EASE-Grid Sea Ice Age, Version 4

USER GUIDE

How to Cite These Data

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

Tschudi, M., W. N. Meier, J. S. Stewart, C. Fowler, and J. Maslanik. 2019. *EASE-Grid Sea Ice Age, Version 4*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/UTAV7490FEPB. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0611

National Snow and Ice Data Center

TABLE OF CONTENTS

1 DATA DESCRIPTION 2
1.1 Parameters 2
1.2 File Information 2
1.2.1 Format 2
1.2.2 File Contents 2
1.2.3 Sample Browse Image 2
1.2.4 Directory Structure 3
1.2.5 NetCDF File Naming Convention 3
1.2.6 Browse Image File Naming Convention 4
1.3 Spatial Information 4
1.3.1 Coverage 4
1.3.2 Resolution 5
1.3.3 Geolocation 5
1.4 Temporal Information 6
1.4.1 Coverage 6
1.4.2 Resolution 6
2 DATA ACQUISITION AND PROCESSING 6
2.1 Background 6
2.2 Acquisition 7
2.3 Processing 7
2.4 Quality, Errors, and Limitations 7
2.4.1 Quality Assessment 7
2.4.2 Error Sources and Limitations 7
3 VERSION HISTORY 8
4 RELATED DATA SETS 8
5 CONTACTS AND ACKNOWLEDGMENTS 8
6 REFERENCES 9
7 DOCUMENT INFORMATION 10
7.1 Publication Date 10
7.2 Date Last Updated 10

1 DATA DESCRIPTION

NOTE: A quicklook version of this data set exists to fill the time between when this data set was last updated and the present: the *Quicklook Arctic Weekly EASE-Grid Sea Ice Age* (NSIDC-0748).

1.1 Parameters

The main parameter for this data set is sea ice age, measured in years.

1.2 File Information

1.2.1 Format

Data are provided in georeferenced netCDF (`.nc`) format.

PNG (`.png`) browse images are also provided.

1.2.2 File Contents

Each netCDF file contains 52 weeks of sea ice ages, coded as integers in a 722 x 722 gridded subset of the 12.5 km Northern Hemisphere EASE-Grid. Table 1 lists the coded integer values and their meanings.

Table 1. Data file values used to describe sea ice age

Value	Description
0	Open water or < 15% sea ice concentration
1, 2, 3, ..., 16	Sea ice age; higher age estimates are not precise, so older ice, 5th-year (4-5 years old) and above, are generally considered together 1 = ice that is 0-1 years old (first-year ice) 2 = ice that is 1-2 years old (second-year ice) 3 = ice that is 2-3 years old (third-year ice) … 16 = ice that is 15-16 years old (16th-year ice)
20	Designates the grid cell contains only land
21	Designates grid cells that contain ocean for which ice age was not calculated

1.2.3 Sample Browse Image

One browse image displaying sea ice age is provided for every week of data. Figure 1 shows a sample browse image.

