NPP Multi-Biome: Gridded Estimates for Selected Regions Worldwide, 1954-1998, R3

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Revision date: August 29, 2013

Summary:

This data set provides two data files (.csv format) containing gridded (0.5-degree) estimates of net primary productivity (NPP), elevation, temperature, precipitation, NDVI, and biome type for selected terrestrial regions of the world. The field data used to develop NPP estimates came from 15 worldwide data sources in several different biomes covering the period 1954-1998. NPP values were developed from natural resource field inventories (e.g., forest, rangeland, crop) at different scales, from plot to county; from data compiled from published literature and high resolution maps; from simulation models using key independent variables; from regression analyses with environmental variables; and by using relationships between remotely-sensed spectral vegetation indices and field observations.

The first file, NPP_Gridded_3654_cells_R3.csv with 3,654 0.5-degree grid cells, is suitable for biome level and overall analyses because of a larger sample size. In this file, 36 cells have above-ground net primary production (ANPP) only, 320 cells have total net promary production (TNPP) only, and 3,298 cells have both TNPP and ANPP. The second file, NPP_Gridded_2335_unique_cell_R3s.csv, was derived from the larger file and contains 2,335 0.5-degree grid cells after outliers were excluded, replicate measurements were averaged out for each unique geographic location, and cells classified as water, bare ground, and urban were excluded. This smaller data file is more appropriate for model/data inter-comparisons.

Overall, gridded ANPP values ranged from 3 to 890 gC/m^2/yr, and gridded TNPP values ranged from 3 to 1,235 gC/m^2/yr. The lowest values are for sparsely vegetated ground (e.g., open shrublands) and the highest values are for forests.

Revision Notes: This data set has been revised to correct the previously reported temporal coverage of field data measurements that were used to develop NPP estimates and the data set title was also corrected to reflect the date change. Missing value codes were added. Please see the Data Set Revisions section of this document for detailed information.

Additional Documentation:

Data were compiled from the published literature for intensively studied and well-documented individual field sites and from a number of previously compiled multi-site, multi-biome data sets of georeferenced NPP estimates. The principal compilation effort (Olson et al., 2001) was sponsored by the NASA Terrestrial Ecology Program. For more information, please visit the NPP web site at http://daac.ornl.gov/NPP/npp_home.html.

Data Citation:

Cite this data set as follows:

Zheng, D.L., S.D. Prince, and R. Wright. 2013. NPP Multi-Biome: Gridded Estimates for Selected Regions Worldwide, 1954-1998, R3. Data set. Available on-line [http://daac.ornl.gov] from the Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, USA. doi:10.3334/ORNLDAAC/614

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1. Data Set Overview:

Project: Net Primary Productivity (NPP)

Most field data for NPP are for relatively small field sites that are effectively points when considered at the 0.5 x 0.5-degree scale commonly used in global biogeochemical models. Thus, direct comparison between field data and coarse resolution model outputs can be misleading. To resolve this issue, consistent estimates of NPP for 0.5 x 0.5-degree grid cells were developed from 15 studies representing NPP in croplands, sparse vegetation, shrublands, grasslands, and forests worldwide. The resulting data set contains two comma-separated-value files, one with data for 3,654 cells [NPP_Gridded_3654_cells_R3.csv] and a subset of 2,335 cells [NPP_Gridded_2335_unique_cells_R3.csv] in which outliers were removed, all replicate measurements were aggregated for each cell, and cells classified as water, bare ground, and urban were excluded. The NPP_Gridded_3654_cells_R3.csv file is suitable for biome level and overall analyses because of its larger sample size. The NPP_Gridded_2335_unique_cells_R3.csv file derived from the larger file is more appropriate for model/data inter-comparisons.

The principal methods used in this study for estimating NPP at 0.5-degree cell resolution include: (1) stratification of grid cells and area weighting of field NPP observations in each stratum; (2) aggregation of finer-scale (plot or stand level) spatial inventory data; (3) local modeling of NPP using key environmental variables for which maps are available; and (4) direct correlation of ground measurements with remotely sensed vegetation indices. Because many components of NPP from field observations were missing, calculations were made, where possible, to provide consistent estimates of total NPP (TNPP).

