ORNL DAAC
DISTRIBUTED ACTIVE ARCHIVE CENTER
FOR BIOGEOCHEMICAL DYNAMICS

Feedback

NASA

☐ Sign in

| ☐ | About Us | Get Data | Submit Data | Data Management | Tools |

NACP VPRM NEE Parameters Optimized to North American Flux Tower Sites, 2000-2006

Get Data

Documentation Revision Date: 2016-11-16

Data Set Version: V1

Summary

This data set provides Vegetation Photosynthesis Respiration Model (VPRM) net ecosystem exchange (NEE) parameter values optimized to 65 flux tower sites across North America. The parameters include the basal rate of ecosystem respiration (beta), the slope of respiration with respect to temperature (alpha), light-use efficiency (LUE) (lambda), and LUE curve half-saturation (PAR_0). Observed eddy covariance data from the 65 tower sites, locally observed temperature and photosynthetically active radiation (PAR) along with satellite-derived phenology and moisture were used as input data to optimize the VPRM parameters for the 65 sites. The data are provided by individual site, plant functional types (PFTs), and all sites together, and as monthly, annual, and all available data. The data are for the conterminous USA, Alaska, and Canada for the period 2000 to 2006.

The 65 observation sites cover nine of the 17 PFTs of the International Geosphere-Biosphere Programme (IGBP) land cover classification scheme (Loveland and Belward, 1997). MODIS Collection 5 data were used for site phenology, land surface water, enhanced vegetation index, and land surface cover type.

There are nine data files with this data set in comma-separated (*.csv) format. The files provide monthly and annual data for individual sites, all sites, and sites grouped by PFT.
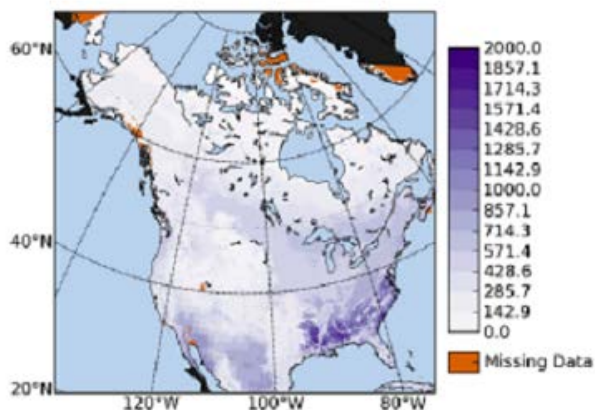

Figure 1. VPRM annual integrated respiration for 2002 provided in g C/m2/yr. Black areas are outside the study domain (Hilton et al., 2014).

Citation

Hilton, T.W., K.J. Davis, K. Keller, and N.M. Urban. 2016. NACP VPRM NEE Parameters Optimized to North American Flux Tower Sites, 2000-2006. ORNL DAAC, Oak Ridge, Tennessee, USA. http://dx.doi.org/10.3334/ORNLDAAC/1349

Table of Contents

1. Data Set Overview
2. Data Characteristics
3. Application and Derivation
4. Quality Assessment
5. Data Acquisition, Materials, and Methods

1. Data Set Overview

Vegetation Photosynthesis Respiration Model (VPRM) is a simple diagnostic terrestrial flux model. An overview of the model structure is provided in Section 5 of this document. VPRM calculates net ecosystem exchange (NEE) using locally observed temperature and photosynthetically active radiation (PAR) along with satellite-derived phenology and moisture. This study examined VPRM parameters optimized to 65 observed data from flux towers across North America (FLUXNET 2007 data set), locally observed temperature and PAR along with satellite-derived phenology and moisture as input data. The parameters include: β- basal rate of ecosystem respiration, α- the slope of respiration with respect to temperature, λ- light-use efficiency (LUE), and PAR_0-LUE curve half-saturation.

Three temporal and three spatial windows for sum of squared errors minimization were examined – in time: monthly, annual, and all available data; and, in space: individual sites, sites grouped by PFT, and all sites together.

Project: North American Carbon Program (NACP)

The North American Carbon Program (NACP) is a multidisciplinary research program designed to improve 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.

2. Data Characteristics

Spatial Coverage: 65 flux tower sites across the conterminous US, Alaska, and Canada.

Spatial Resolution: Varied- These are modeled estimates using observed flux tower data and MODIS data.

Temporal Coverage: 2000 - 2006. One file provides data for 2007.