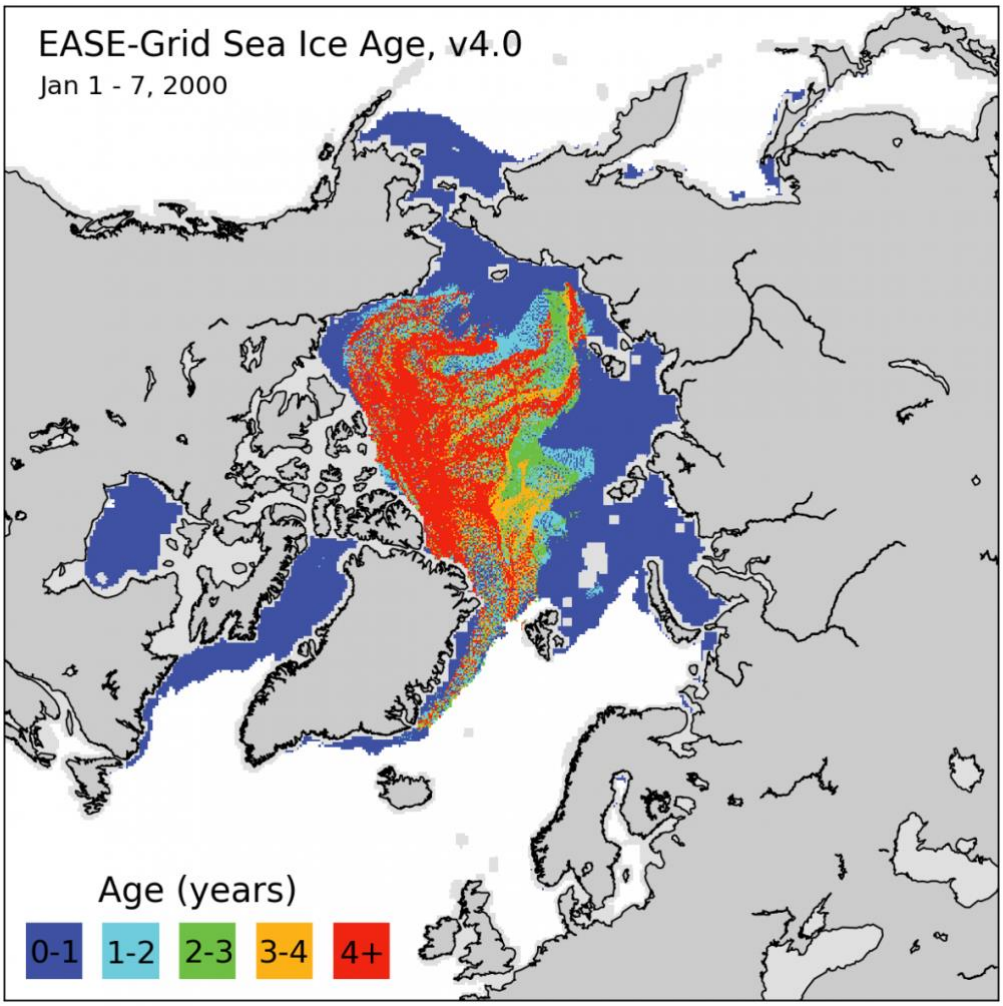

Figure 1. Sample browse image displaying sea ice age for the week of 01 – 07 January 2000

1.2.4 Directory Structure

Data are available for download via HTTPS; the link is accessible through the "Download Data" tab. Within the file directory, there are two folders, data and browse. The data folder contains the sea ice age netCDF files, while the browse folder contains the PNG browse images, which are further subdivided into folders by year.

1.2.5 NetCDF File Naming Convention

The data files are named according to the following convention and as described to Table 2:

`iceage_hh_rrrr_<start-date>_<end-date>_v##.nc`

Example:

`iceage_nh_12.5km_19840101_19841231_v4.1.nc`

Table 2. Daily and Weekly Ice Motion File Naming Convention

Variable	Description
hh	Hemisphere (nh = Northern)
rrrr	Resolution of input data source in km (e.g. 12.5 km)
<start-date>	First day of data contained in the file, written in yyyymmdd (4-digit year, 2-digit month, 2-digit day) format
<end-date>	Last day of data contained in the file, written in yyyymmdd (4-digit year, 2-digit month, 2-digit day) format
v##	Version number

1.2.6 Browse Image File Naming Convention

The browse images are named according to the following convention and as described to Table 3:

```
iceage_hh_rrrr_<start-date>_<end-date>_v##.png
```

Example:

iceage_nh_25km_20000101_20000107_v4.1.png

Table 3. Browse Image File Naming Convention

Variable	Description
hh	Hemisphere (nh = Northern)
rrrr	Gridded spatial resolution (e.g. 12.5 km)
<start-date>	First day of the week that the image represents, written in yyyymmdd (4-digit year, 2-digit month, 2-digit day) format
<end-date>	Last day of the week that the image represents, written in yyyymmdd (4-digit year, 2-digit month, 2-digit day) format
v##	Version number

1.3 Spatial Information

1.3.1 Coverage

This data set covers the Arctic Ocean within the boundaries defined below:

Southernmost Latitude: 48.4° N

Northernmost Latitude: 90.0° N

Westernmost Longitude: 180.0° W

Easternmost Longitude: 180.0° E

1.3.2 Resolution

12.5 km

1.3.3 Geolocation

Data are projected using a 12.5 km Northern Hemisphere EASE-Grid. The grid is shifted one-half grid cell relative to the standard version of EASE-Grid, which have the center of the grid right over the pole. More details can be found in the tables below. More details on EASE-Grid can be found on the EASE Grids website.

