectors and reporting zones (Figure 1). The spatial patterns are driven both by the estimated direct, vertical surface fluxes, as well as the lateral transfer of carbon between sectors in the form of harvested products.

The inventory-based estimates of NEE were compared with results from a suite of terrestrial biosphere and atmospheric inversion models. The study used ‘off-the-shelf’ model simulations without a consistent set of driver forcing data or simulation protocols and other recently published studies. These simulations and studies served as a pre-cursor to more formal model inter-comparison activities that will follow this study.

The mean model estimates from both the terrestrial biosphere and inverse models suggest a much stronger overall North American sink than the inventory-based estimate. Yet model estimates generally do follow similar spatial patterns as the inventory-based data where the strongest sinks are found in US forests on the east and west coasts and in croplands of the midcontinent, with a smaller source from the tropical area of southern Mexico. However, the model vs inventory differences are mostly in the magnitude of the estimates.

The wide range in the land surface flux estimates is related to a number of factors, but most generally because of the different methodologies used to develop estimates of carbon stocks and flux, and the uncertainties inherent in each approach:

• Biomass inventories provide valuable constraints on changes in the size of carbon pools over years to decades. However, dynamics and fluxes can be under-sampled or missed altogether (e.g., inventory sampling can produce reliable estimates of biomass, but other carbon pools, such as litter and soil C stocks, may not have been sampled at the same intensity in all areas. Inventory-based modeling can be used to estimate growth and disturbance impacts, but does not yet provide full capability in partitioning the forcing brought about by non-disturbance factors. On the other hand, inventory and

commerce data sets can often be used to quantify the storage, emissions and/or lateral movement of carbon in product pools, which are typically not well characterized in modeling approaches.

• TBMs can be used to simulate the dynamics of multiple ecosystem components. However, TBMs contain substantial uncertainty because of the sheer number of often poorly understood underlying processes simulated. They also vary widely in the data used to drive them, in the particular processes simulated, and in their level of detail.

• IM analyses provide constraints on estimates of land-atmosphere carbon exchange at a detailed temporal resolution, relying on the strong diurnal and seasonal cycles in CO2 concentration in the observations. However, these estimates are associated with large uncertainties from the limited density of observation networks, uncertainty in the transport models, and errors in the inversion process.

In summary, this study highlights the differences in three general scaling approaches to NEE (inventory, forward TBMs, and inverse modeling), and by comparing and evaluating their estimates several strengths and weaknesses emerge (Table 18). For additional information, consult Hayes et al. (2012).

Table 19. A comparison of the strengths and weaknesses of alternative NEE scaling approaches (inventory-based, IMs and TBMs (Source: Hayes et al., 2012).

	Inventory-based	Atmospheric Inversion Models (IM)	Terrestrial Biosphere Models (TBM)
Strengths	Employs a large number of repeated biomass measurements	Assimilates measurements of atmospheric CO2 concentration	Processes are represented so attribution is possible
	Allows estimation of product related C sources	Employs atmospheric mass balance	Sensitive to interannual variation in climate
			Many opportunities for validation
Weaknesses	Not all C pools are measured	Transport model uncertainty	Many inputs, each with their own uncertainty
	Potential under-sampling	Limited number of CO2 measurements	Many parameters, each with their own uncertainty
	Limited attribution ability	Low spatial resolution	Spatial resolution may not resolve management scale disturbances
	Missing NEE of unmanaged ecosystems	Limited attribution ability	
	Poorly resolved temporally		

5. Data Acquisition Materials and Methods:

5.1. Inventory Zones

The NACP standardized-gridded model output data were aggregated onto inventory zones in order to be compared with inventory-based national GHG data. The inventory zones for North America are defined as states for the United States and Mexico and ecoregion-based managed forest reporting zones for Canada. The definition of inventory zones for North America is consistent between the aggregated standardized-gridded model output data and the national GHG data. Figure 1 shows the map for all 97 inventory zones in North America and Table 19 lists the zone IDs and names.

Table 20. North American Inventory Zones

No	Zone ID	Zone Name	Country
1	1	Aguascalientes	Mexico
2	2	Alabama	United States
3	3	Alaska	United States
4	4	Arizona	United States
5	5	Arkansas	United States
6	6	Atlantic Maritime	Canada
7	7	Baja California	Mexico
8	8	Baja California Sur	Mexico
9	9	Boreal Cordillera	Canada
10	10	Boreal Plains	Canada
11	11	Boreal Shield East	Canada
12	12	Boreal Shield West	Canada
13	13	California	United States

