

The ORNL Distributed Active Archive Center (DAAC) is a NASA-sponsored source for biogeochemical data and services useful in environmental research. The ORNL DAAC currently archives and distributes more than 1,100 products categorized as Field Campaign, Land Validation, Regional and Global, or Model Archive.

Please visit us online at <http://daac.ornl.gov> for a comprehensive description of data, services, and tools available from the ORNL DAAC. Current and past news can be found at <http://daac.ornl.gov/news.shtml>.

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ORNL DAAC News

Daymet Weather Data Now Hosted by ORNL DAAC

Daymet data are now available from the ORNL DAAC as mosaicked gridded estimates of maximum air temperature, minimum air temperature, precipitation, shortwave radiation, snow water equivalent, water vapor pressure, and day length. These seven weather parameters, generated by Peter Thornton and co-workers at the Climate Change Science Institute, ORNL, are currently available on a daily time step at a 1-km by 1-km spatial resolution in Lambert Conformal Conic projection covering the time period January 1, 1980 through December 31, 2013. The Daymet data covers the conterminous United States, Mexico, and southern Canada. The data are in CF-Compliant NetCDF file format and are assembled by parameter and year with each yearly file containing a time dimension of 365 days. Data are archived as: *Daymet: Daily Surface Weather Data on a 1-km Grid for North America, Version 2*.

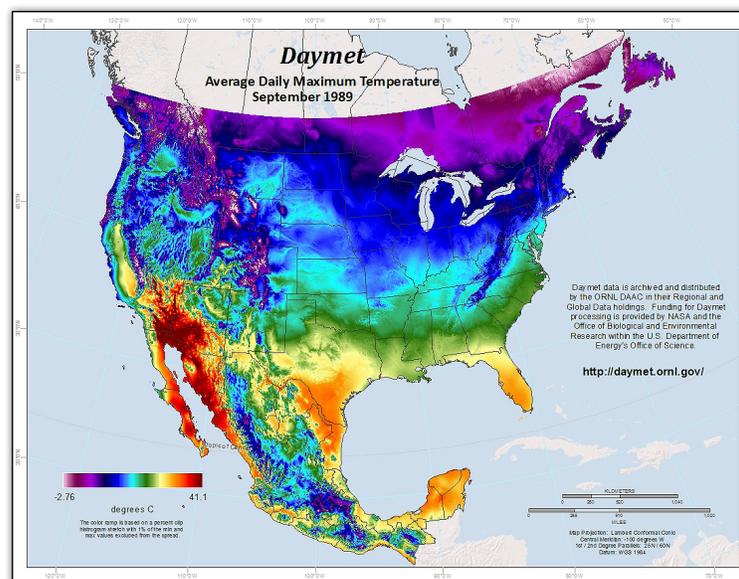


Figure 1. Daymet Average Daily Maximum Temperature, September 1989.

Daymet has benefited from a long history of support and sponsorship from NASA and it is fitting that the curation and stewardship of the data products are with the ORNL DAAC. Daymet development was initially supported through a NASA Terrestrial Ecology Program research grant to Peter Thornton while with NTSG at the University of Montana, Missoula. Building on the logic from earlier meteorological predictive routines (MT-CLIM), Thornton developed the Daymet algorithms to fulfill the need for spatially continuous, gridded estimates of daily weather parameters to drive terrestrial ecosystem process models. These ecosystem models determining photosynthetic growth require daily weather parameters of not only minimum and maximum temperature and precipitation, but also benefit from daily estimates of radiation inputs and humidity. Expanding on the interpolation and extrapolation routines that estimated unknown point locations from known weather stations, Thornton developed

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Daymet Weather Data Now Hosted by ORNL (continued)

the algorithms and software to create a fully gridded daily data product of these important ecosystem driver variables. Over the years the scientific, research, and education community have applied the Daymet data products far beyond the intent of their original application. Because of this, and through the continued support of NASA's [Terrestrial Ecology Program](#) and [Earth Science Data and Information System \(ESDIS\)](#), algorithm

improvements, processing routines, and output products in the form of daily gridded file formats including on-line distribution have occurred and are freely available to a broad user community. Additional support is provided by the U.S. Department of Energy's [Office of Biological and Environmental Research](#). [The Daymet Web page](#) provides additional details and access to the Daymet data.

Daymet Website

The ORNL DAAC, as part of its mission within NASA's EO-SDIS data center network, is ensuring that the Daymet data is easily accessible to the user. In order to reach the widest user community, the ORNL DAAC has developed

routines to transform and mosaic Daymet raw data outputs to appropriate standard file formats that are recognizable by a broad range of users, data access tools, software, and clients. In addition, the ORNL DAAC provides an ancillary

Daymet web site to support the Daymet user community. This web site enables direct access to the standardized Daymet data products as well as providing a number of tools and web services. Additional information and data documentation is provided throughout the web site including facilitation of sharing ORNL DAAC and user community contributed scripts and tools that automate access to and process Daymet data.

