EASE-Grid Land Cover Classifications Derived from Boston University MODIS/Terra Land Cover Data, Version 1

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

Knowles, K. 2004. EASE-Grid Land Cover Classifications Derived from Boston University MODIS/Terra Land Cover Data, Version 1. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/J0CJG7RZW3IJ. [Date Accessed].

Brodzik, M. J. and K. Knowles. 2011. *EASE-Grid 2.0 Land Cover Classifications Derived from Boston University MODIS/Terra Land Cover Data, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/XR8523MC24TB. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0608 or https://nsidc.org/data/NSIDC-0610

National Snow and Ice Data Center

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This user guide covers two data sets:

- EASE-Grid Land Cover Classifications from Boston University MODIS/Terra Land Cover Data
- EASE-Grid 2.0 Land Cover Classifications from Boston University MODIS/Terra Land Cover Data

1 DETAILED DATA DESCRIPTION

These data sets use the International Geosphere Biosphere Programme (IGBP) land cover classes from Boston University's (BU) 1 km MOD12Q1 product (Friedl et al. 2002). Table 1 lists the IGBP land cover classes. For each projection/spatial resolution combination, the 1 km MOD12Q1 product is resampled to the coarser resolution grids: 3 km, 5 km, 6.25 km, 9 km, 10 km, 12.5 km, 25 km, 36 km, and 100 km. See the Data Acquisition and Processing section of this document for more information.

Table 1. IGBP Land Cover Classes

Class Number	Category	Class Number	Category
01	Evergreen needleleaf forest	10	Grasslands
02	Evergreen broadleaf forest	11	Permanent Wetlands
03	Deciduous needleleaf forest	12	Croplands
04	Deciduous broadleaf forest	13	Urban and built-up
05	Mixed forests	14	Cropland/natural vegetation mosaic
06	Closed shrublands	15	Snow and ice
07	Open shrublands	16	Barren or sparsely vegetated
08	Woody savannas	17	Water bodies
09	Savannas		

1.1 Format

The data are in flat binary, 1 byte files that are stored by row. Each of the resolution and projection combinations are described by a Grid Parameter Definition (GPD). Tables 2 and 3 list the short name for each GPD. For each GPD, there are 17 land cover files, one for each IGBP land cover class (Table 1). For the 17 land cover files, each pixel in the grids is the percent of land covered by the IGBP class noted in the file name. For example, the file `EASE2_N25km.igbp_landclass.01.720x720.bin` is the 25 km EASE-Grid 2.0 Northern Hemisphere file that contains a 721x721 grid where each grid cell represents the percent of land in that cell that was characterized as IGBP class 1 (Evergreen needleleaf forest). See the Data Acquisition and Processing section of this document for information on how these percents were

derived. Pixels that are off the map or were undefined in the input data were given the value 255. Tables 2 and 3 list the resolution, grid dimensions, and files size for each GPD. See Table 4 for the file naming convention.

Table 2. EASE-Grid Land Classification Resolutions and Grid Sizes

Projection	Resolution	Grid Dimensions (r x c)	File Size	GPD Short Name
N., S. Hemisphere	25 km	721 x 721	508 KB	Nl, Sl
	12.5 km	1441 x 1441	2 MB	Nh, Sh
Global	25 km	1383 x 586	792 KB	Ml
	12.5 km	2766 x 1171	3.1 MB	Mh