This data set is a contribution to the Global Primary Production Data Initiative (GPPDI) (Olson et al. (2012). Above-ground NPP ranged from 3 $gC/m^2/yr$ for sparse vegetation to 890 $gC/m^2/yr$ in forests, while total NPP ranged from 3 to 1,235 $gC/m^2/yr$, respectively (Zheng et al., 2003).

Zheng et al. (2003) identify issues that must be considered during the aggregation of field-scale data to coarser spatial resolutions, usually in the form of grid cells. They evaluate the data set by comparison with existing literature and the widely used Miami model.

2. Data Description:

This data set contains two data files (.csv format) of gridded NPP estimates and ancillary data: NPP_Gridded_3654_cells_R3.csv which is suitable for biome level and overall analyses and NPP_Gridded_2335_unique_cells_R3.csv which is more appropriate for model/data inter-comparisons.

Spatial Coverage

Site: Global (gridded)

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

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude	Elevation (m)
Global (gridded)	-122.25	152.75	63.75	-33.75	1 - 3,795.5

Site Information

The field data used to develop 0.5-degree grid cell estimates of NPP came from 15 sources in several different biomes and regions (Table 1). The NPP cells are unevenly distributed geographically since the investigators depended entirely on existing data sets. The cells are concentrated in five major regions with 77.3% of the cells in the USA, followed by 16.8% in Australia, 2.7% in China, 2.2% in Sweden/Finland, and 0.9% in Senegal.

Table 1. Biomes and regions represented in the GPPDI gridded data set

Biome	Location	NPP estimation method	Years	NPP type	Number of cells	ID value ranges	Source
Grassland	Great Plains, USA	Rangeland inventory	Average (1989-1993)	P	922	1000s	Tieszen et al. (1997)
Temperate, coniferous forest	Yellowstone, USA	Measurements of DBH increment (540 plots) within uniform stands, regression analysis	1991	A	3	2000s	Hansen et al. (2000a)
	Queensland,	Measurements of grassland					Day et al. (1997); Day et al. (pers.

Grassland	Australia	biomass increment, modeling	1959-1998	A	1	4000s	comm., 1999)
Boreal forest	Minnesota, USA	FIA forest inventory (2,711 plots)	FIA latest survey interval (1979-1984)	A	2	5000s	Goetz and Prince (1996)
Temperate mixed forest	Mid-Atlantic and Maine, USA	FIA forest inventory (2,640 plots)	Potential NPP (1977-1990)	P	245	6000s	Jenkins et al. (2001)
Boreal forest, Temperate deciduous and mixed forests	Russia, SE and NE USA	Forest inventory	Varied	A	8	7000s	Gower et al. (2001); Krankina et al. (2001)
Grassland	Great Plains, USA	Rangeland inventory, regression analysis	Average (1984)	P	100	8000s	Sala et al. (1988)
Cropland	Mid-West, USA	NASS crop inventory and growth model	1992 for midwest states; mean of 1982-96 for Iowa	A	220	9000s	Prince et al. (2001)
Temperate, coniferous forest	Pacific Northwest, USA (HJ Andrews, OR)	Literature giving estimates by stand age, remote sensing	1988	A	1	10000s	Turner et al. (2000)
Grassland	Great Plains, USA	Rangeland inventory, regression analysis	Average (1954-1990)	P	1,262	11000 - 12000s	Gill et al. (2002)
Temperate forest	Eastern forests, USA	FIA forest inventory by county	FIA latest survey interval (1962-1996)	A	62	13000s	Brown et al. (1999)
Varied (grassland, etc)	Australia	Literature	Potential NPP (1965-1998)	P	615	14000-17000s	Barrett (2002)
Boreal forest, coniferous	Finland and Sweden	5-year set of forest measurements (660 plots) with allometric equations, remote sensing	1990-1993	A	82	18000s	Zheng et al. (2004)
Savanna, tropical	Senegal	11-year set of measurements for major cover types, remote sensing	1987-1997	A	32	19000s	Diallo et al. (1991)
Forests	China	Forest inventory (>1,000 plots), remote sensing	Average (1989-1993)	A	99	20000s	Jiang et al. (1999)

Notes: FIA = Forest Inventory and Analysis. FIA survey intervals vary by state. NASS = National Agricultural Statistics Service. A =actual measurement. P = potential based on modeling. There are no "3000" or "20000-21000" ID value ranges.