From the [Daymet Website](#), all Data Access Methods are provided in the left hand side of the page.

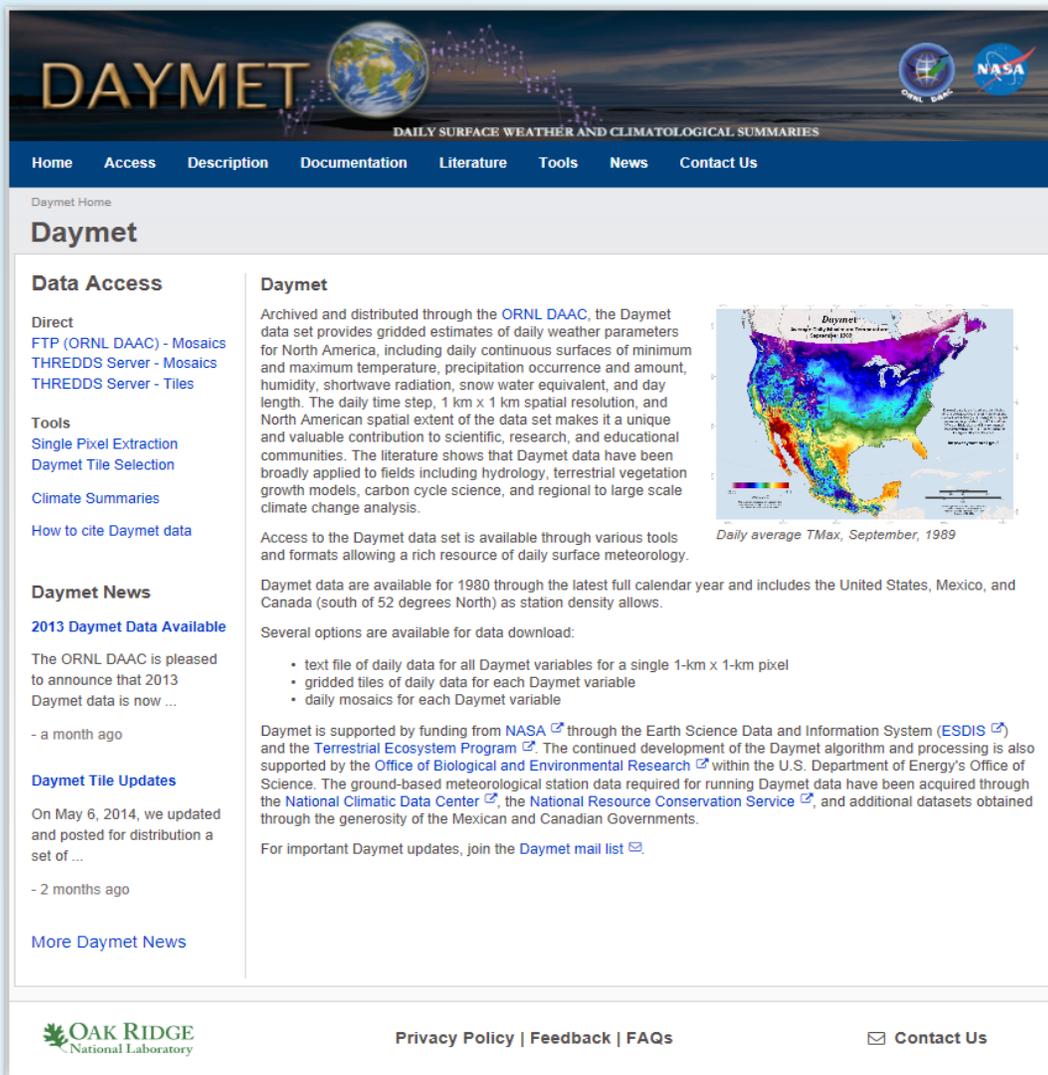


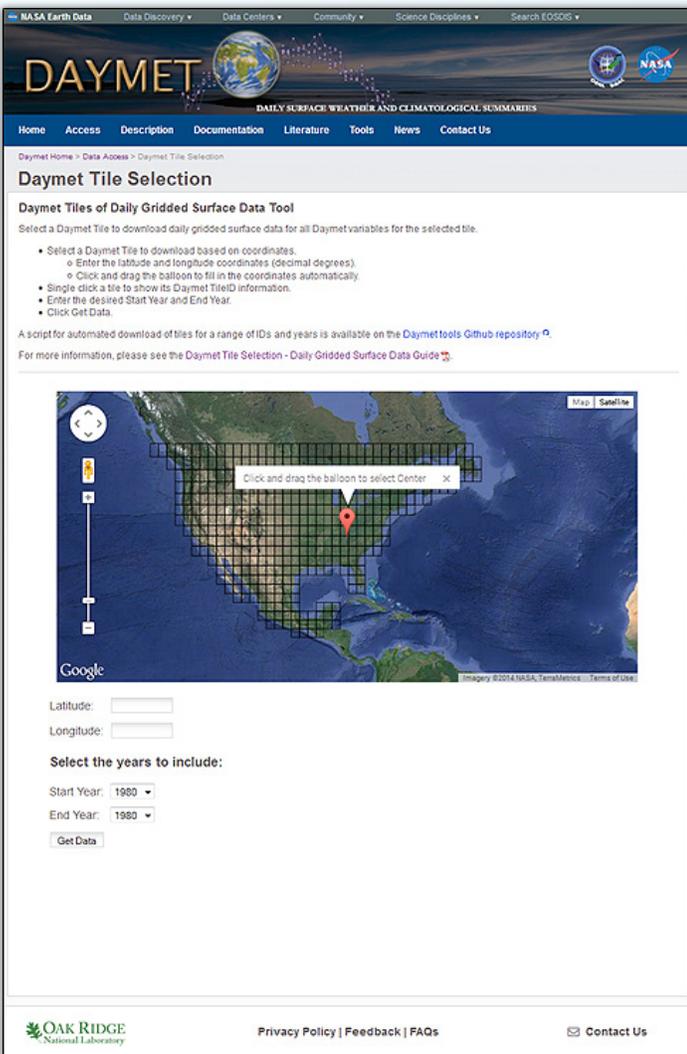
Figure 2. The Daymet Website.

Daymet Tools

Daymet mosaics for North America can be downloaded directly through [ORNL DAAC File Transfer Protocol \(FTP\)](#), and through a Thematic Real-Time Environmental Distributed Data Services (THREDDS) Data Server (TDS). The [ORNL DAAC TDS](#) serves data and provides metadata using a variety of services including OPeNDAP, HTTPServer, WCS, WMS, NCML, NetcdfSubset, and ISO. The OPeNDAP dataset access form allows users to select attributes and download in text or NetCDF formats. HTTPServer provides direct download via http. WCS, WMS and NCML provide XML that includes syntax that can be called from local programs to access the data or portions of the data without downloading a local copy. ISO provides metadata report in XML format and NetcdfSubset provides a GUI based Subset Service for Grids. For users who do not require the entire spatial extent of the mosaic Daymet files, other

tools on the web site are available. Smaller, 2° x 2°, tiled subsets of the daily gridded data for all Daymet variables can be downloaded using the [Daymet Tile Selection Tool](#). One year or a range of years is provided by the user for the selected tile. For