Table 4. Geolocation Details

Geographic coordinate system	N/A
Projected coordinate system	NSIDC EASE-Grid North
Longitude of true origin	0
Latitude of true origin	90
Scale factor at longitude of true origin	N/A
Datum	N/A
Ellipsoid/spheroid	International 1924 Authalic Sphere
Units	meter
False easting	0
False northing	0
EPSG code	3408
PROJ4 string	+proj=laea +lat_0=90 +lon_0=0 +x_0=0 +y_0=0 +a=6371228 +b=6371228 +units=m +no_defs
Reference	http://epsg.io/3408

Table 5. Grid Details

Grid cell size (x, y pixel dimensions)	12534 projected meters (x) 12534 projected meters (y)
Number of rows	722
Number of columns	722
Geolocated lower left point in grid	29.7° N, 45.0° W
Nominal gridded resolution	12.5 km by 12.5 km
Grid rotation	N/A
ulx – x-axis map coordinate of the outer edge of the upper-left pixel	-4518421 projected meters
uly – y-axis map coordinate of outer edge of the upper-left pixel	+4518421 projected meters

1.4 Temporal Information

1.4.1 Coverage

The temporal coverage for this data set is January 1984 through December 2020. For more recent data, see the Quicklook Arctic Weekly EASE-Grid Sea Ice Age data product.

1.4.2 Resolution

Weekly

2 DATA ACQUISITION AND PROCESSING

2.1 Background

The method used to estimate sea ice age involves Lagrangian tracking of sea ice from week-to-week using gridded ice motion vectors (Maslanik et al. 2011; Tschudi et al. 2020). Starting in late 1978, ice age can be estimated by treating each grid cell that contains ice as a discrete, independent Lagrangian parcel and tracking the parcels at weekly time steps as they are advected by the weekly ice motions. The process can be viewed as a set of stacked planes overlying the grid used, with each plane corresponding to an age category. Parcels move around on their respective planes, independent of parcels of other age categories, which in turn lie in their own planes. To produce maps of ice age, the set of parcels for each weekly time increment is rasterized by assigning parcels to the 12.5 km x 12.5 km grid cell within which each parcel's position lies. In cases where parcels of different ages fall within a single grid cell, the age of the grid cell is assigned to the oldest parcel (Maslanik et al. 2011; Tschudi et al. 2020). Physically, this approach assumes that younger ice deforms more easily than older ice, and as such older ice will cover a greater fraction of the area within the grid cell. For example, if two parcels, one that represents first-year ice and one that represents third-year ice, both fall within the domain of a single grid cell, then the age of that cell will be assigned as third-year ice.

If the ice concentration of a grid cell remains at or above 15 percent throughout the melt season, then that parcel is assumed to have survived the summer minimum sea ice extent (typically reached in September), and the parcel's age is incremented by one year. The age of the ice is categorized as first-year ice (0-1 years old), second-year ice (1-2 years old), and so forth based on how many summer melt seasons the ice parcel survives (Tschudi et al. 2010). Note that grid cells with less than 15 percent sea ice concentration are treated as open water, even though the cells could still contain some ice.

2.2 Acquisition

The input ice motion vectors used to create this sea ice age data set are the weekly Polar Pathfinder Daily 25 km EASE-Grid Sea Ice Motion Vectors, Version 4. For details on how these ice motion vectors are created, see the Data Acquisition and Processing section of that data set's User Guide.

2.3 Processing

- Input ice motion data - weekly fields from the Polar Pathfinder Daily 25 km EASE-Grid Sea Ice Motion Vectors, Version 4 data set - are bilinearly interpolated to a 12.5 km x 12.5 km EASE-Grid.
- Ice parcel position is computed weekly.
- Each year's ice is tracked from year to year as a Lagrangian tracer parcel that starts at the center of each grid cell and moves according to the weekly mean ice velocity.
- Ice age is discretized in yearly increments, where a year defined as the melt season which runs from one season's minimum Arctic ice extent (usually in September) to the next year's minimum.
- If a parcel remains at 15 percent or more for a melt season, then it is aged one year. If a parcel travels to a grid cell that has less than 15 percent ice concentration, the tracer parcel is assumed to have melted away.
- The age of a grid cell is the age of the oldest tracer parcel that exists in the grid cell.

2.4 Quality, Errors, and Limitations

2.4.1 Quality Assessment

A 15% sea ice concentration threshold was chosen to provide the most conservative possible estimates of change in areas where multiyear ice is present. For example, at the end of summer melt, a grid cell within the marginal ice zone might have a total passive microwave-derived concentration of 15 percent. Even though, upon freeze-up, 85 percent of the grid cell would consist of first-year ice, the age of that grid cell is assigned to the oldest ice that survived within that grid cell. Hence, the maps indicate the coverage of areas that contain at least some (15 percent or more) multiyear ice but do not provide information on proportions of ice of different ages within individual grid cells. The 15 percent threshold is also the standard used by other sea ice index products at NSDIC (e.g. ASINA).