Table 3. EASE-Grid 2.0 Land Classification Resolutions and Grid Sizes

Projection	Parent Grid	Resolution	Grid Dimensions (r x c)	File Size	GPD Short Name
N., S. Hemisphere	100 km	100 km	180 x 180	32 KB	EASE2_N100km, EASE2_S100km
		10 km	1800 x 1800	3.1 MB	EASE2_N10km, EASE2_S10km
		5 km	3600 x 3600	13 MB	EASE2_N05km, EASE2_S05km
	36 km	36 km	500 x 500	245 KB	EASE2_N36km, EASE2_S36km
		9 km	2000 x 2000	3.9 MB	EASE2_N09km, EASE2_S09km
		3 km	6000 x 6000	35 MB	EASE2_N03km, EASE2_S03km
	25 km	25 km	720 x 720	507 KB	EASE2_N25km, EASE2_S25km
		12.5 km	1440 x 1440	2 MB	EASE2_N12.5km, EASE2_S12.5km
		6.25 km	2880 x 2880	8 MB	EASE2_N6.25km, EASE2_S6.25km
		3.125	5760 x 5760	33 MB	EASE2_N3.125km, EASE2_S3.125km
Global	36 km	36 km	964 x 406	383 KB	EASE2_M36km
		9 km	3856 x 1624	6 MB	EASE2_M09km
		3 km	11568 x 4872	54 MB	EASE2_M03km
	25 km	25 km	1383 x 584	792 KB	EASE2_M25km
		12.5 km	2776 x 1168	3.1 MB	EASE2_M12.5km
		6.25 km	5552 x 2336	13 MB	EASE2_M6.25km
Temperate[1]	25 km	25 km	1388 x 540	750 KB	EASE2_T25km
		12.5 km	2776 x 1080	3.0 MB	EASE2_T12.5km
		6.25 km	5552 x 2160	12 MB	EASE2_T6.25km
		3.125 km	11104 x 4320	50 MB	EASE2_T3.125km

[1]The temperate grid is a subset of the global grid that omits the most poleward latitudes. It extends from 67 N° to 67 S°.

1.2 File and Directory Structure

1.2.1 EASE-Grid

Data are available via FTP in ftp://sidads.colorado.edu/pub/DATASETS/nsidc0608_classification_ease/. This directory contains a subdirectory for each EASE-Grid projection—north, south, and global—with subfolders labeled by resolution (12km, 25km). Each resolution folder contains 17 land classification files corresponding to the parent projection and resolution.

1.2.2 EASE-Grid 2.0

Data are available via FTP in ftp://sidads.colorado.edu/pub/DATASETS/nsidc0610_classification_ease2/. This directory contains a subdirectory for each EASE-Grid 2.0 projection—north, south, global, and temperate—with subfolders labeled by resolution (3km, 3.125km, 5km, 6.25km, etc.). Each subfolder folder contains 17 land classification files corresponding to the parent projection and resolution.

1.3 File Naming Convention

1.3.1 EASE-Grid

Example File Name: `Nl.igbp_landclass.01.721x721.bin`
Generic File Name: `Pr.igbp_landclass.CC.colxrow.bin`

1.3.2 EASE-Grid 2.0

Example File Name: `EASE2_N25km.igbp_landclass.01.720x720.bin`
Generic File Name: `EASE2_PRRkm.igbp_landclass.CC.colxrow.bin`

The following table describes this data set's file name variables:

Table 4. File Naming Convention for the Land Classification Files

Variable	Description
EASE2_	File contains EASE-Grid 2.0 data. Files without this variable contain EASE-Grid data.
P	Projection. Values: N = N. Hemisphere; S = S. Hemisphere; M = global; T = temperate
EASE-Grid: r EASE-Grid 2.0: RRkm	Resolution (EASE-Grid). h = 12.5km, l = 25km Resolution in km (EASE-Grid 2.0). For example: 03km = 3 km; 3.125km = 3.125 km; 05km = 5 km...

Variable	Description
igbp_landclass	Land cover classification file.
CC	2-digit land cover classification code. See Table 1 for values.
colxrow	Grid dimensions in pixels, column x row.
.bin	Binary file extension.

1.4 Spatial Coverage

1.4.1 EASE-Grid

These data cover the entire globe and are provided in projections for the entire globe and for the Northern and Southern Hemispheres. See Table 2 for a complete listing of the projection/resolution combinations.

1.4.2 EASE-Grid 2.0

These data cover the entire globe and are provided in projections for the entire globe and for the Northern and Southern Hemispheres. See Table 3 for a complete listing of the projection/resolution combinations.

1.4.3 Projection and Grid Description

These data are provided in both the EASE-grid projection and the EASE-Grid 2.0 projection. The grid sizes are given in Table 2 and Table 3, respectively. For complete details on these two projections, see the EASE-Grid web page.

1.5 Temporal Coverage

Land classifications are derived from MODIS (Version 4) data obtained between July and December, 2000 (Friedl et al. 2002).

1.6 Parameter or Variable

These data provide land cover classifications in percent area per grid cell using the IGBP land cover classifications described in Table 1. They were derived from 1 km classifications in MOD12Q1 according to Friedl et al. 2002.

2 SOFTWARE AND TOOLS

See the EASE-Grid page for links to software and tools that geolocate and display EASE-Grid data sets.