Temporal Resolution: Monthly and Annual.

Study Area (All latitudes and longitudes are given in decimal degrees)

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
North America: Conterminous US, Alaska, and Canada	-156.63	-68.74	71.31999	28.46

Table 1. The 65 North American flux tower sites used to parameterize VPRM. PFTs (land cover) are taken from the International Geosphere-Biosphere Programme (IGBP) land cover classification scheme (Loveland and Belward, 1997) or investigator descriptions where available, and otherwise derived from MODIS 1 km land surface classifications (Hilton et al., 2014). In the data files with "pft" in the file names, PFT corresponds to the land cover in the table below.

Site	Land cover (PFT)	Site name	Latitude	Longitude
CA-Ca1	1 – Evergreen Needleleaf Forest	British Columbia – Campbell River – Mature Forest Site	49.87	-125.534
CA-ca2	1 – Evergreen Needleleaf Forest	British Columbia – Campbell River –Clearcut site	49.87	-125.29
CA-ca3	1 – Evergreen Needleleaf Forest	British Columbia – Campbell River –Young Plantation site	49.87	-124.9
CA-Gro	5 – Mixed Forest	Ontario – Groundhog River-Mature Boreal Mixed Wood	48.22	-82.16
CA-Let	10 – Grasslands	Lethbridge	49.71	-112.94
CA-Mer	1 – Permanent Wetlands	Eastern Peatland – Mer Bleu	45.1	-75.52
CA-NS2	1 – Evergreen Needleleaf Fores	UCI-1930 burn site	55.91	-98.52
CA-NS3	1 – Evergreen Needleleaf Fores	UCI-1964 burn site	55.91	-98.38
CA-NS4	1 – Evergreen Needleleaf Fores	UCI-1964 burn site	55.91	-98.38
CA-NS5	1 – Evergreen Needleleaf Fores	UCI-1981 burn site	55.86	-98.49
CA-NS6	1 – Evergreen Needleleaf Fores	UCI-19389 burn site	55.92	-98.96
CA-NS7	1 – Evergreen Needleleaf Fores	UCI-1998 burn site	56.64	-99.95
CA-Oas	4 – Deciduous Broadleaf Forest	Sask – SSA Old Aspen	53.63	-106.2
CA-Obs	1 – Evergreen Needleleaf	Sask – SSA Old Black Spruce	53.99	-105.12

	Forest			
CA-Ojp	1 – Evergreen Needleleaf Forest	Sask – SSA Old Jack Pine	53.92	-104.69
CA-Qcu	7 – Open Shrubland	Quebec Boreal Cutover Site	49.27	-74.04
CA-Qfo	1 – Evergreen Needleleaf Forest	Quebec Mature Boreal Forest Site	49.69	-74.34
CA-SF2	6 – Closed Shrublands	Sask – Fire 1989	54.25	-105.88
CA-SF3	6 – Closed Shrublands	Sask – Fire 1998	54.09	106.01
CA-SJ1	1 – Evergreen Needleleaf Forest	Sask – 1994 Harv. Jack Pine	53.91	-104.66
CA-SJ2	1 – Evergreen Needleleaf Forest	Sask – 2002 Harvested Jack Pin	53.95	-104.65
CA-WP1	11 – Permanent Wetlands	Western Peatland – LaBiche-Black Spruce/Larch Fen	54.96	-112.46
US-ARM	12 – Cropland	ARM Southern Great Plains site – Lamont – Oklahoma	36.61	-97.49
US-Atq	11 – Permanent Wetlands	Atqasuk – Alaska	70.47	-157.41
US-Aud	10 – Grasslands	Audubon Research Ranch – Arizona	31.59	-110.51
US-Blo	1 – Evergreen Needleleaf Forest	Blodgett Forest – California	38.9	-120.36
US-Bn1	1 – Evergreen Needleleaf Forest	Delta Junction 1920 Control site	63.92	-145.37
US-Bn2	4 – Deciduous Broadleaf Fores	Delta Junction 1987 Burn site	63.92	-145.37
US-Bn3	7 – Open Shrublands	Delta Junction 1999 Burn site	63.92	-145.74
US-Bo1	12 – Croplands	Bondville – Illinois	40.01	-88.29
US-Bo2	12 – Croplands	Bondville – Illinois (companion site)	40.01	-88.29
US-Brw	11 – Permanent Wetlands	Barrow – Alaska	71.32	-156.63
US-CaV	10 – Grasslands	Canaan Valley – West Virginia	36.06	-79.42
US-Dk1	10 – Grasslands	Duke Forest-open field – North Carolina	35.97	-79.09
US-Dk2	4 – Deciduous Broadleaf Forest	Duke Forest-hardwoods – North Carolina	35.97	-79.1
US-Dk3	1 – Evergreen Needleleaf Fores	Duke Forest – loblolly pine – North Carolina	35.98	-79.09
US-FPe	10 – Grasslands	Fort Peck – Montana	48.31	-105.1
US-Goo	10 – Grasslands	Goodwin Creek- Mississippi	34.25	-89.97
US-Ha1	4 – Deciduous Broadleaf Forest	Harvard Forest EMS Tower – Massachusetts (HFR1	42.54	-72.17
US-Ha2	1 – Evergreen Needleleaf Forest	Harvard Forest Hemlock Site – Massachusetts	42.54	-72.17
US-Ho1	1 – Evergreen Needleleaf Forest	Howland Forest (main tower) – Maine	45.2	-68.74
US-Ho2	1 – Evergreen Needleleaf Forest	Howland Forest (west tower) – Maine	45.21	-68.75
US-KS1	1 – Evergreen Needleleaf Forest	Florida-Kennedy Space Center (slash pine)	28.46	-80.67
US-KS2	6 – Closed Shrublands	Florida-Kennedy Space Center (scrub oak)	28.61	-80.67
US-Los	6 – Closed Shrublands	Lost Creek – Wisconsin	46.08	-89.98
US-Me2	1 – Evergreen Needleleaf Forest	Metolius-intermediate aged ponderosa pine – Oregon	44.55	-121.56