14	14	Campeche	Mexico
15	15	Chiapas	Mexico
16	16	Chihuahua	Mexico
17	17	Coahuila	Mexico
18	18	Colima	Mexico
19	19	Colorado	United States
20	20	Connecticut	United States
21	21	Delaware	United States
22	22	District of Columbia	United States
23	23	Distrito Federal	Mexico
24	24	Durango	Mexico
25	25	Florida	United States
26	26	Georgia	United States
27	27	Guanajuato	Mexico
28	29	Guerrero	Mexico
29	30	Hidalgo	Mexico
30	31	Hudson Plains	Canada
31	32	Idaho	United States
32	33	Illinois	United States
33	34	Indiana	United States
34	35	Iowa	United States
35	36	Jalisco	Mexico
36	37	Kansas	United States
37	38	Kentucky	United States
38	39	Louisiana	United States
39	40	Maine	United States
40	41	Maryland	United States
41	42	Massachusetts	United States
42	43	Mexico	Mexico
43	44	Michigan	United States
44	45	Michoacan	Mexico
45	46	Minnesota	United States
46	47	Mississippi	United States
47	48	Missouri	United States
48	49	Mixedwood Plains	Canada
49	50	Montana	United States
50	51	Montane Cordillera	Canada
51	52	Morelos	Mexico
52	53	Nayarit	Mexico
53	54	Nebraska	United States
54	55	Nevada	United States
55	56	New Hampshire	United States
56	57	New Jersey	United States
57	58	New Mexico	United States
58	59	New York	United States
59	60	North Carolina	United States
60	61	North Dakota	United States
61	62	Nuevo Leon	Mexico
62	63	Oaxaca	Mexico
63	64	Ohio	United States
64	65	Oklahoma	United States

65	66	Oregon	United States
66	67	Pacific Maritime	Canada
67	68	Pennsylvania	United States
68	69	Puebla	Mexico
69	70	Queretaro	Mexico
70	71	Quintana Roo	Mexico
71	72	Rhode Island	United States
72	73	San Luis Potosi	Mexico
73	74	Semiarid Prairies	Canada
74	75	Sinaloa	Mexico
75	76	Sonora	Mexico
76	77	South Carolina	United States
77	78	South Dakota	United States
78	79	Subhumid Prairies	Canada
79	80	Tabasco	Mexico
80	81	Taiga Cordillera	Canada
81	82	Taiga Plains	Canada
82	83	Taiga Shield East	Canada
83	84	Taiga Shield West	Canada
84	85	Tamaulipas	Mexico
85	86	Tennessee	United States
86	87	Texas	United States
87	88	Tlaxcala	Mexico
88	89	Utah	United States
89	90	Veracruz	Mexico
90	91	Vermont	United States
91	92	Virginia	United States
92	93	Washington	United States
93	94	West Virginia	United States
94	95	Wisconsin	United States
95	96	Wyoming	United States
96	97	Yucatan	Mexico
97	98	Zacatecas	Mexico

5.2. Forest/Crop/Other Land Sectors

The aggregation of gridded model output into different land sectors for each reporting zone requires a mechanism to calculate the fraction of forest, crop, and other land sectors. In this NACP regional interim synthesis activity, it's achieved by analyzing the Global Land Cover 2000 (GLC2000) (Bartholome and Belward, 2005) data at 1-km spatial resolution.

GLC2000 data uses a land cover classification scheme containing 22 different types mapped at a pixel resolution of 1 x 1 km. These types were first mapped to 3 sectors for the NACP analyses: forest, crop, and other, as described in Table 20. For detailed information on the mapping process, please see the companion file, Regional-Standardized Inventory Zones.pdf, pp 6-8.

Table 21. Mapping between GLC2000 Land Cover Classes and Group Classes (Forest, Crop, and Other)

	Land Cover Classes	Group Classes
1	Tree Cover, broadleaved, evergreen	Forest
2	Tree Cover, broadleaved, deciduous, clsd	
3	Tree Cover, broadleaved, deciduous, open	
4	Tree Cover, needle-leaved, evergreen	
5	Tree Cover, needle-leaved, deciduous	
6	Tree Cover, mixed leaf type	

7	Tree Cover, flooded, fresh water	
8	Tree Cover, flooded, saline	
9	Mosaic: Tree Cover/Other Veg	
10	Tree Cover, burnt	
11	Shrub Cover, closed-open, evergreen	Other
12	Shrub Cover, closed-open, deciduous	
13	Herbaceous Cover, closed-open	
14	Sparse herbaceous or shrub	
15	Regular flooded shrub or herbaceous	
16	Cultivated and managed areas	Crop
17	Mosaic: Cropland/Tree Cover/Other Veg	
18	Mosaic: Cropland/Shrub and/or grass	
19	Bare Areas	Other
20	Water Bodies	
21	Snow and Ice	
22	Artificial surfaces	
23	No data	

5.3. Aggregated Model Output

Selected variables, including NEE, NPP, Veg, Rh, and FE, depending on availability, of the NACP standardized-gridded model output data were aggregated from 1-degree spatial resolution to the North American inventory zones.