Spatial Resolution

The spatial resolution of the data used to provide gridded estimates of NPP vary from one study to another, ranging from plot, to stand, to large segments of entire counties. The gridded data are 0.5-degree latitude-longitude grid cells.

Temporal Coverage

Field measurements and remotely-sensed data from 15 sources cover the period 1954-1998. Some data values are averages for the individual data collection interval. See Table 1.

Temporal Resolution

All NPP estimates are based on plant dry matter accumulation, expressed as $gC/m^2/yr$ (carbon content of dry matter weight).

Data File Information

Table 2. Data files in this data set archive

FILE NAME	TEMPORAL COVERAGE	FILE CONTENTS
NPP_Gridded_3654_cells_R3.csv	1954/01/01-1998/12/31	Gridded NPP, elevation, temperature, precipitation, NDVI, and biome type for selected terrestrial regions of the world.3,654 0.5-degree grid cells.
NPP_Gridded_2335_unique_cells_R3.csv	1954/01/01-1998/12/31	Gridded NPP, elevation, temperature, precipitation, NDVI, and biome type for selected terrestrial regions of the world. 2,335 0.5-degree grid cells, a sub-set of the larger file.

NPP Data. The value -999 is used to denote missing values. All NPP estimates are based on plant dry matter accumulation, expressed as $gC/m^2/yr$ (carbon content of dry matter weight).

Table 3. Column Headings in NPP file (NPP_Gridded_3654_cells_R3.csv)

Column Heading	Definition	Units
Sequence	Sequential ID number assigned to rows	Numeric
latitude	Latitude of 0.5-degree cell centroid	Decimal degrees
longitude	Longitude in degree of 0.5-degree cell centroid	
anpp	Above-ground net primary productivity (ANPP)	$gC/m^2/yr$
totnpp	Total net primary productivity (NPP)	
elev	Elevation	meters
anu_avgT	Annual mean air temperature (1901-1995 mean)	degrees Celsius
anu_ppt	Annual total precipitation (1901-1995 mean)	mm
anu_ndvi	Annual mean NDVI	index (0-1)
landcover	Satellite-derived land cover type for grid cell	Numerical code (0 through 13). See Table 3.
biome	Biome types reported by individual studies (if not available, then aggregated based on 1-km classification, e.g. in Senegal)	Text
methods	Methods used to estimate NPP	Text
year	Year or range of years represented by the measurements	YYYY, YYYY-YY, or Text
source	Primary author for NPP values	Text
id	Unique ID number for each record (for	Numeric

	cross-referencing with GPPDI)	

Table 4. Land cover classification scheme (Hansen et al., 2000b)

LAND COVER CLASSIFICATION	CODE FOR LAND USE CLASS
Water	0
Evergreen needleleaf forests	1
Evergreen broadleaf forests	2
Deciduous needleleaf forests	3
Deciduous broadleaf forests	4
Mixed forests	5
Woodlands	6
Wooded grasslands/ shrubs	7
Closed bushlands or shrublands	8
Open shrublands	9
Grasses	10
Croplands	11
Bare ground	12
Urban and built-up	13

Sample NPP Data Record (NPP_Gridded_3654_cells_R3.csv)

Sequence, latitude, longitude, anpp, totnpp, elev, anu_avgT, anu_ppt, anu_ndvi, landcover, biome, methods, year, source, id

1, 48.75, -113.25, 79, 185, 1559, 3.6, 466, 0.31525, 7, grass, Inventory, Average, Tieszen, 1001
2, 48.75, -112.75, 89, 200, 1278, 4.5, 364, 0.247083333, 10, grass, Inventory, Average, Tieszen, 1002
3, 48.75, -112.25, 68, 158, 1171, 5.2, 319, 0.214916667, 10, grass, Inventory, Average, Tieszen, 1003 ...