each year-variable combination, all 365 days of daily data are available in one netCDF file. This 2-degree tile system is created by the Daymet algorithm as a means to manage the large number of input station data and large spatial extent of the data and is the original output system for Daymet gridded data – see the [Daymet Description](#) for more information. These same tiled outputs are also available through a [THREDDS Data Server](#).

Figure 3. Daymet Tile Selection Tool.



[Back](#) | [Download Data](#) | [Visualize Data](#) | [Readme](#)

Latitude: 35.9271 Longitude: -84.322 X & Y on Lambert Conformal Conic: 1352048.46 -570474.75 Tile: 11208 Elevation: 259 meters

YEAR	DAY	TMAX deg c	TMIN deg c	DAYL s	PRCP mm/day	SRAD W/m ²	SWE kg/m ²	VP Pa
2011	1	14.00	6.50	34560	56.00	144.00	0.00	960.00
2011	2	11.00	-1.50	34560	0.00	278.40	0.00	560.00
2011	3	6.00	-7.00	34560	0.00	288.00	0.00	360.00
2011	4	7.50	-5.50	34560	0.00	288.00	0.00	400.00
2011	5	8.00	-4.00	34906	5.00	208.00	0.00	440.00
2011	6	4.50	-1.50	34906	3.00	128.00	0.00	560.00
2011	7	5.50	-0.50	34906	3.00	128.00	0.00	600.00
2011	8	4.00	-4.00	34906	4.00	163.20	0.00	440.00
2011	9	-0.50	-11.50	34906	0.00	275.20	0.00	240.00
2011	10	-0.50	-8.50	34906	7.00	188.80	8.00	320.00

Figure 4: Daymet CSV tabular output.

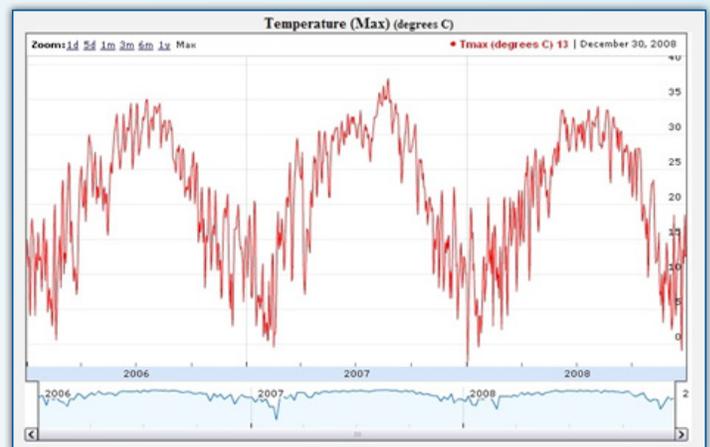


Figure 5. Time series graphical visualization.