3 DATA ACQUISITION AND PROCESSING

These data are derived from the Boston University MODIS/Terra 1 km Land Cover product (MCD12Q1, V004), which utilizes the Interrupted Goode Homolosine projection. MCD12Q1 data are reprojected to either EASE-Grid or EASE-Grid 2.0 and resampled by counting the number of 1 km observations for each classification that map into the target coarser resolution cell. The counts are then converted to percentages and a separate map is generated for each IGBP land cover classification (see Table 1). As such, the set of land classifications for each grid/resolution comprises 17 files.

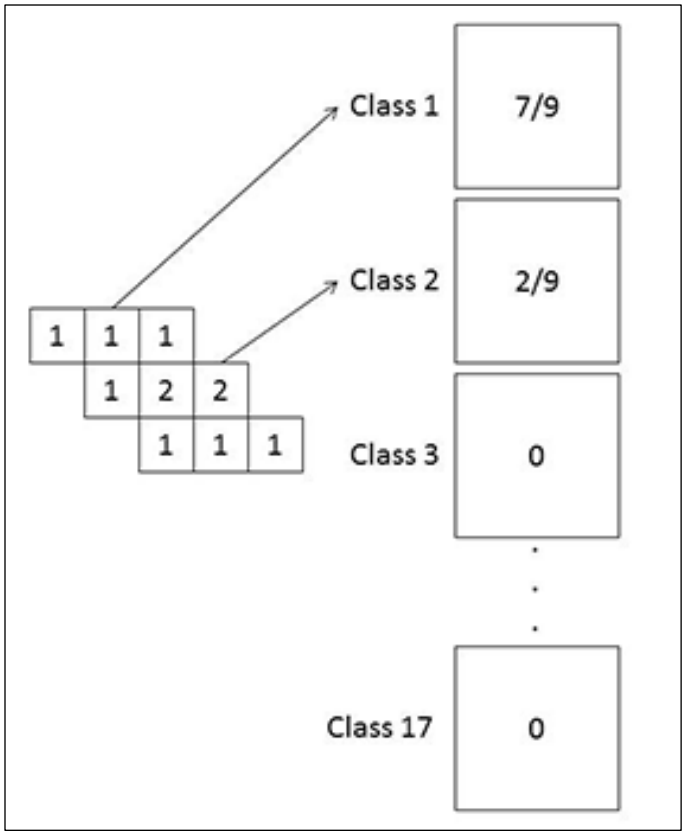

Figure 1. Resampling Process.
On the left is the set of 1 km2 pixels from the input data that map to the coarser resolution pixels on the right. On the right is one of the coarser pixels from each of the classification files and the percent that the file contains that land classification.

Example:

1. To resample the 1 km MCD12Q1 data to each of the coarser EASE-Grid and EASE-Grid 2.0 resolutions, a certain number of 1 km2 cells are mapped to the given coarser-resolution cells (Figure 1).
2. For each of the 17 coarser resolution land class files, each separate IGBP class type is counted in each of the sets of 1 km2 MCD12Q1 data. For example, if a nine-pixel set of 1 km2 cells happens to map to a coarser resolution EASE-Grid cell, as shown in Figure 1, then seven 1 km2 pixels are characterized as Class 1, two pixels are characterized as Class 2, and zero pixels are characterized as the other 15 classes. This means that this pixel in the Class 1 output data file is 7/9 (78%) covered by Class 1, that same pixel in the Class 2 file is 2/9 (22%) covered by Class 2, and that pixel in all of the other files (Class 3 to 17) is zero (Figure 1).
3. The counts are then converted to a percent. The floating point percent values were rounded to the nearest integer percent. There were three problems with the result:
   A. Water and missing value ambiguity: Boston University used zero for water instead of the IGBP value of 17. Because this is a land product, there were large areas in the oceans that were assigned 255 (fill) instead of 0 (water). See #1 in Data Corrections Applied section for the correction used.
   B. Round-off error: The sum of the integer percent values at any pixel location ranged from 98 to 102, due to round-off error. See #2 in Data Corrections Applied section for the correction used.
   C. Anomalous water in the Ross Ice Shelf: Due to an unexplained artifact in the original 1 km data, a small number of resampled pixels with an area of about 6000 square kilometers in the middle of the Ross Ice Shelf were coded as partially open water, rather than the expected snow and ice category (IGBP class 15). See #3 in Data Corrections Applied section for the correction used.
4. Pixels that are off the map or were undefined in the input data were given the fill value 255.