Table 5. Column Headings in NPP file (NPP_Gridded_2335_unique_cells_R3.csv)

Column Heading	Definition	Units
Sequence	Sequential ID number assigned to rows	Numeric
latitude	Latitude of 0.5-degree cell centroid	Decimal degrees
longitude	Longitude in degree of 0.5-degree cell centroid	
anpp	Above-ground net primary productivity (ANPP)	$gC/m^2/yr$
totnpp	Total net primary productivity (NPP)	
elev	Elevation	meters
anu_avgT	Annual mean air temperature (1901-1995 mean)	degrees Celsius
anu_ppt	Annual total precipitation (1901-1995 mean)	mm
anu_ndvi	Annual mean NDVI	index (0-1)
landcover	Satellite-derived land cover type for grid cell	Numerical code (0 through 13). See Table 3.
biome	Biome types reported by individual studies (if not available, then aggregated based on 1-km classification, e.g. in Senegal)	Text
source	Primary author for NPP values	Text
id	Unique ID number for each record (for cross-referencing with GPPDI)	Numeric

Sample NPP Data Record (NPP_Gridded_2335_unique_cells_R3.csv)

Sequence, latitude, longitude, anpp, totnpp, elev, anu_avgT, anu_ppt, anu_ndvi, landcover, biome, source, id

1, 48.75, -113.25, 79, 185, 1559, 3.6, 466, 0.31525, 7, grass, Tieszen, 1001
2, 48.75, -112.75, 89, 200, 1278, 4.5, 364, 0.247083333, 10, grass, Tieszen, 1002
3, 48.75, -112.25, 68, 158, 1171, 5.2, 319, 0.214916667, 10, grass, Tieszen, 1003...

Notes for the data files:

(1) Except for 14 cells (IDs 1921, 1922, 5001, 5002, 7001-7008, and 10001), and those provided by Barrett (2002), for which NPP was expressed in units of $gC/m^2/yr$ (no conversion required), all other cells were provided in units of grams biomass, and were converted to $gC/m^2/yr$ by multiplying by 0.475 for forest and 0.45 for grassland.

(2) The total NPP values for cells with ID 8001-8100 (Sala et al., 1988) were calculated by TNPP ($gC/m^2/yr$) = 1.54ANPP + 111.7, derived from Parton (pers. comm.) ANPP and TNPP, because only ANPP was provided for those cells.

(3) Cells 1921 and 1922 have the same coordinates as 1919 and 1920 (all from Tieszen et al., 1997). However, the NPP data were derived from different methods. The NPP values (1921, 1922) were derived from land cover stratification and NPP values for all the other 920 cells of Tieszen et al. (1997) were based on STATSGO.

(4) For Prince et al. (2001) data, the total NPP values for cells with ID# 9001-9155 were for Midwest states in 1992, while the total NPP values for cells with ID# 9156-9220 were the mean from 1982 through 1996 for Iowa state.

(5) Methods used for developing NPP for the 62 cells based on Brown et al. (1999) are described in Zheng et al. (2003), and summarized below:

(a) Brown's original data contain above-ground annual mean woody increment;

(b) Leaf litterfall production was estimated based on latitude (Lonsdale, 1988);

(c) Fine root production = leaf litterfall (Raich and Nadelhoffer, 1989);

(d) Coarse root production = 22.5% of above ground woody increment (Krankina et al., 2001) -- as a result, ANPP=a+b, and TNPP=ANPP+c+d; and

(e) Only those counties in Brown's study with forest cover >= 75% and cells (0.5x0.5) that were fully covered with the selected counties whose NPP were calculated using area-weighted method were used.

(6) Vegetation type for each cell was based on the 1-km gridded global land cover map of Hansen et al. (2000b).

(7) The criteria used for selecting cells vary from one study to another, balancing between the data quality and availability of NPP cell quantity. Details are:

(a) there were a total of 2,550 0.5-degree cells available in Australia, but only those cells in which the dominant land cover type covered > 90% of the total cell area were selected (resulted in 615);

(b) a total of 68 0.5-degree cells were available in Senegal, then 75% criteria was used (32 selected); and

(c) for the study in Finland/Sweden, the cells selected met the criteria (i) location < 66.0 N latitude, (ii) forest cover > 80% of the cell area, and (iii) evergreen needleleaf forest > 50% of the cell area (resulted in 82).