For users who need data for only one or a few specific locations or for users who need x,y location data in CSV tabular format, the [Single Pixel Extraction Tool](#) is available. Through this tool, Daymet data for a specified pixel containing the specific location is converted and displayed in tabular format for any single pixel within the Daymet spatial domain. A csv file of the data can be downloaded, and a time series graphical visualization is available.

(continued on p. 4)

Daymet Tools (continued)

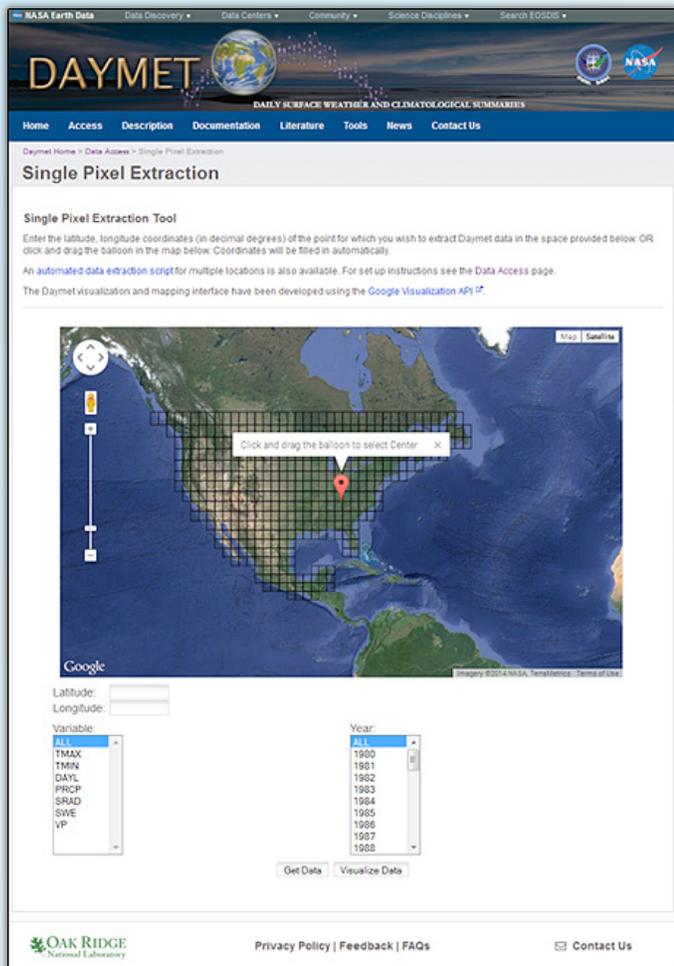
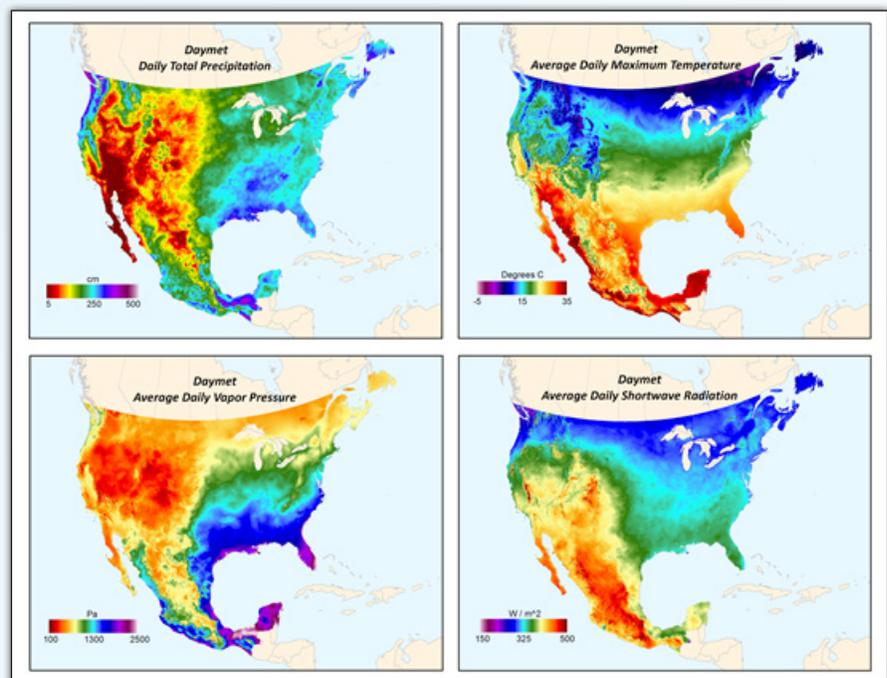


Figure 6. Single Pixel Extraction Tool.

Downloading a large number of single pixel locations, tiles, or mosaic files can be cumbersome and time consuming for the user. The ORNL DAAC therefore provides a number of scripts and documents describing automation techniques to facilitate multiple file downloads. These can be found on the [Tools](#) page of the Daymet web site and includes a script to automate data extraction at multiple locations for the Single Pixel Extraction tool and information to automate the download multiple Daymet tiles or mosaics files available through the THREDDS Data Server.