US-Me4	1 – Evergreen Needleleaf Forest	Metolius-old aged ponderosa pine – Oregon	44.5	-121.62
US-MMS	4 – Deciduous Broadleaf Forest	Morgan Monroe State Forest – Indiana	39.32	-86.41
US-MOz	4 – Deciduous Broadleaf Forest	Missouri Ozark Site	38.74	-92.2
US-Ne1	12 – Croplands	Mead – irrigated continuous maize site – Nebraska	41.1	-96.29
US-Ne2	12 – Croplands	Mead – irrigated maize-soybean rotation site – Nebraska	41.1	-96.28
US-Ne3	12 – Croplands	Mead – rainfed maize-soybean rotation site – Nebraska	41.18	-96.44
US-NR1	1 – Evergreen Needleleaf Forest	Niwot Ridge Forest – Colorado (LTER NWT1)	40.03	-105.55
US-PFa	5 – Mixed Fores	Park Falls/WLEF – Wisconsin	45.95	-90.27
US-SO2	6 – Closed Shrublands	Sky Oaks – Old Stand – California	33.37	-116.62
US-SO3	6 – Closed Shrublands	Sky Oaks – Young Stand – California	33.38	-116.62
US-SO4	6 – Closed Shrublands	Sky Oaks – California	33.37	-116.62
US-SP1	1 – Evergreen Needleleaf Fores	Slashpine-Austin Cary – 65 yr nat regen-FL	29.74	-82.22
US-SP2	1 – Evergreen Needleleaf Fores	Slashpine-Mize-clearcut-3 yr-regen-FL	29.76	-82.24
US-SP3	1 – Evergreen Needleleaf Fores	Slashpine-Donaldson-mid-rot – 12 yr-FL	29.75	-82.16
US-Syv	5 – Mixed Forest	Sylvania Wilderness Area – Michigan	46.24	-89.35
US-Ton	8 – Woody Savannas	Tonzi Ranch – California	38.43	-120.97
US-UMB	4 – Deciduous Broadleaf Forest	Univ. of Mich. Biological Station – Michigan	45.56	-84.71
US-Var	10 – Grasslands	Vaira Ranch – Ione – California	38.41	-120.95
US-WCr	4 – Deciduous Broadleaf Forest	Willow Creek – Wisconsin	45.81	-90.08

Data File Information

There are nine data files in comma-separated (.csv) format with this data set. The files provide VPRM parameter values optimized to 65 flux tower sites across North America. The data are for the time period 2000-2007. Not all files include the entire period. Only one file includes data for 2007. There are no missing values.