3. Data Application and Derivation:

The data set is a contribution to the Global Primary Production Data Initiative (GPPDI) (Olson et al., 2012). The file NPP_Gridded_3654_cells_R3.csv is suitable for biome level and overall analyses because of larger sample size. The file NPP_Gridded_2335_unique_cells_R3.csv was derived from the larger file; however, outliers were excluded, replicate measurements were averaged out for each unique geographic locations, and cells classified as water, bare ground, and urban were excluded. This data file is more appropriate for model/data inter-comparisons.

4. Quality Assessment:

Data quality assessment for this data set involved several outlier analysis tests. First, outliers in the data were identified by calculating the means and standard deviations of NPP for broad biomes. No NPP values were excluded from the data set since (1) the current data may not be representative for each biome, for example, there are no tropical high-productivity NPP cells in this data set, thus a cell NPP value of 1,235 $gC/m^2/yr$ that is currently an outlier, may not necessarily be unreasonable if more high-productivity NPP cells are added; (2) some cells had only a single year of observation while others were long-term averages; and (3) the GPPDI data set includes both actual and potential NPP.

Further outliers were detected by examining relationships between NPP and other environmental variables based on: (1) climate values outside of the 0.01 to 0.99 percentiles for each biome calculated assuming a normal distribution of variables; (2) linear regression analysis between NPP and actual evapotranspiration (AET), precipitation, elevation, and temperature. Cells falling outside of the 0.95 confidence interval about the regression line were flagged; and (3) managed vegetation (e.g., the cells originally reported as crop) were excluded (Olson et al., 2001). After the outlier analysis on the original 3,654 0.5-degree grid cells [NPP_Gridded_3654_cells_R3.csv], averaging replicate measurements of the same cell (mainly in the Great Plains Region, USA), and excluding cropland cells, 2,335 cells remained [NPP_Gridded_2335_unique_cells_R3.csv].

To confirm the data quality, all available cells that had TNPP values (3,618) were used for comparisons with the Miami model [precipitation based (Lieth, 1975)]. The TNPP values were well correlated (r2=0.73) with the Miami model results, but were consistently

lower. The grid-cell NPP estimates are compared with other key environmental variables at the same resolution (0.5-degree), such as AET (1961-90) and NDVI (1981-94) to test the consistency of the estimates. See Zheng et al. (2003) for discussion.

For data analyses at biome level, the full data set of grid cells was assigned to biomes through two steps: (1) a gridded land cover map with 0.5-degree cell size, aggregated from a 1 km^2 map (Hansen et al., 2000b); and (2) within the forest and grass categories, climate was used to identify sub-classes (e.g., minimum monthly temperature >15°C for tropical, -15° to 15°C for temperate, and <-15°C for boreal forest, respectively (Prentice et al., 2000). Cells classified as water, bare ground, and urban were not included. Biomes containing <60 cells were also excluded.

Terrestrial boundaries do not match precisely when the data from different sources with different original spatial resolution apply to a land mask at 0.5-degree longitude/latitude. The NPP cells were unevenly distributed geographically since the investigators depended entirely on existing data sets. The cells were concentrated in five major regions with 77.3% of the cells in the U.S.A., followed by 16.8% in Australia, 2.7% in China, 2.2% in Sweden/Finland, and 0.9% in Senegal.

Sources of Error

The problem of temporal mismatch between NPP and model forcing variables must be recognized. NPP measurements are often made over a single growing season and ought only to be used in conjunction with climate and in comparison with model outputs for the same period. NPP estimates based on long-term measurements should also use long-term mean climate data to account for inter-annual variations. Unfortunately the lack of data that represents consistent time periods often makes it necessary to use data sets with mismatch time periods. Consequently, a quantitative analysis of errors for the data aggregation is difficult, if not impossible. Ninety-five (95) percent of the cells reported in the GPPDI data set represented either potential or mean NPP values over periods > 10 years.

5. Data Acquisition Materials and Methods:

NPP Data Sources

The field data used to develop 0.5-degree grid cell estimates of NPP came from 15 sources in several different biomes. The type of data varied from one study to another, ranging from plot, to stand, to large segments of entire counties. Moreover, the characteristics of the data varied, because of the different purposes of the originally collected data and the particular constraints on measurement presented by different vegetation types. None of the sources included all components of NPP, most commonly the below-ground NPP (BNPP) was not measured. Where possible various techniques were adopted to estimate the missing components so that both ANPP and total NPP (TNPP) could be reported.