Both annual and monthly climatologic summary files for the standard Daymet weather variables; minimum and maximum temperature, precipitation, vapor pressure, shortwave radiation, and snow water equivalent have been generated and are available as referenced mosaic geoTIFF files for all years of currently available Daymet data. (Fig. 5). These files are made available on request through our <http://daymet.ornl.gov/contact.html> page. Additional climate summaries for other time periods will be available in 2015.

Figure 7. Annual climate summary of precipitation, temperature, vapor pressure, and shortwave radiation from daily gridded data products for year 2002.



The Daymet User Community

Because of the unique features of the Daymet data set (multiple weather variables, fully gridded, daily time step, 1 km pixel resolution, 1980 - 2013), and the value added tools and services that the Daymet web site offers, the Daymet user community has expanded beyond ecosystem modelers to include a broad range of research and educational disciplines.

One advantage to having the ORNL DAAC archive and distribute the Daymet data set is that it has a formal data product citation, including digital object identifier (DOI), whereby scientific investigations that result in journal publications that have used and cited this data can be tracked. The ORNL DAAC assigned the Daymet data set a DOI in 2012, and it has been [cited numerous times](#) in publications.

The variety of research and educational applications using the Daymet data set is wide-ranging. Along with the aforementioned cited journal articles, many conference talks and posters, thesis projects, and even Middle School Science Lessons have made use of Daymet data.

Conference Talk: [Use of NN based approaches to create high resolution climate meteorological forecasts](#)

Conference Poster: <http://daac.ornl.gov/news/esaposter31july.pdf>

Thesis: http://daac.ornl.gov/news/Aurand_Recharge_Thesis_2013.pdf

Middle School Lesson: http://daac.ornl.gov/news/Climograph_Investigation.pdf

In addition, an active [User Contact](#) form is available whereby a researcher can get timely answers to scientific and data access, format, and/or manipulation questions. Over 400 email exchanges have occurred from this support form.

Another exciting aspect of open access through Common Data Models, is that the data can be directly read and used in other web-based services. The [USGS Geo Data Portal](#) is one such example.

Overall, we have had the pleasure of providing Daymet data and support to the research and education community.

“many thanks again for providing the dataset. A definite time saver. You’ve saved me some considerable time downloading and processing ...”

Dennis Duro ~ Post Doctoral Fellow, Carlton University

“I am quite happy with how Daymet performs. I have more than 200 other sites throughout the Southern Appalachian mountains I can do additional Daymet validation.”

Todd McDonnell ~ M.P.S. Research Hydrologist, E&S Environmental

“... thanks again for your assistance - and also for this product that you have developed. It is going to be a great asset for our research.”

Leslie Ries ~ Assistant Research Scientist, University of Maryland

2014 ACSI web-based survey coming

Thank you to everyone who participated in the 2013 survey. The ORNL DAAC scored a 79 on the Customer Satisfaction Index, an increase of two points from the 2012 survey. Information collected in this survey helps us improve our website to better serve our users..

During early September of 2014, ORNL DAAC users will receive an email invitation from CFI Group on behalf of NASA to participate in this web-based survey about the quality and utility of ORNL DAAC products and services. This anonymous questionnaire takes approximately 10 minutes to complete; optional comment fields are provided to address user concerns.

Please participate!

Your feedback affects our future performance and helps us to identify science needs.

The ORNL DAAC is one of twelve NASA Earth Observing System Data and Information System (EOSDIS) data centers evaluated by this survey.



Recent additions to the ORNL DAAC online archive

Along with the addition of Daymet, the ORNL DAAC published 13 data sets in the first quarter of 2014.

Seven of these were added to our [North American Carbon Program \(NACP\)](#) collection. NACP is a multi-disciplinary research program designed 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.

- [NACP MCI: Cropland Productivity and Biophysical Properties, Nebraska, USA, 2001-2008](#). This data set provides an integrated collection of (1) ground-based meteorological, radiometric, and vegetation measurements, (2) flux-based estimates of gross primary production (GPP), and (3) numerous vegetation indices derived from satellite imagery for three eddy covariance flux tower locations near Lincoln, Nebraska, USA. (A. Gitelson)
- [NACP MCI: CO₂ Emissions Inventory, Upper Midwest Region, USA, 2007](#). This data set provides a bottom-up CO₂ emissions inventory for the mid-continent region of the U.S. for the year 2007. (Ogle, S.M., A.E. Schuh, T.O. West, K.R. Gurney, L.S. Heath, J.L. McCarty, J.E. Smith, E.J. Breidt, and D. Cooley.)
- [NACP MCI: CO₂ Flux from Inversion Modeling, Upper Midwest Region, USA, 2007](#). This data set provides estimates of Net Ecosystem Exchange