Table 2. File names and descriptions

File name	Description	Number of observations in each file
VPRM_parameters_all_sites_all_data.csv	This file provides parameter values for all years combined and site (site = "all")	1
VPRM_parameters_all_sites_annual_data.csv	This file provides yearly data for the years 2000 – 2007 for each of the four parameters and site (site = "all")	8
VPRM_parameters_all_sites_monthly_data.csv	This file provides parameter values for each month for each year for 2000 – 2006 and site (site = "all")	85
VPRM_parameters_individual_sites_all_data.csv	This file provides yearly parameter values for each of the 65 sites and "site", which is the Fluxnet site ID. Note that there is not data for each year for each site. There is one year of data for each site. The data are for the period 2000 – 2004 where data are provided for some sites for the year 2000 and for other sites for 2001, etc.	65
VPRM_parameters_individual_sites_annual_data.csv	This file provides parameter values for each of the 65 sites by year for the period 2000 – 2006. Note that data are not provided for every year for each site. This file also includes	286

	“site” which is the Fluxnet site ID.	
VPRM_parameters_individual_sites_monthly_data.csv	This file provides parameter values for each of the 65 sites for each month for the years 2000 – 2006. Note that data are not provided for every year for each site. This file also includes “site” which is the Fluxnet site ID.	3,432
VPRM_parameters_pft_sites_all_data.csv	This file provides parameter values by nine PFT classes for the year 2000 only.	9
VPRM_parameters_pft_sites_annual_data.csv	This file provides parameter values by nine PFT classes for each year for 2000 – 2006	61
VPRM_parameters_pft_sites_monthly_data.csv	This file provides parameter values by nine PFT classes for each month for each year for 2000 – 2006.	732

Table 3. Parameters in the data files

Site	This is provided in the files named VPRM_parameters_individual_sites__. This is the FLUXNETsite ID. It is also provided in the files named VPRM_parameter_values_all_sites, and the value is "all"
PFT	This is only in files named VPRM_parameters_pft_sites__. This is the land cover classification number as provided by Hilton et al., 2013. Refer to Table 1.
tstamp	Time stamp. Refers to the year or date of the provided data, in yyyy or yyyy-mm-dd.
lambda	Maximum light use efficiency
alpha	Slope of respiration with respect to temperature
beta	Basal respiration rate
PAR_0	LUE half-saturation value (PAR_0 in the model)

3. Application and Derivation

Our findings are relevant to both land surface model upscaling as well as atmospheric inversion studies.

4. Quality Assessment

The structural simplicity of VPRM allows parameter estimations to be conducted that use many thousands of model evaluations. However, caution is advised against attempting site-specific ecological interpretation of short-term fluctuations in VPRM parameter values, fluxes, and residuals.

5. Data Acquisition, Materials, and Methods

VPRM calculates net ecosystem exchange (NEE) using locally observed temperature and photosynthetically active radiation (PAR) along with satellite-derived phenology and moisture. Temperature and PAR can come from site-level observations when modeling a point. VPRM does not consider driver data or flux results from previous time steps.

VPRM data inputs

Observed input data were from 65 flux towers across North America. These data are part of the 2007 FLUXNET Synthesis data set (http://www.fluxdata.org). For each site, this data set contains CO2 flux, air temperature, and PAR observations at 30 min intervals, as well as many other quantities not needed for VPRM. The 65 observation sites cover nine of the 17 PFTs of the International Geosphere-Biosphere Programme (IGBP) land cover classification scheme (Loveland and Belward, 1997): evergreen needleleaf forest (27 sites), deciduous broadleaf forest (8 sites), mixed forest (3 sites), closed shrublands (7 sites), open shrublands (2 sites), woody savannas (1 site), grasslands (7 sites), permanent wetlands (4 sites), and croplands (6 sites).

MODIS Collection 5 data were used for site phenology, land surface water, enhanced vegetation index, and land surface cover type:

- Site phenology is from data set M*D12Q2 (Strahler et al., 1999a)
- Reflectances are from data set M*D43A4 (Strahler et al., 1999b)
- Vegetation indices are from data set M*D13A2 (Huete et al., 2002, and 1999)
- IGBP land surface cover types are from data set M*D12Q1 (Loveland and Belward, 1997; Strahler et al.,1999a).

The “*” in M*D is either “O”, representing the data from the Terra satellite, or “Y” representing the data from the Aqua satellite. Only MODIS data of “best” quality, as indicated by each MODIS product's associated quality assurance flags were considered (Hilton et al., 2013).