Five categories of data sources and subsequent data processing were applied (Table 5), although elements of several were combined in some cases. NPP values were developed (1) from natural resource inventory data (e.g., forest, rangeland, crop) at different scales, from plot to county; (2) from published literature data for major components of a landscape with high resolution maps used to measure the area of each component; (3) from simulation with models using key independent variables, for which maps were available; (4) by using regression analyses with environmental variables; and (5) by using relationships between remotely-sensed spectral vegetation indices and field observations.

Table 5. Methods of estimating NPP

Method	Definition
Inventory	Aggregation of finer-scale (plot or stand level) spatial inventory data
Literature review	Compiling estimates of NPP from published literature and using high resolution maps to calculate area coverage
Local modeling	Local modeling of NPP using key environmental variables, for which maps are available
Regression	Stratification of grid cells and area weighting of field NPP observations in each stratum
Remote sensing / inventory / allometric	Direct correlation of ground measurements with remotely sensed vegetation indices

To convert biomass units to carbon units for this data set, factors of 0.475 and 0.45 were used for forests and grasslands, respectively. Few of the data sources used in this study were originally for 0.5-degree cells so the average of all the original fine-scale cells that fell within each 0.5-degree cell was used to represent the NPP value for that 0.5-degree cell. Any cells with no data were excluded. For the studies in which the original resolution was coarser than 0.5 x 0.5-degrees (e.g., inventory data at county level), resampling procedures were used. All locations were specified by the latitude and longitude at the centers of the cells.

Aggregation to Finer-scale Spatial Inventory Data

Zheng et al. (2003) describe how yield data for crops, rangelands, and forests routinely collected for resource management purposes by NASS, FIA, and others (Brown et al., 1999; Goetz and Prince, 1996; Jenkins et al., 2001; Gower et al., 2001; Krankina et al., 2001; Prince et al., 2001; Tieszen et al., 1997) were aggregated for large area NPP estimates. Data for privately owned land were not accessible at a fine enough scale for this study.

Local Modeling of NPP Using Mapped Environmental Variables

In many cases highly parameterized local models are the most effective means of extending local NPP measurements across the landscape. Usually these models are forced with variables such as climate, soils, and vegetation cover, all of which can be estimated reasonable accurately for limited areas. Although these are model results, and not direct observations of NPP, they are highly tuned to local conditions and can be used, with due caution, to validate more general models that are applicable to the entire global land surface. This method was used for the continent of Australia (Barrett, 2002) and the Mitchell grasslands of Australia (Day et al., 1997; Day et al.,

pers. comm., 1999).

Regression Models

This method has commonly been applied in areas where NPP is strongly controlled by a single environmental variable, such as elevation, temperature, or precipitation. In this study, the method was applied to the greater Yellowstone region of the U.S.A. (Hansen et al., 2000a) and grasslands in the Great Plains of the U.S.A. (Sala et al., 1988; Gill et al., 2002).

Mapping and Area-weighting of Field NPP

Where maps were available of properties of the vegetation that were strongly related to productivity, an efficient method of estimating NPP of large areas was used to obtain estimates of NPP for each mapped class and then weighting factors proportional to the area of each class were applied. Zheng et al. (2003) describe the methods used for forests in the U.S. Pacific northwest (Turner et al., 2000).

Direct Correlation of Field NPP with Remotely-Sensed Spectral Vegetation Indices

Under certain circumstances vegetation indices calculated from remotely-sensed spectral reflectance of vegetation in the red and infrared are well correlated with NPP (Prince, 1991). The widely used NDVI has been shown to be nearly linearly related to the proportion of photosynthetically active radiation that is absorbed by a green leaf canopy (fPAR) (Gower and Dye, 1997). Zheng et al. (2003) describe how NDVI was correlated with field data for a savanna in Senegal (Diallo et al., 1991), forests in China (Jiang et al., 1999), and forests in northern Europe (Zheng et al., 2004).