(NEE) flux for the U.S. Upper Midwest at 0.5-degree resolution for the year 2007. (Schuh, A.E., T. Lauvaux, S.M. Ogle, K.J. Davis, A.S. Denning, N.L. Miles, S.J. Richardson, and M. Uliasz)

- [NACP CMS: Land Cover Projections \(5.6-km\) from GCAM v3.1, Conterminous US, 2005-2095](#). The data provided are annual land cover projections for years 2005 through 2095 generated by the Global Change Assessment Model (GCAM) Version 3.1. (West, T.O. and Y. Le Page)
- [NACP CMS: Forest Biomass and Productivity, 1-degree and 5-km, Conterminous US, 2005](#). This data set contains spatially-gridded estimates of above ground biomass (AGB), net primary productivity (NPP), and net ecosystem productivity (NEP), provided for forested areas of the conterminous U.S. (West, T.O. and Y. Le Page)
- [NACP Greenhouse Gases Multi-Source Data Compilation, 2000-2009](#). This data set is a collection of measurements of carbon dioxide (CO₂) and non-CO₂ greenhouse gases made across North America by none independent atmospheric monitoring networks from 200-2009. (Wofsy, S.C. and A. Dayalu)
- [NACP MsTMIP: Global and North American Driver Data for Multi-Model Intercomparison](#). This data set provides environmental data that have been standardized and aggregated for use as input to

carbon cycle models at global (0.5-degree resolution) and regional (North America at 0.25-degree resolution) scales. (Wei, Y., S. Liu, D. Huntzinger, A.M. Michalak, N. Viovy, W.M. Post, C. Schwalm, K. Schaefer, A.R. Jacobson, C. Lu, H. Tian, D.M. Ricciuto, R.B. Cook, J. Mao, and X. Shi.)

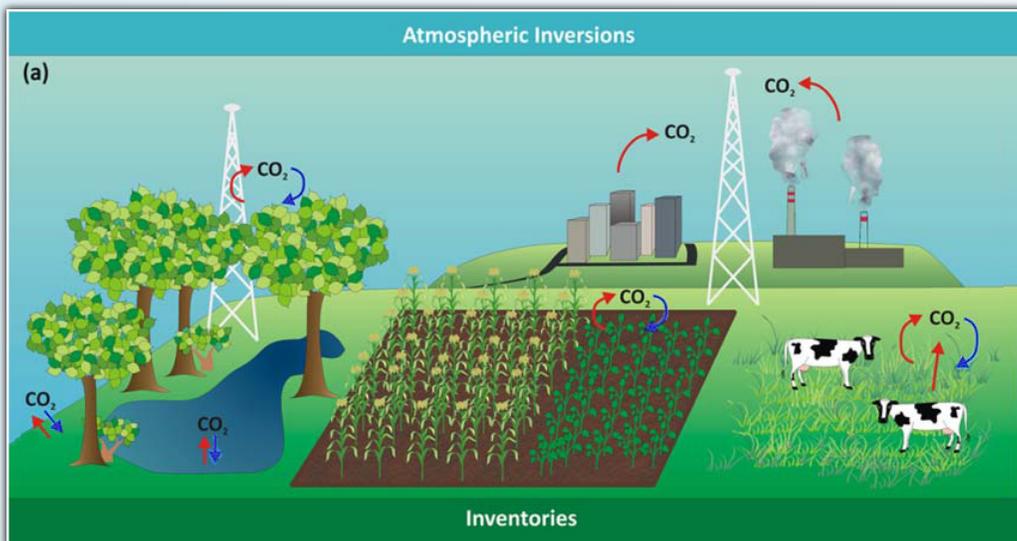


Figure 8: Sources (red arrows) and sinks (blue arrows) of atmospheric CO₂.
Source: NACP MCI: CO₂ Emissions Inventory, Upper Midwest Region, USA, 2007

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Recent additions to the ORNL DAAC online archive (continued)

Two data sets were added to the [Vegetation Collections](#). Vegetation regulates the flow of numerous biogeochemical cycles, most critically those of water, carbon, and nitrogen. The ORNL DAAC compiles, archives, and distributes gridded data on vegetation from regional to continental scales.

- **Tree Canopy Cover for the Circumpolar Taiga-Tundra Ecotone: 2000-2005.** This data set provides a map of selected areas with defined tree canopy cover over the circumpolar taiga-tundra ecotone (TTE). (Ranson, K.J., P.M. Montesán, and R. Nelson.)
- **MODIS-derived Biophysical Parameters for 5-km Land Cover, North America, 2000-2012.** This data set provides MODIS-derived surface biophysical climatologies of bidirectional distribution function (BRDF), BDRF/albedo, land surface temperature (LST), leaf area index (LAI), and evapotranspiration (ET) as separate files for each of the MODIS land cover types, and four radiative forcing data files for four scenarios of potential vegetation shifts in North America (Zhao, K., and R.B. Jackson).

Figure 9.