5.3.1. Models and Variables

Table 2 lists all the models and their corresponding output variables that were aggregated to inventory zones, along with their temporal coverage and resolution.

5.3.2. Aggregation Procedure

The aggregation process started with the standardized gridded model output data that have been standardized to a common geographic projection and a 1-degree resolution gridded format. The aggregation processing was performed using the commercial GIS software, ESRI ArcGIS. Key input layers were derived separately and used within a processing model built with the ArcGIS Model Builder. The overall processing model is shown in Figure 3.

For detailed information on the aggregation procedure, please see the companion file, Regional-Standardized Inventory Zones.pdf, pp 10-13.

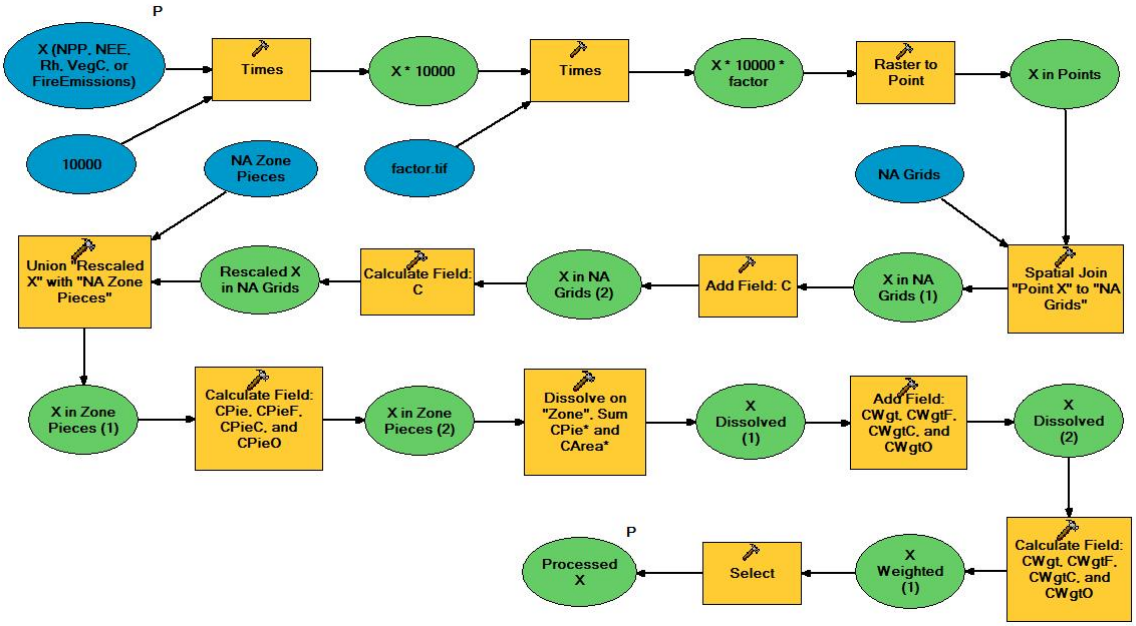

Figure 3. The aggregation model diagram within ArcGIS Model Builder

5.4. National GHG Inventories

The national GHG inventories database compiled for the NACP synthesis activities contains inventory-based data on productivity, ecosystem carbon stock change and harvested product stock change to produce estimates of land-atmosphere exchange of CO_2 (NEE) for the 2000 to 2006 time period for the Forest Lands and Crop Lands sectors in Canada and the United States. Additional information from national-level GHG inventories was used to fill in data on carbon balance in the Other Lands sector, including data on human and livestock consumption of harvested products. For Mexico, the national GHG inventories database accounts primarily for carbon flux caused by land use change according to the study by de Jong et al. (2010), which covers the period of 1993 to 2002. Data on carbon exchange for each sector are summarized according to GHG inventory "reporting zones."

The methodology for producing estimates of NEE for each country/sector during the study period can be found from S4. Supporting Information Tables and Figures in Hayes et al. (2012). For additional information, please see the companion file, Regional-Standardized Inventory Zones.pdf, pp 14-15.

6. Data Access:

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

Data Archive:

Web Site: http://daac.ornl.gov

Contact for Data Center Access Information:

E-mail: uso@daac.ornl.gov
Telephone: +1 (865) 241-3952

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Please also see the Reference section in the NACP Regional Synthesis - Description of Observations and Models document for publications related to the TBMs and IMs used in this study.