6. Data Access:

These data are 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

7. References:

Barrett, D. J. 2002. Steady state turnover time of carbon in the Australian terrestrial biosphere. Global Biogeochemical Cycles 16(4): 1108-1030.

Brown, S.L., P.E. Schroeder, and J.S. Kern. 1999. Spatial distribution of biomass in forests of the eastern USA. Forest Ecology and Management 123: 81-90.

Diallo, O., A. Diouf, N.P. Hanan, A. Naliaye, and Y. Prevost. 1991. AVHRR monitoring of savanna primary production in Senegal, West Africa: 1987-1988. Int. J. Remote Sens. 12: 1259-279.

Day, K.A., M.R. McCaskill, and G.M. McKeon. 1997. A review of pasture production data in Queensland. In K. A. Day, G. M. McKeon, and J. O. Carter (eds.), Evaluating the Risks of Pasture and Land Degradation in Native Pastures in Queensland. Final report for Rural Industries Research and Development Corporation Project DAQ-124A, February.

Gill, R.A., R.H. Kelly, W.J. Parton, K.A. Day, R.B. Jackson, J.A. Morgan, J.M O. Scurlock, L.L. Tieszen, J. Vande Castle, D.S. Ojima, and X.S. Zhang. 2002. Using simple environmental variables to estimate below ground productivity in grasslands. Global Ecology and Biogeography. 11(1): 79-86.

Goetz, S.J., and S.D. Price. 1996. Remote sensing of net primary production in boreal forest stands. Agric. For. Meteorol. 78.

Goward, S.N., and D.G. Dye. 1997. Global biospheric monitoring with remote sensing, pp. 241-272. IN: Gholz, H.L., K. Nakane, and H.T. Shimoda (eds.). The Use of Remote Sensing in the Modeling of Forest Productivity. Kluwer Academic Publishers, Dordrecht, The Netherlands. 323 pp.

Gower, S.T., O. Krankina, R.J. Olson, M. Apps, S. Linder, and C. Wang. 2001. Net primary production and carbon allocation patterns of boreal forest ecosystems. Ecological Applications. 11: 1395-1411.

Hansen, A.J., J.J. Rotella, M.P.V. Kraska, and D. Brown. 2000a. Spatial patterns of primary productivity in the Greater Yellowstone ecosystem. Landscape Ecol. 15: 505-22.

Hansen, M. C., R. S. Defries, J. R. G. Townshend, and R. Sohlberg. 2000b. Global land cover classification at 1 km spatial resolution using a classification tree approach. Int. J. Remote Sens. 21: 1331-364.

Jenkins, J.C., R.A. Birdsey, and Y. Pan. 2001. Biomass and NPP estimation for the mid-Atlantic region (USA) using forest inventory data. Ecol. Appl. 11(4): 1174–193.

Jiang, H., M.J. Apps, Y. Zhang, C. Peng, and P.M. Woodard. 1999. Modelling the spatial pattern of net primary productivity in Chinese forests. Ecol. Modell. 122: 275-88.

Joyce, L.A., and D.E. Chalk. 1986. Range Forage Data Base for 20 Great Plains, Southern, and Western States. Fort Collins, Colo.: U.S. Dept. of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. General Technical Report RM-133. 17 pp.

Krankina, O.N., S. Brown, J.C. Jenkins, D. Kicklighter, M.J. Apps, and R.J. Olson. 2001. Use of forest inventory data for estimating NPP.

Ecological Applications (manuscript).

Lieth, H. 1975. Modelling the primary productivity of the world, pp. 237-263. IN: Lieth, H., and R.H. Whittaker (eds.). Primary Productivity of the Biosphere. Springer-Verlag, New York. 339 pp.

Lonsdale, W.M. 1988. Predicting the amount of litterfall in forests of the world. Annuals of Botany 6: 319-324.

Olson, R. J., K.R. Johnson, D.L. Zheng, and J.M.O. Scurlock. 2001. Global and Regional Ecosystem Modeling: Databases of Model Drivers and Validation Measurements. ORNL Technical Memorandum TM-2001/196. Oak Ridge National Laboratory, Oak Ridge, Tennessee, U.S.A.