2.4.2 Error Sources and Limitations

When age classes are aggregated into first-year and multiyear ice categories, the information is comparable to the passive and active microwave satellite-derived time series of first-year and multiyear ice analyzed by previous studies. Overall, this remote sensing-based age product is

similar in nature and information content to the buoy-derived age fields produced by Rigor and Wallace (2004), but with greater spatial detail. The age estimates are restricted to open ocean areas only, where ice motion can be resolved in the microwave data. Note that this excludes the passages in the Canadian Archipelago. The cited values for ice coverage are therefore less than the actual amount of ice present in the Arctic.

Errors in the method of estimating sea ice age depend on the following ice motion errors:

- Resolution of the satellite sensor
- Geolocation and binning errors of each image pixel
- Atmospheric effects and temporal variability of the surface, especially during the summer months

The sea ice age shown in this dataset is the *oldest* age within each grid cell and does not necessarily indicate that all ice in that cell is of that age. Ice may also be present in grid cells that are designated as open water if the concentration is less than 15 percent.

3 VERSION HISTORY

Table 6. Version Summary

Version	Release Date	Description of Changes
V4	March 2019	The input ice motion data used for this data set is now derived from Polar Pathfinder Daily 25 km EASE-Grid Sea Ice Motion Vectors Version 4 and extends through December 2018. Data files are now provided in netCDF format.
V3	April 2016	The input ice motion data used for this data set is now derived from NSIDC-0116 Version 3 data.
V2	December 2014	Initial release of these data as an NSIDC data set.

4 RELATED DATA SETS

Polar Pathfinder Daily 25 km EASE-Grid Sea Ice Motion Vectors

Quicklook Arctic Weekly EASE-Grid Sea Ice Age

5 CONTACTS AND ACKNOWLEDGMENTS

Mark Tschudi, Chuck Fowler, and Jim Maslanik
Colorado Center for Astrodynamics Research (CCAR)
Department of Aerospace Engineering Sciences

University of Colorado, Boulder
Boulder, Colorado, USA

Walter N. Meier and J. Scott Stewart
National Snow and Ice Data Center
University of Colorado, Boulder
Boulder, Colorado, USA

6 REFERENCES

Cavalieri, D. J., P. Gloersen, and W. J. Campbell. 1984. Determination of Sea Ice Parameters with the NIMBUS-7 SMMR. *Journal of Geophysical Research*, 89(D4): 5355-5369. http://dx.doi.org/10.1029/JD089iD04p05355

Fowler, C., W. J. Emery, and J. Maslanik. 2004. Satellite-derived evolution of Arctic sea ice Age: October 1978 to March 2003. *IEEE Geoscience and Remote Sensing Letters*, 1(2): 71-74. http://dx.doi.org/10.1109/LGRS.2004.824741

Maslanik, J. A., C. Fowler, J. Stroeve, S. Drobot, J. Zwally, D. Yi and W. Emery. 2007. A younger, thinner Arctic ice cover: Increased potential for rapid, extensive sea-ice loss. *Geophysical Research Letters*, 34(L24501). http://dx.doi.org/10.1029/2007GL032043

Maslanik, J., J. Stroeve, C. Fowler, and W. Emery. 2011. Distribution and trends in Arctic sea ice age through spring 2011. *Geophysical Research Letters*, 38(L13502). http://dx.doi.org/10.1029/2011GL047735

Rigor, I.G., and J.M. Wallace, 2004. Variations in the age of Arctic sea-ice and summer sea-ice extent. *Geophysical Research Letters*, 31(L09401). http://dx.doi.org/10.1029/2004GL019492

Tschudi, M. A., Fowler, C, Maslanik, J. A., Stroeve, J. 2010. Tracking the movement and changing surface characteristics of Arctic sea ice. *IEEE Journal of Selected Topics in Earth Observation and Remote Sensing*, 3(4). http://dx.doi.org/10.1109/JSTARS.2010.2048305

Tschudi, M.A., W.N. Meier, and J.S. Stewart, 2020. An enhancement to sea ice motion and age products at the National Snow and Ice Data Center (NSIDC). *The Cryosphere*, 14,1519-1536. https://doi.org/10.5194/tc-14-1519-2020

7 DOCUMENT INFORMATION

7.1 Publication Date

March 2019

7.2 Date Last Updated

May 2021