The time period examined was 2000 to 2006, bounded in 2000 by the MODIS instrument launch and in 2006 by eddy covariance flux availability.

The VPRM model

VPRM is a simple diagnostic terrestrial flux model. VPRM models net ecosystem exchange (NEE) as the sum of a photosynthetic component (gross ecosystem exchange, GEE) and an ecosystem respiration component. An overview of the model structure followed by the definitions of the four parameters studied and included with this data set are provided below (refer to Hilton et al., 2013 and 2014).

GEE is modeled via the equation:

(1) $GEE = \lambda \cdot Tscale \cdot Pscale \cdot Wscale \cdot EVI \cdot \frac{1}{1+PAR/PAR0} \cdot PAR$

PAR is observed photosynthetically active radiation and EVI is the satellite-derived enhanced vegetation index (Huete et al., 2002). PAR0 and λ are user-supplied parameters.

Pscale, Wscale, and Tscale are dimensionless scaling terms. They each take values between 0.0 and 1.0 and are defined as follows:

Pscale is satellite derived and describes the impacts of leaf expansion and senescence on canopy-scale photosynthesis. Pscale is defined as 0.0 outside of the growing season, 1.0 during growing season peak greenness, and is a linear function of the satellite-derived land surface water index (LSWI) (Xiao et al., 2004) during leaf expansion and senescence.

(2) $Pscale = \frac{1+LSWI}{2}$

Wscale is satellite derived and describes canopy moisture, and is defined as:

(3) $Wscale = \frac{1+LSWI}{1+LSWImax}$

with LSWImax the growing-season maximum LSWI value. The value of the third dimensionless scaling term Tscale is taken from literature and describes the relationship between photosynthesis and temperature.

Tscale is defined as:

(4) $Tscale = \frac{(T-T_{min})\,(T-T_{max})}{(T-T_{min})\,(T-T_{max}) - (T-T_{opt})^2}$

Pscale, Wscale, and Tscale by definition, vary in both time and space (Mahadevan et al., 2008). Respiration (R) is modeled as a linear function of observed surface air temperature (T):

(5) $R = \alpha \cdot T + \beta$

with user-supplied parameters α and β. NEE is the difference between the photosynthetic flux and the respiration flux:

(6) $NEE = R - GEE$

Four estimated parameters:

Within equations (1), (5), and (6), are the four estimated parameters provided in this data set:

- **λ** governs the slope of the light-response curve (the relationship between photosynthetic CO2 flux and PAR)
- **α** defines the slope of the respiration response to temperature
- **PAR_0** defines a half saturation value for photosynthesis. That is, it specifies a PAR value at which further increases in PAR no longer enhance photosynthesis, as other limiting factors become dominant.
- **β** thus specifies a minimal level of respiration that occurs regardless of air temperature.

The source code used to estimate these parameter values is available at https://github.com/Timothy-W-Hilton/VPRMLandSfcModel.

VPRM NEE parameters

Model residuals are the combined effects of flux observation errors, model structural error, and natural variability uncaptured by the flux model. The goal was to have VPRM parameters that caused VPRM NEE to closely match observed NEE (Hilton et al., 2013).

NEE varies on a number of different time scales (e.g.,daily, annual) and space scales (e.g., local land use and PFT heterogeneity, larger regions that experience similar climate patterns). An ideal land surface model parameter estimation method would allow parameter values to vary at space and time scales matching the ecological variations in NEE. Optimizing parameter values in short time intervals and small spatial windows would run the risk of overfitting as well as incur unnecessary computational cost. In this study, three temporal and three spatial windows for the sum of squared errors (SSE; we define VPRM residuals as NEEVPRM minus NEEobserved) minimization were examined:

- in time: monthly, annual, and all available data
- in space: individual sites, sites grouped by PFT, and all sites together.

This approach resulted in nine different parameter sets.

To search for parameter values that minimized SSE, differential evolution (DE) (Price et al., 2006) was used. DE is a genetic optimization algorithm that is both fast and more reliable in identifying a global optimum compared to gradient-based minimization algorithms. The DEoptim package (Ardia and Mullen, 2009) for the R language and platform for statistical computing (R Development Core Team, 2007) was used.

The Markov chain Monte Carlo (MCMC) optimization approach offers the advantage of delivering probability density functions (PDFs), and thus parameter uncertainties, rather than the single optimal value estimates provided by DE. Because of the substantially increased computational expense and the lack of a statistically robust residual likelihood function, DE was chosen to obtain the point estimates provided (Hilton et al., 2013).