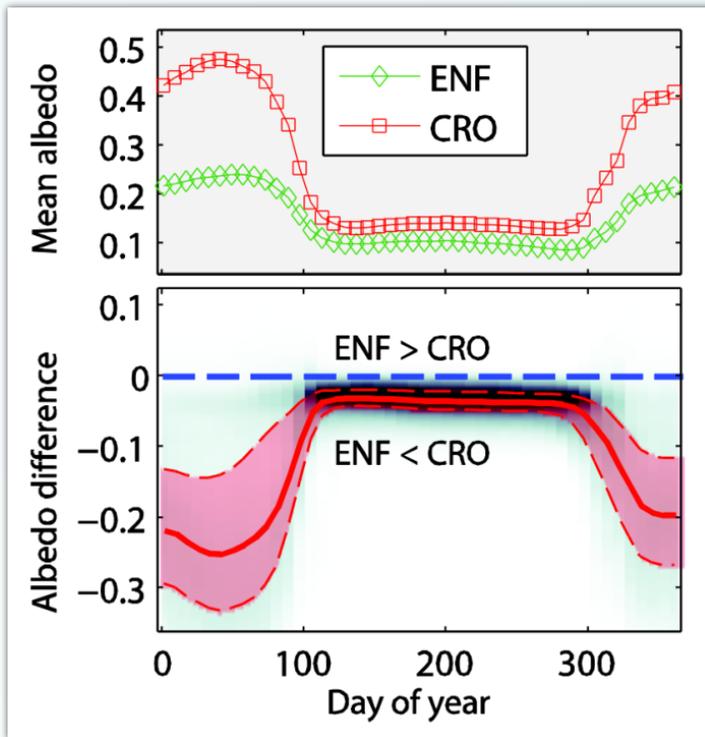
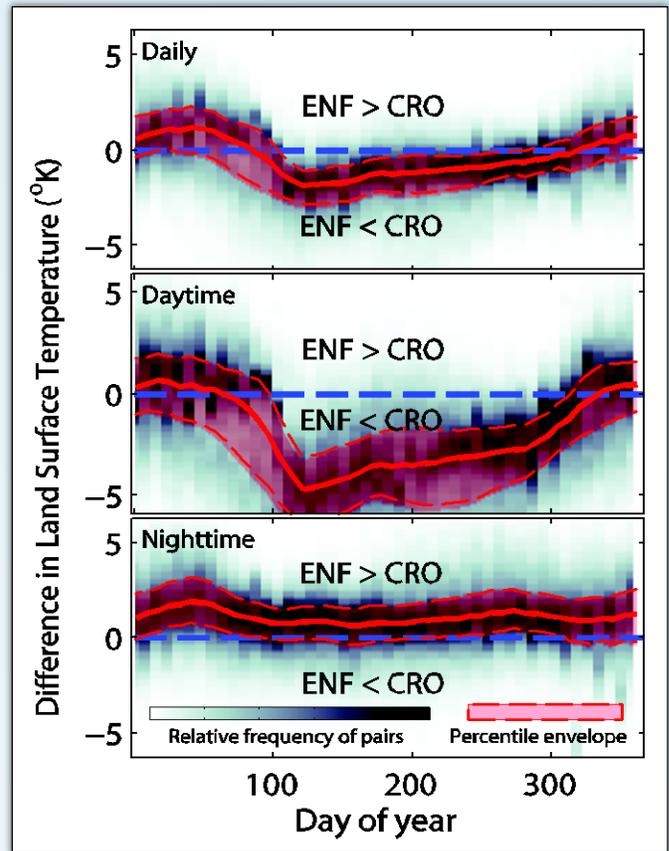


Figure 10.



Figures 9, 10: Systematic differences in surface biophysics exist between spatially-adjacent contrasting vegetation types, as depicted here for comparing albedo and land surface temperature between nearby evergreen needleleaf forest and cropland. The results were derived from the MODIS-based data set (MODIS-derived Biophysical Parameters for 5-km Land Cover, North America, 2000-2012).

Two data sets were added to the [Large Scale Biosphere-Atmosphere Experiment in Amazonia \(LBA\)](#). The LBA project was an international research initiative conducted from 1995-2005. This project focused on the question: “How do tropical forest conversion, regrowth, and selective logging influence carbon storage, nutrient dynamics, trace gas fluxes, and the prospect of sustainable land use in Amazonia?”

- **LBA-ECO LC-14 Specific Leaf Area and Phenology, km 67 Site, Para, Brazil: 2001-2006.** This data set provides measurements of specific leaf area and monthly phenological observations for selected tree and vine species at the km 67 Seca Floresta site, Tapajos National Forest, Para, Brazil. (Nepstad, D.C., P. Moutinho, D. Ray and P. Brando.)