Olson, R.J., J.M.O. Scurlock, S.D. Prince, D.L. Zheng, and K.R. Johnson (eds.). 2012a. NPP Multi-Biome: Global Primary Production Data Initiative Products, R2. Data set. Available on-line [http://daac.ornl.gov] from the Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A. doi:10.3334/ORNLDAAC/617

Olson, R. J., J. M. O. Scurlock, S. D. Prince, D. L. Zheng, and K. R. Johnson (eds.). 2012b. NPP Multi-Biome: NPP and Driver Data for Ecosystem Model-Data Intercomparison, R[evision]2. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A. doi:10.3334/ORNLDAAC/615

Prentice, I.C., M. Heimann, and S. Sitch. 2000. The carbon balance of the terrestrial biosphere: Ecosystem models and atmospheric observations. Ecological Applications 10: 1553-1573.

Prince, S.D. 1991. Satellite remote sensing of primary production: comparison of results for Sahelian grasslands 1981-1988. International Journal of Remote Sensing 12: 1301-1311.

Prince, S.D., J. Haskett, M. Steininger, H. Strand, and R. Wright. 2001. Net primary production of U.S. midwest croplands from agricultural harvest yield data. Ecol. Appl. 11(4): 1194-1205.

Raich, J.W., and K.J. Nadelhoffer. 1989. Belowground carbon allocation in forest ecosystems; global trends. Ecology 70: 1346-1354.

Sala, O.E., W.J. Parton, L.A. Joyce, and W K. Lauenroth. 1988. Primary production of the central grassland region of the United States. Ecology 69: 40-5.

Tieszen, L.L., B.C. Reed, and D.D. Dejong. 1997. NDVI, C3 and C4 production, and distributions in Great Plains grassland land cover classes. Ecol. Appl. 7: 59-78.

Turner, D.P., W.B. Cohen, and R.E. Kennedy. 2000. Alternative spatial resolutions and estimations of carbon flux over a managed forest landscape in Western Oregon. Landscape Ecol. 15: 441-52.

Zheng, D., S. Prince, and Wright, R. 2003. Terrestrial net primary production estimates for 0.5 grid cells from field observations—a contribution to global biogeochemical modeling. Global Change Biology 9: 46-64.

Zheng, D.L., S.D. Prince, and T. Hame. 2004. Estimating net primary production of boreal forests in Finland and Sweden from field data and remote sensing. Journal of Vegetation Science 15 (2): 161-170.

8. Data Set Revisions

Revision Summary:

This data set has been revised to correct the previously reported temporal coverage of field data measurements that were used to develop NPP estimates. Missing value codes were added.

Data File Changes: The temporal coverage of this data set has been changed to correct the dates of field data measurements.

	NPP Multi-Biome: Gridded Estimates for Selected Regions Worldwide, R[evision]2		Corrected in NPP Multi-Biome: Gridded Estimates for Selected Regions Worldwide, R[evision]3	
	Beginning Date (YYYY)	Ending Date (YYYY)	Beginning Date (YYYY)	Ending Date (YYYY)
Temporal Coverage	1989	2001	1954	1998

Data values in the following data files HAVE NOT BEEN CHANGED except to replace blank cells with -999 to denote missing values:

NPP_Gridded_3654_cells_R3.csv

NPP_Gridded_2335_unique_cells_R3.csv

Data set documentation was updated to reflect the new temporal coverage of the field data measurements that were used to develop NPP estimates as described by Zheng et al. 2003 and in the cited data sources.

Data User Action: If you downloaded the referenced data set from the ORNL DAAC on-line archive before August 29, 2013 you should download it again from the ORNL DAAC.

Revision History:

Revision 2 Documentation

Zheng, D.L., S.D. Prince, and R. Wright. 2004. NPP Multi-Biome: Gridded Estimates for Selected Regions Worldwide, 1989-2001, R2.

Data set. Available on-line [http://daac.ornl.gov] from the Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A. doi:10.3334/ORNLDAAC/614

Revision 1 Documentation

Zheng, D.L., S.D. Prince, and R. Wright. 2003. NPP Multi-Biome: Gridded Estimates for Selected Regions Worldwide, 1989-2001, R1. Data set. Available on-line [http://daac.ornl.gov] from the Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A. doi:10.3334/ORNLDAAC/614

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