VPRM NEE residual spatial structure

Semivariograms were used to evaluate residual spatial structure. Because VPRM NEE residuals are simply the difference between NEEobs and NEE$_{VPRM}$, the spatial behaviors of these three quantities are interrelated.

For additional information, please refer to Hilton et al. 2013 and 2014.

6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

[NACP VPRM NEE Parameters Optimized to North American Flux Tower Sites, 2000-2006](#)

Contact for Data Center Access Information:

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

7. References

Ardia, D. and K. Mullen. 2009. DEoptim: Differential Evolution Optimization in R, R package version 2.0-1, http://CRAN.R-project. org/package=DEoptim (last access: 1 June 2012), 2009.

Hilton, T.W., K. J. Davis, and K. Keller. 2014. Evaluating terrestrial CO$_2$ flux diagnoses and uncertainties from a simple land surface model and its residuals, Biogeosciences, 11, 217-235, doi:10.5194/bg-11-217-2014.

Hilton, T.W., K. J. Davis, K. Keller, and N.M. Urban. 2013. Improving North American terrestrial CO2 flux diagnosis using spatial structure in land surface model residuals, Biogeosciences, 10,4607–4625, doi:10.5194/bg-10-4607-2013.

Huete, A., K. Didan, T. Miura, E. Rodriguez, X. Gao, and L. Ferreira, L. 2002. Overview of the radiometric and biophysical performance of the MODIS vegetation indices, Remote Sens. Environ.,83, 195–213, 2002.

Huete, A., C. Justice, and W. van Leeuwen. 1999. MODIS vegetation index (MOD 13) algorithm theoretical basis document, Version 3, available at: http://modis.gsfc.nasa.gov/data/atbd/atbd_mod13.pdf (last access: 1 June 2012.

Loveland, T. and A. Belward. 1997. The IGBP-DIS global 1km land cover data set, DISCover: first results, Int. J. Remote Sens., 18, 3289–3295, 1997.

Mahadevan, P., S. Wofsy, D. Matross, X. Xiao, A. Dunn, J. Lin, C. Gerbig, J. Munger, V. Chow, and E. Gottlieb. 2008. A Satellite-Based Biosphere Parameterization for Net Ecosystem CO2 Exchange: Vegetation Photosynthesis and Respiration Model (VPRM), Global Biogeochem. Cy., 22, GB2005, doi:10.1029/2006GB002735

Price, K., R. Storn, R., and J. Lampinen. 2006. Differential Evolution – A Practical Approach to Global Optimization, Springer, Berlin, Germany, ISBN number: 3540209506

Strahler, A., D. Muchoney, J. Borak, M. Friedl, S. Gopal, E. Lambin, and A. Moody. 1999a. MODIS Land Cover Product Algorithm Theoretical Basis Document (ATBD) MODIS Land Cover and Land-Cover Change, USGS, NASA, http://modis.gsfc.nasa.gov/data/atbd/atbd_mod12.pdf , (last accessed: 4 June 2012).

Strahler, A. H., W. Lucht, C.B. Schaaf, T. Tsang, F. Gao, X. Li, J.P. Muller, P. Lewis, and M. Barnsley. 1999b. MODIS BRDF/albedo product: algorithm theoretical basis document version 5.0, http://modis.gsfc.nasa.gov/data/atbd/atbd_mod09.pdf (last accessed 4 June 2012.

Xiao, X., Q. Zhang, B. Braswell, S. Urbanski, S. Boles, S. Wofsy, B. Moore, and D. Ojima. 2004. Modeling gross primary production of temperate deciduous broadleaf forest using satellite images and climate data, Remote Sens. Environ., 91, 256–270.

Privacy Policy | Feedback | FAQs | Site Map

OAK RIDGE National Laboratory

Home

About Us
Who We Are
Partners
User Working Group
Biogeochemical Dynamics
Data Citation Policy
News
Workshops

Get Data
Complete Data Set List
Search for Data
Field Campaigns
Validation
Regional/Global
Model Archive

Data Management
Plan
Manage
Archive
DAAC Curation
Submit Data

Tools
Data Search
Site Search
Search by DOI
WebGIS
SDAT
MODIS Land Subsets
THREDDS

Help
FAQs
Tutorials

Contact Us