3.1 Data Corrections Applied

In order to produce a more consistent data set, NSIDC performed the following corrections:

A. Water class 17 was derived from MOD12Q1 classes 0 through 16 with the following equation: water class = 100 - (sum of nonwater classes, 1-16)/(sum of all classes, 0-16).
B. To adjust the round-off error, the integer sum at each pixel was normalized to 100 by examining the original floating point values and reversing what would have rounded up or down for those values with decimal parts closest to 0.5; this was only done for enough classes to achieve a sum of 100. Since non-normalized sums ranged from 98 to 102, this adjusted the rounding in any given category by at most three percentage points.
C. The misclassified open water in the Ross Ice Shelf was changed to class 15.
D. The pixel containing the North Pole in the Northern Hemisphere was undefined in the original data set. It was set to 100 percent water.

3.2 Derivation Techniques and Algorithms

3.2.1 Version History

The following tables show the version history for these data sets.

Table 5. Version History for EASE-Grid Land Cover Classification

Version	Release Date	Description of Changes
V1.0	2004	The EASE-Grid Land Cover Classification data were created as an ancillary data set, not part of the official NASA DAAC data catalog. Instead, some of the data were distributed as ancillary data via a web page and others via personal communication with the authors.
V1.1	2014	These data were accessioned into the NASA DAAC catalog and given a data set ID number. During this process, NSIDC changed the title, filenames, and organization of the data to improve usability. For example, the old file name for the Northern Hemisphere 25 km class 01 file was changed as follows: Nl.gl_g.sds01.v4.01.bin (old name) Nl.igbp_landclass.01.721x721.bin (new name) The algorithms and processing were not changed.

Table 6. Version History for EASE-Grid 2.0 Land Cover Classification

Version	Release Date	Description of Changes
V1.0	2011	The EASE-Grid 2.0 LOCI masks were created as an ancillary data set, not part of the official NASA DAAC data catalog. Instead, the data were distributed via personal communication with the authors.
V1.1	2014	These data were accessioned into the NSIDC system and given a data set ID number. During this process, NSIDC changed the title, filenames, and organization of the data to improve usability. For example, the old file name for the Northern Hemisphere 25 km class 01 file was changed as follows: EASE2_N25km.gl_g.sds01.v4.bin (old name) EASE2_N25km.igbp_landclass.01.720x720.bin (new name) The algorithms and processing were not changed.

3.2.2 Error Sources

Refer to Data Corrections Applied in the Data Acquisition and Processing section.

4 REFERENCES AND RELATED PUBLICATIONS

General

Friedl, M. A., et al. 2002. Global Land Cover Mapping from MODIS: Algorithms and Early Results. Remote Sensing of the Environment 83: 287-302.

EASE-Grid

Brodzik, M. J. and K. W. Knowles. 2002. "EASE-Grid: a versatile set of equal-area projections and grids" in M. Goodchild (Ed.) Discrete Global Grids. Santa Barbara, CA, USA: National Center for Geographic Information & Analysis..

EASE-Grid 2.0

Brodzik, M. J., B. Billingsley, T. Haran, B. Raup, M. H. Savoie. 2012. EASE-Grid 2.0: Incremental but Significant Improvements for Earth-Gridded Data Sets. ISPRS International Journal of Geo-Information, 1(1):32-45. doi:10.3390/ijgi1010032. http://www.mdpi.com/2220-9964/1/1/32.

Brodzik, M. J., B. Billingsley, T. Haran, B. Raup, M. H. Savoie. 2014. Correction: Brodzik, M. J. et al. EASE-Grid 2.0: Incremental but Significant Improvements for Earth-Gridded Data Sets. ISPRS International Journal of Geo-Information 2012, 1, 32-45. ISPRS International Journal of Geo-Information, 3(3):1154-1156. doi:10.3390/ijgi3031154. http://www.mdpi.com/2220-9964/3/3/1154.

4.1 Related Data Collections

EASE-Grid Land-Ocean-Coastline-Ice Masks Derived from Boston University MODIS/Terra Land Cover Data
EASE-Grid 2.0 Land-Ocean-Coastline-Ice Masks Derived from Boston University MODIS/Terra Land Cover Data

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6 DOCUMENT INFORMATION

6.1 Publication Date

October 2014

6.2 Date Last Updated

11 February 2021