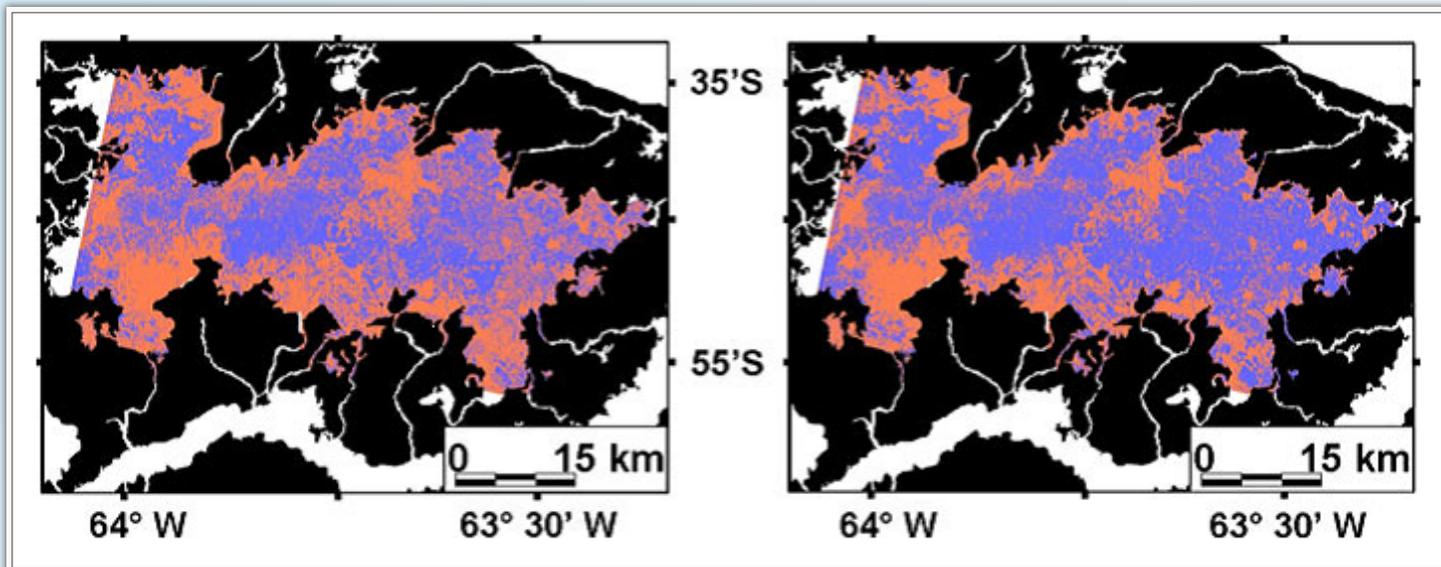
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Recent additions to the ORNL DAAC online archive (continued)

- LBA-ECO LC-07 CO₂ and CH₄ Flux from Wetlands, Negro River Basin, Brazil: 2004-2006.**
 This data set provides estimates of daily and monthly carbon dioxide (CO₂) and methane (CH₄) diffusive and ebullitive flux for dry and

flooded areas from two study sites, Cuini and Itu, in the interfluvial wetlands of the upper Negro River basin, Brazil. (Belger, L., B.R. Fosberg and J.M. Melack.)

Figure 11: Inundation of Cuini wetland site, Negro River Basin, at low water (left) and high water (right).
 Source: LBA-ECO LC-07 CO₂ and CH₄ Flux from Wetlands, Negro River Basin, Brazil: 2004-2006.



Two data sets were added to our archives for **The International Satellite Land Surface Climatology Project, Initiative II (ISLSCP II)**. The ISLSCP II Project was part of the **Global Energy and Water Experiment (GEWEX)** and was responsible for addressing land-atmosphere interactions, process modeling, data retrieval algorithms, field experiment design and execution, and the development of global data sets.

- ISLSCP II Reanalysis Near-Surface Meteorology Data.** This data set for the ISLSCP Initiative II data collection provides near surface meteorological variables, fluxes of heat, moisture and momentum at the surface, and land surface state variables, all with a spatial resolution of 1 degree in both latitude and longitude. (Dirmeyer, P., M. Zhao, G. White, and W. Ebisuzaki.)
- ISLSCP II Air-Sea Carbon Dioxide Gas Exchange.** This data set contains the calculated net ocean-air carbon dioxide (CO₂) flux and sea-air CO₂ partial pressure (pCO₂) difference. (Takahashi, T., S.C. Sutherland, R.H. Wanninkhof, R.A. Feely, R.F. Weiss, D.W. Chipman, N. Bates, J. Olafsson, C. Sabine, A. Poisson, N. Metzl, B. Tilbrook, Y. Nojiri, and C. Sweeney.)

ACCESSING ORNL DAAC DATA



Web-based interface:
<http://daac.ornl.gov/>

NASA's Earth Observing System
 Data and Information System (EOSDIS):
<https://earthdata.nasa.gov/>

Advanced data search:
<http://mercury.ornl.gov/ornldaac/>

MODIS Land Products Subsets:
<http://daac.ornl.gov/MODIS/modis.shtml>

FLUXNET Project:
<http://daac.ornl.gov/FLUXNET/fluxnet.shtml>

Spatial Data Access Tool:
<http://webmap.ornl.gov/wcsdown>

All data from the DAAC are free and are available electronically.